iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** II **Month of publication:** February 2020

DOI: http://doi.org/10.22214/ijraset.2020.2110

www.ijraset.com

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 8 Issue II Feb 2020- Available at www.ijraset.com

Real Time ECG Extraction

Heena Jaysukh Gohil[1], Sarvesh Shrikant Tawde[2], Komal Ashok Sutar[3], Miss.Gauri Salunkhe[4], Sanjay Vijay Bane[5]
[4]*Assistant Professor,* [1, 2, 3, 5]*Electronics and Telecommunication, Atharva College of Engineering, Mumbai, India*

Abstract: ***The paper describes the simplest and convenent way of ECG measurement for the user. In this paper, designing of wireless ECG sensor and display its output on smartphones using Wi-Fi technology. The signals received from the body are measured through the electrodes and signal conditioning and amplification of the signal is done by using an instrumentation amplifier. The signals are digitized using Analog to Digital Converter and then the microcontroller will forward the data which is suitable for transmission. The result obtained is wirelessly transmitted and the output will be observed through a website or smartphone.***

Index Terms: ECG circuit, Wi-Fi technology, IoT Cloud

I. INTRODUCTION

Nowadays, the measurement of Electrocardiogram (ECG) recorded in hospitals is growing rapidly due to which people suffering from heart diseases are increasing at a worrying rate. The ECG is one of the medical devices that can measure the heart rate, transform it into a signal and moniter the data on a piece of broadsheet or on a monitor. Electrocardiogram (ECG) is a diagnostic tool that measures and records the electrical activity of the heart during each cardiac cycle. The Electrocardiogram (ECG) has an essential diagnostic tool that measures the signal at the node after 200ms. It is a graph of voltage versus time of the electrical activity of the heart. For this process, electrodes are placed on the skin. These electrodes detect small electrical changes. This occurs due to cardiac muscle depolarization followed by repolarization during each cardiac cycle (heartbeat).Ag-AgCl electrodes are the most common and favored electrodes in clinical measurements for recording biological signals such as ECG and EEG. The main advantage of using Ag-AgCl electrodes is the low noise level it generates during biological signals recording.

II. LITERATURE SURVEY

In the present day, every Medicare wireless system uses Bluetooth or Wi-Fi to communicate between sensors and monitors. Due to the advancements in wireless technologies and energy-efficient design, new applications for wireless devices have been developed which includes remote monitoring, networked micro sensors etc .In India itself, every year many people experience a heart attack and approximately half of these deaths occur due to delay in detection of attack . Early detection and treatment of life-threatening events can be done by monitoring the ECG continuously, thereby saving many lives.[5]. It is possible to interpret multiple ECG channels by using the techniques of Microprocessors and Digital signal processing[2]. In Wireless ECG Monitoring,the ECG circuit is interfaced with a microcontroller[2]. The signals are digitized using an analog to digital converter and microcontrollers will format the data for suitable transmission[3]. The hardware allows data to be transmitted wirelessly from sensors to a handheld device using Wi-fi. Data is then transmitted for analysis using a website[4]. Using microchip wireless-based wearable physiological parameters monitoring system, the patient is wirelessly monitored at his/her home. The device detects the heart rate and these signals are sent to a website. A patient has to be monitored continuously using wireless sensors networks.Its development and future challenges are about the heart rate sensors, and temperature sensors [3]. Using ECG data paper, the hardware allows data to be transmitted wirelessly from an electronic circuit and a battery as the energy source. In Wearable Wellness on-body sensors to a handheld device using IOT technology, data is then transmitted to a backend server for analysis using a website or android app[6]. This portable system enables the doctor to remotely monitor a patient across the globe.

III. METHODOLOGY

There have been several attempts to develop a wireless ECG monitoring system. In this system, the patient being examined is to be free of wires. The first implementation developed during research used a completely different idea for a wireless ECG monitor. In this method, Ag-AgCl electrodes are physically connected together and then an ECG signal is calculated. This processed data is transmitted wirelessly from the patient to a website or mobile application. The final implementation uses IOT.

A. Heart Monitoring of clothed Person

The first implementation developed uses a completely wireless system where a heartbeat sensor was devised that works without electrical connections to the patient.The device measures displacement current, which is a measure of the changing electric field in the air, generated by the shifting voltages on the skins surface.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
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B. Micromedical

It has also attempted to implement a wireless ECG monitoring system where a three-node system (as a single device) takes the ECG reading and is capable of connecting to a mobile phone. The ECG signal is then transmitted to the treating doctor. Although the implementation is not ideal for hospital situations, it can be used as a general checkups for patients in remote locations.

C. FM Based ECG system

Another ECG system encountered where several nodes are connected as a system (placed on the patient's chest) to calculate the patients' ECG and relays this through the tissue of the body (using FM modulation) to a transmitter located on the patient's wrist and is transmitted to a base station. This modification obtains extremely low power consumption. This is due to the method used for signal transmission, however, it suffers from the method of producing the ECG wave before transmission and where this is not the goal of this project.

