Contents

Cover Story
The Medical Virtual Patient Simulator (MedSIM) – an initiative under eHealth 7
Digital India
Prema Nedungadi, Romita Shine, Rathish G. and Raghu Raman
Prospective Healthcare in Digital India with transforming Information and Communication Technologies
Aaquil Bunglowala and Gaurav Paliwal

Technical Trends
HALE: An insightful journey towards a better and healthy world 15
Reshmi Ravindranathan and Robin Tommy

Articles
Classification Strategies of EEG Signal to Discover the Brain Abnormalities 19
M Balamurugan, Nancy Abraham and Vijaykumar Selvam
A Glimpse of E-Health Systems in India 21
P Aruna and A George
An Anthology of Ideas for Student Projects in healthcare using ICT
Kalaimagal Swamun
HMIS-The Cornerstone to a Confident Hospital Management 26
S Durga Bhavani, Parasuvedi Aparna and S Hari Chandra Siva Prasad
Information and Communication Technology (ICT) for health care In India: Challenges and solutions
M A Jabbar
Integration of MiOT and Taming Data using Data Civilizer and Medical Administration System
Aquatil Bunglowala and Uma Maheswari
Cloud and Big Data Technologies in Healthcare IT
Sanjaya Kumar Panda, Swati Mishra and Brojo Kishore Mishra

Professional Certifications
NoSQL Nano-Degree Courses for Research and Placement – A Complete Path to Certification 35
Reshmi Ravindranathan and Robin Tommy

PLUS
Chairman Publication Committee and Editorial Team 6
Tech Talk 24
Second International Conference on Smart Computing & Informatics (SCI-2018) 36
CSI Nihilent eGovernance (CNeG) Awards 2017 - Call for Nominations 36
International Conference on Data Management, Analytics and Innovation - Call for Paper 37
Brain Teaser 43
CSI Reports 44
Student Branches News 47
A Tribute to Prof. Yash Pal 51
52nd Annual Convention of Computer Society of India Back Page

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Dear Fellow CSI Members,

“By reducing the silos and bringing information together, you can start doing care coordination, best clinical practices, and personalized medicine. That’s really the promise of where we’re going (ICT in Healthcare),”

– Marc Perlman
Global Vice President of Healthcare & Life Sciences, Oracle

The theme for the Computer Society of India (CSI) Communications (The Knowledge Digest for IT Community) August, 2017 issue is ICT in Healthcare

As the healthcare industry goes digital, all of those doctor visits and other health-related transactions are creating terabytes of highly valuable data. The future is all about implementing enterprise-wide data warehouses and analytics capabilities that provide a comprehensive view of healthcare operations—patient visits, diagnoses, test results, prescriptions, referrals, and more—making it possible to arrive at insights that can lead to improved patient care and outcomes. Big Data in healthcare is being used to predict epidemics, cure disease, improve quality of life and avoid preventable deaths. ICT is revolutionizing healthcare and CSI Communications is headlining the ICT impact in healthcare in this issue.

In this issue, there are 2 cover story articles, “The Medical Virtual Patient Simulator (MedSIM) – an initiative under eHealth Digital India” by Prema Nedungadi, Romita Shine, Rathish G & Raghu Raman showcases MedSIM project, under Digital India, eHealth Mission, funded by Ministry of Electronics and Information Technology and developed by AmritaCREATE, Amrita University.

“Prospective Healthcare in Digital India with transforming Information and Communication Technologies” by Aaquil Bunglowala & Gaurav Paliwal gives us an overview of ICT Based Technologies deployed in Indian Healthcare.

In Technical Trends, we have showcased a predictive analytics solution in healthcare, “HALE: An insightful journey towards a better and healthy world” by Reshmi Ravindranathan & Robin Tommy from Tata Consultancy Services (TCS).

Other articles in this issue on ICT in Healthcare provide us information on various applications, information systems, technologies, governmental initiatives, student project ideas and challenges in an Indian context.

