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Wearable Non Contact Armband for Mobile ECG Monitoring System

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Abstract: In this project, the proposed concept is to replace the existing methods used to measure ECG. The existing methods have lots of disadvantages such as it can't give actual measurement when it is tied above the cloth. Similarly it can't give reading when the person is doing some other daily activities. Then there is a standard method for measuring ECG which is mainly used in hospitals i.e., 12 lead clinical ECG system. But problem is that we can't use this system in our home. The proposed method can give more accurate reading over clothes of any thickness. It can track heart activities even when the person is doing any other living activities. It can be used for real time monitoring of permanent as well as temporary heart patients. When any abnormality appears in ECG, system will send data to the doctor using IOT. GPS is also used to send the location of the patient. The proposed method is really helpful in case of heart patients. Since it can track heart activities, it can save lots of life from heart related diseases. Chances for early attack can be prevented to some extent.

Keywords: Armband, IoT, GPS, ECG monitoring, Wearable device

I. INTRODUCTION

One of the best ways to obtain health information is from an Electrocardiogram (ECG). Through an ECG, characteristics such as patients' heartbeats, heart conditions, and heart disease can be analyzed. Unfortunately, most available healthcare devices do not provide clinical data such as information regarding patients' heart activities. Many researchers have tried to solve this problem by inventing wearable heart monitoring systems with a chest strap or wristband, but their performances were not feasible for practical applications M-HEALTH or mobile health is a term that is used to describe healthcare services with the assistance of mobile devices. The M-health monitoring and diagnostic medical devices market is currently in its infancy but is expected to grow rapidly due to market demand for remote monitoring systems. According to a new report from Transparency Market Research, the market for mobile health monitoring and diagnostics will grow at a compound annual growth rate of 43.3 percent from 2013 to 2019. This will put the market at $8 billion in 2019. Increased sports activities and awareness about health and fitness are some of the factors that are anticipated to fuel the growth of this market. Unfortunately, high demand does not automatically guarantee that the devices available in the market are reliable and trustworthy. Various studies have been conducted related to the development of remote healthcare systems, especially heart rate monitoring systems. Most of these studies have focused on four main topics: sensor technology, wearable systems, signal processing, and mobile monitoring systems. Researchers have tried to develop sensors that are able to sense bio-signals without generating side effects or distracting users, but these were still unable to provide a high level of accuracy. The standard procedure in a hospital to measure an electrocardiogram (ECG) is to use a 12-lead ECG.

In a conventional 12-lead clinical ECG system, electrodes are affixed to specific parts of the chest, arms, or hands and legs. Even though this promises highly accurate results, it often requires a great deal of preparation and an expert to attach the electrodes to the patient's body. These electrodes also require skin preparation and conduction gel to reduce contact impedance. The main problem with this method is that it cannot be used for long-term measurement because of the limitation of the gel and complicated wiring. Because of this, other techniques have been provided to overcome these weaknesses, such as using dry electrodes or noncontact electrodes.

Dry electrodes consist of a metal with no electrolyte or conductive gel between the electrode and the skin. Instead, sweat or moisture on the skin will reduce the impedance between the skin and the electrodes. Various applications have been proposed using the dry-electrode technique, but these required direct contact with the skin. Thus, researchers have invented a noncontact or capacitive-coupled ECG. The capacitive-coupled ECG was first introduced by Lopez and Richardson. Then, researchers expanded its use in various environments. Lim etal.and Yama et al. developed a heart

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monitoring system in office chairs and mattresses using flexible fabric electrodes. Leonhardt et al. introduced the idea of an insulated electrode implemented in a car system. Lee etal. Proposed the use of thin and flexible electrodes for a wearable ECG system to build a system that can measure an ECG in remote areas. Oehleret al. proposed an integrated 15-capacitive-electrode array and combined this array with a personal computer tablet.

Different placements of sensors have been proposed by various researchers. Some have suggested using belt-type ECG monitoring systems with the implementation of conductive fabric and active electrodes. Others have suggested using bio-clothes for vital sign monitoring. Different placements would provide different shapes of the ECG signal; thus, they tried to find the best place from which to measure an ECG based on demand. Nevertheless, researchers also focused on developing a mobile monitoring system. This system uses bio-signals to analyse health conditions with a mobile device as an interface and an analysis device. Thus it is a promising method to measure an ECG in remote areas without inconveniencing or disturbing the user. The advantages of this technique are that it can measure an ECG without direct contact and provides better accuracy than other methods, especially for measuring stress. The proposed monitoring system is important for monitoring exercise intensity, estimation of maximal oxygen uptake and energy expenditure and early detection and in helping keep persons healthy by being able to track their heart activities at any time. Currently, most systems that are available in the market use a chest strap or a wristband, but this system is uncomfortable and requires direct contact with the skin. Consequently, an armband was chosen as an alternative to this inconvenient system. The proposed armband ECG is equipped with a variety of features. Considering mobile monitoring, it is equipped with an Android mobile application and Internet of Things (IOT) data transmission. Real-time heart rate detection was added to the Android application, and this was tested in various scenarios, from sitting in a chair, standing, and walking to jogging or running in place. The results show that this monitoring can function in all of these scenarios.