IV. BLOCK DIAGRAM

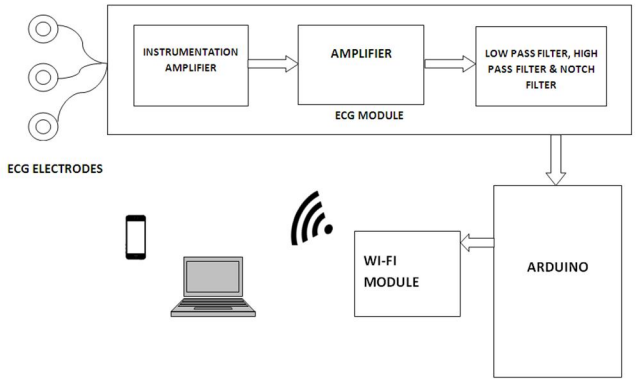

Fig.1 Block Diagram of the System

V. HARDWARE

A. Electrodes

Surface Ag-AgCl electrodes are the most common electrodes in analytical measurements for recording biological signals such as ECG, EMG and EEG. These electrodes are used for perceiving bio-electric potentials is caused by muscle and nerve cells. ECG electrodes are mostly of the direct-contact type. The working of these electrodes is the conversion of ion current at the surface of human tissues to electron current to be delivered through the lead wire to the instrument to read. These types of transducers are known as recessed electrodes. They generally consist of a metal such as silver or stainless steel, with a jelly electrolyte that contains chloride and other ions.

B. ECG Circuit

Electrocardiogram (ECG) circuit for use with oscilloscopes. It is an electrical recording of the heart and is used for an investigation of heart disease.

1) *Instrumentation Amplifier:* A patient cable is used to carry the ECG signal from the human body to the instrumentation amplifier to reduce the interference noise.
2) *Filtering:* In this work, we use three types of filters, first one high pass active filter with cutoff frequency 0.5 Hz to remove baseline drift. The second filter is a low pass filter with a cut off frequency 100Hz to remove muscle contraction noise. The third filter is band stop (band rejects) filter with a cut off frequency 50Hz to block interference power supply.
3) *Amplifier:* Non-inverting amplifier with high gain to amplify ECG signal.

C. Arduino

Arduino is an OS software used to design electronics projects. Arduino consists of both hardware programming and a piece of software program, or IDE (Integrated Development Environment) that can runs on your computer, and is used to write and upload computer code to the physical board.

D. Wi-Fi Module

Wi-Fi module is usually a hardware component that provides a wireless product to work with the computer. Wi-Fi module can send and receve the data as it contains small transmitting and receiving antenna.

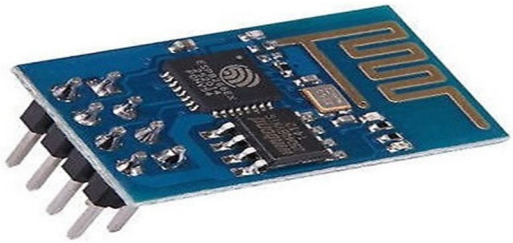

Fig.2 Wi-Fi Module

E. Electrocardiogram

The P, QRS and T waves characterize the ECG waveform (Figure 3). The most important feature is the QRS complex, where R denotes the peak of the QRS complex. Fig. 3 The typical cardiac cycle of an ECG if any disturbance in the regular rhythmic activity of the heart (amplitude, duration, and shape of rhythms) is known as arrhythmia. Cardiac dysrhythmia may cause the heart to pump less effectively, causing insufficient blood to reach the brain another vital organ. When the body's blood flow is irregular, the person can faint or suffer chest pain. Sometimes, sudden cardiac death can occur. Therefore, continuous cardiac monitoring and online analysis system could detect this rare activity of cardiac dysrhythmia.

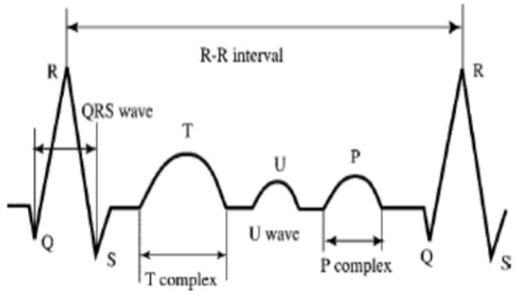

Fig.3 Typical cardiac cycle of an ECG

F. Standard ECG lead system

Two electrodes placed over different areas of the heart and connected to the meter will pick up the electrical currents, resulting from the potential difference between them. The resulting tracing of voltage difference at any two sites due to the electrical activity of the heart is called a "lead". Most of the ECG machines use a 12-lead system, whereas in this project a 3-lead system is used. If the heart's electrical activity is viewed as a simple dipole, these three leads record the projection of this dipole onto the sides of the 'Einthoven Triangle'(figure 4), i.e. The equilateral triangle formed by the vectors of the limb leads**.**

