Remote Health: A Framework for Healthcare Services using Mobile and Sensor-Cloud Technologies

Funding Agency	Information Technology Research Academy (ITRA), Media Lab Asia
Sanctioned Amount	Rs. 49.16 Lakhs
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Project Status	Continuing since November, 2013

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Collaborative Institute(s) (if any): Jadavpur University, Kolkata; University of Calcutta, Kolkata; National Institute of Technology, Durgapur; Kalinga Institute of Industrial Technology, Bhubaneswar; Feroz Gandhi Institute of Engineering and Technology, RaeBareli

Brief Description of the Project

One important criterion for developing a good healthcare system is "universal access, access to an adequate level, and access without excessive burden". In India, where nearly three quarters of 1.2 billion population lives in rural areas, providing efficient healthcare service is a significant challenge. Due to tremendous shortage of trained manpower and huge cost for setting up state-of-the-art facilities, it is often not possible to deliver proper healthcare services in the rural and remote areas. Lack of accurate and timely information further adds to the problem. It is proposed that efficient use of technology can improve the overall performance of the healthcare system and its reachability amid the citizens of India. The advancements of the Internet, wireless mobile computing, sensor networking and cloud computing technologies have led to cutting-edge research in a wide variety of applications that can significantly improve our daily lives, including healthcare systems (e.g., telemedicine, wellness management).

The major objectives of the Remote Healthcare project are as follows: (1) to provide efficient solutions for pervasive healthcare services (e.g., Video-Medic) over wireless networks while meeting the quality of service (QoS) requirements, (2) to develop a sensor-cloud infrastructure for deployment of adaptive healthcare services remotely, and (3) to apply knowledge extraction techniques for mobile healthcare applications.

Methodologies/Approaches Adopted (Simple description)

The work proposed under this Remote Healthcare project has several dimensions. Specifically, the work will be distributed around three central themes: (1) developing sensor-cloud infrastructure for provisioning (remote) healthcare services, (2) providing efficient solutions for pervasive healthcare services over wireless networks while ensuring the quality of service (QoS) requirements, and (3) developing knowledge extraction techniques for mobile healthcare applications.

The project team in its entirety will work for

1. Finding solutions to the integration of these technologies,

2. Conducting a survey to find the usage in healthcare where the proposed framework will suit the best,

3. Developing representative services for healthcare,

4. Setting up a test-bed for experimentation and deployment of remote healthcare services portal,

5. Providing training to rural health workers and enabling them to use the technology for establishing communication between the patients and the caregivers remotely.

6. An E-Module system is developed to create a virtual classroom mode for rural health workers.

Project Highlights

In India, where nearly three quarters of 1.2 billion population lives in rural areas, provisioning *people-centric* and *efficient* healthcare services remotely is very important albeit extremely challenging. It is well understood that if the basic healthcare services remain out of the reach of most of the citizens in a country, the *disease burden* of the society becomes tremendously high. It is proposed that efficient use of technology can substantially improve the accessibility to healthcare services for the marginalized and vulnerable sections of Indian citizens. We propose to handle the issue using an integrated framework based on cloud computing, sensor networks and mobile technologies. Cloud technologies and models have not yet reached their full potential and many of the aspects associated with cloud are yet to be researched and further developed. The concept of sensor-cloud is even a newer research area. Generally, sensor networks are deployed to address specific needs. On the other hand, cloud resources are provisioned dynamically as and when needed. Thus, many challenging issues crop up while mediating the relationship between the cloud and the sensor and mobile devices to enable the proposed framework. In particular, research issues like resource management and service provisioning, seamless connectivity over heterogeneous networking protocols, management of data streams from sensor and mobile devices, scalability, security, QoS maintenance etc. are required to be handled and will be researched under this project. Besides provisioning healthcare services, the proposed framework can also be utilized for provisioning other citizen services. For example, environment monitoring, habitat monitoring etc can be developed on top of this framework. Therefore, a good solution to the challenges identified in the proposed research work bears huge relevance towards developing the IT infrastructure of the country.
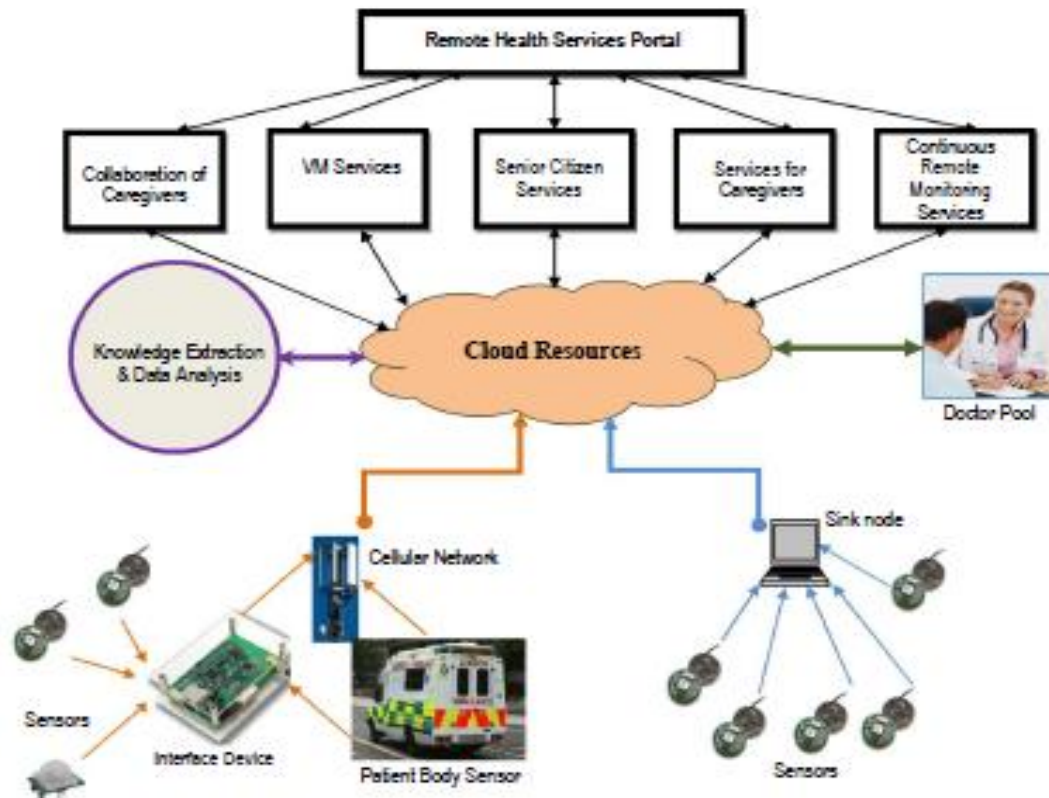
Figure 1:Schematic Diagram of Remote Healthcare Framework

