Quality Healthcare Management- using Android Application

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***Abstract*— The main objective of this paper is to develop an Android App which is useful especially for the nurses in the ICU (Intensive Care Unit) and the doctors in the hospital. In this management system an Android App is used to reduce the manual work at Health centers. All tasks are performed by the system, like registration details of an individual (i.e. patients, doctors, nurses and others). This system also provides the medical history of a patient in order to take appropriate medical treatment by the doctors before proposing any treatment to a patient, or when the patient is unable to give his details during emergencies like unconsciousness/ coma etc. This management system also monitors the ECG (EKG) i.e. Electrocardiogram of the patient including the prescribed medical treatment & gives alerts (via Bluetooth communication) to the doctors, nurses & the patient's attendants if the condition of the patient is deteriorating. Early warning or alerts and patient awareness are critical in preventing permanent heart damage and saving much of the heart muscles from further damage. These critical conditions motivated me to propose this App to continuously monitor the condition of the patients in the ICU. All the updated information of any individual can be accessed anywhere by the authorized persons. In addition, this system helps in fixing the doctor's appointments & enquiries, etc. This app reduces laborious paper work and the burden of file storage, making it Eco-friendly. Experiments were conducted using this App in real-time by collecting the ECG of the patients, in stationary as well as moving conditions. In both the situations, this application fulfilled all the requirements of the proposed management system.**

***Keywords*— registeration details, appropriate medical treatment, ECG, EKG, Bluetooth, emergencies, alerts, reduce paper work, eco-friendly.**

I. INTRODUCTION

Considering the well-known quote by Virgil - "The greatest wealth is HEALTH". For a smart living, interactive applications are increasingly important especially for the interaction of people and the environment. Access to essential standard health care is one of the most important issues facing our nation. Every year more than 440,000 people die as they suffer some type of preventable harm that contributes to their death. This emphasizes the need for introducing Quality Healthcare to save & protect the precious lives, the god gifted. The pressing need to protect our environment leads to the development of applications (Apps) which are becoming popular, convenient, comfortable & easily accessible. This inspires us to develop an App to provide quality care to the mankind. This paper shows the live monitoring of the ECG device, to calculate the patient's heartbeat rate and finally alerts the nurse, doctor and patient's kin or dependents about the patient's condition when the patient is abnormal.

II. LITERATURE SURVEY

A. The Anatomy of Heart

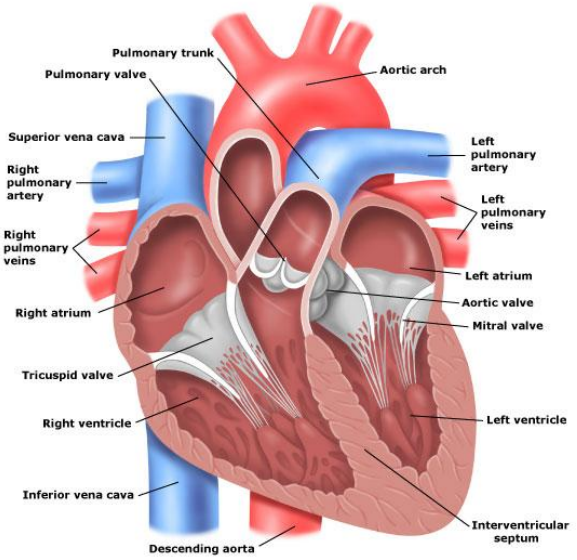


Fig 1. Anatomy of Heart

The heart is a muscular organ about the size of a closed fist that functions as the body's circulatory pump. It is surrounded by a double-membrane sac called pericardium. It takes in deoxygenated blood through the veins and delivers it to the lungs for oxygenation before pumping it into the various arteries (which provide oxygen and nutrients to body tissues by transporting the blood throughout the body). The heart is located in the middle compartment of the mediastinum in the chest. [1].

The heart has four chambers, two upper (right and left) atria, the receiving chambers, and two lower (right and left) ventricles, the discharging chambers. A wall of muscle called

the septum separates the left and right atria and the left and right ventricles. The left ventricle is the largest and strongest chamber in your heart. The left ventricle's chamber walls are only about a half-inch thick, but they have enough force to push blood through the aortic valve and into the body [2].