The articles are as follows:
- “Classification Strategies of EEG Signal to Discover the Brain Abnormalities” by M Balamurugan, Nancy Abraham & Vijaykumar Selvam
- “A Glimpse of E-Health Systems” in India by P Aruna & A George
- “An Anthology of Ideas for Student Projects in healthcare using ICT” by Kalaimagal Sivamani
- “HMIS-The Cornerstone to a Confident Hospital Management” by S. Durga Bhavani, Parasuvedi Aparna & S Hari Chandra Siva Prasad
- “Information and Communication Technology (ICT) for health care In India: Challenges and solutions” by M A Jabbar
- “Integration of MIoT and Taming Data Using Data Civilizer and Medical Administration System” by S Jeyanthi & N. Uma Maheswari
- “Cloud and Big Data Technologies in Healthcare IT” by Sanjaya Kumar Panda, Swati Mishra & Brojo Kishore Mishra

We have a new section on Professional Certifications primarily for the benefit of our student members, “NoSQL Nano-Degree Courses for Research and Placement – A Complete Path to Certification” by R. Sasikala

This issue also contains Crossword, CSI activity reports from chapters & student branches; calendar of events and Call for Papers (CFP) for CSI conferences supported by Springer.

The contact details of the CSI National Student Committee consisting of National Student Coordinator (NSC), Regional Student Coordinator (RSC) and State Student Coordinators (SSC) is also published for the benefit of the CSI Student Branch community.

We are thankful to entire ExecCom for their continuous support in bringing this issue successfully. We wish to express our sincere gratitude to all authors and reviewers for their contributions and support to this issue. We look forward to receive constructive feedback and suggestions from our esteemed members and readers at csic@csi-india.org.

With kind regards,

Prof. (Dr.) S. S. Agrawal
Chief Editor

Prof. Prashant R. Nair
Editor

www.csi-india.org
The Medical Virtual Patient Simulator (MedSIM) – an initiative under eHealth Digital India

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India’s has a large medical education system with over 400 medical colleges and an intake of 63,000 students annually. Medical education in India has been slower in the adoption of educational technologies in the classroom. Many medical institutions of higher education in India are grappling with the financial justification to design, develop and deploy costly training programs involving the use education technologies like interactive simulation and virtual patients.

Under the Digital India, eHealth Mission, MedSIM project, research funded by Ministry of Electronics and Information Technology, offers medically accurate, high quality yet cost effective approach to this problem.

The Medical Council of India (MCI), the apex body overseeing medical education, released reform document titled Vision 2015 that has recommended immediate Adoption of Contemporary Education Technologies like Skills lab, E-learning, Simulation. Experts estimated that 100,000 deaths occur each year in hospitals as a result of medical error. The utility of animations and interactive simulations in healthcare is most interesting to consider in the context of patient safety. Incorporation of computer based simulations into medical training has recently gained momentum, as advances in technology have coincided with increase in the use of medical simulation training to improve patient safety. Simulation facilitates learning through immersion, reflection, feedback, and practice -- minus the risks inherent in a similar real-life experience. Perhaps the most important feature of all is that computer-based simulation can realize all these benefits without risk to any real patients.

Medical Virtual Patient Simulator (MedSIM) brings a new approach to computer-aided medical teaching and learning by using dynamic simulation and interactive experiments. Medical Virtual Patient Simulator (MedSIM) is a cutting-edge E-learning innovation for medical and other health professionals. It consists of a framework that supports various patient cases, tailored by interdisciplinary medical teams. Each virtual patient case follows the critical path to be followed for a specific patient in a hospital. MedSIM takes the student on a journey that enables the student to interview, examine, conduct physical, systematic and ultimately reach a diagnosis based on the path that is chosen. After the interactions, the student must decide whether each responses is normal or abnormal and use the virtual findings to identify multiple probable diagnosis or reexamine the virtual patient with the goal to narrow down to the correct disease and then provide treatment. We present the architecture and functionality of the MedSIM platform and include a pilot study with medical students.