II. PROPOSED SYSTEM

The proposed system consists of pulse sensor embedded in an armband. It is considered to be a reliable and robust ECG monitoring system. The reliability of this system was achieved by the careful placement of sensors in the armband. Internet of Things (IOT) was used as the protocol for data transmission. For robustness, the proposed system is equipped with analysis capabilities–e.g., real-time heartbeat detection and a filter algorithm to ignore distractions from body movements or noise from the environment.

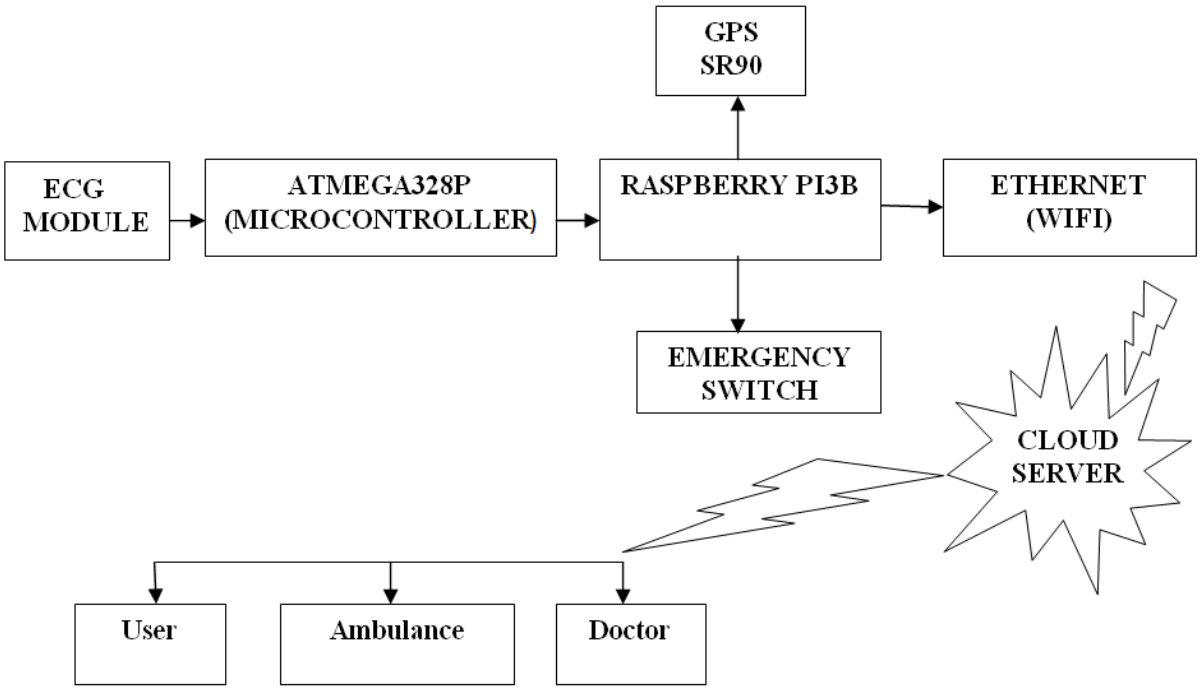

Fig.2.1.Block diagram of proposed system

The block diagram mainly consist of Atmega328p (micro controller), Raspberry pi3, Global Positioning System (GPS), Emergency switch, Ethernet with Wi-Fi module, Cloud server.

