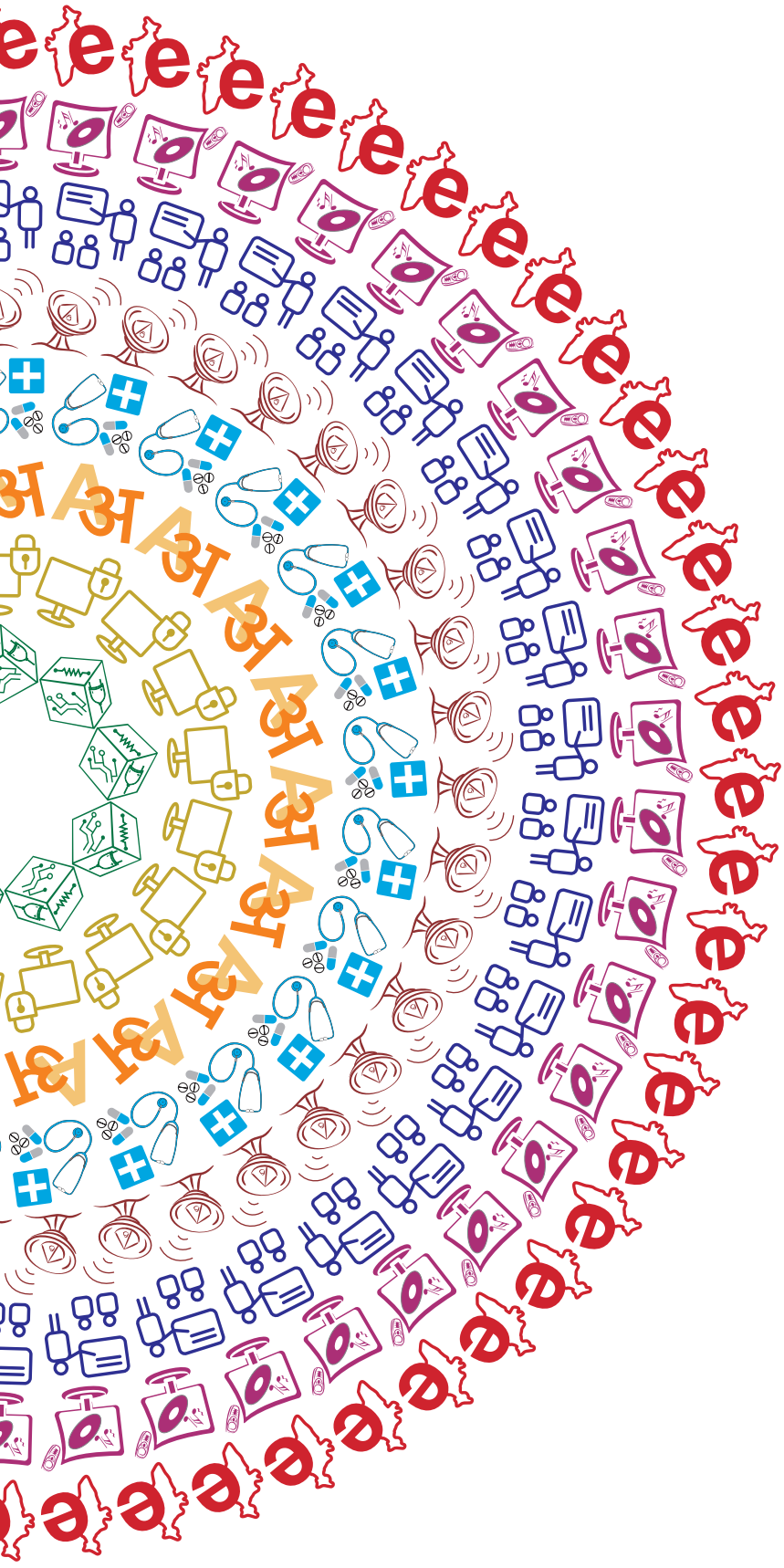

Annual Report
2009 - 2010

CENTRE FOR DEVELOPMENT OF ADVANCED COMPUTING

Governing Council

(As on 31 March 2010)

Shri. A. Raja
Chairman, Governing Council, C-DAC and
Hon'ble Minister of Communications
& Information Technology

Shri. R. Chandrashekhar
Vice Chairman, Governing Council, C-DAC and
Secretary, Department of Information Technology
Ministry of Communications and Information Technology

Dr. T. Ramasami
Member, Governing Council, C-DAC and
Secretary, Department of Science & Technology
Ministry of Science & Technology

Prof. Samir K. Bramhachari
Member, Governing Council, C-DAC and
Secretary, Department of Science
and Industrial Research
Ministry of Science & Technology

Shri. S.R. Rao
Member, Governing Council, C-DAC and
Additional Secretary,
Department of Information Technology
Ministry of Communications and Information Technology

Shri. R. Bhattacharya
Member, Governing Council, C-DAC and
Additional Secretary & Financial Advisor
Department of Information Technology
Ministry of Communications and Information Technology

Shri. N. Ravi Shanker
Member, Governing Council, C-DAC and
Joint Secretary, Department of Information Technology
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Shri. V.B. Taneja
Member, Governing Council, C-DAC and
Group Coordinator (R&D in IT),
Department of Information Technology
Ministry of Communications and Information Technology

Shri. F. C. Kohli
Member, Governing Council, C-DAC and
Ex Dy. Chairman, Tata Consultancy Services and
Member Executive Committee, TCS,

Prof. N. Balakrishnan
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Department of Electrical Engineering,
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Member, Governing Council, C-DAC and
Professor & Director, Anna University, Chennai

*** Dr. R. Sreehari Rao**
Member, Governing Council, C-DAC and
Scientist of DRDO

Dr. Ajay Bhushan Pande
Member, Governing Council, C-DAC and
Secretary, Information Technology
Govt. of Maharashtra

*** Shri. Ashok Kumar C. Manoli**
Member, Governing Council, C-DAC and
Principle Secretary,
Information Technology,
Govt. of Karnataka

Shri. Rajan T. Joseph
Member, Governing Council, C-DAC and
Director General, C-DAC

Dr. U. R. Poharkar
Secretary, Governing Council, C-DAC and
Registrar, C-DAC

Shri. Jainder Singh, Vice Chairman, GC & Secretary, DIT upto 31/5/2009
Shri. R. Chandrashekhar, Member, GC & Special Secretary, DIT upto 31/5/2009
Dr. A. K. Chakravarti, Member, GC & Advisor & Group Coordinator (R&D in IT), DIT upto 31/7/2009
Shri. R. C. Misra, Member, GC & Special Secretary & Financial Advisor, DIT, upto 8/12/2009
Shri. Saurabh Chandra, Member, GC & Additional Secretary & Financial Advisor, DIT, upto 26/01/2010
Shri. S. Ramakrishnan, Member, GC & Director General, C-DAC upto 31/5/2009

* Members of Governing Council, C-DAC w.e.f. 19/02/2010

Contents

Overview

Prelude:

As one more year slips into history, C-DAC is proud of the accomplishments of the past and is charged with vibrant aspirations into the future. Over the years of dedicated efforts, C-DAC has become a recognized destination for multi-disciplinary, core Research and Development (R&D), conceptualizing and implementing the design, development and deployment of state-of-the-art products and technologies in Electronics and Information Technology. C-DAC has demonstrated superior competencies in many areas including High Performance Computing, Language Technologies, Cyber Security and Professional Electronics. A three thousand strong technical workforce spread across the nation in fourteen Laboratories and the Corporate Office focuses on consolidating the R&D initiatives of the centres, building a national visibility and branding for the organization.

C-DAC pursues Research and Development in several scientific domains encompassing Electronics and Information Technology. In all these development efforts, C-DAC has created innovative technologies for imaginative applications. There has been enhanced emphasis on the major areas and activities listed below:

- High Performance Computing
  - Hardware, High Speed Network, Software, Systems Software
  - Applications in CFD, Atmospheric Science, Bioinformatics, etc
  - Infrastructure and Facilities

- Grid Computing and Cloud Computing
  - Hardware, Middleware, Applications, Infrastructure
  - International Grid Certification Authority (IGCA)

- Multilingual Technologies
  - Tools, Fonts, Products, Solutions, Applications Integration
  - Applied Artificial Intellience (AAI), Speech Processing
  - Optical Character Recognition (OCR)/ Optical Handwritten Character Recognition (OHR)
  - Heritage Computing

- Real Time Systems and Professional Electronics
  - Digital Broadband, Communications, Network Technologies
  - Power Electronics, Automotive Instrumentation
  - Embedded Systems, VLSI/ ASIC Design
  - Automation Systems
  - Electronics for Strategic Applications

- Software Technologies
  - Software and tools development for e-governance, geomatics, etc.
  - Open Source Software : Operating Systems, Tools and Technologies

- Cyber Security
  - Tools, technologies and solution development, Research and Training
  - Steganography, Malware, Biometric, Intrusion Detection

- Health Informatics
  - Telemedicine
  - Hospital Information System,
  - Decision Support System

- Ubiquitous Computing

- Education and Training including e-learning

While building capabilities in promising and enabling technologies, C-DAC has also implemented end-to-end solutions in various verticals of economic and social segments. The technologies have addressed key sectors such as Science and Engineering, Finance, Healthcare, Power, Steel, Agriculture, Cultural Heritage, Industrial Controls, Broadcasting, Education and e-Governance.

Some of the highlights across all the areas, and focus on special initiatives are described below.

Innovation Promotion

A strong innovation initiative is the driving force of C-DAC behind the development of various tools and technologies. An intense interaction between Research & Development activities and Academics has addressed various grand challenge problems on national level. Significant impact was created by several technologies, as illustrated here:

- Weather Research Forecasting (WRF) for Short Range Weather Forecasting of Kerala and Maharashtra region
- Acoustic Landmine Detection System
- Cyber Forensic tools, Adaptive Intrusion Detection System, Intrusion Prevetion System, Steganography tools, etc.
- Integrating DICOM and HL7 standards

Skill Development

C-DAC organized several workshops, and training programs at different skill levels to enhance the competencies of stakeholders, and to share the R&D expertise, facilitating the creation of high quality manpower through various specialized training programs. Special initiatives such as Tech-Sangam help to enhance outreach significantly. Training programs were conducted for skill upgradation of minorities, women, backward classes, etc.

Agreements were signed with Ministry of External Affairs (MEA) to establish Centres of Excellence in Dar es Salaam, Yerevan, Belarus, Lesotho, Riyadh. PG Diploma Courses were launched in Cyber Security, Healthcare and Software Technologies. C-DAC has major aspiration and proposals to contribute significantly to the national mission on skill development, being implemented by the Government of India.

ICT Based Solution for Masses

Building on the organizational skill sets, C-DAC pursues the strategy seeking to step up the efforts in ICT research and innovation to maximise the utility and impact on society. A number of ICT innovations have been initiated and deployed during the year. The Intelligent Transporation Systems (ITS) which helps build a cleaner, more efficient and safer transport, Indian Language Software Tools and Fonts, India Development Gateway (InDG) with "Social Welfare" as an additional vertical, standardization and deployment of e-Governance applications, healthcare solutions, etc. are significant examples.

Strengthening Academia and Industries Interactions

With prime focus on R&D, C-DAC has created strong interfaces with the Academia and Industry, including organizations such as IISc, IITs, AU-KBC, Punjab University, All India Institute of Medical Sciences, Regional Cancer Centres, etc.

C-DAC entered into an MoU with the Motilal Nehru National Institute of Technology (MNNIT), Allhahabad for joint implementation of e-learning programs. Tech-Sangam was launched in nearly 300 colleges. A number of Training programmes were conducted through ACTS, PACE and the network centres across nation. Corporate Collaboration, Grid Awareness events, NaMPET, AsTEC, Boss Proliferation, Information Security Awareness, etc. are also fine examples of nurturing fruitful interactions.

Alignment with National Vision

Recognizing its lofty role as a national technology organization, C-DAC aligned its overall framework of plan and activities with the National vision. C-DAC participated in national initiatives such as upliftment of North-East region by deploying bouquets of advanced technologies ranging from High Performance Computing (HPC), Multilingual Technologies, AyuSoft, Agri Electronics, etc. These efforts have empowered the local population, now driven by the benefits of ICT in terms of infrastructure and employability. C-DAC also contributed to the skill upgradation and consequent development of deprived sections including women, minorities, etc.

C-DAC made significant stands in reforming the structure and stability of the organization. The Heads of Centres ensure appropriate, adequate attention to evolve and establish R&D direction and strategies, facilitated by a transparent, responsive Corporate headquarters. There has been progress in project management, manpower streamlining, inter-centre linkages and in overall system and practices.

This report is an attempt to consolidate the accomplishments and major activities of the year 2009-10.

Technical Areas

HIGH PERFORMANCE COMPUTING AND GRID COMPUTING

Activities were centred around the prestigious PARAM Yuva system. Strengthening and stabilizing the operations of the PARAM Yuva, creating compute intensive applications on Param Yuva as well as the Garuda grid, preparing the roadmap for migration of Garuda to NKN were the major developments during the year. Both PARAM Yuva and the grid are available for use by external agencies engaged in scientific applications.

C-DAC HPC Resource Management Engine – CHReME

C-DAC HPC Resource Management Engine (CHReME) launched during the year, provides web-based submission and monitoring of jobs. It also facilitates integration with other tools for tracking and managing workloads. CHReME portal works with other schedulers and workload managers such as Torque, PBSPro, Sun Grid Engine, Load leveller, etc. Customization of this new integrated tools enrich the existing portal functionality. CHReME has been successfully deployed at NCMRWF Noida, Bharathidasan University Trichy, North Eastern Hill University Shillong and Centre of Excellence in Information and Communication Technology Tanzania.

ONAMA

ONAMA incorporates a set of parallel as well as serial applications and tools across various engineering disciplines such as Computer Science, Mechanical, Electronics & Communication, Electrical, Civil, Chemical Engineering, etc., It also includes nVIDIA CUDA enabled applications in several domains of science. Onama was effectively deployed at Kashibai Navale College of Engineering, Pune.

Reconfigurable Computing Systems (RCS) – IV

The RCS-IV was designed to achieve substantial enhancement of the computing power and I/O bandwidth over the present generation of RCS-III. Specifically catering to the space saving servers with 1U size and a small form factor. RCS-III was earlier incorporated with the PARAM Yuva, creating a unique Supercomputing Environment. Development of additional hardware libraries named 'Avatars' is in progress.

PARAM Installations

- Under the inter-Governmental collaboration program, 'PARAM Serengeti', a Linux based Supercomputing cluster with Param interconnect was commissioned at Centre of Excellence in Information and Communication Technology, Tanzania. The facility includes 20TB of High Performance Storage, 38 TB backup, relevant backup software with low latency and high speed system area network based on Gigabit Ethernet. The facility is being used for scientific applications such as Computational Fluid Dynamics, Bioinformatics, Finite Element Analysis, Seismic Data Processing, Materials Modeling and Climatology.

- PARAM based HPC system for Regional Forecast and Mountain Meteorology was installed at NCMRWF, Noida for high end research in climate modelling. The storage is designed to reduce frequent human intervention and to handle large dataset volumes for increased accuracy. Joint discussions and workshops on HPC and parallel computing were conducted in the field of weather forecasting models.

- MoU signed with Indian Institute of Tropical Meteorology, Pune for establishing HPC facility named "NIMBUS" for conducting research activities in the field of Climatology. Under this MoU, a 2.5 TF system was installed with 144 TB SATA based storage. The system is used primarily for research in the field of Climatology. Applications, Tools and Libraries, installed on NIMBUS include Echam5, COSMOS, MOM4, PRECIS, ROM, WRF, NEMO, CCSM, SYNTEX, CFS, GME, WRF, WRF (Post Processing Tools), MM5, ROMS-forcing package, Opensees, Ray2Mesh.

- IIT Delhi has established a HPC facility at its Centre for Atmospheric Science (CAS) in collaboration with C-DAC. This HPC cluster consists of 16 nodes system and is widely used for research purposes by Ph.D. Scholars at CAS department. The applications ported onto the cluster at IIT Delhi are WRF V 3.0.1.1, WRFDAV3.1.1 VAR model and ARWPost. Extending the collaboration further, C-DAC is also associated with IIT Delhi for collaborative research projects in domains.

C-DAC has established a HPC facility at the Physics Department of Bharatisadan University. This facility is of benefit to the research community and the students. The facility includes HPC Cluster, storage system with System Administration and Application (Scientific & Engineering) support, and also the resource management portal CHReME.

Centre of Excellence at North East Institute of Science and Technology, (NEIST) Jorhat

Under the upliftment of North East region Programme, C-DAC established a State of the Art PARAM facility backboned by indigenously developed high-speed low latency PARAMNet-3 Interconnect. Applications ported onto this ParamGem include:Ray2Mesh (Benchmarking), GIMBOS, LsqrSolve, SismoVTK, OpenSees, Seismic-Unix, Seisan and WRF and Visualization tools like ParaView, VisIt, Mayavi and GnuPlot.

'PARAM SHEERSH' HPC facility at North-Eastern Hill University (NEHU), Shillong

Application porting was completed at NEHU in the areas of Environmental Sciences (WRF, MM5, MOM, ROMS), Computational Chemistry (Quantum ESPRESSO, OpenMX, ABINIT), Bio-informatics (mpiBLAST, ClustalW, MrBayes), Mathematics (ParGAP) etc. This facility enabled NEHU to enhance their research activity, helping them specifically in publishing work including five research papers in international journals in a record time of two years (the minimum permissible time) because of huge time saved by parallel computing using ParGAP software. A training programme was organised on Parallel Programming concepts, Linux and Cluster system administration, Network administration and storage administration.

HPC Applications

- **Computational Atmospheric Sciences**

  Different atmospheric models such as Weather Research Forecast (WRF), Regional Climate Model Version 3 (RegCMs) and Regional Spectrum Model (RSM), Ocean Models like Regional Ocean Model System (ROMS) and Hybrid Coordinate Ocean Model (HYCOM) have been examined for their ability in simulating the India Summer Monsoon (ISM). Developed and analysed a coupled to coupled Atmospheric Model 'WRF' and clear model 'ROMS'. It was observed that the simulated ISM as well as the Indian Ocean Sea Surface Temperature (SST) Climatologies and variability is much improved in coupled model compared to its corressponding uncoupled models.

  A study was made to explore the high-resolution mesoscale model forecast capability for Kerala using IMD, Meteorological and Oceanographic Satellite Data Archival Center (MOSDAC) Automatic Weather Station (AWS), Kerala State Planning Board (KSPB) station observations and Tropical Rainfall Measuring Mission (TRMM) data. Different statistical verification methods were applied to check the comparative performance among the experiments with various cloud microphysics schemes, resolution sensitivity and 24 / 48-hour lead-time forecasts over Kerala.

  Considering the requirement of weather forecast at block level, the model simulated block specific rainfall is compared to the TRMM data. There is a high mean bias range from 4.1 - 9.9 mm of 24 hour forecast compared to 48 hour forecast in which the bias ranges from -0.1 to -3.18 mm. It is proposed that the TM scheme may be used for the cloud microphysics scheme with 3 km horizontal resolution with the lead time of three days in advance. The overall analysis from the IMD and MOSDAC AWS analysis indicates that the high-resolution model is able to predict accurately the weather features.

  Through the India Development Gateway (InDG), daily twice village level weather forecast is being provided for public access. The data is presently available for 50000 villages.

- **Study of q-state Potts model with site disorder and long range interaction**

  The q-state Potts model exhibits a very rich phase diagram. Using Wang-Landau algorithm the model was analysed with Monte Carlo simulation. The model shows a first order transition for $q > 4$ and the second order transition for $q < 4$. It helps to calculate the free energies directly from the density of states obtained in the simulation. It also helps to write down the partition function explicitly and can numerically extract the zeros of the partition function to study the nature of the transition.

- **Parallelization and Benchmarking of Coupled Cluster (CCSD) code**

  This aims to develop parallel and distributed codes for CCSD and related techniques on HPC platforms and facilitate researchers in this field to handle large scale problems. Program achieved is indicated below. :

  - Parallelized both relativistic and non-relativistic codes with Message Passing Interface.
  - For relativistic code, completed calculations for atoms like cesium, Th -IV isotope, Magnesium and sodium.
  - With non-relativistic code, we have obtained correlation energies for molecules with basis 138 and 198.

- **Computational Fluid Dynamics**

  A 3D CFD simulation was carried out on PARAM Yuva for computing flow around a group of buildings (domain size: 15 x 10 x 48 m) by solving Navier Stokes equations using parallel PHOENICS. The simulation was performed with grid cells of around 3.6 million (120 x 80 x 384) on different processors ranging from 1 to 32 processors.

- **Computational Structural Mechanics**

  In Earthquake Engineering domain, in collaboration with SGSITS-Indore a project on "Computer Aided Seismic Analysis and Design of Concrete Structures" was completed. As part of the Earthquake Engineering - Public Domain software activity, porting and benchmarking of OpenSees software on PARAM Yuva and Grid GARUDA was carried out. Simulation of Engineering

Structures (Bridges/ Multistory Buildings) using OpenSees software framework was also carried out on PARAM Yuva. Development and parallelization of numerical methods for the non-linear analysis of complex structures and Mathematical Modeling and Research of Fundamental problems in mechanics of continuum media on multiprocessor computer systems like PARAM was completed.

- **Bioinformatics**

  Bioinformatics Resources and Applications Facility (BRAF) is an effort towards providing a high-end supercomputing facility to Bioinformatics researchers. Towards this BRAF provides access to one Teraflop supercomputing cluster named BIOGENE. Various software like GAUSSIAN, AMBER, CHARMM, GROMACS, GAMESS, NAMD, BLAST, FASTA, CLUSTALW, MEME etc. have been ported and optimized on Biogene followed by benchmarking. The development of GIPSY portal along with Grid enabling of AMBER, CHARMM, Openeye and numerous other applications have been completed. Facility of Web Computing portal for Bioinformatics codes has led to various collaborative projects and publications.

- **Computational Workflow for High-Throughput Genome Analysis**: Anvaya is a stand-alone client-server workflow environment that consists of Bioinformatics tools and databases loosely coupled together in a coordinated system to execute a set of analysis tools in series or in parallel. It consists of 11 pre-defined workflows for frequently used pipelines in genome annotation and comparative genomics ranging from EST assembly and annotation to phylogenetic reconstruction and microarray analysis. Implementation includes the 'Rules Engine' that defines rules for logical connection between the existing tools. 'Custom tools' were also developed which offers the user, novel functionalities to carry out exhaustive comparative analysis.

- **GENOPIPE:** GENOPIPE was developed for annotation of *Salmonella* and *Mycobacterium* genomes. It serves as an auxiliary pipeline for improved prokaryotic genome annotation and comparative genome analysis. The core basis for annotation using GENOPIPE is 'identification of orthologous groups' following which the functional annotation is carried out. SNP data, paralogous gene list and unique genes (with reference to the genomes being compared) are also generated, which play a major role in understanding pathogenicity and host-specificity amongst several other features. Using the GENOPIPE package, annotation of 5 *Salmonella* serovars sequenced by Institute of Animal Health, UK were annotated by the Bioinformatics Team. The five serovars affect a wide host range from humans to pigs, cattle and chicken.

  Very high end simulations have been performed on PARAM Yuva for the highly challenging biological problems like protein folding, understanding membrane proteins and structural studies on antisense molecules. Replica Exchange Molecular Dynamics (REMD) simulations were performed using AMBER 10. Multiple REMD simulations for protein folding were carried out.

- **Seismic Data Processing**

  "Parallel Post-Stack and Pre-Stack Kirchhoff 3D Depth Migration" was initiated, to study various depth migration algorithms and to develop an efficient 3D Kirchoff depth migration scheme for both post and pre-stack seismic data. MPI libraries on PARAM series of supercomputer with a user interface will be used to build the algorithm. The MPI based parallel program can be easily ported to any parallel processing environment. The Graphical Interface tools for input and output data would are being developed to make the software user friendly.

- **Collaborative research work on GPCR proteins with IIT Madras**

  A collaborative project between C-DAC and Indian Institute of Technology (IIT) Madras was initiated. to provide computational support for the experimental work. Three systems were simulated after inserting the protein into POPC bilayer and solvating with SPC water, using GROMACS on the PARAM Yuva machine.