Simulations endow the user with the proficiency to acquire and preserve task-oriented and behavioral skills across the spectrum of medical specialties in a practical manner. Simulations offer the users a secure, practical, and credible means to attain skills and efficiently handle real life clinical scenarios. Simulations have favorable qualities such as enhancing student knowledge capability by learning from making medical errors on a virtual
case, without harming the real patient and learning in a realistic context. In India, knowledge-rich simulation technologies are available for other domains in Engineering, Biotechnology and for high school sciences, however a comprehensive simulation-based learning and evaluation platform for the medical community has been lacking.

Fig. 2: MedSIM Presentation at AIMS, Ernakulam.

Though the currently available virtual patient cases provide reasonable learning capability about the procedures and the type of investigations required, these educational tools do not provide the end users with accurate images, simulations and audio for proper learning of patient symptoms, examinations and diseases. Other individual simulations and animations of different medical software’s offer restricted learning regarding the particular organ or exam.

MedSIM incorporates realistic simulations, visuals, audio and animations of the complete learning process into a virtual patient case to present an end-to-end instructional and evaluation tool for medical students.

The MedSIM Platform

MedSIM consists of simulations based on clinical patient cases that incorporate features such as the deliberate practice and pointers for expertise development, coverage of hard to visualize procedures and clinical cases, using interactive virtual patient cases. MedSIM integrates these features into virtual patient cases with the aid of medically precise simulations, animations (2D and 3D), videos and evaluations.

Each MedSIM case was developed based on the training protocols followed during clinical examination, and contains seven core modules - History Taking, Physical Examination, Systemic Examination, Investigation, Diagnosis, Treatment and Evaluation. The student while diagnosing a particular virtual case should select the appropriate questions or procedures from the different modules. MedSIM logs all student actions along with the time taken and mark it as relevant /irrelevant for the diagnosis of the virtual patient.

This mobile first design for UI is web-based, responsive, renders the simulation seamlessly on computers, mobile, and tablet devices with Internet connectivity. MedSIM uses Scalable Vector Graphics for UI and WebGL for 3D Views. While designing MedSIM, the development team ensured all incorporated data was in accordance with International Standards such as ICD-10-CM (International Classification of Diseases, 10th Revision, Clinical Modification), ATC (Anatomical Therapeutic Chemical classification system for drugs) and INN (International Nonproprietary Names for generic drugs) and hence can be easily customized and localized. MedSIM can efficiently work on highly modular and reusable medical activities, and can be configured to run various virtual cases.

Anatomy of MedSIM Virtual Patient Modules

History Taking

The ‘medical history’ consists of an organized set of interview questions to get the complete picture of a patient’s health and health problems. In this module, the student has to identify the correct set of questions to elicit the proper responses from the patient regarding the disease. The interview questions are available under different subsections, which is accessible on the left panel of the simulator. The student can click on the required questions as per the case presented.

The user needs to extract skillfully information about the symptoms and medical conditions from the patient in order to identify the right diagnosis. The general order consists of greeting the patient, finding out the main complaint and associated features of the illness, any medical problems in the past, allergies, family, social and personal information, and other patient concerns.

Physical Examination

The condition of a patient’s health and well-being can be recognized by conducting a thorough physical examination.

This module helps a student to check the overall patient status by methodically examining the patient by going through the four sub modules/segments - General Inspection, Vitals, Examination of Eye and ENT.

The user can click on the desired segment and access the tools/simulator to examine the patient. The system provides suitable tools such as thermometer, blood pressure meter (sphygmomanometer), stethoscope etc., under each sub-section to do the physical examination of the virtual patient. The doctor can choose the
relevant physical examination he/she needs to perform with the virtual patient based on the history taking that is already performed.

**Systemic Examination**
Systemic examination reviews the major systems of the body like the central nervous system, respiratory system, cardiovascular system and the gastrointestinal system. The student should both determine and perform the activities relevant for the given virtual case to diagnose correctly.

**Investigation**
The student can select various laboratory investigations or specific tests to get a better idea about the patient diagnosis. Some of the tests available to the users are blood test, X-ray, ECG and so on. On selecting the required lab test, the result of the test will be shown.

