Low Cost and Portable Patient Monitoring System for e-Health Services in Bangladesh

Mithun Chandra Paul,Suman Sarkar,Md. Mahfujur Rahman,Sayed Mohsin Reza
Institute of Information Technology
Jahangirnagar University
Savar-1342,Dhaka
Email:{mithunpauliit,sumaniit02,mrrajuiit,smrezaiit}@gmail.com

Dr. M Shamim Kaiser
Associate Professor
Institute of Information Technology
Jahangirnagar University
Email:mskaiser@juniv.edu

Abstract—This paper proposes a low cost and portable patient monitoring system for e-Health services in Bangladesh. A raspberry pi microcomputer based system has been developed which can be used by paramedics for collecting different sensor data such as ECG signal, blood pressure signal, heart beat signal, Situation of Oxygen in Blood(SPO2), temperature and generating different signals from a patient and send these signals to specialist doctor who are in a centre or in a hospital. A web based application has been developed for both doctor and paramedics for efficient communicate with each other. It has been found that the system can be suitable for village health care centre of Bangladesh.

Index Terms—ECG, e-health, raspberry pi, Situation of Oxygen in Blood(SPO2), blood pressure signal, raspbian etc.

I. INTRODUCTION

The e-Health is an early arena in the connection of medical informatics, community health and business, mentioning to health facilities and information provided or improved through the internet and associated technologies [1]. In a wider sense, the term describes not only a technical expansion, but also to improve health care locally, county-wide, and worldwide by using information and communication technology. The e-Health covers Electronic Medical Records such as patient records, digital imaging, prescribing, internet based telemedicine and telecare services [2]. Itś also covers virtual genuineness, digital imaging, computer supported surgery, wearable and portable monitoring systems, health portals and decision making supporting for self-care.

For getting health care in the remote area is the critical fact because of poor financial infrastructure and communication problem in bangladesh. The specialist doctors are also not willing to go to the remote area. With the advent of the ICT specialised doctor can give their advises to the distant patient using e-Health system for diagnosis for proper treatment and prevention of disease. e-Health system can be beneficial for the rural patients through using telecommunication and information technologies. It helps people who leaving in a rural area to eliminate distance and can improve access to medical services that would not be often consistently available in rural communities. It is also the solution package for emergencies and critical solution [3].

e-Heath can be beneficial to patients living in isolated communities and remote regions, who can receive care from specialist doctor without having to travel to the doctors location or chamber. Recent developments in mobile collaboration technology can allow healthcare professionals in multiple locations to share information and discuss patient issues as if they were in the different place.

Bangladesh is a developing country. There are more than 68 thousand villages in Bangladesh, most of the peoples are living in these villages, the per capita income of this villagers are low compared to whose are working in urban city. Moreover the average per capita income is less that that of India and Pakistan [4] and the Road traffic communication is poor. Due to these lack of facilities, specialist doctors are not willing to go in thee villages. In Bangladesh, 70 percent people live in rural area. In rural areas about 40 percent of the population was count up as poor and 30 percent as extreme poor in 2014 by World Bank. They cań get proper medical treatment lacks of services in the village. This paper has approached e-Health service by which rural people can easily make communication with the specialist doctor.

This paper describes a low cost portable device for patient monitoring system. Here the system has proposed to work about ECG signal, blood pressure signal, heart beat signal, Situation of Oxygen in Blood(SPO2), temperature and generating different signals using corresponding sensor to analyze the electrical activity of patient condition. Raspberry pi and a web application has also developed for deployment. The signal has been transmitted over web server to specialist doctor and displays the data in doctorś site on an organized Graphical User Interface (GUI). After getting the signal and available information, the doctor can give proper treatment for the patient.

The main goal of this paper is to introduce the difficulties related to urban areas health care. This project also provides a possible solution to overcome one of the main problems that comes collaboration of specialist doctor. Proposed model fulfil the requirements both the patient or remote paramedics and the specialist doctor. This portable device provides cheapest, fastest, home based health care services in the whole country especially elderly and remote areas.