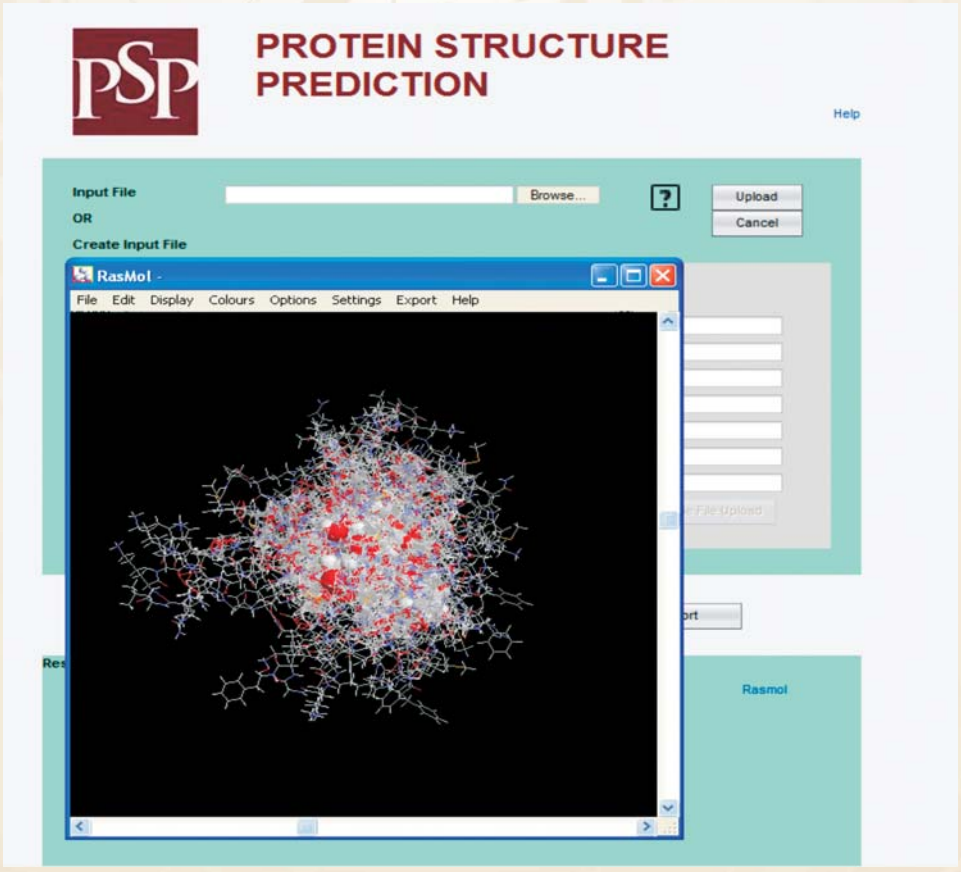
- **Collaborative research work on Furin complexes with OHSU, USA.**

  A collaborative project work between C-DAC, Bioinformatics Team and Oregon Health & Sciences University (OHSU) was initiated. The main objective of this collaboration was to provide computational support to the experimental work carried out by the researchers at OHSU on two cancer related proteins called Furin and PC1. Their experimental findings that the propeptide domain of Furin acts as a pH sensor by exhibiting higher fluctuations at pH6 as compared to normal pH conditions, whereas PC1 does not, were validated by carrying out MD simulations using NAMD software suite on the Biogene cluster at C-DAC.

Grid Computing

The Garuda Grid provides problem solving environments for applications like Disaster Management, Bioinformatics, Computational Fluid Dynamics etc. Many of the system level and middleware tools are being developed as part of this project. Grid to Cloud interface is also being explored as part of this project. The developments as part of the Grid Computing Project include:

- Portal for Service-oriented Grid GARUDA enhances GARUDA Access Portal by providing more functionalities such as more varieties of job submission, better file management, and integration with GARUDA Storage Resource Manager solution
- Essential Services such as login service, job accounting (cpu, memory, etc), compiler service and resource reservation service
- GARUDA Storage Resource Manager (GSRM) a unified access point for huge capacity distributed GARUDA storage resources
- Automatic Grid Service Generator Tool: to convert existing applications or executable files as a Grid Services.
- PSE for Protein Structure Prediction: The application based on Genetic Algorithms (GA) was grid enabled for Garuda grid and a Problem Solving Environment (PSE) was developed to aid users to work easily with the Protein Structure Prediction (PSP) software.



The **GARUDA Foundation Phase** was completed, with a major technology shift by migrating to Service Oriented Architecture. The major achievements include:

- Upgradation of the PoC GARUDA Architecture to support Service Oriented Grid
- middleware to support SOA and QoS
- Open Source Scheduler Gridway for Grid
- Garuda Access Portal and other tools to support service oriented Garuda
- Establishment of the Indian Grid Certification Authority (IGCA), an authority/agency to certify grid users and resources
- VOMS deployment
- Addition of 4TF each at Bangalore, Chennai and Hyderabad Centres.
- Enhancement of Disaster Management, Computer Aided Engineering, High Throughput Molecular Modeling (Openeye), Collaborative Learning, and other select application for improvement

The Operational phase of Grid Garuda was initiated. The main objectives of this project include Middleware and Associated tools: Development, Deployment and Operational Support, Migration of the underlying network fabric to NKN, Resource aggregation and co-ordination with resources initiative, and grid enablement services for select applications including interoperation with international grids.

15 Garuda locations migrated to 1 GBPS NKN connectivity. Essential services such as login service, accounting service, compilation service, and reservation system were supported on the service oriented Garuda architecture. Dissemination activities conducted include the GARUDA Boot Camp, tutorial in ADCOMP 2009, and invited talks in Research and Academic institutes (IIA, IISc, and engineering colleges).

A testbed cluster of Cloud is established with the Garuda nodes available in C-DAC, Chennai using various open source tools. The existing Globus toolkit cluster will be utilized from the Grid perspective. Analysis and design of integrating the Cloud and Grid at the portal level as a Proof of Concept is in progress. The analysis, design, and integration of the IGCA certification mechanism with the Cloud portal was initiated, to enable users with single IGCA credentials to access both Cloud and grid resources independently. Development and integration of two components viz., Distributed Content Search and A/V Conference with LMS was initiated.

Applications on Grid

PHOENICS is general purpose commercial CFD software to solve problems related to fluid flow coupled with heat / mass transfer. Sequential and parallel version of PHOENICS CFD software was ported on Garuda Grid.

- **Problem Solving Environment (PSE) for Garuda Grid:** The PSE is a web-based integrated computing environment for composing and running Science and Engineering applications on grid Garuda. The system accepts information about the software that needs to be executed, i.e. the user input data. The system executes the selected software, and allows users to retrieve the output results. The users can inquire about status of various jobs or software submitted by them through the PSE. The system also supports other miscellaneous operations such as bulletin boards, feedback forms and downloading of data preparation and visualization software.

- **Phylogeny on GARUDA Grid:** Reconstruction of phylogenetic trees is a highly compute-intensive application that requires thousands of CPU hours on large data sets. Molecular phylogeny pipeline that includes steps like database searching for identification of orthologous genes; multiple sequence alignment of orthologous genes and reconstruction of phylogenetic trees have been implemented on the local test-bed.

- **Seismic Data Processing:** The main objective of Earthquake Research Grid will be to create a virtual earthquake research facility by linking the data from the earthquake observatories and earthquake research laboratories along with the necessary analysis, simulation and data processing softwares and online computing facility.

MULTILINGUAL COMPUTING AND HERITAGE COMPUTING

C-DAC has well established credentials in Multilingual Computing, spanning the entire space from fonts and encoding (including Unicode) to Machine Translation and Speech Technologies. In a highly multilingual country like India, the importance of this area cannot be overstated. In addition to continued enhancements in existing technologies and products, the current year saw significant activity in enabling language applications on mobile platforms, national mission mode rollout of CDs containing basic language resources for all official languages, and significant progress in major challenging language problems such as Optical Character Recognition (OCR), Machine Translation (MT), Cross Lingual Information Access (CLIA), etc., through nationwide consortia projects.

LIPS Live - Language Independent Programme Subtitles On-Air

LIPS Live is the pioneering technology that enables Television Broadcasters to display subtitles on air. It consists of a multilingual creation station or editor with auto time-coding and overlaying facility. Broadcasters can easily integrate it with video automation system and enhance their workflows as no tapes or manual intervention is required. The cost effective solution will help broadcasters to telecast more and more programs with subtitles enabling more viewers to benefit from the program. The Salient Features of the system are:

- Supports all Playout Automation systems and Subtitle protocols
- Generates high-resolution subtitles with specially designed fonts for video
- Online subtitle creation and auto time coding facility
- Preview with online editing of subtitles
- Simultaneous video editing and subtitle overlaying
- Searching scene through Subtitle
- Frame stepping for precision time coding
- Flexible On-screen positioning
- Support all video standards
- Digital Interface (SDI)
- Fully automated (No manual intervention)
- File based workflow (Tape less)

Internationalized Domain Names in Indian Languages

Understanding the need to extend Internationalized Domain Names (IDN) in Indian scripts and languages, C-DAC launched this initiative to enable the Indian users to register an IDN in English and also in all the 22 official languages of India. Seven major languages have already been proposed to Internet Corporation for Assigned Names and Numbers (ICANN) for final vetting. Work on the remaining 15 languages is in progress.

Policy Formation Completed the Policy document creation including variant table, language table etc. for 14 official languages, namely, Assamese, Bangla, Gujarati, Hindi, Kannada, Konkani, Marathi, Malayalam, Nepali, Oriya, Punjabi, Sanskrit, Tamil and Telugu.

Policy Finalization Finalized policy for languages viz. Urdu, Sindhi (Perso-Arabic), Sindhi (Devanagari), Kashmiri (Perso-Arabic), Dogri, Maithili, Santhali and Manipuri.

Fonts Development of “IDN Bharti” fonts (on the lines of Sakal Bharati) for use in IDN was initiated. This single font provides the ideal visual representation for entered data to all brahmi based Indian scripts, viz. Assamese, Bangla, Gujarati, Hindi, Kannada, Konkani, Marathi, Malayalam, Nepali, Oriya, Punjabi, Sanskrit, Tamil, Telugu, Urdu, Sindhi (Perso-Arabic), Sindhi (Devanagari), Kashmiri (Perso-Arabic), Kashmiri (Devanagari), Bodo, Dogri, Maithili, Santhali and Manipuri.

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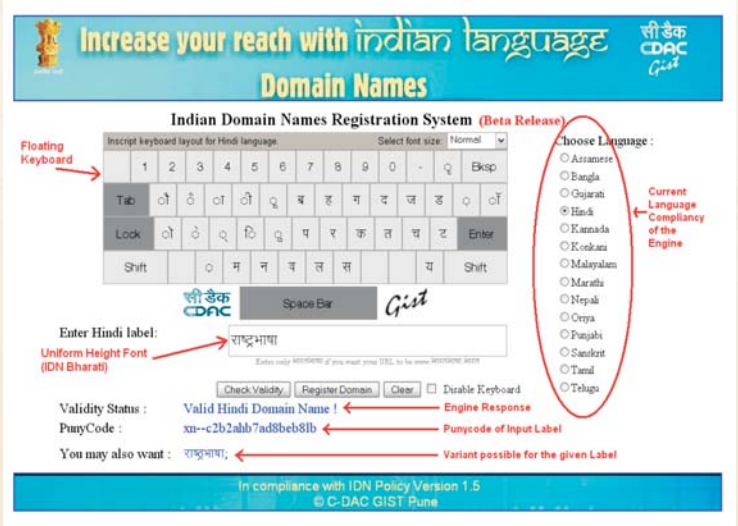
Floating Keyboards: Javascript based floating keyboards for entering language specific Unicode URLs was completed for 18 languages.

Shri. Rajan T. Joseph, Director General C-DAC and Ms. Tulika Pandey, Additional Director, DIT Releasing the IDN Policy during the workshop at PUNE - 29th October 2009



GIST-IDN WebService Suite

There are several choices one can make when deciding on a Indian language domain name. Better optimized lists of domain names help registrants discover all the ways they might describe their website or online service. With more high value domain name options generated by IDN webService Suite, registrants are more likely to register multiple domain names. GIST offers different types of web services in GIST-IDN WebService Suite which provides relevant and desirable domain name alternatives for भारत top level domain. These web services can be categarized as following -

- Web Service for Character by character phonetic conversion for आयसीआयसीआय kind of URL
- nTrans WebService – provides option to edit the hindi text
- Transliteration WebService – provides options in different Indian languages.
- Synonym WebService – provides options which are having similar meaning.
- Homograph WebService - provide options which look similar (homographs) to the desired URL.

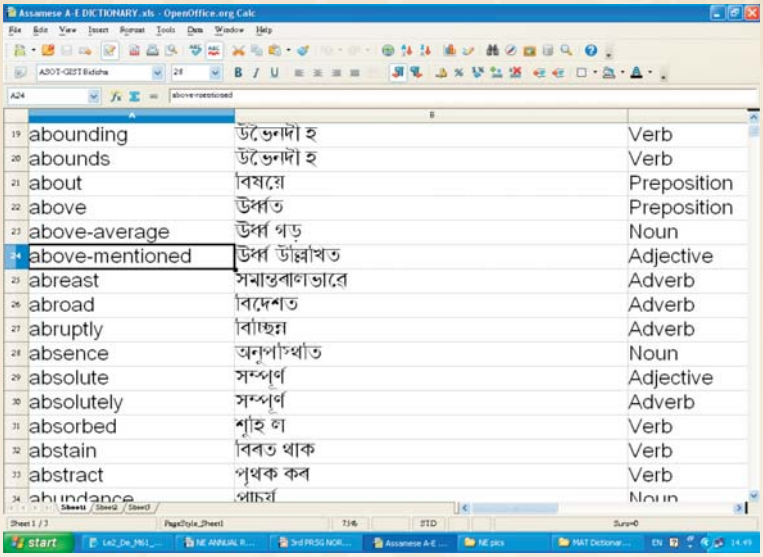
Using these WebServices an application named as **Domain Name Suggestion Tool** is also developed to assist users with the best and the most reliable domain name in Indian languages. This application strengthens the registrar's presence in both established and growing international regions and satisfy the registrants' demands for native language domain name options.

Languages supported by IDN WebService Suite -

WebService Name	Language Supported
Gist-Trans	Hindi, Gujarati
Web Service for Character by character	Hindi, Marathi, Gujarati, Panjabi, Tamil, Telugu, Oriya, Bengali, phonetic conversion Assamese, Malayalam, Kannada, Bodo, Dogri, Maithili, Santali, Sindhi-Dev, Kashmiri – Dev, Nepali, Sanskrit, Manipuri, Konkani, OL Chiki, Urdu, Sindhi, Kashmiri
nTrans WebService	Hindi, Marathi, Gujarati, Panjabi, Tamil, Telugu, Oriya, Bengali, Assamese, Malayalam, Kannada, Bodo, Dogri, Maithili, Santali, Sindhi-Dev, Kashmiri – Dev, Nepali, Sanskrit, Manipuri, Konkani, OL Chiki, Urdu, Sindhi, Kashmiri
Transliteration WebService	Hindi, Marathi, Gujarati, Panjabi, Tamil, Telugu, Oriya, Bengali, Assamese, Malayalam, Kannada, Bodo, Dogri, Maithili, Santali, Sindhi-Dev, Kashmiri – Dev, Nepali, Sanskrit, Manipuri, Konkani, OL Chiki, Urdu, Sindhi, Kashmiri
Homographs WebService - Similar looking	Assamese, Bengali, Gujarati, Kannada, Konkani, Malayalam, Marathi, Nepali, Oriya, Punjabi, Sanskrit, Tamil and Telugu
Synonyms WebService - Similar meaning	Hindi, Gujarati, Marathi, Telugu, Bengali, Oriya, Urdu

Tools and Fonts for Major North-Eastern Languages (Consortia mode)

For the development of official languages of the North East viz. Bodo, Assamese, Manipuri and Nepali, the project provided fonts, keyboards and inputting mechanism. It also covered diverse areas such as Common Locale Data Repository (CLDR), Spell checkers, corpus development, MAT driven dictionary etc. This gives an impetus to these languages and enables close collaboration with institutions in the North-East to serve as a template for future collaborative efforts.



"Web Based Patent Analysis and Management System"and Patent Search Centre

Intellectual Property Rights (IPR) is a major issue in India considering the large knowledge base generated by the scientific community. At present patenting is an expensive process involving prior art search and thus SMEs and MSMEs do not have the wherewithal to protect their valuable Knowledge base. These projects help propogate this awareness of IPR and provide facilities for searching The web portal provides information about IPR and copyrights, and facilitates advanced patent search with ontological tools. The portal also accepts abstract from an inventor for prior art search and patent registration.

Dictionary of IT Terminology

IT Terminology is a multi-lingual web application to develop a standardized dictionary of computer terms along with its translation, transliteration, definitions and images. The dictionary including nearly 10,000 terms, with images for about 500 terms has been compiled.

Establishment of Indian Language Technology Proliferation and Deployment Centre

The centre consolidates the large amount of knowledge and research undertaken by the different consortia covering areas as diverse as Fonts, keyboards standardization, OCR, OHWR, Machine Translation, CLIA, Text to Speech, Automatic Speech Recognition, NLP and Corpora. The Data Centre, as the name suggests, will be a store house and a repository where all such tools as well as technologies will be stored and made available to researchers and scholars working in these areas.

Multiple Language Subtitles on Direct to Home (DTH)

The DTH offers a solution for online DVB subtitle generator to generate DVB compliant subtitle streams for DTH platform in multiple languages including non-Indian languages. This helps the viewer to select the language of his choice while viewing a programme. Apart from normal viewers, this technology is specifically suited to the hearing impaired. The initial prototype was successfully tested with broadcasting set-up. The effort has a great societal value as it allows users of one language to view films in other languages with sub-titles, thereby making accessible all Indian languages to the general public at large.

Consortium Mode Projects

Considering the huge magnitude of the major problems in multilingual computing and large number of languages that need to be catered to, TDIL programme had initiated many projects in consortia mode involving a number of developers across India. The current set of consortia projects include English to Indian language Machine Translation, Indian language to Indian language Machine Translation, Optical Character Recognition, Cross Lingual Information Access, Speech Recognition and synthesis, etc. C-DAC centres have been participating activitely in almost all these consortia as members, and as consortia leaders for some consortium. These projects help bring together multiple perspectives on the associated problems and the existing expertise at different institutions at different levels such as basic tools, corpus management, higher levels of language processing, speech and signal processing, etc.

Testing and Evaluation of Multilingual Technologies

Evaluation of effectiveness of Multilingual computing is a major challenge, since often the performance depends on the specific project objectives, assumptions made by the project, and the size and nature of the corpus used for building and testing. Recognising this situation, C-DAC was assinged to formally test and evaluate all language related development projects supported by TDIL, DIT, including all the consortium projects as well. Elaborate testing framework was designed and implemented for applications like Machine Translation, Information Retrival, Speech Synthesis, etc.

Online Handwritten Character Recognition (OHWR)

Development of online handwritten recognition technology for Hindi is in progress. The technology is of particular use in hand held devices such as PDA's, Mobile Phones where it provides better human machine interface than the limited keyboard functionalities.

Machine Assisted Translation projects (IL-ILMT, EILMT, AnglaMT)

C-DAC associated STQC, Delhi in evolving the Testing, Benchmarking and evaluation strategies for various consortia projects viz. EILMT, ILILMT, AnglaMT. Alpha level testing was carried out for AnglaMT and IL-ILMT machine translation projects. Some of the internationally accepted norms of testing such as BLEU, Metor are getting suitably modified to support Indian languages.

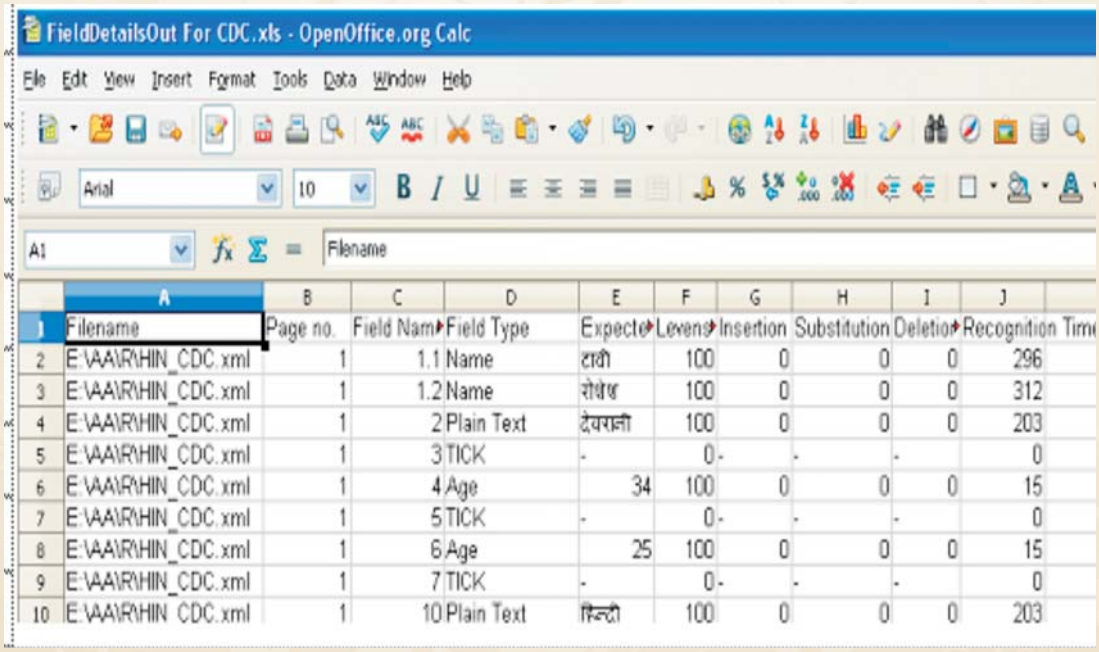
Online Handwritten Character Recognition

The engines developed by different consortia members are integrated in different prototype applications, Census Data Processing, Encumbrance Certificate, Vehicle Inspector report. Testing of these applications and the accuracy evaluation of all engines though the applications is targeted in this round. For this data from 25 users per language has been collected for all applications. Test data set and semi automation tools required for undertaking the testing, evaluation and benchmarking has been developed.

C-DAC OHWR Accuracy Evaluation tool is a simple and intelligent tool through which it can evaluate output of OHWR Engine on the basis of standard algorithm namely Levenshtein. It works on a UNICODE *.XML file in which annotated and its corresponding engine output are given in the form of XML file.Languages supported currently are Bengali, Hindi, Kannada, Malayalam, Tamil and Telugu. The result evaluated can be exported as a *.xls file.

Automatic Speech Recognition (ASR)

Automatic Speech Recognition (ASR) in Indian languages was designed under consortium mode, for the Agriculture domain. Testing strategy for Automatic Speech Recognition (ASR) version 1.0 was developed.



	A	B	C	D	E	F	G	H	I	J
1	Filename	Page no.	Field Nam	Field Type	Expecte	Levens	Insertion	Substitution	Deletio	Recognition Time
2	E:\AA\R\HIN_CDC.xml	1	1.1	Name	दादी	100	0	0	0	296
3	E:\AA\R\HIN_CDC.xml	1	1.2	Name	रोशेष	100	0	0	0	312
4	E:\AA\R\HIN_CDC.xml	1	2	Plain Text	देवगानी	100	0	0	0	203
5	E:\AA\R\HIN_CDC.xml	1	3	TICK	-	0	-	-	-	0
6	E:\AA\R\HIN_CDC.xml	1	4	Age	34	100	0	0	0	15
7	E:\AA\R\HIN_CDC.xml	1	5	TICK	-	0	-	-	-	0
8	E:\AA\R\HIN_CDC.xml	1	6	Age	25	100	0	0	0	15
9	E:\AA\R\HIN_CDC.xml	1	7	TICK	-	0	-	-	-	0
10	E:\AA\R\HIN_CDC.xml	1	10	Plain Text	हिन्दी	100	0	0	0	203

OCR for Printed Indian Scripts

OCR engines are developed by different institutes and are integrated in one application. Test data set and semi automation tools required for undertaking the testing, evaluation and benchmarking was developed. Test data is of two types: one which is provided by Consortia and other set is prepared by the C-DAC testing team. Test data set prepared by C-DAC comprises of natural data (books, newspaper) and synthetic data (which is created to check features specified in SRS). Quick test Professional (QTP) a record and playback tool was deployed for the OCR testing. Manual process of running "End to End OCR" was automated using QTP for large database.

OCR version 1.5 was received in which following languages were integrated: Devanagari, Gurumukhi, Gujarati, Kannada, Bangla, Tamil, Telugu, Oriya and Malayalam. For these languages "End to End OCR" was tested. A tool was developed based on Levenshtein Edit Distance algorithm, to calculate character level accuracy including insertion error, substitution error and deletion error.

Language/Script	Input File	Total No. of Characters in I/P File	Total No. of Characters in OCR O/P File	Levershtein Edit Distance Total Error – IE+DE+SE	Insertion Errors (IE)	Deletion Errors (DE)	Substitution Errors (SE)	Comments	Total Error	Accuracy	Av Ac
Devanagari	CV_Manga_16pt_100_CM_Page1.txt	760	940	520	189	0	330		68.47	30 53	
Devanagari	CV_Manga_16pt_100_CM_Page2.txt	32	33	12	3	2	7		37.5	62.5	
Devanagari	CV_Manga_20pt_100_CM_Page1.txt	474	570	304	102	5	196		64.14	35 86	
Devanagari	CV_Manga_20pt_100_CM_Page2.txt	318	395	212	81	3	128		66.67	33 33	
Devanagari	CV_Manga_24pt_100_CM_Page1.txt	324	403	230	87	8	135		70.99	29 01	
Devanagari	CV_Manga_24pt_100_CM_Page3.txt	144	174	101	31	1	69		70.14	29 86	36

English to Indian Language Machine Translation System (E-ILMT) PHASE-II

Phase I of the English to Indian Language Machine Translation System (E-ILMT) project was completed, covering the Tourism domain for English to Hindi, English to Urdu, English to Oriya, English to Marathi, English to Bangla and English to Tamil language pairs. This project was implemented by a Consortium of 10 Institutions with C-DAC as consortium Leader.

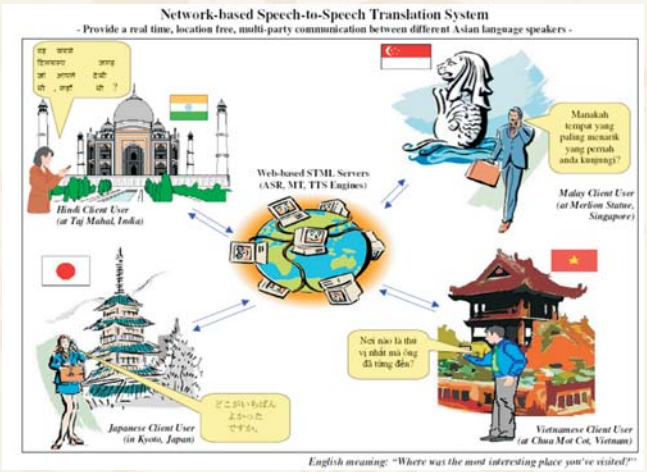
Consortium of 11 R&D and educational Institutions participated in extending the project to Phase-II, with C-DAC as the consortium Leader. This project aims at enhancement of MT system developed in Phase I for Tourism domain and addition of Health as new Domain for the language pairs English to Hindi, English to Urdu, English to Oriya, English to Marathi, English to Bangla and English to Tamil.

