ELECTRONIC HEALTH MONITORING UNIT

J. P. Josh Kumar[1], Mohamed Ismail. K[2]

Department of Electronics and Communication Engineering, Agni College of Technology, Chennai.

Abstract- Cardiac arrest is a sudden, abrupt stopping where the heart malfunctions and causes breathlessness, unconsciousness and often leads to a person's death. Today, 85% of the cardiac arrests happen outside the hospitals and it accounts for the 24.8% (2010) of the total deaths in India. Rural areas compared to urban areas are affected more due to the lack of proper hospitalization facilities and awareness of Cardiac Vascular Diseases (CVD). The causes of CVD maybe arrhythmia, cardiomyopathy, valvular heart diseases, sudden heart attacks or electrical malfunctions in the heart. It is said that resurrection by CPR or electric shock in a timely manner can save many lives. Here we propose to design a system to overcome this problem by integrating a pulse oxi-meter in a smart watch to a mobile application and a portable ECG system. The pulse-oximeter records our pulse variations and when the change in variations goes below the threshold value, a beep is sounded from the watch and alert is sent from the mobile application to registered emergency contacts. The user is asked to use the portable ECG and immediate report is sent to user application. If the report appears erratic or has a cause for concern, an alert for ambulance is sent if the patient is at home, or when outside they are urged to go to the hospital. This way, we can give timely intervention to prevent death.
Keywords — CVD, Sudden Heart Attacks, Pulse-oximeter, Wireless Portable ECG, Smart Watch, User Application.

I. INTRODUCTION

Cardiovascular Disease which comprises of cardiac myopathy, cerebrovascular, atrial fibrillation, arrhythmia, sudden heart attacks and congenital heart diseases etc., accounts for 3 million deaths in our country. In 2015, at ages 30-69 years, of 1.3 million cardiovascular deaths, 0.9 million (68.4%) were caused by coronary heart disease and 0.4 million (28.0%) by stroke. Rural areas are more affected because they lack proper and adequate hospitalization facilities and they do not have awareness of heart diseases compared to urban areas and these are the increased reasons for remote heart monitoring sensing. About 14 lakh people are affected in the urban areas and 16 lakhs in the rural areas. The data from National Rural Health Mission shows that nearly 8% of primary health centres in rural India were functioning without a doctor, while 61% of them had just one doctor as of March 2017. Urban areas may face lack of timely attention due to which countless lives are lost. We keep researching new methods to offer timely intervention but there are many instances where lives are lost because the cardiac arrests were not detected on time. Patients who have already undergone heart treatments or having heart problems need constant monitoring and they cannot afford to sit at the hospital all their lives and need to have a correct diagnosis at a given time. It is costly and people need to live their daily lives without constantly fearing about their health. Here we bring about an **Intensive Health Monitoring Unit** that serves as a remedy to constantly monitor our heart rate and if abnormalities are detected, the required steps are taken. Smart watch is a device that can be connected to smartphone to receive calls, emails, notifications from applications. This smart watch is integrated with a pulse oxi-meter. A pulse oxi-meter is a non-invasive device which measures blood oxygen level by sending infrared rays and finds out the blood saturation level known as the SpO_2 level. The reading is typically between 95 and 100. A threshold value is set and

if the average variation falls below it, it sounds an alert from the watch. This alert prompts the user to check their ECG.

II.   DESIGN

1.   SMART WATCH

Smart watch [5] is a device which is interfaced with our smartphones. It can be used to receive calls, e-mails, notifications from applications, etc., It is a combination of physical buttons and touch mechanism. Today, smart watches are used as a fitness device and used mainly to track our health and sometimes calorie count, pulse.

In this project, a smart watch is interfaced with a smartphone and consists of:

1.1   Pulse oximeter:

Pulse is the rhythmic beating of the heart and in a typical human body the heart beats are between 60-100 per minute. If the pulse rate falls below 60, then it is Bradycardia and if it increases more than 100, it is Tachycardia. We ensure that the heart rate stays at the correct level and if the rate falls below or above, it indicates the malfunctioning of the heart. We use a pulse oxi-meter to monitor the pulse and blood oxygen level. It is a non-invasive device, where two infrared rays are sent, with variations in absorption at each wavelength, by this we can determine the ratio of oxygenated hemoglobin to deoxygenated hemoglobin which is represented by red light and infrared light respectively. The value of the pulse oximeter is typically between 95 and 100 and if this average variated value of the blood oxygen reduces drastically, an alarm is sounded from the watch to alert the user to the decreasing oxygen levels in the body. A report is sent to the user indicating the variations.

