

A Survey on Secured ECG Monitoring System Using Wireless Sensor Networks and IOT

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Abstract: In the present day world, the polluted environment paves way for huge number of health problems. It is not always easy for a doctor to continuously monitor his patient. The main aim of this paper is to conduct a survey on the existing healthcare devices and to develop a more efficient system. The best way to acquire health information is from an electrocardiogram (ECG) analysis. Through an ECG, characteristics such as patient's heart disorders, heart conditions, and heart disease can be analyzed. Unfortunately, most available healthcare devices do not provide clinical data and history of the patients' heart activities. Many researchers have tried to solve this problem by inventing portable ECG systems with a chest strap or wrist band, but their performances were not satisfactory for practical purposes. Thus, the aim of this study is to build a new system for early detection and warning system for heart attacks. The proposed system consists of a sensor network for collecting information regarding the heart condition and this sensor network sends data on a continual basis, filtered, and effectively mined to the doctors mobile phone by first sending to a cloud server where all the patient history is stored. For effectiveness, the proposed strategy is outfitted with analysis capabilities-e. g., A real-time QRS-wave detection has been implemented by passing through a high pass and low pass filter. The system can identify premature heart muscle contractions(PVC), which are very important for the subjects who are being monitored. In this work, we highlight the opportunities and challenges for IoT in realizing this vision of the future of health care.

Index Terms:— ECG monitoring, Internet of Things, Raspberry Pi, GPS, R peak algorithm, Ethernet

I. INTRODUCTION

In the late years, world is encountering high rate of heart diseases. Heart infections have ended up one of the main sources of death, and World Health Organization (WHO) expresses that cardiovascular illnesses are the world's biggest executioners, asserting 17.1 million lives a year. The traditional system for monitoring heart conditions is direct connection between the patient and the ECG instrument. A conventional system is only used to collect the clinical data and the diagnosis and analysis is done offline. The developing wireless sensor innovation gives the capacity to consistently sense, handle and transmit the obliged signs to a control station and to give an early warning of any. This ability can be utilized for ongoing observing of cardiovascular patients, which will diminish the impacts of diseases. Wireless sensor nodes are constrained of their available energy and memory. This confinement can be minimized by incorporating different remote system advances with the present wireless sensor system. Mobile phones are one of the most common devices available with each and every individual in this world. Mobile phones are one of the most common devices available with each and every individual in this world. have enough available memory, energy, and processing power. So these techniques of mobile phone technology can be used to beat the limitations of wireless sensor system innovation for transmission, handling, and buffering of the detected data.

At present there are many telemedicine technologies for bedridden patients. But they all are only currently designed to acquire clinical data and to store them in the hospital system for a short amount of time and then transmits to the doctors end. Some of the research proposals are based on the following ECG features.

- ♣ Systems that perform offline analysis and record signals;
- ♣ Systems that perform real time analysis
- ♣ Systems that perform local real time classification.

The framework together will give the ECG signal analysis of a cardiovascular patient, remote checking, conveyance of alert to a specialist, relative, and the healing center, and an augmented administration of exchanging the ECG signals and past records of the patient to his specialist in a remote area. The data transferred to the doctors phone will be encrypted to avoid any possible misuse of the information. A two phase warning methodology is incorporated in this framework as knowledge based and without knowledge based warnings. This system can be used for providing enhanced healthcare services to the rural areas of the developing countries that are facing shortage of efficient specialized doctors. Thus the cardiovascular disease causing the death of patient can be reduced immensely by the

implementation of this proposed system, in both rural and urban areas and from any part of the world.