Cross Lingual Intelligence Access (CLIA)

The project was implemented by a consortium of academic and research institutions and industry partners. Beta version of the CLIA was released and hosted at IIT Mumbai server. The languages incorporated are Bengali, Hindi, Marathi, Punjabi, Tamil and Telugu. The project aims at creating a portal where the user enters a query in one Indian language (source language) and will be able to access documents available in the language of the query Hindi (if the query language is not Hindi), and English. The search results are presented in the language of the query, and also in the language in which the information originally resided. A new and upgraded testing strategy of CLIA project (version 2.03) was developed after testing of the application. The Alpha level testing has been carried out.

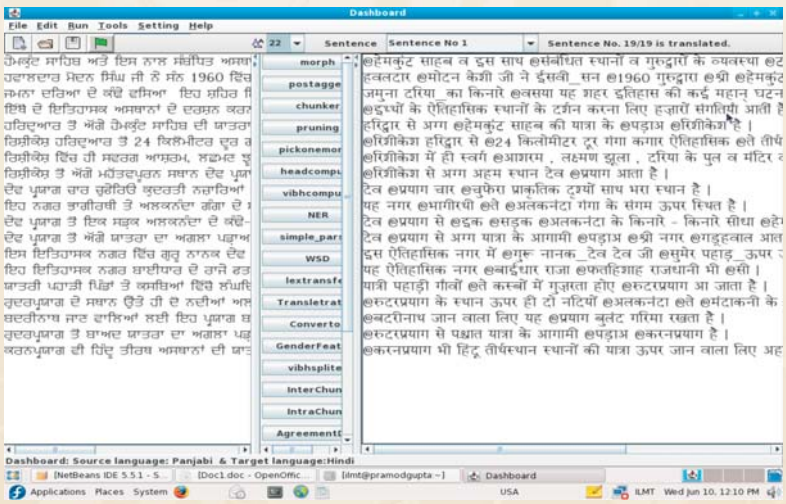
Speech to speech translation among Asian Languages (A-STAR)

A-STAR was initiated under a consortium of South Asian countries with the objective of speech to speech translation among Asian languages. Many international institutions of global repute are participating in the project. There are three major components namely Speech Recognition, Statistical Machine Translation and Speech Synthesis. C-DAC has been assigned the Hindi language development.



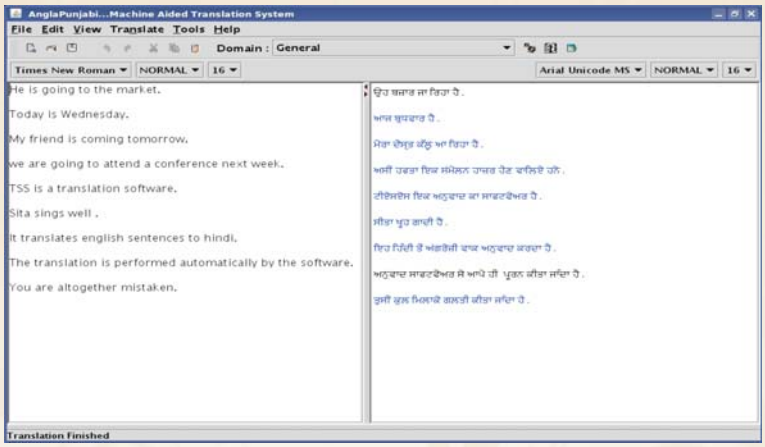
Indian Language to Indian Language Machine Translation

This consortium based project is aimed at facilitating translation among Indian languages. The first version of IL to IL Machine translation system has been completed. Various tools were developed for Indian languages including Parsing, Vibhakti Analysis, Word sense disambiguation, Transfer grammar and named Entity recognition, Linguistic resources such as lexicon, tagged POS and chunk tagged corpus and Parallel corpus for snippet translation



English to Indian Language Machine Translation

The System for English to Hindi is being adapted to some of the Indian languages by exploiting the commonality among various Indian languages. The work is being accomplished by a consortium of institutions with C-DAC developing Punjabi and Urdu translation system. Corpus Analysis, target language dependent changes in the modules and lexical resource building are being handled for Health and Tourism domains.



Anglabharti system

National CD Rollout

Under the National Rollout Plan, C-DAC released software tools and fonts in Bengali, Manipuri, Kashmiri, Konkani, Santhali and Sindhi on 8th September 2009. With this release of language software tools and fonts CD for free usage the project has logically concluded, covering all the 22 Official Indian languages.

Development of free single CD distributed through MAIT has been completed. CD contains a single Unicode compliant open type typing tool catering to all the 22 scheduled Indian languages/ Scripts, Localized version of Bharateeya Open Office suite and 2 fonts per languages.

Multilingual Computing Products

Phonetic Assistant for UNICODE: The phonetic assistance was provided on the basis of the current running script in the application entered by the user. It displays all the possible combinations of the last typed character with all other characters - which are typed before this character according to syllable. The product is designed to provide a client side GUI for easily getting the help on typing with phonetic keyboard Layout.

Next character which can be typed after this character

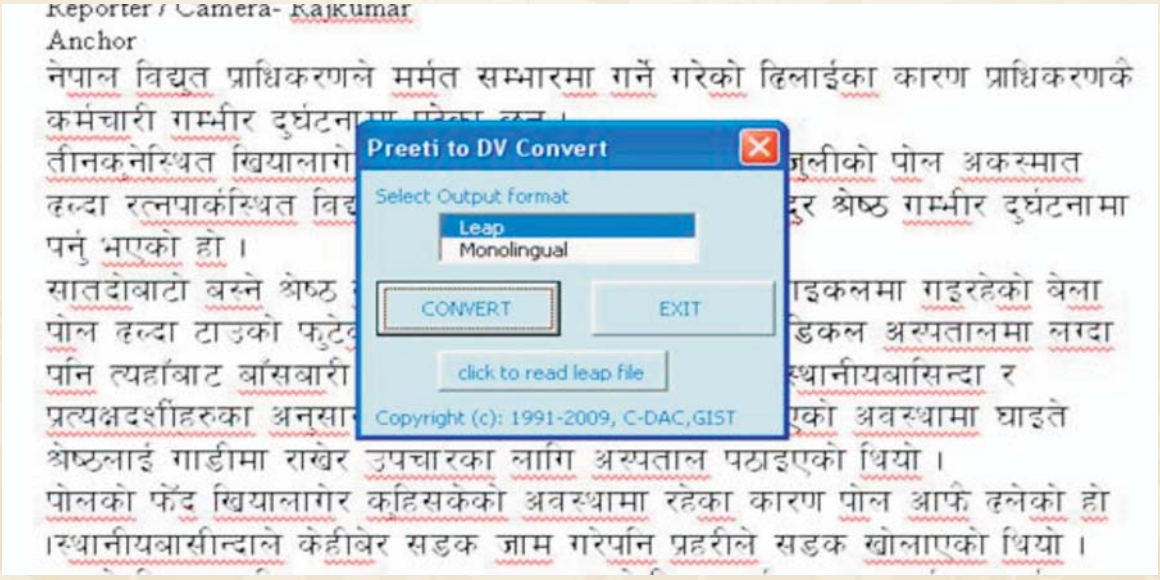
ISM V6 – Intelligent Script Manager

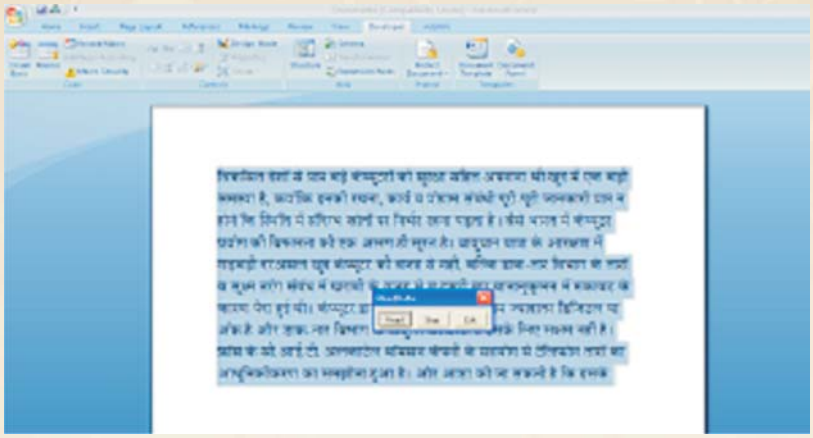
ISM V6 was launched in June 2009 as a product of C-DAC. This includes new features like Registration Form, ISM Demo Movie through CD, Comprehensive help File, Enhanced Spellcheckers and additional languages. Currently we also support Bodo, Dogri, Maithili, Konkani and Nepali.

ISM V6 is enabled for latest:

- Windows releases such as Windows7, Windows Server 2008
- Office releases such as Ms-Office 2010
- Office releases such as Open Office 3.1

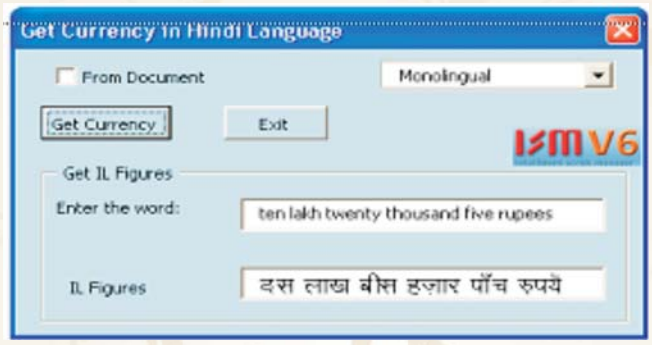
GIST-Preeti Converter for Nepali





GIST-ISMTTS Macro - Macro which is used to convert Text to Speech.

Currency Translator This utility is useful to convert currency in English to Indian language in all fontTypes and can translate currency in words from document.



ISM - ENPS OT Typing Tool

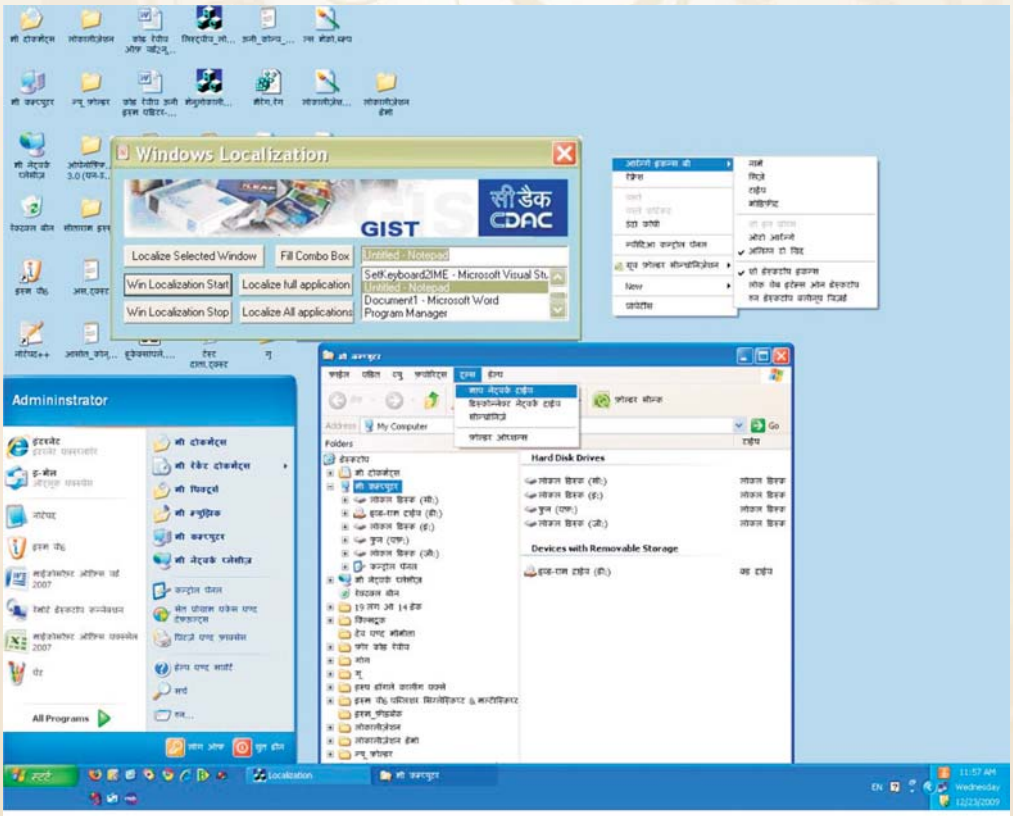
This utility is used to type on ENPS editor used in video industry.

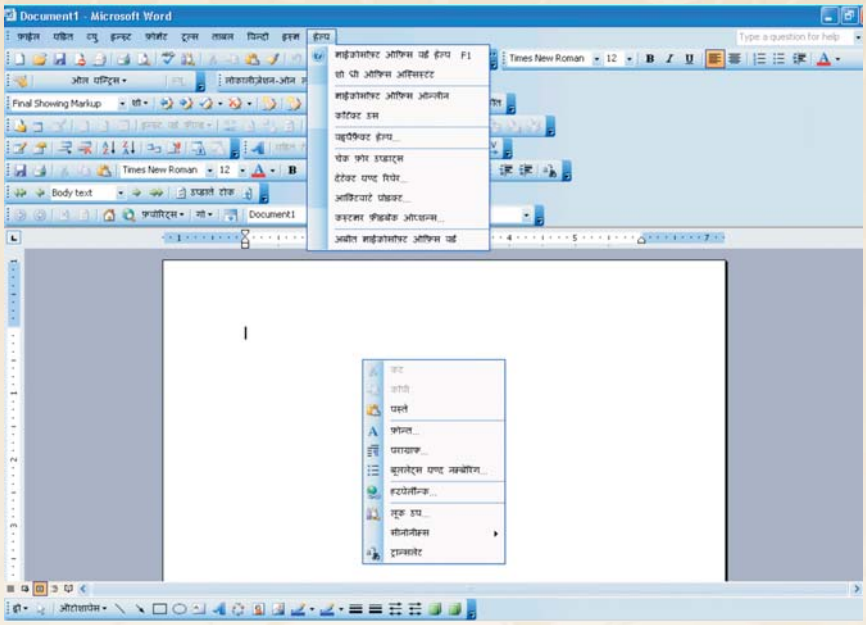
OT Typing Tool

This tool is used to install Keyboards and Fonts for 27 Script and language pairs. With this single tool, the user will be able to type in Windows based applications such as Open Office, MS Office, Internet Explorer, FireFox, Outlook, etc. OT Typing Tool has been developed to work with various Indian languages/ scripts.

Windows Localisation

Localization of Windows desktop and menus into Indian languages using GIST Tools was completed. Localisation framework also works on data (.doc, xls), code (HTML, ASP, CSS), Browsers (iPlugin Toolbar) and third party applications. In MS-Office localization two types of prediction engines namely Word Prediction Engine and Interword Prediction Engine have been developed.





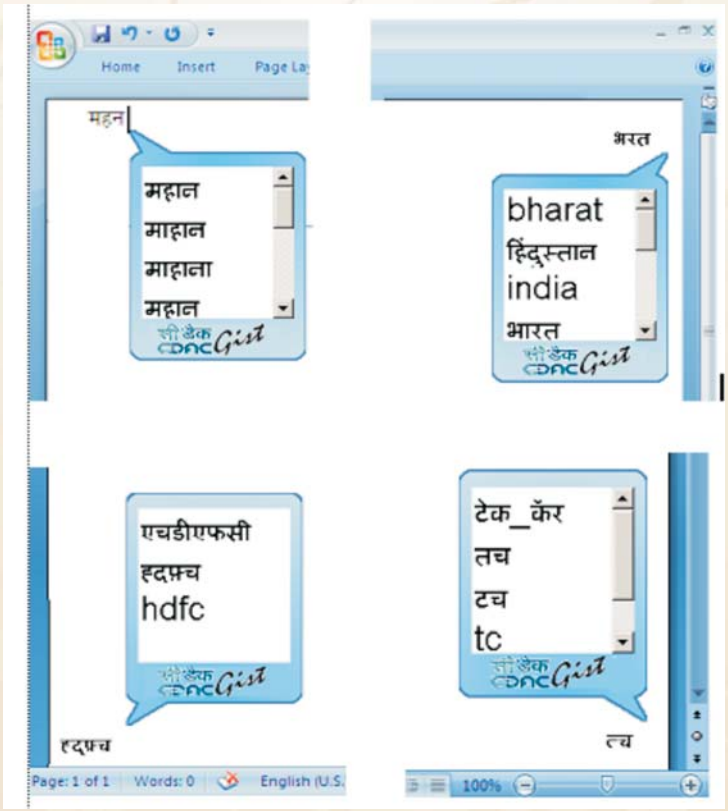
Word Prediction Engine

Word Prediction engine dynamically predicts the word being entered by the user is entering. These predictions are based on frequency and syllable analysis. This engine will predict the most frequently used words. With the help of intelligent GUI, the typing efforts of user are greatly reduced. The basis of predictions being frequency, the user gets the predictions of the words he is most likely to enter.

Interword Prediction Engine

Predicts the next word based on the prior typing. iSuggest is a new keyboard which phonetically transliterates a word into multiple intelligent suggestions.

Glimpses of iSuggest:



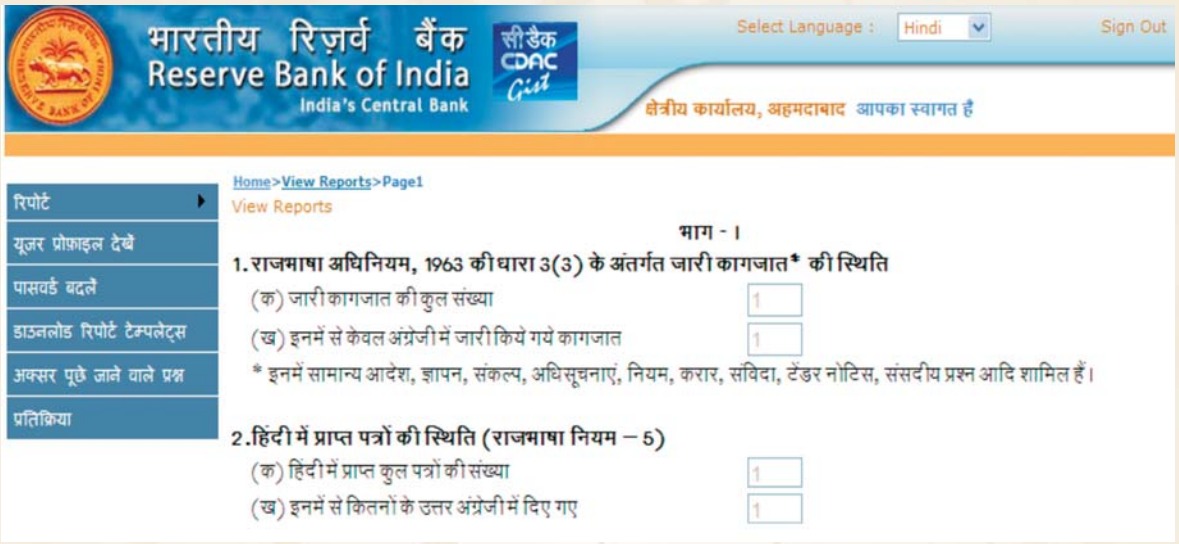
Different positions of iSuggest Notifier

iSuggest supports Hindi, Marathi, Tamil, Nepali, Gujarati, Punjabi, Urdu, Bangla and Telugu. iSuggest resides dormant in the background until it discovers a space bar following a word. When it gets invoked, the user can select one of the suggestions using mouse or using arrow keys on the keyboard. iSugget monitors the typed word and it quickly generates intelligent suggestions based on number to text conversion, abbreviation like ICICI, forward and reverse splitting of long English words like BharatBhasha, SMS and chat terms like 2moro for tomorrow, words with spelling difference like Localise and Localize.

It is compatible with editors like Open office, Microsoft Word, Notepad, WordPad etc, and works for the browser where GIST tools can be used. It can be easily integrated with both web based and desktop based applications like iPlugin, ISM and GIST typing tools.

Integrated Rajbhasha Reporting System (IRRS)

The Integrated Rajbhasha Reporting System (IRRS) is a web based Reporting System, which reduces the time taken for data collection, consolidation, monitoring and address the issues of diverse methodologies used by RBI Rajbhasha Department's constituents in preparing and submitting the reports and information with accurate compliance.



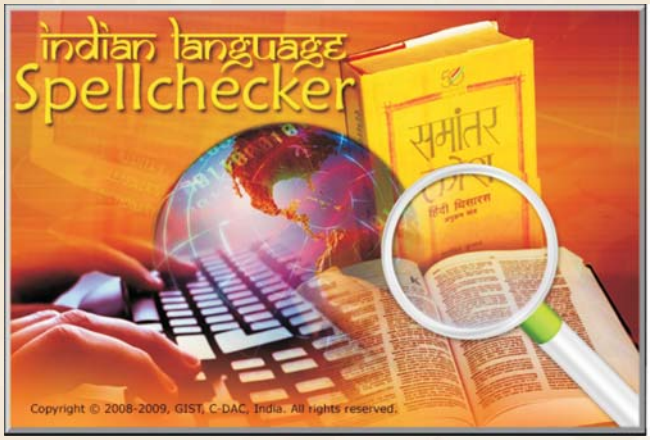
Sample Online filled Quarterly progress Report

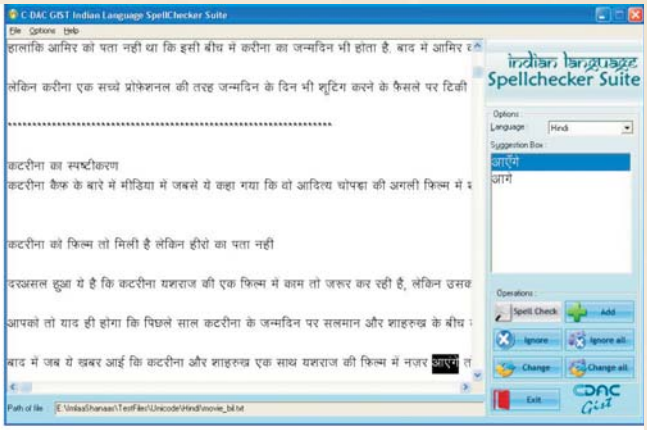
Homophone Engine for a Credit Information Services Company

Development and deployment of a Homophone Engine for a Credit Information Services Company was completed. Depending on the credit history it is decided to grant or deny the loan.. The engine helps get history of the customer and makes it easy to decide on granting the loan. Such tool plays a major role when customer's name is entered in different ways in different banks (intentionally or unintentionally) leading to non-detection of his name and hence his credit history.

Indian Language Spell Checker Suite

The Indian Language Spell Checker Suite has been developed to support Bengali, English,Gujarati, Hindi, Malayalam, Marathi, Nepali, Tamil, Telugu and Urdu.





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. The spell-checker provides the top three suggestions with an intelligent word-splitting algorithm ensuring it is safely handled. The suite also can handle Unicode, UTF-8 as well as ISCII and PASCII data. The suite has an added language i.e. “Indian English” which handles English terms and words as used in India.

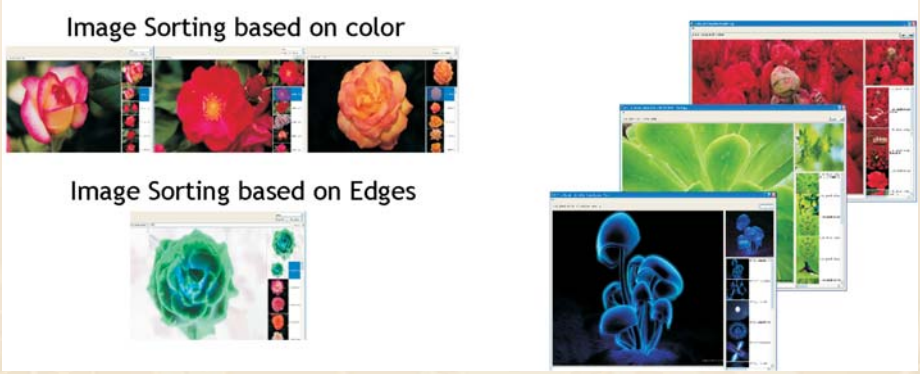
CMC-GAD English-Urdu Name Translation

C-DAC offered customized tools and technical know-how for executing the conversion of names in English to Urdu for the constituency of Hyderabad and Secunderabad. The solution included a conversion engine in the form of a dll (API) which can be called from an existing Visual Basic application of client. This conversion engine will have around 80-85 % accuracy depending on the nature of data. The data so converted to Urdu mode is available in UNICODE.

