AN INNOVATIVE WEARABLE HEALTH MONITORING SYSTEM USING IoT

R.SAKTHI AISHWARYA
B.E Student
Department of Electronics and Communication Engineering
Sathyabama Institute of Science and Technology, Chennai – 600119,India

Dr.I.REXILINE SHEEBA M.E.,Ph.D
Department of Electronics and Communication Engineering
Sathyabama Institute of Science and Technology, Chennai – 600119,India

***Abstract*— Internet of things(IOT) based real time health monitoring system is designed with the goal of reducing the stress and movement of sick and exhausted patients. For getting results immediately. IOT based real time health monitoring system allows the patients to perform all the required medical tests at the same spot within a short period of time. In this research work, all the six testing devices were merged which is kind of a broad innovation comparing to previous history. According to the survey, most of the patients would prefer to use such kind of devices for the purpose of medical testing. Four individual device(thermometer, blood pressure, pulse oximeter, heartbeat)are combined and turned into one device. In present days IOT plays an important role in the health care systems, remote health care monitoring has evolved at such a rapid pace, due to increased use of wearable sensors.This paper describes a wearable health monitoring system which can continuously monitor the patients heartbeat, temperature, blood pressure by ESP32.**

Keywords: IoT; ESP32 ; Temperature ; Pulse oximeter

I. Introduction

Internet of things is a network of interconnected devices that are equipped with software, sensors, network connectivity and electronic devices that allow them to exchange and collect data, allowing them to be more responsive. Internet of things divided into two parts that is internet and things, where internet describes that network that connects world widely by using some standardized protocols. Things that state the devices which are connected to it. In recent years IOT market in the healthcare sector has grown rapidly patients will be able to quickly access and track/monitor their health information thanks to the use of the internet in healthcare. With the growth of IOT, the healthcare industry has made a huge quantitative leap. The rapid implementation of the Internet of things(IOT) in healthcare has generated providers. People nowadays suffer from wide range of ailments and health issues, including high blood pressure, high rate IOT heart beat which are commonly seen in elderly people. So, a continuous monitoring device is required to ensure a proper medical care. This project discusses the advantages of utilizing an ESP32-based system for monitoring the health of a patient. The sensors used to diagnose, monitor or treat diseases in medical domain are known as medical sensors. There are functions of different types of medical sensors as described below for various applications. 2 • Temperature probes: Used for body temperature measurement. This helps in providing better medication and treatment of patients. They are called as thermometers. • Forbes sensors: Used in kidney dialysis machine. • Airflow sensors: Used in anesthesia delivery systems, laparoscopy, heart pumps etc. • Pressure sensors: Used in infusion pumps and sleep apnea machines. Most of the pressure sensors are integrated with embedded systems. They are used for medical diagnosis, blood pressure monitoring, infusion pumps etc. • Implantable pacemaker: It is a real time embedded sensor system which delivers a synchronized rhythmic electric stimulus to the heart muscle in order to maintain effective cardiac rhythm. • Oximeter: It measure the fraction of oxygen saturated hemoglobin relative to the total hemoglobin count in the blood. • Glucometer: It measures approximate blood glucose concentration. • Magnetometer: It specifies direction of user by examining the changes in the earth's magnetic field around the user. • Electrocardiogram sensor: It measures the electrical activity of the heart. It is called as ECG sensor. 3 • Heart rate sensor: It counts the number of heart contractions per minute. • Electroencephalogram sensor: It measures the electrical activity of the brain. • Electromyogram sensor: It records electrical activity produced by skeletal muscles. • Respiration rate sensor: It counts how many times the chest rises in a minute

II. Literature survey

1. K.Jhansi Priya, K. Harish Yadav, K.Jyothsna [1], "A portable wearable tele ecg monitoring system" [1] : It describes about ECG monitoring system concept using PIC 16F877 microcontroller. It is used to measure body temperature, heart rate value, blood pressure of patients. The only limitation is absence of buzzer, which is useful for alerting the authorized person when the patient's state becomes aberrant.

2. Shivkumar Dharmoji, Akshata Anigolkar, Prof. Shraddha M [2]," IoT based patient health monitoring using ESP8266" [2] : This paper describes about patient health monitoring system using Arduino UNO and ESP8266 module. An Arduino in this project collects data from the pulse rate and temperature sensors and sends it to the thingspeak webpage by using wi-fi module, where the data can be monitored by the doctor. The limitation of this project is absence of spo2 sensor which is used to measure the oxygen saturation in the blood.

3. "Md.Raseduzzaman Ruman, Amit Barua, Waladur Rahman, Khan Roushan Jahan, Md.Jamil Roni", Md.Foyjur Rahman [3], "IoT

based emergency health monitoring system" [3]: This paper shows a health monitoring system that uses an IOT cloud platform (thingspeak) which collects data from an Arduino via a WI-FI module. The main limitation is the absence of LCD (liquid crystal display), which is beneficial for displaying the parameters.