II. KEY CONTRIBUTIONS

This kind of paper [2] describes about the design of simple heart rate monitor system based on arduino board which exhibits the outcome on a LCD display and concurrently transmitting the data to phone via Wireless Bluetooth. There is certainly often a need to access heart rate testing instrument which provide appropriate and quick readings of patients. Unlike the typical way, the doctor doesn't have to be present at the time of measuring the cardiovascular rate. The system can take the physical input from pulse sensor by positioning the patients' finger on the sensor and then the input is refined by Arduino to rely the number of signal and displaying the outcome. This kind of invention [2] relates to a heart rate measurement device containing a sensor unit that detects an user's cardiovascular system rate, a signal finalizing unit that receives and processes the signal made from the sensor and a wireless signal sending unit that takes the signal from the finalizing unit and the broadcast the signal to be able to the tweaked device. The fñhler unit detects the regularity of change blood vessels density to derive the heart rate, with finely-detailed and efficiency of diagnosis of heart rate, working together the technique of cellular transmission, and so our goal of promoting accuracy and reliability of detection and bettering convenience of using is achieved.

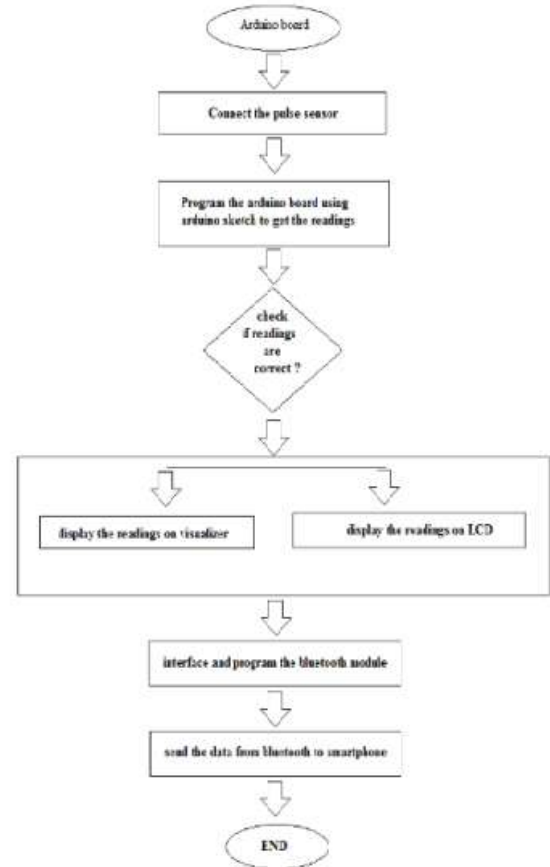


Figure 1: Flow diagram [2]

The model encompasses of Arduino board Bluetooth device, Pulse Sensor etc for signal conditioning of beat input from patients body and displayed CRISTAL LÍQUIDO. The data even dispatched to the pc via serial communication and that we can view the graphical form of the pulses on the monitor.

The study on the paper [3] presents a narrative easy-to-use, portable, low-power, current, and auto alarm electrocardiogram (ECG) intelligent diagnosis system on MSP430 microcontroller. The current ECG signal is bought at V1 lead and instantaneously amplified and purified on front end signal and then, the indication is converted from analog ECG signal to digital value and filtered with Cohen Daubechies Feauveau 9/7 wavelet. Also, the ECG waveform is displayed on LCD and the current calculated heart rate is displayed on segment CRISTAL LÍQUIDO, refreshed every 4 moments. The buzzer alarms and the alarm message with

the position information of the patient are provided for the doctors or family immediately, once an unnatural ECG is detected. A real-time R-wave detection criteria based on integral discharge function has been integrated, which is specially designed to be adaptive against the most frequent options for noise and interference present and standard wandering when acquiring the ECG. Experimental results show the R-wave detection accuracy and reliability of the proposed system is 98. 8% and the PVC detection and identification of the offered system is 92. 1%.

This innovation [4] presents a system that helps in the real time monitoring of the heart beat of the patient live by the doctor using a pulse sensor. It also consists of a SMS alert. This project designs an implementation that makes it available for people at a low cost but efficient and flexible heart beat monitoring and alert system using GSM technology. The sensor sense the abnormalities in the pulse rate of the patient and sends the signal to the control unit for proper processing and determination of heart beat rate which is displayed on a LCD. If there is any variation in the pulse rate, there is an alarm system to alert and SMS is send to the mobile phone of the medical expert if and only if the threshold value of the heart rate is maximally exceeded. Thus this system helps in monitoring the heart rate and helps in the diagnosis.