Video Search

Video search technology to analyze and automatically extract the information describing the recorded material is being explored. The search involves extracting text from film titles, analyzing the audio track, making a semantic interpretation of activities, recognizing cast scene, image, text, dialogue or a video clip and assigning meaning to particular segments of the video. The features include:

- Query by image from Image / Video Database
- Multiple Videos Supported
- Search based on Colour, Edge, Texture and Shape information
- Segmentation based on Colour and Texture
- Search based on Region Segmentation
- Clustering of Database



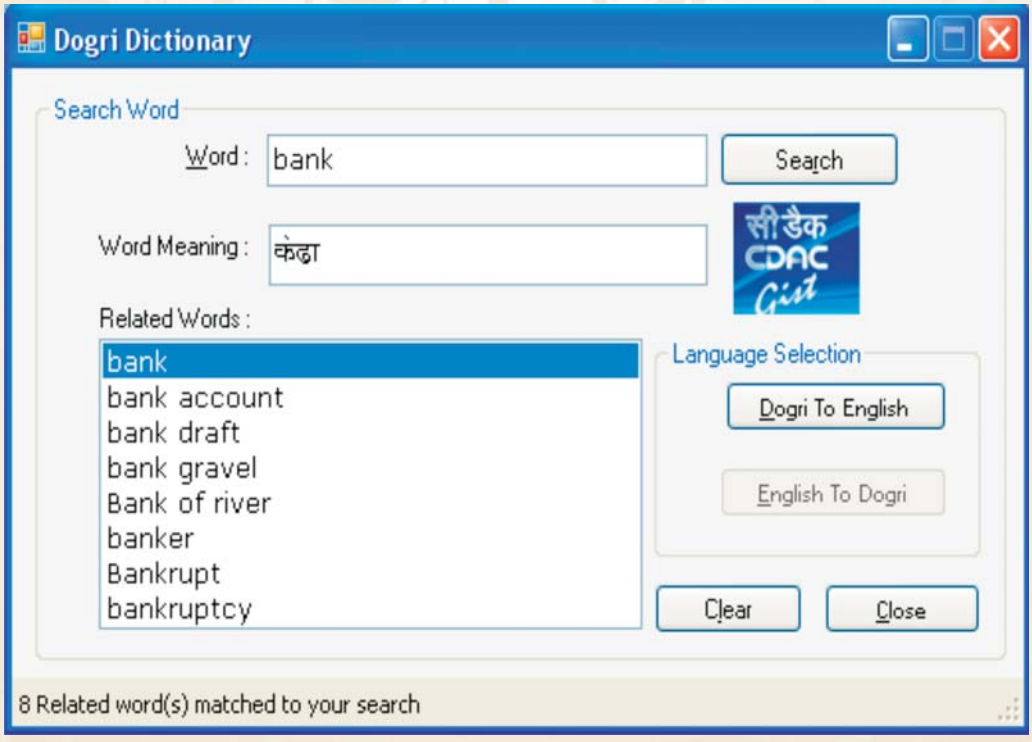
FONTS

Development of Condensed Fonts in 14, 16 and 19 pixel height in all Indian languages alongwith Bitmap Fonts in Urdu Naskh script for Printers was completed.

Heritage Script and New fonts from C-DAC

GIST Dictionary Tool for Dogri, Manipuri, Maithili and Nepali

This tool is used to search the dictionary for the English word and provides its meaning in Dogri along with the related words. There is also a provision of reverse search i.e. Dogri to English.



E - Gate Pass (Automatic Entry Pass Utility)

E-GatePass manages visitor' information and generates entry passes and photographs. The system has been developed using open source tools and can be localized in any language.

Sutra

Sutra 1.4 is a multiuser translation assistance tool for software and text localization. It makes intelligent suggestions to translators on possible reuse of translations from older translations, previous versions or related domains.

Xlit

Xlit is a transliteration tool to convert words from English to Indian languages and back, without losing the phonetic characteristics, It has potential use in Machine Translation Systems, e-Governance and other applications that require entry of text in Indian languages and English.

Sambandh: An RST Tool

The performance of automatic text summarizers and business rule extractors can be significantly improved if they also use rhetorical relationships between different parts of text apart from the commonly used lexical and syntactic parameters. The markup tool was developed and exploration in the form of identifying appropriate machine learning algorithms to automatically identify the rhetorical relations is in progress.

Amnesia

Amnesia is an extension to the Firefox web browser that enables users to annotate web content using notes and drawings and provides web services to store and fetch these annotations.

FileSecure Plugin for OpenOffice.org

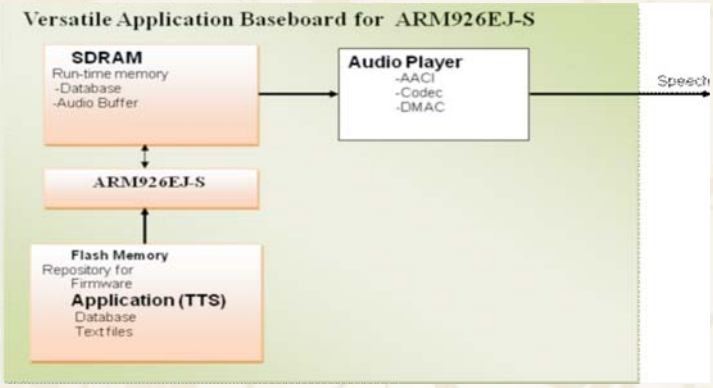
FileSecure is a Digital Rights Management (DRM) product by Seclore Systems, an IITB incubated start-up. C-DAC participated in the design and development of the plugin to incorporate DRM features for OpenOffice.org.

WiRWiB – Write it Right, Write it Better

Released an OpenOffice.org extension for WordNet (English and Hindi) called WiRWiB. It allows the OO.o user to access the information available in WordNet (Lexical database containing synonyms, usage examples for different senses of words) right into the text editor.

Embedded Text to Speech [ETTS]

This customized version of the popular PC based Text-To-Speech conversion system based on ESNOLA (Epoch Synchronous Non-Overlapping Add), was optimized for ARM 9 based embedded applications. The system database was customized with a smaller memory foot print, and the data retrieval was made faster by converting the database to a single, in-memory binary file. The Speech Synthesizer Performance has been enhanced by adapting the signal conditioning algorithm for vowel generation from floating point to a fixed point implementation.



Annotated Speech Corpora for Indian English

This project aims at building Speech Corpora to facilitate improvements in the quality of Speech technology applications. Application areas include Spoken Language Research, Automatic Speech Recognition Systems and Text-to-Speech (TTS) Systems. The projects involved the preparation of speech corpora and its transcriptions in Indian English with Malayalam and Tamil accent. Speech samples were also collected from speakers covering different age groups and maintaining equal male-female ratio. The Text Corpus contains about 3 million words and the reading materials have about 1000 phonetically rich sentences.

Standardization of IPA symbols for 3 Indian Languages (IPA-IL) Hindi, Bangla and Assamese

The place and manner of articulation of Bangla phonemes are objectively verified based on the instrumental verification of place of articulation and acoustic study for manner of articulation. A recommendation of proper representation of Bangla phoneme is provided in the study report. For Hindi and Assamese, phonemes are represented by a comprehensive list of commonly used IPA symbols for that particular language with their corresponding example words.

Adequate Intonated Text to Speech Synthesis systems for Nepali

Based on the indigenously developed ESNOLA technique, Nepali Text to Speech Synthesis System for unlimited vocabulary was developed. The system takes Unicode text as input and generates Nepali speech as output.

Indo-Japan program on Modelling of Spoken Language Prosody and its Use in Speech Synthesis (Bangla)

Automatic extraction of Phrase and action boundary from Continuous Speech and written text, Prosody Model of Bangla based on Fujisaki F0 Model and integration with ESNOLA Method based Bangla TTS were implemented.

Mega center: Digital Library of India – Phase II: Content Creation, Storage and Access

"Digital Library of India" project was initiated by the 'National Digital Library Cell' of Department of Information Technology, Ministry of communication & IT, Govt. of India in collaboration with Carnegie Mellon University, USA. C-DAC is involved in digitizing the 'Rare & Copyright Free' books as a part of Heritage Preservation. It has already digitised over 50,000 Copyright Free books by installing the Book Scanners at different libraries in West Bengal and almost 35,000 books are presently available at www.dli.ernet.in for free access.

Teach yourself Sanskrit *(Sanskrit Swadhyaya) CD Project.*

This software is a multimedia application for self learning of Sanskrit, comprising four books Varnamala, Vakya Vyavahara, Vakya Vistara and Sambashanam.

PROFESSIONAL ELECTRONICS INCLUDING VLSI AND EMBEDDED SYSTEMS

C-DAC has significant products and expertise in specialized domains such as sonic and ultrasonic testing, Tetra based communication, wireless communication, smart cards, biometric measurements, electromechanical controllers, RFID, ubiquitous computing, wireless sensor networks, electronic nose-vision-tongue, etc. These have been applied to a variety of practical domains including defence (e.g. landmine detection), material testing, agriculture (tea and rice industry, for example) and disaster recovery.

SOUNDS

SOUNDS is a System for Non Destructive Testing and Evaluation of materials, using Sonic and Ultrasonic frequencies. The system measures the velocity of a sonic-ultrasonic wave through the test specimen, along with the attenuation of the wave in the material. If the velocity of propagation of the wave in the material is known, the thickness of the material can be calculated accurately. SOUNDS can thus be used for detecting internal flaws in test specimens, as well as for studying the characteristics of materials under test, The lower frequencies used in SOUNDS makes it useful in situation such as the testing of ceramic materials, where common high frequency NDT system cannot be used. Different models, with advanced features, were released in the SOUNDS series. SOUNDS2 was designed using standard PC components (COTS) and in-house developed PC-Add-On Boards, packaged in a custom designed rugged enclosure. SOUNDS2 R3 features interface for Plug-in Transducer Modules and Transducers with built-in preamplifiers. This was used for testing of materials used in India's Space Missions.

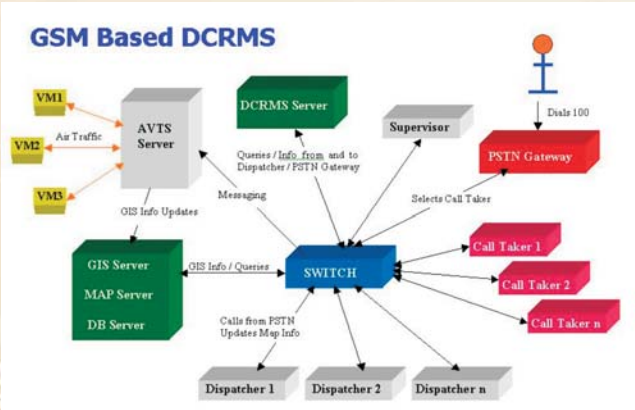
In order to cover a wide frequency range, Transducers with different frequencies are supplied with SOUNDS.

Major features are:

- Frequency sweeping, using different transducers
- Digital filtering
- Manual/Auto mode Triggering
- Relative mode measurement.
- Signal Data Archival and Play back.
- Facility to view current and archived measurements on the same graph for comparison
- Designed around COTS PC components and custom designed PC-Add On Boards
- Standard 15'', 1024x768 LCD display, built into the housing, on a foldable stand.
- Rugged and Portable Design

Distress Call Response Management System for Kolkata Police

Distress Call Response Management System (Dial 100) forwards the user calls to dispatcher terminals in the police control room. The operator retrieves the caller's identity and his location from the GIS map integrated with a Directory information database. The patrol vehicle nearest to the distress location is immediately delivered to the site, with the assistance of the vehicletracking system. The system utilizes the Vehicle Tracking and PSTN Gateway technologies which enable the state police to provide timely assistance to people in distress.



Major Features:

- Call Handling and dispatching facility
- Digital voice recording
- Dynamic GIS Map loading
- Identifying Proximate Rescue Vehicle
- Text and Image based communication
- Vehicle Monitoring
- Complete event logging and History search

TETRA Air Interface Analysis Tool (TAIAT)

TAIAT system captures four uplinks (TETRA Terminal to TETRA Base Station) and four downlink carriers simultaneously. The captured bursts are identified and tagged as per TETRA nomenclature and logged into the memory/ hard disk. The tagged bursts are also displayed on a GUI window. Development of the tool was completed and one unit has been handed over to Centre for Artificial Intelligence and Robotics (CAIR), DRDO for real time testing.

Major Features:

- Analyze TETRA signals from BS or MS
- Frequency Band 410 - 430 MHz
- Bursts identified and displayed on GUI window
- Tetra Air Interface Standard EN 300 392-2 compliant
- Detects 'Un Identified' Bursts
- Real Time Display of different kinds of bursts
- Each slot duration shown in different colour depending on the type of burst
- Search facility for different types of bursts
- Burst analysis aided by Message Sequence Charts
- Login Window, Set-up Menu and Display window
- Diversity Reception option

Secure Communication Adapter using TETRA for TAC3I Enhanced Tactical ComputeR (SCATTER)

The SCATTER system is a point-to-point secure wireless link for data and voice transfer using which a mobile commander can access network resources from LAN and originate or receive voice calls from a Telephone Network, while user is on the move.

Major features

The system consists of a mobile wireless transfer unit (SCATTER-M) and a fixed wireless transfer unit (SCATTER-F).

SCATTER-M is mounted on the commander's vehicle and the SCATTER-F is located in his office premises with wired connection to LAN and to PSTN.

In TETRA radio mode, the voice and data calls between SCATTER-M and SCATTER-F are established using base stations. In Combat Network Radio (CNR) radio mode, there is no base station and the call is established directly between the two CNR radios.

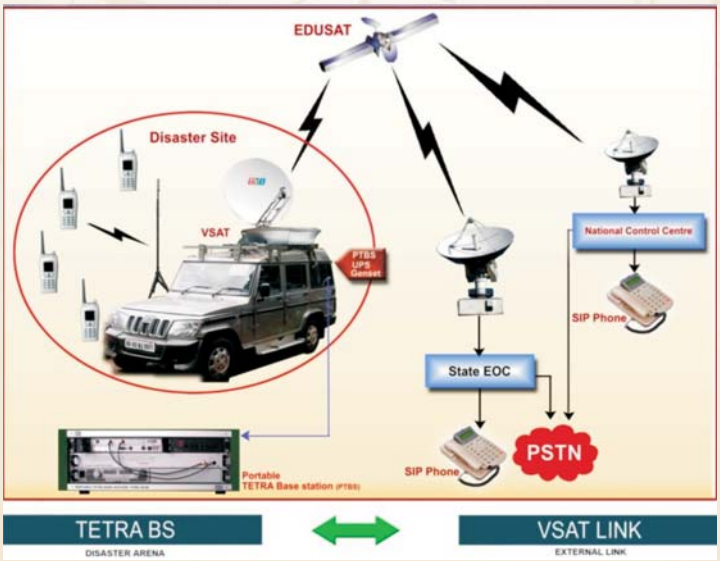
The unit has a Man Machine Interface (MMI) comprising of keyboard and display mounted on the panel. The SCATTER-M incorporate a bluetooth wireless headset for hands-free operation in addition to the wired headset and telephone handset.

The SCATTER unit has a USB interface for connecting the unit to an external USB host, Ethernet interface for connecting a PC / LAN and a GPS interface for GPS antenna connectivity. The development was done in collaboration with the Centre for Artificial Intelligence and Robotics (CAIR), DRDO.

TETRA Communication System for Disaster Application

The system is intended to ensure reliable communication for the relief and rescue teams on disaster sites. 'DHRUV', system comprises of a Portable TETRA Base Station (PTBS) and a transportable VSAT system, integrated on a vehicle.

The system is amenable to quick deployment, almost within 15 to 20 minutes. The IP enabled PTBS effectively establishes connectivity to the Disaster Management control centres across the nation, through ISRO EDUSAT link. The system also supports local communication at the disaster site via TETRA wireless handsets, by individual calls as well as group calls. Text messages can also be sent using the system. They can also send text messages to the volunteers.

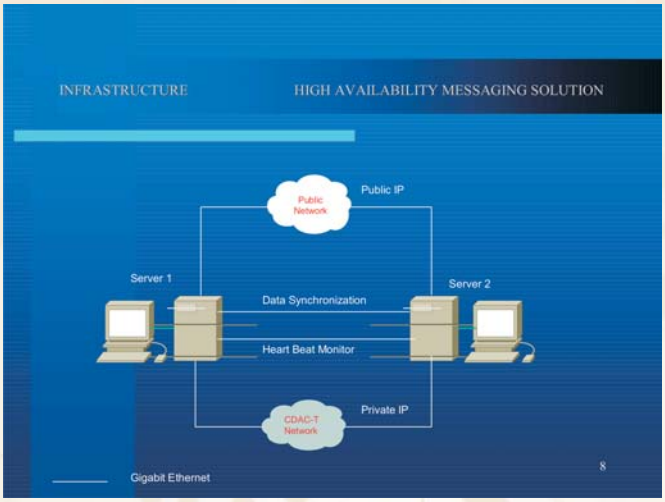


High Availability Messaging Solution

High Availability Messaging System integrates two independent servers, one acting as an active mail server and the other as a standby, a synchronization module for data synchronization, a heartbeat monitoring module for checking the health of the servers and a failover module for passing control to the standby server when the currently active one fails.

Salient Features :

- Gigabit backbone using Fiber Optic Technology
- Fully redundant L3 core switch – Redundant Supervisor Engine and Power Supply
- VLAN – thereby containing broadcast traffic spread
- Manageable switches
- GSM/GPRS Communication technology
- MODBUS Communication Protocol implementation
- Data Concentrator for Substation
- Failover Software (FoS) for dual redundant Servers on Linux and Windows platforms



Biometric Identification Module [Fingerprint ID]

Developed with a robust algorithm for finger print enhancement, extraction, identification and storing and implemented on an embedded hardware. A Biometric Access Control System developed, as part of the project, by combining the finger print identification module with a smart card reader.

Salient Features :

- False Acceptance Rate – 0.001% and False Rejection Rate - 1.0%
- Processing time < 1 Sec
- Single supply operation
- Contact-less smart card technology with normal range of (5-6) cms.
- ISO 14443A Contact-less Smart Card standard
- Operating frequency 13.56 MHz.
- PC Interface using Ethernet or USB/ UART.
- Multiple fingerprint sensor support
- Multiple verification methods
- High scanning resolution 500dpi
- fingerprint verification time < 2 S
- Template Size < 3 Kbytes
- works with existing access control systems
- 4 x 4 Keypad
- 2 Line 16 character LCD display
- Voltage: 5.5V DC
- 10/100 Mbps Ethernet connection

Low Voltage Embedded Real Time Controller for Three Wheeler Series Hybrid Electric Vehicle (3WSHEV)

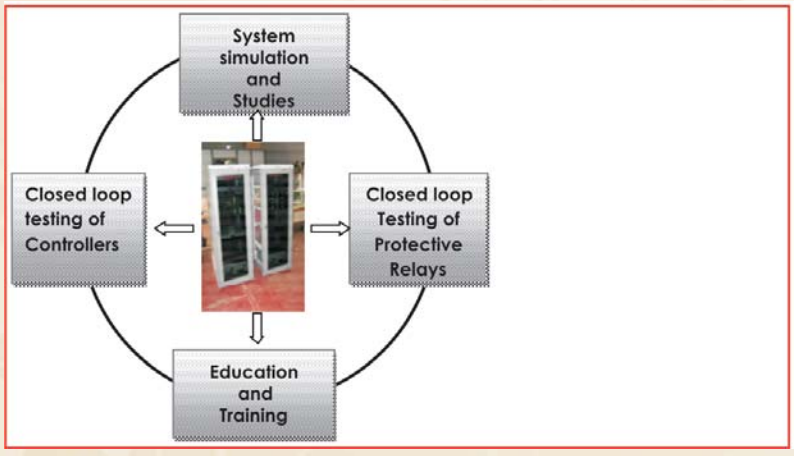
A Three-Wheeler HEV was developed in association with M/s Kerala Automobiles Ltd. (KAL), Thiruvananthapuram. The Automotive Research Association of India (ARAI), Pune conducted the acceptance test and certified the prototype. Major modules developed include Low voltage electronic control hardware with embedded DSP and CAN interface, Hybrid Power Source with battery and alternator, and CAN based network for inter-module power control. The technology is intended to be used in the passenger carrier auto rickshaws..

Product Specifications

Gross Vehicle Weight (GVW	Less than 1000 kg
Passenger capacity	350 kg
Maximum speed	50 Kmph
Maximum gradient	1 in 7
Total run per day	250 km
Run in pure EV mode	10 km (min)

Full Spectrum Simulator (FSS)

The System emphasizes on the Hardware-in-Loop (HIL) feature for Power Electronics and Power Systems with Simulation in SEQUEL (A **S**olver for circuit **EQ**uations with **U**ser-defined **El**ements) environment.



The simulator provides off-line and real-time simulation. The system can be easily configurable for custom applications at an affordable cost. This was a joint development with IIT Mumbai, under the NaMPET programme.

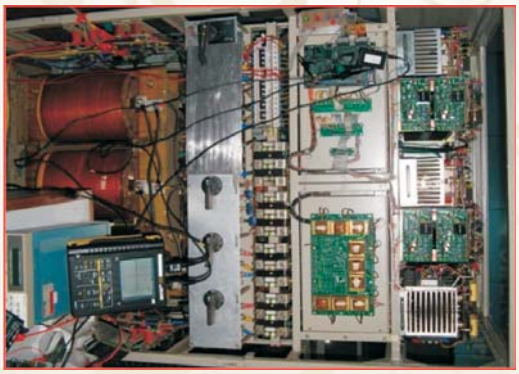
Hazardous Object Removal System

The system a high mobility platform equipped with video cameras to enable remote control by an operator. The product is flexible enough to go through doors, move up ramps and even climb steps. The system can be used to pick up and remove potentially hazardous objects to avoid mishaps and casualities.

Minimum external components assured for efficient overload limiting design. The technology highlights include a new concept wheel design for efficient skid-steer operation, a fail-safe braking system which does not consume any electric power, a new concept gear box to split traction and steering functions (enabling the use of separate motors) in a differential steer drive, and the efficient use of pulse width modulation technique for the drive. An arm carrying wrist/gripper with rotation about two axes. to remove hazardous objects like bombs, explosives, radioactive materials etc, is under development.

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

The technology for High Power Converters employing high speed Control Area Network bus (CAN) was successfully developed. The system has efficient control algorithms for enabling modularity and bus paralleling of multiple power modules. The Controller uses fast space vector control with the aid of a digital signal processor. The technology has been proven with two 50 KVA UPS Power modules. This technology has potential applications in UPS Systems, AC Drives, and STATCOMs.



Active Front-end rectifier

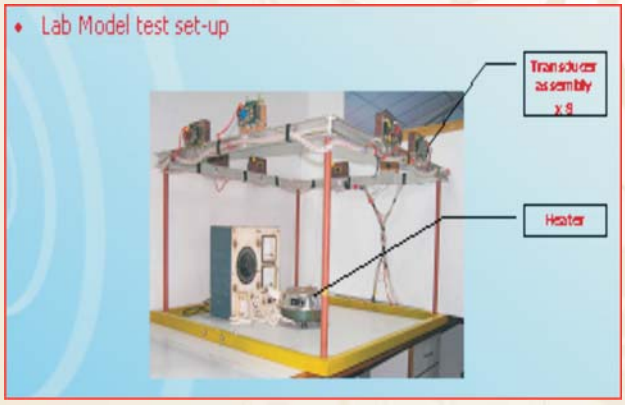
IGBT based Active Frond-end Rectifier, is a tool to improve the powerfactor minimizing current harmonics injected to the grid, to facilitate grid-friendly operations.

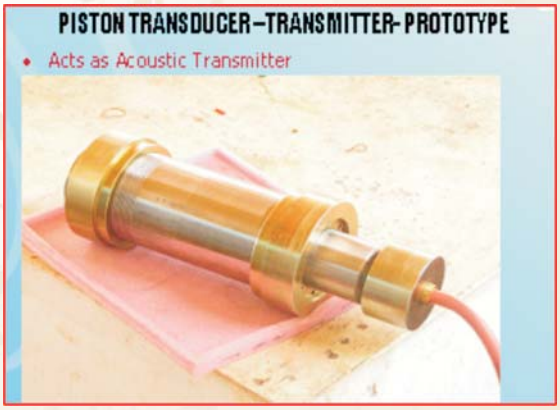
AC Drive with Sensorless Vector Control

Two types of AC Motor Drives – Single-to-Three Phase in the 0.25 Kw to 2.2 Kw range and Three-to-Three Phase in the 0.5 Kw to 30 Kw range – using Sensorless Vector Control technique was developed. The technology does away with the speed sensors found in the conventional Variable Voltage and Variable Frequency (VVVF) drives to regulate the drive speed. The control software calculates the actual speed of the machine using Field Orientation Control for the speed loop feedback. The technology finds application in the control of industrial Pumps, Fans, and Compressors, etc.

Acoustic Thermal Profiler

Acoustic pyrometry provides a practical approach for the on-line continuous measurement of gas temperature and velocity in hostile furnace and stack environments. Acoustic Thermal Profiler maps the temperature distribution inside the furnace/boiler using acoustic pyrometry. The non contact instrument technique provides average line-of-sight measurements between the acoustic transmitter and the receiver.





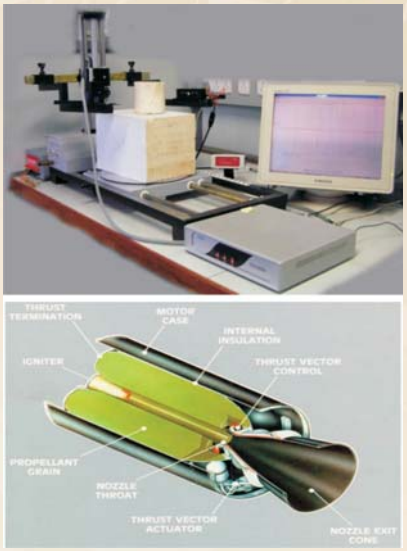
The product facilitated the study of line of sight measurement of temperature of different paths in a plane. Mapping software was also developed for converting the line of sight temperature to plain wide temperature.

Acoustic Tomography System-1 (ATOMS-1)

This Non Destructive Test System (NDT), based on the principles of Acoustic Tomography, consists of an array of transducers, one or more transmitter and receivers, signal processing hardware and tomography software. Digital Signal Processing and Scientific Visualization tools are used to generate the tomogram. The system is used for evaluating the interiors of materials such as thermal tiles used in space vehicles and Solid Propellants for rockets. With suitable adaptations and enhancements, the technique developed can be applied in Medical Tomography as well. The following objectives have been achieved.

