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Patient Health Monitoring and Assistance using Wireless Sensor Network

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Abstract: ***Now a day's internet of things (IoT) is becoming a common day to day usage in our regular life it is also changing the environment to more computerised. Also in the medical field it is changing way of treating a patient in a smart manner. Our paper is about monitoring a patient's electrocardiograph, temperature, pressure and spio$_2$ using wireless sensor network(WSN) and the mobile communication such as 4G/5G cellular data communication, wireless fidelity(Wi-Fi), bluetooth and etc. This method gives greater accurate results compared with the photoplethysmography (PPG) based monitoring. In this the patient's data are collected using the sensors and it is then further connected with the web server which will be monitored by the doctors regularly. Finally this project also deals with the issues based on IoT Security, Big data communication and Energy saving using the kits.***

Keywords: internet of things, electrocardiograph, photoplethysmography, wireless sensor network, medical.

I. INTRODUCTION

The simultaneous development in the wireless communication, wireless technology, embedded systems, and integrated circuits have promoted the realization of new sensors and controllers as more intelligent, miniaturized and more reliable connectivity in networking too. IoT is developing at top speed in the direction of more thorough, more extensive interconnection, and deeper intelligence. In future, IoT should serve human beings and it should be human oriented and also be personalized, intelligent and user friendly. Monitoring a patient while they were doing their own work is now a day's a most needed one in the biotechnology and medical fields.

It is important because if a patient who undergoes a surgery after 3 to 4 days he/she gets discharged to home for his comfortable and to do their day to day activity this idea will help the doctors and othelr medical attendant to for seen from anywhere and anytime without creating any disturbance for the person.

It is also helping the doctors and the attendants to monitor a patient condition remotely when they are at the bed for medication.

The section II covers about the existing methodology where the methodology used in now a days for monitoring the ECG and other parameters remotely and their disadvantages too, section III covers about the proposed methodology and how it is helpful in overcoming the disadvantage of the existing method, section IV covers the components used in this system and how they are used section V gives the explanation of how the system is operated in real time, section VI is about the Future scope and working of this system and finally at section VII is about the reference papers used in this proposed system.

II. EXISTING SYSTEM

The existing method that is used in remotely wearable and used device is based on photoplethysmography (PPG) method which is mostly used wrist watches. Photoplethysmography is a simple optical technique used to detect volumetric changes in blood circulation. It is a low cost method that makes measurements at the surface of the skin. The technique provides very accurate information about our cardiovascular system.

PPG makes uses of low-intensity infrared light. When light travels through biological tissues it gets absorbed by bones, skin pigments, venous and arterial blood. Because of light is more strongly absorbed by blood than the surrounding tissues, the changes in blood flow can be detected by PPG sensors as changes in the intensity of light. The voltage signal from photoplethysmography is proportional to the quantity of blood flow through the blood vessels. Even small changes in blood volume will be detected using this method, yet it cannot be used to quantify the amount of blood. Some major factors affecting the recordings from the PPG and disadvantages are site of measurement and the contact force between the site and the sensor. Blood flow variations mostly occur in the arteries and not in the veins.

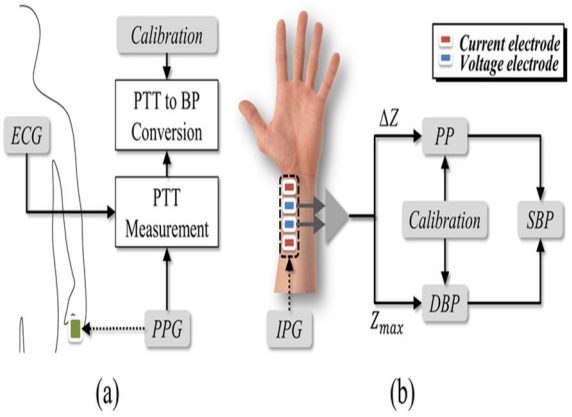

Fig.1: Existing photoplethysmography architecture.

III. COMPONENTS REQUIRED

A. Arduino Board

Arduino is an open source platform of hardware and Software Company and a user community that designs and manufactures microcontrollers for the projects that can be operated by the users using their software.

To build digital devices and more interactive projects that can sense and control thing, humans and etc in the physical world. Arduino board started to adapt themselves to the new needs and challenges, differing from simple board used as products for IoT based applications, wearable materials, and embedded environments.