B. ECG Analysis

The ECG or EKG is an important tool to interpret a wide range of heart conditions. Electrocardiography is the process of recording the electrical activity of the heart over a period of time using electrodes placed on a patient's body. Electrocardiogram is used to check for the problems related to the electrical activity of the heart as line tracings on the device's screen. The spikes and dips in the tracings are called waves. These waves are caused due to the contraction & relaxation of the heart valves and muscles.

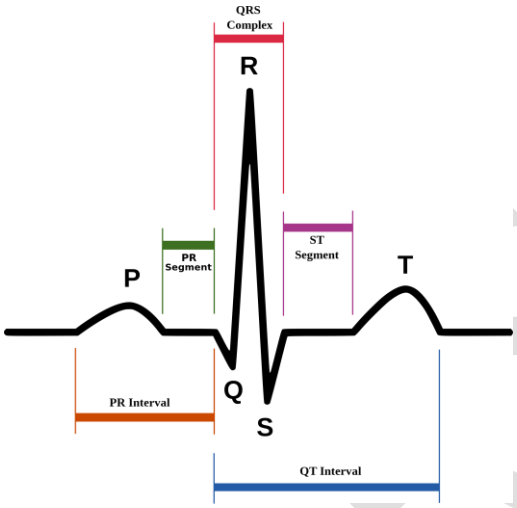


Fig 2. ECG of heart in normal sinus rhythm

The right and left atria or upper chambers make the first wave called a "P wave" — following a flat line when the electrical impulse goes to the bottom chambers. The right and left bottom chambers or ventricles make the next wave called a "QRS complex." The final wave or "T wave" represents electrical recovery or return to a resting state for the ventricles[3].

An abnormal variation in electrical activity of the heart can be caused due to the following reasons:

- Narrowing of valves or hole in heart
- A fault in the conduction of heart waves
- Various heart diseases that are detected by the ECG
- Body size & position, air temperature etc.,

III. EXISTING SYSTEM

In the existing healthcare system, all the functions in medical management are manual and largely paper based and lack standards. All the information need to be recorded in paper which is a very tedious and time consuming task that cannot be implemented in bigger hospitals. In addition to laborious paper work, it requires more manpower making the existing system very uneconomical. In remote areas, there is lack of sophisticated medical equipment and doctors. Moreover, there is no data recording system in order to keep the previous health reports and lab reports of patients. There is a high chance of misinterpretation of data as well as occurrence of errors, & it is cumbersome.

With the increase in volume of patients in the health care institutes, traditional method of management has gone out of phase. As a result of this, an advanced Health Care Management System becomes inevitable.

IV. SYSTEM DESCRIPTION

A. Overview

This system consists of four modules i.e. the patient's ECG Acquisition device, trans-reception module, and the control unit in the mobile phone. ECG device is the real time continuously attended ambulatory cardiac monitoring system.

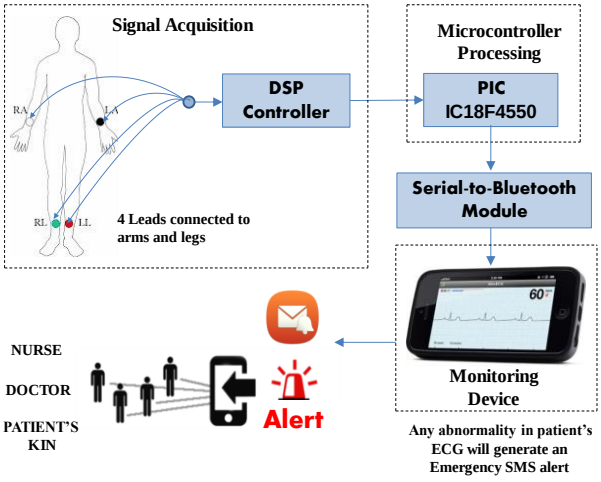


Fig 3. Working of the system

B. Hardware Requirements

1) ECG Leads: Four leads are connected to the patient's arms and legs from which his/her heartbeat is incessantly monitored. The SA (Sino-Atrial) node in the heart generates the heart signals, which are captured by the leads/electrodes connected to the human body.

2) Digital Signal Processing Controller: The signals from the leads are connected to the DSP (Digital Signal Processing) Controller. A DSP can process data in real time, making it ideal for applications that can't tolerate delays. Digital signal processors convert the analog signals to digital signals by using ADC; processes the digital signals (at a sample rate based on resolution of the ECG signal) and is forwarded. Digital Signal Processors use video, voice, audio, temperature or position signals that have been digitized and mathematically interpreted [4].