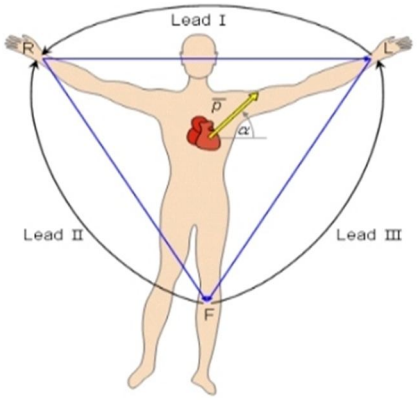

Fig.4 Standard ECG Lead system

VI. CONCLUSION

From this system it is seen that, the ECG monitoring system that is based on IoT is low cost and efficient for remote patient. With the help of an ECG AD8232 monitoring sensor node with three electrodes, real-time ECG signals can be collected with satisfactory accuracy. The collected data were transmitted to the IoT cloud using Wi-Fi. The IoT cloud is responsible for visualizing the ECG data to users and storing these valuable Data for further analysis, which is implemented on the basis of the HTTP server, MQTT server, and storage server. This system is low-cost compared to other existing systems in literature and can also provide Real Time Notification when the ECG signals of patient are abnormal.

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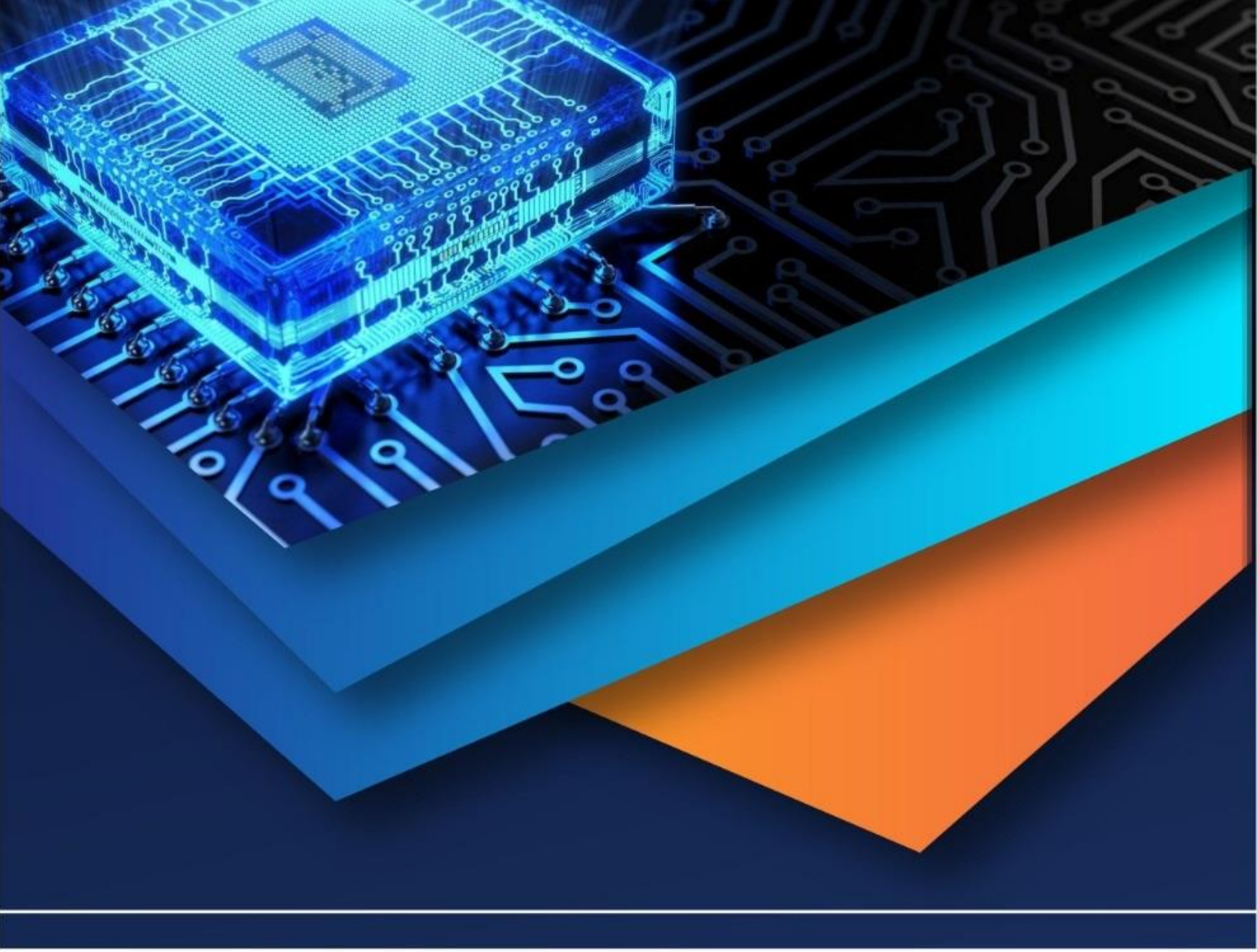

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