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CDAC

2007-2008

ANNUAL
REPORT

CENTRE FOR DEVELOPMENT OF ADVANCED COMPUTING
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Shri Dayanidhi Maran, Chairman, Governing Council and Hon'ble Minister for Communications
& Information Technology upto 17 May 2007

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Overview

Centre for Development of Advanced Computing (C-DAC) is the premier R&D organization of the Department of Information Technology (DIT), Ministry of Communications and Information Technology (MCIT) for carrying out R&D in Information Technology, Electronics, and associated areas. During the year 2007-08, C-DAC focused its activities on the six thematic R&D areas, which are as follows:

- **High Performance Computing and Grid Computing**
- **Multilingual and Heritage Computing**
- **Software Technology (Including Open Source Software)**
- **Professional Electronics (Including VLSI and Embedded Systems)**
- **Cyber Security and Cyber Forensics**
- **Health Informatics**

An overview of significant activities carried out by C-DAC in these areas during the year 2007-08 is given below. An overview of the activities carried out in other areas of operation such as Ubiquitous Computing, Education and Training, Consultancy Services, and Facilitation Services are also included.

High Performance Computing and Grid Computing

Architecting all aspects of Next Generation PARAM System was completed based on the evaluation of off-the-shelf components. Design and development of indigenous components including PARAMNet-3 System Area Network, Reconfigurable Computing System (RCS) based accelerator card, and system software and tools were completed and the components have entered testing phase.

Use of HPC systems in tackling complex mathematical problems of national importance were demonstrated in several areas including Computational Atmospheric Science, Computational Fluid Dynamics, Seismic Data Processing, Bioinformatics and Evolutionary Computing. During the year, C-DAC also executed several HPC projects for installation, commissioning and operation of HPC systems and facilities at end-user locations.

The Proof-of-Concept phase of GARUDA – India's National Grid of HPC systems has been completed. During the year, the GARUDA grid was up with 100 Mbps connectivity across 17 cities and with about 600 processors having aggregate compute power of about 3.5 TeraFlops. GARUDA grid components also include Petabytes of storage, special scientific instruments and a comprehensive software environment for the entire system. After successful completion of the proof-of-concept phase, C-DAC is now working towards building a strong base in the foundation phase of GARUDA to move into the main phase of GARUDA.

Multilingual and Heritage Computing

Efforts in this area continued either towards enhancing the features of already developed tools and technologies or for development of new tools for use of IT in Indian scenario. These include translation and transliteration tools, code conversion tools, office software suite, multilingual information extraction and retrieval tools,

localization tools for localizing existing applications, multilingual speech processing technologies, multilingual web technologies, and technologies for preserving Indian heritage.

Software Technology (Including Open Source Software)

Several software tools, technologies and solutions were developed and deployed in areas of software engineering, e-Governance, web services, geomatics, multimedia computing, networking and systems to emulate human capabilities. BOSS Linux, Electronic Nose, Vision and Tongue, Virtual Museum Builder, QoS test-bed, and various types of information processing and management systems are a few examples.

Professional Electronics (Including VLSI and Embedded Systems)

In the area of professional electronics, several hardware and software components were developed and integrated to design devices and solutions for various sectors. These include powered vehicles, real-time simulators, static power balancer, matrix converter, SCADA systems, traffic control and vehicle tracking system, acoustic devices, IP cores, RFID based systems, TETRA based systems and IP Telephony.

Cyber Security and Cyber Forensics

Development of software and hardware tools for cyber forensics was successfully completed. A series of software suites for cyber forensics were released. A few hardware tools for disk imaging and for protection of storage devices were also developed. Using these tools, C-DAC helped law enforcement agencies in solving several cyber crime cases. Work is now being carried out for developing next generation cyber forensics tools. Other security tools and solutions developed include those for intrusion detection and prevention, end-system security in enterprise networks, authentication system for web-based users, and cryptanalysis.

Health Informatics

C-DAC further enhanced the deployment base of its telemedicine solutions including a few installations in rural areas of Punjab and Himachal Pradesh. The solutions were deployed in additional locations with feature enhancements. New features include web-based telemedicine, mobile tele-oncology, tele-ophthalmology, and additional clinical modules (dermatology and nephrology). Development of Hospital Management Information Systems for additional hospitals in the country was taken up. Other initiatives for healthcare solutions include development of class libraries for DICOM and HL7, an automated pulse analyzer, camera for endoscopy, and assessment tool for mentally retarded children.

C-DAC is developing a coordination and context-aware middleware for *Ubiquitous Computing* using Ubiquitous Semantic Space and Ontology based Context Aware Environment for ubiquitous computing.

C-DAC continued its foray in *Education and Training* through its plethora of both formal and non-formal training programs with the objective of sharing the knowledge generated in its R&D activities with students and the industry.

In addition to its efforts towards Technology Development and Education and Training, C-DAC continued to put efforts towards improvement of its manpower and other resources, facilitation services, and consultancy services.

Technical   Activities

HIGH PERFORMANCE COMPUTING AND GRID COMPUTING

HPC Systems and Technologies

During the year, C-DAC continued with its activities for building the next PARAM system. These included activities for developing indigenous components and evaluation and selection of off-the-shelf components for the system.

Next Generation PARAM System

C-DAC has worked towards system architecture design and evaluation and selection of compute nodes, storage and networks for the proposed Next Generation PARAM System. Architecting all aspects of this system has been completed. This included architectural components of the system like compute nodes, high performance storage, primary and secondary networks, and software stack. C-DAC has also analyzed the key aspects of memory performance of multi-core processors that are being seriously considered as the compute engines for the new PARAM system. This covered the performance of micro (LINPACK, Top-500) and macro benchmarks on the latest systems based on multi-core processors.

PARAMNet-3 System Area Network

PARAMNet-3 is a high performance cluster interconnect network designed indigenously by C-DAC over the last three years. Development of PARAMNet-3 hardware and its software components has been completed during 2007-2008. It will be deployed as a primary network interconnect in the next generation PARAM system. It will also be offered as a key component in HPC solutions offered by C-DAC.

PARAMNet-3 is a low latency, high bandwidth cluster interconnect with data speeds of 10Gbits/sec full duplex, with latencies of less than 10 micro second. It consists of tightly integrated hardware and software components working seamlessly together. These components are:

- Network interface card (NIC)
- 48-port modular packet routing switch
- Kshipra software stack
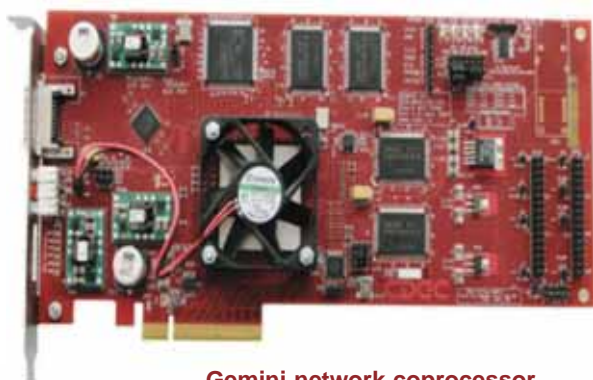
Gemini network coprocessor
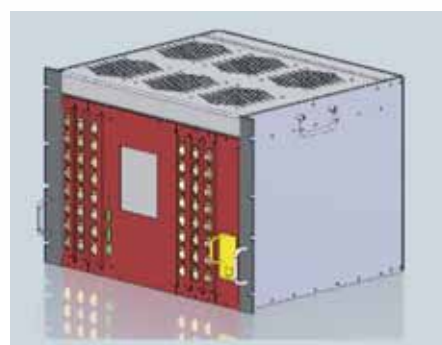

48 Port packet routing switch

PARAMNet-3 NIC is based on C-DAC's next generation GEMINI network co-processor. GEMINI effectively offloads the transport layer to the hardware with direct user level access to hardware end points. It supports send/receive, RDMA and datagram oriented services. Gemini is based on PCI-express (8X) and 10Gbps CX4 interfaces.

PARAMNet-3 packet routing switch is based on a modular, chassis based architecture using line card and backplane approach. A fully populated switch supports 48 ports with each port supporting 10Gbits/sec, full duplex data traffic with an extremely low latency of less than one micro second. The switch is capable of sustaining approximately 1 Terabits/second. The switch supports multi-staging, allowing it to support large cluster sizes.

Kshipra is the PARAMNet-3 software stack. It is a complete program development environment for PARAMNet-3. It supports two industry standard RDMA enabled interfaces - Direct Access Provider Library (DAPL) and Socket Library.

Applications supported over PARAMNet-3 can be divided into two broad categories. The first category includes applications, which make use of the advanced capabilities offered by hardware. Examples of such applications are MPI based applications and third party applications compliant to DAPL. The second category of applications is legacy TCP/IP based applications that can be executed with PARAMNet-3 without any porting efforts.
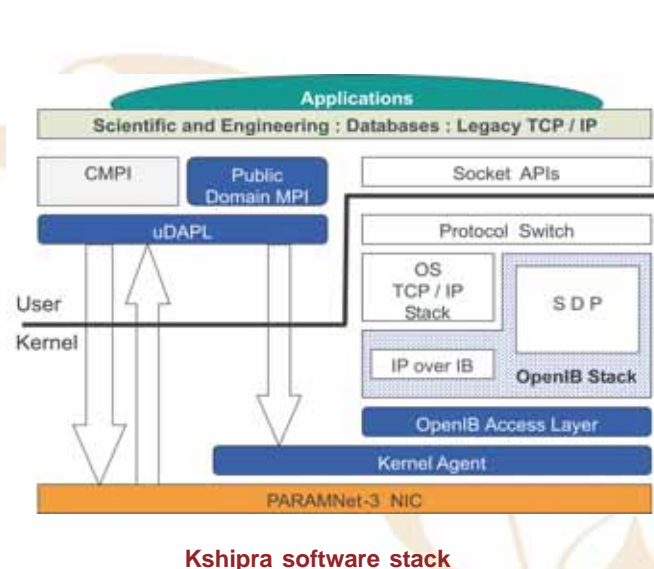
Kshipra software stack
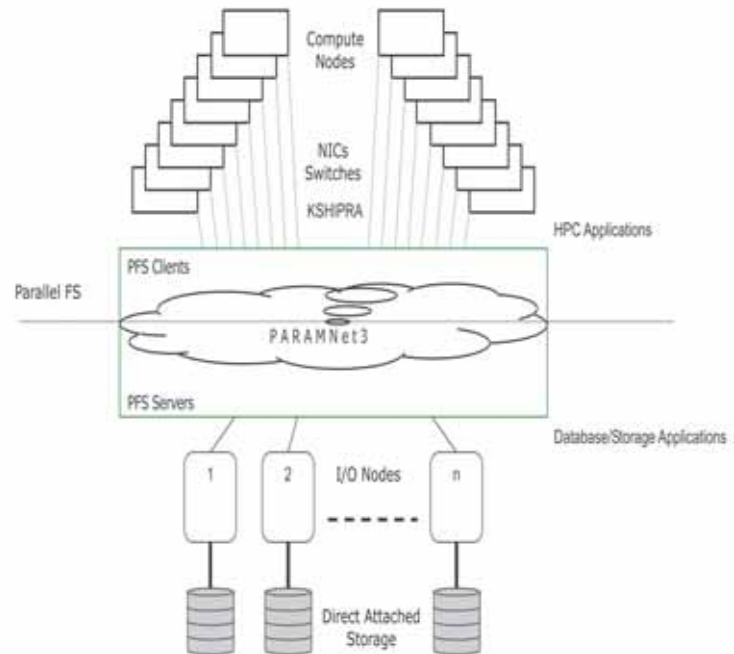
PARAMNet-3 deployment in a cluster

Reconfigurable Computing System (RCS) – III

In order to enhance the computing power and I/O bandwidth of the present RCS, C-DAC took up the design of RCS-III. The design has two compute engines based on the state-of-the-art Xilinx Virtex-5 devices, high-speed memories and PCIe (express) host interface. In order to provide application acceleration, the compute engines can work together or as independent units. In some applications, more than hundred times performance is expected compared to a purely software solution.

Simulation and design of hardware blocks, PCB design and manufacturing of the 12-layer board has been completed. Assembly, integration and testing of the card will commence soon.

High Performance Storage System

The High Performance Storage System is an IP based storage area network, which facilitates inexpensive, flexible, scalable,

available and high performance block based storage access over the network. This may be applicable to database applications in transactional settings where data stored in database keep exploding, as well as for email applications which need raw storage to store emails.

A prototype for iSCSI based SAN has been developed and caching facility has been incorporated in it to improve the performance. The prototype is currently being refined to suit the disaster recovery solutions, especially for NSDG project.

C-DAC Parallel File System - CPFS

CPFS is an initiative to build cluster based high performance storage systems. It is a distributed file system that allows parallel access to data by multiple processes from storage, resulting in high performance input/output. CPFS provides parallelism at both client and server side. It also provides parallel layout of file by supporting file striping. It uses advanced data access performance optimisation techniques like pre-fetching and collective I/O operation and also uses multiple I/O streams to access file data in parallel.

HPC Facilities

C-DAC has setup two National Supercomputing Facilities at Pune and Bangalore. National PARAM Supercomputing Facility (NPSF) is at Pune and C-DAC's Terascale Supercomputing Facility (CTSF) is at Bangalore. Several HPC users make use of the two facilities for solving their scientific & engineering problems. CTSF houses the PARAM Padma system and NPSF currently houses an Intel Xeon based cluster and an AMD Opteron based cluster. The computing systems at both these facilities witnessed heavy usage during the year. There are about 300 registered users for the facilities, including about 100 external users.

HPC Applications

C-DAC has been continuing its work in major applications areas of atmospheric science, fluid dynamics, structural mechanics, seismic data processing, earthquake engineering, bioinformatics, and genetic algorithms. Effective use of HPC systems in tackling complex mathematical problems of national importance has been demonstrated. Key activities during the year in these areas are described below.

Computational Atmospheric Sciences (CAS)

As a part of collaborative project with NEERI, different emission scenarios simulations of air quality over Pune for PM10 pollutant have been carried out using meteorology from WRF model as well as data collected by IMD. A pre-processor has been developed to enable use of 3-hrly IMD data for models like AERMOD, CALPUFF and ISC.
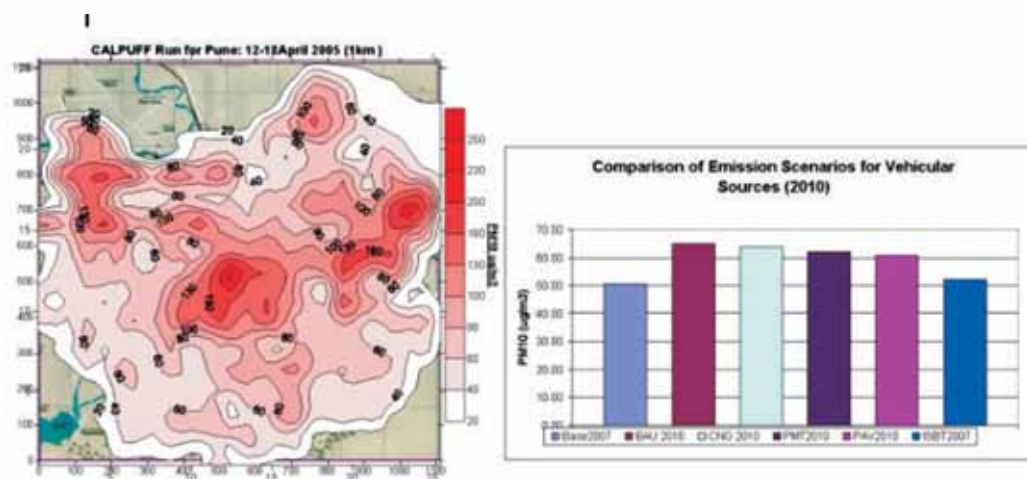
In the regional coupled ocean-atmosphere project (funded by DST), three atmosphere regional models WRF, RegCM3 and RSM have been run for 15 years using the reanalysis data as the initial and boundary conditions. Two ocean models ROMS and HYCOM are being run for a period of twenty years using the monthly COADS and Levitus data to get the model spin up. A strategy has been formulated to couple WRF and ROMS model and this coupled regional modelling system model is being tested. The forecast skill of the coupled system will be evaluated using seasonal monsoon simulations.

Under a project from the Irrigation Department, Govt. of Maharashtra, the crucial rainfall prediction for catchments area of Koyna dam was carried out during the monsoon of 2007 using WRF model. The amount of precipitation for the next 72 hours, over nine stations in the Koyna dam catchments were webcasted daily twice to Koyna Dam authorities. The precipitation forecasts aid the dam authorities to plan the water discharge well in advance and thus better flood management. The WRF model simulations were carried out with 3 nested domains with very high resolution (4 km).

As a part of an ARDB sponsored project, real time high resolution forecasts of critical aviation weather parameters were generated at 15 mins interval using PARAM supercomputer for the Indian Air Force (IAF). The forecasts were used to plan their daily sorties and flight operations. A real time weather forecast portal for aviation specific users has been developed as part of this project.

The CAS group has developed fully automated, flexible, portable, web based software – the "Anuman" Real Time Weather System for regional simulations of the atmosphere. Anuman is an enabling tool designed to provide the user a real time forecast of weather parameters over local scale (sub urban region). The global model forecasts of Temperatures, Pressure, Humidity, mean sea level pressures, etc. are used to initialise regional weather forecasting models, which yield very high-resolution forecast of atmospheric parameters. The output obtained from this tool can be used for understanding the condition of the atmosphere over the region as small as 1 Km X 1 Km. Anuman has a service-oriented architecture, which assists in predicting high impact weather events. The weather forecasts obtained using Anuman can be used for decision support in situations associated with disaster management, extreme weather event modelling, pollution dispersion modelling, aviation planning, agriculture forecast, irrigation planning and maritime weather hazards modelling and also as a tool for the multidisciplinary research community.

'Anuman' as a product was released at the hands of Dr. Shakeel Ahmad, Hon'ble Union Minister of State for Communications and Information Technology at the inaugural session of ELITEX 2008, at New Delhi.

C-DAC is participating in a multi-institutional Indo-US S&T Forum project "Knowledge R&D Networked Centre for Nanoparticle Aerosol Science and Technology (NAST)". This virtual Centre is created with several faculties from IIT Bombay, three partner institutions in the USA: Washington University in St. Louis; University of Iowa; the University of Maryland, and C-DAC, Pune. The focus is on computational simulations of atmospheric aerosols and nano-particles on multiple spatial scales toward understanding their climate and health effects. An atmospheric simulation platform will be developed through interfacing a state-of-the science regional chemical transport model with an operational weather prediction model using PARAM supercomputer.

CAS Group is also participating in collaborative projects with IIT, Bombay, PRL, Ahmedabad and SAC, Ahmedabad for climate and ocean modelling and simulations. It is also participating in EU-India grid project for earth and atmospheric science grid applications.

Computational Fluid Dynamics (CFD)

A research study has been conducted with an aim to convey the utility of High Performance Computing for CFD applications, to the Indian scientific user community working in this area. The PHOENICS CFD software which was benchmarked and tested on XEON Cluster last year has been used for this purpose. A Linux interface for Parallel PHOENICS has been implemented in consultation with CHAM, UK. This project also marked the initiation of research work in the challenging field of high speed, compressible (supersonic) flows. The outcome of the project has been presented at the Seventh Asian Computational Fluid Dynamics Conference held at IISc, Bangalore. Using a complex 3-D flow model and a mesh size of more than six million cells, this study simulated both shock waves as well as flow separation of air over three dimensional obstacles.
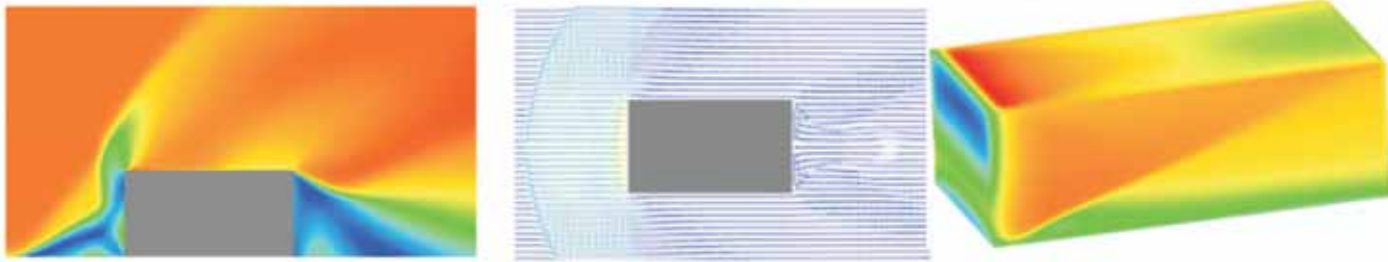
Shock waves and flow separation of air over three-dimensional obstacles

A joint project on the 'Three dimensional flow predictions in passage of transonic compressor rotor' on parallel platform, in collaboration with IIT, Bombay has been completed. The computational resources from PARAM Padma of C-DAC were employed on a large scale. This work had been presented at the Seventh Asian Computational Fluid Dynamics Conference. The simulation of complete flow field in a transonic axial compressor rotor represents a considerable challenge for flow prediction methods. The main purpose of the research was to investigate the applicability and limits of the steady state model for a typical rotor and to predict performance of NASA Rotor 37. A steady state analysis of Rotor 37 was carried out by using three dimensional finite volume based explicit RANS solver using structured multi-block meshes. Frozen rotor method was used as it could be extended for unsteady analysis. The simulations included the effect of clearance at the tip.
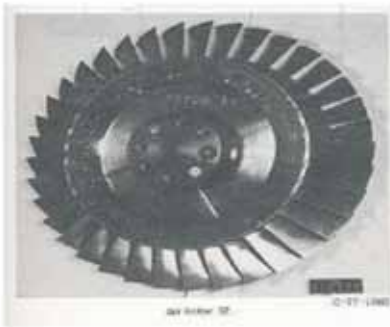

Compressor rotor
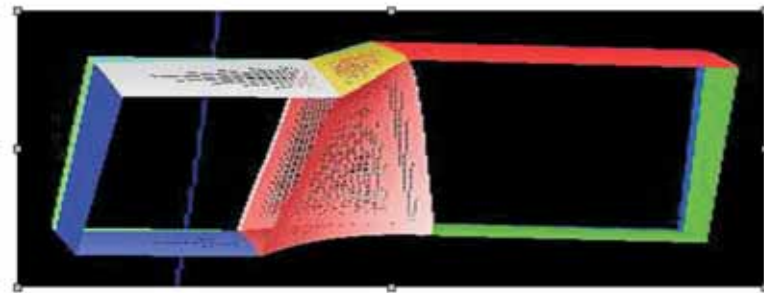
Computational grid for single passage of rotor

The work on the results validation phase of the Internal Combustion (IC) engine project sponsored by automotive industry is in concluding phase with consolidation of results. The simulations for the three combinations COMB1, COMB6 and COMB8 have been completed. The cylinder wall temperature at each engine rpm is now included in the input file and fine tuning of wall temperature for correcting emission trends with respect to r.p.m. is being carried out. Figure below shows the variation of NOx at different wall temperature with respect to r.p.m for one combination.
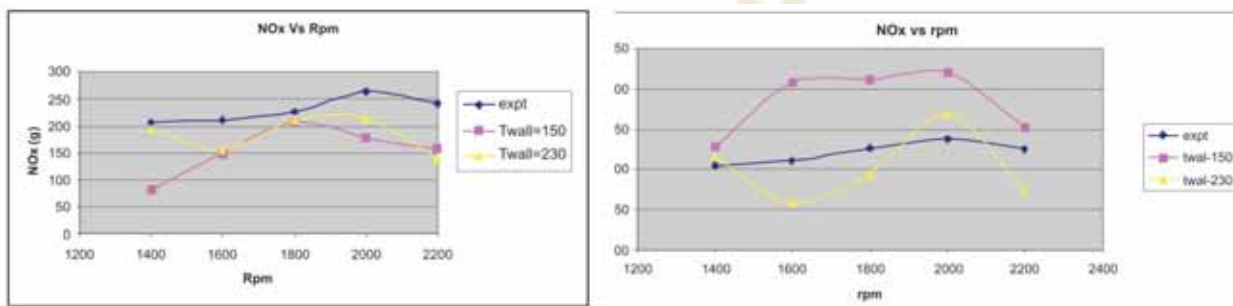
Emission results for Combination-1 at cylinder wall temperatures = 150 and 230 °C

Computational Structural Mechanics (CSM)

INTCOMP v1.0 product development has been completed. It will be made open-source software to be used by academic institutes. INTCOMP is a Finite Element based application for stress analysis of plate/shell structures of fibre-reinforced composite materials. It has been developed in collaboration with IITB-Mumbai, IIT-Guwahati and SGSITS-Indore. The software is based on refined higher-order plate/shell theories.

OpenSees is an open-source, object-oriented software framework for developing applications to simulate the performance of structural and geotechnical systems subjected to earthquakes engineering. It has been ported on PARAM Padma. Linear and nonlinear structural and geotechnical models will be analysed using OpenSees. Nonlinear seismic analysis of a bridge ground system, transient FE simulation was carried out on PARAM Padma.
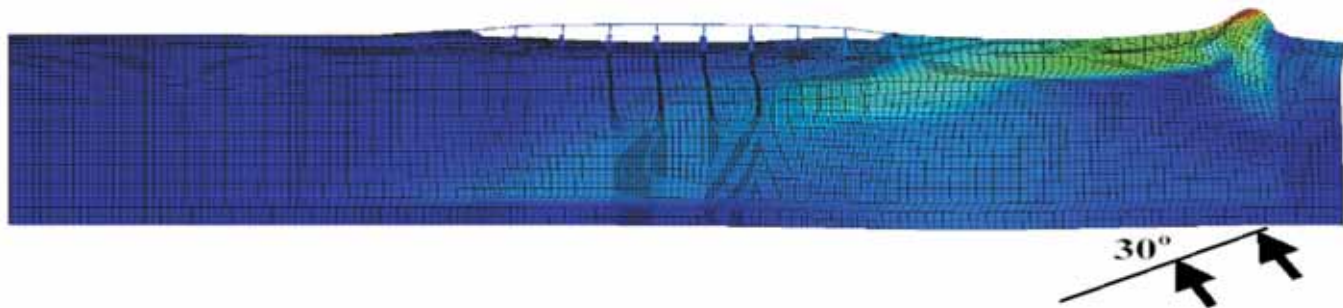
Snapshot of inclined incidence to Bridge

C-DAC is working in collaboration with SGSITS-Indore on an R&D project on 'Computer Aided Seismic Analysis and Design of Concrete Structures'. The coding of static analysis of structural elements has been completed and coding of dynamic analysis is under progress. A project has been formulated with SGSITS on 'Vulnerability Assessment of Existing Stock of R/C Structures under Earthquake Hazards'. The project was submitted to DST for funding. The initial software development in this project, based on IDARC software, has been completed.

The DST sponsored project, 'Optimisation of Laminated Fibre Reinforced Plastic Composites on Parallel Platforms' has been completed. This project was jointly carried out with IIT-Guwahati. With them a new project has been formulated on, 'Optimum Design and Active Vibration Control of Smart FRP Structures on Parallel Platform', and submitted to DST for funding.

Seismic Data Processing (SDP)

INVWAV-II project was accepted by ONGC and MoU has been signed to begin the project. It involves fine-tuning and enhancement of the current software to process real data of Seismic Full Waveform Inversion (INVWAV). A paper was presented on the results of phase I in Society of Petroleum Geophysicist, Hyderabad in January 2008.

The project (in collaboration with NGRI) on seismic travel time tomography (SEISTOM) with real field data is in progress. It is being enhanced to get high-resolution result. A new project for 3D depth migration has been submitted to DST in collaboration with NGRI. Development of GUI (WAVES-II) is in progress for all the modelling and migration codes developed earlier so that they can be accessed from one platform and in a user-friendly way.

Bioinformatics

Bioinformatics Resources and Applications Facility (BRAF) is a DIT funded project, which is presently into the third year. As a part of this project a 1 TeraFlop machine (BIOGENE) has been commissioned at C-DAC. This is an effort to provide dedicated high-end supercomputing facility to the researchers working in the areas of Bioinformatics. Remote access to the users is provided for the applications that are available on BIOGENE. All popular and widely used software have been ported and optimized for the BIOGENE. The Problem Solving Environment (web computing portal) GIPSY has been deployed on BIOGENE and has various sequence analysis and molecular modelling codes and is available for use to academia and industries. The new codes like OPENEYE and MEME are the additions to the GIPSY. GIPSY has been productized and is now available as a product.

Under the BRAF project, Bioinformatics team is already interacting with various industries like Syntel, Inc. (Pune), Capitol Technologies

CTIS (US), Jubilant Biosys Ltd. (Bangalore), Nicholas Piramal Research Centre (Mumbai) for collaborative industry projects. RCS card for Smith-Waterman software is the result of inter-group interactions between the hardware and bioinformatics teams of C-DAC. C-DAC has tied up with Ocimum Biosolution (Hyderabad) for marketing RCS card along with Smith-Waterman software and executing business projects in the area of bioinformatics.

The DBT project on EST analysis of mosquito genome has been completed and the data has been submitted to NCBI. The results of the project have been collated in the form of a database, which has been hosted on C-DAC's server. It is envisaged that this data would be useful in the understanding of spread and control of malaria in India. The comparative genomics work is also ongoing for various species of Mycobaterium. The work in this area is directed towards understanding on metabolic pathways, functional linkages of various genes, understanding of gene expression pattern using micro array data analysis and gene neighbourhood approaches.
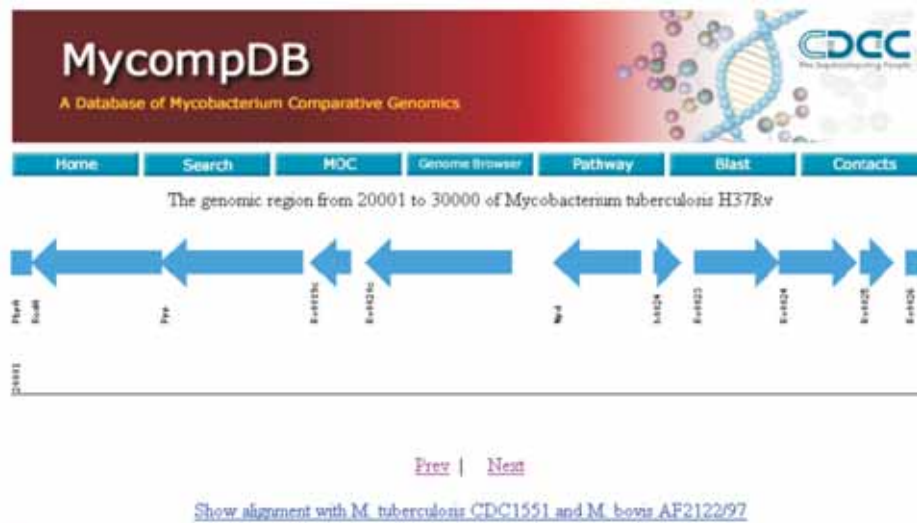
High Throughput comparative genomics using *Mycobacterium* species

The project titled "Development of high-throughput computational workflows for genome analysis" has also been funded by DIT and initiated in December 2007. Scientific workflows allow scientists to automate the repetitive tasks of data management, analysis and visualisation and to document the provenance of analysis results. It is proposed to develop a new Bioinformatics workflow tool, which will be stand-alone, having interactive GUI that will include a wide range of Bioinformatics tools and many more valuable features. The SRS document has been completed and various prototypes are being tested before the architecture would be frozen.

Evolutionary Computing Group (ECG)

A cluster-based version of the problem-solving environment (PSE) for scientific and engineering applications (SECG) incorporating different job schedulers (such as PBS and Load leveller) running on AMD, Xeon, and PARAM Padma HPC clusters has been completed. A grid-enabled version of the PSE, currently running on the PSE server, is being attempted. Study of optical properties of CdTe and ZnSe quantum dots (in collaboration with University of Pune), and magnetic properties of transition metals (like Co, Mn, Fe, etc.) doped in Boron clusters (in collaborations with University of Pune and Michigan Technological University, Houston, USA) is being pursued. Parallelization of the coupled cluster code is in progress. Implementation of the Mahalanobis-Taguchi-Gram-Schmidt's (MTGS) method for pattern classification has been completed. Gene Expression programming tool has been developed in C#. Projects on parallelization of Wang-Landau algorithm for simulation of complex fluids and simulation studies in Blume-Capel model with long-range strain-strain potential. Improving the protein structure prediction methodologies with various Evolutionary algorithms and with different force fields is being pursued. Hybrid Taguchi Genetic Algorithm (HTGA) based on orthogonal arrays has been implemented for protein structure prediction. A graphical user interface for PSP-GA (Protein Structure Prediction using GA), primarily used for training purposes, has been implemented.

HPC Projects

Centre of Excellence in HPC at North East Institute of Science & Technology (NEIST), Jorhat

C-DAC is in the process of establishing a Linux based state-of-art High Performance Computing (HPC) PARAM Facility at North East Institute of Science & Technology, Jorhat. The system will be backboned by C-DAC's High Speed Low latency PARAMNet-3 Interconnect. This facility shall serve as a research platform and assist in Early Warning System for dissemination of scientific data to publicize hazard related information on a real time basis.

HPC Facility at Indian Institute of Tropical Meteorology, Pune

C-DAC is in the process of establishing a HPC facility having a peak performance of approximately 2.5 Tera Flops, 48 Terabytes of storage and Infiniband as the primary interconnect. The system will used for research in the area of Tropical Meteorology using various codes like Hirham, Precis, MOM4, and COSMOS.

HPC Facility at Jawaharlal Nehru University, New Delhi

C-DAC has set up a state-of-the-art HPC facility at JNU, New Delhi. The facility has been in use for about a year for research activities in the areas of Bioinformatics and Life sciences.

Collaborative Initiatives with National Institute of Oceanography (NIO), Goa

A MoU was signed between C-DAC and NIO after considering various IT opportunities at NIO. The current projects undertaken include a fully functional data centre, an HPC facility in Seismic and IT Groups, and LAN audits. Joint collaboration projects in the field of Ocean Modelling, Seismic Data Exploration, Visualization, and Computer Aided Taxonomy Information System (CATIS) have been initiated.

HPC Facility at Physical Research Laboratory (PRL), Ahmedabad

C-DAC has signed a Memorandum of Understanding with PRL, Ahmedabad for establishing a HPC Infrastructure having a peak performance of 3 Teraflops with approximately 10 TB of storage. The scope of the project includes providing consultancy, setting up of a state of the art HPC facility and onsite application engineer support. The facility shall be used for education in research purposes in the areas of Space & Atmospheric Sciences, Astronomy and Astrophysics, Theoretical Physics, Planetary & Geosciences.

HPC System at NCMRWF, Noida

National Centre for Medium Range Weather Forecasting (NCMWRF), Noida has a 0.5 TF HPC system installed and commissioned by C-DAC in 2005 using C-DAC's earlier version of interconnect PARAMNet II. This system is being used in production environment to predict Weather on a daily basis. C-DAC has been providing the HPC and maintenance support. High Performance storage is being upgraded to 80 TB.

Grid Computing

C-DAC has deployed the nation-wide computational grid 'GARUDA' connecting 17 cities across the country in its Proof of Concept (PoC) phase.

The GARUDA grid is up with 100 Mbps and with 600 processors, an aggregate compute power of about 3.5 TFlops - for compute intensive and data-crunching work required in areas such as Bio-Informatics, Disaster Management, etc. The GARUDA project is slowly but surely catching the imagination of not just academia but industry and international partners as well.

The PoC phase of GARUDA has been successfully completed and C-DAC is building a strong base in the Foundation phase of GARUDA to move into the Main phase of GARUDA.