3) Peripheral Interface Controller: The data from the DSP controller is then sent to the PIC (Peripheral Interface Controller) which is an electronic circuit that can be programmed to carry out vast range of tasks. PIC Microcontrollers are simple, efficient relatively cheap. ECG & heartbeat measurement system can be bought as pre-built circuits or as kits which can be assembled by the user. The electrical signals acquired from electrodes are very weak and after processing, these signals are digitized by using ADC [5]. In this system, PIC18F4550 microcontroller is used where it is processed, filtered, and plotted in the form of an actual ECG waveform in the mobile phone (monitoring device) via Bluetooth Module. The reason for the particular usage of this PIC18F4550 is that, the input data can be periodically monitored.

4) Serial-to-Bluetooth Module: Bluetooth is a short-range communication system, intended for cable communication replacement between electronic devices in a low cost, low power, robust way. A Bluetooth system consists of a RF transceiver, baseband and protocol stack offering services to connect and exchange data between devices [6]. Finally, through this low power Serial-to-Bluetooth 4.0 module, the ECG waveform is obtained on the mobile phone.

V. TECHNOLOGY USED

The Bluetooth wireless communication protocol is used in this project. Modern Android smart phones with the ability to run the application already have a Bluetooth radio, hence no extra hardware is required in order to get the communication channel up and running. In addition, the ECG component would be simple to pair using this technology. This means that it would be very simple for the average user to get the entire ECG system up and running on their mobile device [7]. Medical engineering also looks deeper into how this technology can help the hospital make monitoring more effective and quicker without frequently visiting patients [8]. In 2003, just two years after the Bluetooth wireless technology was used officially in the world. U.S. Food and Drug Administration (FDA) approved the first Bluetooth used in medical devices. It is the Serial Port Adapter for emergency room equipment, designed for applications such as wireless printing electrocardiogram or send medical images in the air [8]. An important aspect for this project is the overall power consumption for both the ECG hardware and the mobile device. This paper introduces a mobile system in which the heart's electrical activity is transmitted to the mobile via Bluetooth and released, processed, stored and visualized in real time [8].

VI. WORKING OF ANDROID APP

A. Home screen

The Home page consists of the tabs like Admin, Patient, Doctor, Nurse and Hospital. Fig 4. shows the Homepage of the app which has the options for Admin, Doctor, Nurse, Patient & the Hospital. Every tab on the homepage has a secured login and password.

The functionality is as follows:

1. *ADMIN:* The Admin option is used by authorized persons only. Admin takes the responsibility of maintaining the records of the staffs and the hospital i.e. this person can edit, delete or add the details of the staffs including doctors & nurses.

2. *PATIENT:* The patient's registered information is updated in the app. Even after the patient's discharge they can view their previous medical details (previous medical illness, in which hospital they were admitted in, consulted doctors etc.). Discharge summary, suggested medicines and the next review date are also updated for the patient's reference.

3. *HOSPITAL:* The receptionists can login from their account and can enter the details for the registration of the patients at the reception. The details (including discharge summary and next review date) are updated on the website and later can be viewed on the app.

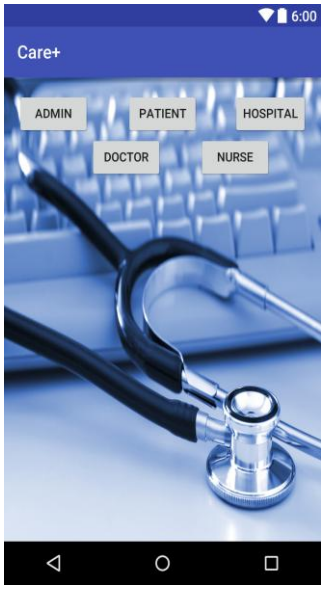


Fig 4. Homepage of the App

4. *DOCTOR:* The doctor can logon to his/her account and view the patient's details for further medication. Doctor can also advise the nurse to give the prescribed medicines for the treatment of the patient admitted in the ICU ward.

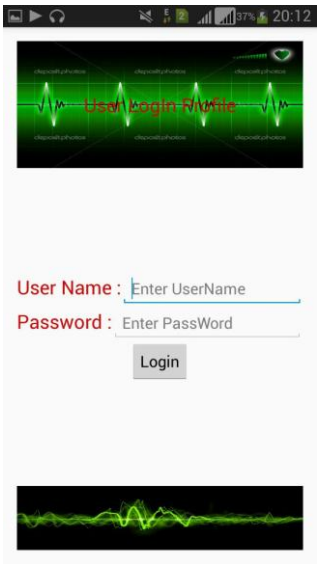


Fig 5. Login screen for each tab

5. *NURSE:* This app is most essential for the nurse to continuously monitor the patient in the ICU. The nurse can view the patient's details and give the prescribed medicines suggested by the doctor.