1.2   Temperature sensor:

It is an electronic device which is used to measure the changes in temperature of the environment in which it is set in. It generates voltage or resistance when there is a change in temperature. The analog input data is converted to electronic data to monitor, record the changes. Non-contact temperature sensors use IR (infra-red) to sense the IR energy emitted from the object and the temperature is calibrated through this. Accuracy and responsiveness of temperature and temperature control is vital for the ensuring an accurate result. We detect human body temperature and it should maintain at 37° Celsius and not fall below 34° Celsius. If the temperature falls below 34°, it is hypothermia and it can lead to a person's death and above 37°, it is a cause for concern and the person may have to be hospitalized.

1.3   Blood pressure sensor:

Blood pressure is the pressure that is generated by circulation of blood against the blood walls. This results mostly due to the pumping motion of the heart throughout the circulatory system. It is measured in two ways: systolic or the higher one which is a result of the heart squeezing and pushing blood through the arteries to the rest of the body. Diastolic or the lower one is when the heart takes rest between beats. The normal blood pressure is 120/85 mm Hg. If the systolic pressure increases more than 135(135/90) it is severe and called Hypertension and more than 180 may prove to be life threatening. Hypertension is a major precursor for heart attacks and CVDs. Too much running or physical activity, stress or eating high carbohydrate foods may cause Hypertension. If the systolic pressure reduces less than 90mm Hg or diastolic is less than 60mm Hg then it is called Hypotension. This causes dizziness and fainting because the brain does not receive adequate blood, which may be fatal. This occurs due to hereditary reasons or medication side effects or low glucose content. It is very important to maintain a correct blood pressure for a healthy body.

All these sensors are integrated in the smart watch to give an accurate reading to determine the health of the patient/wearer.

2.   ELECTRODE

An electrode is a conductive device which is used to record the electrical activity of the heart by attaching it to the patient's body at the specified spots. Here, the electrode has two different configurations: three and six leads. The Ag/AgCl [1] electrodes that are commonly used are disposable after one use. It consists of foam base lining material, conductive material and electrode buckle. This electrode causes skin damage when used for long time process. A dry electrode consists of a single metal that acts a conductor between the skin and the electrode. Both these electrodes cannot be used underwater, so there are new types of electrodes which can be used underwater. It is made up of Carbon Black Powder (CB) and polydimethylsiloxane (PDMS). But after a period of time, this electrode loses its adhesive property so there are bound to be artifacts in the recording. Here, we use non-contact electrodes which are flexible, dry capacitive electrodes and they are gel-free, have a low noise impedance, high CMRR, low power consumption and gives a correct reading. We can also obtain by using a different set of electrodes which sends a narrow beam of microwaves and the echo of the microwave is received. The Doppler effect is used to detect the movements of the heart. This method is used to detect the abnormalities of the heart.

3. MOBILE APPLICATION

Patient data: [2] This module provides the personal and real-time medical report of the patient. This data was recorded by the sensors present in our smart watch.

Alert message: When there is a variation from the average threshold value that is set, an alert message is sent to the patient's guardian(s). This message comprises of the last recorded variation, the current location of the patient and a prompt to connect the ECG device.

ECG Device: This module helps the user to select the mode of configuration – three/six lead. A lead connection check is done. A complete report of the patient comprising the ECG report, pulse variation, BP, temperature is generated and sent to the registered doctor for further medication. Multiple doctors and nurses can be engaged for diagnosing patients.

Location: This module gives the current location of the patient for the guardian to provide medication and for the doctor to send ambulance.

III. EASE OF USE

This project aims to ease the health issues faced by heart patients. Using this device reduces the amount of time spent in hospitals and instead get on with their daily lives. This project also aims to track our health and maintain it. It also gives a complete report to the guardian(s), for them to provide timely medication.

IV. REFERENCES

[1]A Review of Wireless ECG Monitoring Systems Design
[2]A Real-Time Health Monitoring System for Remote Cardiac Patients Using Smartphone and Wearable Sensors
[3] FPGA Based Patient Monitoring System Using Spartan3an FPGA Starter Kit
[4] Electrocardiogram (ECG/EKG) Using FPGA
[5] Wearable Health Devices—Vital Sign Monitoring, Systems and Technologies
[6] FPGA Implementation of ECG Signal Processing
[7] Wireless ECG Monitoring System: Design, Construction and Analysis
[8] Reflectance pulse oximetry: Practical issues and limitations
[9] Health band – A Remotely Monitored Health Status Bracelet.