GARUDA Communication fabric

GARUDA communication network has been established at all the GARUDA partner institutes in close collaboration with ERNET who are also responsible for the operation, maintenance and management of this network.

Currently SAC and C-DAC centres at Bangalore and Pune are connected by GSAT-3 network for exploring possibility of utilizing the grid infrastructure using satellite.

GARUDA Components

The GARUDA grid components include HPC systems, petabyte storage, special scientific instruments and a comprehensive software environment for the entire system.

GARUDA Components
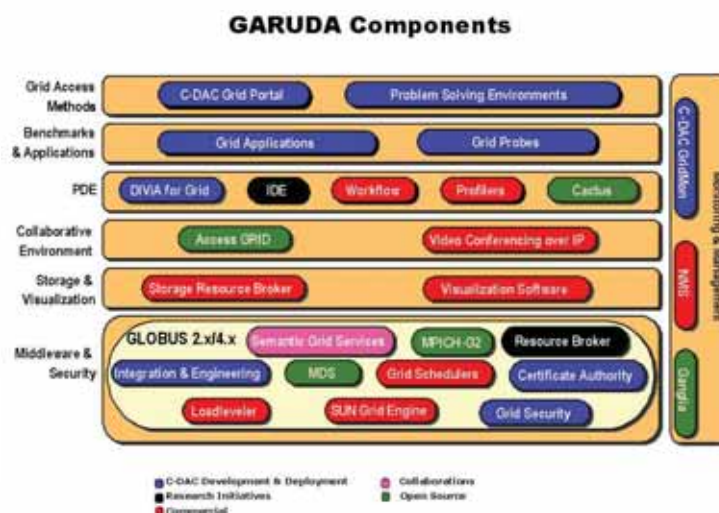
Grid Tools

GARUDA Access Portal

GARUDA portal is the gateway for accessing the GARUDA grid and provides a user-friendly approach for performing tasks on the grid such as: submitting and monitoring jobs, monitoring system performance and browsing the results. It has unique features like semantic resource search, integration with GARUDA data grid solution, and providing application specific Problem Solving Environment (PSE). Added major features include, secured transactions, accounting the jobs submitted through portal, dynamically updating the GARUDA resources, accessing the user credentials from the PURSE database, informing the user in case of memory corruption, uploading failure, unlimited listing of files, uploading the input files irrespective of file size and number of files, and accessing sub-directories using SRB.

GARUDA Monitoring Tool - Paryavekshanam

Paryavekshanam monitors GARUDA grid's health to enhance the reliability, usability and manageability. It captures the dynamic nature of GARUDA with respect to nodes, network, grid middleware, jobs and software installed. It provides the hierarchical drill down of information with dashboard providing the top-level view and status bar for quick and action oriented insight. Radar graph provides the bird's eye view of grid health. It detects, records and reports faults and service degradations to ensure that the grid operates optimally through alert and notification system. A new site addition facility helps administrator to easily interface for monitoring new sites. The historical data for analysis can be navigated through the 'Data Gallery'. Distinctive features like 'Search facility' helps user in knowing resources before submitting the jobs. Multiple views like Grid, Nodes, GOC and Network improves the monitoring capability for administrators.

The resource utilization of Garuda
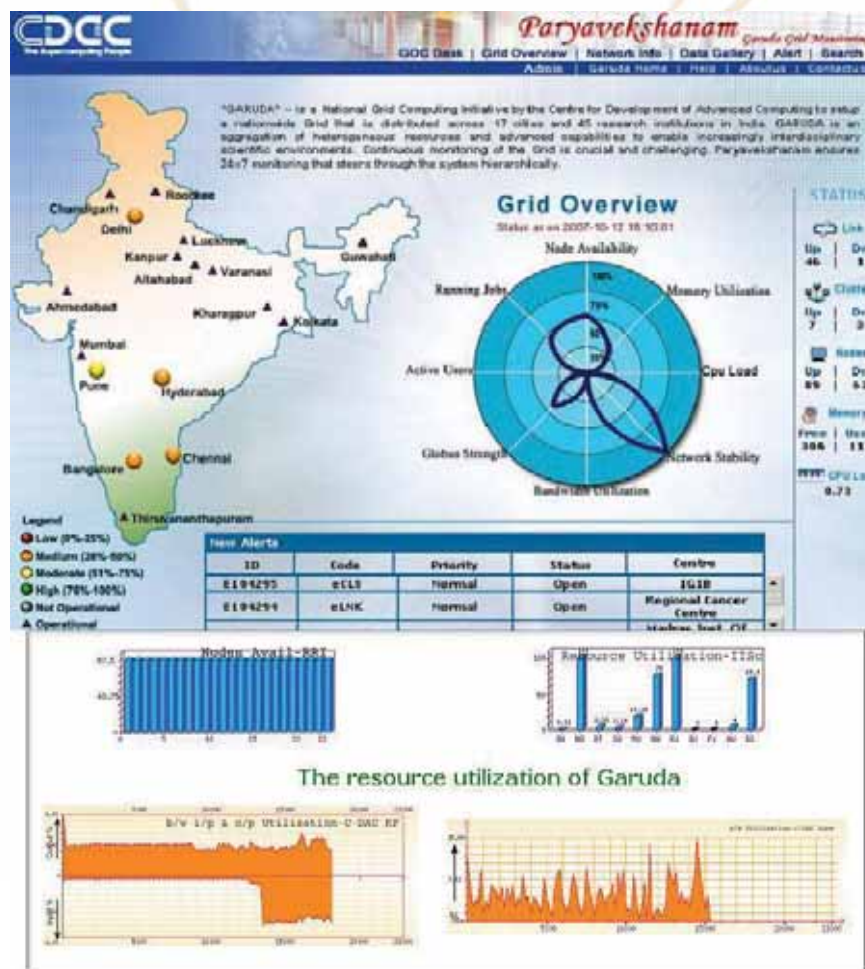
GARUDA Grid Integrated Development Environment - GIDE

GIDE (Grid Integrated Development Environment) is a user-friendly, platform independent, and GUI based IDE for GARUDA grid. It helps application developers with no prior knowledge on grid middleware (Globus), to carry out the entire program development life cycle on the grid and maintain huge grid applications. It enhances the productivity of application developers.
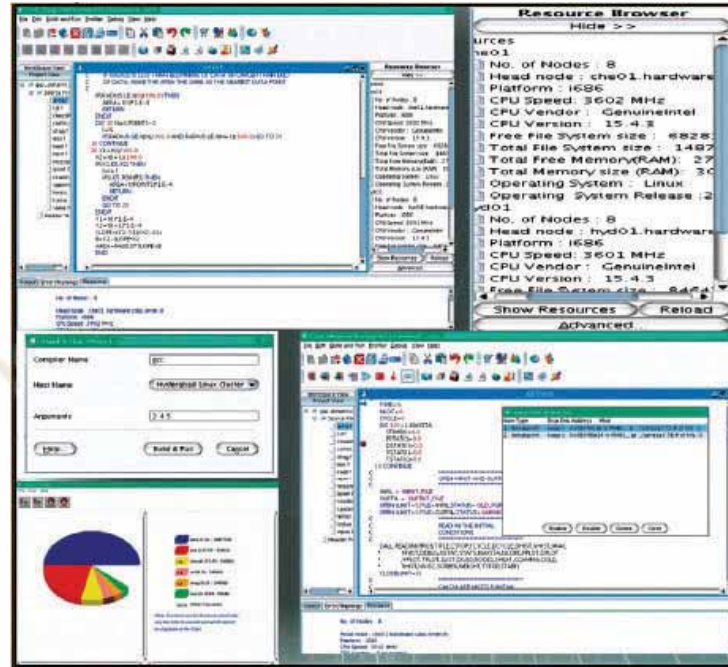
GRIDHRA (Grid Debugger and Runtime Analyser)

GRIDHRA is meant for debugging individual MPI/MPICH-G2 based application. It supports debugging the application written using C language. It has a visualization module using which users can analyse the application performance. It displays various useful statistics for performance analysis using different types of charts.

GARUDA Grid Installation Package – GARUDA Sigma

GARUDA Sigma is a grid installation package, conceived with an aim to unify all the tasks of installation and configuration of GARUDA grid related software. This user-friendly tool frees all the hassles involved in pre and post installation configurations for the end user.

GARUDA Data Management

GARUDA grid provides storage management by deploying Nirvana's Storage Resource Broker (SRB). It provides a data grid solution for the GARUDA grid users, which not only handles heterogeneous resources that are geographically apart but also provides a uniform namespace for the data objects, and also ensures the security and confidentiality of the user's data. GARUDA data grid is based on client/server architecture with the combination of metadata server, agent servers, clients, and automation daemons. The main features that GARUDA data grid supports are data storage and access virtualization by providing global name space and different levels of abstraction. Data management services include backup, replication and synchronization, security, user-friendly interfaces, performance and automation.

Applications in GARUDA – PoC Phase

Applications of national importance that require aggregation of geographically distributed resources have been developed and deployed on the GARUDA grid.

The disaster management application for flood assessment was taken up in collaboration with Space Application Center (SAC), ISRO, Ahmedabad. In this application the data captured using Synthetic Aperture Radar (SAR) was processed using software developed by SAC, on several clusters of GARUDA and the output was analysed using specialized visualization tool (ERDAS). The software for processing the raw data was grid enabled to significantly improve the execution time.
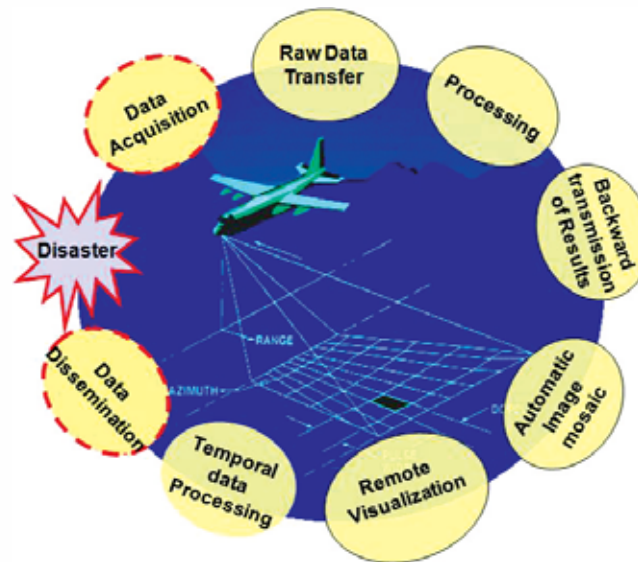
The following projects have been taken up as part of application enablement on GARUDA:

- Parallelization of code from Giant Metrewave Radio Telescope (GMRT) of NCRA (Pune) and porting onto heterogeneous clusters within GARUDA setup
- Debugging of code to solve memory issues in coupled cluster model based code of Indian Institute of Astrophysics (IIAP, Bangalore).
- Porting of Bias-Exchange Metadynamics code on HPC cluster of GARUDA grid nodes as part of EU-India grid collaboration
- Automation of job submission of Protein Structure Prediction code on grid

Under the BRAF project the GenomeGrid software is being developed. Deployment of the portal on Garuda Grid setup across four geographically distributed locations viz., Bangalore, Pune, Chennai and Hyderabad was done. New modules have been added and jsp pages for applications like 'Fasta', 'ClustalW', 'Blast' and 'Amber' have been developed. Enhancement in the look and feel of GenomeGrid with new template was done. Application specific scheduler was modified apart from modifications with regards to job submission in GenomeGrid.

Grid Computing Open Source Software

C-DAC has developed software suites for testing the health of a grid computing system and for benchmarking a grid computing system. The tools were tested with GARUDA grid. They have been put in the Open Source Software (OSS) domain and can be accessed from C-DAC's website.

EU India Grid

EU-India grid deployment and operation is under progress. The infrastructure will make available common, interoperable grid resources to the European and Indian scientific communities, in order to support existing EU-India collaborations in eScience and promoting new ones. The deployment and maintenance of resource site for EU India grid is coordinated from C-DAC, Bangalore. Several scientific and engineering applications are also being ported on EU-India grid by C-DAC.

MULTILINGUAL AND HERITAGE COMPUTING

The IT domain is developing at a massive speed but all the data is available mostly in English and is not actually reaching the masses. Only 4.2 crore people in India are conversant with IT, which is hardly 4% of the total population. For this percentage to increase substantially, it is necessary to be able to use computers in your native language. C-DAC's activities in the area of multilingual and heritage computing are targeted towards this objective. Key activities carried out during the year are described in this section.

Natural Language Processing

Tahreer

Tahreer is a tool for creating content, letters and documents in the Perso Arabic scripts. These scripts are right to left by nature and languages based on these scripts viz. Urdu, Sindhi and Kashmiri are recognized as the official languages of India.

Tahreer is capable of handling right to left scripts on any UNICODE compliant application, such as - Notepad, MS-Word, Database like Oracle, e-mail client viz. Outlook Express, etc. Using Tahreer along with any Unicode enabled web-content creation tool, user can create HTML documents, which can be published on the Web.

Utrans

C-DAC GIST's Utrans is a tool for transliterating Indian Languages to Urdu Language. Deploying a strong genetic algorithm and statistical tools, a set of transliteration utilities is under development, especially to bridge the gap between Latin, Brahmi and Perso-Arabic platforms. Following utilities have been developed.

Name Conversion Utilities

These utilities allow for conversion of names typed in one language platform to another. It is available for transliteration from Hindi, Punjabi, Marathi, Telugu, Kannada, Gujarati, Bangla, and English to Urdu; and conversion from Urdu to English.

Code Conversion Utility (Tarseel)

Allows user to convert legacy and third party text files of Perso-Arabic scripts to UNICODE text files. User specifies the path of folder that contains third party files and on one click, all the files are converted to UNICODE.

Indian Language Spell-checker for Urdu, Malayalam and English

The spell-checker has features that incorporate the latest in both technology as well as in language. It is available for Urdu, English and Malayalam. The dictionary is a judicious mix of vocabulary culled from lexical databases as well as corpora covering topics such as daily news, philosophy, poetry, literature, advertisements, general knowledge, current affairs, basic science vocabulary, mathematical terms as well as vocabulary from encyclopedia to provide the largest range possible of spell-checking.

Suggestions are the heart of a Spell-checker. Based on suggestion heuristics as well as the most common errors made by Urdu speakers, Imla Shanaas provides normally a hit within the top three suggestions. An intelligent word-splitting algorithm ensures that compounding is safely handled. Airabs are also accounted for and the spell-checker can handle all and every diacritic mark used in modern Urdu.

The dictionary comprises over 70,000 root words which when exploded can spell-check around 700,000 words in Urdu. The words in the dictionary are based on the latest spelling norms so as to ensure full compliance with the Urdu Imla. Imla Shanaas can handle Unicode, UTF8 as well as PASCII (the proprietary standard of C-DAC GIST).

Tarjumahkaar

Tarjumahkaar is capable of converting Urdu text to Hindi text using MAT (Machine Assisted Translation) techniques. Documents created by it are PASCII (8-Bit) and Unicode (UTF-8/UTF-16) compliant.

GIST-Sorting Utility (G-SU)

G-SU allows the user to sort text files with many different sorting options. Text files can be of type ISCII or UNICODE. G-SU is a bulk data sorting tool through which we can sort more than one file at a time. Finally all the sorted data are saved in a single file.

Before sorting the data, different sorting options can be selected like user can first set the sort order of output e.g ascending, descending, reverse-ascending, reverse-descending, etc. These options are applied on the whole output data. Along with that, user can set specific options on whole or a part of data e.g. user can specify characters, which are to be ignored in sorting, can give collating sequence file. Also, users can specify field separators, which are to be considered as a separator between fields. After that, user can give specific sorting option on every field. The final data will be sorted accordingly.

Design and Pattern Creation Tool

Design and pattern creation tool allows users to create different designs, and patterns. It can be used for applying any image as a border just by specifying the path and width, height of the image that needs to be applied as border. ISFOC border fonts and symbols can be applied as borders. The tool is Unicode compliant so that user can type in any language. Users can also apply any image as a background and can finally save the whole work in a bmp format.
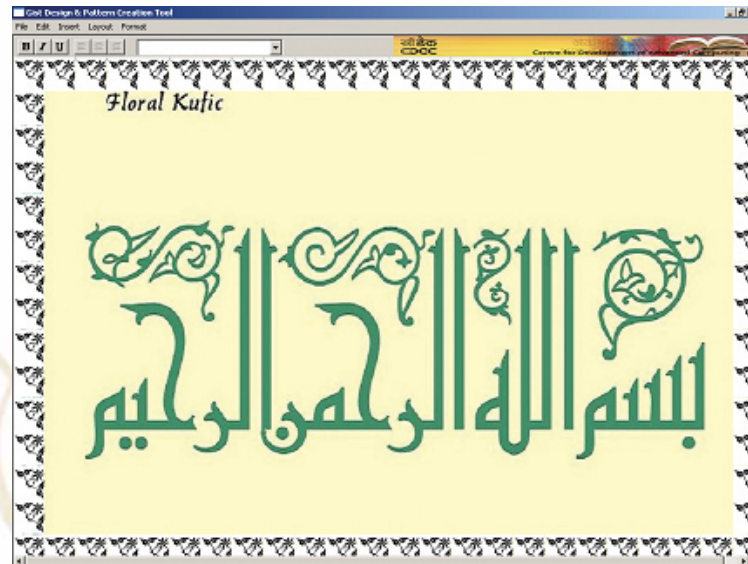
Concordance Tool

This tool is used to generate the wordlist and its related context within the various input Indian language files. It generates a list of head words (can be words, syllables, characters, or Part-of-speech) and generates the context in which the headwords are present in the input files. This tool is used to analyze the text to get various statistical data like freq/percentage of headwords, the context in which they occur, the part of speech of the adjoining words, the references of the tagged text, etc.

It supports various features like concordance on selected phrases, concordance on selected part-of-speech, concordance on particular tag (like chapter 1), concordance based on the proximity of two headwords. It also supports searching in the headwords and context. It allows sorting (ascending as well as descending) based on occurrence, length, frequency, alphabetical, or reverse alphabetical order. The user can also provide the collation order for sorting. It also can be configured to group all the lemmatized and/or synonyms together in the headword list.

The tool supports ISCII as well as Unicode files. It also enables the user to ignore the words or characters during concordance. The user can save concordance as web concordance wherein he can use the html pages later on for further analysis.

Synonym Dictionary Builder

In the areas of NLP, thesauri and dictionaries contribute as a major database for various activities. They are a rich source of words and synonyms, which is highly required for tools and application running on corpus. They are also the backbone of NLP related work like machine translation, search engines and also for developing as well as evaluating spell checkers.

The need for high-end Indian language databases in the 22 official languages constantly makes itself felt and C-DAC has taken up the challenge to provide unique and simple solutions for a multilingual country like India by proposing tools that facilitate the generation of thesauri and dictionaries.

This tool is designed for building a large database of synonyms for respective headwords. The tool is developed for all 22 Indian languages.
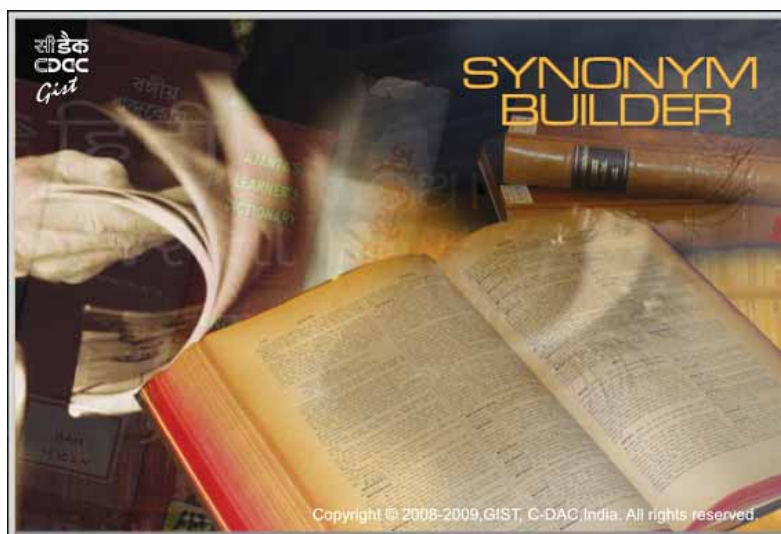
E-Thesaurus Generation Tool

The thesaurus generation tool is a good way to help digitize and store thesaurus data in XML file format. Various traditional thesauri of different languages are studied thoroughly to design it. The structure of the thesaurus is finalized to suit different languages. Thesauri for Bengali and Telugu have been entered successfully using this tool. Also thesauri is ready for Hindi and Gujarati. These are essential plug-ins for search engines, learning tools, e-governance, word net, semantic web and prediction dictionaries.
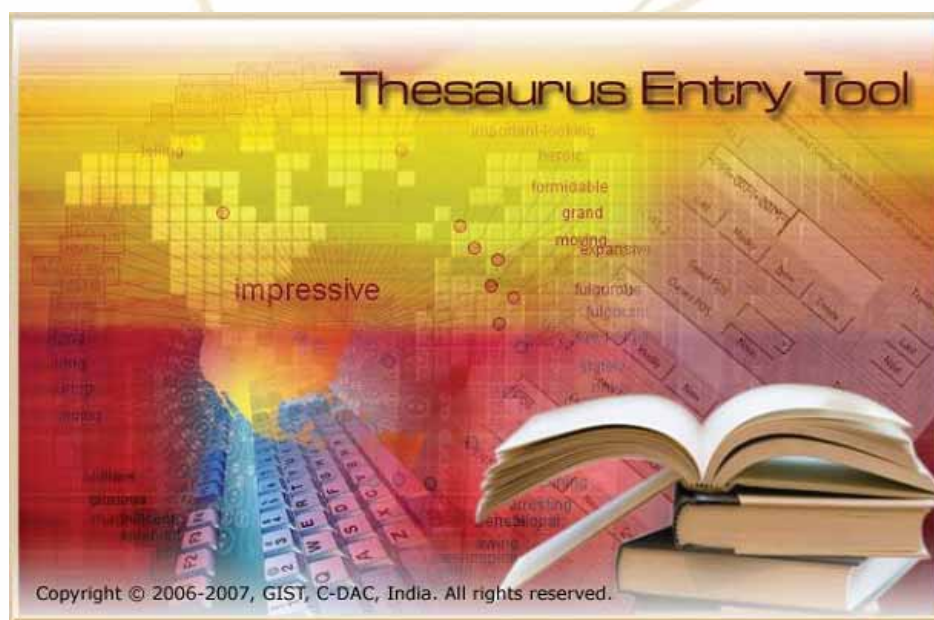
English to Indian Languages Machine Translation (EILMT) System

C-DAC is also working on the development of English to Indian Languages Machine Translation (EILMT) System. This project is being implemented by a consortium of 10 institutes. C-DAC, Pune is the consortium leader. The project is sponsored by Department of Information Technology (DIT), Government of India. The domains are tourism and health-care. Under this project a system has been developed to translate from English to six Indian languages such as Hindi, Bangla, Marathi, Tamil, Oriya and Punjabi. The

work component of C-DAC mainly consist of developing English to Hindi language translation component using Tree Adjoining Grammar (TAG), compilation of corpus related activities and coordination of the project.

MANTRA-Rajbhasha

MANTRA-Rajbhasha project has been sponsored by Department of Official Language (DOL), Ministry of Home Affairs, Government of India. MANTRA-Rajbhasha is a English to Hindi translation system for the domains comprising of Administration, Finance, Small Scale Industries, Agriculture, Information Technology and HealthCare. On the occasion of Hindi Diwas, i.e. September 14, 2007, Mantra-Rajbhasha translation system for Information Technology and Healthcare domains were launched by Shri Shivraj V. Patil, Hon'ble Union Minister for Home Affairs, Govt. of India. Currently development of Machine Translation System for Education and Banking is in progress. The AAI group represented the regional Hindi seminars and TOT programmes (Training of Trainers) conducted by DOL at Delhi, Kolkata and Mumbai.

MANTRA Rajya Sabha

MANTRA-Rajya Sabha has been sponsored by Rajya Sabha Secretariat, Government of India. It is a English to Hindi translation system where daily proceedings of Rajya Sabha like Parliamentary Bulletin, List of Business, Papers to be laid on the table, etc., are translated in an Intranet environment. This project has been launched on 29th August 2007 by Hon'ble Vice-President of India, Shri. Mohammad Hamid Ansari, at Rajya Sabha, New Delhi.

AnglaMalayalam

This project intends to develop a Machine-aided translation system, which enables translation of English documents to Malayalam. The translation engine used for this purpose is "AnglaBharti", a machine aided translation methodology developed by IIT, Kanpur. AnglaBharti is specifically designed for translating English to Indian languages. It uses a pseudo interlingua approach. It analyzes English only sentences once and creates an intermediate structure with most of the disambiguation performed. The next process is of text generation where the intermediate structure will be converted to the required Indian language.
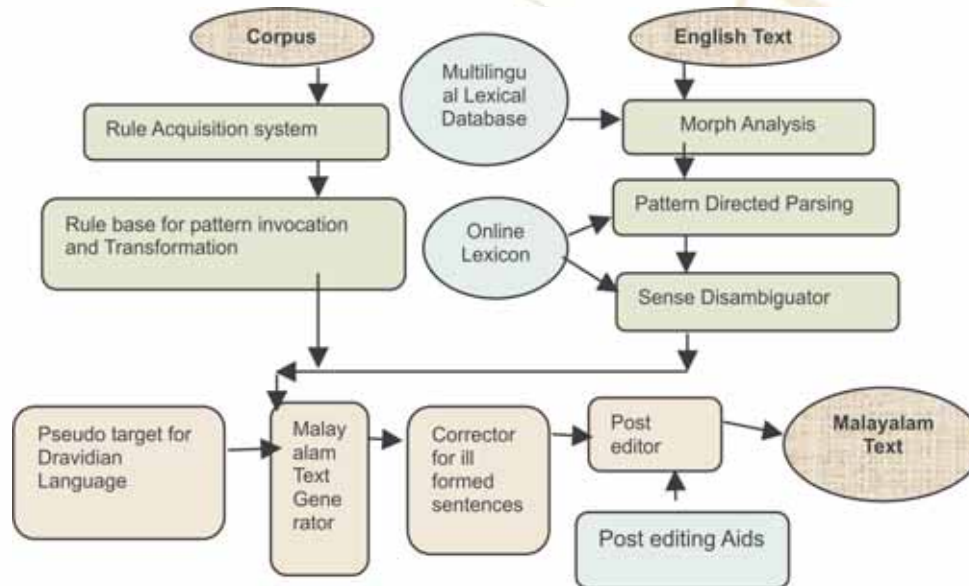
Block diagram of AnglaMalayalam System

The final deliverable of the project is a domain specific English to Malayalam translation support system with 75-80% translation accuracy. The domains selected are health and tourism. The basic system integration has been completed. Domain specific lexicon extraction and entry is in progress.

Indian Language to Indian Language Machine Translation (ILMT) system

C-DAC is participating in the development of Indian Language to Indian Language Machine Translation (ILMT) as a consortium member. A consortium of 12 institutes is implementing this project. The project is sponsored by Department of Information Technology (DIT), Government of India. The work components of C-DAC, Pune consists of development of evaluation modules for evaluation of translation between different Indian language pairs and linguistic related tasks.

Vachantar-Rajbhasha

Vachantar-Rajbhasha is an integrated system that transcribes and translates English speech to Hindi text in the domains of administrative, finance, agriculture, small-scale industry, information technology, health care, education and banking. The system combines a Speech Recognition Engine and MANTRA-Rajbhasha. The beta version of the software was released by Shri Shivraj V. Patil, Hon'ble Union Minister for Home Affairs, Government of India on September 14, 2007 during the Hindi Divas celebrations, at Vigyan Bhavan, New Delhi.

Information Extraction and Retrieval (IE/IR)

C-DAC is participating in the development of Cross–Lingual Information Access (CLIA) system as a consortium member. This project is being implemented by a consortium of 11 institutes. The project is sponsored by Department of Information Technology (DIT), Government of India. For this project, C-DAC is working towards development of font recognizer, meta search engine, parallel and distributed search, soft key board and other corpus related activities.

Machine Translation System: MaTra

Machine translation system "MaTra" has been made available on the web during the last year for feedback from the users. The system is now performing well within the supported types of sentences. Work is in progress to enhance the clause boundary detection, transliteration, word sense disambiguation, etc. to further enhance the quality of translation.

Statistical Machine Translation

Statistical machine translation was initiated as a research area within the NLP activities to supplement the existing MaTra system as a hybrid model. This soon became a part of the EIMLT consortium as one of the four threads for translation. A prototype implementation for English to Hindi using the aligned corpus created by the consortium is now available, and is showing good performance, given the small size of the corpus. We have incorporated separation of root word and morphological inflections, and also gross level word reordering based on target language structure. These have significantly improved performance of the system.

Localization

Bharateeya OO

Realizing the need for localization, as the first step, C-DAC was given the assignment of releasing localized versions of Bharateeya OO, Fire fox, Thunderbird and Pidgin softwares. The strings which needed translations were computer commands, which we use in English. To do this activity, we have appointed more than 70 free-lancers working in various languages from various parts of India.

Now basic translations are over in all the above languages and a process of revalidation is going on. Linguists and laymen have discussed and have come out with the first ever corpus of computer terminology in 22 scheduled Indian languages. This is indeed a gigantic step towards development of IT in India.

We have successfully released language CDs in 11 languages and have been instrumental in reaching IT to even rural areas with the localized versions.

Standardization

Standardization of following languages - Bodo, Santhali, maithli, Dogri, Tibetan and Sinhala have been done with GIST typing tools. About 700 glyphs are there in each of these languages with additional Sanskrit glyphs. Four weights – Normal, Bold, Italic and Bold Italic have been included.

Localization of Web Application - www.trainenquiry.com

The project deals with the design, development and implementation of localized Unicode version of the existing online 'Web based Railway Enquiry System' hosted at www.trainenquiry.com and its related application modules.

As part of the project, a Localized Train Enquiry System in Hindi has been developed which provides up-to-date and accurate information to the passengers regarding:
- Train running information
- Arrival/departure of passenger trains
- Trains between important stations
- Running time table of trains

RBI Banking Tools

C-DAC developed desktop-based dictionary tools along with online banking dictionary. The desktop-based dictionary tools include Dictionary Updation Tool and Dictionary Search Tool.

The tools can be used for adding, updating or searching a word in dictionary. Two dictionaries can also be merged using this tool. The banking domain dictionary is also made available to all web users by online glossary.

CLDR Tool

CLDR (Common Locale Data Repository) is the largest and most extensive standard repository of locale data. This data is used for software internationalization and localization i.e. adapting software to the conventions of different languages. Indian language data for such common software tasks as formatting of dates, times, time zones, numbers, and currency values; sorting text; choosing languages or countries by name; and many other categories can be entered. It creates Unicode compliant linguistic resource for eventual development of high-end NLP tools and technologies.
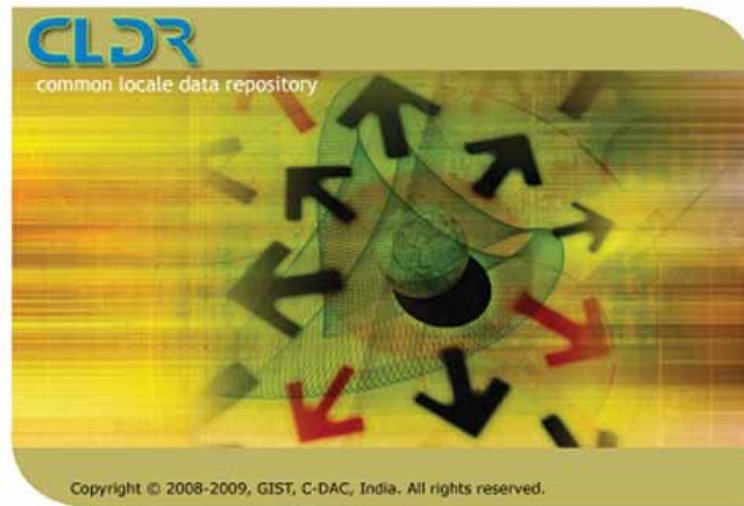
Code Converter

This utility converts files from different legacy ISFOC code to Unicode. It supports Word, HTML and text file. These files can be converted in bulk. It converts all the files from the folder/subfolder depending upon the user selection and put them into the destination folder with the same structure as that of input folder.

Multilingual Speech Technologies

Text-To-Speech System

Facilitated by the phonetic nature of the script systems of a majority of Indian languages, TTS system has a great future in India. Apart from its intrinsic utility for hearing impaired users, it can also be deployed on mobiles, hand-held's, e-books to name only a few of the major applications.

The TTS system developed at present caters to Hindi and offers the following three different text to speech systems, classified as per the needs of the industry.

- A **Limited Domain TTS** geared to the requirements of systems where the number of sentences to be spoken is limited.
- A **Generic TTS** which is a hybrid model (diphones + recorded words) and which can be used as a web-service to be used for a large number of web-applications where there is a need for voice rendering.
- A **Tiny TTS** based on the phoneme level provides a library of a tiny phoneme set which can be deployed on mobiles, hand-held devices, PDA's, etc.