**Differential Diagnosis**
One of the main hurdles the medical community has to tackle is the disease diagnosis based on the symptoms and signs of the patient, which is necessary for quality patient care. Based on the symptoms and examination findings selected by the student, the Differential Diagnosis module shortlists different diseases, and the software expects the student to select the most likely diagnosis from this list. Students can analyze the chosen diagnosis and even go back to the previous modules to review all the exams and tests to diagnose the disease properly.

**Treatment Module**
The treatment module allows the user to make medical errors any number of times without causing harm to the patient. Here the student can administer medicines to treat the virtual patient. Based on the chosen medicine, students will receive warnings of various interactions such as drug-drug interactions, drug-food interactions to direct them to prescribe the right set of medicines. A key objective is to include medical score calculators to the software to assist doctors to analyze the efficacy of the treatment and survival rate for a treatment.

**Pilot Study and Findings**
A pilot study on MedSIM was conducted with fifteen third year MBBS students from the Trivandrum Medical College.

MedSIM is easy to use and can be easily and smoothly handled by beginners and advanced users of computer technology. The workshop was conducted in an interactive manner to engage the interest of the participants, to induce their curiosity, and to make them aware of the different potentials and possibilities of the MedSIM project. The workshop had three sessions that lasted for two hours.

The initial part included a short fifteen-minute introduction to the computer-based virtual case simulation project and the purpose of conducting the workshop. After this, the organizers had a fifteen minutes demonstration of a few simulation-based activities taken from more than the sixty activities developed for the project.

During the next session, the participants had sixty minutes to try out the MedSIM software individually to diagnose the virtual cases. Five virtual cases in the virtual OPD (Out Patient Department) were configured for this pilot study to be diagnosed by the students. The five virtual cases were - Pneumonia, Hypertension, Myocardial Infarction, Chronic Bronchitis, and Stable Angina.

In the last session, the students talked about their thoughts, verbally shared their feedback, and filled an online feedback survey. This last session lasted for thirty minutes.

Using MedSIM - The Hands-on
Session: The participants were able to successfully navigate the MedSIM system and also identify and diagnose the virtual cases. As each participant had a computer they could access and explore the system by themselves, which they did with keen interest.

**Participant Feedback.** At the end of the workshop, the participants filled out a brief survey online, giving their feedback about the project, the virtual cases shown, their evaluations of various aspects of the project and the effectiveness of MedSIM, with room for general comments.

**Discussion & Conclusions**

An outstanding feature of MedSIM, which differentiates it from other medical simulations, is that each case-based virtual patient is equipped with realistic images and medically precise simulations to grant an end-to-end virtual patient experience for the student.

Professor Randeep Guleria, Director AIIMS (New Delhi), reviewed and approved MedSIM as part of the expert panel appointed by MeitY, Gol. Dr. Girija Kumari, Vice Principal, Government Medical College felt that MedSIM would certainly act as an effective tool to supplement medical education for undergraduates. ([https://www.amrita.edu/news/virtual-patients-help-aspiring-doctors-practicel](https://www.amrita.edu/news/virtual-patients-help-aspiring-doctors-practicel)).

![Fig. 6: Screen showing the Differential Diagnosis Module.](image)

**Fig. 6:** Screen showing the Differential Diagnosis Module.

MedSim helps in learning how to manage infrequently occurring medical conditions [Please rate the following questions]

<table>
<thead>
<tr>
<th>Rating</th>
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<th>Agree</th>
<th>Neutral</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Disagree</td>
<td>0</td>
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<td></td>
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</table>

MedSim accelerates their progress in learning curves for skills development (e.g. diagnostic skills). [Please rate the following questions]

<table>
<thead>
<tr>
<th>Rating</th>
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<th>Neutral</th>
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<tr>
<td>Disagree</td>
<td>0</td>
<td>0%</td>
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How do you rate the online performance of the simulator? [Please rate the following questions in regards to the topics that medsim demonstrated well]  

<table>
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<th>Very Good</th>
<th>Good</th>
<th>Agree</th>
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<td>Poor</td>
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</table>

![Fig. 7: A Few Responses from the Online Feedback Survey](image)

![Fig. 8: MedSIM Workshop at Trivandrum Medical College.](image)

