Mobile Health Care Solution for Rural India

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Abstract— People in rural areas face different health issues than people who live in towns and cities. Getting health care can be a problem when you live in a remote area. You might not be able to get to a hospital quickly in an emergency. You also might want to travel long distances to get routine checkups and screenings. Rural areas often have fewer doctors and dentists, and certain specialists might not be available at all. Nearly 70% of all deaths, and 92% of deaths from communicable diseases, occurred among the poorest 20% of the population. Because it can be hard to get care, health problems in rural residents may be more serious by the time they are diagnosed. This research work aims to improve the health care facilities in the rural areas. It also aims at providing improved information and communication facilities between the health care officials and the rural population.

Index Terms—health care, mobile application, rural healthcare

I. Introduction

India is the second most populous country of the world and has changing socio-political demographic and morbidity patterns that have been drawing global attention in recent years. Despite several growth orientated policies adopted by the government, the widening economic, regional and gender disparities are posing challenges for the health sector. About 75% of health infrastructure, medical man power and other health resources are concentrated in urban areas where 27% of the population lives. Contagious, infectious and waterborne diseases such as diarrhea, amoebiasis, typhoid, infectious hepatitis, worm infestations, measles, malaria, tuberculosis, whooping cough, respiratory infections, pneumonia and reproductive tract infections dominate the morbidity pattern, especially in rural areas. However, non-communicable diseases such as cancer, blindness, mental illness, hypertension, diabetes, HIV/AIDS, accidents and injuries are also on the rise. The health status of Indians, is still a cause for grave concern, especially that of the rural population. This is reflected in the life expectancy (63 years), infant mortality rate (80/1000 live births), maternal mortality rate (438/100 000 live births); however, over a period of time some progress has been made. To improve the prevailing situation, the problem of rural health is to be addressed both at macro (national and state) and micro (district and regional) levels. This is to be done in an holistic way, with a genuine effort to bring the poorest of the population to the centre of the fiscal policies. A paradigm shift from the current 'biomedical model' to a 'sociocultural model', which should bridge the gaps and improve quality of rural life, is the current need. It is unfortunate that while the incidence of all diseases are twice higher in rural than in urban areas, the rural people are denied access to proper health care, as the systems and structures were built up mainly to serve the better off. While the urban middle class in India have ready access to health services that compare with the best in the world, even minimum health facilities are not available to at least 135 million of rural and tribal people, and wherever services are provided, they are inferior. The basic nature of rural health problems is attributed also to lack of health literature and health consciousness, poor maternal and child health services and occupational hazards. The majority of rural deaths, which are preventable, are due to infections and communicable, parasitic and respiratory diseases. Infectious diseases dominate the morbidity pattern in rural areas (40% rural: 23.5% urban). Waterborne infections, which account for about 80% of sickness in India, make every fourth person dying of such diseases in the world, an Indian. Annually, 1.5 million deaths and loss of 73 million workdays are attributed to waterborne diseases.[13][14]

Three groups of infections are widespread in rural areas, as follows.

1. Diseases that are carried in the gastrointestinal tract, such as diarrhea, amoebiasis, typhoid fever, infectious hepatitis, worm infestations and poliomyelitis. About 100 million suffer from diarrhea and cholera every year.

2. Diseases that are carried in the air through coughing, sneezing or even breathing, such as measles, tuberculosis (TB), whooping cough and pneumonia. Today there are 12 million TB cases (an average of 70%). Over 1.2 million cases are added every year and 37 000 cases of measles are reported every year.

3. Infections, which are more difficult to deal with, include malaria, filariasis and *kala-azar*.

To improve the prevailing situation, the problem of rural health needs to be addressed in a very efficient manner. This research work focuses on this aspect. It also aims at providing improved information and communication facilities between the health care officials and the rural population The areas of focus include:

A. Personal health care
B. Primary health care

The personal healthcare aspect focuses on the following areas:

1) Consultation advice

2) Reminders for medicine intake

3) Monitoring medication of elders

4) Monitoring daily lifestyle

The primary healthcare aspect focuses on the following areas:

1) Child and maternal care

2) Early learning of outburst of epidemics

3) Location based tracking of epidemics

4) Identifying possible candidate for a particular disease

5) Awareness messages

II. Related Work

Some firms have started using mobile technologies and smart networks to improve the quality of care, reduce costs, and contribute to a healthier world. AT&T's mHealth Solutions are a new set of IT solutions for healthcare that combine mobility technologies, devices, connectivity and applications to help drive down medical costs and deliver improved patient outcomes. AT&T Managed Tablets is a highly-secure, end-to-end management solution bundling software and services with certain tablets that is easy to purchase and deploy. AT&T mHealth Solutions presents DiabetesManager is an initiative between AT&T and WellDoc, that combines the DiabetesManager application and feedback engine with AT&T's highly-secure hosting environment, support and customer care [10].