II. Literature Review

Currently, the health care system is undergoing a cultural shift from a traditional approach to a modernized patient centered approach. In the traditional approach the health care professionals play the major role. They need to appointment the patients for essential diagnosis and instructing. There are two basic complications related with this approach. Firstly, the health care professionals must be on site of the patient all the time and secondly, the patient remains admitted in a hospital, wired to bedside biomedical instruments, for a period of time. There are various work on e-Health and research is now still going on the development of it.

Health Gear System is a real-time wearable system for observing and analyzing physiological signals. For the execution of Health Gear System using a blood oximeter to monitor the users blood oxygen level and pulse while sleeping [5]. Tracking Devices For Elderly Care System By Using GPS: At present, elderly people are surfing from dementia and Alzheimers disease across the world. Those elderly who are suffering from dementia and Alzheimers disease necessitate continuous attention. Hence it is possible to look after not only a single patient but also monitor a number of patients at the same time. Here they use RFID and GPS tracking system for the elder people to take care of them [6]. CareWell will primarily focus on the facility of care and provision to older people who have multifarious health and social care needs, are at high risk of hospital or care home admittance and require a range of high-level intermediations due to their weakness and several chronic diseases. Smart Personal Health is a European Commission provision action to endorse consciousness about problems and challenges of interoperability among personal health systems (PHS) and to other e-Health systems [7].

There have been many studies to offer a clarification to e-Health. They use GSM, satellite communication, RFID etc. Particularly, portable patient motoring system using raspberry pi is a new research arena that achieves low cost patient healthcare, which provide the potential for highly flexible medical services that are not possible with standard e-Health system.

III. Patient Monitoring System

This paper is based on client-server architecture [8]. The server application is responsible for storing data from patients and sending to the doctors sever. Doctors monitors and transmitting treatment to patient through Internet after getting those signal information from patient. Figure 1 shows the flow chart of proposed model. Proposed paper has discussed with four main components. These are:

- Sensors;
- Microcomputer;
- Database;
- Application;

A. Sensors

Proposed paper is based on low cost and portable patient monitoring system for Bangladesh. For signal acquisition form
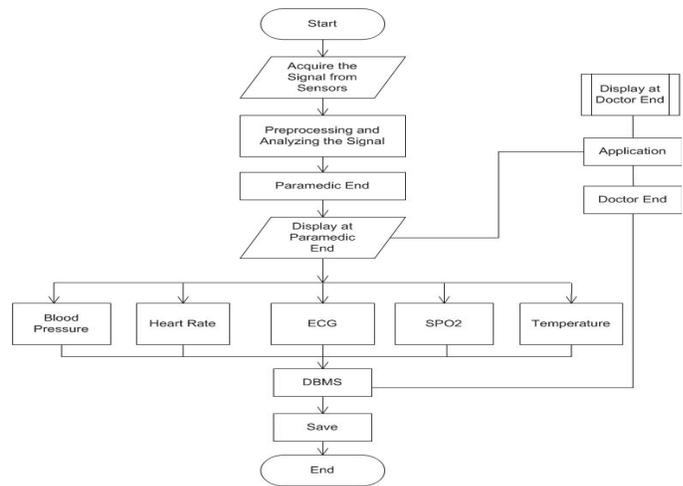

Fig. 1: Flow Chart of Proposed Model

patient body, different sensors are used. The ECG Sensor model AD8232 is used for getting ECG signal [12], Pulsesensor for heart rate [13], RM2426 sensor [14] for blood pressure, AFE4400 Pulse Oximeter Shield Kit for SPO2 and DS18B20 sensor used for temperature sensor [15].