With few changes in developed rules the same TTS system can also be adapted for other languages.
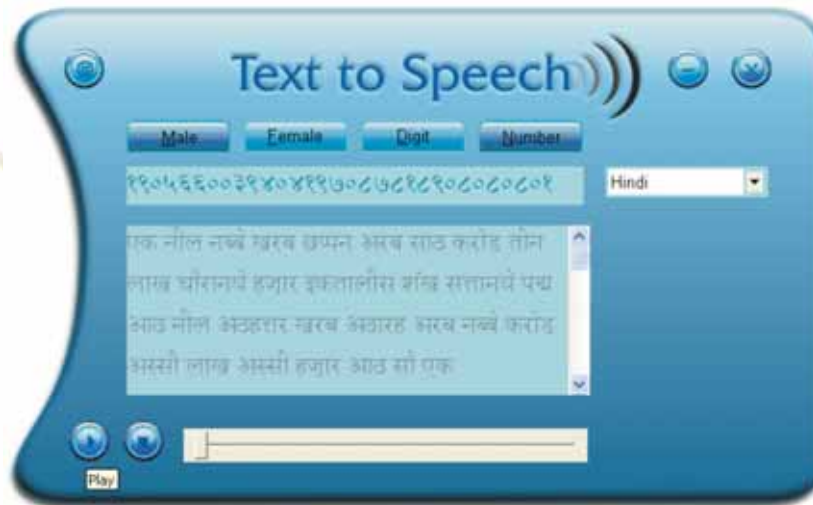
Simultaneous Speech Translation for Asian Languages

Asian Speech Translation Advanced Research (A-STAR) is a consortium of research institutions from Japan, Indonesia, China, Korea, Thailand, Vietnam and India. C-DAC is the partner institution in this consortium from India. The aim of this consortium is to cooperate in research in automated speech translation in Asian languages by conducting joint research. The first major technology demonstration project under this aims to demonstrate simultaneous speech translation between the seven languages in the area of travel and tourism. This technology intensive project is presently in progress in the above seven countries with C-DAC taking care of the Hindi segment. The efforts are going on for a live demonstration involving all seven institutions, in the first quarter of 2009.
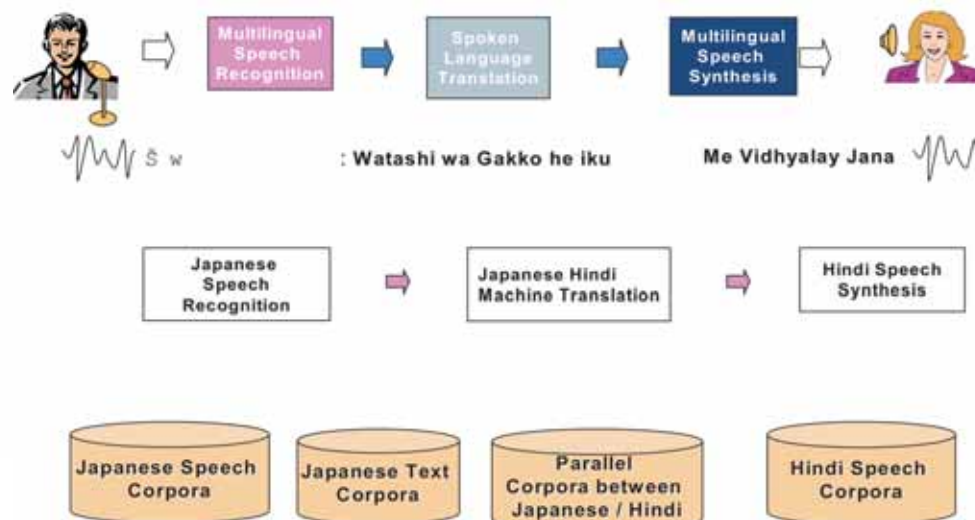
Scheme of speech translation system

Speech Corpora Resource Centre for South Indian Languages

This project involves development of annotated speech corpora for south Indian languages to meet the requirements of Automatic Speech Recognition and Speech Synthesis, which form the main areas of speech technology research. This requires collection of reading materials from different domains for different areas of speech research. The collected materials are read by selected informants in a noise free environment (studio recording) in a standard format. In the preprocessing of the recording, noise reduction, sentence wise segmentation and naming is done. Then the phoneme (Wx representation used) and phrase level annotation is done using speech analyzer. Five level annotation is done using the supporting tool for annotation. The recordings for Text-To-Speech (TTS) are subjected to signal conditioning which involves noise reduction, pitch normalization and amplitude normalization. These signals are then segmented to create the database for TTS.
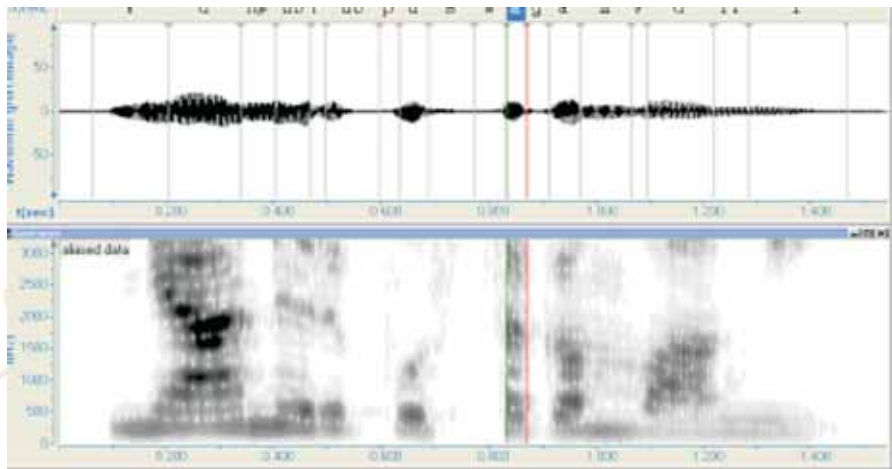
Annotation using speech analyzer

Segment boundary identified by the tool
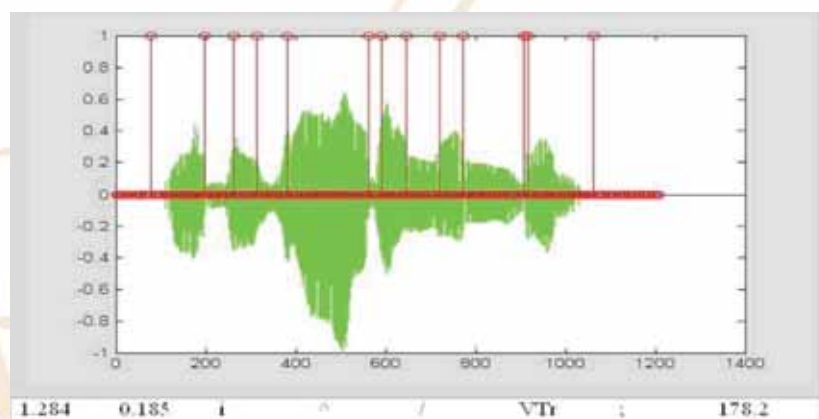
Automatic Speech Recognition System for Malayalam

The project aims at the development of Automatic Speech Recognition (ASR) system for Malayalam language.
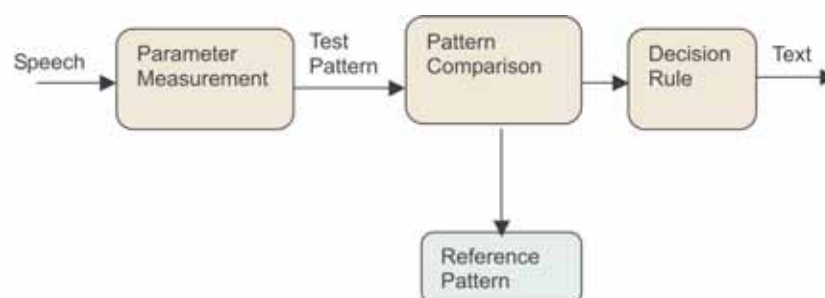
The final outcome of the project will be a speaker independent ASR system capable of recognizing speech in dictation mode with limited vocabulary Malayalam words. The literature survey has been completed and the report is being prepared.

Embedded System TTS

The principal focus of this project is to develop a Text-To-Speech (TTS) system architecture with reduced computation and memory requirements. The major application of this project will be in the form of an assistive technology in situations where a visual interface for mobile devices is inappropriate, as in the case of devices to be used by the visually or physically challenged and the illiterate. The technology will make possible Malayalam speech-enabled electronic gadgets.

Speech Processing in Indian Language

The following R&D activities have been undertaken for the development of speech Technology in Indian languages:

- Text-to-Speech (TTS) system for Nepali language.
- Indo-Japan collaboration program with the University of Tokyo, Japan, for prosody modeling for Bangla.
- Standardization of Indian language phonetic representation (starting with Bangla, Hindi and Assamese).
- Epoch Synchronous Non Over Lapping Add (ESNOLA) method based Bangla Speech synthesis system with integrated prosody model.
- New Manner Based Lexically Driven (MBLD) model for Indian language speech recognition (starting with Bangla).

Parijan – A Text-To-Speech Framework for Indian Languages

Parijan, basically has two major components. One, Indian language module for TTS engine which aids Screen Reader (GNU/Linux based) to read out events on the screen as well as text in Indian language. Currently, it is working for Hindi, Marathi and Kannada languages. It is now in expansion phase, which would cover other Indian languages as well. Second component is writing aids like spell checker, dictionaries in Indian languages, which work on OpenOffice.org text processor. Currently, prototype for Marathi spell checker dictionary is ready and now it is in refinement phase with linguistics modifications.

Multilingual Web Technologies

IDN (International Domain Names)

C-DAC undertook research and study of various RFCs and their applicability vis-à-vis Indian languages under the guidance of the DIT. The research is focused on Domain Names in Indian languages for Hindi, Gujarati, Urdu, etc. and included the following:

- NamePrep and StringPrep Profile - RFC-3492
- PunyCode: Bootstring encoding - RFC-3454
- StringPrep - RFC-3987, Path of IDN, etc.

DAC has submitted recommendations and reports related to possible pitfalls, phishing, (online fraud arising from similar URLs), etc. whilst implementing IDN in Indian Languages.

W3C (World Wide Web Consortium)

C-DAC has made a report on the representation of the seven languages catering to the various recommendations of the W3C. Of these, four belong to the Brahmi family and use Left To Right (LTR) mode to display the characters: Gujarati, Marathi, Konkani and Dogri. While Sindhi, Kashmiri and Urdu, which are Perso-Arabic, use the Right To Left (RTL) mode of visual display. C-DAC has extensively researched the various aspects related to Localization (l10n) and Internalization (i18n). The broad areas of research and recommendations include:

1. Representation of Indian languages on the World Wide Web.

2. Character encoding issues for languages such as Marathi, Konkani, Gujarati, Sindhi, Kashmiri, Dogri, Urdu, etc. in UNICODE

3. Language Names - RFC-3066

4. CSS and Text Formatting

5. CLDR Common Language Data Repository

6. Mobile Web Initiative - Recommendations for correct representation of Indian language on Mobile PDA devices

7. Internationalization Tag Set - XML Tags, which help in localization like translate, ruby, direction, etc.

LILA Hindi Prabodh, Praveen and Pragya on the Internet

LILA (acronym for Learn Indian Languages through Artificial Intelligence) Hindi Prabodh, Praveen and Pragya courses were developed and deployed on the World Wide Web (Internet) which teaches Hindi through the mediums of Gujarati, Punjabi, Kashmiri and Nepalese. The packages were dedicated to the nation by Shri Shivraj V. Patil, Hon'ble Union Minister for Home Affairs, Government of India on September 14, 2007 during the Hindi Divas celebrations at Siri Fort Auditorium, New Delhi. The project was sponsored by the Rajbhasha Vibhag (Department of Official Language [DOL]), Ministry of Home Affairs, Government of India. The packages can be accessed online at the website *http://lilappp.cdac.in*.

DIT Website

The earlier website of the Department of Information Technology (DIT), Ministry of Communications & Information Technology had been in use for a very long time, and had several deficiencies. The website was redesigned to have a new look with the following new features:

a. In accordance with w3c guidelines

b. No scroll homepage

c. Global links throughout the website for easy navigation

d. Controlled depth of information

e. Easily understandable nomenclature (labels)

f. Additional and improved security features

g. Improved ownership of content

h. Templatized website

i. Better presentation of content for comfortable browsing

j. Easily updatable and scalable structure

k. Inactive session reduced to 20 minutes to increase the server speed

The new website was launched on July 18, 2007. Thereafter, it is under maintenance, which involves uploading of static content, addition of new, necessary links, minor changes to the design, etc.

A replica of the website in Hindi is now under design and development which will involve localization of the design, translation of static content as well as localization of the existing interactive applications in English.

Web Internationalization Initiatives for Indian Languages

This project involved the study of standards followed by W3C in the areas of internationalization and localization and prepared a guideline document with recommendations to different standardization bodies for the proper representation of South Indian languages on the World Wide Web. The major areas of study were Character encoding, CLDR, IDN, Text formatting, Language Identification, Font and Rendering and Indian language Tag set.

The guideline document submitted to DIT contains recommendations to different standardization bodies namely Unicode Consortium, IETF and W3C. DIT will consolidate the recommendations for all Indian languages and submit it for the consideration of the respective standardization bodies.

PALS

Conceptualized, developed and productised PALS 1.0 is ready to be released. PALS is a product to enable the access to translations of frequently needed queries by travellers to new places in local languages.

NatakWeb

NatakWeb forays into the area of designing a web-based 3D drama-creation platform, which can be used by multiple story tellers/ directors simultaneously and collaboratively. NatakWeb builds on the earlier standalone system Natak to run over the Web. This product is built using Actionscript and Python. It is now in beta testing.

Enhanced File Transliteration

The File Transliteration Utility transliterates the file content over the Internet from English to Hindi and vice versa. It supports text as well as Excel file. File size limit is 500 kb. It communicates with server for transliteration. So the client system needs to be connected to the Internet. It can also be run from behind a firewall.

Other Multilingual Technologies

BIIDS Pro

The Bilingual Integrated Information Display System (BIIDS Pro) has been successfully developed and installed in the Rajya Sabha and Lok Sabha (Parliament House). The system is being used for covering debates, LIVE on DDK, in the two houses of Parliament. BIIDS integrates Indian language in much better way because of the built-in editors for Indian languages. Lok Sabha and Rajya Sabha secretariats had been using C-DAC's Bi-lingual Integrated Information Display System (BIIDS) since the year 2001 for information display on the CCTVs installed in the Parliament House.

Doordarshan Lok Sabha and Doordarshan Rajya Sabha are full-fledged TV channels today. As per their requirements, C-DAC has developed a digital BIIDS for broadcast quality subtitling in English and Hindi on these channels. The systems were delivered in July 2007 and are working to the client's satisfaction.
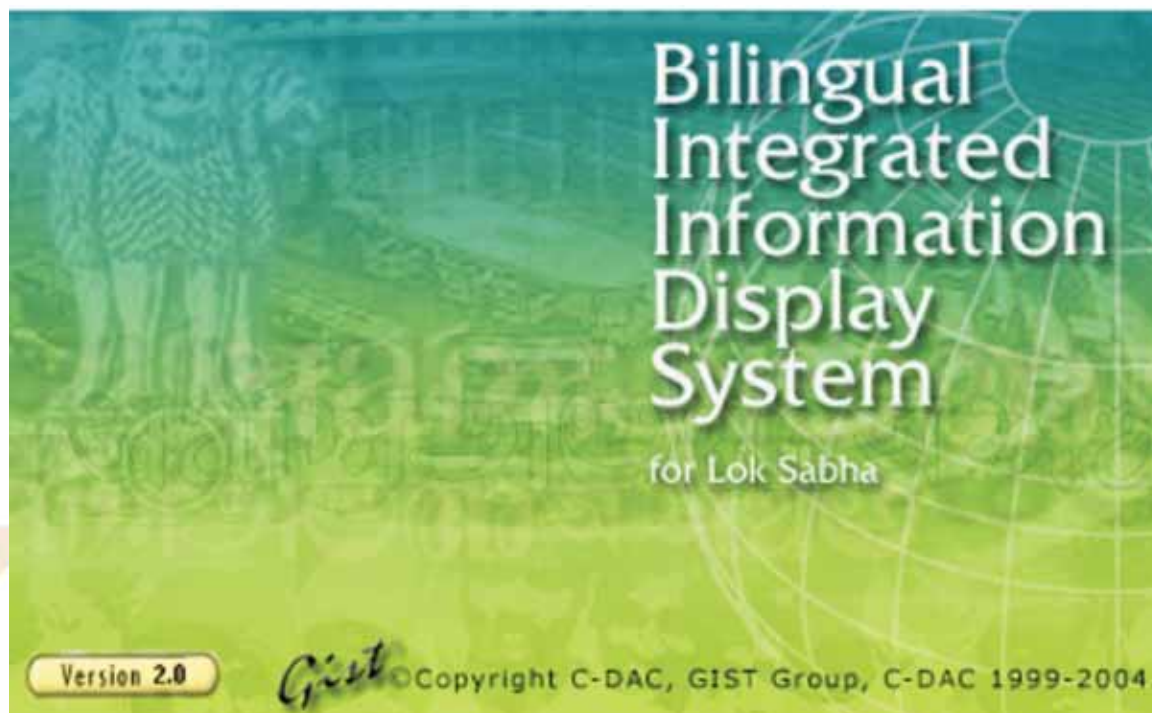
Portable Teleprompter

Designed and developed by C-DAC, the portable teleprompter is an ideal tool for news, anchor-based programs, corporate shoots and outdoor shoots. It has been installed in the ANI studio, New Delhi.

UNICODE based Hindi and Urdu Language Interface (ISM-OT) for Recording Verbatim of Rajya Sabha Proceedings

Rajya Sabha has been using ISM since the year 2001 for generating verbatim of the debates and other information of the house. The verbatim is hosted on the website of the Parliament (www.sansad.nic.in) every day when the Parliament session is on.

Based on latest requirements in compliance to the UNICODE standards, ISM has been upgraded to ISM-OT (for Open Type) fonts, which will reach a far larger audience of Hindi and Urdu speaking community in the world today.

The beta version of the software for Hindi was delivered and installed in the reporter's section of the Rajya Sabha secretariat in February 2008 before the start of budget session. The development of Urdu software is in progress.

Robust Document Analysis and Recognition System for Printed Indian Scripts

C-DAC is the integration agency for this consortium mode project involving a total of 11 consortia members including IISc, Bangalore, IIT, Delhi, IIIT, Hyderabad and Allahabad, Utkal University, MS University, University of Hyderabad, etc. The project aims at developing a system that will read printed text from multiple Indian languages inter-mixed with images and multi-column printing. C-DAC is acting as the repository and mediator between consortium partners so as to integrate the development from all centres into a comprehensive package. The *alpha* version of the system was demonstrated during ELITEX 2008.
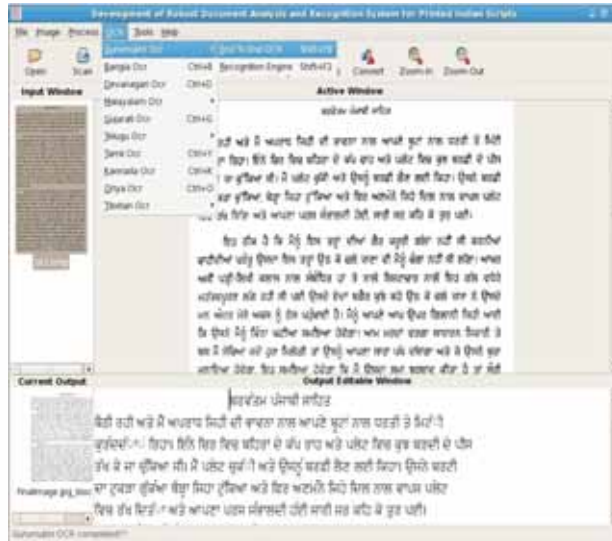
OCR integration system

Online Character Recognition System for Handheld Devices

The objective of this project is to develop an Online Character Recognition (OLCR) system for Malayalam, suitable for hand held devices. The system developed will be able to recognise Malayalam characters as and when they are hand-written on a tablet or touch screen; with minimum number of constraints imposed on the writer. An accuracy of 85% is expected for the basic system. Currently the literature survey is in progress.

Optical Character Recognition System for Traditional Malayalam Script

Recognition of characters in traditional/old Malayalam script needs great effort because of the presence of large number of conjunct characters (900+) in the old script as against the greatly simplified new Malayalam script (150+).

Under this project, C-DAC developed an Optical Character Recognition (OCR) system, based on feature extraction method, for documents printed in traditional Malayalam script. The number of features for character classification was increased for better classification and recognition of Malayalam characters in the old script. An integrated Layout Analyzer using hybrid page decomposition method helps to retain the page layout at the system output. The various methods employed in this project include a two level segmentation scheme, feature extraction method and classification scheme and binary decision tree. The system has different processing modules for noise removal, skew detection and correction, line, word and character segmentation, recognition and post processing.
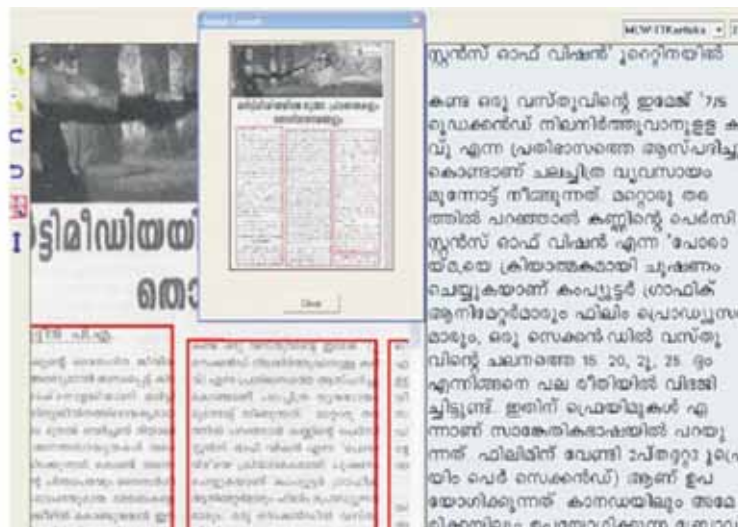
Heritage Computing

Vaidika Sanskrit Encoding

Vaidika Sanskrit encoding project involved creation of proposals for submission to the Unicode Consortium, for encoding of Vaidika Sanskrit characters in Unicode. A proposal was submitted on October 2007 on the same. A revised proposal was drawn in consultation with various scholars, technologists and representatives of Institutes from India and abroad based on the points which remained unresolved in October 2007 UTC meet. This unanimous proposal was submitted in UTC meeting held in Feb '08. The Feb'08 meeting was quite constructive with more than 50 characters qualifying for encoding. However, a few characters are still under discussions and further discussions are to be held to reach to some common consensus.

Vedic Sanskrit on Linux Operating System

This project provided a complete implementation of Vedic Sanskrit, an ancient Indian Language, the language of the Vedas. The implementation was on Linux Platform by using IndiX Library.

Indic Dasher

The Indic-Dasher is an innovative interface for entering Indic characters into the system using gesture based interfaces. This system is now available for testing.

Openoffice.org in Indian Languages

Developed and packaged English to Hindi dictionary and thesaurus for OpenOffice.org. This product is now listed at Softpedia.com (http://www.softpedia.com/progDownload/English-to-Hindi-Dictionary-and-Thesaurus-Download-104237.html) and OpenOffice.org (http://extensions.services.openoffice.org/project/enghinth)

The extension to OpenOffice is the first extension developed by an Indian developer for OpenOffice.org and facilitates lookup/replacements of meaning of English words to Hindi.

Vidwan

Vidwan has been a flagship product from C-DAC, as the only expert system shell developed in India and available at low cost. The system has been now ported as a Web application so that users can take consultation session and even create rule bases using Vidwan over the web. The system is now complete and available on the web. A workshop on expert systems has been now planned, using Vidwan as the base for practical work.

Pandulipi Samshodak

A package for manuscript processing has been developed. The software helps in preserving, processing, and analysis of manuscript in different scripts.

Sanskrit Swa-Adhyaya CD-project

This project is to harness the power of multimedia computer systems for systematic self-learning in Sanskrit with links to analysis. Rashtriya Sanskrit Sansthan, New Delhi, sponsored this project. Varnamala section of the project is completed. Vakya-vyavahara section is under progress.

SANSKNET II Phase

This is an MHRD initiative to network Sanskrit institutions across the southern states. C-DAC is involved in providing technical support, training and web content creation. Web content creation for Rg-Veda Kramapatha has been completed.

IT Terminology (English to Punjabi)

Under this project development of a standardized Lexicon of IT Terms in Punjabi has been undertaken.

Analytical Tools for Large Scientific Knowledge Bases in Grid Computing Environment

Development of the following tools has been undertaken:
- Manuscript Editor for typing text in Sanskrit including Vedic. Manuscripts obtained from SVUORI, Tirupati, PPM, Wai, Deccan College, Pune, IGNCA, New Delhi, RASB, Kolkata, RSVP, Tirupati, Jaiminiya SamaVeda Mss from Thogur and KUML, Thiruvananthapuram.
- Editor for typing Samaveda (including Samagana) accents.
- RgVeda Kramapatha and YajurVeda Kramapatha included in the application.

JATAN: Virtual Museum Builder for Salar Jung Museum

Salar Jung Museum, Hyderabad, one of the most prestigious museums of India, placed an order for procurement of JATAN system. JATAN: Virtual Museum Builder is a specialized collection management system for museums. The existing system has been customized to suit their needs. This included modification of workflow for content integration, realignment of metadata parameters for documentation, creation of exclusive forms for the integration of coins, paintings and manuscripts. Additional features like location based object search and maintaining the history of object locations were developed.

Existing data of approximately 50,000 antiquities of Salar Jung Museum has been migrated from old version of database to JATAN database. It involved intelligent approach to cleaning of data and realignment of metadata at large scale.

Archeological Survey of India, New Delhi and Mumbai Metropolitan Region Development Authority (MMRDA) have also shown interest in procuring JATAN.
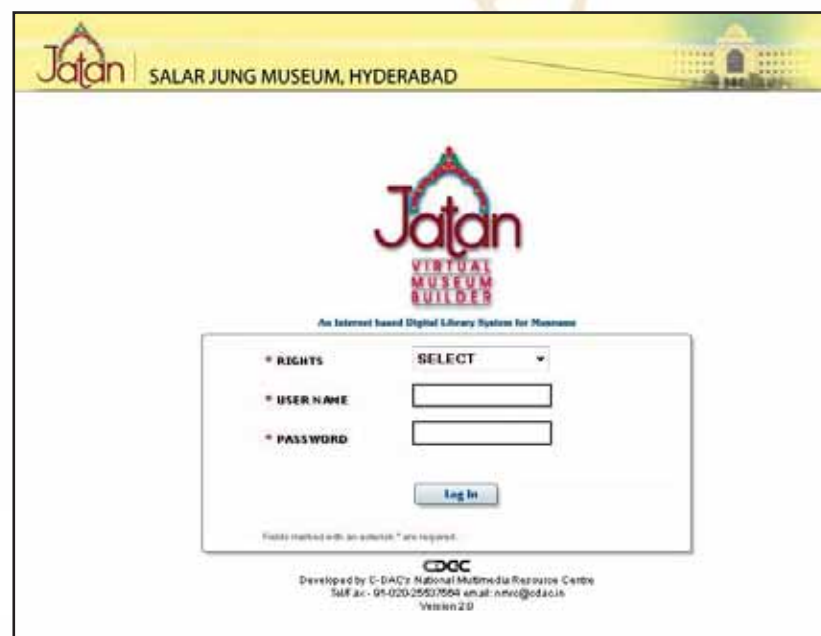
SOFTWARE INCLUDING OPEN SOURCE SOFTWARE

Software Engineering

Veda – Online Testing and Question Banking

In the current year, work focused on developing administrator's support for Veda. Administrator module facilitates creating users and defining their roles, adding them to appropriate group, etc. It monitors exam given to a large group of students. The development of GUI interface for Administrator is done and provides the following features: Session management – browse list of active sessions, kill session etc; User management – create/edit users, search for users, change password etc; Group management – create new groups, edit existing groups, add/remove users from group, etc. The teacher module interface is under development.

National e-Governance Services Delivery Gateway (NSDG)

NSDG is classified as Integrated Mission Mode Project (MMP) with an aim to serve as messaging middleware for integration and interoperability. C-DAC is the first Gateway Service Provider who has designed and implemented NSDG and will be responsible for operation and maintenance post go-live and marketing, promotion, training and awareness of NSDG. NSDG was conferred with 'The World is Open" award for e-Governance at Skoch Challenger 2007.

Decision Support for Automatic Refactoring (DSAR)

DSAR is a software engineering tool for providing automated guidelines for re-engineering an object oriented application. The guidelines include class name, method name or attribute name, refactoring technique to be applied and how to apply the specified refactoring. Aim is to perform the desired refactorings automatically based on the user response for the automated suggestions. In order to suggest the guidelines for refactoring a given application, static analysis of the code is done. The code is analyzed for cohesion, coupling, size and generalization. For analyzing the code, the source code of the given application is parsed and only the relevant information is stored in the internal database and undesired information is suppressed. This simplifies the task of analyzing the code for various properties.

Control Flow Framework for Evolving System (CFFES)

C-DAC is defining a framework for the design of evolving systems such as e-Governance systems leading to seamless evolutions. The objectives include achieving precision in the change impact analysis for the evolutions in the framework based systems and manage evolution proactively by predicting it with help of mining of software repositories techniques to the framework metadata repository.

Multi-modal User Interface for Electronic Medical Records

The multimodal interface is an approach to improve the human computer interaction. This method attempts to use user interaction modes of speech, pen gestures, handwritten recognition and real time images along with conventional input methods like keyboard and mouse based input to process human input. The proposed system provides a user friendly interface to medical practitioners for interacting with Electronic Medical Records.

Personnel Information System for Dakshin Haryana Vidyut Bitran Nigam (DHVBN) Limited

DHVBN has awarded a turnkey project to C-DAC for setting up a computerized Personnel Management System and Pay Bill Register System for all their offices in Haryana. The developed system automates the activities in the Establishment and Accounting

Sections of more than 36 offices of DHVBN and UHVBN. The system can be used in other State Electricity Boards as well with proper customization.

Cryptographic Component Development for "Postal MIS"

A software for securely transmitting financial data for Electronic Money Order System was designed, developed and delivered to the Post Master General Office, Kolkata Post Office for integration and deployment.

e–Governance Framework

An e-Governance framework has been developed using open source technologies based on Service Oriented Architecture (SOA). It assists in service enabling legacy applications of the departments for interoperability and allows development of newer SOA based applications. The framework is capable of streamlining and easing the intercommunications between various departments. The framework provides various access methods and support for service delivery through multiple delivery channels and multiple front end devices for accessing information through the convergence of various communication technologies such as web based clients and mobile computing services (through a mobile phone or similar hand held).

Energy Trading Software

As a subset of Energy Trading Software the Short Term Open Access (STOA) software has been developed for Northern Region Load Dispatch Centre (NRLDC). This is an n-tier application built on J2EE technology using Oracle Application Server and Oracle database server. The major functionalities of the software include:

- Online filing of applications by applicant
- Forwarding/ receiving concurrence to concerned State Load Dispatch Centres
- Processing of applications for approval, pro-rata calculations based on availability
- Generation of payment schedule
- Scheduling for next day, surrendering of applications
- Maintaining the curtailment details in case of transmission constraints
- Monitoring of payments received and payment disbursements

Web Based Software for Short Term Open Access System at Northern Region Load Despatch Centre (NRLDC), Powergrid, New Delhi

Indian electricity grid has been demarked into five regions. An independent Regional Load Despatch Centre (RLDC) manages each regional grid and National Load Despatch Centre (NLDC) coordinates the operation of all regional grids on matters related to inter-regional exchanges. NLDC is a Powergrid office situated at New Delhi. Each RLDC carries out the task of real time operation of the grid in association with State Load Despatch Centres (SLDCs) and Inter-State Generating Stations (ISGSs). In addition to real time operation, RLDCs have to carry out other offline pre-despatch and post-despatch functions in coordination with its associates. Offline activities are short term open access, scheduling, metering and settlement, administration of ABT pool account, reporting & analysis.

The project will provide web-based solution for NRLDC's short-term open access, which includes application processing, calculation and distribution of payments to CTU, STU & applicants. NRLDC will interact with other RLDCs and SLDCs, for their concerns. The SRS has been completed and software development and testing are ongoing.

India Development Gateway (InDG)

India Development Gateway (InDG) initiative seeks to provide responsive and credible information products and services in local languages catering to the needs of rural communities.

During the financial year 2007-2008, two more languages (Marathi and Bengali) were added to the multilingual portal (*www.indg.in*) that hosts information related to key livelihood sectors - Agriculture, Health, Primary Education, Rural Energy and E-Governance. *www.indg.in* currently provides information in six languages - Hindi, Tamil, Telugu, Bengali, Marathi and English covering   information on 1100+ topics. Several new features such as automated content flow, live search, dynamic database, multilingual discussion forum, newsletter, multimedia gallery, etc were added to the portal. One of the key strategies of InDG has been building partnerships. InDG has established partnerships with over 80 stakeholders from government, civil society, academia and private sector for content generation, validation, and translation and outreach activities. Various events such as consultative workshops, community level ICT awareness meetings, and capacity building of village kiosk operators were organized as part of InDG's outreach activities. Over 1200 development professionals and Village knowledge centre operators participated in about 16 events, held in the states of Andhra Pradesh, Tamil Nadu and Jharkhand. Four issues of the multilingual newsletter - "Gateway to India's development" were also published during the period. Content Management flow used in InDG project is given in the figure below.
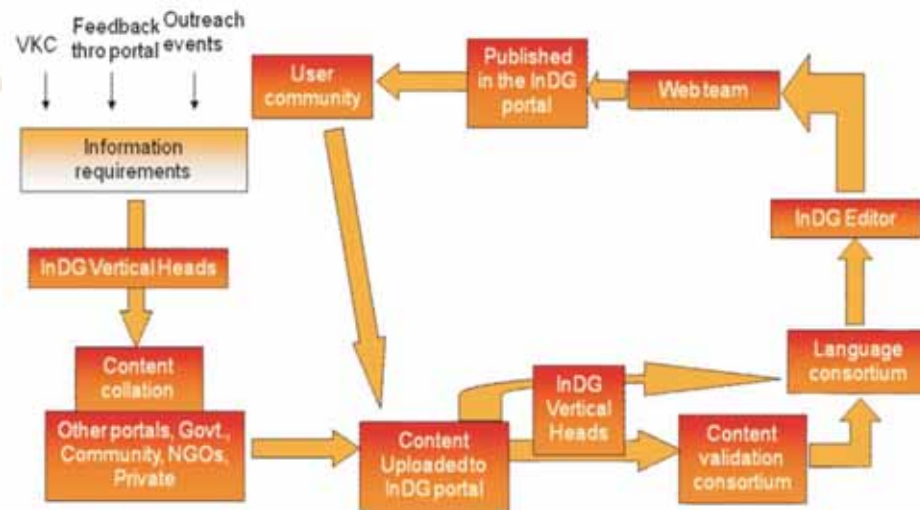
Content Management Flow Diagram

Tailor Board Activities Software

Kerala Tailoring Workers Welfare Fund Board was constituted in 1994 as a statutory board for providing various welfare measures of tailoring such as pension, family pension, retirement benefits, treatment and death benefits, educational schemes for children and other welfare measures. At present the board has above 3.5 lakhs members all over the state.

The activities of the board include Registration of members and registration renewals, contribution collection, distribution of various pensions, distribution of death   benefits, inter office communication, establishment activities at DO and HO level, fund and deposits management, etc.

The above activities were done manually and hence found time consuming and inadequate for the growing needs of future. Considering the prime aspects such as data security, capability to handle large volume of data over couple of years the current method was found inadequate and incapable.

The developed software replaces the current time consuming, manual operational environment by an efficient system, having highly secure information management features. Local language support for the user interface is a notable feature of this package.

Integrated Accounting System for Kerala Toddy Workers Welfare Fund Board

This software system is a complete Accounting Package developed for Kerala Toddy Worker's Welfare Fund Board (KTWWFB).

Collection Bank Account Management, Pooling Bank Account Management, Payment Account Management such as Employee Pension, Worker Pension, Worker PF, Fixed Deposit Management, Employee Payroll, Employee Pension Management, Budget Preparation and Cell Co-ordination reports etc. are the major modules of this accounting package. User interface in the local language is an important feature of this package.
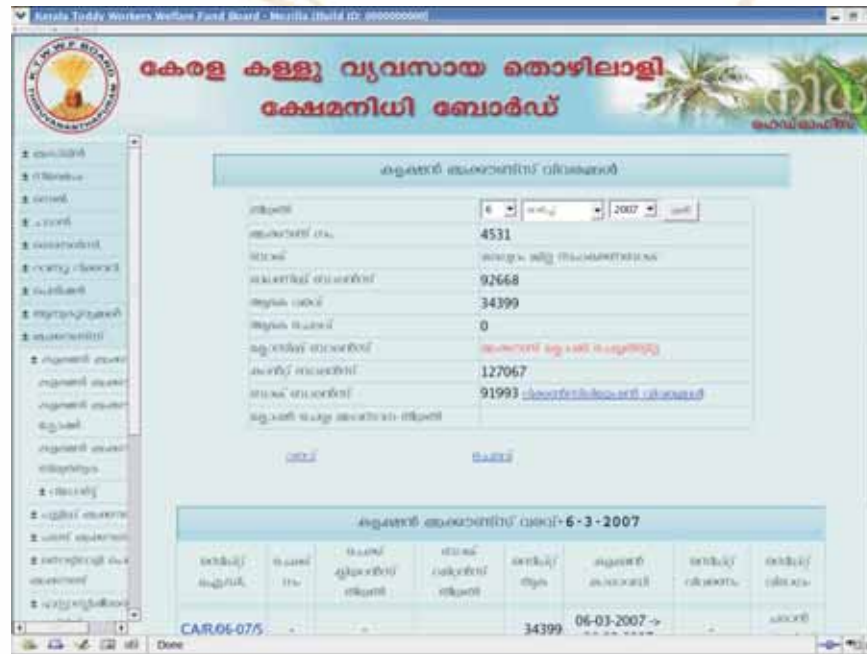
Anumaan

Anumaan is a predictive text entry system, which facilitates text entry by anticipating words based on prior experience/training corpus. This helps enhance the text input speed for those who do not have high keyboard speed and reduces errors due to data entry. A proof of concept for the system has been developed and further development work is on to make the system available for use early next year**.**

SuTra – Support For Localization

Sutra is an intelligent suggestive translation tool for localization. This tool supports activities such as automatic updation of glossary, locating reusable components given a string to be translated, provide for effective use of such strings in creating translation, etc. which will aid the translators in translating any software application. Version 1.0 of this system has been developed and is being released for people to use and give their feedback.