Another venture is ashametrics which provides mobile health solutions and tools for a healthier life. Ashametrics enables patients and clinicians the ability to collect physiological data on a mobile phone and upload it to a medical record database. Ashametrics LifeBands are soft wearable textile bands that measure physiology and transmit data wirelessly to a mobile phone or nearby PC. Lifebands can also be used to record/log data internally and downloaded later via Bluetooth or USB. The AshaView software enables real-time monitoring and recording of physiological data. The mobile application supports simple plotting, real-time annotation, and the ability to configure all the settings on the Ashametrics LifeBands (such as sampling rate, date/time,and patient ID). The basic version of the AshaView mobile application is available for FREE in the Andoid Market [9].

CellTrust Corporation has created a secure mobile healthcare solution that turns the standard SMS into a powerful HIPAA-compliant tool. This enables healthcare organizations and vendors to communicate patient data via secure text messaging to clinicians' and patients' mobile device[11]. Grand Challenges Canada is a unique and independent non-profit organization dedicated to improve the health of people in developing countries [12].

III. Challenges

Future of healthcare is truly a one touch away. Mobiles which have revolutionized our lives is playing a major role in healthcare as well. It supports increasing consumer engagement in wellness and prevention with increased medication compliance among patients. The utilization of wireless technology in healthcare is not without its challenges. More and more solutions are brought in to ensure that the wireless environment runs smoothly and reliably. Developing mobile healthcare solution have its own unique challenges as follows:

A. Security Considerations

Many devices will be in the Wi-Fi connection and by default these devices may not be secured. By security, we are not referring to the data security instead it implies the wireless environment security as well. To ensure security, the amount of data stored in the device is reduced to a great extent and majority of the data is stored in the server. Database query privacy violations and channel privacy attacks also needs to be answered. One of the major concerns in the privacy is the lost or stolen device which contains patient's unencrypted data. Patients think only of their convenience and least bothered about the privacy of the data in the present or future.

B. Meeting user demand

The users do not differentiate between wired and wireless, they expect the same performance and efficiency whatever the technology may be. They look forward for easy connectivity and flexibility and all the features they enjoyed while in wired technology. The user requirements have to be kept in mind while developing the overall architecture of the system and also extreme care has to be taken while designing the user interface. Since the application is targeting a population where majority will be illiterate and not used to having smartphones, the user interface has to be as simple as possible so that maximum of data acquisition errors can be avoided and not requiring the common man to be an IT expert or a technology savvy to use it. Loss of quality due to operator errors is a serious concern. The application will be used by almost all age groups; the youngsters who have an idea of being connected or can realize the importance of these applications and by the aged group who never considers such applications or device as an important part of their lives so have to figure out a way to engage both the patient groups.

C. Connectivity

The connectivity issues include both physical and technology connectivity concerns. The physical connectivity results due to the coverage gaps in the wireless network systems or unfavorable terrain that limits the coverage. To overcome the physical connectivity issues, have to think of extra hardware which is not a viable option. Virtual Private Networks [VPN] can be utilized

where there is little or no wireless coverage without the need to install extra repeater or other hardware. The technology concern is mainly related with the bandwidth availability of the wireless network. The technology connectivity issues may also arise due to the addition of more and more applicants to the network that works in proprietary environment.

D. Network Management

Once the infrastructure is established, proper management of the wireless network is mandatory. The network has to be properly maintained on a daily basis so as to ensure network reliability and connectivity. Wireless network management is an ongoing process; it not only involves the IT experts but may also require user intervention.

E. Data collection

To begin with the development of a mobile healthcare application for the rural population, first and the foremost task was to know the present healthcare facilities in the rural area, its drawbacks and the issues the healthcare professionals are facing due to the limited facilities available in rural areas. And also to get the information from the rural population was quiet difficult as they couldn't accept the importance of technology in their lives or how these applications can help them improve their health aspects [3].

IV. System Features

The Mobile Health Solution focuses on two main aspects of healthcare, personal healthcare and primary healthcare. The personal healthcare aspect focuses on the following areas:

1) Consultation advice: The user will be provided with an interface in his mobile in which he can enter the readings of pressure and sugar level and it will be stored in the user's database. If a similar pattern of information is entered for 3 or more days, then the application will show a message indicating whether to consult the doctor or whether his values are normal or not. Here the mobile will be acting as a knowledge base.