All the Arduino boards are open-source and empowering the users to build projects in them independently and eventually they adapt themselves to the particular needs. The Experimental and working diagram of arduino is on the Fig 2 and the pin configurations, GPIO pin setup and other important pin configuration are explained well on the Fig 3

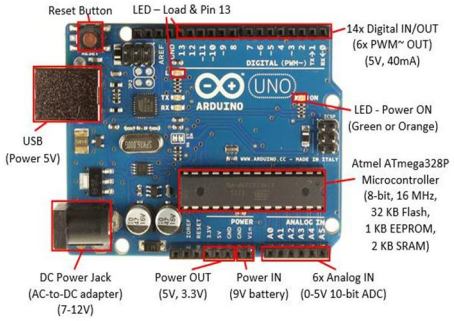

Fig.2: Arduino UNO board Experimental picture.

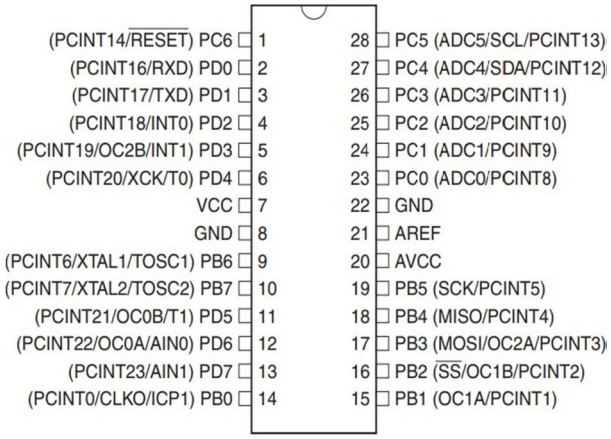

Fig 3: Arduino UNO Pin diagram.

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B. ECG Sensor

ECG is a primary tool for examination of cardiac diseases. An ECG sensing device commonly consists of a group of electrodes to detect electrical activity of heart. The ECG is the electrical manifestation of the contractile activity of the heart and can be recorded easily with surface electrodes on the hands and legs. The rhythm of hearts in terms of beats per minute may be easily estimated by counting the readily identifiable waves.

The amplifier takes the input from three electrodes which are connected to patient's legs and hands which is shown in fig 4

Fig.4: ECG sensor module

C. Blood Pressure Meter

Blood Pressure (BP) is the pressure of circulating blood on the blood vessels. Used without any different specification BP usually refers to the pressure at the large arteries of the systemic circulation. Blood pressure usually expressed in terms of the systolic over the diastolic pressure. Blood pressure device helps to monitor hypertension and pressure the main risk factors for stroke. These devices are highly accurate in monitoring hypertension to be attentive all the time yet they detect irregular heartbeat.

D. Humidity and Temperature Sensor

The humidity sensor measures breathing rate and relative depth of abdominal or thoracic breathing. In physiology respiration is defined as the movement of oxygen from outer atmosphere to the cells within the tissues, and movement of carbon dioxide in opposite direction. The process of breathing does not fill the alveoli with atmospheric air during inhalation, but the inhaled air is carefully diluted and thoroughly mixed with a large volume of gas known as the functional residual capacity which remains at lungs after an each exhalation, and whose gaseous composition differs markedly from that of the ambient air.

DHT11 sensor is a multipurpose usage sensor where the temperature can be also measured using this. Similarly the sensor is placed in contact with the human body then the readings are noted from it. The sensor used for measuring respiration/ humidity and temperature is shown in fig 5.

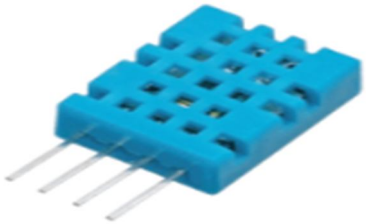

Fig 5:DHT11

E. Wi-Fi Module

The ESP-01 ESP8266 Serial WIFI Wireless Transceiver Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost-effective board with a huge, and ever growing, community.

This module has a powerful enough onboard processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. There is an almost limitless fountain of information available for the ESP8266, all of which has been provided by amazing community support. The Fig 6 shows the simple experimental and real time operating diagram of the simple Wi-Fi module.

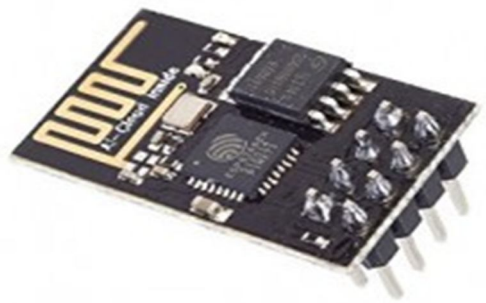

Fig 6: Wi-Fi Module (ESP8266).