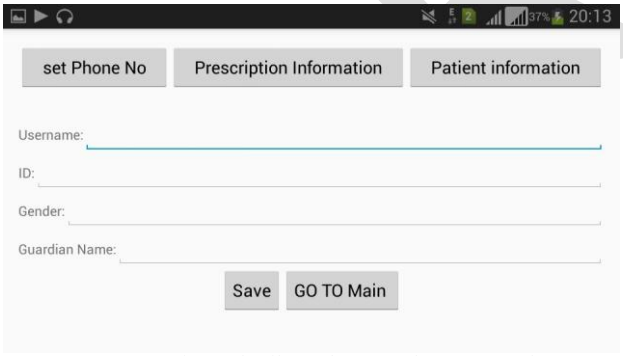


Fig 6. Patient's details & Phone numbers are saved

The above picture (Fig 6.) depicts that the patient's information can be stored, the phone numbers to whom the SMS has to be sent can also be entered. The prescription information by the doctor is also updated in the app for nurse's reference.

The ECG waveform is displayed on the mobile phone as seen in Fig 7. The waveform is displayed according to our pulse rate and the heart rate is determined. If the SMS option is selected, an SMS alert will be generated to the given phone numbers (doctor, nurse & patient's dependent) whenever there is abnormality in the patient's heart rate.

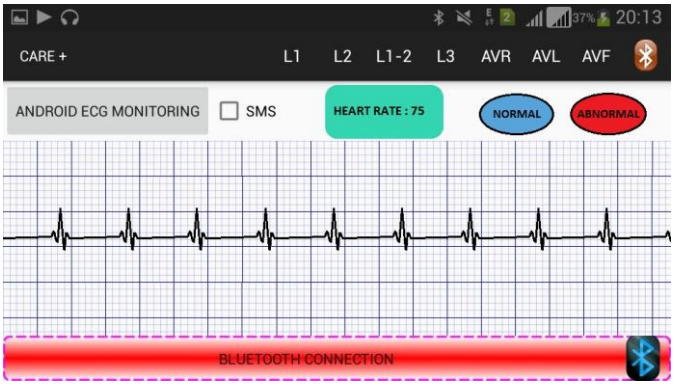


Fig 7. ECG visualization on mobile phone

VII. Conclusion

This proposed App takes care of all the requirements of an average hospital & is capable of providing easy and effective storage & updating of information related to patients, doctors, nurses etc. So, this app-based Medical Management System tries to overcome the drawbacks of the existing system which mainly includes the analysis of the ECG waveform by the doctor. Hence, this App calculates the normal heart rate and only alerts are generated based on abnormal conditions i.e. there is no need for the doctor to analyze the ECG waveform and declare the patient is normal or not. If the nurse is held up in any other work, the doctor can attend the patient, or vice versa. The patient's dependents need not necessarily be present beside the patient every time.

Therefore, this App provides the alerting system, which on implementation can reduce at least 50% of the patient's deaths (which may be caused due to ignorance). This provides a perfect link between doctors, nurses, patients and their attendees through e-way.

VIII. Future Works

Future extensions may include pharmacy system. Based on the availability of medicines, the doctors can prescribe appropriate medicines to the patients.

If the ECG is connected to a Wi-Fi network, the signal from the ECG device is sent to the Internet through a wired Ethernet connection, and the patient's basic information is retrieved by the concerned physician through the same connection, so that the ECG of patient is directly viewed on the mobile phone. Thus, this system has immediate and instantaneous- round the clock access to a physician to review transmitted data and make clinical decisions regarding the patient. The physician can assist the nurse in case of an emergency.

ACKNOWLEDGMENT

I would like to express my gratitude to all those who are involved directly or indirectly in this work. I sincerely thank

my Principal, Dr. T. Chandrashekar, HOD, Prof. Maria Michael Visuvasam, & my Guides, Prof. K. Balachander and Prof. Rejin Paul from Velammal Institute of Technology, Chennai for their support. I also thank all my friends for their encouragement.

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