(From left to right: Mr. Parameswaran Nampoothiri V (CDAC), Shri Sunil Kumar (CDAC), Dr. Girija Kumari (Trivandrum Medical College Vice Principal), Shri D.K. Kalra (Meity) and Dr. Prema Nedungadi (Amrita CREATE Director))

MedSIM was demonstrated to the Vice Chancellor, Dr. K S Ravindranath and Dr. S.S Harsoor, Registrar of RGUHS along with over 30 principals, medical superintendents, heads of departments, etc. from various medical colleges in Karnataka. The participants expressed a keen desire to start using MedSIM in their colleges and to provide more feedback on the software.
Many requested to conduct MedSIM workshops at their institutes to help their medical students understand the technology for individual practice. Some doctors also wanted to monitor the progress made by their students after completing the MedSIM virtual cases.

Faculty members (Pharmacology, Physiology, Ophthalmology, General surgery, Radiology) from the Hassan Institute of Medical Sciences (HIMS) also used the software during a student workshop. They felt the online performance of the simulator offered good control over the interactions. They agreed that the actual clinical scenarios simulated by MedSIM were also very good.

MedSIM was developed to support medical students in the field of medicine during the early years of. Presently there are 10 cardiology and respiratory virtual cases available free of cost online at https://medsim.in/. The next phase of the project will include 100 virtual patient cases that are commonly required by medical students. This user-friendly simulation tool also allows students of medicine to review the results and responses of the attempted cases before making diagnostic and management decisions for the virtual case. Each of these ‘Virtual patients’ have been successfully questioned, examined, diagnosed and treated by various medical students and specialists during multiple workshops and demos.

During these workshops, an analysis on the feedback received showed an overwhelming response in favor of the MedSIM system. Some of the testimonials from these workshops are given below: (https://www.amrita.edu/news/amrita-universitys-medsim-software-well-received-rguhs-bangalore)

“Medical Simulations can positively impact undergraduate medical education”- Professor in Community Medicine (Trivandrum Medical College)

“At most times patient may not allow us to do the examinations when they are sick. It is more like a game than the cumbersome study processes. As medical students it is very helpful.” – MBBS Student.

“The best thing is we are actually visualizing a patient in front of us, everything we clinically practice can be applied here.” – House Surgeon.

“It is successful in creating cases which are similar to real patients. MedSIM included all the routine examinations and investigations in the proper order and the differential diagnoses panel is innovative.”- MBBS Student.

Acknowledgement

This work derives its inspiration and guidance from Amrita University’s Chancellor Shri Mata Amritanandamayi Devi. We are grateful to Dr. Ajay Kumar, Additional Secretary and Shri DK Kalra at Ministry of IT for their continuous guidance. We thank our project partner, CI from CDAC Trivandrum, Shri Sunil Kumar, CDAC Trivandrum for initiating collaborations with Medical colleges and organising MedSIM workshops. We acknowledge the efforts of the members of Amrita CREATE team, doctors from Amrita Institute of Medical Sciences (AIMS) Kochi and Trivandrum Medical College.

References


About the Authors

Dr. Prema Nedungadi, Principal Investigator for MedSIM, is founding Director at AmritaCREATE, an award winning, educational and health technology for societal benefit initiative of Amrita University, with $4.6m in research funding, 2 patents and over 56 publications. She is recipient of the Digital India Award from the Hon’ble Minister of MeitY, in the Category – Digital Empowerment (2015). Other awards include best journal paper, IEEE Transactions in Education (2014) and IT Excellence Award for eLearning and Education, Computer Society of India, (2013).

Dr. Raghuraman, Co-Principal Investigator for MedSIM, is Chairman for Amrita School of Business. His main research focus is in the areas of Diffusion of ICT Innovations in socio-technical systems, eGovernance, Big Data Analytics in Education and Health, Social Network Analysis and Virtual Interactive learning environments.

Dr. Romita Shine is a Research Associate at AmritaCREATE focusing on health and science simulations.

Rathish is Senior Project Manager at AmritaCREATE. He has more than 14 years of experience with the eLearning, Multimedia and Animation industry. He does conceptualization of designs, overall architecture, animations and interactive simulations.