IV. PROPOSED SYSTEM

Our proposed system is about monitoring the patient by placing the electrodes directly on the patient with also having the sensor directly interacted with the human body. This will help us very much to overcome the previous major drawbacks that were found in the PPG systematic method. This method uses the WSN method to store and transmit the data to a cloud server or a web server, the server is used to send the data to the receiver to see the output by a remote controlled device. Using this method the accuracy expectation can be satisfied and the other constraints faced in PPG like blood flow variations are neglected too. This method can produce a mass impact for many people who have done major surgery or undergone major surgery in a period of time where then our productive idea will be very much useful for them because the patient can be monitored 24/7 with the controller placed along with his/ her cloths or placed, belted along with them and then the electrodes and the sensors are placed on the patient's body and their readings are noted with accuracy and sent to the controller then the controller connected with the Wi-Fi Module directly transfers all the data collected from the human body to the cloud using the internet or mobile data connection.

The advantage of this system is that which it has a single controller and it can be easily carried by the patient and they can be remotely monitored by their personals and the medical assistants from a distant location easily from the cloud. The figure 7 is simple block diagram of the proposed model at below.

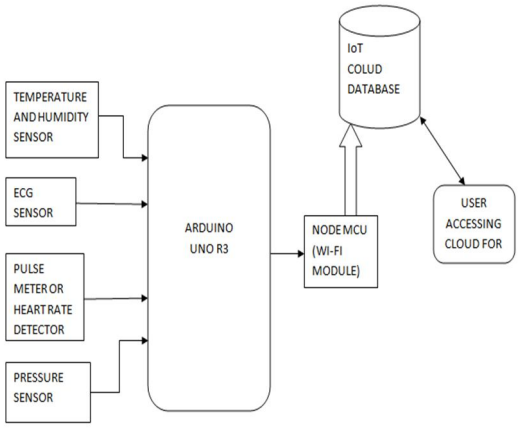

Fig 7. Block Diagram of the proposed system

V. METHODOLOGY

Humidity sensor is used to measure the respiration rate of the patients, ECG sensor is used to measure the electrical activity of heart muscles and the blood pressure meter is used to measure the systolic and diastolic pressure and it measures the heart rate of the patients.

The output of each sensor is fed to the analog input A_0, A_1, A_2 of arduino controller and to the IoT module. The recorded sensor values will be displayed in the server for every single minute. The threshold values for the sensor data are fed to the microcontroller. Then the data's of the patient is remotely always monitored by the medical physicians and attendants if a critical error occur they can save the patient by this remote monitoring using this method.

Figure 8 is a simple experimental setup of the proposed system in real time.

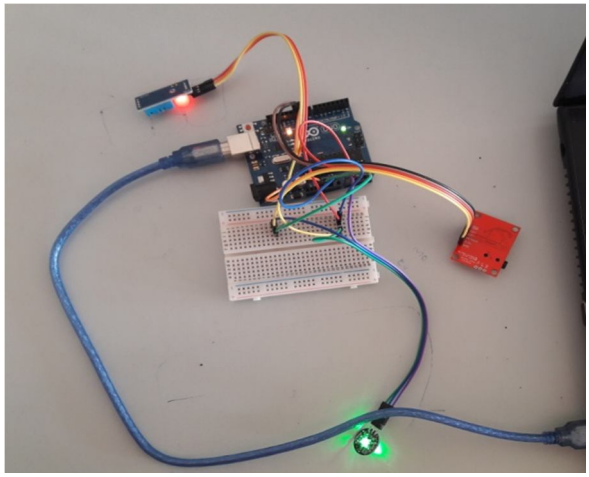

Fig 8: Experimental Setup

VI. RESULTS & OUTCOME

After connecting with the cloud the output can be seen from there and the important updates can be also monitored by the medical assistants. Figure 9 is the PQRS wave form of then ECG monitoring output. Figure 10 is the connected output of the temperature and humidity sensor.

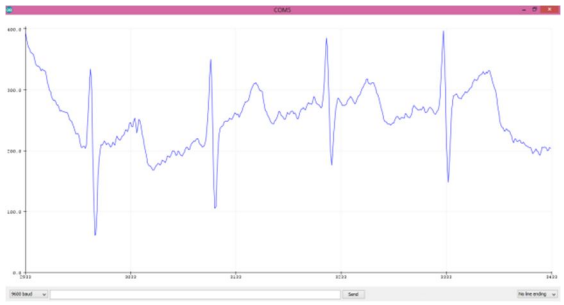

Fig 9. Output of ECG

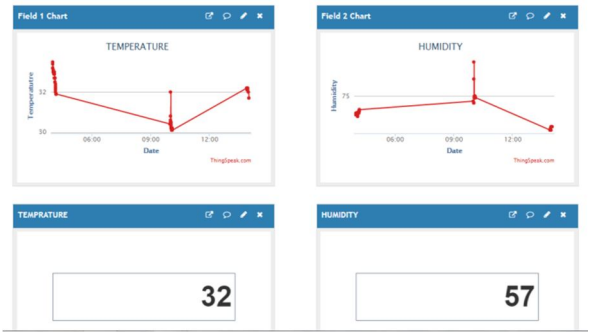

Fig 10. Cloud output of Temperature and Humidity

VI. CONCLUSION

The progress in bio medical engineering, science and technology has paved way for new inventions and technologies. As the world is moving towards miniaturization, handy electronic components are in need. As health care services are important part of our society, automating these services reduce the burden of the humans and eases the measuring process.

