CollabDDS: Collaborative Digital Diagnosis System

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Abstract

The model project "Network Enabled Medical Diagnosis and Education in Skeletal Imaging using X-Rays" funded by the National Knowledge Network (NKN), was undertaken as a Proof of Concept to provide an integrated environment to visualise medical and dental images for diagnosis and treatment planning in an online collaborative environment. Medical data, including digitised X-rays, CT images and 3D models is voluminous, and difficult to transmit through the conventional networks. The highbandwidth and low-latency capability of the National Knowledge Network (NKN) provides the ideal platform for this project. CollabDDS: Collaborative Digital Diagnosis System is an outcome of this project.

CollabDDS provides an integrated online environment to visualise medical and dental images for diagnosis and treatment planning. Remote Health Centres can be connected to expert radiologists and doctors in Centres of Excellence, by suitable tools and channels for data transmission and diagnosis. CollabDDS provides the experts a common platform to collaborate and will also enable the design and fabrication of orthodontic e-models, custom implants, prostheses and surgical instruments using CAD models created from Xray/CT images. The repository of images with annotations by experts can also be used for education and research purposes.

Keywords

integrated online environment, Collaboration, Medical and dental images

Introduction

With an ever increasing population, huge demand is being laid on the resources and services in our country. Be it food, natural resources or health. It is generally said a healthy nation is a prosperous nation. India in the last few decades has witnessed a huge demand on its health service providers and with an increasing brain drain, it becomes imperative that to meet the current demands we utilize our existing resources more efficiently. There is a huge shortage of medical and paramedical personnel in the country and it is vital that efforts are made in this direction so that good health care is available to all the citizens. Further, in modern clinical practice, radiological diagnostics has taken an unprecedented importance in patient management. Higher centers where experts in these fields are based are mostly confined to urban India. Then, there are centers of excellence in this field which are further limited and countable on fingers. This disparity directly affects the quality of Radiology teaching and understanding of the subject between students of different medical and dental colleges. Organizations with expertise in different areas viz. National Informatics Centre, New Delhi, All India Institute of Medical Sciences, New Delhi, Indian Institute of Technology-Bombay, Mumbai and CSIR-Central Scientific Instruments Organisation, Chandigarh joined in for effective development, implementation and roll-out of an application which could bring a shift in the way in which radiological diagnosis and teaching is carried out.

Development of CollabDDS: Collaborative Digital Diagnosis System

The model project "Network Enabled Medical Diagnosis and Education in Skeletal Imaging using X-Rays" funded by the National Knowledge Network (NKN), was undertaken as a Proof of Concept to provide an integrated environment to visualise medical and dental images for diagnosis and treatment planning in an online collaborative environment.

The area of study being complex required expertise in varied domains such as but not limited to Orthodontics, Radiology, Computational Methods, CAD/ Rapid Prototyping, Image Processing & Pattern Recognition. Project was planned in two phases; first one being to develop an application which could enable visualization and processing of radiological data over a collaborative platform and second to effectively roll out and enhance the application as per the end user needs.

NKN-CollabDDS: Collaborative Digital Diagnosis System

Bridging the divide between Rural and Urban Health - Towards Inclusive Society



Figure 1: Schematic Diagram of CollabDDS

The project has been envisaged keeping in view two goals. First one is to connect district level hospitals & expert radiologists/ doctors & dentists at Medical/ Dental colleges and Hospitals using suitable Information, Communication and Technology (ICT) tools and channel for real time radiological data transmission. This platform would enable physicians at district hospitals to have real time radiological diagnosis for their patients. Further, experts could use this platform to collaborate. The high-bandwidth and lowlatency capability of the NKN would provide an ideal platform for data transmission as radiological data is huge in size and thus poses problems for utilization in real time because of latency in data transmission. This would prove to be invaluable for both patients and primary level physicians in rural areas for radiological consultation with experts sitting at tertiary centres in real time and thus provide better diagnoses and treatment.

The second objective was to use this platform to build a repository of rare clinical cases for teaching of medical and dental students thus providing these students with an opportunity to study cases which are currently limited to the centers of excellence in medical and dental field.