2) Reminders for medicine intake: Alarms can be set on the time when the medicine has to be taken. It will display which medicine has to be taken and also its dosage.

3) Monitoring medication of elders: An UI can be created in which the user has to tap the button after he had taken a particular medicine. It can be set as on tapping the button the information that he had taken a particular medicine will be sent to the preconfigured contact number of the person who should be informed and also the information will be stored in the user's database.

4) Monitoring daily lifestyle: It focus on recording the person's pressure and sugar level, intake of medicines etc on a daily basis and by analyzing these data the medical officer can monitor the lifestyle of the person and can advise on improvements if needed.

The primary healthcare aspect focuses on the following areas:

1) Child and maternal care: It focus on maternal and childcare. Our main focus is to help prevent various diseases like tuberculosis, diphtheria, pertusis, tetanus, polio and measles in children by timely alerting the parents about the date and time of vaccination via mobile. The information whether the vaccine has been given or not will be recorded in the user's as well as healthcare office's database so that it can prove useful in future. It also focuses on maternal care. The details regarding the pregnant women will be stored in the healthcare office's database and they will be alerted regarding the various injections and vaccines to be taken during the maternity period.

2) Early learning of outburst of epidemics: By monitoring the data received from the people, the medical officer can detect the outburst of any epidemics at a very early stage.

3) Location based tracking of epidemics: By monitoring the data received from the people, the medical officer can find out in which area a particular disease is getting spread.

4) Identifying possible candidate for a particular disease: By monitoring the lifestyle of a person the medical officer can detect the chances of any disease in future.

5) Awareness messages: This module provides with the message sending facility to all the registered users informing them about medical camps, health tips and other health care related information.

The server side focuses on patients' personal details as well as medical history. It focuses on the following aspects:
A. Patient registration
B. Record updation
C. Record deletion
D. Information retrieval
E. Report generation

The server receives all the medical information sent from various users via android mobiles and stores them in the database for future references. It is the server that calculates the dates based on immunization schedule and sends SMS to the intended person's mobile informing them about the date of vaccination.
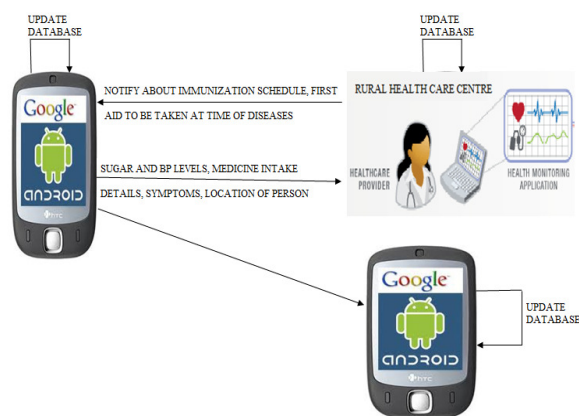
Fig. 1. System Architecture

V. Operating Environment

The Mobile Health Solution is developed using the mobile technology android. The healthcare office system i.e., the server is coded using the popular programming language java. To send and receive SMS text messages to cellphones from a JAVA application the Ozeki JAVA SMS SDK is used.

VI. Advantages

The proposed system is user-friendly. The system does not require any extra hardware and hence the system is cheap. The user does not require any extra knowledge to operate the application installed in his/her android based smart phone. The proposed system is portable and low cost, and it makes it a system for the common man. The system is reliable and robust.

VII. Future Enhancements

As the progress in life is advanced from known to known, the future of any software package lies in its ability to progress from the specified to the general. The basic structure of mobile healthcare solution was designed in such a way that the incorporation of additional utilities and function could be accomplished very easily without any change in the basic design. The system can be enhanced by adding mew modules and giving more server-side capabilities. One module that can be added is statistics and surveys i.e., instead of going to each door and collecting information, can send a SMS with an attached survey form which the user can use to fill in the details and send back through SMS and the healthcare officer can store the data in the office's database. In this work, a dedicated server is being used, instead a framework can be developed which will allow users to communicate with any Hospital Information System using their android mobile.

VIII. Conclusion

The main healthcare issues of rural population have been identified and a mobile health application has been developed. The app includes all vitals and location-based identification and early learning of outburst of epidemics which is a real need of the hour in rural areas. This application can be used by any end user to manage his health as well as communicate with the rural healthcare centre and avail healthcare notifications. The application is developed for android mobiles. It is expected to live up to the objectives for which it was designed and will do a good job in the long run.

Acknowledgment

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