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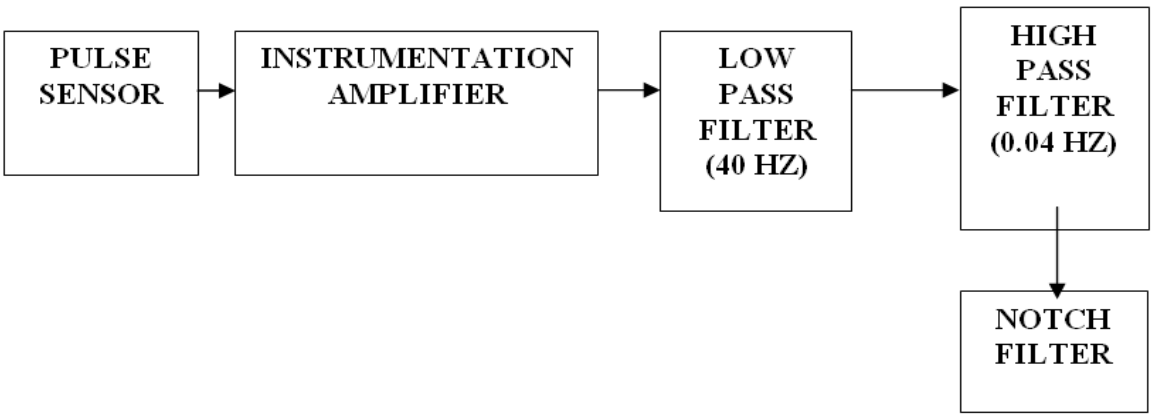

Fig 2.2. Block diagram of ECG module

Within the ECG module we have pulse sensor, an instrumentation amplifier and an analog filter section consisting a low pass filter (40 Hz), a high pass filter (0.4 Hz) and a notch filter. Other than hardware section we have python, embedded C, Shell scripting etc in software section. In this system, the weak signal sensed by the sensor undergoes amplification as well as filtering process by an instrumentation amplifier and an analog filter section. Then this noise free signal is passed to microcontroller and through IOT data is transmitted to the contacts including doctor.

III.WORKING

When the heart pumps, blood pressure rises sharply, and so does the amount of infrared light from the emitter that gets reflected back to the detector. Detector passes more current when it receives more light, which in turn causes a voltage drop to enter the amplifier circuitry. The design consists of operational amplifiers. This is to establish a steady baseline for the signal, emphasize the peaks and filter out noise. The output of op-amp is clean but a weak signal which is amplified by the transistor. The data at this stage is called raw data. This data is passed to arduino for further process. Within arduino the raw data get sampled. The ADC within arduino converts the analog signal to digital signal. This data is then passed to raspberry pi which uses serial communication for reading this sampled data. The P, Q, R, S values along with heart beat(H) are distinguished and graph (ECG) is plotted with the help of matplotlib ,which is then displayed. If there is any problem in ECG, this signal along with the location of patient will be passed to Ethernet. Through cloud server it will reach to the emergency contacts such as doctor, ambulance etc. Emergency switch is there, which will be activated only if anything happens to the patient other than heart issues.

IV.RESULT

The wave form showed above is not processed completely i.e., raw wave form. Initial filtering is done here by the inbuilt filter section in the pulse sensor. Software filtering will be done here for smoothening the wave form.

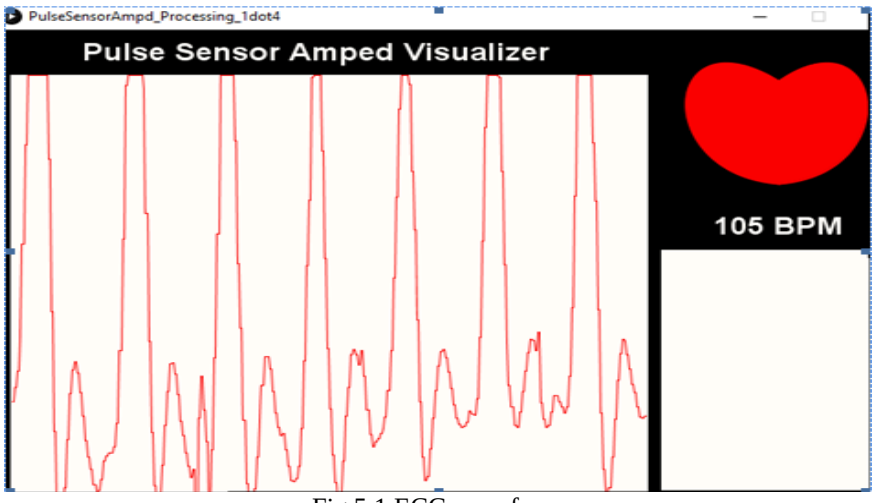

Fig 5.1.ECG waveform

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V.CONCLUSION

Our project is about developing a Mobile health care system that can track our heart activity. It is very much useful for heart patients including people of any age group. The literature survey for the proposed system was completed by studying and analyzing the papers and the relevance of the project was also found out. On the basis of study, new and innovative ideas were included to project with greater efficiency and low cost. New ways to improve the existing methods and technologies were also analyzed. By choosing appropriate components, circuit was designed and implemented to obtain the desired output, i.e., ECG wave form will be monitored.

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