- Travel time tomography and attenuation tomography
- Low noise front end electronics (charge amplifier based)
- Digitally programmable gain from 0 dB to 100 dB in steps of 1dB with Signal sensitivity < 5uv (rms)

- Wide band of operation from 50Hz to 1MHz
- Portable automated scanning mechanism with USB interface



Major Features

- Capable of detecting flaws in specimen with high acoustic attenuation
- Choice of travel time or attenuation tomography
- Tomogram gives a graphical view of the non-homogeneity
- Capable of operation under a wide range of frequency and power levels
- Configurable signal detection algorithms
- Scientific visualization for in-depth analysis
- Logging of scanned data for future offline analysis
- Customizable configuration for scanning and reconstruction to support different type of specimen

Magnetic Modeling Software

The Magnetic Modeling Software finds application in systems for Degaussing (DG) and Deperming of Naval ships and submarines and it marks an important milestone in the development of Range Technology.

A sea-going metal-hulled ship or submarine, due to its interaction with the Earth's magnetic field, develops a magnetic signature as it travels. This signature can be exploited by magnetic mines, or by any magnetic anomaly detection (MAD) equipment. Navy uses deperming procedure, in conjunction with degaussing, as a countermeasure against such eventuality. The magnetic signature can also be used for identifying friendly ships.

The ship's Magnetic Model is created from the data collected by Magnetometers (sensor), while the ship passes over an array of sensors deployed on the sea bed (underwater Range), together with the data on the track of the ship with respect to the sensors, obtained using differential global positioning systems mounted on the ship. The software is now deployed in the DG Analysis machine at the Underwater Ranges, Goa.

Acoustic Landmine Sensor System

Developed for Research and Development Establishment (Engineers), R&D(E), Pune, the system uses acoustic technology to detect anti-personnel and anti-tank mines. With an array of 128 Non-contact sensors, fixed on a vehicle-mount arm capable of automatic height adjustments to compensate for ground undulations, the system can perform ground scans at the rate of 7000 cm^2/sec and can detect mines independent of the material (plastic or metal) used in them. It is usable under different soil conditions (wet or dry) as well. Distributed computing, TDMA Multi-channel Buffered Serial bus, Built-in health monitoring etc. are other highlights of the technology.

National RFID programme

The overall objective of the project was to focus on research and development in the areas of RFID and sensor networks with special emphasis on the Indian scenario and providing technical and educational services to the Indian industry. The project was conducted along with IIT, Kanpur and Sameer, Mumbai.

The following end to end RFID based applications were successfully completed and implemented

- Parcel tracking system for department of posts. This end-to-end application, named Anupathan, tracks parcel as they move in the postal process. It uses hard core plastic RFID tags and fixed and hand held UHF readers. The bar code labels are fixed above the tags, facilitating compatibility with the existing bar code based software of the department of posts. The system also generates automatic delivery bill (AWB) and does faster scanning of postal bags. The online tracking information of the postal bag and, the article are provided through the URL link "DoP portal", indicating the percentage of tracking. The system was implemented at Delhi, Mumbai, Chennai and Bangalore.

- The standalone people management system (SPMS) based on UHF RFID technology, is an application for anytime, anywhere monitoring of the presence or absence of the subject of interest e.g. employees, visitors and students. It is "standalone" as the application runs on the reader itself, which queries for the presence of tag IDs in its vicinity and records the data.

Every individual carries an RFID enabled card on his body. When he passes through the radioactive region of any access points the tag is detected by the antenna and individual's presence in the area is recorded. The transponder and the interrogator work in UHF range with long read range. It provides totally hands free and parallel detection and attendance marking. The system can be extended for Timesheet, payroll, event management system etc.

Open SCADA solution for Jaipur Vidhyut Vitaran Nigam Limited (JVVNL)

This system helps JVVNL utilities and management teams to monitor power flaws and to utilize the generated power efficiently and effectively to create a stable zonal grid generated. Data acquisition, data transaction, presentation and historical storage form components of this project. This solution is based on secure infrastructure for energy accounting.

Black Box Version-II

The device is used to record parameters such as speed, load, brake oil, temperature, etc, of the vehicle during its usage. Two prototypes of 'Black Box Version-II' were developed, with first one using serial memory chips to store data. The memory size was extended considerably by the use of flash memory in the second prototype. The unit has a compact and light weight being optimization of embedded hardware for faster and easy download of stored data, Cost effective video camera and new user interface are prepared for Black Box Version- II.

Salient features:

- RISC processor based design
- Flash memory, large and fast
- Single-sided PCB with minimum complexity
- In-System Programmer
- Compact, light unit

Pilot Deployment of Electronic Nose and Vision (ENV) System for Tea Industriesin North-East States of India

Deployed 5 ENV systems at selected Tea Industries / Research Institutes in the North-Eastern states and created awareness on ENV technology amongst growers, planters, manufacturers and other stakeholders in black tea trade in North Eastern states through series of training, workshops and seminars.

The ENV systems provide the industries/institutes a non-invasive method for objective assessment tea quality, based on the new technology developed by C-DAC. Subsequently C-DAC initiated the tea industry automation project at Tripura.

Measurement of Blackness and Fibre in Finished CTC Tea by Electronic Vision System

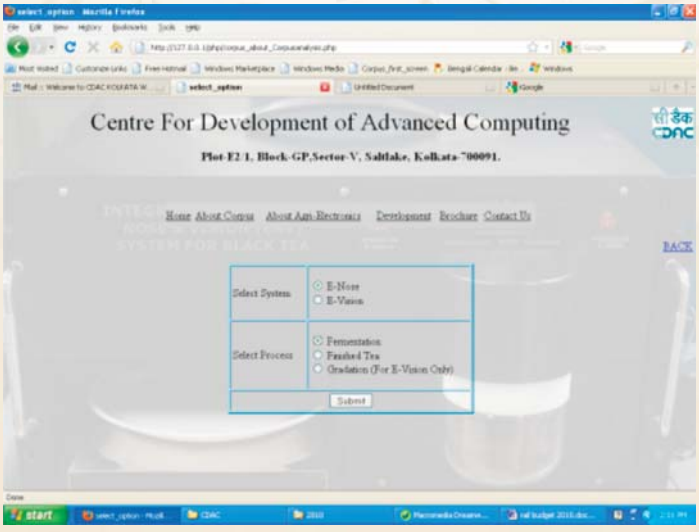
The Electronic Vision Software Module determines the Quality of Black Tea by Measuring Blackness and Fibre of Finished CTC Tea. Image analysis software was developed and tested successfully.

Quality Measurement of Aromatic Rice (Basmati) by Electronic Nose and Vision (ENV) System

Developed ENV System and Software for Measurement of Quality attributes of Aromatic Rice, like, Basmoti, Radhuni Pagol, etc, incorporating image analysis based dimension analysis. Customized rice aroma module was developed for testing boiled rice.

Corpus Creation of Measurable Physical Parameters of Indian Tea

ENV Systems were installed at six different geographical locations in India for tea quality data collection. The system facilitates data collection, archival and presentation of Tea quality corpus data. Study of quality characteristics of Black Tea due to aging is in progress with the corpus data being collected over the internet.



Exploratory Study towards Development of Electronic Tongue for Detection of Rare Earth Materials

Exploration of Development of Electronic Tongue for Detection of Rare Earth Materials for Variable Energy Cyclotron Centre (VECC), Kolkata is in progress. Preliminary testing was done for detection of Rare Earth Elements like, Lanthanum, Cerium, Europium, Zirconium etc. The data analysis was done based on Principal Component Analysis (PCA) and Neural Network to identify the materials.

Synchronous Modules in Ad hoc distributed embedded real time system

The project aims at creating a methodology, tools (compiler and run time executive) for modular design, compilation and execution of synchronous programs in Esterel. The technique employed to achieve a modular sample Esterel program, the synchronous arbiter, tries out various modularization strategies by hand coding, and moves the methods to the open source Columbia Esterel Compiler and a specially created Run time Executive.

Several methodology issues were discovered. The main challenge was the design of the distributed algorithm that starts with tentative tri-state signals (present, absent and unknown) and iteratively firms up the signals to present or absent. A framework was developed to try out by hand various strategies on how to iterate, activate which module and when to decide that a signal can be assumed to be absent.

National Level Ubiquitous Computing Research Resource Centres (Hyderabad, Chennai and Bangalore)

The project aim at advanced research activities in the multidisciplinary areas of such as 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.

Aware Home (Intelligent Room)

The Aware Home integrates Activity based Lighting, Interactive Mirror, Smart Kitchen Cabinet and Smart Bed. A 60 W LED lighting fixture driven by PWM drivers and controlled by Wireless Sensor Network (WSN) was developed. An inventory management system and automatic shopping list preparation functions were implemented for Smart Kitchen cabinet. Movement detection algorithm using load cells were developed to classify body movements during sleep. Face detection and face recognition features were integrated with Interactive Mirror.

Adaptive Framework for WSN, V1.0 was completed and distributed to the Ubiquitous Computing Centers. **Constraint based role based access control (CRBAC)** model for Security Framework was completed. U-Learning with GrUb prototype 0.1 is being integrated. Prototype implementations for **U-Agri, Smart Parking and Intelligent Intrusion Detection System** were completed and deployed in field for testing.

Software Technologies including Free and Open Source Software (FOSS)

The programme aims at the development of methodologies, frameworks, tools and end-to-end application development. Applications were developed for domains such as e-governance, geomatics, accessibility, etc. Contributing to the building of a conducive eco-system for open source is a crosscutting concern. There are also special efforts focussed on this aspect, such as the BOSS support centre project and the NRCFOSS project.

National e-Governance Service Delivery Gateway (NSDG)

NSDG is one of the 27 Mission Mode Projects under the National e-Governance Plan (NEGP) of Government of India. The NeGP aims at cooperating, collaborating and integrating information across different departments in the Centre, States and Local Government. Government systems, characterized by islands of legacy systems using heterogeneous platforms and technologies and spread across diverse geographical locations, in varying state of automation, enhance the challenges of the projects.

The emergence of many e-governance applications for different departments to provide online services to citizens, businesses and government necessiates increasing interactions among departments and external agencies at different levels in the Government. It is necessary to create connectors and adaptors for point to point interfacing between departments. Application tend to get complex, not readily yielding to maintenance support, upgradation, adaption to changing versions, policies, rules and practices. The National e-Governance Service Delivery Gateway (NSDG) was conceived as an effective, standardized interfacing, messaging and routing switch through which the departments, front-end service access providers and back-end service providers achieve interoperability of the data and applications. The National e-Governance Service Delivery Gateway (NSDG) aims at establishing efficient interfacing among autonomous and heterogeneous entities of the Government (in the Centre, States or Local bodies), within a structured framework of e-Governance Standards. The system was operational, and details are available at http://www.nsdg.gov.in/.

State e-Governance Service Delivery Gateway (SSDG)

In synchronization with the vision of DIT on the e-Governance, an interoperable messaging X-change, which acts as a middleware between the Service Access Providers and Service Providers was developed. The project encompasses development and deployment of the X-change software, as well as Training Programs for generation of awareness.

e-Forms Engine (FULCRUM)

The C-DAC e-Form Engine generates e-Form for use by the citizens for online as well as offline submission. Through the state portal, the e-Form data is routed by State eGovernance Services Delivery Gateway (SSDG) to the Centralized Department Server (CDS) where the information is stored. Department services retrieve the information from the CDS process the data and submit the response to the State Portal. SSDG generates periodic status updates for the citizen through State Portal.

e-Forms PoC with 40 forms from 5 states were demonstrated successfully. The eForms Engine-Fulcrum is ready for state officials for online use from India Portal and for customization to the state services. The sites http://eforms.gov.in or http://eforms.cdacmumbai.in give more information on the e-Form Engine.

Decision Support for Automated Refactoring (DSAR)

DSAR project focuses on quality perspective of software technology. Refactoring is suggested to improve the quality of the software. However, the identification of which refactoring should be applied where is still person dependent. The project aims at providing the guidelines that suggest the candidate requiring refactoring and also which refactoring is to be applied. It helps identify the classes, methods and attributes that may be re-structuring to improve the quality of the design of the object oriented programs. The project necessiates computation of various object oriented metrics, detection of clone methods, drawing the lattices, and defining new metrics to suggest generalization based refactoring.

Anumaan: predictive text entry system

Anumaan is a predictive text entry system that predicts the next word / words that the user will enter, based on previously used words/ part of words. The system is available as a standalone application as well as an integrated version with the Linux Desktop.

SoftRouter

In the current implementations of routers, control and forwarding functions are collocated and tightly integrated by static association of control and forwarding elements. This project was aimed at designing a router architecture with dynamic association between control and forwarding elements, and with separation of the implementation of control plane functions from packet forwarding functions based on standards being developed in IETF. A testbed was established using XORP (Extensible Open source Routing Platform) routing engine and Click forwarding plane for implementation of standards. Extensive experimentation was conducted on the test bed for separation of forwarding and control elements.

India Development Gateway (InDG)

India Development Gateway, during its Phase I, established a multilingual platform (www.indg.in) for knowledge sharing with information, products and services in 5 Indian languages on 5 identified verticals. InDG facilitated the networking of more than 250 project partners across India related to rural development sectors and created a large base of users.

Development of Quality Assurance Framework for e-learning

This project attempts to build quality metrics, prototype tool for evaluation, comparison of e-Learning applications**.** A prototype tool was developed for use by end users/developers for benchmarking e-Learning tools and content. The tool produces analytical reports based on five quality parameters viz., Usability, Accessibility, Security, Performance and Content Reusability, etc. The evaluation copy was deployed in STQC Hyderabad and Bangalore centres for feedback on tool functionalities. As part of this project, 450 teachers were successfully trained through workshop.

Release of Nutrition and Health CD, jointly developed by C-DAC and NIN

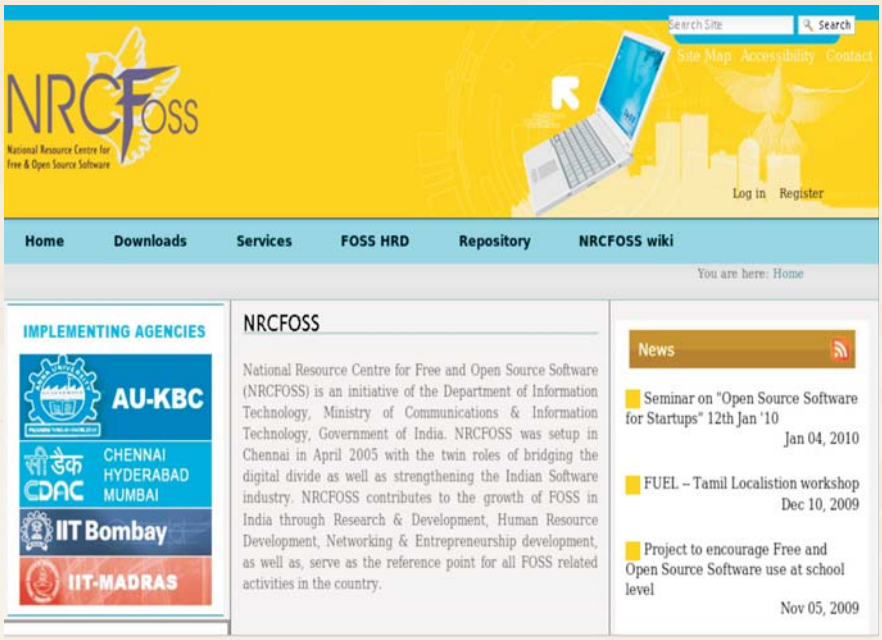
National Resource Centre for Free and Open Source Software (NRCFOSS) Phase-II

Subsequent to the successful completion of the initial phase of NRCFOSS, the second phase of the project was launched. Phase II involves a larger number of installations, consolidates the work done in Phase I, and broadens the scope of work. Phase II involves the following major components:

1. Service oriented architecture, MIDs, repositories for e-governance and scientific computing.
2. Accessible desktop for disabled, dynamic knowledge repository for education
3. Walk-in lab for open source e-learning solutions

This phase also includes object oriented kernel for Linux, GCC resource centre, and formal education in FOSS, as the response building of the partner institutions.

The portal www.nrcfoss.org.in. provides the privileges to edit, submit, review and publish the contents to all the implementing agencies and authorized members. The portal has provisions for updating the contents, files, images and allows interaction with the activities of NRCFOSS, open source activists and NGOs with appropriate authorization



- Provision made for FOSS repository under various categories (e.g., Education, e-Governance, etc.) and interaction with NRCFOSS and contribution from (authenticated) FOSS Community / Users / Developers / NGOs, etc.,
- Open source equivalents for scientific and e-governance domain e.g. Scilab, Octave, Gras. etc., in scientific domain
- Information on / link to open source software developed at C-DAC (PIS) and state level and National agencies such as ELCOT, NIC, etc..

BOSS – Indian distribution of GNU/Linux

New versions of BOSS with updated versions of components including the kernel and new features were released. Significant efforts were made to enhance adoption and deployment through media publicity, special workshops and training programs.

- **EduBOSS – BOSS Linux distribution for education domain**

  The EduBOSS focusses on School education and being tested on-site in school environments. Modification to packages are being done based on feedback from local schools, IT @ School project Kerala. Deployment is being initiated in schools in Punjab as part of BOSS deployment in 46000 desktops under Sarva Shiksha Abhigyan. Designed and developed BOSS User manuals in Punjabi and text course books of various classes from VI and XII of Government Upper primary Schools of Punjab.

- **Migration to FOSS :** Open source equivalents for education and scientific domain such as Scilab, Octave, Qcad, R (Statistical package), etc., were tested to perform on BOSS platform.

- MOU signed with Indian Navy and Government of Tripura for BOSS Linux deployment

Establishment of BOSS Linux Support Centres

As part of this project, BOSS Support Centres were established at C-DAC centres at Mumbai, Bengaluru (E-city), Thiruvananthapuram, Noida, Delhi, Mohalli and Kolkatta. An MoU with NIC was signed to promote adoption of BOSS in NIC projects. Training programs were conducted on BOSS and related technologies. Assisted organizations in adopting BOSS, in building customizations, and in the migration process.

- Central Board of Secondary Education: FOSS was adopted by CBSE in the Senior Secondary curriculum. A joint proposal created in consultation with CBSE, was submitted to DIT for teacher training and resource/capacity building to implement the curriculum. The proposed project includes development of Repository of open source utilities/modules covering Online Tutorials, for Maths, Science and Social Science subjects, Digital Libraries and other Web resources on select topics relevant to school curriculum for secondary level. Edu-BOSS lab for development of repository equipped with relevant hardware, software resources and tools. It is proposed to train around 5000 teachers across ten locations.

- **CHiPS Chattisgarh** – Trained over 175+ staff and installed BOSS Linux in more than 200 systems. BOSS Linux was deployed for the prestigious project CHOiCE, in six districts. The roll-out in the remaining districts of Chattisgarh will start soon. Several services on CHOICE successfully run on BOSS, – such as Data Correction in SC/ST certificate, Data correction Income/Domicile/ Marriage, Integration of workflow is in process on open source for various projects like CHOiCE, SDC, Digital Government, CGSWAN, and Citizen Call Centre for enabling G2C, Smart Card Tool Application deployment on BOSS.

- Activities pertaining to ruggedization, customization and promotion of BOSS OS were carried out. This involved localization of select modules of BOSS OS like OpenOffice.org and IceWeasel. BOSS OS supports 18 languages in OpenOffice.org. As a part of BOSS Resource Centre the team also provided Indic Script support in PDF Export of Jasper Reports.

E-Governance

NCTE On-line, a web portal for ICT penetration in Teacher Education Programme, supported by National Council for Teacher Education (NCTE), successfully implemented at NCTE portal, running at **www.ncte-india.org.** On 28th January 2010, Shri Kapil Sibal inaugurated the 'NCTE Portal' and released the 'User-Manual' to be used by the officers of NCTE and other stake holders. This software system facilitates the integration of the functionalities of NCTE in Head Quarter and regional centres. The online Portal helps the Teacher community to gain access to Internet through ICT and to facilitate other services like online registration of applications, online Appeal filing, online Teacher's registration, online Student's registration, online Institute registration and Integrated MIS for NCTE, are the features of the application.

Beej Prabandhan, a web Based Supply Chain Management and Customer Management Software was developed for National Seeds Corporation Limited (NSC). The software helps in effective planning, easy and accurate forecasting and expediting the work. The system has modules for production planning and control, sales and marketing, inventory management, quality control and financial aspects.

Development of "Beej Prabandhan" has been completed and the system is under implementation nearly 90 offices of NSC spread across India. The application is hosted at C-DAC, Noida Data Centre. Data for the year 2009-10 was successfully captured in the system. The project also integrates extensive training to the System Administrators as well as officials and users in Head Office and Regional Offices of NSC.

e-Court-Digital Recording & Retrieval System (eDRRS) and Digital Evidence Management System (eDEMS)

The integrated system produces and records high resolution digital masters of courtroom proceedings.

The eDRRS project is a tamperproof, secure and integrated Courtroom Scanning system for digitally storing the courtroom proceedings with the retrieval and searching system of the original content. The objective of the eDEMS project is to setup a tamperproof, secure and integrated Courtroom Scanning system for digitally storing the case files and evidences with the retrieval and searching system of the original content. The objective of the eDEMS project enables storage of the case files and evidences, and facilitates retrieval and searching of the original content.

Inauguration by Mr. Justice A.P Shah, Honourable Chief Justice of Delhion Feb 8, 2010 at Kakardooma District Court

Personnel Information System for Dakshin Haryana Vidyut Vitran Nigam (DHVBN) and Uttar Haryana Bijli Vidyut Vitran (UHBVN)

This is a computerized Personnel Management System and Pay Bill Register System for all their offices in Haryana. It automates the activities in the Establishment and Accounting Sections of more than 36 offices of DHVBN and UHVBN. This system shall be made available at all Divisional offices through Internet to perform personnel functions such as e-service records, increment, promotion, transfer, maintenance of staff residential quarters, performance appraisal, sanctioning staff loan/advances, settling retirement benefits etc. The system has been fully implemented in DHBVN and is in an advanced stage of its completion in UHBVN.

Online Test System for Graduate Engineers in IT

This is a software package for conducting online examination for Graduate Engineers in Information Technology has been completed. The software can be used by various agencies for the purpose of conducting examination at class, institute or university level. The system facilitates standardized assessment of skills required by professionals in the IT industry, by creating a collaborative system to use already existing material available in collaborating institutes like NIC, DOEACC, and C-DAC and to expand and by fine tuning it as per the specific requirement of the user community. The PGD entrance examinations and recruitment examinations and DOEACC, Course on Computer Concept (CCC), in C-DAC, NOIDA in the years 2009 and 2010 were conducted with this system.

Goa Valuation and e-Registration Software (GAURI)

The application suite was released statewide, by Shri Digambar Kamat, Chief Minister of Goa, was launched the 'Gauri' software at the Margao Sub-registrar's office on 5th November 2009.

KAVERI -Karnataka Valuation and e-Registration

a) **KAVERI – BHOOMI Integration** - Export facility has been provided from C-DAC's application KAVERI to BHOOMI and vice-versa as per the requirements given by BHOOMI Monitoring Cell. The system was completed and deployed in February 2010. Since then, KAVERI-BHOOMI integration is in operation in Karnataka state.

b) **Dashboard based DSS:** An effective decision support system - MIS has been developed for the Stamp & Registration department of Karnataka. It generate specified reports on performance levels achieved for day-to-day transactions in various Sub-registry offices. Transaction Reports and Revenue Statements are generally used for monitoring and decision support.

c) **Bio-metric authentication:** Bio-metric authentication has been enabled for all types of transactions in KAVERI application. This has been demonstrated to the client.

Online Management, Monitoring and Accounting System (OMMAS) for Pradhan Mantri Gram Sadak Yojana (PMGSY)

An internet application for OMMAS has been designed and developed. This application analyzes business data collected and presents information graphically so that the user can make quality business decisions. Indian regional language interface (currently in Hindi and Oriya) has been incorporated in OMMAS (in citizen's reports section).

Online e-payment voucher to banks for release of payments to suppliers for activities done under Administrative Fund has been introduced in OMMAS. The vouchers generated through the system are secured with encryption and password authentication. Provision of uploading annual/ monthly/ quarterly reports at state login has been provided.

Geomatics

Near Real Time Flood Monitoring

Project on Near Real Time Flood Monitoring in the Brahmaputra Valley using Microwave Remote Sensing has commenced. The salient features of the project are:

- Tool developed for analysing Microwave remote sensing data for monitoring of floods in near real time
- Web GIS based Software developed for dissemination of flood related data and information to the end user in real response time.
- Beta version of the software is installed at DC office North Lakhimpur, Assam

Comprehensive Spatial DSS

A project on Comprehensive Spatial Decision Support System (SDSS) for Bodoland Territorial Areas District (BTAD) has been undertaken. Current achievements include:

- Spatial Decision Support System named 'Aranya' (â version) has been developed and installed at BTAD, Assam
- Tool for village development planning has been developed and incorporated in Aranya.

Multicriteria Spatial Modeling

A project on Multicriteria spatial modeling for identification of potential Afforestation/ Reforestation sites for claiming 'carbon credits' and analysis of futuristic landuse dynamics has been undertaken. Under this project a predictive modeling tool has been developed and Level 1 Site identification (afforestation/ reforestation) has been completed.

Biodiversity Characterization

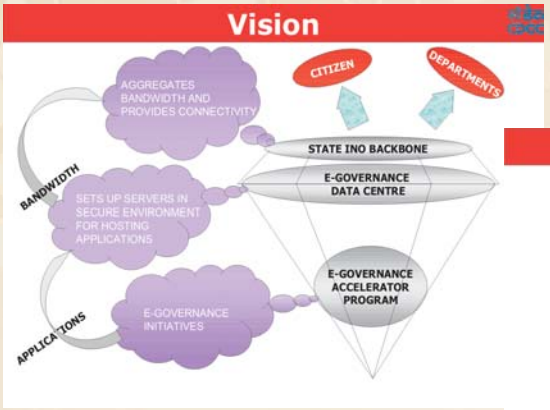
Project awarded by National Remote Sensing Centre on Biodiversity Characterization at Landscape Level in Bihar and Maharashtra and another similar project covering "Western Ghat" have been undertaken. The progress includes:

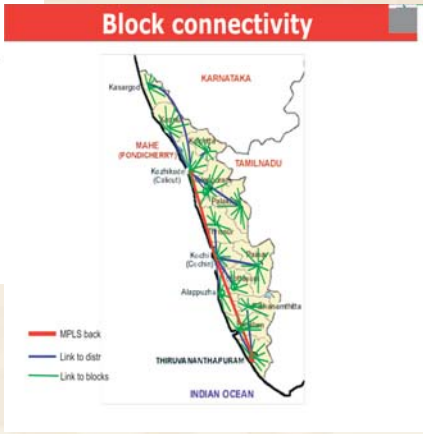
- Vegetation type maps using remote sensing data has been prepared.
- Landscape characterisation to establish disturbance gradient using GIS has been completed.
- Prioritizing areas of bio-richness for bio-prospecting using GIS has been done.