Also the transparency of this system helps patients to trust it. This is an alternative that can be used to help patients with chronic diseases. The objective of developing monitoring systems is to reduce health care costs by reducing physician office visits, hospitalizations, and diagnostic testing procedure.

VII. FUTURE WORK

This project is very much helpful creating the remote monitoring of parameters using the WSN. This is can be improved and more miniaturized in design and constraints can be reduced more in size too.

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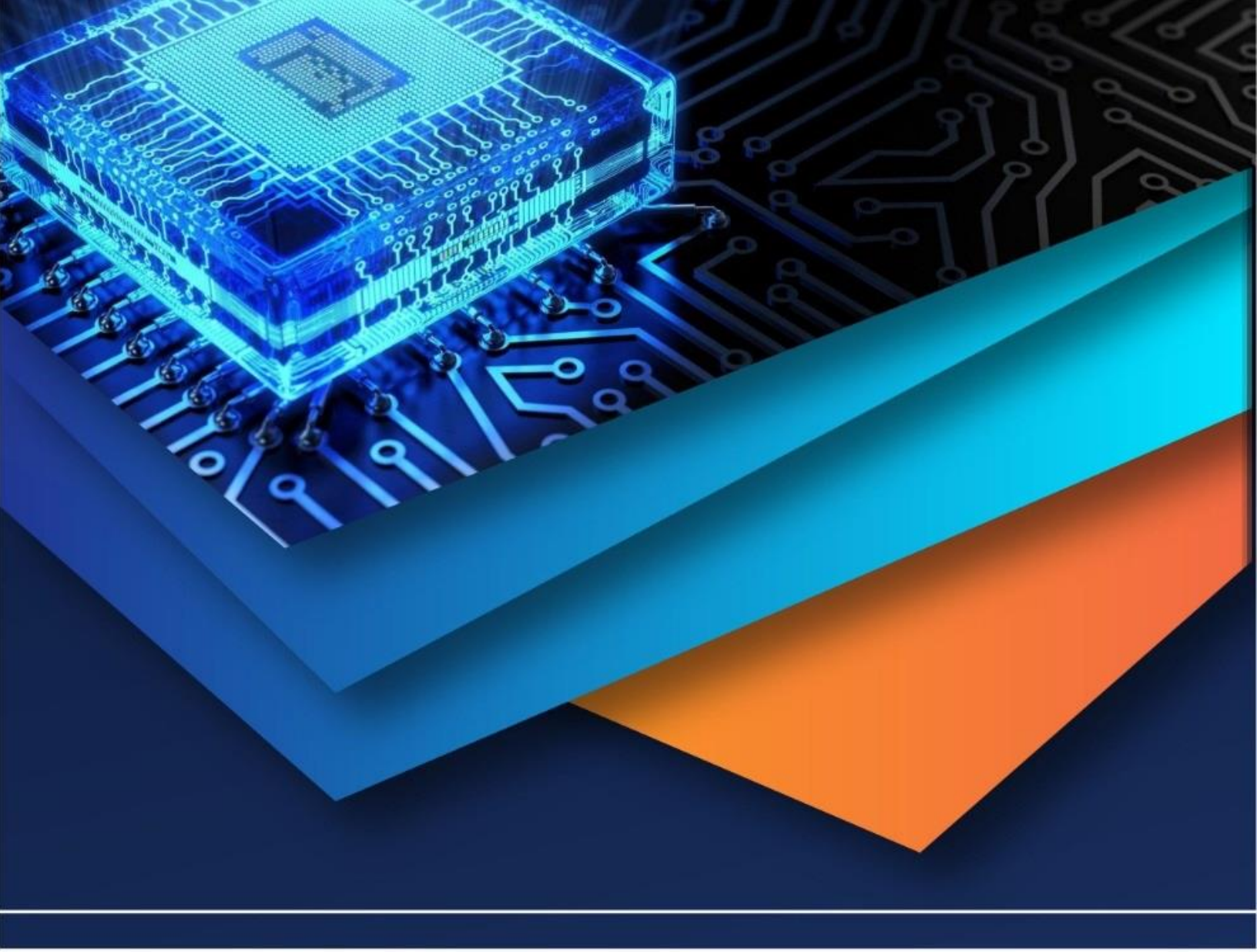

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