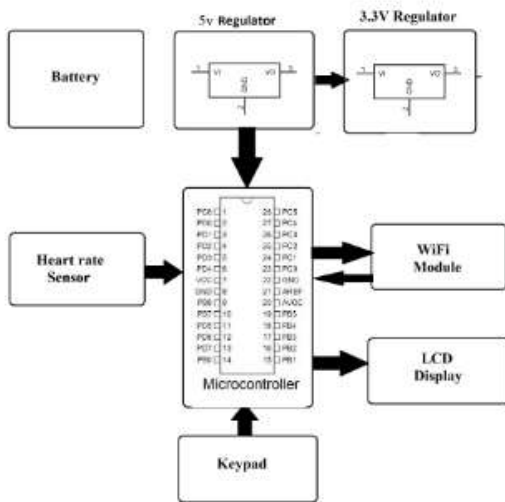


Figure 2: Functional Diagram [4]

The paper [5] presents an android based portable ECG monitor. The patient will be given a small device which

senses the ECG data. This small device send the sensed data to the patient’s Android mobile through Bluetooth. The Android mobile will be having an application which will be running a heart attack detection algorithm. If in case any abnormalities are found the patient will be notified through an audible alarm and first aid techniques will be shown to the patient in the phone’s display. This first aid instruction will increase the chance of survival of the patient. An ECG report will be send to the patient’s doctor through email so that he can prepare himself for the treatment. And also a SMS will be send to the hospital that contain exact patient’s location(GPS) so that help can be given at the earliest even if the patient is travelling. The goal is to provide early heart attack detection so that the patient will be given medical attention within the first few important hours, therefore greatly improving patients chances of survival.



Figure 3: general architecture of the above system[5]

The Wearable electrocardiograph (ECG) monitoring systems[6] today use electrodes that require skin preparation in advance, and require gels to make electrical contact to the skin. To avoid these pastes or gels sensors were used. The developed system is used for remote monitoring of patients heart rate. This system allows the medical experts to understand patient's scenario on the monitor by wireless module. Here low cost, low power consumption and flexible network topology ZigBee wireless module is used to sense the remote patient data. All sensor data are transferred within a group of Zigbee wireless m which module [6] which has a data transmission range on 1500 metres line of sight.

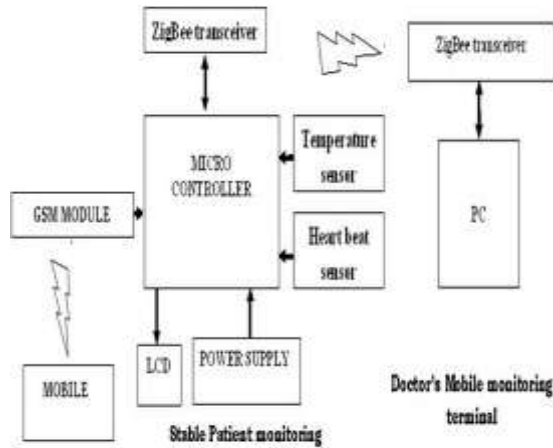


Figure 4: Block Diagram of the above system [6]

This paper [7] describes a heart attack self-test application for a mobile phone which allows potential victims of a heart attack to quickly assess whether they are having a heart attack without the intervention of a medical specialist. Heart attacks can occur anytime, anyplace. Using pervasive technology such as a mobile phone and a small wearable ECG sensor it is possible to collect the user's symptoms and to detect the onset of a heart attack by analysing the ECG recordings. If the application assesses that the user is at risk, it will urge the user to call the emergency service immediately. If the user has a cardiac arrest the application will automatically determine the current location of the user and alert the ambulance services and others to the person's location.