For providing appropriate healthcare, large amount of complex data about patients, hospitals resources, disease diagnosis, electronic patient records, medical devices etc need to be stored, processed and analyzed. However, in rural areas data collected from the patients is often inexact, inconsistent and consists of lot of missing value and redundancy. Therefore, preparation of such data in a homogeneous form is necessary. Therefore, an improved healthcare system can be developed by considering "data quality, data redundancy, data inconsistency, repeated measures, temporal (time-contextual) measures, and data volume".An Ontology-based Information Retrieval System for patient medical record will be developed by IIEST Shibpur. The main tasks are:(i) Development of ontology based clinical decision support system (ii) Partitioning patient health data and handling data uncertainty.The proposed approach for this two tasks are (i)Concept-relation graph development for representation of ontology (ii)Finding best path of diagnosis using stochastic methods and graph traversing algorithm.(iii) Formation of feature subspace using decision tree (iv)Measuring uncertainty using fuzzy set theory.

Project Achievements

The project with its novel objective aims at developing societal sensitivity among the team members, project personnel and students who will be working with this project. To fulfil this we have arranged two Societal Sensitivity development program at Bakura and Sundarban.Such programs will have two-fold impact. Firstly, it will be able to exchange knowledge with the common people regarding the benefits of technological advancement in terms of country's healthcare system. Secondly, participants of these programs will become conversant with the use of technologies developed under this project.
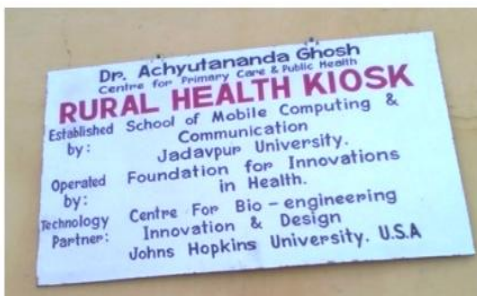
Figure 2: Societal Sensitivity Development program at Bakura and Sundarban

Figure 3: Health Kiosk at Barhra

An E-Module system is developed that will run the recorded lecture of medicine practitioners in synchronization with text documents using multimedia players. The goal of developing such system is to create a virtual classroom mode for paramedical staffs.

Publications

1. Sil, J., and Bhattacharya, I. (2015, October). Patient classification based on expanded query using 5-gram collocation and binary tree. In *IEEE International Conference on Data Science and Advanced Analytics (DSAA), 2015. 36678 2015.* (pp. 1-10). IEEE.

2. Indrani Bhattacharya and Jaya Sil, " Query Classification using LDA Topic Model and Sparse Representation Based Classifier ", ACM IKDD Conference on Data Science, CoDS'16, March 13-16, Pune.

3. Indrani Bhattacharya and Jaya Sil, "Sparse Representation Based Query Classification using LDA Topic Modelling", Springer International Conference on "Data Engineering and Communication Technology", ICDECT'16, March 10-11, 2016, Lavasa.

Project Staff

1. JRF: Indrani Bhattacharya, M. Tech, Leading toPhD
2. JRF: Sayan Das, M. Tech, Leading to PhD

Plan of Future Project Proposal based on the Current Project

1. Information retrieval module in health care domain.
2. Deployment of ontology based clinical decision support system.
3. Fuzzy Rule mining and feature learning for expert reasoning systems.