Expert at AIIMS

Doctor at District Hospital

Figure 2: Collaboration in CollabDDS

With this vision an application CollabDDS: Collaborative Digital Diagnosis System has been developed. The first version of the CollabDDS was released in July 2012 and Version 1.5 was released in January 2014. The strength of CollabDDS lies in its real time collaborative environment where both the doctor and expert will view the same image simultaneously. The expert could interpret the image for diagnosis. This kind of a collaborative activity amongst PHC's with Medical/Dental Colleges & Hospitals and Centres of Excellence would help to provide better diagnosis.

CollabDDS provides a real time collaborative environment to visualize medical (Skeletal) and dental images (digitized X-Ray images or DICOM data) for diagnosis and treatment planning. CollabDDS has various image processing tools to visualize the data and also annotate. An inbuilt repository of annotated images can be used for education. Further it enables real time collaboration for diagnosis between physician at the primary or secondary level and experts at medical colleges and hospitals. CollabDDS is unique as it allows the viewing and processing of digitized X-Rays in various standard image formats like JPEG and DICOM and also allows this data to be saved for later review/ study.



Figure 3: Visualizing a Radiograph in CollabDDS

The patient's X-Ray/CT is submitted to the district hospital. This is transmitted to the connected higher level centers after scanning it. The digitizer at the time of scanning permits the technician to enter certain details and have the X-Ray in DICOM format if required. DICOM files along with the relevant diagnosis are stored in the Repository at the data center to be accessible for any future reference and teaching purposes.



Figure 4: Visualizing a Dental Radiograph in CollabDDS

A repository of teaching files will be created for the purpose of education. Provision of such a repository would prove extremely beneficial for education and research for medical/dental undergraduates and postgraduates and researchers as such a repository is still lacking in our country. CollabDDS may also enable design and fabrication of orthodontic/orthopedic e-models, custom implants, prosthesis and surgical instruments using CAD models created from X-ray/CT images.

The Benefits of CollabDDS are

- Efficient Digital Workflow of X-Ray Imaging (Skeletal and Dental)
- Improved Diagnosis and Treatment through Collaborative Consultation
- Enhancement of Quality of Medical Services in Rural Areas
- Reliability, Security and Accessibility of Medical Records
- Education based on Expert Diagnosis

Pilot Implementation of CollabDDS and Enhancement

With the proof of concept having gone through successfully, the project is now extended to a Pilot Project for Implementation of CollabDDS at Medical and Dental Colleges and Hospitals under the aegis of NKN. The 6 colleges selected for the pilot implementation are

- SN Medical College, Agra (Medical)
- Andhra Medical College and King George Hospital, Visakhapatnam (Medical)
- Sawai Man Singh Medical College, Jaipur (Medical)
- Government Dental College, Goa (Dental)
- Government Dental College and Hospital, Ahmedabad (Dental)
- King Georges Medical University, Lucknow (Medical & Dental)

This pilot implementation would be used to evaluate the efficiency and effectiveness of remote diagnosis. Further this phase also includes the Enhancement of CollabDDS and would also incorporate a module which could carry out cephalometric analysis for orthodontic surgeons to enable diagnosis and treatment planning of their patients.

Acknowledgements

CollabDDS is an outcome of the model project of the National Knowledge Network mission of the Government of India. The project investigators are

- 1. Dr. Savita Dawar, CollabCAD Group, National Informatics Centre, New Delhi
- Dr. Arun Gupta, Department of Radiodiagnosis, All India Institute of Medical Sciences, New Delhi
- Dr. Raju Sharma, Department of Radiodiagnosis, All India Institute of Medical Sciences, New Delhi
- Dr. O.P. Kharbanda, Department of Orthodontics and Dentofacial Deformities, Centre for Dental Education and Research, All India Institute of Medical Sciences, New Delhi
- 5. Dr. Devasenathipathy Kandasamy, Department of Radiodiagnosis, All India Institute of Medical Sciences, New Delhi
- 6. Prof. B. Ravi, OrthoCAD Lab, Indian Institute of Technology Bombay, Mumbai
- 7. Dr. H. K. Sardana, Central Scientific Instruments Organisation, Chandigarh
- 8. Mr. G. Prasad, CollabCAD Group of National Informatics Centre, New Delhi

The inputs of the NKN Model Projects Evaluation Committee are greatly appreciated.