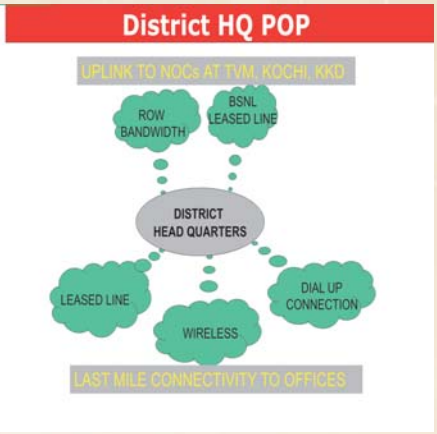
Kerala State Wide Area Network (KSWAN)

KSWAN makes use of the State Information Infrastructure (established earlier under the DIAMOND project funded by DIT) to provide connectivity up to Block level, and is the prime enabler for the E-governance activities of the state of Kerala. The State Information backbone extends from Thiruvananthapuram to Kozhikode, with Network aggregation centers at Thiruvananthapuram, Kochi and Kozhikode. The network coverage includes 14 District level and 152 Block level POPs. Over 600 Government offices access the E-Governance applications running at the Data centres and more and more offices are getting linked to KSWAN on an ongoing basis.

The WAN makes use of IEE 802.11g wireless technology with AES (Advanced Encryption Standard) and WPA (Wi-Fi Protected Access) security and a MPLS (Multi Protocol Label Switching) backbone.







ICT Enabled Integrated Assessment tool for Mentally Retarded Children

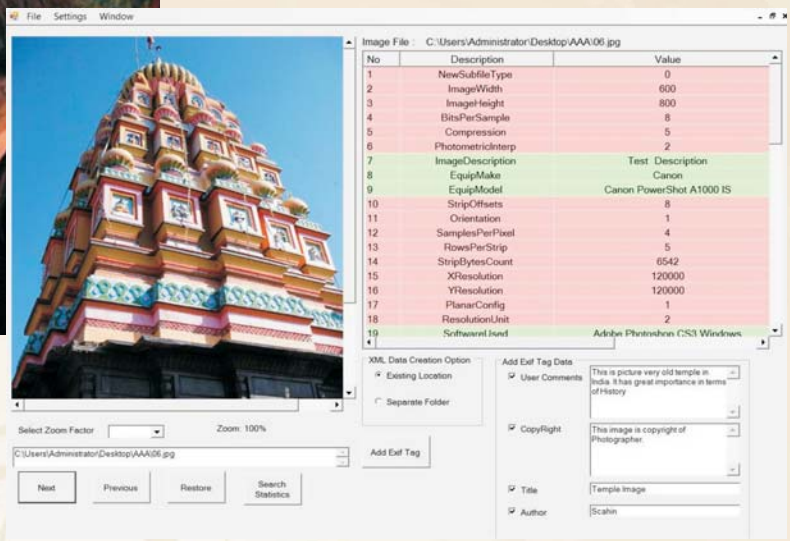
The tool aids specialist teachers to maintain detailed assessment and programming records and helps them in analyzing the results and evaluating mentally retarded (MR) children. The package supports Functional Assessment Checklist for Programming (FACP) and the BASIC-MR (both methods developed by the National Institute for the Mentally Handicapped (NIMH), Secunderabad) and Madras Developmental Programming System (MDPS), for evaluation. The system is already put into operation at eight special schools in Kerala.

Major features

- Areas of achieved independence, areas in need of strengthening and problem areas are identified for each child and based on this analysis, long term goal and short term objectives are suggested for each child, by the system. Also suitable lesson plans are suggested from a built-in lesson plan repository.
- For group teaching, a grouping algorithm suggests who are to be grouped together based on the current assessed level of each child.
- The development pattern of each individual child can be analyzed term wise, year wise, level wise and domain wise, which will be a very useful tool in planning the programming of children.
- Custom reports like evaluation report, case diary etc. can be viewed/ printed. Graphs for domain wise evaluation, growth charts etc. are also automatically generated.
- The system can be hosted in public domain for use of any/all special schools in the country by which we get a national repository of details about the children with MR.

Interactive Kiosk Software on Harappan Civilization at Prince of Wales Museum, Mumbai

- The touch screen based interaction kiosk software has been deployed in Prince of Wales Museum. This helps to
- Become an archaeologist yourself (reconstruct a broken artifact)
- Play Harappan toys
- 3D Visualization of Harappan water system, townplans and settlements
- Information in English and Marathi Languages (both in text and audio formats)
- Image Browser for viewing the rare pictures of Harappan excavation sites like Dholavira



Metadata Extraction Tool for Heritage Archives

An automatic extraction tool for capturing the technical metadata of images and audio files has been developed based on the EXIF standard. A functional prototype of this tool has been developed and tested over the digital collection of heritage archives. Features of metadata extraction tool like Support for JPG, TIFF and WAV formats, Batch processing with XML output, Metadata management.

Bharateeya Embroidery- ver 1.0 (Phulkari-traditional embroidery of Punjab)

Software to create motifs or to design a new pattern of shirt using the library has been developed. The demo version developed earlier has been upgraded to version 1.0 after conducting beta version testing.

IPR CELL -

C-DAC has established two Patent Search Centres in ICT domain located at Pune and DIT Delhi. Patent Engineers shall man the centres and provide assistance to various IPR related requirements in ICT.

CYBER SECURITY & CYBER FORENSICS

As the technologies move from closed, isolated and proprietary environment to more open, standardized and interconnected environments, the systems have become more vulnerable to attacks. Protection of such critical infrastructure is vital because such an attack impacts the life, economy, environment, and the pride of the nation. Security in the age of digital technology has many dimensions; and C-DAC has been playing an ever increasing role in this domain, with a number of innovative solutions and technologies.

Cyber Forensics Lab for CBDT (Central Board of Direct Taxes)

Three Cyber Forensics labs was set up in CBDT at Delhi and Mumbai offices. The entire basic infrastructure required for cyber forensics investigation and analysis has been deployed at the centre. The centre is equipped with high-end forensics workstations and analysis machines, portable forensics workstations, write-protecting devices, disk cloning devices, disk wiping devices and shadowing devices. The analysis workstations are loaded with powerful disk imaging tools, data recovery and analysis tools, password recovery tools and tools for network forensics and device forensics.

Cyber Forensics & Digital Analysis Centre for Kerala Police

A state of the art training lab with interactive learning facilities has been setup for Kerala Police. All prominent Cyber Forensics Tools, have been deployed at the Centre. The centre has facilities for seizing, authenticating, acquiring analyzing and documenting digital evidence from computer storage media and computer networks, Mobile Phones, PDAs, Smart Phones etc. The Centre also facilitates the law enforcing agencies to get their officers trained in cyber forensics investigations.

Malware Prevention System

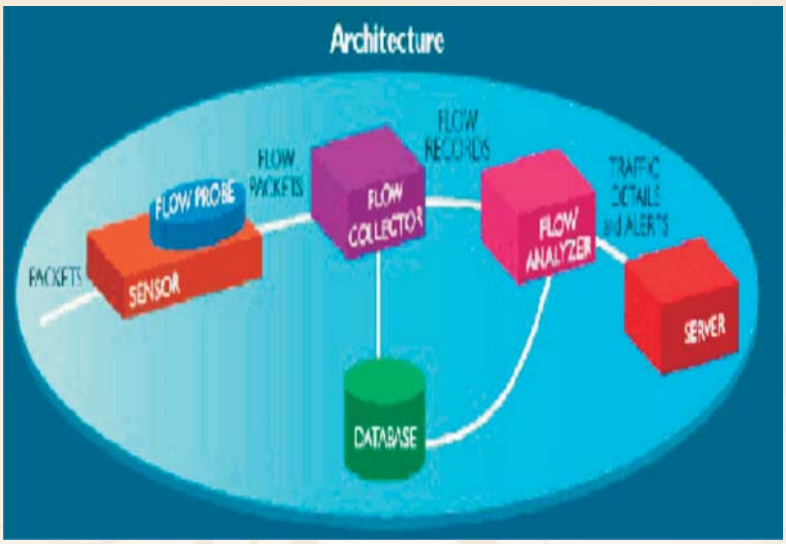
Prototype implementation of the solution for specific applications such as MS Word, MS
PPT, MS Excel and PDF reader profiles on Windows OS and PDF reader, messaging application and Firefox profiles on Linux OS) has been completed. The development of generalised solution with extended functionality and to accommodate / create number of applications has been completed for Windows OS and Linux OS and also independent testing of the Process Execution Control module has been completed by user agencies.

Hardware based Network Intrusion Prevention System (IPS)

Guard Your Network (GYN) is a Network Intrusion Prevention System (IPS) being developed as a part of this project. GYN captures packet in the in-line mode at wire speed, carry out multi-method detection using several signature and anomaly detection mechanisms

and will be capable of taking preventive action of any critical attacks detected. Currently GYN is available as Software in-line IPS (with IDS mode) and work is in progress to develop the NetFPGA based Hardware GYN.

Anomaly Detector and Traffic Information System (Adrisya) is a web based traffic monitoring and anomaly detection tool. It uses flow data, which can be imported from various network devices like routers and switches, suitable for carrying out high-speed network traffic analysis. The major components are, probe (flow enabled devices), collector and analyzer. It also collate data from multiple probes and provide the traffic details in the web interface.



Dynamic Network Firewall for Grid Environment (DyNeF) is a dynamic network firewall developed to grid environment to protect it from network intrusions. It has implemented widely used Community Authorization Service (CAS) to define access privileges for hosts within the virtual community. In addition, firewall agent component does the dynamic re-configuration based on the common policy derived for hosts, in view of the VO and administrative domains.

Rudraa (intRUsion Detection pRevention signAture formulation)

It is essential to craft different type of signatures to identify the potential attack. To validate the IDP signatures, it's necessary to carry out the validation and attack analysis. RUDRAA has the support framework (packaging, bug tracking, code improvement and customization), which improves the usability. Bug fixing mechanism enables the end user to report "bugs" found in IDP software, and, further developer refers the bug details to fix it. End user may check the status of announced bug and, if it has fixed, then, they can update their existing version of IDP with new release.

STARS (Two-Factor Authentication)

STARS is a Two-factor Authentication Solution for Web based Services. It ensures strong security for authentication systems besides achieving excellent usability. STARS offers flexibility of using any other external device such as USB Token. It also chooses the software tokens to be installed on the personal machines. It is based on an efficient protocol that uses cryptographic hash functions and offers dynamic authenticated key for securing further communication.

Steganography Resource Centre

Hidden communication using Steganographic technique is an increasing threat towards the society internationally related to the issues on cyber crime. The objective of the resource centre is to develop steganalysis tools to detect, extract and reconstruct the message (Text) embedded innocuously within different digital covers using steganography tools available as freeware or shareware.

Two products namely Stegocheck ver.4.0.3 and StatAnalyst Ver 1.0 have been developed. Stegocheck ver 4.0.3 is planned to be installed in four North Eastern states. Expression of interest from different user agencies has been received regarding the deployment

of the developed tools in the field condition as well as expansion of its capabilities to cover the cracking of more steganographic tools.

Development of the Face Recognition system tolerating greater variation of Pose, Intensity and Expression

Development of Face Recognition Engine to suit the requirement of the various security agencies, targeting to develop a prototype face recognition system to meet the user specification including :

- Pose variation - ±30° out of plane rotation from frontal position.
- Illumination variation: ±20% relative Intensity Variations between test image against stored facial images.
- Expression Variation – Six (6) types of Mild human emotional expression variations in facial images (namely: Happiness, sadness, Disgust, Fear, Surprise etc.)

Development of Distributed Honeynet system

Dynamically configurable Honeynet Node is based upon the vulnerability exploitation. System has been developed with the help of virtulization technologies. In addition to that, the following objectives have been achieved.

1. Design of distributed Honeynet architecture.
2. Design and development of distributed Honeynet node for capturing malware binary.
3. Malware analysis for Bot detection (Analysis and Detection)

In the Malware Binary Collection domain, C-DAC has developed a remotely deployable honeynet node capable of malware collection involving following:

1. Mechanism applied for collecting Malware Binary from High interaction Honey pot
2. Mechanism for periodically sending the binary collections to central server using SSL/TLS based secure channel
3. At central server, these binaries are fused with other log files and converted into a relational database form

HEALTH INFORMATICS

C-DAC continues to consolidate its strength in core areas of Health Informatics. E-Shushrut and Tejhas, well know Hospital Information Solutions (HIS) clocked more installation in the year. C-DAC offers a range of telemedicine solution including the well established Mercury and Sanjeevani, and the open source based e-dhanwantari aimed at Rural healthcare. C-DAC's telemedicine solutions have been deployed in Myanmar and Tanzania. Implementation in Himachal Pradesh has been done. 24 mode telemedicine network is being actively used in Punjab with about 75-100 consultation taking place every month. A new version of Sanjeevani working over the web has just been released. In Kerala, a specialization of telemedicine for cancer teleoncology has been developed and deployed. An implementation in Tamilnadu has just been completed.

Significant efforts to align with international standards effort have been initiated. Fully compliant software development kits are now available as products for HL7 and DICOM standards. Over a 1000 downloads have been reported. Work on EHR is progressing.

Medical imaging is seeing significant growth with focus on analysis of scan images. Cerviscan is a project led by C-DAC Thiruvanathapuram and Sweden.

Another active area of growth is biomedical instrumentation. The Digital Programmable Hearing Aid has now been released and deployment of about 40,000 units is to commence soon. A pulse analysis package capable of analyzing one's pulse as per Indian 'Medi Chikista' is under development. It is a joint project between BARC, IIT Bombay and C-DAC. This uses advanced signal processing techniques to classify pulse as per the traditional scheme. Another significant development effort is to build a leakage analysis for critical and sensitive equipments such as those used in ICU. A working version of the system is now available.

One major challenge in this area is interfacing medical informatics system with medical equipments. C-DAC is building expertise in this area in adapting and building device drivers in this area.

Analyzing and using medical documents is an emerging area in C-DAC. Semantic analyses of medical documents, e-health portal, knowledge visualization, cure@home, etc., are examples of efforts in this category.

Cure@home is an awareness building system now available as a product. It gives information about common diseases, healthy life style, home remedies, etc., A number of copies have been developed at North-East too.

C-DAC has designed and built the entire hospital computerization including the ERP system in many places. Sawai Man Singh Hospital has completed phase I and is now moving to phase-II. PGIMER is nearing completion.

As detailed health information data becomes available, further levels of technology become enabled. Attempts have been started to look at cancer records for data mining and building decision support system. Leveraging on its strength, a number of state of the art educational and training program are also being offered by various C-DAC centres. These include courses on repair and maintenance of biomedical equipment, module on telemedicine (8 weeks), 6 month post-graduate diploma in health informatics, etc.

Recognizing the significance of health informatics across the world, C-DAC has active international linkages in this area. These include

- Joint R&D projects under Indo-Sweden collaboration
- Ethiopia telemedicine project
- Myanmar and Tanzania telemedicine project
- CaBIG, USA collaboration for cancer care and Research tools on GARUDA grid

Many of our solution are also now moving to exploit new technological advances. From desktop to web, Sanjeevani has moved. Support for barcode, wireless connectivity, smarter interfaces including touchscreen, rulebased diagnosis component, etc. are actively being incorporated building a new generation of solution.

Setting up of Telemedicine Facilities in Tamil Nadu

In continuation with deployment of the Telemedicine facility across the country, C-DAC has setup telemedicine facility in Tamilnadu.

The Patient-side nodes were established at the Government Hospitals of Thiruvannamalai, Rameshwaram, Thiruvellore, Kancheepuram, Dali-Krishnagiri, and Ooty. The Specialist-side nodes were established at Government Roypettah Hospital, Chennai and General Government Hospital (GGH), Chennai. Various medical devices and computing resources were deployed as part of the project. More than a thousand patients benefited with Specialist care remotely at locations near to their residence rather than incur travel to Chennai.

Technology Development for Building Distributed, Scalable, and Reliable Healthcare Information Store

The objective of the project is to architect and develop technology / mechanisms / framework that can be used to build a distributed, scalable, and reliable healthcare information store system. The system can have a single Electronic Health Record (EHR) for every individual of a nation in the area of Medical Informatics.

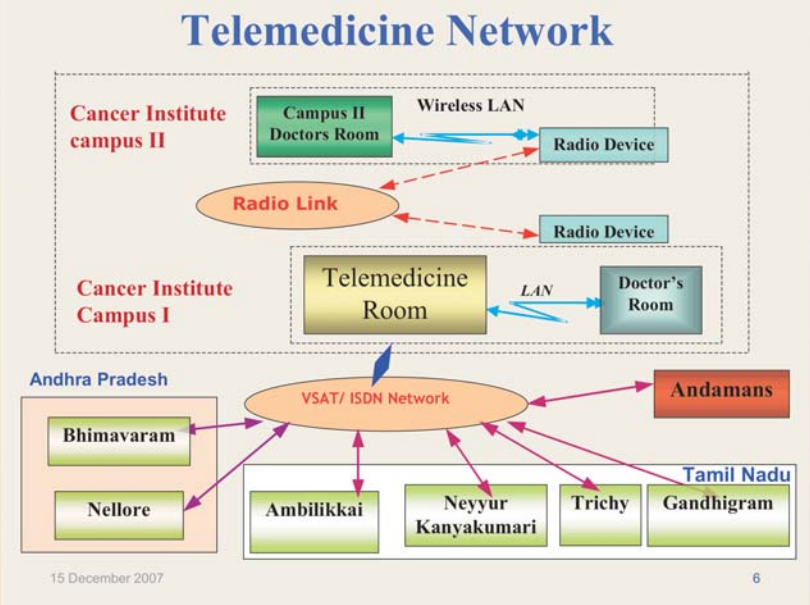
The project is initiated under Sweden-India Technology Collaboration program and is being jointly executed with Swedish Institute of Computer Science (SICS).

C-DAC's Medical Informatics Software Development Kit Suite v2.0 containing SDK for DICOM PS-3.0-2004 and SDK for HL7 v2.5 were released on the occasion of 21st Foundation Day. The product is available from the website (http://medinfo.C-DAC.in).

Web based Image Processing system and Telemedicine Network For Cancer Institute (WIA), Adyar, Chennai.

The telemedicine hub is set up at Cancer Institute (W.I.A) campus which is the specialty centre and the telemedicine remote centres are set up at the peripheral hospitals across Tamilnadu, Andhra Pradesh and Andaman. All 8 centres are connected with high bandwidth VSAT/ISDN network.

The telemedicine centres focus primarily on early cancer detection, follow-up treatment, creating cancer awareness, training and Continuing Medical Education. Early Cancer detection Centres have Tele-pathology and Tele-radiology support. Image capture, storage, transmission and remote viewing etc. are done through Mercury software developed by C-DAC.



Oncology Web portal hosted on Internet provides all details about the hospital to the public. Learning Resource Centre for Oncology provides cancer related information to clinicians, health planners, health workers etc. The system also facilitates easy access to up-to-date oncology information. This helps cancer detection at an early stage and to shift rural patients in critical stages to Cancer Institute, Adyar for comprehensive treatment.

The system creates a virtual environment of super specialty in rural hospitals enabling patients to have a live discussion with their specialist doctor. Facility for real-time transfer of patient demographics and images over the network helps reduce the number of patient visit to the specialist hospital to a minimum. The tele education facility is utilized to build cancer awareness among rural masses and to update the knowledge of junior doctors working at remote hospitals.

Hospital Management Information System (HMIS)

PGIMER - Chandigarh

Development of Phase -1 and Phase-2 consisting of 17 Modules was completed. The Modules developed are – Patient Registration, Patient Billing, Emergency, Out Patient Management, In Patient Management, Patient Enquiry, OT Management, Blood Bank Management, Laboratory Information System, EPR, Appointment, PIS, Accounts, Payroll, Online Inventory and Procurement. Patient Registration Module is live in PGIMER, Patient Billing, Blood Bank Management is under implementation. HMIS is under deployment at Sawai Man Singh Hospital Jaipur, GNCT Delhi. Phase I has been deployed at SMS and Phase I under deployment GNCT Delhi. Apart from these modules, some specific modules such as Biometric Interface. Digital Pen has also been deployed at the site.

Customized Hospital Management Information Solution for Composite Hospital, ITBP Chandigarh

The fully process automated system has been deployed at ITBP Chandigarh. The system helps to bring transparency and accountability in the day to day operations.

Establishment Tele-ophthalmology Centres at 'Drashti Netralaya' Dahod, Banswada and Mobile van

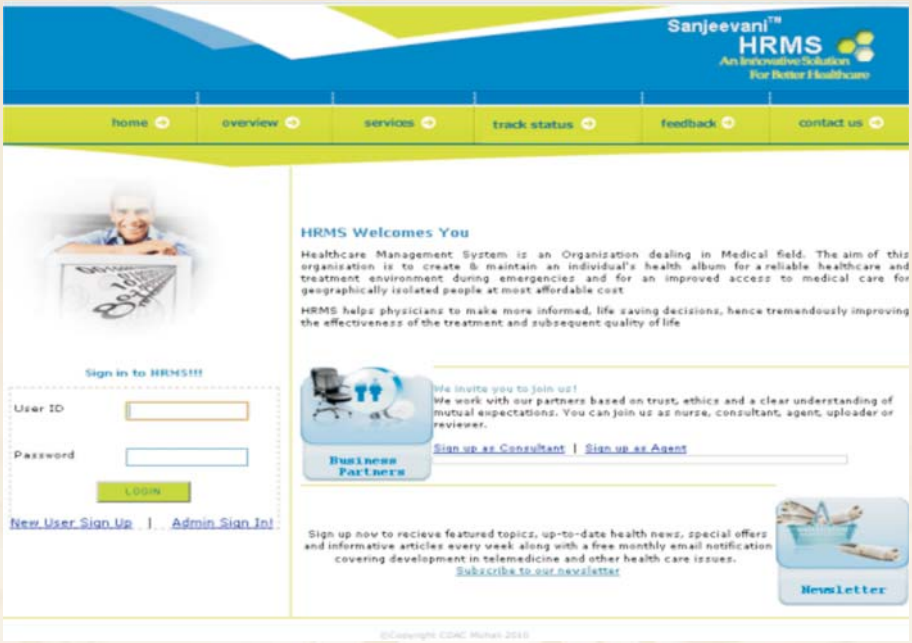
- Drishti Netralaya at Dahod Gujarat required Tele-ophthalmology Setup to connect with Remote centre at Banswada and with their existing Mobile van.
- The remote site at Banswada has basic ophthalmic examination equipment that needed to be interfaced with the tele-ophthalmology software. The Drashti Netralaya Dahod is serving as a super specialty referral centre.
- Web based telemedicine solution eSanjeevani has been deployed

Telemedicine Software

Upgradation of the existing telemedicine software by including additional clinical modules of dermatology and nephrology and maintenance of the existing Telemedicine network is under progress

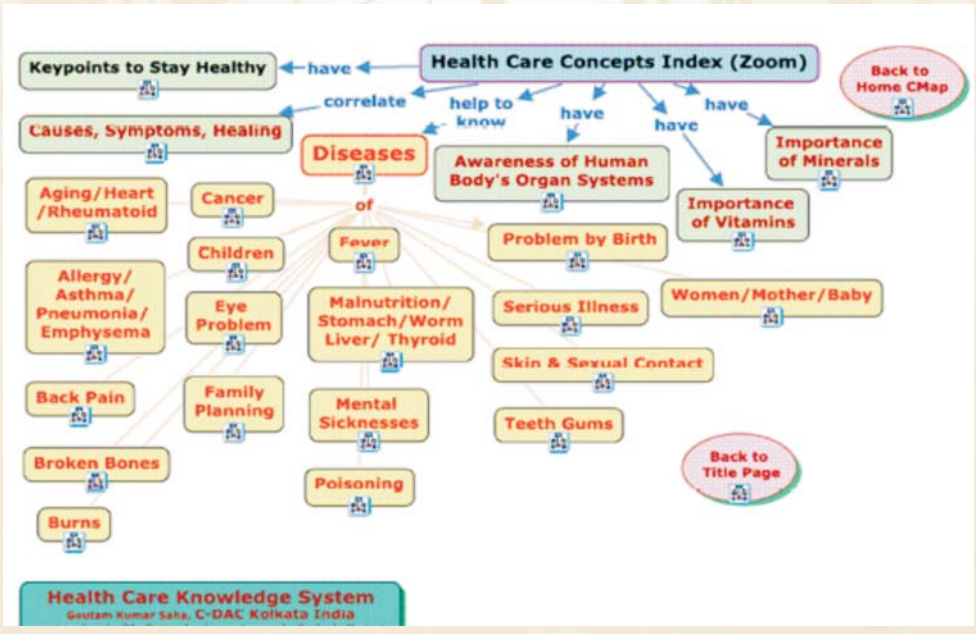
Establishment of telemedicine including videoconferencing facility at Govt. Hospital Sirsa under Telemedicine

- General Hospital Sirsa requires tele-referral system using Telemedicine connectivity, for performing Video Conferencing with PGIMER Chandigarh, PGIMS Rohtak, SGPI Lucknow, AIIMS New Delhi, IG Medical College Shimla and TM Cancer Hospital Mumbai etc.