CONESIS

The aim is to develop and implement agent based techniques for concept extraction in social or community Information System that could be applied across many Indian languages. Scope of this R&D activity includes identifying and representing contexts and concepts, integrating these techniques in a live social information system to learn and fine-tune the techniques to real-user based scenarios, and generalizing these techniques so that it could be applied to similar information systems with orientation towards Indian languages.

Open Source Software

National Resource Centre for FOSS: Part-II: Product Development

The main objectives of NRCFOSS are:

- To contribute to the growth of F/OSS through intensive research, design and development, training of manpower and setting up of facilities for National resource centre on F/OSS promotion in the area of e-governance, School, SME's.
- To encourage and promote the development of applications under F/OSS & SOA framework within SME's, and Government environment
- To develop generic robust middleware based on OSS that will be relevant for school, SME's, and e-governance domain
- To organize study programmes, Lectures symposia, conferences exhibitions and similar promotional activities related to F/OSS development.
- To establish and maintain a research and reference library in pursuance of the objectives of the centre

BOSS Linux (Bharat Operating System Solutions) ver 2.0

BOSS Linux ver 2.0 was released during Connect 2007 in Chennai by the Hon'ble Chief Minister of Tamil Nadu. It is fully localised to Tamil and Hindi.

Release of BOSS 2.0 by Hon'ble chief Minister of Tamil Nadu

BOSS Linux Server (Entry level edition) ver 1.0

BOSS Linux Server has unparalleled features that includes user-friendly GUI Front end that has Fire fox, Thunderbird and also supports printers and USB devices such as cameras. Presently it supports Intel and AMD x86/x86-64 architecture and is being tested on other architectures. One of the most attractive features of BOSS Linux is the ability to remotely control the server. BOSS Linux Server currently configured for the entry level includes a Linux Kernel 2.6.21, Apache web server, Squid Proxy Server, Database Server My SQL, and Postgre SQL.BOSS server. It is targeted towards Government departments / SME's and also towards Linux distro (distribution) developers for further development on Linux.

BOSS Linux Server (entry level edition) ver 1.0 with the above features was released during ELITEX 2008 by Hon'ble Union Minister of State for Communications & Information Technology.

Geomatics

Landuse-Landcover Mapping of Bihar and Part of Uttar Pradesh

Landuse/ landcover (LULC) is a highly dynamic feature and therefore its regular inventory is required for planning and management of natural resources and its allocation. Considering this, National Remote Sensing Agency (NRSA), Hyderabad awarded C-DAC the project titled "NR-Census LULC 1:50K" for the state of Bihar and part of Uttar Pradesh, under the Natural Resources Census (NR-Census) Project. It involved interpretation of LULC classes at Level III from Indian Remote Sensing Satellite (IRS) P6, Linear Imaging Self Scanning Sensor (LISS)-3, Advanced Wide Field of View Sensor (AWiFS) and panchromatic (PAN) data using heads-up visual interpretation technique at 1:50000 scale. Interpretation was carried out in three different cropping seasons, viz. Rabi, Kharif and Zaid. The project work involved extensive fieldwork and high-end visual image interpretation skills. Interpreted classes in one season were updated in subsequent seasons to derive the final map. Both internal and external quality checking were carried out at different stages of the project in order to ensure the required accuracy.

Landuse/landcover map of Jehanabad (Bihar)
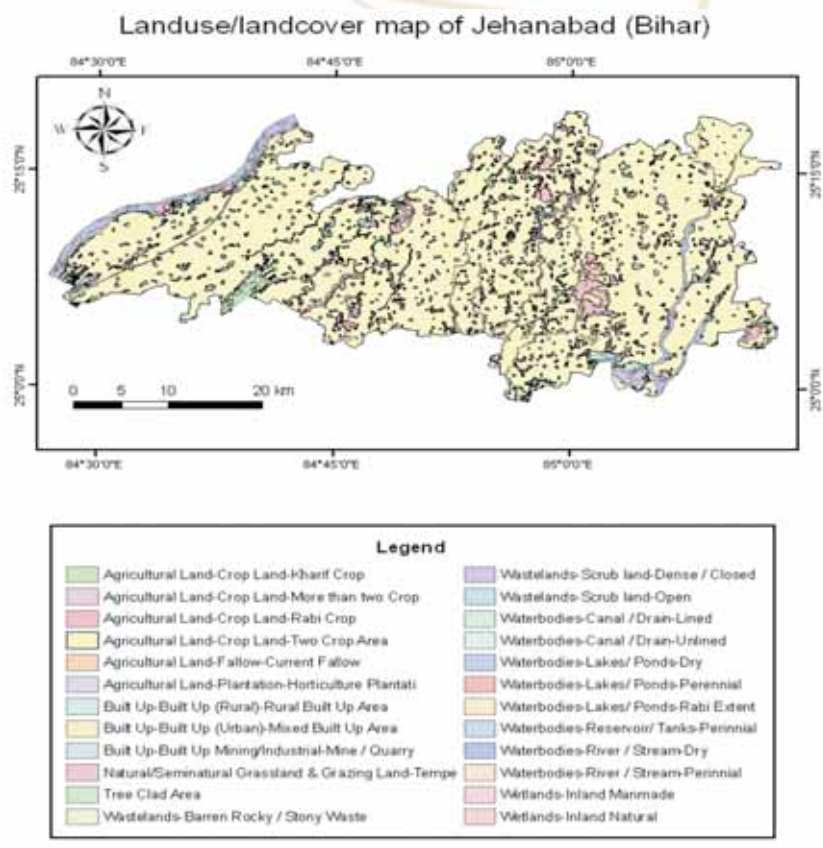
Land Use/Land Cover Map of Jehanabad

Himalayan Glacier Inventory Mapping

The aim of this Ministry of Environment & Forest, Govt. of India/ Space Applications Centre, Ahmedabad funded project is to generate glacier morphological maps using multi-temporal IRS LISS III satellite images and ancillary data. Specific measurements of mapped glacier features are the inputs for generating glacier inventory data sheet parameters as per the UNESCO/TTS format and additional features associated with the de-glaciated valley. The data sheet would provide glacier-wise details mainly related to the glacier identification in terms of number and name, location, elevation, dimensions, orientation, etc. By using the glacier inventory map layers in GIS environment, systematic observations and measurements on the glacial features are being made and recorded in tabular form in the inventory data sheets. Outputs of the project will be input to the envisaged Himalayan Snow and Glacier Information System and the Natural Resources Database.

A View of the Himalayan ranges

Preparation of Generalised Probable Maximum Precipitation (PMP) Atlas over the Krishna River Basin using GIS

Dams, barrages and other hydraulic structures across the rivers must be designed and built to withstand maximum floods that can occur at a site. Probable Maximum Precipitation (PMP) is widely taken to mean the theoretical upper limit of the depth of precipitation that is possible for a given duration and a particular basin. Hence, the PMP information is critical to design hydrological structures. The project has been awarded by the Central Water Commission (CWC), New Delhi. Scope of the project included interpolation of PMP values of all rain gauge stations to entire Krishna basin, preparation of seasonal and annual rainfall maps, severe rainstorm map, digital drainage map and isohytal patterns of all historical rainstorms. An interactive software for estimation of storm parameters for the study area and a tool for storm transposition on the digital map were also developed.
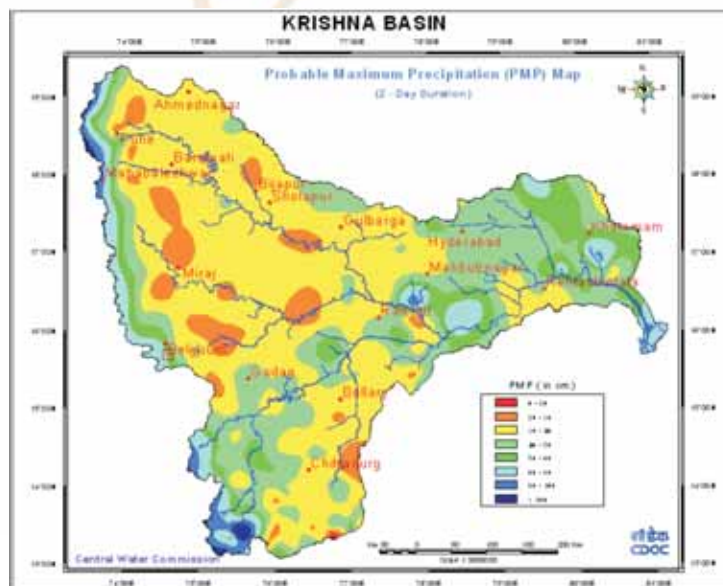
Probable Maximum Precipitation Map of Krishna Basin

Multimedia

Watershed Trainer

It has the following two modules:

i) Realistic River Generation on 3D Terrain

Generating a realistic river on 3D terrain is a challenging task. We aim to simplify this problem by creating a generalized solution for generating a realistic river. At present, we have created an independent mesh for river and this triangle mesh is mapped on the terrain at the places where the river has to be rendered. The textures are then mapped on this river triangle mesh and blended with the terrain textures to render realistic river.

ii) Dynamic Terrain and Objects Rendering

Dynamic Terrain Rendering module involves modeling and rendering of terrain based on view frustum and LOD (Level of Detail) and also real time rendering of the objects on the terrain. Dynamic Rendering or Real time rendering is a key technique for Virtual Reality and interactive visualization. With Level of Detail (LoD) modeling or multi-resolution representation, the appropriate resolution model of object is rendered according to the object's projected size in the screen so that a lot of insignificant details are ignored and rendering efficiency is greatly improved.

Systems to Emulate Human Capabilities

e-Vision Systems for Measurement of Blackness and Fibre Content of Black Tea

C-DAC is widening the application base of e-Vision systems by the following:

- Blackness detection of tea
- Fibre content measurement in black tea

Appearance of finished tea plays a crucial role in determining quality of black tea. Out of a number of appearance parameters, blackness of tea is very important since this very attribute decides customer preferences all over the world. But, as of date, there is no standard measurable parameter for this blackness. Research is ongoing towards measurement of this blackness parameter of tea using the e-Vision system jointly with the United Planters Association of South India (UPASI).

Further, plucking practices all over the world for tea is transforming from manual plucking to mechanical harvesting. Also, with proliferation of bought leaf factories, leaves with lesser and lesser percentage of fine content are being used by the tea manufacturers due to economic constraints. As a result, very high content of fibres are found in the finished CTC teas. Being distinctly visible, these fibres adversely affect the price fetched by teas in the market. E-Vision system is being used to detect the fibre content at various stages of tea manufacturing so that corrective actions may be taken at the process end for manufacturing teas with less fibre content.

e-Vision System

Integrated Electronic Nose and Vision (ENV) System for Black Tea Quality Measurement

Based on the successful demonstration of laboratory prototypes of e-Nose and e-Vision systems, development of an Integrated Electronic Nose and Vision (ENV) System has been completed. In addition to making available e-Nose and e-Vision facilities in the same hardware, their software have also been integrated and the user can operate the ENV system from a single user interface.

Electronic Nose and vision system and Analysis of Rice using ENV system

The developed ENV system has been deployed in pilot scale at four tea industries in India and one in Kenya. These are a) Kanan Devan Hill Plantations, Munar, b) Parry Agro, Valparai, c) UPASI Tea Research Foundation, Valparai, d) Malankara Plantation, Kerala and e) James Finlay, Kenya.

Electronic Tongue for Taste Characterization of Black Tea

Three out of ten quality of manufactured black tea comes from the liquor generated by tea in boiled water. With the sponsorship of the National Tea Research Foundation, Tea Board, e-Tongue systems are being designed to measure these qualities in a physical manner to complement the measurement of other seven physical parameters measured with e-Nose and e-Vision for a complete physical measurement of manufactured black tea quality. The Instrumentation Department, Jadavpur University, Kolkata is a research partner in this project. The development of e-Tongue is anchored on Voltammetric technique with multiple electrodes. The laboratory level prototype of the e-Tongue has already been developed and the system has been found capable of classifying different tastes of tea.

ENV System for Quality Measurement of Cultivated Aromatic Cereals

In a manner analogous to determining the quality of manufactured black tea, quality of cultivated aromatic cereals (say, Basmati) is being developed by C-DAC. Unlike the manufacturing of black tea, aromatic cereals are cultivated by small growers and that leads to possible adultration with other similar-looking non-aromatic cereals! This challenges the sensitivity of the developed e-Nose to its limit. R&D Level joint-participation from other Government bodies (say, Indian Agricultural Research Organisation (IARI) Pusa, New Delhi or Central Food Research Institute (CFTRI), Mysore) are being sought for the requisite domain knowledge and/or graded supply of samples.

Applied Image Processing for Strategic Application

Keeping in view the public disclosure norms in this area of strategic applications, major activities in this specialization is for human face recognition; and that too for more advanced and challenging arena of emotional expression recognition from analyzing human faces. For both of these applications, creating meticulously a calibrated facial database of reference faces constitutes an important enabling landmark. Even though human recognize faces instinctively, to a camera (through which only computer can at all see), human face is a 3-Dimensional object that has no intrinsic fixed aspect/attitude. Moreover, the facial database must contain images of a number of human faces each having associated labels containing carefully measured/categorized (a) emotion, (b) attitude, (c) aspect, and (d) intensity. Hence, a carefully designed infrastructure was designed for collecting calibrated images of human faces.

As an outcome of this R&D activity, an indigenous Face Recognition System (FRS V3.0) has been developed, which can recognize a person from his/ her digital or, scanned stored image or, on-line image grabbed by a camera. The FRS V3.0 is being benchmarked with a number of international commercially available products and their literature. The performance analysis in terms of False Recognition Rate (FRR) and False Acceptance Rate (FAR) are comparable with the international products. FRS V3.0 has been integrated with the Talash database of National Crime Record Bureau (NCRB) for aiding their missing person enquiry requirement. The system is under field trial at their campus at New Delhi to get user feedback essential for upgradation of the system. Moreover deployment of the FRS V3.0 for sieving duplicate entries in the electoral role of West Bengal is envisaged in near future.

C-DAC will now extend their R&D activity in the area of Facial Expression Analysis. DST under Indo-Japan Collaboration has initiated this activity. Research shows that the verbal part (i.e. spoken words) of a message contributes only for 7 percent to the effect of the message as a whole, the vocal part (e.g. voice intonation) contributes for 38 percent while facial expression of the speaker contributes for 55 percent to the effect of the spoken message. So automatic facial expression analysis can bring facial expressions into man-machine interaction as a new modality and make the interaction tighter and more efficient. Such a system can also make classification of facial expression widely accessible as a tool for research in behavioral science and medicine. Based on this requirement analysis, C-DAC and NICT, Japan, have formulated a joint R&D project for the development of a high quality Facial Expression Analysis engine (FEA).
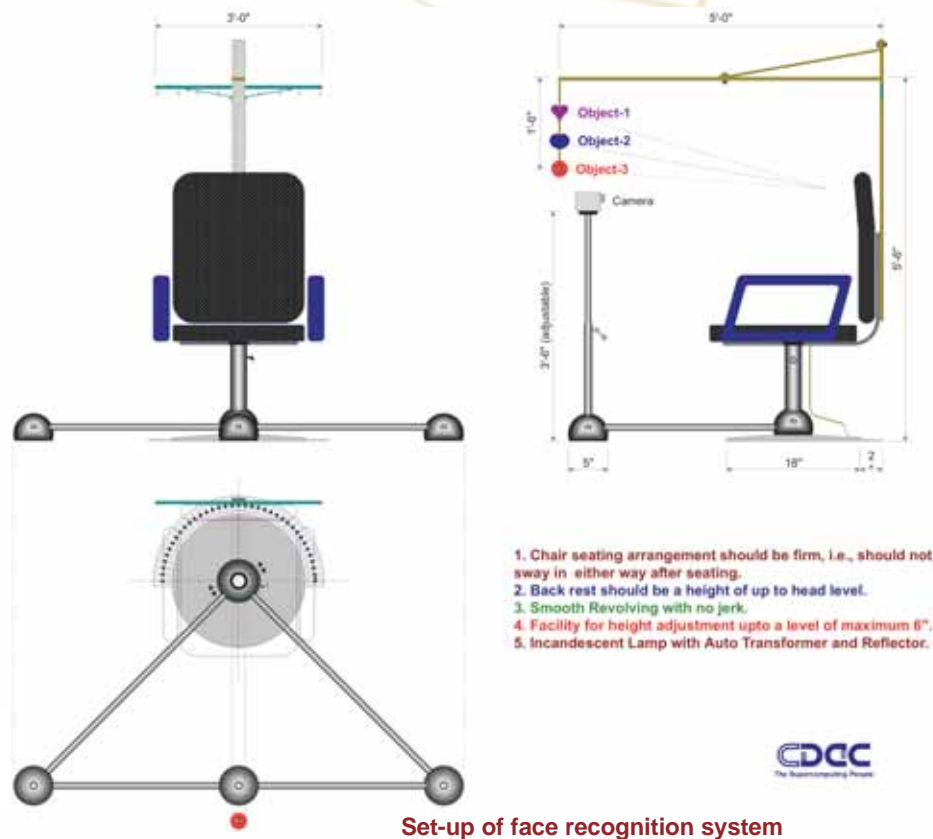
Set-up of face recognition system

Electronic Nose for Tea

C-DAC has developed a special Electronic Nose that has been successfully used to monitor volatile emission pattern in black tea fermentation process over passage of time. Through prolonged experimentation with various clones, fermentation processes and climatic variations, it has been established that smell changes during the process may be reliably detected repeatedly by Electronic Nose. Even the smell peaks during so called "First Nose" and "Second Nose" may also be clearly detected with this new smart instrument.

The Electronic Nose is also capable of sensing the volatile compounds of the finished tea sample and reliably predicts Tea Taster like scores with a high degree of accuracy. Neural network based soft computing techniques are used to tune near accurate co-relation smell print of multi-sensor array with that of tea tasters' scores.

Networking

Kernel Immune System

The Human Immune System (HIS) can detect and defend against harmful and previously unseen invaders. Can we build intrusion detection and prevention systems for computers and computer networks by learning from and including features of HIS? This project was started in September 2007. Self study and seminars on Artificial Immune System (AIS), Computer security, Kernel immune system, danger theory and modular programming were conducted. Currently work is progressing in designing a kernel space IPS with conventional approach. AIS knowledge is being acquired looking at the literature and a few source code. Finally the two will be combined.

Modular Router Architecture

The objective of the SoftRouter project is to modularize and separate control and forwarding elements of the Internet router so that they can be developed and deployed independently. The specific aim is to implement the ForCES protocol that specifies the control/forwarding plane interaction using OpenSource Router packages like Xorp and Click. Currently, ForCES protocol has been extensively studied and Xorp has been modified to be compatible with ForCES architecture.

Synchronous Modules in Ad hoc Distributed Embedded Realtime System

Synchronous programming is the most rigorous and successful methodology for design, development and deployment of safety critical systems. The imperative synchronous language Esterel is well suited for control oriented safety-critical systems but faced the problem of not being suitable for distributed systems. Other synchronous formalisms like data flow (Lustre) were adapted for distributed systems. Along with other efforts, C-DAC too investigates the challenges in applying Esterel to distributed environment. Our plan is to simplify the compile time processing and transfer the complexity of distribution to the run time. Thus protocols between the independent Esterel modules and a distributed run-time executive will be designed so that the whole system behaves according to the synchrony hypothesis.

PKI Outreach Programme (POP)

POP (PKI Outreach Programmme) is a Nationwide PKI Awareness initiated by Controller of Certifying Authority (CCA), MCIT, Government of India and being carried out by C-DAC.

The Government of India has taken a major initiative to make the country e-ready by initiating various e-governance implementations like automation of Income tax, passport, etc. that brings out the serious directives of India. PKI forms the backbone for all these initiatives and the ultimate success of these initiatives lies in the citizens, adopting the PKI.

The PKI team has successfully conducted a 2-day awareness and training program on Public Key Infrastructure (PKI). More information is available at http://www.pki-outreach.in

Nation-wide QoS Test-bed

This is a joint project being carried out by C-DAC, IIT-Mumbai, Kharagpur, Chennai, Delhi, IISc and ERNET. The aim of the project is to set-up a nation wide QoS testbed to try out various applications. Activities being carried out as a part of this project include software development for KYN (Know Your Network), QoS experiments like dynamic bandwidth provisioning for specified applications, and network operation activities for experimental network among partnering agencies.

Enterprise wide Self Managed Network Solution

As part of this project, C-DAC is carrying out research for developing a self-managed network solution. The aim is to develop a self managed network solution that shall be intelligent enough to self-monitor, self-tune and self-manage to keep track and adapt as per the changes in the network environment. C-DAC will also build in capabilities to report exceptions, upon situations of failure in reaching a consensus for a self-managed decision. The initiative is funded by DIT, MCIT, Government of India.

Others

DGF ICT R&T Centre Project

The Development Gateway Foundation (DGF) and Govt. of India, DIT MCIT, funded project - "ICT Research and Training Centre for Bridging the Digital Divide" was completed in September 2007. The project has resulted in the development of several useful technologies, tools, products, solutions and applications many of which have also been widely and successfully deployed in several locations in India (and in one case abroad also). Notable products that were launched are Bharateeya OO (OpenOffice for Indian languages), ECKO (a community centric portal), Vartalaap (Virtual classroom), Vyapar / Pradarshani (application for exchange of information regarding rural products and services), e-Forms (a form designing tool for rapid data collection), Matrubhasha (a text to speech engine for Indian languages) and DAAL (application for cross-lingual information retrieval). Some of the organizations / locations where these applications have been deployed are Dhan Foundation, MSSRF, AFFARM, Kutch Nav Nirman Abhiyaan, BAIF-BIRD-K, UNDP-Orissa and several others. The Aid Management Platform (AMP) - a web-based e-government solution designed to facilitate and streamline aid (financial assistance) management efforts between a country's government and the donor agencies has been deployed in the Ministry of Finance & Economic Development (MOFED) of the Govt. of Ethiopia. The experience and expertise gained from the project can be harnessed for further work not only in India but also in other emerging markets.

Information Technology Consultancy Clinic

Under this project, Small and Medium-scale Enterprises (SME) are encouraged to incubate their ideas in the Consultancy Clinic provided in the Noida centre of C-DAC, where academic facilities and the Post Graduate student community are available for prototyping their systems. Twenty-three companies have already registered under this project and many of them have been able to come out with viable systems and products.

A workshop was organized in January, 2008 to enlist the services of teaming partners for its various commercial projects in the area of e-governance, health informatics, BOSS Operationalization and Digital Libraries. More than twenty five SMEs have shown keen interest in this program and have signed MoUs with C-DAC.

Rural Tele Centres in Lao PDR

This project was implemented as part of bilateral cooperation between Lao PDR and India in the area of communications and information technology. As part of this project, C-DAC established physical, networking, computing and software infrastructure in ten rural tele-centres spread across Lao PDR. C-DAC also re-engineered e-Governance applications to suit the needs of the Lao language and imparted necessary training to operators at Lao PDR. The project was completed on turnkey basis within a short span of four months.

Inauguration of Training at LaoPDR

Computerization of E.S.O. Department, Government of Punjab

This project is sponsored by Department of Planning, Government of Punjab. It is a web Application based management information system, which deals with the following:

- Consumer Price Index and Wholesale Price Index
- Village directory and Block at a glance
- State Income Monitoring System
- Employee Statistical Information System
- Municipal Statistics
- Farm Accounts, Family Budget and Housing Data

About 60% of the project has been completed.

Computerization of Planning Department, Government of Punjab

This project is sponsored by Department of Planning, Government of Punjab. It is a web based management information system, which deals with the following:

- Border Area Development Programme
- Non-Government Organizations
- District Planning Schemes
- Backward Regions Grant Fund
- Annual Plans

About 40% of the project has been completed.

# PROFESSIONAL ELECTRONICS INCLUDING VLSI AND EMBEDDED SYSTEMS

Power Electronics

Powered Vehicles

C-DAC has developed an Electric Vehicle (EV) that derives power from a battery. A three-phase, high speed, water-cooled induction motor is used for the propulsion of the EV. The motor is coupled to the rear axial differential of the vehicle.

An IGBT inverter converts the DC input power from the battery to the three-phase AC output suitable for driving the motor. The inverter module is fully enclosed and water-cooled. The inverter is connected to the battery through a fuse and contactor. An auxiliary contactor is used for initial charging of the AC filter capacitor.

The torque command is applied by the driver using the torque pedal. An instrument panel is provided on the dashboard which provides the driver information about the status of the vehicle. An ON/OFF key switch, FORWARD/REVERSE switch and an EMERGENCY OFF push button switch are also provided for the driver. Digital hardware provides all the control functions for the vehicle drive.
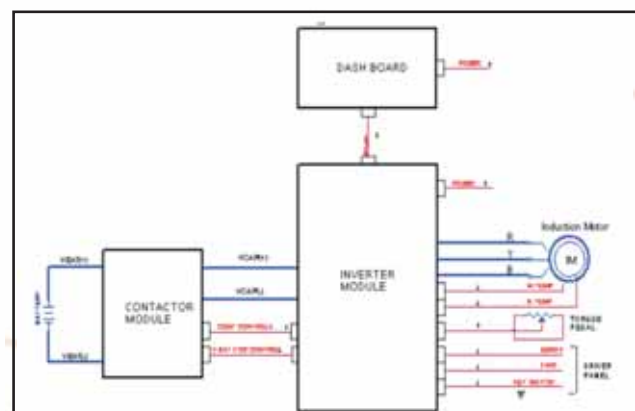
70KW drive and AC motor

Another activity in this area is development of a low voltage, embedded realtime Hybrid Electric Vehicle (HEV) controller for passenger carrier auto rickshaws manufactured by the Kerala Automobiles Ltd. (KAL), a public sector company located in Trivandrum. The scope of technology development in this project covers areas such as Low voltage electronic control hardware with DSP and CAN, Hybrid power source with battery and alternator, and CAN based network for inter-module power control. The first prototype is undergoing trial runs.

C-DAC is also developing a power assisted bicycle whose prototype is currently under trial run.

Motor Wheel Chair Version 2

Motor wheel chairs usually have two separate motors driving the two main wheels on either side. When the two motors run exactly at the same speed the machine goes in a straight line. The motors are run at different speeds to achieve turns. The problem of achieving the exact relative differences in speeds is not trivial; especially when one wheel momentarily experiences an increase in rolling resistance due to surface irregularities.

To overcome this problem, C-DAC has developed a novel concept of using one motor for propelling the machine forward or backwards in a straight line and another motor for generating the difference in speed between the driven wheels. The first motor

drives the two wheels in exact synchronism regardless of differences in rolling resistances. The second motor causes equal and opposite rotation of the wheels; adding to the rotation caused by the first motor on one side wheel and subtracting exactly the same rotations from the wheel on the other side regardless of differences in rolling resistances. This makes the electronics very simple. A patented gear mechanism makes this possible.

A very low cost joystick is another innovation, which brings down the cost of the machine. The canvas seat is light and comfortable. Both the armrests can be swung out of the way to facilitate getting on and off the machine. When the armrests are raised, they swing clear of the users shoulder width. This too is another unique feature of the wheelchair.

All these innovations make the C-DAC motor wheelchair cost effective without any sacrifice on performance.

Gate Drivers for a Range of IGBTS

The design and development of state-of-the-art, reliable gate drivers with adequate protection for IGBTs is a challenging task. The product that has been developed under this project is a complete board solution with specifications that match or exceed those available in the market. Innovative design ideas, together with the appropriate selection of components, have resulted in a product that could achieve a selling cost much lower than existing gate drivers. With the technological superiority and the cost benefit, this product has an edge in the highly competitive Indian and international markets.

To achieve the dV/dt immunity, pulse transformer isolation has been used for the electrical interface types. The dc-dc converter, including the transformer, has been designed in-house. The dc-dc converter is fully protected against overloading on the secondary side. A power supply monitor has been included on the HV side of the driver. This provides more reliable protection of the IGBT and the driver itself. The output stage is made of MOSFETs. The user can individually select the gate drive resistors, viz. Rgon, Rgoff, Rgsoff.

Two design variants have been implemented, viz drivers with electrical interface, and drivers with Fibre Optic interface. Single and Dual channel interfaces of both types, for 1700V/1200V/600V IGBTs, with 30A peak drive current, have been developed.
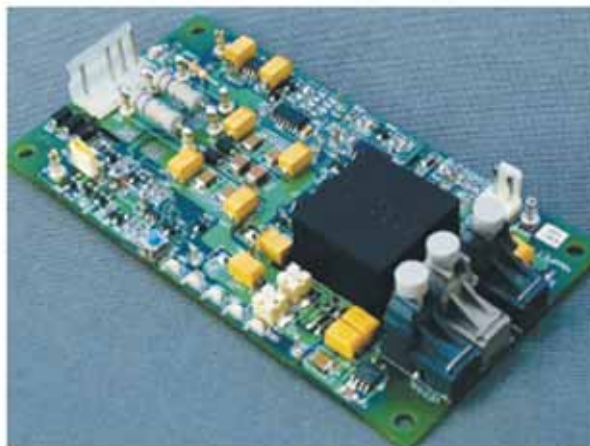
Gate Driver fo IGBT

Full Spectrum Simulator

A real time simulator is an extremely important tool for power systems and power electronics systems. Given the nonlinear and complex nature of these systems, analytical approaches are usually impossible. As a result, several commercial simulators for such systems have emerged in the market. While there are some public-domain simulators in existence, their capabilities are inadequate to handle realistic problems in these areas. Commercial simulators that are powerful enough to tackle these problems are expensive in the Indian context. Further, they come with a limited number of licenses.

The purpose of the current project is to develop a Full-Spectrum Simulator (FSS) using the expertise available in the academic institutes and R&D labs collaborating under the National Mission on Power Electronics Technology (NaMPET) initiative of DIT. The resulting product will be an excellent simulation tool for practicing engineers, R&D professionals, industries, college teachers and engineering students. The assembly of full system is in progress.

Static Power Balancer

Static Compensators (STATCOMs) working with synchronous reference frame method of control is suitable for balanced loads only. Under unbalanced load conditions, the system fails to work with conventional d-q transformation and decoupled current control. To make a 3-phase, 3-wire STATCOM suitable to compensate the unbalanced load, a different control strategy is required.

In Static Power Balancer (SPB), the load current is broken into its sequence components namely, positive, negative and zero sequence. 3-wire STATCOM cannot compensate for zero sequence components present in the load. The positive and negative sequence components are transformed into each ones synchronous reference frame. So d-q components of positive sequence components and d-q components of negative sequence currents are extracted. The DC bus voltage controller and the current controllers of the SPB are implemented taking both positive and negative sequence components into consideration.

SPB hardware is divided into two blocks. One block consists of the power circuit in which the converter stack, series choke, capacitor bank and other power circuit auxiliaries (SFU, Contactors etc) are the major building blocks. The other block is the control module, which is formed by the circuits and boards used for the control of the SPB.

The prototype developed uses DSP based Digital controller (TMS 320 F240/F2812) and has a power rating of 50 KVA.

Prototype of SPB

Active Power Filter, Double Conversion UPS and Electric Vehicle Controller

National Mission on Power Electronics Technology (NaMPET) is a 5-year project launched by DIT and the Power Electronics group of C-DAC has been identified as the Nodal Centre for implementing this project. For technology demonstration at the Nodal Centre and exhibition purposes at various conferences/seminars and as part of the infrastructure upgradation at the Nodal centre, it was decided to develop Low capacity models of Active Power Filter, Double Conversion UPS and Electric Vehicle (EV) Controller with CAN interface.

Working models of Active Power Filter (1KVA), Double Conversion UPS (1KVA), and EV controller with CAN interface (5KW) have been developed.

Active Power Filter

EV Controller

Double Conversion UPS

Matrix Converter

The matrix converter offers an all silicon solution for AC-AC conversion, avoiding the need for reactive energy storage components (Capacitors and Inductors) used in conventional rectifier-inverter based systems. It does not have any dc-link circuit and does not need any large energy storage elements.

A 3-phase to 3-phase matrix converter consists of nine bi-directional switches that are used to connect the input phases directly to the output phases of the converter. The switching of these bi-directional switches is then modulated to produce the desired output voltage and frequency.

The key element in a matrix converter is the fully controlled four-quadrant bi-directional switch, which allows high-frequency operation. The early work dedicated to unrestricted frequency changers used thyristors with external forced commutation circuits to implement the bi-directional-controlled switch. With this solution, the power circuit was bulky and the performance was poor. The introduction of power semiconductor devices for implementing the bi-directional switches makes the matrix converter topology more attractive.

Matrix converters offer many advantages over traditional topologies such as the ability to regenerate energy back to the utility, sinusoidal input and output currents and controllable input current displacement factor. The size of the converter can also be reduced since there are no large reactive components for energy storage.

This has potential application in variables speed drives, non-conventional energy conversion, automobiles, and aircraft ground power supply. The testing of 10KVA 3*3 matrix converter has been completed, and 50KVA matrix converter testing is in progress.

Hazardous Object Removal System

The project aims to develop a mobile platform with a manipulator arm capable of picking up objects, which can be operated from a control station at a distance of up to 500 m.

The platform is a six-wheeled vehicle with all wheel drive and has the capability to carry a 100 kg load. There are several novel innovations, which makes the mobile platform unique. It can execute zero radius turns like a tracked vehicle and even go up a flight

of steps. The onboard video cameras help the remote human operator to steer the vehicle. A radio LAN module transmits commands to the mobile for operating the vehicle and its payload.

Phase two of the project will go on to develop the manipulator for picking up potentially hazardous objects. The mobile platform can also be used to mount other types of payload requiring mobility for different applications.

The development of an extreme mobility platform to carry the manipulator is nearing completion.

Controller with CAN Interface for Power-up-scalable Converter Modules

The project aims at the development of a controller and efficient control algorithms for enabling modularity and bus Paralleling of High Power Converters, employing high speed Controller Area Network bus (CAN). This technology can be used in areas of power control like UPS Systems, AC Drives, STATCOMs (Static Compensator), etc.

Existing parallel redundant indigenous technology requires a common panel, which means this is not a true redundant system and also restricts the number of converter modules in parallel. The current unbalance between systems is in the order of minimum 10% of the rated value. The new paralleling scheme can support "n" number of units since no common elements come into picture. The system uses the fast space vector control with the aid of digital signal processor and the fast CAN bus protocols to meet the specific requirements. At present, the prototype testing is in progress.

Power Conditioners for Fuel Cell Power Plants

Fuel cells have been considered as the primary energy source for the next generation electric utilities. In addition to higher efficiency and zero pollution emissions they are low noise devices and do not require frequent maintenance. Fuel cells produce DC voltage from hydrogen-rich fuel gas and air that flow over two cell electrodes. This development is envisaged for an effective power conversion and use of the energy from fuel cells. Development of power conditioners for 1kW and 3kW Fuel Cell Power Plants with scope of extension to higher capacity have been take up in this project. This project is sponsored by NMRL (a DRDO Lab), Mumbai. The Boost Converter is being tested at NMRL, Pune.