B. Microcomputer

Raspberry Pi is a microcomputer which is used for receiving and analyzing signal from different sensors and sending those signal to specialist doctor. GPIO pins of Raspberry pi are used for receiving signal from different sensors [9]. The Raspberry Pi is a low cost, credit-card sized computer with monitor and uses a standard keyboard and mouse. It is accomplished with tiny device that assists people to explore computing. Proposed model has used raspbian operating system in raspberry pi with 16 gb memory card [10].
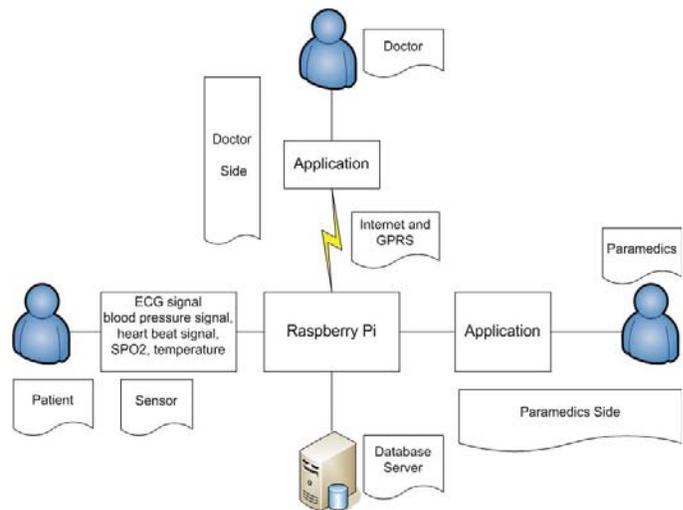

Fig. 2: Entire Scenario of the System

C. Database

A relational DBMS has been used for storing the patients and doctors information. DBMS is also used for storing the signal which acquires from different sensors. Doctors treatment are also available in the database. Paramedics and doctors can access the information whenever they will be needed.

D. Application

A web based application using ASP.Net is responsible for the client-server architecture which assists to communicate between paramedics and specialist doctors [11,17].

*Client Side:*Client-side allows interaction within paramedics and doctors. Paramedics are responsible for acquiring signal from patients body using different sensors. Those signals are transmitted over internet using GPRS to specialist doctors. A web application that is used for visualizing signals to patient or paramedics and the doctor [18,19]. The remote paramedics first access the application and input the patients information and attach the picture of both physiological and biological signal which has been acquired from the device. When paramedics will submit patients information with signal, he/she will get a patient pin or id number for access later. Here paramedics will add new patient information or edit an older patient information if needed. The specialist doctor can see all the information with signal picture. As a result, The doctor will give better advice and treatment for the patient by analyzing patient information.

Server Side: The Server is used for storing and making available incoming vital signals which originated from the clients. The server also has a database to store all the information both patient and the doctor. If the patient or doctor wants to communicate each other, they can easily get all the information from the data store. Basically, the server is developed with ASP.Net application and a relational database. The application compromises the following features: a) Patients information; b) Visualization of signals; c) Show sending patient information and treatment d) Show receiving patient information and treatment d) Prescribing Patient and chat conversation.

IV. EXPERIMENTAL SETUP

Proposed model has used the raspberry pi microcomputer for acquiring the signal using different sensors from patient's body. A web application has been developed for sending those signals with required information to specialist doctor for getting better treatment. Here patients, paramedics and doctors are vital users for this proposed system. Figure 2 show entire scenario of the system.

Paramedics fill up all the patients information such as name, address, age, sex, phone, disease field in application. He can also attach a blood pressure signal, ECG signal, heart beat signal, Situation of Oxygen in Blood(SPO2), temperature signals which getting form sensors. After completing all the fields he will save it to the database and prepared for sending

information to doctor. Doctor is responsible for analyzing the signal and giving treatment to patient(figure 3).
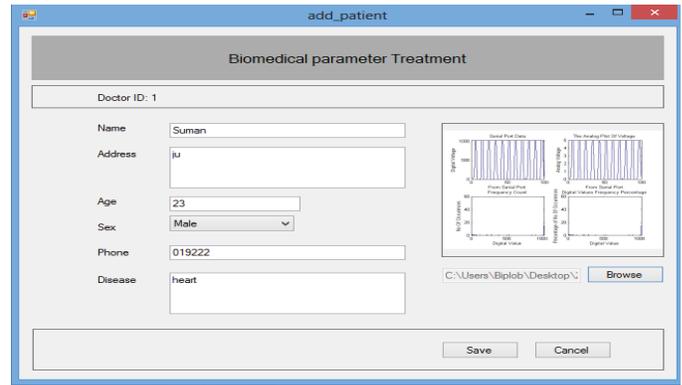