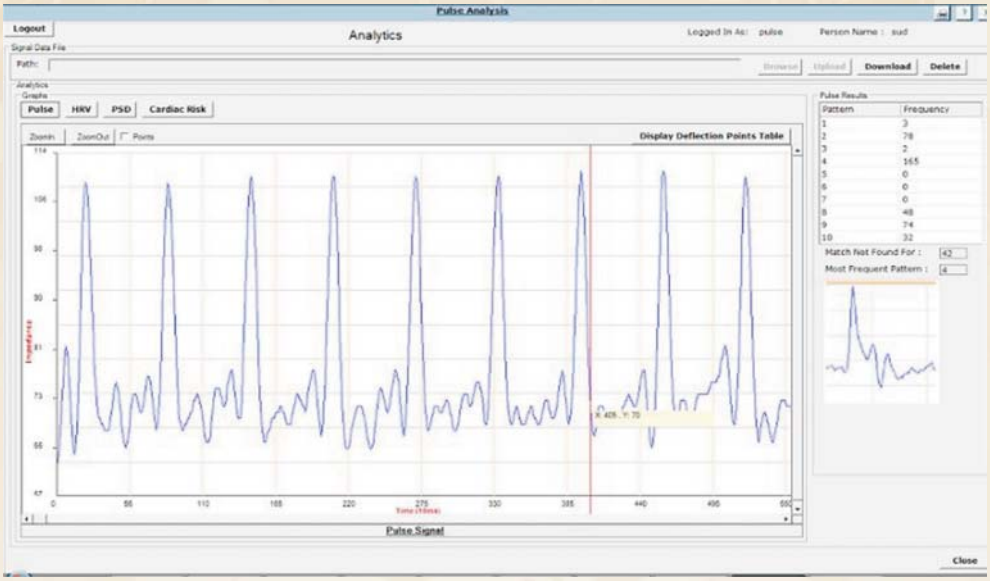
Healthcare Management System

A web based health care system has been developed having access digitized Electronic Medical Record (EMR) of patients on internet. It is a central repository of the patient's data. Efforts are underway to make it include global health standards.



PulseAnalysis

Metabolic Syndrome is one of the major health care challenges. It is cluster of various disorders that includes Obesity, Diabetes, Hypertension, Coronary Heart Disease and dyslipidemia. Pulse analysis can have major role in management of these diseases in terms of prediction, early diagnosis and prevention of complications. C-DAC has collaborated with reputed hospitals and super-speciality clinics of Pune.



The project involves instrumentation assisted Decision Support System deploying Data Mining Techniques for Pulse Examination and Diagnostics (Nadee Pareeksha). The system capture Pulse data and its variations with other physiological parameters using instrument(s),and to develop Computational Models for Clinical Assessment of pulse qualities.

Research and development activities of Pulse project included automatic detection of dominant Dosha. These trends were validated with manual examination of Pulse by senior Ayurveda physicians. A system based on mathematical modeling was developed to automate the detection of Pulse pattern.

Cure@Home

Standalone version of the Software has been deployed at 10 e-villages in Arunachal Pradesh, a couple of team members visited for seminar and feedback. Deployment has been planned for web-version of software at Tripura. Two marketing partners have started sale of software.

Web-enabled version of Cure@Home has been developed and deployed for testing.

EDUCATION AND TRAINING

C-DAC continued its foray in education and training through its several formal and non-formal training programmes with the objective of sharing the knowledge generated in its R&D activities, with students and the industry. Some of the key activities and training programmers carried out during the year are mentioned below.

New Courses Launched:

- A new course on Healthcare informatics, titled "**Post Graduate Diploma in Healthcare Informatics"** has been designed and launched in August 2009. The objective of the course is to enable student to understand the concepts in Healthcare Informatics, learn the skills required for solving issues involved in aggregation and analysis of information on various factors of healthcare.

- **Diploma in Integrated VLSI and Embedded Systems Design (DIVESD)** has been designed and launched as a pilot batch. This course gives an understanding of Embedded Systems and VLSI system. This DIVESD course is designed with emphasis on both areas, so that the students can face challenges in the design and development of the system.

Training for the students from Minority Communities:

Ministry of Minority Affairs, Government of India has taken an initiative to offer job oriented training programmes to empower the students belonging to the minority communities. This training has been planned to be executed through empanelled agencies. Under this scheme, 2200 students from the minority communities are being trained. This programme has been launched at 31 locations and 15 states across India.

The ICT training programmes offered under this scheme are as follows:

- Diploma in IT Project Management (DPM)
- Diploma in Business Computing (DBC)
- Diploma in Embedded Programming (DEP)
- Diploma in Java Programming (DJP)
- Diploma in MS.NET Programming (DMS.NET)
- Diploma in Software Quality Assurance (DSQA)
- Post-Graduate Diploma in Information Security (PGDIS)
- Full-time Post-Graduate Diploma in Advanced Software Technology (FPGDST)
- Post Graduate Diploma in Information Technology

Information Security Education and Awareness (ISEA) programme

A comprehensive national campaign on Information Security for Industry, academia and masses has been conducted under the Information Security Education and Awareness (ISEA) programme:

- Total 104 workshops conducted across country and 33 cities covered in 17 states
- Total 4000 Teachers/Parents/NGOs participated
- Total 16000 School Children/Students and 543 Engineering Students are covered in the above workshops
  www.infosecawareness website (new look) designed and making ready for inauguration.
- 10 cartoon stories developed for Children Story Book
- Four e-newsletters distributed through e-mails for registered users
- Course material like guidelines for XP, Linux, wireless configurations are developed
- Flash movies are developed
- New sections like women section was started
- Hindi translation is in process for release of website

PKI under ISEA Programme

Public Key Infrastructure (PKI) Awareness and Training Program comes under the Information Security Education and Awareness programme, PKI Awareness initiated by, Government of India and carried out by C-DAC Mumbai. Two day Awareness and Training Program conducted under ISEA project at C-DAC Mumbai during 24-25 April, 2008. The targeted audience was staff of other C-DAC centers, System Administrators, Managers and Technical staff of any organization working in the field of Information Security.

Collaborations

SPANCO

C-DAC and SPANCO have entered into an agreement to jointly bid for the e-Migrate project of Ministry of Overseas Indian Affairs, GOI.

TCS

C-DAC and TCS have signed an MoU for R&D in the areas of Software Architecture and Refactoring for large software.

ICT Training for North East Region

The objective of imparting the training in this region is to develop citizens of this region. It is done through establishment and operation of progressive and efficient training programmes, thus improving the quality of the technical knowledge. This also aims at installing and using the best modern practices and techniques in the conduct of IT training programmes. C-DAC has planned to establish 5 centers of excellence in ICT training at North east region. Signed MoU with **National Institute of Technology, Agartala** for collaboration in training and research in ICT. NIT Agartala has been made the Satellite Training Centre of C-DAC.

Setting up of CAD and Training Centre for Weavers/Artisans of Gangtok, Imphal & Aizal

This Project will focus on establishment of Computer Aided Design (CAD) Centre with an aim to upgrade skills of Weavers / Artisans and creation of innovative IT Based Design Development with state-of-the art IT-based tools and techniques so that they are e-enabled to respond to fast changing global needs.

Sarva Siksha Mission (CAL) Program in Purba and Paschim Midnapur

Teachers Training Program to empower School Teachers so that they can made their own lecture material (CAL) for respective subjects.

Corporate Training

C-DAC offers various specialized training programmes for corporate and organized sector. C-DAC is working with the Indian Army since 1999 and has signed MoU for offering IT training programmes to the Army personnel. Over 8000 personnel are getting trained every year in 16 different courses designed for Indian Army. Similar training initiatives are carried out for Indian Navy. NESEC (Advanced Network Security Training programme) was conducted at BEL Bengaluru on 9th Dec 2008, at Defense organizations Thiruvananthapuram on 16th Jan 2010, and at MTNL Mumbai on 4th April 2010.

Formal Education

C-DAC continued its role as human resource developer in the IT area and offered courses of various shades including high end programmes of M.Tech (VLSI Design) and M.Tech (EPDT).

Programme for Advancing Computer Education (PACE)

Along with the creation of tools and technologies for putting Indian languages on the digital medium, a spear-headed movement is needed to spread computer education in Indian Languages. This is all the more important if computer literacy has to permeate to the general public which does not understand English and would like to work in their own languages. PACE attempts to address this challenge providing training in computer literacy at various levels. Following important actions were undertaken:

(a) **Capacity Building Education and Skills Development programme.** Since women play a key role in social and economic growth, a pilot training program has been undertaken under the aegis of the Department of Information Technology to train the women community of Gujarat. "Capacity Building Education and Skills Development programme" for Women targeted especially at the weaker strata covers the aspects of Language Technology on Computers and makes them self-reliant opening up employment prospects in the digital medium.

(b) **Language Training Activities:** Imparted training to approx 28000 students covering the aspects of multilingual computing and solutions along with the existing market technologies; also trained 1200 teachers of Pune District in July 2009, under the Sarva Shiksha Abhyan.

(c) The Government of Gujarat has approved Certificate course in "Computer Concepts" in their recruitment criteria.

(d) During the year the employees of the following were trained:

- Hindustan Machine Tools, Kerala
- Kerala Health Services, Kerala
- Medical Council of India, Delhi
- Indian Air Force, Hindon etc.

TechSangam

Under the **TechSangam** Scheme, around 300 engineering colleges across India have been affiliated. 10 faculty development programmes under TechSangam have been conducted.

C-DAC has signed MoU for conducting various high-end IT courses in following four institutions.

- C-DAC has entered into agreement with VelTech University, Chennai for conducting M.Tech programmes jointly. As per the agreement C-DAC shall provide expertise in designing and formulating the course structure and syllabus of various ICT related two year M.Tech Programmes, with Internship, Research and Dissertation work.
- Smt Kashibai Navale College of Engineering, Pune
- Vyas College of Engineering, Jodhpur
- Vyas Engineering College for Girls, Jodhpur
- S S College of Engineering, Udaipur

Placement Initiative

The Common Campus Placement Programme for the February 2009 and August 2009 batches were conducted in the months of July 2009 and February 2010 respectively. Efforts were made to bring maximum number of companies and thereby give maximum chances to students.

Design and Development of e-Learning contents for e-security Solution Developers Achievements:

- e-Learning contents on e-security for three category of users have been developed , namely
- Post graduate /Engineering students
- System Administrators/Working Professionals
- Scientists
- The developed contents have been hosted on C-DAC (N) and DOEACC Website.
- Free training of the developed e-security contents to the users is being imparted in e-Learning mode from C-DAC Noida and DOEACC Website
- Till date there have been around 3000 plus registrations for the courses

Releasing the Proceedings of Eleltech India 2009 on November 5, 2009. Members present (L-R) – Dr. Sarat, Mr. Ramakrishnan, Mr. Ravi Shankar, Mr. Anant, Dr. D.N. Reddy, Mr. Rajan Joseph, Dr. Vijayakumari, Professor, JNTU

Design and Delivery of e-Learning Programme for Disaster Management Development in existing project

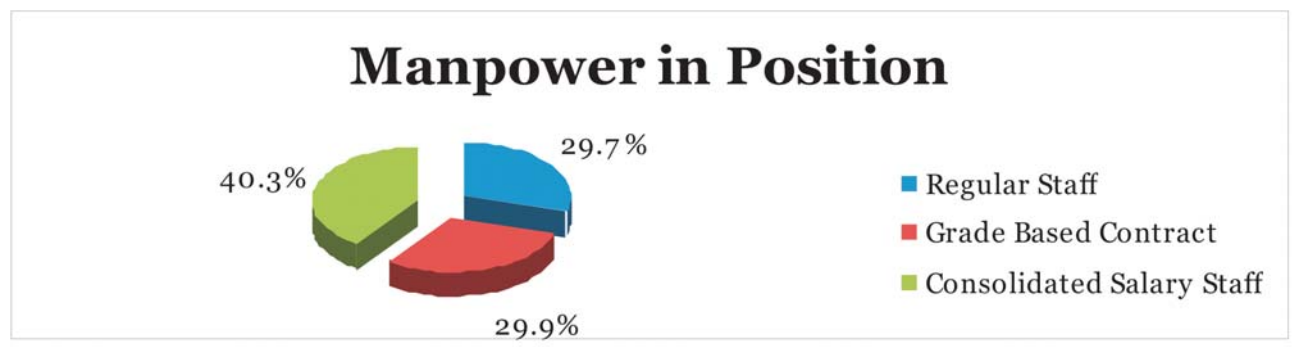
- Developed e-learning portal , Registration module and Administrative module
- Designed and customized LMS
- Developing e-Learning courses on Disaster Management

Resources, Facilitation Services and Initiatives

Human Resource Development (HRD)

C-DAC is an R&D organization involved in the design, development and deployment of advanced IT based solutions in addition to its high-end research activities. It has its presence across India with approximately 2600 employees working at various centres. The employees are in three categories, i.e. those who have been recruited against i) Regular vacancies, ii) Grade Based Contract positions and iii) on contractual terms on consolidated salary. The duration of Contractual appointments are generally co-terminus with the on-going projects' durations.

Following chart shows the latest manpower position of C-DAC in the form of a Pie-chart:



Corporate HRD team at C-DAC strived hard to ensure that the three main areas which Human Resource Development is involved viz. Individual, occupational and organizational development occurred in this organization. Corporate HRD aimed to bring in latest stage in the long tradition of training, education, and developing employees for the purpose of contributing towards the achievement of individual, organizational and societal objectives. HRD intervention through training programs helped the employees of C-DAC to rejuvenate and invigorate the intellectual resources and to act as catalysts in the fulfilment of the objectives of the institution.

Major Activities undertaken by Corporate HRD team during the year under report

The year 2009-10 has been an eventful year for C-DAC and the Corporate HRD team has successfully carried out several major activities to ensure the organizational development and employee satisfaction.

Apart from the regular HR functions, Corporate HRD of C-DAC initiated process for recruitment of Executive Directors of four C-DAC centres namely Pune, Knowledge Park, Bangalore, Mohali and Kolkata, Director HPC, Pune and Director R&D at Corporate office. It is highly satisfying to note that the complex process of selection was completed and brought to a logical end by placing all the incumbents in the respective positions. This, indeed, was a major achievement as, despite our best efforts, we could not get the right candidates in the last 3 to 4 years.

The successful implementation of Sixth Pay Commission at C-DAC was yet another milestone which was achieved due to the untiring efforts of Corporate HRD Team. Corporate HRD played key role in getting the approval of the competent authority and issued appropriate implementation directions and monitored the same. With the implementation of Sixth Pay Commission, more than 150

anomaly representations had come up which were also addressed to the satisfaction of the employees. An Audit Committee was created to verify and authenticate the implementation of the Sixth Pay Commission across the Centres.

Based on the feedback received from the employees and the senior managers of the institution, a customized training programme, 'Fast Forward: Towards Taking Ownership', was conceptualized to address the needs of the middle level S&T and non S&T officers of the organization. An expert facilitation team was identified for this purpose. Corporate HRD had already conducted three such residential Training Workshops out of which approximately 200 employees from across C-DAC Centres benefitted. Apart from this, Corporate HRD continues to be involved in the organization of skill set training programmes, technical as well as soft skill, across C-DAC Centres based on the needs from time to time.

Corporate HRD team at C-DAC acts as a catalyst in the fulfilment of the objectives of C-DAC. The primary focus of the Corporate HRD was responding 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 Corporate HRD was maintaining a member friendly, transparent, conducive and professional work climate to facilitate the efforts of its members.

Corporate HRD at C-DAC strived to develop and instil a few important characteristics on the employees, viz.

- The overall perspective which would help the employees view the institution in its entirety and understand the organization position in the environment in which it operates.
- Development of Analytical and integrative skills leading to accurate definition of problems, generation of creative solutions and timely implementation of the entrusted job.
- Technical and functional skills which comprise of professional competence in discharge of duties.
- Integrity which can be defined as personal ethics that makes conscientious and competent managers and true and ethical professionals.
- Ability to acquire a holistic approach coupled with inner merit, transforming each employee into a leader with vision, deep sense of ethics and responsibility.

With the fast changing economic and market conditions, there is increasing pressure on C-DAC to perform which requires them to have talent that can evolve, champion, steer and support the strategic initiatives of the organization. To attract and retain the best talent anywhere in the country, one of the key processes focused by Corporate HRD team at C-DAC, is 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 organization as a 'desirable employer', both internally as well as externally. The intangible aspect of employer branding enabled C-DAC as an organization to create competitive advantage.

Corporate HRD at C-DAC focused on the role of its employees and ensured their role in creating a unique and differentiated brand experience. C-DAC maintained a value based culture tied to a clearly articulated institutional vision and parameters for measurement of distinctive cultural characteristics, continuous communication, feedback seeking culture and transparency as well as consistency in actions thereby creating a desirable employer brand experience.

Several ways have been chosen by the C-DAC to recognise and appreciate its employees such as:

(a) Identifying, recognising and rewarding key contributions made by the employees.
(b) Opportunities for foreign study trips.
(c) Honouring employees who have demonstrated their commitment and efforts etc.

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

- 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, symposia, technical and management trainings, were conducted across all the centres.
- Several employees were felicitated by C-DAC for completing 10 years / 15 years / 20 years/ 25 years of continuous service with C-DAC.

C-DAC is committed to providing its employees with unique opportunities for their career progression, leveraged career proposition to retain its employees. It shall be the endeavour of C-DAC to focus on leveraging internal strength externally, to align the systems, processes, communications and brand messages to C-DAC values, sustain the experience through continuous improvement and co-create experience by partnering with stake orders.

C-DAC truly believes in creating human capital that are responsive, trustworthy, creative, innovative and courageous and the Corporate HRD team at C-DAC will be an instrument at C-DAC in achieving this goal.

Legal and IPR

The work of Project entitled "Web based patent analysis and management system" sanctioned by IPR Division DIT, New Delhi is in progress. The 3rd PRSG Meeting has reviewed the work and expressed its satisfaction over the progress.

Project entitled "Establishment of Patent Search Centre to be implemented by C-DAC, Pune" has been sanctioned vide Admn Approval No. DIT/IPR/7.1/73/2009 dated 02/07/2009. C-DAC has already communicated to 2455 SMEs requesting them to avail free Prior Art Search & Invention Analysis. Besides, we have written to NASSCOM, MCCIA, IITC, CII, SME Chamber of India and Ministry of SME requesting them to inform their members to avail our IPR services.

Apart from drafting/ vetting several contracts/ MOUs, the legal/ IPR group also organized IPR awareness programmes as mentioned below. Such awareness/ sensitization talks/ lectures generally result in filing of patent/ copyright/ trademark applications.

- Organized IPR Seminar at Trivandrum on 27th July 2009.
- Organized IPR seminar on 7th December 2009 at Noida
- Organized workshop at Pune from 27th to 30th Jan 2010 on IPR awareness & Patent Search and trained 50 people on Patent Search.
- Organized IPR seminar in association with TiE, Bangalore on 9th February 2010

During the year Mr R.Y. Deshpande, Head – Legal was invited to deliver lecture/talk on IPR, cyber law etc. at ILS Law College, Modern College, Academic Staff College, Pune University. He also organized 2 lectures on technology law in association with Technology Law Forum.

IPRs

- Transliteration tool for English-Hindi
- Transliteration tool for English-Marathi
- Transliteration tool for English-Oriya
- Morph Synthesizer for English-Hindi
- Morph Synthesizer for English-Marathi
- Morph Synthesizer for English-Oriya
- Multilingual Typing Tool for Hindi, Urdu, Oriya, Marathi
- Statistical-PosTagger

- Vyakarta-Statistical-TAG Parser
- HeadCorner-TAG Parser
- POS Conversion
- User Log Module
- Category Collation Module
- Collation and Ranking Module
- File Format Processor
- Soft Keyboard for Hindi
- Soft Keyboard for Bengali
- Soft Keyboard for Marathi
- Soft Keyboard for Tamil
- Soft Keyboard for Telugu
- Soft Keyboard for Punjabi
- English - Marathi parallel list of named entities (Jointly with IITB)
- Automated detection of Dosha levels and dominant Dosha
- Automated detection of pulse morphology pattern for diagnosis of Diabetes

Copyright and Trademarks

Following software products have been registered under copyright Act of India. The logos and names of the products have been registered as trademarks.

- Mercury Inter-Site Server Edition (ISS)
- Mercury Inter-Site Client Edition (ISC)
- Mercury Peer-To-Peer Edition (P2P)
- Mercury Central Repository Server (CRS)
- Mercury Web Interface (MWI)
- Mercury Web Telemedicine – Centralized (MWT-C)
- Mercury Web Telemedicine – Distributed (MWT-D)
- Medical Informatics Software Development Kit for DICOM (JAVA Edition)
- Medical Informatics Software Development Kit for DICOM (.NET Edition)
- Medical Informatics Software Development Kit for HL7 (JAVA Edition)
- Medical Informatics Software Development Kit for HL7 (.NET Edition)
- SEISTOM
- EQ-Check
- iMoldock
- Genome Grid
- GENOPIPE.
- Aroma Based food quality measurement machine for tea testing.
- Instrument for Appearance Based Fermentation Process Monitoring in Tea.
- Tea Quality Measuring Instrument Based On Taste.
- Healthcare Knowledge System Concept Maps.
- A Method for Detecting Global Anomalies.
- Cure@home
- PulseAnalysis

RTI, 2005

During the financial year **137** applications were received under RTI Act, 2005 by all centres of C-DAC. Applications were disposed off as per Provisions of RTI Act, 2005.

Library and Information Centre

C-DAC has well equipped and automated libraries attached to Pune, Knowledge Park and Electronics City Bangalore, Noida, Juhu and Kharghar Mumbai, Mohali, Kolkata, Hyderabad and Thiruvananthapuram. These libraries are catering to the needs of members and students of different courses.

C-DAC libraries are actively participating in the 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.

The Pune Centre library offers current awareness services especially on Grid Computing, Supercomputing, Telemedicine and E-Governance. It also helped local libraries in installing E-Granthalaya, the management software developed by NIC and promoted by MCIT Library Consortium.

C-DAC, Mumbai has its main library located at Juhu, which has an exhaustive collection of print and electronic resources. It also subscribes to ACM Digital library.

Libraries at Knowledge Park, Electronics City Bangalore and Thube Park, Pune adopted the E-Granthalaya library management software.

The library at Knowledge Park, Bangalore launched a Digital Repository wherein the open source digital repository software Dspace is being used. Future plans are to make it into the C-DAC Knowledge Management Portal.

C-DAC, Thiruvananthapuram has a well-equipped library (Technical Information Centre). The library is automated using library management software WEBLIBMAN developed by the Thiruvananthapuram centre.

Awards

- **"Special Recognition Award"** was received for Smart Parking solution, at Citizens for City contest organized by the Foundation for Futuristic Cities at Hyderabad. The Smart Parking Solution has been developed by C-DAC Hyderabad as part of the National Ubiquitous Computing initiative. The System is deployed at Greater Hyderabad Municipal Corporation (GHMC) parking complex, Abids, Hyderabad.
- Mr. Sachin Nanavati received First prize for Oral presentation at Raman Memorial Conference, University of Pune, February 2010.
- Mr. Sachin Nanavati received M R Bhide memorial award for best industrial oriented project at Raman Memorial Conference, University of Pune, February 2010.

Conferences/ Events Organized

- Inauguration of 'GAURI' Software by Shri Digambar Kamat, Chief Minister of Goa at Margao Sub Registrar's Office, Goa.
- Telemedicine Society of India (TSI) in association with Grant Medical Foundation Ruby Hall Clinic and International Society for Telemedicine and eHealth (ISfTeH) organized 5th National Congress, "Telemedicon 2009", during November 6-8, 2009 at Hotel Le Meridian, Pune.
- National seminar ELELTECH INDIA 2009 was organized during 5th – 6th Nov 2009
- Seminar for teachers on "Demystifying ELearning" organized at C-DAC Navi Mumbai campus. Lalitanand Dandge delivered a talk on Gimp, Audacity and Kino. Aparna Ramamurthy delivered a talk on Introduction to Localization.
- Invent '09 on 17th March 2009; Teachers Training Programme on Content Creation, Department of Computer Science, Goa University, Panaji, Goa on 19th 20th June 2009.
- Organised a conference on "Competitive Positioning in the Current Economic Perspective" March 6, 2010
- IFIP HWID 2009 Conference on Usability in Social, Cultural and Organizational Contexts was held on October 7-8, 2009 at International Convention Centre (ICC), Pune, India The conference was hosted in collaboration with Copenhagen Business School, Denmark; Aarhus University, Denmark and Indian Institute of Technology, Guwahati, India. This event was an initiative of Working Group on Human Work Interaction Design (HWID) of International Federation for Information Processing (IFIP).

Participants of IFIP HWID 2009 Conference on Usability in Social, Cultural and Organizational Contexts

Selected research papers were peer reviewed, enhanced and published in the form of an international book. The details are as under-

"Human Work Interaction Design: Usability in Social, Cultural and Organizational Contexts" Edited by Dinesh Katre, Rikke Orngreen, Pradeep Yammiyawar, Torkil Clemmensen; IFIP AICT 316, ISBN-10: 3642117619, Published by Springer Verlag, Germany.

- Organised NCOSS - 09 - the National Conference on Open Source Software at C-DAC Mumbai campus in May 2009.