4. G. Sharanya, C. Sai Abhishek, K. Manikanth Reddy [4], "Health Monitoring Device" [4]: This paper describes about health monitoring idea using PIC 16F877A and Bluetooth module. Useful for checking a patient's body temperature and blood pressure

III. Basic Methodology

In the absence of the doctors, the patients cannot consult the doctors due to which emergency situation may also be created. The personal health monitoring of each individual is considered very important because of the rise in health problems in today's world. The increasing stressful lifestyle is taking a maximum toll on public health. With the ever- increasing queues at hospitals and an increasing number of patients, the doctor fees have sky rocketed which is affecting especially those patients who cannot afford the fee or who are not suffering from major ailments but get to know so only after paying a hefty fee to the doctor.

The wireless health monitoring system is used to transfer the data from the TX section to the RX section wirelessly. • The proposed system mainly focuses on the situation where the doctors and patients are at the distant location and it is very important to give the entire details about the heartbeat and thetemperature of the patient to the doctor. • Besides this, if made particular changes in this project, it can also be applicable for acknowledging the students with the fastest mode of information about certain notices. To make an automated system that will help to monitor host remotely is our primary objective. • To create an alarm or reaction system which will react whenever there is an alarming situation. • To provide a way to remotely control the temperature, pulse, blood pressure via ESP32. • To contribute to the field of IOT to pave the way for a future project in technological development.

3.1 ESP 32

ESP32 is a series of low-cost, low-power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth. The ESP32 series employs either a Tensilica Xtensa LX6 microprocessor in both dual-core and single-core variations, Xtensa LX7 dual-core microprocessor or a single-core RISC-V microprocessor and includes built-in antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power-management modules. ESP32 is created and developed by Espressif Systems, a Shanghai-based Chinese company, and is manufactured by TSMC using their 40 nm process.[2] It is a successor to the ESP8266 microcontroller.

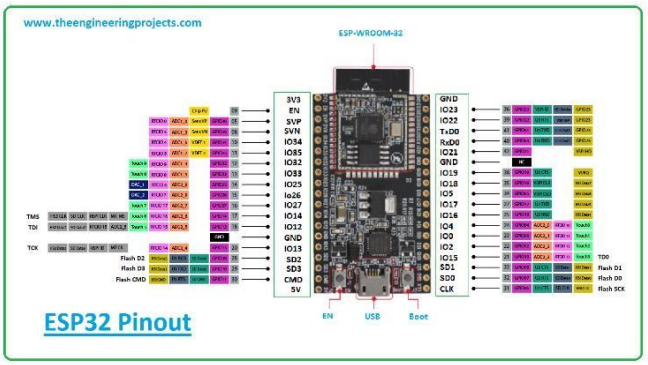

Fig.1. ESP32

3.2 Temperature sensor

The digital temperature sensor like DS18B20 follows single wire protocol and it can be used to measure temperature in the range of -67oF to +257oF or -55oC to +125oC with +-5% accuracy. The range of received data from the 1-wire can range from 9-bit to 12-bit. Because, this sensor follows the single wire protocol, and the controlling of this can be done through an only pin of Microcontroller. This is an advanced level protocol, where each sensor can be set with a 64-bit serial code which aids to control numerous sensors using a single pin of the microcontroller. This article discusses an overview of a DS18B20 temperature sensor

Fig.2. TEMPERATURE SENSOR(DS18B20)

The DS18B20 is one type of temperature sensor and it supplies 9-bit to 12-bit readings of temperature. These values show the temperature of a particular device. The communication of this sensor can be done through a one-wire bus protocol which uses one data line to communicate with an inner microprocessor. Additionally, this sensor gets the power supply directly from the data line so that the need for an external power supply can be eliminated. The applications of the DS18B20 temperature sensor include industrial systems, consumer products, systems which are sensitive thermally, thermostatic controls, and thermometers.

3.3 Pulse oximeter (MAX30102)

The MAX30102 is a very versatile sensor and it can also measure body temperature other than heart rate and blood oxygen level. This is a sensor designed by Analog Devices and features two LEDs (one Infrared and one Red), a photodetector, optics, and low-noise signal processing unit to detect pulse oximetry (SpO2) and heart rate (HR) signals.

The MAX30102 Digital Pulse Oximeter and Heart Rate Sensor, and this module have 7 pins VCC, SCL, SDA, INT, IRD, RD, and GND. All the pins of this sensor module are digital, except VCC and Ground. **The** Pinout of the Pulse Oximeter and Heart Rate Sensor is

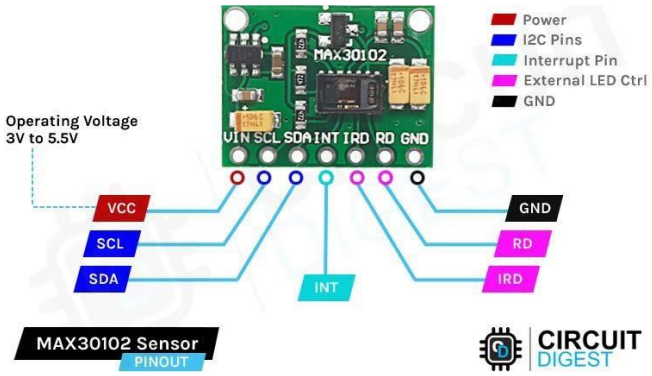

Fig.3.MAX3010
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VCC is the power supply pin of the Pulse Oximeter and Heart Rate Sensor that can be connected to 3.3V or 5V of the supply.