1 kW Fuel cell based power plant

Portable Medical Electrical Safety Analyzer

This project aims to develop an indigenous technology for a Portable Medical Electrical Safety Analyser, for onsite electrical safety testing of electrical equipments in hospitals and other health care delivery settings. This project is implemented jointly with SreeChithraTirunal Institute for Medical Science & Technology (SCTIMST), Trivandrum. The lab testing and modifications in design are in progress.

Portable Medical Electrical Safety Analyzer

Statcom For IT Park

This project aims at developing a STATCOM (Static Compensator) solution for IT parks, by compensating for harmonics and neutral currents in their power distribution system. Due to single-phase non-linear loading in IT parks, large amount of current tends to flow in the neutral, causing transformer heating and low power-factor. This special STATCOM is realized by connecting a four-wire voltage source inverter to grid through interconnecting choke.

The software design is in progress. Detailed stack design has been completed and panel design is in progress. Component procurement is also in progress.

Universal Auxiliary Converter

Auxiliary Converters are used in the railway traction rolling stocks (viz. locomotives, EMUs etc.) to feed three-phase supply to various auxiliary motors and battery charger onboard. The input supply system, rated capacity, volume occupied, cooling arrangement, interface with the locomotive control circuit and method of control etc. differ in each of these rolling stocks. With such a variety of products, activities like procurement, inventory management and maintenance are becoming troublesome.

The objective of this project is to develop a common Auxiliary Converter, which can be interfaced universally in EMUs, conventional as well as three phase locomotives. The preliminary testing of the proto unit has been completed.
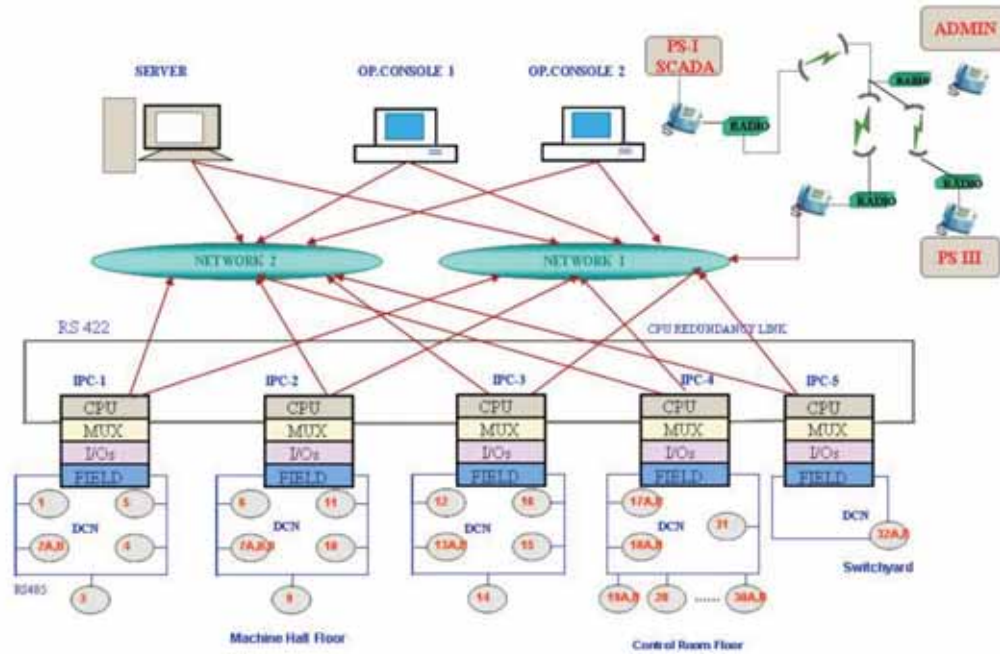
Process Control Systems

Distributed Intelligent SCADA for TCFHP PS-II & III

C-DAC has developed and implemented a state-of-the-art scalable, distributed intelligent SCADA system for the Teesta Canal Fall Hydel Power Stations in Siliguri. This technology has been developed with funding from the Department of Information Technology, Government of India and the project implementation cost has been borne by the West Bengal State Electricity Board. The final phase of the system handing over was completed on 30th November 2007. Besides individual plant monitoring and control, the SCADA system facilitates coordinated remote control of all three power stations from a central station.

The building blocks of this indigenous SCADA technology are well proven in Steel plants, Thermal power plants, Power Distribution Automation Systems, Water treatment plants and other Process industries. These system building blocks are scalable to any extent to configure cost effective SCADA solutions to the micro and mini hydels as well.

SCADA SYSTEM FOR PS-II

SCADA Hardware

ADSP Based PCU   Link Multiplexer Module (MUX)   Field Bus Unit (FBU)

Standard Input/Output Card

4-20mA Analog Input Module   230V AC/DC Digital Input Module   24V Digital Output Module

Distributed Control Nodes

Power DCN   230V Digital Input DCN   4-20mA Analog Input DCN   Recorder DCN

Enhanced Features for Power SCADA System

The objective of this project is to develop and incorporate enhanced hardware and software features in the sub systems of Central Control System (CCS), Substation Control System (SCS) and Distributed Nodes (DN), which was developed earlier as part of the Distribution Automation Project for Thiruvananthapuram City.

The MODBUS communication protocol implementation for SCS has been completed. The Windows version of the failover mechanism for the CCS has also been implemented.
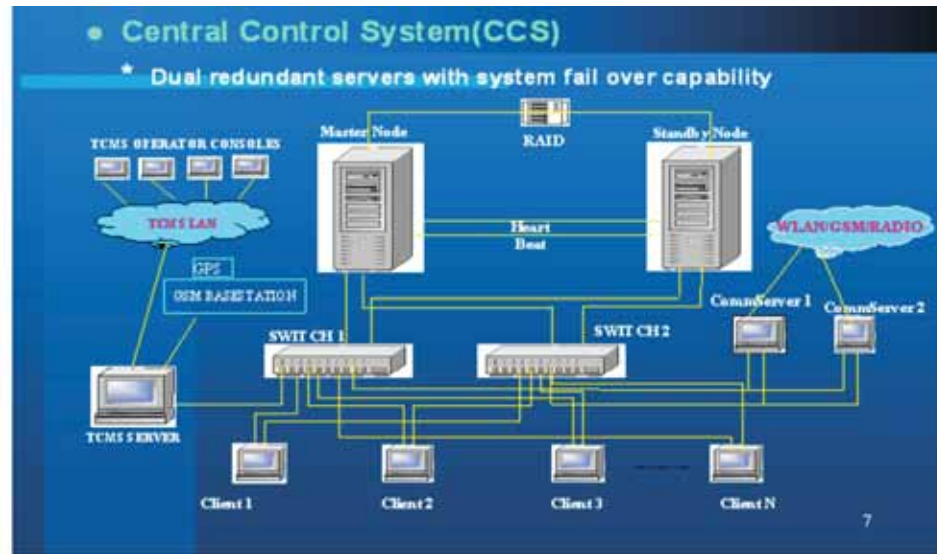
Central Control System

IEC61499 based Intelligent System

The objective of the project was development of a prototype test bed, based on IEC 61499, which helps the design of distributed architecture based systems and the conversion of a control application to demonstrate the operation of the test bed.

IEC Functional Blocks (FB) with event handling and Execution Control Chart (ECC) were developed as part of the project. User can design the control strategy using the basic FBs or Composite Blocks. Composite blocks are made up of basic FBs connected in a sequence for achieving a specific task. These composite blocks can be configured by the user and kept in the block library along with the basic FBs and can be used as a single block. The user may predefine the inputs and outputs to the composite block.

Each block is initiated by an event signal, which may be connected to the head of the block. The ECC will be executed only in the case of an active event signal.

The configuration file is stored in XML format as per the IEC 61499 standard. Client and server blocks are implemented in the RTU for making the distributed architecture possible. Inter RTU communication is carried out through the client and server blocks. Tags in one RTU may be accessed by another RTU using these blocks.

As an application for the test bed, Filter Bed Automation at Kerala Water Authority, Aluva was taken up.
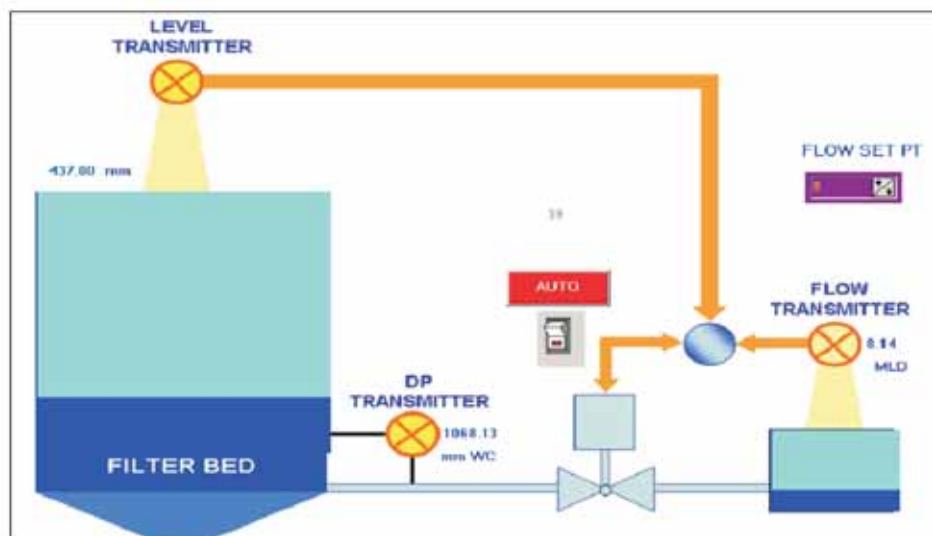
Working Controller Scheme

Automation Systems Technology Centre

The overall objective of this mission mode project is to provide the country with the capability to become a significant player in the area of automation technologies. The project has applications in process industries, power plants, metallurgical industries, Electricity Boards, etc. This is a national level R&D project involving Research, Development, Demonstration and Technology transfer leading to production and commercialization.

Major subsystems that will be developed under this project include:

- Colour and Level Sensor Systems
- Intelligent Actuators for Process Control
- Wireless Sensor Network System
- Advanced Control Algorithms, Optimization Algorithms, Plant Models and Data Fusion Models
- Recognition and Decision-making System for Diagnosis and Root Cause Evaluation of alarm and process faults in Process Control Systems.
- Multi Agent System to provide operator guidance for fault detection, isolation and restoration
- General Purpose Embedded Controller and Intelligent IO modules
- Single Board Controllers
- Low Power Controllers
- Communication Configurator
- Flexible Open SCADA Software
- SCADA Security Tools
- Network Protocol and Associated Software
- Configurable Embedded CRM and ERP Interface.

At present, the preliminary work on three projects – Embedded Controller, Flexible Open SCADA, and Colour Sensor has been started.

Control Hardware and Software for Vehicle Control Unit (VCU) & Train Communication Network (TCN) for Rolling Stock Application as per IEC-61375 standard

Presently, Indian Railways employs a distributed architecture for control and data communication in locomotives. The control hardware, software and protocols are proprietary products. Being proprietary in nature, any basic change needed to handle the obsolescence in electronic component and software is not possible due to non-availability of design knowledge and source codes of firmware and operating system. Hence, it was decided by railways to standardize and develop indigenously appropriate hardware and software as per IEC-61375 open standard for all types of rail vehicles for control and data communication.

Through this project, C-DAC will develop the required hardware and software for Vehicle Control Unit (VCU) and Train Communication Network (TCN) as per IEC-61375. Presently, the system specification finalization has been initiated with consultant.

Traffic Control and Vehicle Tracking System

Next Generation Traffic Controller

This project aims at the design, development and implementation of a miniaturized, low power, pole-mounted traffic signal control system with wireless connectivity to the signal heads, and operating on both solar power and AC power. Solar power is considered for the traffic controller and the signal lamps. Currently, the design is in progress. Earlier, C-DAC has successfully developed an Urban Traffic Controller, which is used as a Traffic Controller in the Area Traffic Control System Project at Pune.

Tracking System Version 2.0

The system comprises a Vehicle Mount Unit and a Base Station Unit. The Base Station Unit is interfaced to a PC. The Vehicle Mount Unit employs a GPS (Global Positioning System) receiver to identify the location of the vehicle and transmit the information to a base station over the GSM network using GSM modem / MSS / GPRS / CDMA. The Base Station Unit has a communication equipment for reception of messages from Vehicle Mount Unit. The Base Station Software collects the vehicle position information and logs onto a database. Web based plotting software uses this information from the database and the position of vehicle is mapped. This information is then made available over the LAN or on the Web for online display and reporting.

Vehicle Tracking System

Blackbox for Automobiles

Black Box

It is a project sponsored by DIT, MCIT, Government of India. The project has been completed. A deal for Transfer of Technology of this product has been signed with a Faridabad based company. The black box developed in this project is a product meant for vehicles plying on roads. It keeps the records and stores various parameters (like speed, load, steering rod, head lights, indicators, temperature, brake oil, distance, and alcohol) of the moving vehicle. These parameters can be stored via different sensors, which have been planted at various sensing sites on the vehicle. All these parameters can be analyzed by using software designed for this purpose.

Acoustic Sensor Based Systems

Parametric Sub-Bottom Profiler

The Parametric Sub Bottom Profiler (PSBP) is a Deep-Sea Parametric echo sounder with depth range of 10,000m and a penetration of 100m below bottom, and used for Oceanographic Explorations.

PSBP works on the principle of non-linear acoustic interaction in the water, between two primary beams of different frequencies, to generate secondary acoustic beams at the difference frequency, the sum frequency, and also at the harmonic frequencies of each primary signal. The difference frequency is continually being formed with increasing range from the source, as a result of which, the difference frequency signal has narrow beam width and negligible side lobes. Once generated, these secondary components proceed independent of the primary waves, suffering from the appropriate spreading loss and the appropriate frequency dependent attenuation loss. As a result of the high frequency, the sum frequency gets attenuated faster. But, by virtue of the very low frequency, the difference frequency signal travels higher depths and penetrates the sea bottom. The reflected echoes from the different layers of the sub bottom are received in the parametric receiver and processed. The processed signal gives valuable information on the different strata of the sub bottom.

For sounding higher depths as well as to penetrate the sub bottom, very low frequencies at higher power levels are to be employed. Again a very narrow beam width is preferable for better spatial resolution of bottom as well as accurate depth measurements. This in turn necessitates much bigger transducer arrays and very high power transmitters. The main advantage of the parametric technology over the conventional echo sounding technology is the use of smaller transducers to realize lower frequencies. For example, when parametric technology is implemented to generate a 4 KHz signal of 4° beam width, using a 33 KHz transducer array of the same beam width, the transducer size required is approximately 8 times smaller.
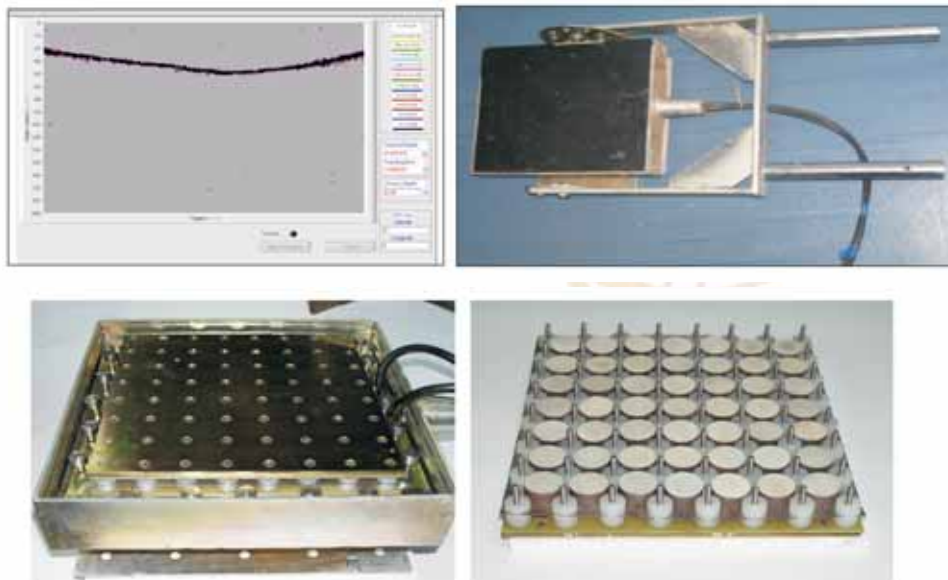
Parametric Sub Bottom Profiler

Acoustic Land Mine Detector Systems

The objective of this project is to design and develop a seismo-acoustic land mine detection and discrimination technique, which does not depend upon the material from which the mine is fabricated, whether it be metal, plastic, wood or any other material.

The new technology uses acoustic-to-seismic coupling and digital signal processing technologies for detection and discrimination of artificial objects, such as land mines, pipes, containers etc., buried in the ground.

C–DAC is also working on a vehicle mounted detection system for landmines using ultrasonic techniques for military use, with funding from DRDO. The resulting product, after extensive field trials, is likely to be inducted for use by army.

A need also exists for a simpler, low cost, portable, battery operated, landmine detector with minimal weight. C-DAC is working on a portable landmine detector for this purpose. The technology being developed can be used for humanitarian de-mining (of anti-personnel mines) purpose by Police, Paramilitary forces, Border Security Force, etc.

Acoustic Thermal Profiler

Temperatures in the combustion zone of a large furnace/boiler can be in the range of 2000-3000°F. Conventional temperature measurement methods such as the use of thermo couples are not practical in such cases.

Acoustic pyrometry provides a practical approach for the online continuous measurement of gas temperature in the hostile furnace and stack environments. The technique uses average line-of-sight measurements between the acoustic transmitter and the receiver. Using multi path, side-to-side, front-to-back, and diagonal measurements within a furnace, volume information can be computed on plane wide average temperature. Deconvolution methods can produce isothermal maps at any given plane of the furnace interior. The transducer development is in progress.

Sonic Ultrasonic Miniature NDT Instrument

SOUMINISOUNDS (or SOUNDS Mk3) is the third model in SOUNDS series of equipments from C-DAC for Non Destructive Testing and Evaluation of materials, using Sonic and Ultrasonic frequencies.

Using SOUNDS, the user can measure the velocity of a sonic-ultrasonic wave through the test specimen, and the attenuation of the wave in the material. If the velocity of propagation of the wave in the material is known, the system can be used to measure the thickness of the material accurately. This way, SOUNDS equipments can be used for detecting internal flaws in test specimens, as well as for studying the characteristics of materials under test.

The semi-automatic method of measurement makes the system a powerful tool in the hands of an expert user, and at the same time permits easy measurements by a non-expert. Two transducers are used in SOUNDS. Transmitter transducer transmits the wave to the specimen and the Receiver transducer receives the waves after it passes through the specimen. To cover a wide frequency range, transducers with different frequencies are used in the system.

SOUMINISOUNDS is a miniature version of the SOUNDS series, designed using standard Note Book PC and C-DAC's custom designed boards, both packaged in a custom designed rugged enclosure. The Transducer Interfaces, Signal Conditioning, Data Acquisition, and part of the Signal Processing are handled by the custom designed board. The user interface, data archiving, and part of the signal processing is done on the note book PC.

SOUMINISOUNDS

Acoustic Path Checker

The objective of this project is to develop Acoustic and Ultrasonics based Path Checking System (Obstacle Detection System), which can be mounted on an autonomous vehicle. Autonomous Vehicles (AV) are used in various strategic areas. By employing an obstacle detector (Obstacle Early Warning System) the AV can move on it's own. The system will detect the presence of an obstacle, which may possibly obstruct the movement of the AV and give a warning signal so that the AV can change the direction of movement or stop to avoid a collision. Presently, experimental prototype testing is in progress.

Acoustic Torch for Visually Challenged (ACOTO)

Acoustic torch is a sightless perception supplementation for the visually challenged, which the visually challenged can use in the same way as a normal person uses a torch light, to avoid obstacles while moving in dark. This project aims to develop a handheld equipment which will give an audio feedback about the surrounding objects to the visually challenged user. The study of available systems and theory for ACOTO is in progress.

Non-contact Vibration Analyzer

Vibration measurement of machinery, structures, electronic assemblies, etc. is a widely used health monitoring, and failure prediction technique. In non destructive impact testing, vibration measurement is used for material characterization and structural integrity testing. This project aims to develop a scalable product for non contact measurement of the vibrations of a surface. At present, the study of available systems and understanding theory of non contact vibration analysis are in progress.

IP Cores

Sigma Delta ADC core

This undertaking intends to design and develop a Sigma Delta ADC core for ASIC embedding. Sigma Delta technology offers system cost savings because the analog anti-aliasing filter requirements are considerably less complex and the sample-and-hold circuit is intrinsic to the technology due to the high input sampling rate and the low precision A/D conversion. Sigma Delta ADCs are widely used mainly in applications such as audio processing and instrumentation, where the signal band is relatively small. Sigma Delta ADC core is suitable for high accuracy systems due to the qualities of multi-bit resolution, linearity of the conversion characteristic, and effective digital filtering of the converted signal. In addition, they are inherently insensitive to process imperfections such as component mismatch.

A sigma-delta modulator and a digital decimation filter are the two basic blocks of Sigma Delta ADCs. The modulator block, which is mostly analog, coarsely quantizes the analog signal into a 1-bit sequence of ones and zeroes at a high sampling rate. The digital decimation filter, filters out the noise, and converts the one bit data stream (at high sampling rate) into a 16-bit data stream (at low sampling rate). Decimation is done in more than one stage since filters are expensive to build at the elevated sampling rate.

The design and testing of the decimation filter and modulator using discrete components has been successfully carried out. The full custom design of modulator is in progress.

32-bit RISC Processor IP Core

This project aims to develop a System-on-Chip (Soc) architecture built around a 32-bit RISC processor IP core 'ER902', which has already been proven on silicon and embedded in two products. The various processes of the development of this project involves the design & interfacing of MMU, Cache, Coprocessor and AMBA compatible interface resulting in performance enhancement of ER902.

The development system will be implemented in an FPGA based board, integrating various other in-house developed IP cores (UART, USB, Ethernet, Timer, etc.) to build a full-fledged customizable 32-bit RISC Processor based embedded system prototyping platform. The development system can be used as a test bed targeted to a host of embedded applications like portable computing, information systems, consumer products and other portable instruments, where power and speed are of prime concerns. The platform will be accessible as a full function product for ASIC integration, complete with design framework and test suite.

The design of MMU, Cache, Coprocessor and AMBA compatible interface has been successfully completed and validated on FPGA. Circuit design of development of board is complete and PCB routing is in progress.

USB_OTG Controller IP Core

The usage and popularity of USB has risen as an interface for exchanging data between PC and peripherals. Today an ever-increasing number of portable peripherals are using the USB interface to communicate with PC.

USB traditionally consisted of a host-peripheral topology with the PC being the host and the portable peripheral being a dumb device. USB On-The-Go (USB OTG) is a supplement to the USB2.0 specification that augments the capability of existing USB peripherals by adding USB host functionality to USB peripherals. USB-OTG interface facilitates the portable devices to communicate with each other without a PC.

The aim of this project is to design, develop, and validate an advanced IP core of USB OTG for ASIC embedding, thereby providing a low-cost connectivity solution to consumer portable devices such as mobile phones, PDAs, digital cameras, MP3 players, etc.

The design and implementation of host controller and device controller have been successfully completed. OTG protocol implementation is in progress.

Asynchronous 8-bit Processor

This project intends to design, develop and validate the advanced IP core of a clock-less 8-bit Asynchronous CPU, which will be offered as a full function product for ASIC integration, complete with design framework and test suite.

Asynchronous logic is an alternative style of circuit design that eliminates the clock signals of conventional logic, and uses logic modules that are self-timed and that pass results among one another using handshaking protocols. Asynchronous processors are of great interest to the technical community due to its power saving potential.

Asynchronous logic consumes zero dynamic power when there is no activity and it also saves power by not driving clock signals.

The design of the Asynchronous Processor core is in progress.

BMI Processor Board

BMI Processor Board is an interface board used in Bio-Medical Instrumentation applications, such as interfacing an ECG instrument to a PC. The board integrates the in-house developed 32-bit RISC processor 'ER902', together with 64 KB Flash EPROM, 64 KB Battery backed Static RAM, Battery backed RTC, 16 x 8-bit ADC, 2 Timers, 12 Input lines, 28 Output lines, 4 Interrupts, USB Port, and RS232 Port. ER902 and most of the peripheral functions required for the implementation are integrated inside an FPGA with minimum external components. This board is a multi-layer board with SMD components to ensure minimum board size. The board was successfully developed and fifty such boards have been supplied to BARC.
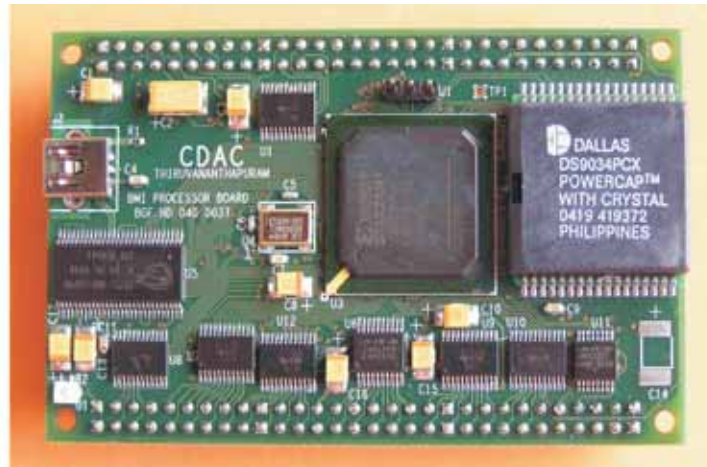
BMI Processor Board

Reconfigurable MPSoC for Embedded System

The limits of processor speed and deep-sub-micron-geometry IC fabrication are rapidly being reached with the ramifications of very high costs. To address the performance gap, called Moore's Gap, due to the limitations of single CPU architecture, the latest trend has been to integrate multiple microprocessor cores on to a single chip, and enhance the overall MIPS performance by parallel computing techniques, architectures and algorithms.

This project to design, develop and validate an advanced reconfigurable, Multiprocessor System-on-Chip (MPSoC) for embedded systems, is being undertaken with the objective of understanding and mastering the technological issues in Multiple-SoC architectures and to design a high-speed multiprocessor CPU core, for embedded system applications demanding high performance.

When successfully completed, it will enable the creation of very high-performance CPU IP Cores with technology independent designs developed in-house.

RFID Based Systems

The National RFID Programme is a joint project of the DIT involving IIT, Kanpur, SAMEER, Mumbai and C-DAC. The project aims at setting up a well-equipped RFID laboratory and demonstrate the utilization of the technology in end-to-end applications. IIT, Kanpur provides the academic lead for the development, SAMEER provides the expertise in antennae and field measurement technologies, while C-DAC provides integration expertise for generating end-to-end solutions.

C-DAC is currently discussing with Department of Posts (DoP) for tracking of Speed Post bags using this technology. Two pilot tests were conducted between Mumbai and Delhi in this regard and based on the success, DoP has agreed to operationalize the system at 25 collection centres each in Delhi and Mumbai. Once this phase is successful, the system will be extended to all major metros in the country and subsequently to all Speed Post Centres and Transit Mail Offices.

"People Management System" is another end-to-end application that has been successfully demonstrated, under this project. It uses RFID enabled identity cards or entry passes to unobtrusively keep record of the movements of people over a campus using UHF antennae set up at various points. A 'Proof of Concept' in this connection was demonstrated during the Annual Seminar on C-DAC, Noida Technologies (ASCNT-08), in February 2008. This system is presently under set up at C-DAC, Noida for employee and student tracking through various areas like library, canteen, conference hall and important laboratories, etc.

Based on the success of the above, C-DAC has proposed implementation of a similar system for trolley tracking for Bio-medical

Waste Management to Delhi Government hospitals and the same was approved by them. The first system in this connection will be operationalized in Guru Gobind Singh Hospital by the end of 2008.

RFID Based Speed Poster Tracking
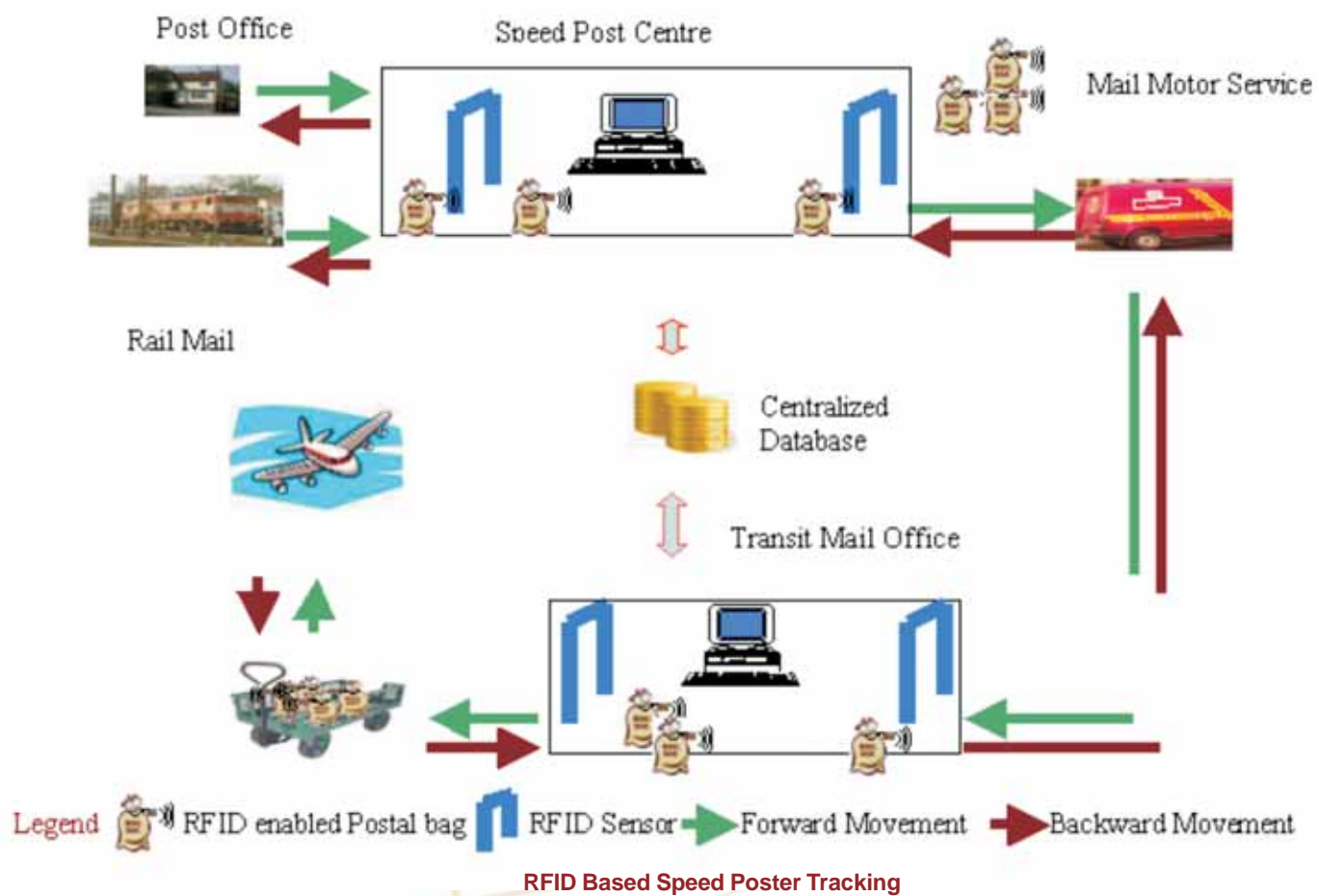
As yet another application of RFID, C-DAC has developed a document tracking system called 'ANUPATHAK'. It centrally manages what documents you have, where they are, who uses them, and all access history associated with the document.

C-DAC is also developing a RFID tag read/write engine, which can read/write data into tags supporting EPC and ISO standards. The RFID reader chip has been identified and circuit design has been completed. The PCB design is in progress.

TETRA Based Systems

Advanced Hand Portable for TETRA

Hand Portable TETRA Mobile Radio is developed centered on TI OMAP dual core processor comprising 55X DSP and ARM9 micro controller. The security functions run on ADU 7020 processor. The upper layers of protocol stack, MMI and PEI are implemented as different processes running on the OMAP under the control of a real time operating system Micro C OS. The implementation of the protocol stack is done on SDL platform for ease of maintenance and the code generated automatically. The DSP core is responsible for the lower levels of the protocol stack. It also has complete control over the RF hardware via the FPGA. TETRA security is based on a set of standard algorithms supplied by ETSI as 'C' functions. All secure data is handled by the co-processor. The implementation meets the Class 3 security requirements defined by TETRA standard and also complies with the requirements for interoperability defined by TETRA MoU association. The major features are Air Interface Encryption, Authentication, End-To-End Encryption, Direct Mode Operation (DMO), Packet data and supplementary services.

Baseband Embedded Software Solutions for TETRA (BEST)

Baseband processing for transmission as well as receiving signals for TETRA cellular standard in realtime has been achieved through software means. Power amplifier linearisation in realtime is achieved through software processing of cartesian closed loop. Major blocks developed are p1/4 DQPSK modulation, differential detection, RRC filtering, up-sampling, decimation, FIR filtering, adjustments of gain/phases/offset, symbol clock recovery and timing synchronization.

Phase I of this development was tested by running the software on a transmit card used for Tetra Base Station. Phase II development involved the digital realization of power amplifier linearisation using cartesian loopback method.

Tetra Communication System for Disaster Management

The Tetra Communication System for disaster management comprises a battery operated, two-carrier, portable Tetra Base Station, VSAT terminal interface, SIP Gateway for VoIP and suitable software to interface with the existing ISRO disaster management network. The portable Tetra BS can be deployed at short notice and proper communication link can be established by using a VSAT terminal at the disaster site. The Tetra mobile telephone users can then directly communicate with the group leader available at the site as well as talk to the Disaster Management Command Center, located at a central place, through the satellite link. Suitable SIP protocol and the necessary interface were developed as part of this project.
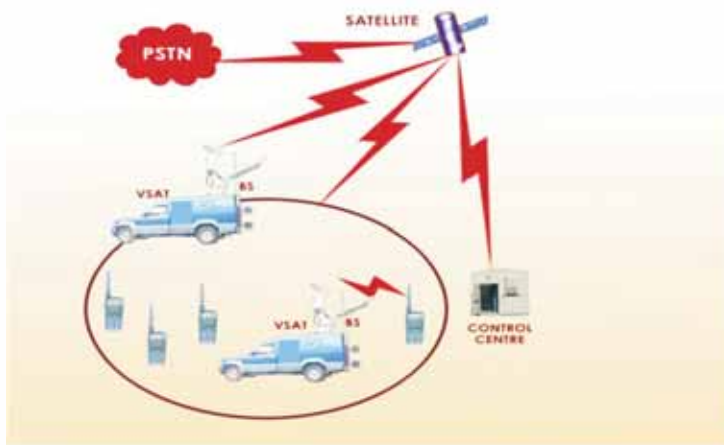
Tetra Communication System
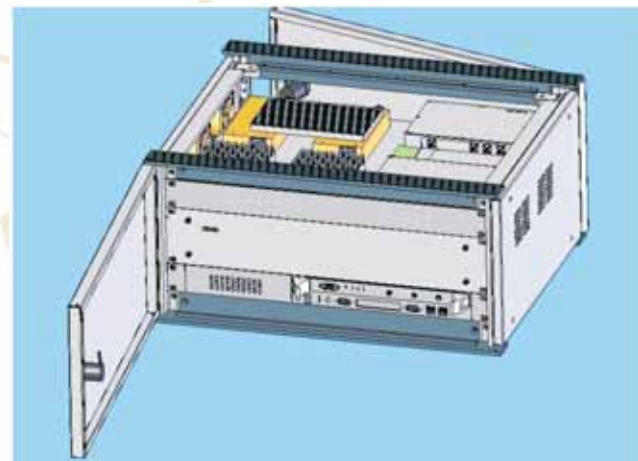
Low-cost TETRA Handset (THS-IW)

The project aims to develop hardware and software for a TETRA Hand portable Radio for Indian markets. TETRA Hand Set (THS) is a mobile digital radio designed as per the standards of European Telecommunication Standard Institute for Professional Mobile Radio users. This radio has two modes of operation i.e. communicate through TETRA network or direct radio-to-radio mode operation.