Workshops organised

- State Level Introductory workshop in Madhya Pradesh : Knowledge sharing for Rural Development - InDG as a platform – Feb 2009
- Information Security Awareness Workshop for Teachers and NGOs – January 22, 2010
- Training for the CSC operators of SAHAJ e-Villages in Tamil Nadu on 8th and 9th January 2010
- Video Streaming Technologies – August 10, 2009
- Conducted training for IITM Scientists on ocean, atmosphere and coupled model usage.
- Bioinformatics team organized a two-day symposium titled 'Frontiers in Computational Biology' at C-DAC, Pune during July 23-24, 2010.
- Stakeholders meetings at Kokrajhar (BTAD Assam) for demonstrating the software and collecting the feedback were held during 08-09 July 2009 and later 03 - 06 March 2010. During the meetings the spatial Decision Support System Tool (Aranya) developed by C-DAC was demonstrated and feedback were collected from stakeholders.
- DIT and Sardar Krishi Nagar Dantiwada Agricultural University organised an Agri-bio workshop from August 17 - 22, 2009 to May 22, 2009 at Sardar Krishi Nagar, Ahmedabad, Gujarat.
- DIT and Central Plant Crop Research Institute (CPCRI) organised an Agri-bio workshop from May 18, 2009 to May 22, 2009 at Kasargod, Kerala.
- Sreedhar Challa and Chandra Bhushan Roy conducted a training programme on PHOENICS CFD software at IGCAR during September 2009
- A two day training programme on Intel tools for users, developers and system administrators of PARAM Yuva was held on 17-18 Jun 2009.
- State Level Content Development Workshop at Guwahati, Assam on 29th June 2009
- Training for the CSC operators of AP Online on 22nd December 2009
- ISEA Workshop – November 7, 2009
- e-Learning and e-Learning Technologies (ELELTECH INDIA 2009) – November 5-6, 2009
- Tutorial on Vide Streaming Technologies November 4, 2009
- State level multi stakeholder workshops and InDG introductory workshops in Uttarakhand, Madhya Pradesh and Assam
- Seminar on Cloud Computing by Dr. Rajkumar Buyya – Dec 28, 2009
- Seminar on Molecular Visualisation Software, University of Kerala, TVM
- Workshop on MCF5225x using MQX Bangalore
- Workshop on Intellectual Property Rights, KSCSTE Trivandrum
- Workshop on Silicon Microsystem Kakkanad, Kochi
- SPSS Workshop on Data Mining Using PASW Modular, University of Kerala, TVM
- Indo US Conference and Workshop, AIMS, Kochi
- Seminar on Public Procurement, Hotel residency TVM
- Workshop on Cloud Computing, Hotel residency TVM
- Mind Power Programme, C-DAC (T)

- A Path to User Centered Innovations, C-DAC (T)
- Mobile Applications Technology and Business, Hotel Mascat, TVM
- Telemedicon' 09, Pune
- Fucetech 2009, Mumbai
- WINGCOM'09, Hotel Udayasamudra
- Workshop on Spoken Language Prosody, C-DAC, Kolkata
- India IT Summit 2009, Hotel Leela, TVM
- Tech Day Embedded Processing, Bangalore
- Conference on Scientific Python in Action, Technopark
- Seminar on Automation System Technology, Chennai
- Public Transportation in Indian Cities, Delhi
- NCC2010, IIT Madras, Chennai
- Ubicomp-India 2010, C-DAC, Chennai
- Latest Trends in Foundation Field Bus, IIT Madras, Chennai
- Indo-US Workshop on Emerging Trends in intelligent Transport Systems, IIT Madras, Chennai
- International Conference on Humanitarian Technology, Hotel Udayasamudra
- Promise of a Smart Grid, Hyatt Regency, New Delhi
- Omni vision Day, Bangalore
- Transforming Health care with information Technology, New Delhi
- Emerging Trends in Computing, Govt. Engg. College, Trissur
- Workshop on Human Speech Digital Standards Indian Language Initiative' conducted on 30-Oct-2009 at C-DAC (KP), Bangalore.
- TARKSHYA consortium partners meet on 3-December-2009 at C-DAC(KP), Bangalore.
- The Garuda Boot Camp was conducted from 16th to 18th July 2009 at C-DAC, Knowledge Park, Bangalore
- A two day workshop on Ubiquitous Computing "Ubicomp-India 2010"was organized on 28th and 29th January 2010, by C-DAC Chennai and the technologies developed by National Ubiquitous Computing Research Initiative were presented to participants from R&D, academic institutions and industry.
- Workshop for DIARA 'Honeypot\Honeynets , Attack data collection, Monitoring and Analysis'
- Workshop on 'Bringing Theory and Practice Together Using Telemedicine Applications' held on 18th August 2009 at C-DAC Mohali that is jointly organized by C-DAC Mohali, Laboratory of Innovative Technology and Engineering Education USA and International Centre for Information Technology and Development USA.
- 3rd workshop 'Telemedicine- Today and Tomorrow' on the theme 'Practical Telemedicine' was held at C-DAC, Mohali on 23rd Oct 2009.
- Two day Workshop to 'Enhance Usability of Integrated Telemedicine Technology (Sanjeevani)' Organized by C-DAC Mohali on 11th -12th March, 2010
- One day Workshop-cum-Demo of Open Source Software Tools/ Technologies was organized on 31st July, 2009 at Hotel Taj, Chandigarh

- One day workshop on RFID Technology: Concepts, Trends and Applications was held at C-DAC Noida on 10th July 2009
- One day workshop on Intellectual Property Rights was held at C-DAC Noida on 7th December 2009
- HR Meet 2009 was conducted in association with CII at C-DAC, Noida on 08 January 2009
- Second Industrial Liasioning Workshop on IT-Technopreneurship, was organized by C-DAC Noida on 09 January 2009
- Workshop on Personality Development Programme was conducted in C-DAC, Noida during 29 – 31, December 2008 and 02, January 2009
- Workshop on Question Bank for National Online Examination System Organized by C-DAC Noida on 17-21 June 2009
- National Workshops for ensuring public approval and Awareness Raising of the IDN organized in Pune, Hyderabad and Guwahati.
- 1st workshop and Release of IDN draft policy document at Pune - 29th October 2009.
- 2nd workshop held in Hyderabad on 27th November 2009.
- 3rd workshop held in Guwahati - 10th February 2010.
- Dr. V.K. Jayaraman and Dr. V. Sundararajan conducted a DST sponsored SERC school on Applications of Novel Artificial Intelligence and Machine Learning Techniques for Chemical and Petrochemical Industries, during 28th December 2009 to 2nd January 2010 at MIT college, Pune.
- Coordinated a DST-RFBR sponsored Indo-Russian workshop on “scientific and engineering applications on high performance systems” during November 24-26, in collaboration with ICAD at Moscow.
- e-Security R&D meet of C-DAC during April 24th and 25th 2009
- Workshop on parallel computing were conducted at theses institutions: North East Institute of Science and Technology (NEIST), Jorhat; National Chemical Laboratory, Pune; Jawaharlal Nehru University, Delhi; Physical Research Laboratory, Ahmedabad and Indian Institute of Technology Delhi.
- Organized workshop at Pune from 27th to 30th Jan 2010 on IPR awareness and Patent Search and trained 50 people on Patent Search.
- BOSS Seminar
    - Hi-Tech Institute of Technology, Bhubaneshwar on 4th and 5th April 2009.
    - One Day workshop on Open Source Titled “Open Source Demystified” organized by C-DAC Kolkata for the Govt. officials working in Eastern and North Eastern part of India on 19th August 2009 at Hotel HHI Kolkata.
    - Roland Institute of Technology, Orissa.
    - St. Anthony College Shillong 23rd Oct 2009.
    - FOSS Seminar organised by IOTA West Bengal in March 2010.
- Workshop-cum-Industry Meet on Electronic Nose and Electronic Tongue and Short Visit to few Tea Industries in North Bengal held on 30th October 2009 at Rotunda Hall, Manikanchan SEZ, Saltlake, Kolkata jointly organized by C-DAC, Kolkata and Jadavpur University.
- The first India Workshop on Reverse Engineering was organized by C-DAC, Mumbai on 25th Feb 2010 with ISEC 2010 in Mysore.
- One day tutorial on “Customise your Moodle” on 24th May 2009 Pre-conference tutorial in NCOSS 2009
- A workshop on “Biometric Authentication” was organized by Biometric Division, C-DAC Mumbai, on 18th Nov. 2009. The venue was C-DAC JUHU (Lecture Theatre).

- (FOSS) From the Open Source Shelf: C-DAC Monthly Seminar Series from November 2009 till date.
- Conducted BOSS workshop at NITTE Deemed University, Mangalore. The team helped the University in setting up a BOSS Linux lab.
- Conducted BOSS Workshop for Government officials in state of Karnataka.
- Network security workshops at JNTU Hyderabad in March 2009, New Horizon College of Engineering Bengaluru in November 2008, Punjab Engineering College Mohali in Feb 2009.

Important Visitors and Delegations

- Delegation from KACST, Saudi Arabia visited during 27-29th April, 2010 to explore the possibility of working together in the area of Machine Translation for English to Arabic and English to Farsi Language Pairs
- Visit of Prof. Vipin Kumar (Head of the Computer Science and Engineering Department at the University of Minnesota) on 22nd June, 2010 for collaborative work in the area of Data Mining
- Visit of NICT Delegation on 10th May, 2010 for collaborative work in English-Korean Translation system
- Ms Madhulika Tripathi, CEO, Biomantra visited C-DAC, Pune for a collaborative work in the Chinese, Pali Machine Translation on 8th June, 2010
- Visit of Commodore Talvelkar for Russian Translation on 16th June, 2010
- Dr. Sajal Das delivered a seminar on 'From Wireless Networking to Smart Computing: Challenges and Solutions' for C-DAC's Advanced Computing Training School students.
- Ms. S. Jalaja, Secretary and Shri B. Anand, Jt. Secretary, Dept. of AYUSH, Govt. of India, visited C-DAC, Pune on 29th June 2009. They discussed several projects and activities those would be addressed by proposed Centre of Excellence for AYUSH Informatics.
- Dr. Narendra Jadhav, Member, Planning Commission, Government of India and Ex-Vice Chancellor, Pune University, visited C-DAC Stall during 83rd Marathi Sahitya Sammelan at Pune in March, 2010

Invited Talks

- Sunitha Manjari delivered a talk on "Comparative Genomics of Mycobacteria aid to decipher functional linkages via Gene Ontology terms" during the workshop on "Biomedical Informatics and Communication" at JBTDRC, Mahatma Gandhi Institute of Medical Sciences, Wardha on 20th November 2009.
- Dr.Rajendra Joshi delivered a talk on "Advanced Molecular Dynamics Stimulations of Protein Folding: Advantage High Performance Computing" at Yashada, Pune in "78th Annual Meeting of Society of Biological Chemists" on 30th October 2009.
- Dr. Sanjay Kadam, Delivered invited lectures on "*Neural networks, Imaging transforms and Face recognition*" in the UGC sponsored refresher course in 'Computer Applications to Mathematics' for College and University teachers of Mathematics, held at the Department of Mathematics, University of Pune, Nov 2009.
- Dr. V. Sundararajan delivered a key-note speech on 'Clones of Computing: HPC, Grid and Evolutionary computing', on the occasion of Science Day programme "Sciclone" at MIT College, Aurangabad, Maharashtra, 26 Feb 2010.
- Dr. V. Sundararajan delivered a talk on 'HPC activities in India' EU-India joint meeting at Delhi organised by DST, 11 Jan 2010.
- Dr. V. Sundararajan delivered a Key-note lecture on "A Gentle Introduction to high performance computing", during the International Workshop at Noida and member of the IT advisory committee, IISER, Pune.

- Dr. V K Jayaraman delivered lecture on Applications of Ant-colony optimization at NIT Trichy, August 2009 and a lecture on Applications of Pattern Recognition in Process Engineering at NIT Trichy, October 2009.
- Dr. V. K. Jayaraman delivered invited lecture on Applications of Support Vector Machines at Bose Institute, Kolkata, March 2010.
- Presentation of Predictive Writing to reduce keyboard overhead (particularly for Indian Languages text)' by Sagun Baijal, in National Conference on Information and Communication Technology for Differently Abled People (DAP) on September 1920, 2008 at Ahmedabad, Gujrat.
- Presentation on an Ophthalmology EMR system, using Open Source tools by Abey S.A in FOSS Conference
- Presentations: Content preparation using DIA' and 'Indian language content' by Aparna Ramamurthy; Tools of Online Learning – Drupal and GIMP by Dattatray Bhatt; Content creation using Audacity and OpenOffice – by Dr. Sasikumar; Talk on "Localisation of GNU/Linux Desktop" by RKVS Raman at ASEAN FOSS Training Programme at C-DAC Chennai, February 2009.
- Talk on "Open Source Software for Micro, Small and Medium Enterprises" given by RKVS Raman at CII Workshop for FOSS for MSMEs at Bengaluru, February, 2009.
- Talk on "Localisation of GNU/Linux Desktop" given by RKVS Raman at International Conference on Open Source Computing (INCOSC-08), NMAM Institute of Technology Udupi and Hewlett Packard System Technology and Software Division (STSD) Bengaluru, December 2008.
- Talk on "Latest Trends in Information Technology" given by RKVS Raman at National Level Technical Exhibition Kavery Engineering College, Salem, April 2008.
- Pre-conference tutorial on "Extending OpenOffice.org-How to build your extensions for OO" given by Sawani Bade at National Conference on Open Source Software, C-DAC Navi Mumbai, May 2009.
- A tutorial on "Professional PHP Development" delivered by Praveen Reddy at the AICTE Seminar on Open Source Web Development Using LAMP at Institute of Road and Transport Technology, Erode, January 2009.
- S. P. Sood, "Key Note Speech", International Conference on Training and Education at Chandigarh., India. 26 August 2009

Others

- Release of Software tools and Fonts CD for Bangla, Manipuri, Kashmiri, Konkani , Santali and Sindhi languages at the hands of Hon. Union minister for Communications and Information Technology, Thiru. A. Raja on 08th September, 2009.
- HBCG Health Informatics products at European World Ayurveda Congress (EWAC), Baden- Baden, Germany, 10th to 11th October 2009.
- Dr. Sanjay Kadam, taught M. Sc.(Tech) students of Department of Mathematics, University of Pune; a full semester course in *"Java Programming"* during January-March 2010.
- Dr. Sanjay Kadam, taught a full semester course at International Institute of Information Technology, Pune on "*Programming Environment in Parallel Computing*" to M.Tech (Computational Fluid Dynamics) students, February to June Jun 2010.
- "Computer Fundamental in Nepali Language" CD released by Hon'ble Governor of Sikkim In 'Sikitex 2009' fair organised by Dept. of Information technology, Govt. of Sikkim.
- Hon'ble Governor of Sikkim Shri Balmiki Prasad Sing inaugurates the Self Learning CD on "Computer Fundamentals" in NEPALI Language developed by IT TO MASS Group of C-DAC, Kolkata in presence of Sri R. Ravindra Kumar, ED, C-DAC (K).
- Adobe Flex "Train the Trainer" course conducted by Adobe, was attended by Amarghosh and Mansingh Shitole, Bengaluru August 2008.

Papers Published

- Vijayalakshmi B, Kathiresan C and Sarat Chandra Babu N, "India Development Gateway Initiative"; IEEE Conference on Technologies for Humanitarian Challenges, 28th August 2009, Bangalore
- Kathiresan C., Vijayalakshmi B. and Sarat Chandra Babu N.; "InDG Initiative- Empowering Rural India"; "National Seminar on ICT for Agriculture and Rural Development", September 9-11, 2009, Pasighat, Arunachal Pradesh
- Anandaraja N., Sriram N., Kathiresan C., Sebastian S. and Vadivel E., "Web cum Mobile based Dynamic Market Information Support for Agri-Horti Produces: Linking the farmers with Market", 4th International Conference for Internet Technology and Secured Transactions (ICITST-2009), November 2009, London, UK.
- Saravanan R., Kathiresan C., Indradevi T., Supriyadevi and John Pathri; "Innovative e-Agriculture Initiatives and Lessons from North-East India", eIndia2009, August 2009, Hyderabad
- Raghuram.N.C, Lakshmi Eswari.P.R, Manjulatha.B, Chaithanya.M.K, Sarat Chandra Babu N., "Authentication and Authorization Framework for Ubiquitous Computing Environment", Ubicomp India 2010, Chennai; 29-30 January, 2010
- M Kumar, Ramu Parupalli, Nava Jyothi Karna, Sarat Chandra Babu N, Radhika K, "Moving Towards Ubiquitous Learning Utilizing GrUb Computing", Ubicomp India 2010 C-DAC, Chennai, 29-30 January, 2010
- Ramu Parupalli, Nava Jyothi K, "Dynamic Content Adaptation to Mobile Devices", 3rd National Seminar on e-Learning and e-Learning Technologies JNTU, Hyderabad, India, 5-6 November, 2009
- M.Kumar, Nava Jyothi K, "RFID based Context Aware Ubiquitous Learning System", 3rd National Seminar on e-Learning and e-Learning Technologies JNTU, Hyderabad, India, 5-6 November, 2009
- Pramod P. J, S. V Srikanth, Vivek N, Mahesh U Patil, Sarat Chandra Babu N; "Intelligent Intrusion Detection System (In2DS) using Wireless Sensor Networks", Proceedings of IEEE International Conference on Networking, Sensing and Control, Okayama, Japan, 2009
- S. V. Srikanth, Pramod P. J, Dileep K. P, Tapas S, Mahesh U. Patil, Sarat Chandra Babu N, "Design and Implementation of a prototype Smart PARKing (SPARK) System using Wireless Sensor Networks", Proceedings of Fifth IEEE HWISE 2009 Workshop, Bradford, UK, May 2009
- Mahesh U. Patil, Poonguzhali P, "Challenges and Issues in WSN Application Development : A Solution Through C-DAC's WSN IDE", UbiComp India 2010, Chennai, 29-30th January, 2010
- Santosh Sam Koshy, Y. Nagaraju, Sowjanya P, Y.G. Prasad, N.S.C. Babu; "u-Agri", UbiComp India 2010, Chennai, 29-30th January, 2010
- Tapas S.,V. Sreekanth, Dileep K.P, "Smart Parking Using Wireless Sensor Networks", UbiComp India 2010, Chennai, 29-30th January, 2010
- Vivek Nainwal, Pranita S. Acharekar, Pramod P.J, "Intelligent Intrusion Detection System (In2DS)", UbiComp India 2010, Chennai, 29-30th January, 2010
- N. Satyanarayana, Nava Jyothi and Ramu, Sarat Chandra Babu N., "A Service Oriented Overlay Network Architecture for Collaborative Class Room", WWW/Internet 2009 Conference, Rome, Italy, November 17-22, 2009
- Vikas Garg, N. Satyanarayana, Vikas Rangi, "e-Content Evaluation Framework - An approach and evaluation strategy", ELELTECH 2009 - National Seminar on E-Learning and E-Learning Technologies, Hyderabad, November 5-6, 2009
- Vikas Garg, N. Satyanarayana, Vikas Rangi; "Personalized Learning Environment and Proposed Architecture for Building PLEs", ELELTECH 2009 - National Seminar on E-Learning and E-Learning Technologies, Hyderabad, November 5-6, 2009

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- Sudhamony .S, "Hospital Information System in the CME program on Hospital Administration", Federation of Hospital Administrators (FHA) Kerala Chapter, at Sree Chitra Tirunal Institute for Medical Science and Technology (SCTIMST), Trivandrum
- Z.V Lakaparampil, "Electrical Devices for EVs and HEVs at the Workshop on Propelling India in 2020", Society of Indian Automobile Manufactures (SIAM) at Chennai
- S. Rominus Valsalam, Anish.S, B. Rajasingh, "Boiler Modeling and Optimal Control of Steam Temperature in Power Plants", in the International Symposium on Power Plants and Power System Control International Federation of Automatic Control (IFAC), at Tampere, Finland
- Alexander G, "ONCONET-A Telemedicine network for Cancer Patients", in the Summer School on "e-Healthcare" Indian Institute of Information Technology Allahabad, by DIT, MCIT, New Delhi
- Aby Joseph, "Active Filter Based PQ Solutions", in the two-day short-term course on "Power Quality and Energy Management Perspectives in Indian Industries" C-DAC (T) and Coimbatore Institute of Technology Coimbatore
- Ramesh P, "Control of Distributed Hybrid Power Plant", in the International Conference on Renewable Energy Sources (CLIKTRONIKA'09) Consortium of Electronic Industries of Karnataka (CLIK), Bangalore
- Dhanesh P.R, "Electronics for Hybrid Electric Vehicles", in the Internal conference on Renewable Energy Sources (CLIKTRONIKA'09) Consortium of Electronic Industries of Karnataka (CLIK), Bangalore
- Navin Samuel, "Grid Connected Single Phase Solar Inverter", in the international conference on Renewable Energy Sources Consortium of Electronic Industries of Karnataka (CLIK), Bangalore
- V. Muralidharan, "Next Generation Traffic Controller", 16th Intelligent Transport System World Congress 2009 held in Stockholm, Sweden
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- Shine K P, S. Krishnakumar, "Extended Bipolar Echo Kernel for Audio Watermarking", International Conference on Advances in Recent Technologies in Communication and Computing(ARTCom 2009)
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Release of free software tools and fonts for Bangla, Konkani, Kashmiri, Sindhi, Manipuri and Santali by **Thiru A Raja, Hon'ble Union Minister for Communications and IT** on September 8, 2009. Also seen in the picture are **Dr Debesh Das,** Minister in Charge, Department of Information Technology, Government of West Bengal, **Shri R. Chandrashekhar,** Hon.'ble Secretary, Department of Information Technology, Ministry of Communications and IT, Government of India, **Smt Swaran Lata,** Director & HOD, TDIL and **Shri M D Kulkarni,** Programme Coordinator, GIST, C-DAC, Pune

Lamp Lighting ceremony of 23rd Foundation Day of C-DAC
(L to R) **Shri Rajan T Joseph**, Director General, C-DAC**, Dr Hemant Darbari**, Executive Director, C-DAC, Pune, **Shri Ravi Pandit,** Chairman and Group CEO, KPIT Cummins Infosystems Ltd, **Shri Rakesh Singh**, Additional Secretary, DIT, Government of India, **Shri S P Dixit,** Director, C-DAC, Pune, **Padma Bhushan Shri F C Kohli,** former Dy Chairman, Tata Consultancy Services, **Padma Shri Dr Vijay Bhatkar,** Founder Director, C-DAC and Chairman, ETH Research Labs

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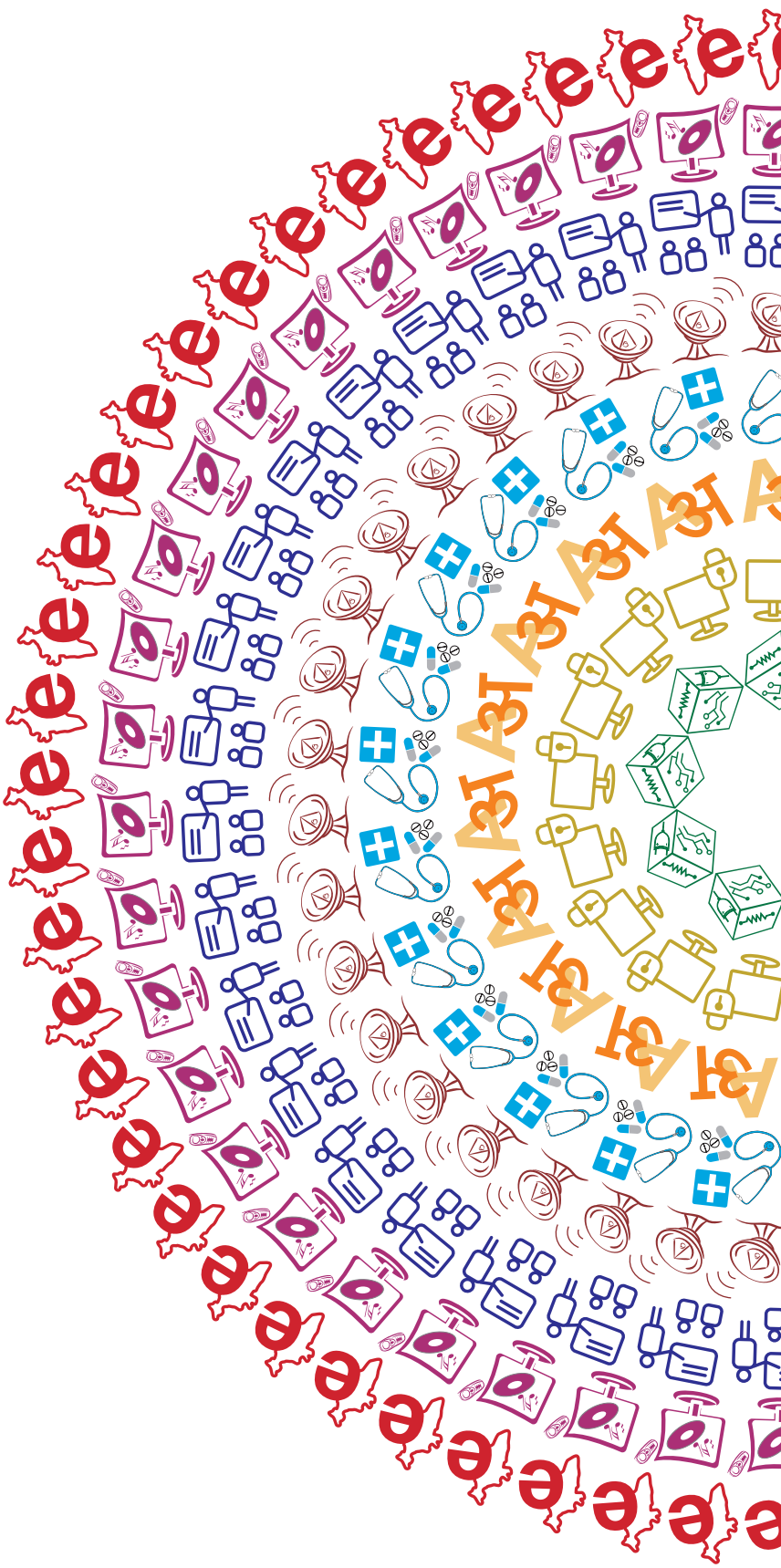

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