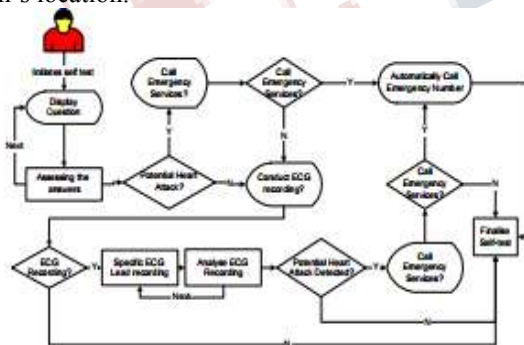


Figure 6: Flow Chart of self-test app[7]

[8] Health monitoring system is good for the patients and society where the implementation of such system will save hospital bill, waiting time and reduce traffics in the hospital. The objective of this project is to design and develop body temperatures measurement device that can be observe by a doctor in real time as well as history data via

internet with an alarm in the event of in the case of abnormalities. In the proposed health monitoring system, heart rate and body temperature wireless detectors were developed. The temperature sensors will send the readings to a microcontroller using Xbee communication. To send the real-time data to health monitoring database, wireless local area network (WLAN) has been used. Arduino with Ethernet shield based upon IEEE 802. 11 standard has been used for this specific purpose.

[9] Electrocardiographic (ECG) equipment plays a vital role for diagnosis of cardiac disease. However, the price tag on this equipment is huge and the procedure is too much complex which are unable to offer better services to a huge population in expanding countries like Bangladesh. In this paper, we now have designed and implemented an affordable single channel ECG monitoring system using phone having android operating system and Arduino. This manuscript also demonstrates the use of Android smartphone for processing and visualizing ECG signal. Our designed system is battery powered and it gives wireless feature. This system can be used with computer or laptop having either Windows Apache or Mac OS. To get this purpose a software is developed. An android application is developed using Processing IDE, which requires Android version 2. 3 and API level of 10. This application will not need USB web host API. For this reason, around 98% Android smart phone in the market can provide for this system.

[10] A proposal was given to the rendering of a wireless network based on Bluetooth (BT) for recording, monitoring and analysis of electrocardiographic alerts (ECG). Three surface electrodes are put on the chest, following standardized factors of triangle of Einthoven. The signals measured are amplified and filtered by components in an outlet and then they are carried to Arduino ALCUNI card. The ECG transmission is sent by BT from Arduino UNO to a mobile device taken by the user, so they can send it to a workstation where the ECG is prepared or analyzed by an expert. This proposal would help the health sector to increase the quality of their service in the care of patients with heart diseases; also costs of health care would significantly decrease.

[11] The key purpose of this research work is to develop a wireless sensor network system that can continually monitor and identify heart disease experienced in patients at remote areas. A wearable wireless sensor system (WWSS) is designed to continually capture and transmit the ECG signals to the patient's cellphone. The speediest alert

will be given to doctors, relatives, and hospitals, using the recommended data processing algorithm applied in the patients mobile phone. The complete data from WWSS will also be transmitted to a core station, which provides something to the doctor to view his patient's record and provide his {health professional pharmaceutical remotely, on his demand. A heterogeneous wireless network design is also suggested for the continuous transmitting from WWSS to a Central Data Center (CDC). The proposed system is integrated with an active data collection algorithm that collects the ECG alerts at regular intervals, based on the health risk perceived in each patient. Employment of this system will make contributions in reducing heart diseases, leading to death of a patient, and also act as {a highly a powerful health care in order to patients in rural area. This continuous monitoring system will provide effective, and fast health care service to patients at risk, even if the doctor, relatives are not near to the patient and also during the non availability to the cellular network.

III. CONCLUSION AND FUTURE ENHANCEMENTS

From the conducted survey , it is clear that the most of the papers use wireless technologies like Zigbee, Bluetooth technologies which made a great demerit regarding range as its signal transmission is line of sight. The capability to monitor multiple patients at a time, to deliver remote diagnosis and prescriptions, and also for providing fast and effective warnings to doctors, relatives, and the hospital was not incorporated to practical use yet. Comparatively, this system can be produced in low cost, since it only needs to develop a wearable wireless sensor system, the software platforms, and the development of data storage capability. The current system will be modified later, by incorporating other sensors, to monitor blood pressure, diabetes, and respiration process, to reduce false alarms.

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