The PCB design and mechanical design has been completed. Procurement of components is currently in progress.

Other Technologies and Products

Sub-10K PC

The objective of this project is to deploy low cost PCs with a price target of Rs 10,000/-, in high volume, which is compatible with the standard IBM PC. The proposed PC would be ported with Linux OS and an application suite enabling basic computing needs in English and Indian languages.

The CPU and chip set have been identified, circuit design has been completed and PCB design is in progress.

Biometric Identification Module

The scope of this project is to design necessary algorithms for finger print enhancement, extraction, identification, storing and implementation of the same on a hardware module as an "engine" for embedding into other applications. Application areas include Time Attendance, Access control, Identification card, Immigration checks, Police records, etc.

The fingerprint identification algorithm has been implemented and tested on PC. The same is now being ported on to embedded processor.

Software Modification of Unified Electronic Controller

C-DAC had earlier designed and developed a Unified Electronic Controller (UEC) for controlling gear transmission, payload monitoring, vehicle monitoring and hoist control of BH-85 dumper trucks manufactured by BEML. After successful development, testing and field trials, the technology was transferred to BEML along with a few prototype models. BEML wanted to upgrade the software of UEC to improve the overall system performance.

The upgraded software will help to manage equipment productivity related information and in characterizing the physical condition of the terrain in which the dumper runs. As the software logs, with date and time stamp, the details of occurrences of error codes and EVMS parameters, this serves the purpose of a Black Box for troubleshooting the equipment, in case of breakdown. The upgrading has been completed and units handed over to BEML.

Smart Card Technologies and Products

Smart card based products developed and deployed internally by C-DAC include Portable Smart Card Readers, Access Control Systems, Time Attendance System, Time Attendance & Access Control System. This project is executed, with internal funding, as part of proving and demonstrating this technology.

The Attendance Management System of C-DAC (T) is based on the Time Attendance System hardware developed in-house. Access Control Systems developed domestically have also been deployed in the various departments of the centre.

The fixed and portable smart card readers are used for canteen management and the development of a modified version of portable smart card reader is in progress. Access Control System and Time Attendance System have been deployed in C-DAC, Pune as well as various other C-DAC centres across India. All the other products are ready for technology transfer. Adtech Systems Pvt. Ltd, a Trivandrum based company has taken ToT of Smart AccessPlus, a Time Attendance & Access Control System.

The design of the portable reader is in progress.

Smart Card Products

Compact IP Telephone Module

The growing need among communications providers and telephone subscribers for a new generation of IP based services is now met by SIP – the Session Initiation Protocol. This IP-based voice communication system also enables conference calling, instant messaging, unified messaging and better mobility. SIP is the first protocol to enable multi-user sessions regardless of media content and is now a specification of the International Engineering Task Force (IETF). The SIP Phone that has been developed is based on Texas Instruments' Communications Processor chip TNETV1055, which is a system-on-chip (SoC) solution for VoIP communication.

The SoC solution has reduced the component count of the product and has helped in reducing the size and cost of the IP telephone.

Major features are VoIP protocol support, audio, network support, call features, dialing, power ports/connectors.

C-DAC is developing an embedded SIP telephone for VoIP applications.
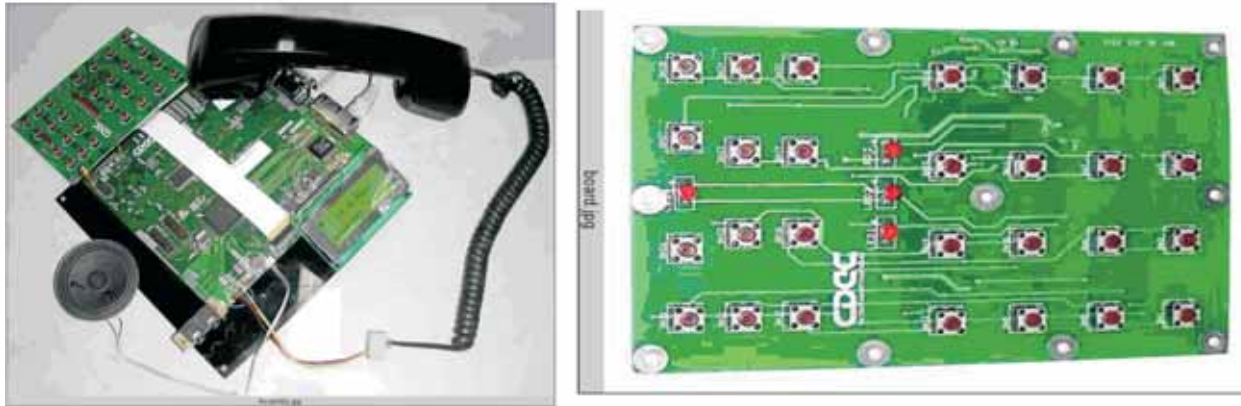
Compact IP Telephone

RF Multicarrier Power Amplifier for Advanced Wireless Base Station

Single carrier amplifiers and power combiners in Base Transceiver Stations are increasingly being replaced by single multi-carrier units that take less space, consume less power and cost less. The project scope covers the development of MCPA for low power applications, for a specified frequency band. The technology developed could later be extended to high power applications and other frequency bands. The MCPA would be a component of Software Defined Radios (SDR). This project makes use of the latest DSP based design. The MCPA will have 4 channels for the 380-470 MHz band and will be scalable for all major modulations and mobile radio standards. One fully functional 9" rack-mountable, MCPA prototype will be developed as a stand alone unit. The schematic and PCB design is in progress.

Audio Broadcast Monitoring System Based on Watermarking

This project aims at the development of a system, including both hardware and software, for monitoring and recording the broadcast status of audio commercials or music programmes from an FM audio broadcast station, using watermarking technique.

The scope of the project includes the development of an algorithm for data embedding and extraction on MP3 compressed audio for streaming audio applications over the Internet and mobile wireless networks. The echo hiding algorithm development and FM Robustness evaluation have been completed, while the PCB design and fabrication are in progress.

Digital Radio Mondiale

Digital Radio Mondiale (DRM) is a set of digital radio broadcast technologies designed to work over the bands currently used for AM broadcast, particularly shortwave. DRM can fit more channels than AM into a given amount of bandwidth, using various MPEG-4 codecs. DRM can deliver FM-comparable sound quality, with more robustness against the fading and interference which often plagues conventional broadcasting frequencies below 30 MHz. DRM has been designed especially to use with older AM transmitters, avoiding major new investments. The encoding and decoding can be performed with Digital Signal Processing (DSP), so that a low cost embedded computer with a conventional transmitter and receiver can perform more complex encoding and decoding. Presently, the design is in progress.

Intelligent Dispatcher Telephone Interface (IDTI)

Distress call management is a key function in any police security system. Combining such a need with the TETRA wireless system and use its data capability for exchange of distress call needs is a current requirement for various state police departments.

The IDTI will have interface to a telephone exchange and will route the incoming calls to the respective dispatcher unit for further processing. IDTI can expand the application arena of TETRA for distress call management required by state police departments. The PSTN gateway design and echo cancellation algorithm development are in progress.

Based on this technology, C-DAC is developing an automated dial 100 system for Kerala police to fully automate the functions of the distress call response, logging, and record creation of dial 100 functions in police control room.

SPIL Cards

The Serial Processor Interface Link (SPIL) card provides access to the processor, memory and I/O of the Digital Flight Control Computer (DFCC) in the Ground Support Facility. The SPIL add-on card has four link adapters capable of operating independently at 5 Mbps speed. These four links communicate with the system bus through a PCI bus target interface chip and establishes the communication link with four channels of DFCC independently. These SPIL cards are now used by Aeronautical Development Authority (ADA) and M/s Vankesh Avionics.

Remotely Operated Submersible

The objective of the project is to design and construct an underwater Remotely Operated Submersible (ROS), which can be controlled by an operator located above water. The operator's station will be connected to the ROS by an umbilical cable to carry power and commands from control station to ROS and video pictures and data from ROS back to the control station. The implementation of the project is currently in progress.

Automatic Meter Reading System

The basic idea behind the system is to implement the remote reading system by collecting the information from the meters using Power Line Communication. In such a system, a data concentrator is placed near the neighborhood transformer, which collects the data from the electricity meters located in the houses connected to this transformer. The data is then transferred from the concentrator to the central office using the mid-voltage power grid, or telephone, or wireless link etc. The system is also used for additional value added services like energy management and flexible tariffs.

The proposed Automatic Meter Reading system consists of Consumer Premises Equipment (CPE), Consumer Data Concentrator (CDC), Data Transfer Unit (DTU) and the Host Terminal (HT). The CPE is the energy-computing unit and is located at the consumer premises. The CDC will be located immediately after the distribution transformer. The CDC communicates with all the CPEs connected to it through the power line (using Power Line Modem integrated in both CPE and CDC) and collects the energy consumption details at periodic intervals. The CPE can be also used as a repeater for increasing the effective range of the system. The data stored in CDC is transferred to a DTU using a wireless link (IrDA or Bluetooth). The DTU collects data from several CDCs and transfers it to the HT located at the substation using USB/Bluetooth.

The development and testing of CPE, DTU and CDC have been successfully completed. Development of HT interface program is in progress.

Signal Processing Engine with Embedded Digitisers

This project aims to develop a Multi Channel Signal Conditioning, acquisition and processing system using a cluster of Digitally Controlled Gain Blocks, ADCs, and DSPs. This indigenous technology will replace multiple signal processing boards with a single board with Multi-Channel Data Acquisition and parallel processing capabilities. The board testing has been completed with Ethernet interface.

CYBER SECURITY AND CYBER FORENSICS

Cyber Forensics

C-DAC has set up a state-of-the-art Resource Centre for Cyber Forensics (RCCF), which develops software and hardware tools for cyber forensics, provides training on cyber forensics to Law Enforcing Agencies (LEAs) and provides technical support to LEAs for seizing, acquiring and analyzing cases involving cyber crimes.

RCCF developed software and hardware solutions for disk forensics and software solutions for network and device forensics. C-DAC has released a series of software suites such as CyberCheck Suite containing TrueBack – a disk imaging tool, CyberCheck – a data recovery & analysis tool and Hasher – a tool for checking data integrity; NetForce Suite containing CyberInvestigator – a forensic log analyzer and NeSA – a network session analyzer; Device Analyst Suite containing PDA Imager and Analyzer, SIM Card Imager and Analyzer, and Call Data Record Analyzer. The centre has also come out with a few hardware tools such as TrueImager – a high-speed hardware tool for disk imaging and TrueLock – a hardware tool for write protecting storage devices.

RCCF provides various technical services to law enforcement agencies by helping investigating officers for seizing material objects from scene of crime, analyzing material objects involved in cyber crimes and presenting analysis reports before courts of law. RCCF has helped the law enforcement agencies for seizing and analyzing storage media of different computer systems involved in a number of cyber crime cases. Also, RCCF received material objects involved in about 125 cases from various courts of the country and has submitted reports on 93 cases after analyzing them.

Training to LEAs (Investigating officers, Judiciary officers, Forensics Science Laboratory officers, etc.) on cyber forensics is another continuous service provided by RCCF. C-DAC has conducted over eighteen such training sessions so far.

Presently, several products are ready for commercialization. C-DAC has already signed a MoA with Pyramid Cyber Security & Forensics (P) Ltd., New Delhi, for marketing CyberCheck Suite.

CyberCheck Suite

RCCF is now designing and developing of next generation forensic tools for tackling issues like malware detection, software forensics, huge storage devices forensics, memory analysis and chat room monitoring. It is also setting up a virtual training facility for imparting training to law enforcement agencies on cyber forensics.

Intrusion Detection and Prevention Systems

Intrusion Prevention System

Intrusion prevention is the process of detecting intrusion and preventing security events of high severity. Typically, an Intrusion Prevention System (IPS) operates in, in-line mode where the captured traffic is made to pass through one or more detection engines, based on which appropriate preventive or reporting of incidents is carried out.

With network traffic attaining multi-gigabits speed performing real time prevention using a single processor based system in software is not viable. In this project it is proposed to develop an appliance, which has prevention capabilities for network traffic of the rate of maximum of 1 Gbps in real time. As speed and accuracy are two pillars of any IPS, C-DAC is planning to use combination of hashing and bit parallelism for signature matching and underlying hardware i.e. Net-FPGA for achieving this throughput. At the end of the project the output will be an appliance with intrusion prevention capabilities with maximum throughput of 1 Gbps. The project is funded by DIT, MCIT, Government of India. C-DAC is also working towards building an IPS called "Guard Your Network" that has capabilities of capturing packets at wire-speed, multi-method detection to confirm attacks, specific algorithms for hardware based pattern-match and content analysis.

RUDRAA

RUDRAA is an effort to carryout Attack Analysis and Signature Forumation for Intrusion Prevention Systems. Current weaknesses in Misuse IDP's include the fact that new attacks are not detected until someone has generated a rule or signature that picks up that specific attack and that most attacks need only be slightly altered in order to bypass existing rules. New signatures are generally created manually addressing the application vulnerabilities. Some signatures may tell you which specific attack is occurring or what vulnerability the attacker is trying to exploit, while other signatures may just indicate that unusual behaviour is occurring, without specifying a particular attack. So, it is essential to craft different type of signature to identify the potential attack. To validate the IDP signatures, it's necessary to carry out the validation and attack analysis.

DyNeF - Dynamic Network Firewall

DyNeF (Dynamic Network Firewall) is a dynamic network firewall for grid environment, that supports the dynamic nature of the grid and protects it from network intrusions. C-DAC's architecture provides host-based access privileges for hosts within the virtual communities, and utilize these privileges for configuring the network firewall dynamically.

Other Cyber Security Initiatives

e-Security

Anticipating the need for end system security in enterprise networks, C-DAC developed end system security solutions for safeguarding network applications. EnSAFE and RealSAFE are two such solutions for securing TCP and UDP applications. Salient features of these solutions are End to End Security, Application Transparent, Confidentiality and Integrity for Network Communication, Session wise Key Exchange, Machine Authentication, Role Based Network Access Control, Multi layered Defense, Plug-in support for Crypto Algorithms and User Authentication mechanisms. Security solutions for all TCP/IP based applications run on Windows and Linux, and are easy to use and administer.

In order to address other critical end system security issues, C-DAC is now developing an end system based Malware Prevention System using process behavior modeling approach, which is funded by DIT. During the financial year 2007-2008 team members initiated work on Malware Prevention System development and started developing a prototype and made some enhancements to EnSAFE. Efforts are also put towards technology transfer of EnSAFE.
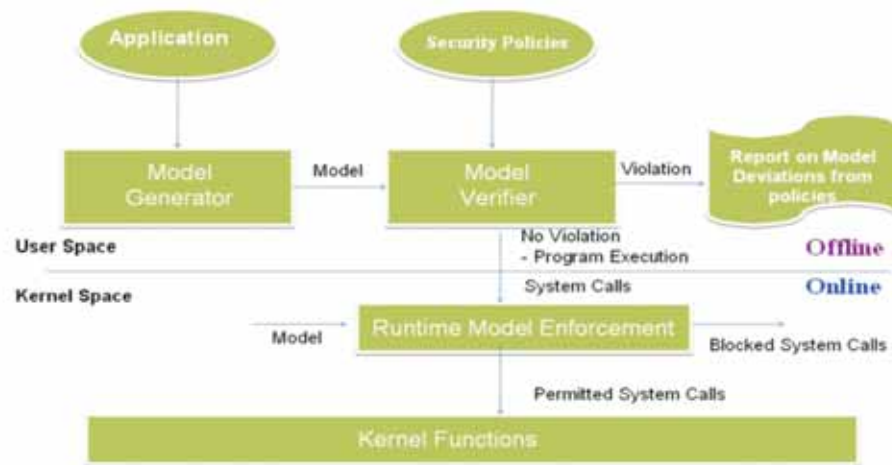
Block Diagram of Malware

Cryptanalysis: Algorithms and High Performance Computing Techniques

Sieving and filtering for RSA512 and for other three 512 bits numbers has been completed. Coding for 64-bit classical sieve and four large prime variations has also been completed and testing is being carried out. Coding and testing for 64 bit factor base generation and filtering and coding for 64 bit matrix stage have also been completed.

On hardware side, AES and DES brute force engines have been ported on Virtex-4 and tested on DINI card procured for the purpose of prototyping. AES and DES encryption engines have been added to the LEON3 microcontroller as peripherals. A GUI has been designed for the purpose of demonstrating brute force engines.

STARS

STARS stands for Secure Two factor based Authentication for Remote Systems. The aim is to develop a strong two factor authentication system for web based users. A protocol to provide important security features such as confidentiality, integrity and authentication against several types of security threats is being designed. As part of this, a secure authentication protocol is designed and published in International Conference on Security. Further to it, a Proof of Concept implementation is completed which will soon be kept online for validation and feedback. The expected outcome of this project is a security product which provides security for online transactions and which can be easily integrated with other tools. The possibility of linkup with various government and private R&D organizations for technical and implementation related aspects is being explored.

HEALTH INFORMATICS

Telemedicine Solutions

Telemedicine Facilities in Tamilnadu

The project is funded jointly by the DIT, MCIT, and by the State Govt. of Tamilnadu. C-DAC and DCL Software Limited, Chennai are jointly implementing it. The objective of the project is to setup Tele-Consultation services in the state of Tamilnadu.

The Govt. Royapettah Hospital, Chennai is the Telemedicine Referral Center (TRC) under the project. The Remote Telemedicine Centers (RTCs) are Government Head Quarter Hospitals at Tiruvallur, Kancheepuram, Tiruvannamalai, Krishnagiri, Ooty, and Rameshwaram.

During the trial phase, the doctors and specialists have already started using the services and are holding regular telemedicine sessions. Some programs under Continuing Medical Education (CME) are also being conducted for benefit of doctors as RTCs. The Telemedicine facility at the Govt. General Hospital, Roypettah is slated to be inaugurated soon.

Mercury™, C-DAC's Integrated Telemedicine Solution deployed under the project has been developed by C-DAC under a DIT funded project.

Telemedicine & Tele Education Facilities in Kerala

The project was initiated with the aim to setup identified Tele-health services in the state of Kerala viz. Tele-consultation and Tele-education for Continuing Medical Education (CME). The five referral telemedicine centres which are taluk hospitals in Kerala have been connected to the Specialty hospitals and the telemedicine software 'MERCURY' has been deployed at each centre for creating and transferring the consolidated Electronic Medical Record (EMR) from various sources like ECG, Microscope, Scanner, etc.

The five nodal telemedicine centres which are taluk hospitals in Kerala (Quilandy, Vythiri, Mavelikkara, Neyyattinkara) and Mental Health Centre, Thiruvananthapuram have been connected to the specialty hospitals (Medical College Hospital, Sree Chithira Thirunal Institute and RCC-T) through 128 Kbps ISDN dial-up connection.

Through this project, a high performance Video Conferencing system and online interaction facility between patient-end and specialist-end with Tele-health services is established and also continuing medical education programs are provided at the taluk hospitals in coordination with the clinical resources from identified referral hospitals.

Web Based Imaging System and Telemedicine Network for Cancer Institute (WIA), Adyar, Chennai (ONCONET-Tamil Nadu)

The aim of the project is to develop a Web Based Medical Image Processing Solution for the capture, storage, transmission and processing of medical images from biomedical equipment and implementing a comprehensive telemedicine network for ACI-Adayar Cancer Institute (W.I.A), Chennai and seven Nodal Centres at different places of Tamil Nadu (Kasturba Hospital, Gandhigram; CFCHC, Ambilikkai; GVN Hospital, Trichy; International Cancer Centre, Neyyoor), Andhra Pradesh (MGMM Trust Hospital, Bhimavaram; IRCS Cancer Hospital, Nellore) and GP Bandh Hospital, Andaman.

C-DAC's telemedicine software "MERCURY" provides the collaboration tool to facilitate telemedicine interactions between doctor at a specialty hospital and patient at a remote hospital.

The Oncology Web Portal (www.cancerinstitutewia.in) and Web based digital library has been put into use recently.

Map of Cancer Institute Adyar and its Nodal Centres

Mobile Tele-Oncology

This project is for design and development of a mobile platform fully equipped with medical equipment for detection of cancer among the rural population of Malabar. The system will be implemented at Malabar Cancer Care Society (MCCS), Kannur for providing Tele-Oncology services for Kannur, Kasargode, Kozhikode, Wayanad and Malappuram districts of Kerala. ISRO is providing free satellite communication facility and free use of satellite channel for consultation of needy patients with doctors of remote specialty hospitals like Regional Cancer Centre, Thiruvananthapuram.

A fully equipped mobile unit facilitates the following activities for the rural masses; Follow-up consultation for cancer patients who have undergone treatment at Regional Cancer Centre, Thiruvananthapuram; Palliative care for terminally ill patients and Improve rehabilitation programs; Early detection for cancer patients at their door steps; Awareness programs on how to prevent and detect early the killer diseases through out reach programs from Malabar Cancer Care Society, Kannur and other hospitals, on VSAT network.

Presently, the system study is in progress.

Health Care Delivery System through Telemedicine using ICT (RuralTMK)

C-DAC is implementing this rural telemedicine project, which is sponsored by Media Lab Asia, Govt. of India. The objective of the project is to develop and pilot implement a rural healthcare delivery system through Telemedicine at Tirur Taluk of Malappuram District, Kerala using available network coverage provided by Akshaya network. This project will facilitate some of the selected PHCs, CHCs, BPHCs, Taluk Hospital, and District Hospital to have expert consultation with the specialty hospitals like RCC-Thiruvananthapuram, Medical College Hospital- Thiruvananthapuram, Sree Chitra Tirunal Hospital, Thiruvananthapuram and Medical College Hospital, Kozhikode. Also, this will allow the rural hospitals to attend appropriate CME programs hosted at the specialty hospitals.

The procurement of equipment has started and the site preparation is in progress. Network testing has also been initiated while the iPACS testing over data center is in the final stage.
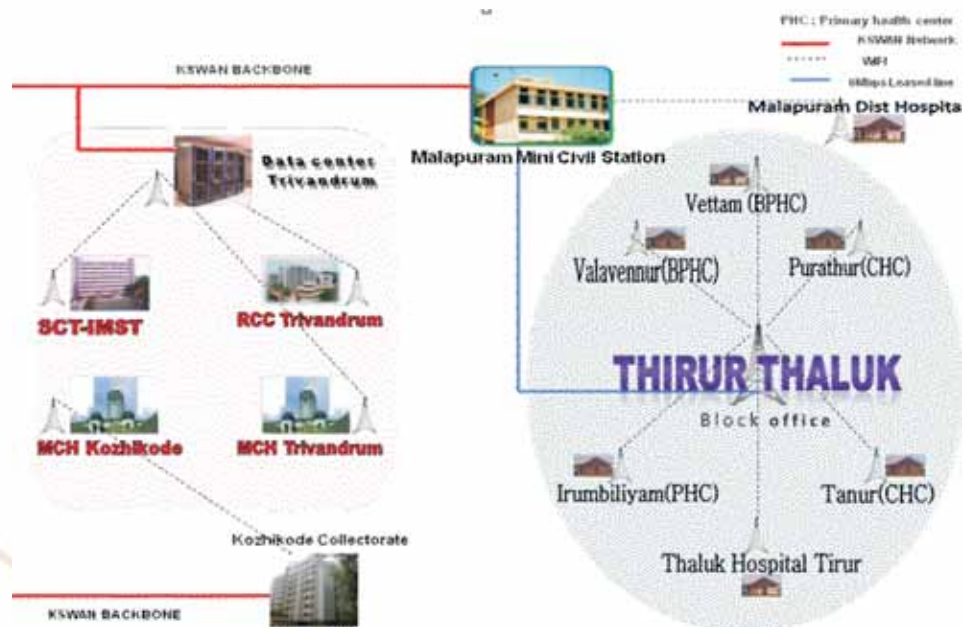
Representative diagram of rural healthcare delivery system

Teleophthalmology for Multi Specialty Eye Care in Remote Areas of Punjab

The project was sponsored by the Ministry of Health and Family Welfare and has been completed in March 2008.

The project has been implemented at Ropar district, Punjab. Under this project, a mobile van has been sponsored by Punjab Health Systems Corporation, Mohali and it has been transformed into a mobile Tele-Ophthalmic consultation unit by C-DAC. This mobile clinic, under the supervision of Punjab Health Systems Corporation with telemedicine linkage has been visiting rural areas within Ropar district.

Telemedicine Facilities in Punjab

Under this project a statewide telemedicine network is being laid in Punjab. Eleven sites have already been equipped with the infrastructure appropriate for telemedicine and others are underway. For the first time in the Northern India, VPN over broadband has been used for telemedicine applications "Sanjeevani" with the set of modules enabling Tele-Pathology, EMR, Tele-Cardiology, Tele-Radiology and Tele-Consultation. First five sites were inaugurated by Prof. Laxmi Kanta Chawla, Honorable Minister of Health and Family Welfare, Punjab on January 16, 2008 at Civil Hospital, Mohali. The project is sponsored by the DIT, MCIT, Govt of India and Punjab Health Systems Corporation.

Telemedicine Facilities in Himachal Pradesh

Under this project, all the twenty-one sites in Himachal Pradesh have been connected over ISDN lines for teleconsultation by using "Sanjeevani". This version of Sanjeevani has modules like Telepathology, Telecardiology, Teleradiology and Teleconsultation. To enable proper use of technology, to impart training to the users, the project has been extended till August 2008. This project is sponsored by the DIT, MCIT, Govt of India and the Department of Health and Family Welfare, Govt. of Himachal Pradesh.

Centre for Enhancement of IT Skills at Yangon, Myanmar

This project is sponsored by the University of Computer Studies, Yangon (Myanmar) in collaboration with the Ministry of External Affairs (MEA), Govt. of India.

Needs assessment study for establishing a centre of IT in Yangon, Myanmar has been completed. C-DAC intends to provide an integrated telemedicine solution for telemedicine consultancy between Centre for Enhancement of IT Skills (CEITS) and Community Information System (CIC) for the purpose of medical diagnosis, patient care, expert consultation and medical education. The training to users will be imparted at CEITS in Yangon. Besides providing training to the users, C-DAC will handhold the centre for a period of six months at Yangon, Myanmar.

Hospital Management Information Systems

Computerization of PGIMER, Chandigarh

The project envisages setting up a complete ERP solution in the health sector in a turnkey mode. The system consists of all aspects of Hospital Management including registration, IPD, OPD, blood bank, diet kitchen, bio-medical waste management, back office functions, etc. C-DAC is responsible for the full system implementation including setting up of infrastructure, networking, training, hand-holding and facility management. This massive project involves 14 hospital buildings, about 3300 computing nodes and 14 kilometres of fiber optic cabling in the campus wide network. The first phase of the project is expected to be operationalized by the end of 2008.

Computerization of SMS Hospital, Jaipur

In the project, M/s. RajComp, a state government enterprise will take care of setting up hardware and networking infrastructure while C-DAC is responsible for the Hospital Information Management software and training support. The first phase of the project is expected to be inaugurated by mid of August, 2008. M/s. RajComp has also entered into a MoU with C-DAC under which they can set up the systems developed in any other government hospital in Rajasthan, after paying appropriate royalty fees to C-DAC.

Computerization of GNCT Delhi Hospitals

Under this project, C-DAC's Hospital Information System software will be used in all the 32 hospitals in GNCT Delhi. The implementation is in phases and the first phase is expected to go operational by December, 2008 in Guru Gobind Singh Hospital. Once this is successfully completed, the implementation in remaining hospitals will be taken up parallely and it is expected that by the end of the decade all Government hospitals in Delhi will be running C-DAC software for their health management applications.

Knowledge Management based Smart Hospital Information System

The project aims at developing Knowledge Management based Smart Hospital Information System for use in hospitals and other healthcare institutions. It will facilitate healthcare institutions to introduce new innovative features/facilities for improving quality of healthcare services. This project will build on the Hospital Information System developed by C-DAC, which is already installed and running at the Thiruvananthapuram Medical College Hospital.

This project will also implement the Medical Records Library as per the ICD10 standards. This will provide support for e-case sheets, which will be useful for medical practitioners for reference purpose. HIS Knowledge Repository and software, Data Mining models and rules, user manual and various reports, etc. will also be generated.

At present, the literature survey has been completed, and the system study is in progress.

Rural Health Management Information System

This project is for extending the Health Management Information System to BPHCs/CHCs/PHCs and then to sub-centres, and

ultimately to the field workers using handheld devices. The pilot implementation will be carried out at Tirur taluk of Malappuram District, Kerala. A central Health Information Server for HMIS at e-Governance data centre will be setup. All the BPHCs/CHCs and PHCs of Tirur taluk will be connected to the central server using Kerala State Wide Area Network. The health workers of the sub-centres will be equipped with handheld devices, which will be used, for data collection from the household and various reports can be generated using this raw data.

The design and development of the PDA application is in progress. Data porting is also progressing.

Data Management System for Oncology

This project aims to enhance TEJHAS (Web based Hospital Information System developed for ONCONET, Kerala project by C-DAC(T)) by developing and implementing a Data Management System for Oncology using patient database at Regional Cancer Centre (RCC), Thiruvananthapuram, with the help of available clinical guidelines and Electronic Medical Record, which is compatible with HL7 and DICOM standard.

Doctors' Work Bench (DWB) is a product that will be developed as part of Data Management System for Oncology. DWB is a Clinical Information System for data management in hospitals. It is an enhancement of the consultation room module of TEJHAS. The objective of DWB is to develop and implement a user friendly application for doctors to use in a consultation room, which provides an image enabled, doctor defined data collection tool and provides an interface to a Hospital Information System for other activities, such as investigations ordering/viewing, equipment scheduling, writing out a prescription and viewing inpatient details. The application should facilitate the capturing and saving of clinical information of patients in a structured manner, irrespective of its volume and should provide options to configure the tool for new clinics and hospitals.

The design and development of DWB is in progress, presently.

Screenshots of DWB Vers 1.0
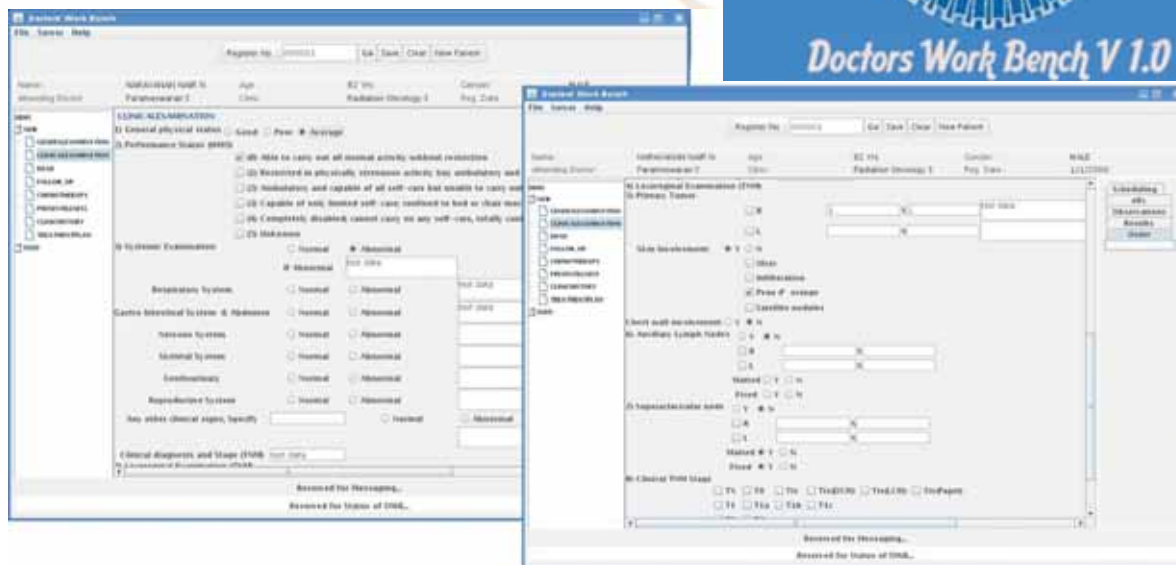
Kerala Health Management Information System Phase II

This project forms part of the implementation of the recommendations made in the master plan (C-DAC was engaged earlier by the Sector Reforms Cell of the Directorate of Health Services, Department of Health, Govt. of Kerala to prepare a master plan) for setting up a Health Management Information System (HMIS) for the state of Kerala, with funding from the European Commission.

It comprises the development of an integrated HMIS with disease surveillance capability for the Directorate of Health Services, by linking all District Medical Offices (DMOs) in the state.

The application is hosted on a central server, and necessary infrastructure is setup at the Directorate of Health Services (DHS) and the District Medical Offices (DMOs) under the DHS, for health related data entry and reporting.

The health programme module facilitates the data collection and reporting functions of HMIS. Data entry and report generation for various health programmes like Family Welfare Programme, National Blindness Control Programme, Community Needs Assessment Approach Forms, Disease Surveillance, etc. is possible.

This project also includes the development and implementation of an Administrative Application Suite comprising of various modules for handling Institution Infrastructure, Budget Monitoring and Control, Employee Records, File Flow Management, etc.

Currently, the application is running satisfactorily. Establishment of connectivity to DMO Office's via State Information Infrastructure (SII) is in progress.

Other Healthcare Solutions and Initiatives

Class Libraries for DICOM and HL7

The project is funded by the DIT, MCIT for building indigenous standard protocol implementation for healthcare domain.

The objective of this project is to design and develop components that can be used to build class libraries/SDK/API/Toolkit, which in turn can be used to incorporate Digital Imaging and Communications in Medicine (DICOM) and Health Level 7 (HL7) support in end user applications in the area of Medical Informatics.

The components will be adhering to the standards and would provide functions/services as mandated in NEMA's DICOM v3-2004 standard and ANSI approved HL7 v2.5 standard.

The beta version of the SDK is expected to be available around August 2008.

Pulse Analysis (Nadi Pariksha)

The objective of this project is to develop a Decision Support System (DSS) by capturing Pulse data and its variations with other physiological parameters using instrument(s), and to develop computational models for clinical assessment of pulse qualities. Ministry of Communications and Information Technology, Govt. of India has funded this project. C-DAC, BARC, and IITB (Mumbai) would jointly work and yield a software system, which can do analysis of the variabilities captured by the medical instrument simulating Nadi Pariksha for probable diagnosis or prediction of disease proneness of an individual.

Tasks accomplished till date are:

- Data capture continued in clinics and other institutes using the following methodologies:
    - Physician's examination
    - 3Ch pulse analyzer instrument of BARC
    - Vasomon s/w based Vasomon instrument of L&T
- System Requirement Specifications (SRS) document
- Prototype development
- Computational models development
- On-Line-Analytical applications development

Till date, data of 586 subjects from various reputed colleges/institutes/clinics/hospitals have been captured.