Fig. 3: Patient's Information

After filling up all patients information, then he would be able to assigning patient to a specialist doctor. He could select a corresponding doctor to a corresponding patient for getting better treatment(figure 4).
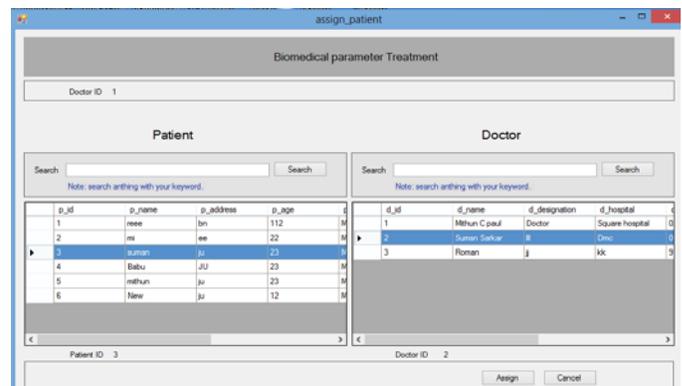

Fig. 4: Assign patient to Specialist Doctor

After seeing all the information about patient, doctor could prescribe to the patient and then paramedics could download the treatment file as .pdf , .doc or .xls(figure 5).
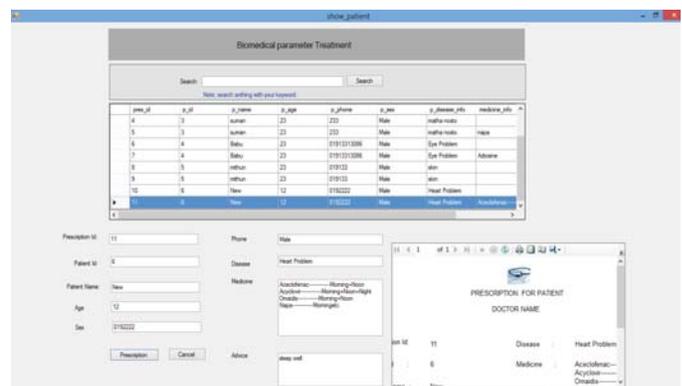

Fig. 5: Prescribing Patient by Specialist Doctor

V. RESULT DISCUSSION

The system was implemented as previously described. As mentioned, both client and server side utilized ASP.NET programming language. The proposed system is meant to operate in an application by doctor and paramedics. The major task will be monitoring the patient health condition by checking on different signals and doctor could prescribe to the patient and then paramedics could download the treatment file as .pdf , .doc or .xls(figure 5).

Evaluating the result is an important issue of patient monitoring system. In order to evaluate the effectiveness , the proposed system works with different types data set. For example, ECG signal data set, blood pressure data set, heart beat data set, Situation of Oxygen in Blood(SPO2) data set, temperature data set. After getting data set proposed model preprocess the signal [16], analyze the signal and finally evaluate the result [figure-6].
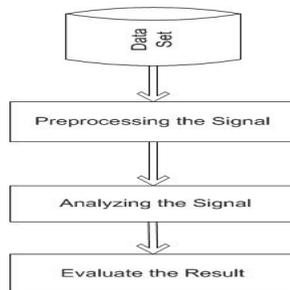

Fig. 6: Data Set and Result Evaluation

VI. CONCLUSION

In this paper a portable patient monitoring system for e-Health of Bangladesh has been discussed. As most of the people of Bangladesh are living in villages, and infrastructure development and imcome of these villages are low, the proposed portable patient monitoring system can be used by paramedics in the Health care center. The specialist doctors give them consultation from any part of the country using very good ICT infrastructure of the country. In future a doctor assisting system will be included along with the portable patient monitoring system. It moderates expenditures and increases the quality of life of patients. As the modern life becomes more hectic and severe diseases appear, sustained treatments become more necessary. This paper fulfills the requirements to both the patient or remote paramedics and the specialist doctor. The proposed model is more sustainable for using GPRS. This time communication take place via the wireless transmission which is more fast and easy system. If proper research and development work is initiated in this field today, then it is possible to propose a better solution to urban health care or remote areas those are far away from specialist doctor. Construction of standard prototypes and patents for home based health care makes our life more easier. e-Health care embodies a rising field in the health assistance. It moderates the need of transporting patients between hospital and patients house. e-Heath department in every central or city hospital and making it an integral part of the hospital management system reduces the difficulites of urban health care.

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