Following analytics are done on the pulse signal:

- Dosha Dominance and pulse signal
- Correlation amongst major deflection points in the pulse morphology patterns
- Correspondence between a disease and the pulse morphology pattern/s with special focus on Diabetes Mellitus (DM) and Ischemic Heart Disease (IHD)
- Fisher's Likelihood Ratio Test for statistical signals of pulse is also computed for entire duration of the record. Our results show its significant application in – (i) classifying pathological and normal morphology-patterns in any selected time-interval of the record; (ii) detection of morphological variations over time.
- Spectral analysis parameters of total energy and prominent frequency namely the K-ratios were computed and analyzed of new sets of data of over 200 pulse signal records of healthy as well as pathological cases. One of these parameters shows significant use in early diagnosis and successive monitoring of coronary and other cardiac problems.
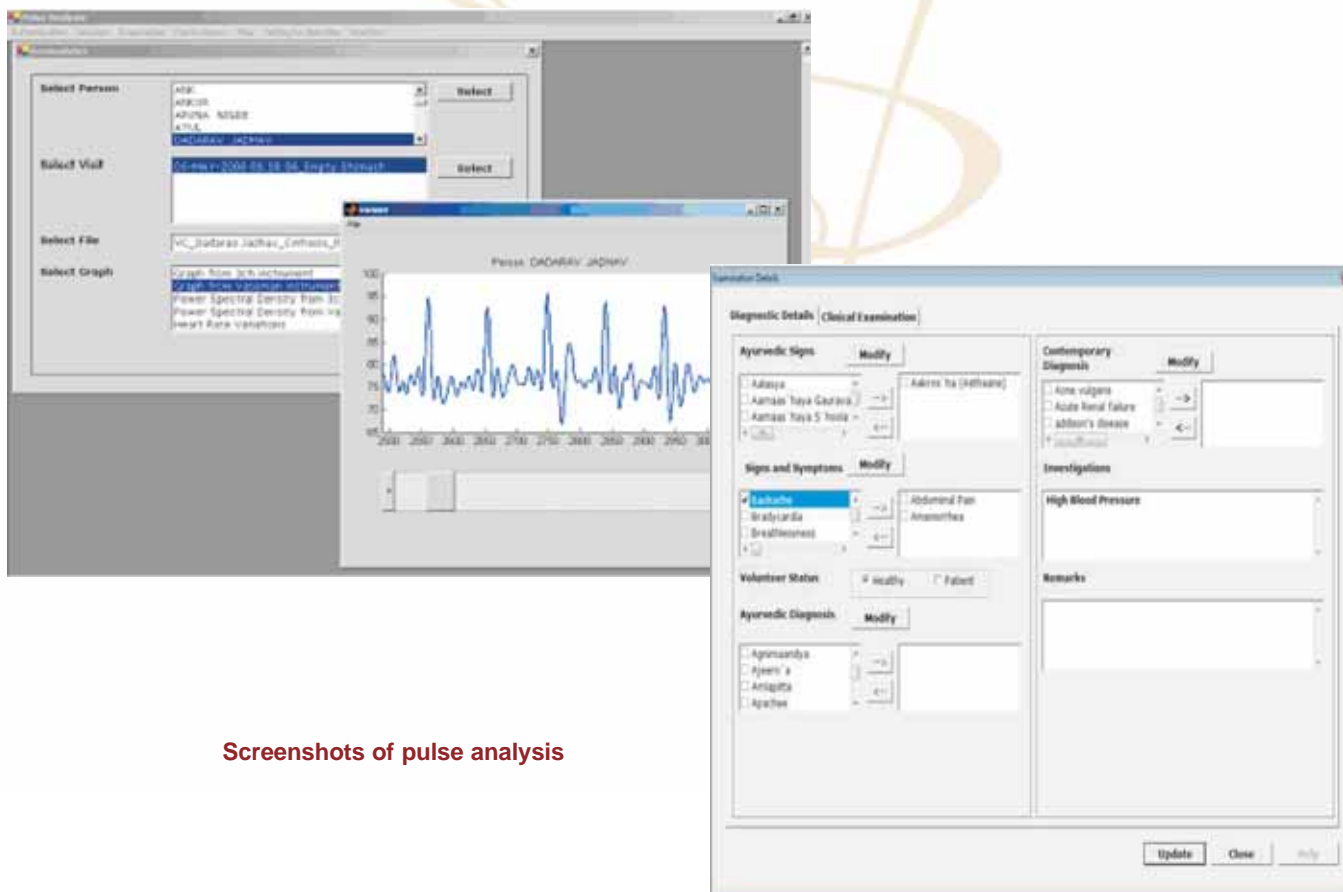
Screenshots of pulse analysis

Cure@Home

C-DAC has initiated a project on Integrative Medical Informatics for the common man of North Eastern region termed as "Cure@Home", funded by the Ministry of Communications and Information Technology, Govt. of India. The objective is to design and develop a multilingual, decision support system with knowledge base of Integrative Medicine to address the healthcare needs of a common man of North East region, NGOs and National Health Care Systems. It would help in building awareness about personal and community health and facilitate constitution assessment, evaluation of health status, diet and lifestyle advice. It would provide information about home remedies according to signs and symptoms of common ailments, kitchen gardens, preparations of formulations and first aid.

Cure@Home shall provide various applications such as:

- MyCare
    - Constitution analysis and diet and lifestyle advice according to the constitution.
    - Various calculators: Body Mass Index, Waist Hip Ratio, Expected Date of Delivery
    - Immunization chart
    - Facility to enter and archive the health record
- Treatment, diet and lifestyle advice according to disease – symptoms
- Detailed encyclopedia comprising of articles, audio clips, video clips, images with description of the same, and a glossary of common terms.

This rich and vast knowledge will be available to the common man through various means such as Personal Computers, Public Kiosks, etc.

Following tasks have been completed till date:

- Prototype of the final system
- Software requirement document that spells out all the requirements related to the software in detail.
- Discussions/expert advice from

    Seva Bharati (SB), My Home India (MHI), Guwahati medical college, North-Eastern Hill University, Shillong (NEHU), North Eastern Indira Gandhi Regional Institute of Health & Medical Sciences (NEIGRIHMS), Assam Medical College, Dibrugadh, Assam, Assam Government Ayurvedic College, Guwahati, Department of Health & Family Welfare, Govt. of Assam, Secretariat, Dispur, Guwahati., Gramvardhini (GV), Vivekanand Kendra

- Data collected from the North-East region of India
    - Treatment according to signs-symptoms and diseases
    - Emergency conditions
    - Herbs
    - Formulations
    - Dietary recipes
    - Dietary ingredients like fruits vegetables, etc.
    - Prevention of diseases

User interface of Cure@Home

AyuSoft

In the year 2007–2008, AyuSoft extended its business to the deeper pockets of India and some reputed international Ayurveda institutes. To propagate AyuSoft, different modes like training programmes, presentations were organized at various national and international platforms. AyuSoft training programme was conducted at C-DAC, Pune on March 4-5, 2008 for the physicians and researchers of institutions.

Department of AYUSH, Ministry of Health & Family Welfare, Government of India, has taken initiative to propagate AyuSoft through their institute network. AyuSoft has been installed in fifteen reputed institutes of AYUSH department.

Several experts of Unani, Homeopathy and Yoga systems have also appreciated this model. AyuSoft is being used in a national level constitution based research project also various researchers and MD/Ph.D scholars, physicians and undergraduate students are using AyuSoft in their study and clinical activities.

User Interface of AyuSoft

Medical Investigation Camera for Endoscopy

The aim of this project is to develop a technology for a miniaturized micro-electronic camera, in a capsule form, suitable for ingestion by patients. The first phase of this highly complex blue-sky R&D, comprises development of the sample version as a proof-of-concept, later to be engineered into a testable product.

The most important component would be the miniature camera using CMOS technology. This will be appropriate for wireless transmission through body tissue. In order to identify the requirements of the image data logger, used along with camera, and to identify the candidate materials for other components such as lens and enclosure, a detailed study would be carried out. The selection of materials for the enclosure is critical since they need to be biocompatible, with outside surface properties to prevent adhesion of biological fluids to their surface, to prevent reduction in the quality of the image. The intermediate milestone of this effort is identified as a detailed Feasibility Study Report (FSR) listing out technology alternatives.

The next phase of the project will focus on the development of the electronics subsystems using discrete electronics technology. The important aspect of concern is the miniaturization to the greatest extent possible, without incurring the high NRE costs of ASIC implementation. Another critical issue is about the power consumption, since the operation will be from an integrated battery within the capsule, with very limited operating life. The mechanical aspects and manufacture of compact capsule-shaped housings using biocompatible materials and processes will also be tackled. Once the pre-clinical trials on appropriate models are over, both in-vitro and in-vivo, suitable mid-course corrections can be made if required.

A suitable CMOS sensor module for camera and transceiver modules has been identified, procured and testing of the same is in progress along with system study.

Digital Programmable Hearing Aid (DPHA)

C-DAC has developed DPHA for hearing impaired persons to provide near normal hearing capability to them. DPHA is a real time system with a 32-bit RISC processor, Hardware Digital Signal Processing Modules, UART and associated Hardware blocks, all implemented in the FPGA. The device is developed as a multi-listening program, multi-channel audio signal processing system. State-of-the-art, real time Digital Signal Processing algorithms have been implemented using a 32-bit RISC processor working along with Hardware Digital Signal Processing Modules. The frequency response, input-output response, response time, channel boundary frequencies, compression parameters and response time can be programmed into the hearing aid.

ICT Enabled Integrated Assessment tool for Mentally Retarded Children

A child with mental retardation undergoes a comprehensive evaluation to determine the nature of services required. Evaluation is done for three purposes: diagnostic, instructional, and progress monitoring. Following this evaluation, collected data is translated into statements of special education needs. The Functional Assessment Checklist for Programming (FACP) and the BASIC-MR both methods developed by the National Institute for the Mentally Handicapped (NIMH), Secunderabad is used for the evaluation. Madras Developmental Programming System (MDPS) is another method that is available for evaluation.

The tool will be initially deployed in 8 special schools in Kerala for the field trial and finally be integrated to the portal of Rehabilitation Council of India (RCI). The package will be capable to assess each MR child based on the inputs given by the teacher. Based on the assessment results the system can suggest a suitable long term goal for each child. This long term goal will be further divided into short term goals. For each short term goal the system will try to suggest a suitable lesson plan. The system will be capable of generating charts and graphs on the development pattern of each child.

Preliminary design of the tool has started.

Human Resources Portal for Department of Health, Government of Kerala

C-DAC has developed a web portal for the Department of Health & Family Welfare, Kerala state, for their HR management functions like employee records maintenance, monthly payroll computation, real time reporting on employees, self service functions to the employees for preparation of pay bills, filing of claims (medical, tour etc.) computation of tax projection statements, preparation of IT returns, etc. The portal is accessible to the public over the Internet, where a detailed description of the services provided by the Health & Family Welfare Department and exclusive portals on Ayurveda, Homoeo and Modern Medicine are available. As part of this project, C-DAC has also set up a Health Information Center with a high availability, high reliability, scaleable server at the e-Governance Center for hosting the portal, along with a communication network linking all the five Directorates of the Health and Family Welfare Department and the Health Secretariat in Trivandrum, to the Health Information Centre.

The portal facility is accessible by the public through the URL: www.healthkerala.gov.in

Kerala Health Portal Software Screen shots

Portal of department of Health & Family Welfare, Kerala

Kerala Health Portal Software Screen shots

Drishti: An Electronic Medical Records System for Ophthalmology

Drishti is developed for the Sankara Eye hospital, Coimbatore. The main users of the system are doctors, refractionists, laboratory, pharmacy, personal counseling section, patient registration counter, and optical center. Each group of users have their own access privilege. The major modules of the system are the Patient Registration module, the Refraction module for entering information about refraction tests, Doctor's module and Personal Counseling / Report Generation module. The Doctor's module helps doctors enter patient's medical history/diagnosis/advice, etc. This module also supports image drawing capability to record some of the observations with the help of an image and helps doctors prescribe medicines/eye-glass and this record will be visible at pharmacy and optical center of the hospital. In addition, doctors can also navigate through patient's previous records (if he/she is a follow-up patient) and the various test results. The Personal Counseling/Report Generation module helps build a consolidated case sheet; including prescriptions, corresponding to a particular consultation. The system was developed and demonstrated to the doctors at Sankara. Based on their feedback and changes suggested in the requirements set, the system has been modified and is ready for deployment.

EMERGING AREA

As part of Ubiquitous Computing initiative of DIT, MCIT, C-DAC was awarded an R&D project titled "Establishment of National Level Ubiquitous Computing Research Centres" at C-DAC - Hyderabad, Chennai and Bangalore". The main objective of the programme is to carry out R&D in the area of Ubiquitous Computing, establishing centres of excellence for undertaking research in the multidisciplinary areas like hardware, sensor networks, middleware, context-aware computing; resulting in development of research prototypes, tools, core technologies leading to products, and proof-of-concept applications that have the potential to improve the quality of life.

The following development activities are being carried out at the Ubiquitous Computing Research Centres at C-DAC:

1.   Development of context aware middleware framework

2.   Setting up of an intelligent room with three objectives:

    ●   Develop an intelligent health-care room

    ●   Develop applications using sensor technologies to demonstrate energy efficient operation of devices used in home environment.

    ●   Conference room with sensing and context-aware applications

The progress made so far include:

1.   Literature survey on Context Modelling approaches, Intelligent Room projects, Healthcare architecture, Context-aware applications, Ultra-wide Band technology, Location sensing, and Service Oriented Device Architecture (SODA), have been carried out and reports were prepared.

2.   Architecture for context-aware framework has been finalized. A prototype on Event Notification Model using publish-subscribe design pattern has been implemented.

3.   The design of the following artefacts to be used in the Intelligent room is under progress:

    ●   Illumination control using wireless sensor network motes.

    ●   Interactive mirror.

4.   Based on the pre-project research work carried out in the areas of context-aware computing, location based services, distributed discovery using semantic clustering, four papers have been published/presented/accepted for presentation in international conferences.

In addition, C-DAC has initiated development of various components like Adaptive Framework for Wireless Sensor Network Applications (AFWA), Grid and Ubicomp (GRUB) platforms for U-Learning, Security, Trust and privacy management platform (U-Viswaas), proof of concept applications of Wireless Sensor Networks in U-Agri, Intrusion Detection and Smart Parking. Literature survey and software requirement specification have been completed during the financial year 2007-2008. An MoU has been signed with the Centre for Renewable Energy and Dryland Agriculture (CRIDA) to work together in the area of Pest monitoring and control systems. U-Agri system architecture is given in the figure.
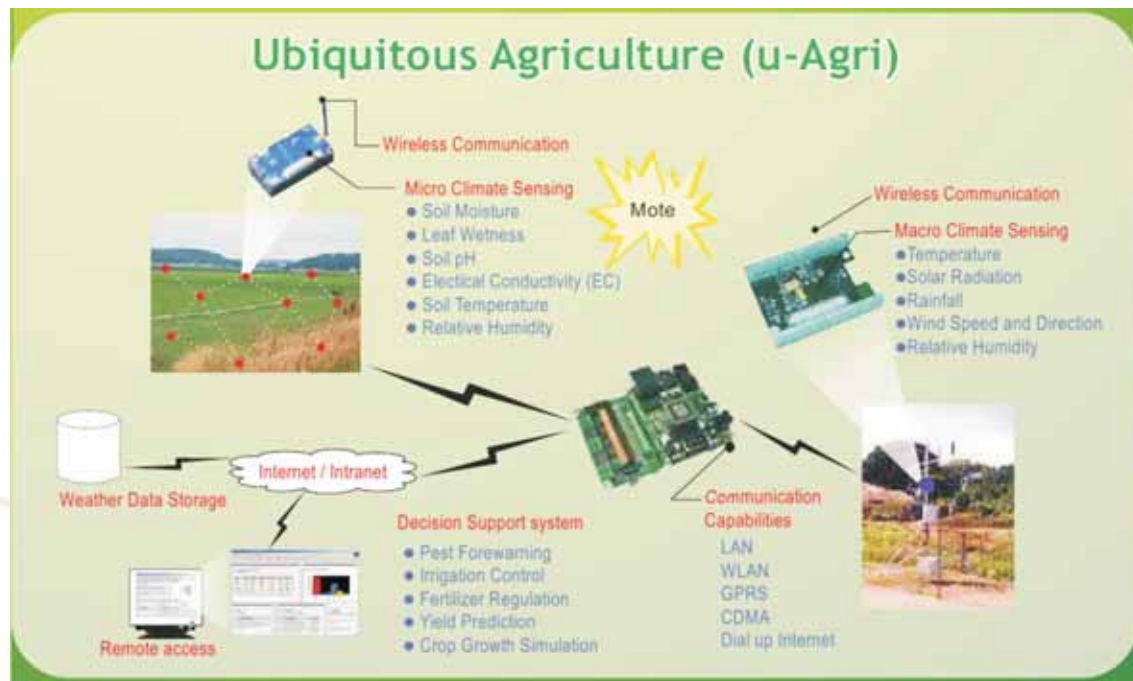
U-Agri system Architecture

EDUCATION AND TRAINING

C-DAC continued to offer its education and training services through its various courses and programmes in the year under review. All these courses are well received by the industry and the students trained under these courses have been recruited by leading companies.

During the financial year 2007-2008, the Hyderabad centre has designed two new courses in association with JNT University, Hyderabad namely, Certificate Courses on Networking and Systems Security (CNSS) and Digital and Analog VLSI Design (CDAD). The centre has successfully completed one batch under each of these courses.

Over 1000 students studied at its Noida campus under formal and non-formal Postgraduate programs. Two students of the M. Tech. program were awarded gold medal for securing first position in university.

Prepare Future

C-DAC has been awarded a project by HRD division of DIT under the manpower development for duration of two years. The objectives of the project are:

- Enhance Diploma in Embedded Systems Design (DESD), Diploma in Systems Software Design (DSSD) and Diploma in Advanced Computing (DAC) courses conducted at C-DAC, Hyderabad for an additional intake of 60% of admissions.

- Impart advanced training through innovative and participative learning-teaching approaches within a project based training framework for engineering faculties in the areas of Information Technology (Embedded Software, Systems Software & Application Software) for faculty updation to bring out industry ready graduates.

- Setting up of laboratory based classroom for engineering faculties, imparting pragmatic exposure and hands-on.

- Electronic content development specific to Embedded software, Systems software, and Application software.

The planning of execution was completed during the financial year 2007-08. The necessary infrastructure was created to expand DESD course intake and also to offer faculty development programs during the next financial year.

Programme for Advancing Computer Education PACE

C-DAC's GIST-PACE offers various programs ranging from short term basic computer awareness programs to Post Graduate level covering all aspects of multilingual computing (Certificate, Diploma, Advanced Diploma and Post Graduate Diploma) through a network of 250 Authorized Training Centres (ATCs) spread across 15 states.

GIST-PACE has launched a Teachers Training course and a two-level Multimedia course i.e, (Diploma and Advanced Diploma) through its network during April '07.

GPACE has imparted training to the students under the sponsored project of District Rural Development Agency, and the certificates have been awarded by the H'onble Chief Minister of Gujarat, Shri Narendra Modi. Apart from this, training has also been imparted to Gujarat Administration Department, Development Department, Gujarat, Kerala Health Services, Kerala Punjachayats, etc.

GIST PACE has also received approvals, for certificates for duration above 6 months, from the Kerala Public Service Commission and the West Bengal Employment Exchange, for their human resources recruitment requirements.

Over approx. 30000 students have been trained for the year 2007-08 including Government employees.

M.Tech. VLSI

M.Tech. in VLSI is offered by R&D Group at C-DAC. In all 18 students were admitted to this program in 2007. This is the 4th cohort of this program.

M.E. Electronics Product Design & Technology (EPDT)

M.E. (EPDT) is offered by C-DAC in collaboration with Punjab Engg. College, Chandigarh. Twenty-one students were admitted in this program in 2007.

MCA Programme

C-DAC trainess had an excellent academic record for the batch passed out. One of the students, Mr Abdul Majeed bagged the first rank in the MCA examinations conducted by CUSAT. Out of the 60 students who appeared for the exam, 58 had managed to score first class.

Information Security Education & Awareness (ISEA) Programme

C-DAC is actively involved in various activities of the Information Security Education and Awareness Programme of DIT. These activities include:

a) National Awareness Campaign on Information Security

The vision set for the implementation of this programme is, "Generate information security awareness among Indian citizens to enable them to participate safely in information society". C-DAC will be executing this project with the help of various identified participating institutes. The following activities were carried-out during the year 2007-2008 for the creation

of information security awareness for the stakeholders:

- Promotion material in the form of animated movies, pamphlets, brochures, posters illustrating the security issues and how to safe guard one from various attacks including social attacks has been developed.
- Content for conducting workshops to different target groups like parents, teachers, children, home users, etc. has been prepared.
- A portal development to host campaign material has been initiated (www.infosecawareness.in)
- Security Guide Book and Security Tool Kit has been developed.
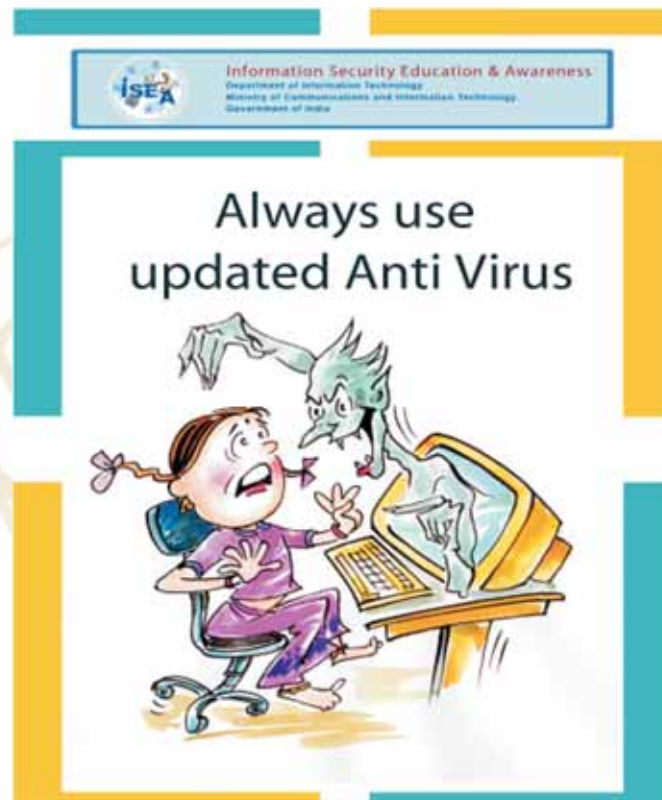
Sample Information Security Awareness Material

b)   Six-month Course in Network Security

Certificate Course in Networking & Systems Security (CNSS) has been successfully conducted at C-DAC, Hyderabad during the financial year 2007-2008.

c)   Information Security Courseware Design for Training Government Officers

C-DAC is working on courseware design for training of Government Officers on information security. Initial design of the courseware covering all type of users is completed. The following modules were identified and content is being prepared with the help of internal and external experts. Modules identified under this course are Training the Trainers Skills, Unix and Scripting Languages, Information Security Management, Understanding TCP/IP, Threats, Vulnerabilities & Countermeasures, Introduction to Cryptography and Security Protocols, Perimeter Security, Incident Handling and Enterprise Forensics, Business Continuity and Disaster Recovery Management and Security Standards and Models.

Activities planned for the financial year 2008-2009 are completing the design of Information Security courseware.

d)   Imparting Training to Government Officers on Information Security

As part of this programme, three 1-week practical oriented training programs on Information Security were conducted during the financial year 2007-2008 and 50 Government officers from BSNL, CDFD, DRDL, ISRO, JNTU, NTO, Vikram Sarabhai Space Centre, UoH, SBIICM, etc. were trained.

During the financial year 2008-2009, four 1-week training courses on Information Security will be conducted with a target of 80 officers.

PG Diploma in Language Technology

Local language software applications are required to penetrate the language barrier and take the benefits of computer and Internet to the English illiterate Indian population, which forms almost 90% of the total population. The Post-graduate Diploma Programme in Language Technology prepares the participants for a career in the localization industry. In product localization, aspects such as language and culture must be localized so that products and services appear to be specifically developed for a local market.

This course will enable participants to understand general concepts of localization, such as industry expectations, translation tools and processes. They are introduced to multilingual computing, product development and localization cycles and projects. Common projects bring all participants together to solve problems in teamwork settings. Topics in this program address the localization of web sites and Internet as well.

At present, the classes are in progress. The results of the first semester have been published. The second semester will commence from April 21, 2008.

Educational Content Creation Under 'Sarva Siksha Mission' Program as per the Syllabus of "School of Secondary Education", Government of West Bengal

Through earlier assignments, C-DAC had developed in-depth recognized domain knowledge on Development of Educational Content. Appreciating earlier achievements, the SCERT Department, Govt. of West Bengal had identified C-DAC, Kolkata to work out a Workshop on 'Methodology Development on Computer Aided Learning Material Preparation' for four selective subjects. C-DAC, Kolkata had already implemented a high end R&D infrastructure for this project at SCERT, Govt. of West Bengal. Hence, such innovative technology-driven Educational Content will boost the student as well as teacher.

Subjective Evaluation Framework

This project aims at building a framework for subjective examinations for universities. The project is done in collaboration with the OSS division of C-DAC. The framework provides for defining question paper patterns with the usual complexities of optional, choose-any-n, etc. often found in university papers. Teachers can create specific question papers as per given template, students can take the examination online and examiners can evaluate the answers. An experimental version is now ready.

National Online Test System for Graduate Engineers in Information Technology

The aim of this important initiative by DIT is to create a national test system for benchmarking of graduate engineers in IT for self-assessment, supervised learning and placement in the industry. The system is expected to start operations by the close of 2008 with linkages of C-DAC and DOEACC centres. Once fully operational, it would be primarily hosted in C-DAC with possible multiple hosting all over the GARUDA network so that a large population of students could use it. The backbone of the system is a large question bank in the area of IT originating from participating academic institutions across the country. This ensures that the

question bank properly captures changing academic scenario, dictated by multiple universities and other educational institutions operating in this sphere.

RE Portal

This project is being developed for IBM India for their Re-inventing Education (RE) program. The aim of this portal is to provide an e-learning environment where teachers can communicate and collaborate with each other, in building and sharing course plans, content and other teaching experiences, so as to evolve a better teaching and learning environment. The system features will include a platform for uploading good quality content on topics, provision for sharing one's contents with other teachers and students, means to have one-to-one communication with other users or group of users and a platform to share queries on topics with others and get responses for the same. There have been meetings with the client to formulate the requirement specification for this system. An initial prototype was developed for better understanding of the requirements.

TechLink

This is a European Union funded project. This project aims at conducting localisation courses across the country in collaboration with the Localisation Research Centre, adapting and localising the learning resources they have. In the last year, we had meeting with the LRC partner for planning the activities. The project team has also delivered talks on localisation, at various conferences and workshops across the country, so as to promote awareness of the area, which we thought is required to run this course in India. An e-learning course on "Introduction to open source software" is also being developed as a part of this effort.

ICT based Program for Rehabilitation Officials and Specialist Teachers

The objective of the project is to provide a scalable pilot infrastructure facility for imparting distance training for the trainers in the field of special education. This is a VSAT based solution by using the bandwidth of EDUSAT. The teaching end facility as well as the facilities at seven schools of special education will be set up and managed as part of the project.

In this project, sponsored by Media Lab Asia, KVM School of Special Education, Chertala, Kerala has been identified as the teaching end and the existing hub location at Gorky Bhavan, Trivandrum has been identified as the uplink station. Seven special schools have also been identified as virtual classrooms in the pilot phase with Satellite Interactive Terminal (SIT).

At present, the connectivity between the teaching end and the uplinking station has been established over the State Information Backbone. Trial run has been completed and regular classes are in progress.

International Centres for Enhancement of IT Skills

In May 2007, C-DAC completed the setup of two International centres for enhancement of IT skills. These are at Jawaharlal Nehru India Uzbekistan Centre for IT (JNIUCIT) at Tashkent, Uzbekistan and Bedil India Tajikistan Centre for IT (BITCIT) at Dushanbe, Tajikistan.

C-DAC also signed an agreement with Ministry of External Affairs (MEA) on December 20, 2007 for establishing "India–Myanmar Centre for Enhancement of IT Skills" at Yangon and 10 CICs in Myanmar. C-DAC is required to provide the requisite hardware including Networking and Video Conferencing equipment, and technical consultancy and for setting up of the centre. C-DAC will also conduct various training programmes like DIT, ADIT, DBC, DWT and DIL courses for around 1000 aspirants in Yangon. 10 of their participants have completed DAC course in Pune, who will eventually train other aspirants in Yangon after the centre is operational. The procurement of equipment for the project is being processed.

Convocation Ceremony of Students from Myanmar

e-Learning System for e-Security

e-Learning is an emerging field with potential to complement the conventional learning and teaching methods in a very significant fashion. Considering the importance of this
area, C-DAC has set up an e-learning resource centre for e-security applications. Hosted at its Noida centre, this system has been attracting users within and outside the country. A workshop was conducted to demonstrate and popularise this technology and a lot of interest was generated in the exploitation of the technology for providing e-security education using this medium of communication. The system is now fully functional and is regularly being used by the many enthusiastic users.

SMDP -VLSI Website

The project involves the design and development of the VLSI website that provides latest information on VLSI designing and centralized databases for the benefit of premier institutes of India striving towards promotion of special manpower development in VLSI design and related activities. Static as well as dynamic data, with ease in accessibility of information is the guiding criteria for

the design of this website. The design specifications as well as the content for the website were formulated in coordination with Department of Information Technology, Ministry of Communications & IT. Phase I of the design and development has been completed, and the website has been uploaded on the NIC server (www.smdp2vlsi.gov.in). The second phase of development is in progress.

ISEA Website

The project envisages a website on Information Security Education and Awareness to provide latest information on various tools and applications available for information security related knowledge, like protection of information against unauthorized disclosure, transfer, modifications or destruction whether accidental or intentional.

This website will act as a one stop shop for all information related to various aspects of security and will bridge the gap between the "as-is" to "to-be" model. This will act as a gateway to promotion of Information Security design and related activities. The specifications and content for the website are to be compiled in coordination with the concerned section in the DIT, MCIT. The website will provide a link-up of the Resource Centres (IITs AND IISc, Bangalore), Participating Institutions (NITs, Govt. Engineering Colleges, IIITs) and other implementing agencies like NIC, STQC, CERT-IN, DOEACC, ERNET India and C-DAC.

The design and development of the website is completed. Web security audit is in progress.

Expansion Initiatives

Realizing the need for more skilled manpower in advanced areas of IT, the Department of Information Technology (DIT) has initiated the project entitled "Expansion of the state-of-art facility for advanced Information Technology Training Programmes for the increase of 40% of admission. In order to generate skilled manpower in diversified area of ICT, C-DAC has planned to launch diploma courses in Geo-Informatics, Language Computing, Network and Cyber Security, Animation and Gaming.

As a part of reaching out to a larger section of audience, C-DAC recently planned a national initiative called Tech Sangam. As part of this programme, C-DAC will tie up with the various engineering colleges in the country and thereafter provide faculty orientation/ training programmes, periodic seminars on latest technology trends in the IT field, consultancy services for setting up/upgrading the institution's IT infrastructure, etc. to these institutions.

C-DAC is now in the process of doubling its training capacity from the August 2008 batches. Classroom arrangements and other infrastructure requirements are being planned accordingly.

Resources, Facilitation Services and Technical Events

Human Resource Development (HRD)

C-DAC has its presence across India with approximately 2500 employees working at various centres on regular, contract and project basis.

During the year, C-DAC continued to strive hard to establish and maintain its image of being an employee centric organization. The primary focus of the HRD team was to respond to the demands of the institution in attracting and retaining the finest talent needed for attaining the institutional goals. Another equally important charter for the HRD was to maintain a member friendly, transparent, conducive and professional work climate to facilitate the efforts of its members.

With the fast changing economic and market conditions, there was increasing pressure on C-DAC to perform which required C-DAC to have talent that could evolve, champion, steer and support the strategic initiatives of the organisation. To attract and retain the best talent anywhere in the country, one of the key processes focused by the HRD team at C-DAC was that of 'employer branding'. Employer branding has been receiving a lot of attention in the recent time, as a form of managing corporate identity by creating a favourable image of the organisation as a 'desirable employer', both internally as well as externally. The intangible aspect of employer branding enabled C-DAC as an organisation to create competitive advantage.

Under the initiative of HRD team of C-DAC, a software has been created at C-DAC automating the routine processes to start with, and gradually expanding the scope to cover every critical area and aspects. This will help employees to work at their best potential, fully aligning to institutional goals and targets.

C-DAC ensured that all new appointees during the year were given induction training at the first instance to enable them to integrate seamlessly into the organisation. The new joiners are briefed on C-DAC's value systems and the importance of inculcating these values.

Following are the other activities undertaken by C-DAC during the financial year across all the centres for manpower resource enrichment:

- Recruitment across various technical and non-technical posts by way of Direct Recruitment / Transfer absorption / Deputation / Campus Interviews was carried out across all centres.
- Regular Performance Appraisals, Probation Clearance, Contract Review (Contract Extension, Termination, and Increment etc.) were taken up during the financial year.
- Various external and in-house trainings, including induction, symposia, technical and management trainings, were conducted across all the centres.
- Around 30 employees were nominated for attending seminars / conferences abroad.
- Employee Engagement Survey to assess the level of involvement of its members in the activities of C-DAC. The results of this survey revealed that a significant section of its members intended to continue working with C-DAC.

- Corporate HRD team has set up workgroups to prepare a blueprint for a new Performance Management System.
- Several employees were felicitated by C-DAC for completing 10 years / 15 year / 20 years/ 25 years of continuous service with C-DAC.

Legal and Contracts and IPR Activities

The legal department of C-DAC is executing an **IPR Watch Project,** which provides e-Prompt to concerned Indian parties the watch reports on National and International IT-Patents.

Besides drafting/vetting contract deeds, MoUs and agreements the IPR cell organized IPR awareness programmes in C-DAC, which results into filing of patent/copyright/trademark applications. Invited lectures on IPR, cyber law, etc. were delivered at Academic Staff College, University of Kerala, ASC-Pune and select law colleges in Pune. In association with Technology Law Forum under the aegis of NASSCOM, four lectures on technology law were organized at Pune. A day long workshop on 'Patent Search' was conducted at C-DAC, Pune on October 29, 2007.

Knowledge Management Cell in consultation with technical groups facilitated filing of applications for 38 Copyright, 4 Trademarks and 2 Patents.

RTI Act 2005

During the year, 54 applications in all were received under RTI Act, 2005 and were disposed off as per provisions of the act.

Library and Information Centre Facilities

C-DAC has well-equipped and automated libraries in all its centres. These libraries cater to the needs of members and students of different courses. These render reference, referral and reprographic services.

C-DAC libraries are active members of MCIT Library Consortium. Under this consortium, IEEE Digital Library containing complete IEEE and IEE literature has been subscribed for organization wide access. User Awareness and Orientation Programs were held for the benefit of members at various locations.

Library at C-DAC, Pune offers Current Awareness Services especially on Grid Computing, Supercomputing, Telemedicine and E-Governance. It helped local libraries installing E-Granthalaya, the management software developed by NIC and promoted by MCIT Library Consortium.

Library at C-DAC, Mumbai has a collection of print and electronic resources. It also subscribes to ACM Digital library. It is enhancing its collection in the field of Online and distance learning and Open Source Software besides other computing subjects.

Library at C-DAC, Thiruvananthapuram is automated using library management software WEBLIBMAN developed by the same centre.

Awards

C-DAC bagged the Best Poster Award for 'GARUDA: THE INDIAN NATIONAL GRID PROJECT' in 3rd IEEE International

Conference on 'eScience and Grid Computing' in eScience 2007 held during December 10-13, 2007 at Bangalore, India.

Scientists of C-DAC, Kolkata have won the "Computer Society of India Trophy – Regional 1st Runners-up – East, Regional Competition for Young IT Professionals 2007, during the competition held at Science City, Kolkata on November 24, 2007 for the paper entitled "EBGM Based Face Recognition System - a State-of-the-art Steganalysis Software".

Conferences/Events Organized

2nd Workshop on Developing Applications for GARUDA (DAG'07) June 28-30, 2007 at IIT, Mumbai

3rd Workshop on Developing Applications for GARUDA (DAG'07) October 4-6, 2007 at JNU, New Delhi

3rd GARUDA Partners Meet on March 3-4, 2008 at Bangalore, focusing on experiences of Grid partner's with GARUDA

Workshop on Understanding the Problems faced by System Administrator's and GARUDA users - GARUDA Grid Operation and Administration (GGOA-08), was organized by SENG, C-DAC.

C-DAC co-sponsored the e-Science 2007, 3rd IEEE International Conference on eScience and Grid Computing, held on Dec 10-13, 2007 in Bangalore, India

A four-days technology-training programme on Grid Programming was conducted at C-DAC, Hyderabad in November 2007.

A four-days technology-training programme was conducted in collaboration with University of Hyderabad on Programming on Multi Core Processors (ProMCore 2008) at the Centre for Modeling Simulation and Design (CMSD) during February 05-09, 2008.

"DST-JST Joint Workshop for awareness on funding opportunities under Bilateral Co-operation in the field of ICT", was organized by C-DAC, Noida on July 16, 2007.

"Industrial Liaisoning Workshop on IT Techno-preneurship" was organized by C-DAC, Noida on October 5, 2007

"e-Health and Visualization" - Indo-Swedish Workshop was organized by C-DAC, Noida during December 3-5, 2007.

"e-learn'2007", One Day National Seminar on E-security Education Through E-learning, was organized by C-DAC, Noida on Dec 14, 2007.

"ASCNT-08" **-** Annual Seminar of C-DAC, Noida Technologies – 2008, was organized by C-DAC, Noida during February 28-29, 2008.

C-DAC Library Juhu and C-DAC's Open Source Software Resource Centre (OSSRC) at Kharghar jointly organized and conducted a Two Day Workshop on Open Source Software Tools for Library Professionals: Koha – Integrated Library System and Drupal – Content Management System during November 29-30, 2007.

A three-day meet of BOSS Linux developers from various C-DAC centres was organized in Chennai during February 25-27, 2008.

C-DAC, Chennai organised a BOSS Linux user awareness training for officials of the Indian Navy during November 2007.

State Level Consultation Workshop on "Designing Information Systems for Sustainable Agriculture", in Hyderabad, as part of India Development Gateway (InDG) project was organized by C-DAC, Hyderabad during April 11, 2007

Content Generation Workshop on "Universalization of Education and Child Rights", at Madurai, Tamil Nadu, as part of India Development Gateway (InDG) project was organized by C-DAC, Hyderabad during June 7, 2007

Identification of Information Needs in Agriculture Pertaining to Tamil Nadu at Madurai, Tamil Nadu as part of India Development Gateway (InDG) project was organized by C-DAC, Hyderabad during July 19, 2007

Low-power Design and Test jointly with VLSI Society of India, Bangalore was organized by C-DAC, Hyderabad during July 30-31, 2007

Designing Information Systems on Rural Energy at Madurai, Tamil Nadu as part of India Development Gateway (InDG) project was organized by C-DAC, Hyderabad during August 17, 2007

e-Suraksha – A Practical Approach to Network Security was organized by C-DAC, Hyderabad during August 27-31, 2007

Content Generation for Universalization of Education and Child Rights in Ranchi, Jharkhand as part of India Development Gateway (InDG) project was organized by C-DAC, Hyderabad during Sept 26, 2007

Identification of Information Needs in Agriculture Pertaining to Jharkhand in Ranchi, Jharkhand, as part of India Development Gateway (InDG) project was organized by C-DAC, Hyderabad during Sept 28, 2007

Internet Security Awareness Programme was organized by C-DAC, Hyderabad during Sept 29, 2007

Workshop on e-Learning jointly with UGC Academic Staff College, Jawaharlal Nehru Technological University (JNTU) at JNTU campus was organized by C-DAC, Hyderabad during Oct 26-29, 2007

Workshop on e-Learning was organized by C-DAC, Hyderabad during Nov 21-25, 2007

One-day Training Program on Basic IT Skills to Knowledge Centre Operators, Madurai, Tamil Nadu was organized by C-DAC, Hyderabad during Nov 21, 2007

One-day Training Program on Basic IT Skills to Knowledge Centre Operators, Garwah, Jharkhand was organized by C-DAC, Hyderabad on Nov 28, 2007

Workshop on Designing Information Needs and Developing Region Specific Content in Agriculture was organized by C-DAC, Hyderabad on Dec 11, 2007

One-day Training to the Ashwini Centre Operators on Basic IT Skills, Bhimavaram, Andhra Pradesh as part of the India Development Gateway project was organized by C-DAC, Hyderabad on Dec 13, 2007

IPR Patent Search Workshop was organized by C-DAC, Hyderabad on Jan 08, 2008

Five-days Training Programme on e-Suraksha (A practical approach in Network Security) was organized by C-DAC, Hyderabad during Jan 21-25, 2008

"Information need identification related to Women and Child Health" at Ranchi, Jharkhand was organized by C-DAC, Hyderabad on Jan 29, 2008

One-day Training program on Basic IT Skills to knowledge centre operators. Latehar, Jharkhand was organized by C-DAC, Hyderabad on Jan 30, 2008

A Workshop on "Telemedicine - Today & Tomorrow" was held at C-DAC, Mohali on Sep 29, 2007

"Two-Days Regional Tele-Ophthalmology Workshop" was organized at C-DAC, Mohali on October 12-13, 2007

C-DAC, Mohali organized "Awareness Programme in Telemedicine for Participants From Punjab Health Systems Corporation" on Jan 16, 2008

A seminar 'Hindi Bhasha Computing ke kshetra mein CDAC ka Yogdan – Ek Sangosti' was organized by C-DAC, Pune on September 19, 2007

A one-week workshop-cum-training program on Computational Linguistics was organized by C-DAC, Pune to the students of North Eastern Hill University (NEHU), Shillong during January 2-8, 2008.

NEHU Students

Participation in Technical Events

EU-India Grid Site Administrators Training Programme, June 11-15, 2007, Kolkata, India.

EU-India Grid Workshop on Atmospheric and Earth Science & Material Sciences, September 24-26, 2007, Pune, India.

Workshop on Software Productivity Improvement - Techniques, Tools and Best Practices in VIT, Vellore and presented Metric Advisor - Enabling Developers to build-in Quality.

ELITEX 2008 at Indian Habitat Centre, New Delhi during April 24-25, 2006.

11th National Expo held at Rajdanga, Kolkata during September 7-11, 2007.

One day seminar on "Knowledge Society and Life Long Learning: Role of Librarians" organized by BOSLA on June 16, 2007 at Tata Institute of Social Sciences, Deonar.

Lecture on Using XML Technology for Information Integration by Dr. Max Stempfhuber from Germany on September 10, 2007.

Seminar on New Technologies for Library Marketing, E-book launching by Elsevier Publishers on September 20, 2007.

Seminar organized by BOSLA and IGIDR on "Preserving the past and Co-operative approaches to Digital Long-term Preservation" held on November 2, 2007.

National Workshop on Library Automation through Koha organized by the Library Science Dept. of University of Burdwan during December 3-7, 2007.

11th National E-gov Conference at Panchkula on Feb 7-8, 2008.

Papers Published

High Performance Computing and Grid Computing

Atanur Santosh, K. Sunitha Manjari and Joshi Rajendra, "Comparative Genomics of Mycobacterium using uniform re-annotation protocol", 15th Annual International Conference on Intelligent Systems for Molecular Biology (ISMB) and 6th European Conference on Computational Biology (ECCB), Vienna, Austria, July 21-25, 2007 – (Poster presentation)

Ayre Aditya, Deshpande Aniket, Rustagi Vishal – "Co-simulation: Verification Advantage with PCI Express Endpoint SystemC Model", 11th IEEE VLSI Design And Test Symposium (VDAT2007), August 8-11, 2007, Saha Institute of Nuclear Physics Convention Centre, Kolkata, Progress in VLSI Design & Test, VDAT 2007, VLSI Society of India , p507

Bijoy M B, Arunachalam B, Arackal Simon Vineeth, Chandrachoodan C K, Sridharan R, Prahlad Rao B B and Mohanram N - "Portal for Emerging Grid Computing Systems", IEEE International Conference on eScience 2007, Bangalore, India, December 10-14th, 2007

Bindhumadhava B.S & Banu Priya - "QoS Management for the grid: An agent based approach", The 14th annual IEEE International Conference on High Performance Computing (HiPC 2007), Goa, India, December 18-21, 2007

Dalvi Mohit, Grell George, Peckham Steven and Skamarock Bill - "Development of an Offline Wrf/Chemistry Model", 8th WRF Users' Workshop, National Center for Atmospheric Research, Colorado, USA, June 11-15, 2007

Dalvi Mohit, Rakesh Kumar, Ojha Ajay - "Air Modeling Scenario Analysis for Pune City", International Workshop on Air Dispersion Modeling and Emission Inventory Development for Urban Air Management, Mumbai, December 4-6, 2007 -

Debgupta Soumen, Singhal Rekha – "Design and Implementation of an Efficient iSCSI Target" National Conference on Advancement in Information and Communication Technologies (NCAICT), organized by CSI, Allahabad chapter, Hotel Kanha Shyam, Allahabad, March 15-16, 2008

Gupta Neelima, Garg Reena, Shah Kirti Kr., Tanwar Akhilesh and Pal Sourav, "Deprotonation of 1,2-dialkylpyridinium ions: A DFT study of reactivity and site-selectivity", Journal of Physical Chemistry A, 111 (36), 2007, p.8823 -8828

Janakiraman S. & Nanjundiah, Ravi. S. "Variable resolution global spectral method on the sphere with finer resolution over tropics", Workshop on the Solution of Partial Differential Equations on the Sphere, U.K. Meteorological Office, Exeter, U.K, September 24 – 27, 2007

Janakiraman S, Nanjundiah Ravi S, Murthy A S Vasudeva – "A variable resolution global spectral method on the sphere with finer resolution over tropics", Solution of Partial Differential Equation on the Sphere, 2007 Workshop, UK Meteorological Office, Exeter, UK, 24-27th September 2007 (Presentation)

Joshi Rajendra - "Genome Grid: A framework for Bioinformatics Applications on a Computational Grid", International Supercomputing Conference (ISC'2007) Dresden, Germany, June 26-29, 2007

Joshi Rajendra - "MycompDB: A comparative genomic resource of Mycobacterium", The 48th Annual Conference of Association of Microbiologists of India, IIT Chennai, December 18 – 21, 2007. (invited talk)

Kant Krishna, Dey Alpana, Ramakrishnan S., Purohit.S.C, Joshi Rajendra and Sonavane Uddhavesh - "Development and Utilization of Bioinformatics Resources and Application Facility" The 5th International Symposium on Rice Functional Genomics, International Congress Center, Tsukuba, Japan, October 15-17, 2007. – (Poster presentation)

Kesarkar Amit P. and Kaginalkar Akshara - "Computational environment for Real Time Mesoscale Weather Predictions", Proceedings of National Symposium on Emerging Trend in Meteorology and Oceanography, METOC-2007, Cochin, May 21-22, 2007.

Kesarkar Amit P. and Kaginalkar Akshara – "Simulation of Planetary Boundary Layer over the Western Ghats of India using the WRF model", Proceedings of National Symposium on Emerging Trend in Meteorology and Oceanography, METOC-2007, Cochin, May 21-22, 2007

Kesarkar Amit, Tyagi Ajit and Kaginalkar Akshara - "Mesoscale Weather Forecasting for Deep Convection over Indian Subcontinent", National Seminar on Emerging Trends in Space and Aviation Meteorology, New Delhi, February 18 – 19 , 2008

Kesarkar Amit, Kaginalkar Akshara, Samala Basanta Kumar, Shelke V. C., Panse R.V. - "Verification of Experimental Quantitative Precipitation Forecast over Koyna Dam Catchment using WRF", World Group of Numerical Experiments Blue Book 2008 Series, WMO TD, 5, 2008.

Kesarkar Amit, Dalvi Mohit, Thomas Ancy and Kaginalkar Akshara - "Simulation of Diurnal Variation of Planetary Boundary Layer Parameters over Western Ghats of India", World Group of Numerical Experiments Blue Book 2008 Series, WMO, Section 5, 2008

Mangala N and Prahlada Rao B.B. - "Tutorial-Applications Enablement on Grid", IEEE International Conference on eScience 2007, Bangalore, India, December 10-14th, 2007

Nanavati Sachin P., Vijayaraghavan Sundararajan, Mahamuni Shailaja and Ghaisas Subhash - "Ab initio Optical Properties of ZnSe Clusters", Material Research Society (MRS) 2007 Fall Meeting, Boston, U.S.A., 26-30 November 2007 (Poster presentation)

Nandrishi Shubhada, Singhal Rekha – "FACT for Improving iSCSI Performance", National Conference on Advancement in Information and Communication Technologies (NCAICT), organized by CSI, Allahabad chapter, Hotel Kanha Shyam, Allahabad, March 15-16, 2008

Prabu D, Vanamala , Deka V, Sanjeeb Kumar, Sridharan R, Prahlada Rao BB, Mohanram N - "Design and Implementation of High Performance MPI for Large Scale Cluster Computing System", In Proceedings of IEEE 4th The International Conference on Information Technology- New Generations (ITNG 2007), Las Vegas, USA, April 2 - 4, 2007, pp. 929-930

Prahlada Rao B. B., Mohanram and Mangala - "Experiences of GARUDA - The Indian National Grid Computing Initiative", IEEE International Conference on eScience 2007, Bangalore, India, December 10-14th, 2007

Purohit S. C, Challa Sreedhar, Kodumoori Ashok and Vikas Kumar - "Recent Advances in HPC for Computational Fluid Dynamics", Indo-Australian CFD Workshop, IIT Roorkee, April 12 – 14, 2007.

Purohit. S. C - "Numerical Modeling for Air Pollutant Dispersion", National Workshop on Modeling on Fluids- Macro to Nano Scale, IIT, Kharagpur, September 20-21, 2007

Purohit. S.C - "Fluid Flow Simulation using PARAM systems", Seventh Asian CFD Conference (ACFD7), NAL, Bangalore, November 26 – 30, 2007.

Purohit. S.C - "Challenges in Application Software Development on High Performance Computing Systems", 42nd National Convention of Computer Society of India, Bangalore, November 29, 2007.

Purohit S.C - "High Performance Computing and Scientific Applications", 34th National Conference on Fluid Mechanics and Fluid Power, BIT, Ranchi, December 10-12, 2007

Purohit S. C, Kesarkar Amit and Kaginalkar Akshara – "A Panorama of Scientific Data Management in Weather and Climate Modeling", Jalvigyan Sameeksha (Hydrology Review), 22, 59-78, 2007

Ranalkar Manish, Kesarkar Amit, Rudra Pratap, R.D. Vashistha - "Study of lightning activity over Indian subcontinent", Proceedings of International Roundtable on Lightning Physics, Colombo, Sri Lanka, 22-25 May, 2007

Rajaraman Krithika - "GenomeGrid: A Bioinformatics Grid Computing Portal", DAG'07 Workshop on Developing Application on Garuda, IIT Bombay, June 28 – 30, 2007 (invited talk)

Rajagopal Sudha, Sridevi.S, Rajagopalan M.R., Selvi S.Thamarai – "Distributed Discovery of Semantic Grid Service using Semantic Clustering of Service Ontologies", IEEE TENCON 2007, IEEE Computer Society, Taipei, Taiwan, 30th Oct 2007 to 2nd Nov 07

Rastogi Richa, Srivastava Abhishek, Ray Amit – "An Algorithm: Seismic Travel Time Tomographic Inversion using Real Coded and Binary Coded Genetic Algorithm", 7th Conference and Exposition on Petroleum Geophysics, Society of Petroleum Geophysicists, Hyderabad, 14-16 January 2008 - Oral Presentation

Rastogi Richa, Srivastava Abhishek, Shirodkar Kalpita, Das S.K., Chako Ajith - "Seismic Full Waveform Inversion and Modeling", 7th Conference and Exposition on Petroleum Geophysics, Society of Petroleum Geophysicists, Hyderabad, 14-16 January 2008 - (Poster Presentation)

Saluja Payal, Sridharan R, Vanamala V, Prahalada Rao B and Mohan Ram - "Deriving Trust value for GARUDA Data Grid", IEEE International Conference on eScience 2007, Bangalore, India, December 10-14th, 2007

Shah M.S. and Chaudhari R. D. – "Impact Analysis of FRP Composites Using Parallel Computing", published as chapter 'FINITE ELEMENTS', WSEAS Press, June 2007, pp78-85 (Book chapter)

Shah, M.S. and Gavali, P. G. – "Performance Evaluation of Structural Engineering Opensees Software on HPC and Grid Computing Systems", Proc. of International Workshop on Earthquake Hazards and Mitigations (RJAM07), December 7–8, 2007, IIT Guwahati

Singhal Rekha, Singh Ranjana – "On Use of Operation Semantics in Parallel iSCSI Protocol", International Online Conference - CISSE, Dec, 2007, and at WSEAS-SEPADS Conference, University of Cambridge, UK Feb 20-22, 2008

Sonavane Uddhavesh, Sharma Smriti and Joshi Rajendra - "Molecular Modeling Studies of Peptide Nucleic Acids", Albany 2007 15th Conversation, Albany, USA, June 19 - 23, 2007. – (Poster presentation)

Sonavane Uddhavesh - "Introduction to RNA structure and function", Workshop on Knowledge Discovery In Life Sciences: Modeling of Small Molecules to Macromolecules, Bioinformatics Center, University of Pune, December 11 – 17, 2007. (invited talk)

Sreedhar C, Ashok K and Purohit S.C – "Analysis of Three dimensional flow structure around surface mounted obstacle", Seventh Asian CFD Conference (ACFD7), NAL, Bangalore, November 26-30, 2007.

Sreedhar C, Kalamkar V. R., Shevare G. R. and Roy, B. - "Three dimensional flow predictions in multiple passages of transonic compressor rotor", Seventh Asian CFD Conference (ACFD7), NAL, Bangalore, November 26-30, 2007

Sukeshini, Kalaiselvan K, Vallinayagam P, VijayaNagamani MS, Mangala N, Prahlada Rao BB and Mohan Ram - "Integrated Development Environment for GARUDA Grid (G-IDE)", In Proceedings of IEEE International Conference on eScience 2007, Bangalore, India, December 10-14th, 2007, pp 499-506

Venkata Ratnam J., Sikka D.R. and Banerjee Sudipta - "Simulation of Monsoon 2006 using T170L42 AGCM: Sensitivity to convective parameterization schemes", Int. J. Climatology, pp 34, 2007

Vijay Bhaskar B., Jeba Rajasekhar R. V., Muthusubramanian P., Kesarkar Amit P., "Measurement and Modeling of Respirable particulate (PM10) and lead pollution over Madurai, India", Air Quality, Atmosphere and Health, Springer Publication. IO.1007/S 11869-008-004-0, Jan.30, 2008

Multilingual and Heritage Computing

Abrol Preeti, Manchanda Chetan, Sidhu Pushapjit Singh – "Real Time 3d Virtual Environment for the Digital Tour of Historical Monuments, A Case Study on the Rock Garden, Chandigarh", 2nd National Conference on Information & Emerging Technologies, 7th - 8th Sept., 2007, Publisher- IET Bhaddal

Das Mandal Shyamal Kr, Datta A. K – "Epoch Synchronous Non-Over Lapping Add (ESNOLA) Method Based Concatenative Synthesis System for Bangla", 6th ISCA Speech synthesis workshop, University of Bonn, Germany, 22nd – 24th August, 2007, pp. 351-355

Das Mandal Shyamal Kr, Gupta B.K., & Datta A. K – "Word Boundary detection based on suprasegmental features: A case study on Bangla speech", International Journal of Speech Technology, Vol.9, 19th September 2007, pp. 17-28

Das Mandal, Gupta S. K., Datta, A. K., (2007), "Word Boundary detection based on suprasegmental features: A case study on Bangla

speech," <u>International Journal of Speech Technology</u>, Vol.9, pp. 17-28

Doctor Raiomond – "Font development from view of Unicode", <u>National workshop on Calligraphy and Typography</u>, April 19th-April 20th 2007, Hotel Pride, Shivaji Nagar PUNE (Presentation)

Khanore Prakash – "Aesthetic of Fonts", <u>National workshop on Calligraphy and Typography</u>, April 19th-April 20th 2007, Hotel Pride, Shivaji Nagar PUNE (Presentation)

Kulkarni M.D. – "Overview on Calligraphy and Typography", <u>National workshop on Calligraphy and Typography</u>, April 19th-April 20th 2007, Hotel Pride, Shivaji Nagar PUNE (Presentation)

Manoj G. – "Tibetan Font Design", <u>Typography day 2008,</u> March 29th-April 29th 2008, IDC Mumbai (Presentation)

Nankar Ravi – "Typographic shapes and Calligraphic strokes in Grantha", <u>National workshop on Calligraphy and Typography</u>, April 19th-April 20th 2007, Hotel Pride, Shivaji Nagar PUNE (Presentation)

Naveen Kumar, Sasikumar M. - "Automatic Generation of Speech Interface for GUI Tools/Applications using Accessibility Framework", <u>Techshare India</u>, February 4-5, 2008, New Delhi, India

Patole Vishwas – "Indian language Bitmap Fonts for printer and Display media", <u>National workshop on Calligraphy and Typography</u>, April 19th-April 20th 2007, Hotel Pride, Shivaji Nagar PUNE (Presentation)

Ramanathan Ananthakrishnan, Bhattacharyya Pushpak, Hegde Jayprasad, Shah Ritesh M., Sasikumar M. – "Simple Syntactic and Morphological Processing Can Help English-Hindi Statistical Machine Translation", <u>International Joint Conference on Natural Language Processing (IJCNLP-08)</u>, January 7-12, 2008, Hyderabad, India

Razzaq Abdual – "Urdu Nastaliq Calligraphy on Computer platform", <u>National workshop on Calligraphy and Typography</u>, April 19th-April 20th 2007, Hotel Pride, Shivaji Nagar PUNE (Presentation)

Roy Chandrima, Basu Tulika, Saha Arup, Das Shyamal Kr Mandal & Datta A. K – "Studies on Duration of Steady states and transitions in V-V Combination in Bangla Words", <u>International Symposium Frontiers of Research on Speech and Music</u> <u>FRSM-2008</u>, Jadavpur University, 25th – 26th February, 2008, pp. 157 – 160

Roy Rajib, Basu Tulika, Basu Joyanta, Saha Arup – "Study of Nucleus Vowel Duration and its Role in Prosody of Bangla", <u>Oriental COCOSDA-2007</u>, Hanoi, Vietnam, 4th – 6th December, 2007, pp. 181 – 184

Saha Arup, Das Mandal Shyamal Kr., Datta A. K – "Semi-Automatic Speech annotation System", <u>Oriental COCOSDA-2007</u>, Hanoi, Vietnam, 4th – 6th December, 2007, pp. 13-16

Satpute Pravin – "Open type Font processing in various platform", <u>National workshop on Calligraphy and Typography</u>, April 19th-April 20th 2007, Hotel Pride, Shivaji Nagar PUNE (Presentation)

Software Technologies (Including Open Source Software)

Balaji R., Ravikumar B – "Community Computing for Development", <u>First International Conference on ICT Solutions for Socio-Economic Development (ISED – 2007)</u>, Bangalore, India, February 11-13, 2007

Bhattacharya Nabarun, Tudu Bipan, Jana Arun, Ghosh Devdulal, Bandhopadhyaya Rajib, Bhuyan Manabendra – "Preemptive Identification of Optimum Fermentation Time of Black Tea Using Electronic Nose", <u>Sensors and Actuators B</u>, ELSEVIER, Vol No. 131, December,2007, P. 110-116

Bhattacharya Nabarun, Tudu Bipan, Jana Arun, Ghosh Devdulal, Bandhopadhyaya Rajib, Saha Amiya Baran – "Illumination Heating and Physical Raking for Increasing Sensitivity of Electronic Nose Measurements with Black Tea", <u>Sensors and Actuators B</u>, ELSEVIER, Vol No. 131, December, 2007, P. 37-42

Bhattacharya Nabarun, Tudu Bipan, Bandhopadhyaya Rajib, Ghosh Devdulal, Jana Arun - Title of the Book: <u>Applied Bioinformatics Statistics and Economics in Fisheries Research</u> Title of the chapter**:** Non-Invasive Methods Of Fish Freshness Determination By

Electronic Olfaction, New India Publishing Agency, February, 2008, P. 233-245

Dutta Upasana, Singh Yogesh – "Micro Level Planing using Spatial Database", <u>Current Science</u>, Banglore, Oct 2007, Vol. 93, No. 7

Gowri Ganesh N.S., Viji Gopal – "A Semantic Approach for the enhancement of Ranking of Web Services", <u>National Conference on Intelligent Computing Models,</u> Department of Compter Science, Periyar University, 22-23, February, 2008, Narosa Publication, Book yet to publish

Gowri Ganesh N.S., Viji Gopal – "OSIAN : Ontology based Service Index Annotator", <u>International Multiconference of Engineers and Computer Scientists (IMECS 2008)</u>, NewsWood Limited, International Association of Engineers, Regal Kowloon Hotel, Kowloon, Hongkong, 19-21, March 2008, Vol II (ISBN 978-988-17012-1-3), pp.,766-770

Johnson, C.P., Deshmukh, B., Kale, M. - "Role of GIS and Remote Sensing in the Sustainable Development of Mauritius", <u>International Conference on Global Spatial Data Infrastructure (GSDI)</u>, 25-29 February 2008, Trinidad

Kaushal Ashok, Singh Yogesh – "Managing hazards in snow covered Himalayas", <u>Journal of Geomatics</u>, Ahmedabad, Oct 2007. Vol.1, No.1

Kulkarni Bhakti S., Tanwar Akhilesh and Pal Sourav - "Reactivity descriptors for ligand chemistry: A case study of 2,2'-bipyridine and its analogues", <u>Journal of Chemical Sciences</u>.,119 (5), 2007, p.489-499,

Ragha Leena R, Sasikumar M. – "Fusion of Geometric, Positional and Moments Features for Handwritten Character Recognition Using Neural Networks", <u>National Conference on Computer Vision, AI & Robotics (NCCVAIR 07)</u>, October 3-5, 2007

Sajeevan G – "Latitude and longitude – A misunderstanding", <u>Current Science</u>, Bangalore, Vol. 94, No. 5, March 2008, Page.568-569

Sajeevan G – "GIS – Intrinsic Programming or Object-oriented Methods", <u>GIM International,</u> The Netherlands, vol.22, issue 1, year 2008, page 21-23

Singh Yogesh, Srivastava S. K., Dutta Upasana – "Global Positioning System & Its Applications", <u>GIS Window</u>, Pune, May 2007

Subramanian N., Balaji R., Neelanarayanan V. – "Project Management Approaches for Developing Public Community Software Solutions", <u>Project Management Leadership International Conference</u>, New Delhi, Feb 13-14, 2007

Tudu Bipan, Bhattacharya Nabarun, Jana Arun [3], Ghosh Devdulal, Das Barun, Bandhopadhyaya Rajib – "Evaluation of Quality of Freshwater Fish using Electronic Nose with Time-Delay Neural Network", <u>International Sysmposium on Electronic Nose (ISOEN)</u>, Petersburg, Russia, 3-5 May 2007

Unnikrishnan A.K, Aby Joseph, Joshy Subhash .T.G. – "Three-level converter based active filter for harmonic compensation of 4MW induction furnace", <u>Power Electronics and Applications</u>, 2007 European Conference, 2-5 Sept. 2007, p. 1-7

Vora Urjaswala – "Architectural Design Methodologies for Complex Evolving Systems", <u>Twelfth IEEE International Conference on Engineering of Complex Computer Systems (ICECCS 2007),</u> Auckland, New Zealand, July 11-14, 2007

Vora Urjaswala – "Modularization with Externalization of Control Flow", <u>1st Workshop on Assessment of Contemporary Modularization Techniques (ACoM 07), International Conference on Software Engineering (ICSE'07)</u>, Minneapolis, Minnesota, USA, May 19-27, 2007 -

Vora Urjaswala – "Aspects in Architectural Description of Evolving Systems", <u>First Workshop on Aspects in Architectural Description, Sixth International Conference on Aspect-Oriented Software Development</u>, Vancouver, British Columbia, March 12-16, 2007

Professional Electronics (Including VLSI and Embedded Systems)

George Gopan, Gopal Sanju, Oommen Biju C., Ravindrakumar R. – "Design, Simulation and Testing of Switched-Capacitor Sigma Delta ADC", <u>IP-07, Design and Reuse</u>, Grenoble, France 6th December 2007, p. 403 to 407

Kalluri Rajesh, Mahendra Lagineni & Bindhumadhava B.S - **"**Next Generation SCADA:Software Agent based Intelligent Real time Multiprotocol Gateway**"** <u>International Conference on Power Systems (ICPS – 2007)</u>, Central Power Research Institute, Bangalore,

December 12-14, 2007

Rajesh K.R., Nair Reghunathan G, Mohanachandran R – "MEMS based Seismic signal for Early Warning of Earthquake", International symposium on Ocean Electronics- (SYMPOL 2007) Cochin University of Science and Technology, Cochin, 11-14, Dec.2007

Saurav Sumit Kumar, Jamthe Swapnil, R.K Senthil Kumar & Bindhumadhava B.S - "Power Sector SCADA:Person-Centric Graphical User Interface", International Conference on Power Systems (ICPS – 2007), Central Power Research Institute, Bangalore, December 12-14, 2007

Singh Pritam Pal, Nagpal Ritu, Pal Rishi, Nagamani Vijaya, PrahladaRao B.B. - "MemHunt: Dynamic Memory Leak Analyzer and Garbage Collector", National Conference on Emerging Trend and Applications in computer engineering (NCETA- 2007), Ajmir, India, April 13th - 2007, pp 802-806

Vetri Selvi M, Lakaparampil Z V, Sreekumari B - "Digital Signal Processor Based Control Scheme for Utility Interconnected Photo-Voltaic Inverter for Power Generation", National Conference on Electrical Engineering and Embedded Systems (NCEEE'08), March 20th and 21st 2008, Department of Electrical and Electronics Engg. Anna University, Chennai-25, Proceedings of NCEEE'08, p. 146 to 151

Cyber Security and Cyber Forensics

Khedo K, Usmani K.A – "Secure Routing Protocols for Mobile Ad-Hoc Networks: Open Research Challenges", Proceedings of the International Conference on Advances in Information and Communication Technologies (ICICOT07), 28-30th December, 2007, Manipal, India

Parial Jayanta, Chanda Anupam – "Open source intrusion prevention system", 22nd Natinal convention of computer Engineers. Organised by The computer Engineering Division, The Institution of Engineers(India). Theme: "Information Security - The challenges Ahead", 29th Feb - 1st March 2008, The computer Engineering Division, The Institution of Engineers(India), Page no. 58-60

Parial Jayanta, Chanda Anupam – "Implementation of secure user management in a distributed network usng ldap", National Level Symposium on Security and Soft Computing NSSC 2007, SVNIT, SURAT, March 29-31,2007, Page No. 53-56

Patil Rajendra B., Soni Santosh Kumar, Kamatchi R. – "Data Integration of Government Organization for Security, Manintenance and Accessibility", National Seminar on Current Trends in Information Technology (NSCTIT 2008), Feb 9-11, 2008, Sangamner, Ahmednagar, India

Patil Rajendra B., Bhole K. G., Soni Santosh Kumar – "Next Generation Trends in Distributed Computing", National Seminar on Current Trends in Information Technology (NSCTIT 2008), Feb 9-11, 2008, Sangamner, Ahmednagar, India

Ramana Murthy M. V. – "Performance Limitations of Mobilie IP over WLAN", National Conference on Information Security and Mobile Computing (NCISMC – 08), February 3-4, 2008

Vinukumar A R, Jose Tessin K – "Fast Hardware Implementation of the MD5 Hash Algorithm", National Seminar On Information, Communication & Intelligent Systems, The Institute of Electronics and Telecommunication Engineers, Cochin, 8th and 9th of February 2008, p. 32 to 40

Health Informatics

Nandakumar K, Sudhamony S, Binu P J, Issac Niwas S, Sudalaimani C – "Telemedicine for Oncology", National Conference on Advancements in Information & Communication Technology (NCAICT-2008), Allahabad March 15-16 2008, Computer Society of India, National

Sudhamony S, Nandakumar K, Binu P J, Issac Niwas S – "Telemedicine and Tele-Health services for Cancer-Care Delivery in India", IET Communications, Herts, United Kingdom, February 2008, Institution of Engineering and Technology, Vol 2, No 2 February 2008, PP.231-236

Ubiquitous Computing

Joy Vimal, Vimal Laxman P – "Smart Spaces: Indoor Wireless Location Management System", <u>IEEE Next Generation Mobile Applications, Services and Technologies (NGMAST 2007),</u> IEEE Computer Society, Cardiff, Wales, UK, 11-14 Sept 2007, pages from 261-266

Joy Vimal, Sridevi S, Vimal Laxman P – "Location Based Services–Enterprise Mobility", <u>IEEE Wireless Communications and Networking Conference (WCNC 2008),</u> IEEE Computer Society, Las Vegas, NV, USA, 31 March- 3 April, 2008, pages from 3087 – 3092

Koshy Santosh Sam, Reddy P. Sowjanya, Nagaraju Y., Babu N. Sarat Chandra, Kathiresan C., Patil Mahesh U. – "Precision Farming through Wireless Sensor Networks", <u>Agrometeorology and Food Security,</u> Organized by Association of Agrometeorlogies, Anand (Gujarat) and CRIDA, Hyderabad<u>,</u> February 18-21, 2008, Page No. 89 of the proceeding

Rajagopal Sudha, Rajagopalan M.R., Sridevi.S, Selvi S.Thamarai – "An Efficient context Aware Coordination Model for Ubiquitous Computing", <u>The First International Workshop on Mobile and Ubiquitous Context Aware Systems and Applications MUBICA 2007),</u> IEEE Computer Society, Philadelphia, PA, USA, 6th Aug 2007

Education and Training

Rane Archana – "Plagiarism in Online Assessment", Seminar on <u>"Demystifying E-Learning"</u> for teachers, January 5-6, 2008 at C-DAC Navi Mumbai

Sasikumar M. – "E-learning: Opportunities and Challenges", Seminar on "<u>Demystifying E-Learning</u>" for teachers, January 5-6, 2008 at C-DAC Navi Mumbai

Sasikumar M. – "Accessibility: Making IT Accessible", <u>National conference on computers and information technology and automation,</u> Parshavanath Engg College, Thane, January 17, 2008

Sinha Ravi K., Rao L. Prakasa, Venkataswamy G., Bapat Suyog N. – "School Management – An Integrated Approach", <u>DigitalLearning Magazine</u>, August 2007, http://www.digitallearning.in/articles/current-article.asp?fm=8&yy=2007, <u>e-India 2007</u>, July 31- Aug 3, 2007, New Delhi, India

Thiru A Raja, Hon'ble Minister for Communications and IT, Government of India addresses the members of C-DAC and Anna University, during the foundation stone laying ceremony of C-DAC Innovation Centre, Chennai

Dr. Shakeel Ahmad, Hon'ble Minister of State for Communications and IT, Government of India and Shri Jainder Singh, IAS, Secretary, DIT, Govt. of India at the C-DAC stall during ELITEX 2008 at New Delhi

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