SCL SCL stands for Serial Clock the master device pulses this pin at a regular interval to generate clock signal for communication. Connect to the A5 pin of the Arduino.

SDA Stands for Serial Data, through this pin data exchange happens between two devices. Connect this pin to the A4 pin of theArduino.

INT is the Interrupt pin of the IC. This IC can be programmed to generate an Interrupt a on each pulse. This pin is open drain in nature, so it's pulled high through an onboard resistor. When there is an interrupt this pin goes low and stays low until the interrupt is cleared.

IRD This is the pin that is connected to the IR LED of the Module. This module has a LED driver built in. use this pin if you want to manually drive the LED with code, otherwise leave the pin open.

RD this pin is similar to the IRD pin the only difference is that a RED LED is connected to this pin. Leave it untouched if you don't want to drive the LED yourself.

GND is the ground pin of the pulse Oximeter and Heart Rate Sensor module and it should be connected to the ground pin of the ESP 32.

3.4 Room temperature and Humidity (BME280)

Bosch's BME280 is a precision sensor used in a myriad of applications ranging from weather monitoring to gaming controls to altitude measurement where accuracy of just a few feet is required. This sensor is simple to use, comes pre-calibrated, and requires no additional components, so you can start measuring relative humidity, temperature, barometric pressure, and altitude in no time.

Measuring Temperature The BME280 can measure temperatures ranging from -40°C to 85°C. Over the temperature range of 0 to 65°C, the accuracy is ±1.0°C; outside of that range, the accuracy drops to ±1.5°C.Note that this temperature measurement is used internally to calibrate the pressure and humidity sensors. Because the sensor self-heats, the measured temperature is usually slightly higher than the actual temperature. If this is critical to your project, compare the measured temperature to the actual temperature and apply an offset if necessary.

Measuring Humidity The BME280 can measure relative humidity over a range of 0 to 100% with an accuracy of ±3%.According to the datasheet, the sensor can measure up to 100% humidity over a temperature range of 0 to 60°C. However, the maximum measurable humidity decreases at extremely high and low temperatures.

Fig.4.BME280

IV.PROPOSED METHOD

In this system,24 x 7 human health monitoring is designed. In this system,the ESP32 board is used for collectingand processing all data. Wireless devices have invaded the medical area with a wide range of capabilities. Monitor the patient details in a periodic interval is overhead using existing technologies. To overcome this we have changed recent wireless sensor technologies. Added advanced sensors like pulse oximeter for measuring blood pressure. Different Sensors used for, measuring different parameters. All this data is uploaded to thing speak for remote analysis.

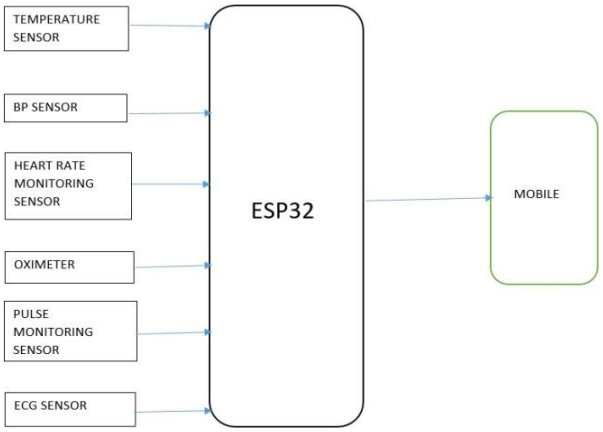

Fig .6.Proposed method

V.Hardware part

The article is considering the possibility of building a monitoring system for patients with diabetes mellitus. Hardware part of monitoring system includes: • ESP32; • Heart rate (pulse) sensor; • Temperature Sensor; • Red LED; • Breadboard and Jumper Wires. The DS18B20 sensor was used to measure body temperature. The PPG sensor was used to measure heart rate. The red LED connected to the digital pin of the ESP32 that blink according to the heart rate (pulse) sensor. The ESP32 sends data from these sensors to the ThingSpeak platform. In order to do that, the ESP32 must be connected to a Wi-Fi network. The ESP32 is a line of low-cost, high-performance, low power microcontrollers with built-in Wi-Fi and Bluetooth. The Arduino IDE makes it easy to program the ESP32 in C++. The DS18B20 is a temperature sensor with a 9-to- 12-bit conversion resolution. The majority of the control parameters are set by the user independently. They are saved in memory and can be changed at any time. The 1-Wire interface protocol is used to communicate with the DS18B20 sensor. Each model of this sensor that has been released has its own unique code. Pulse refers to the rhythmic movements of blood vessel walls that occur during heart contractions. The importance of heart rate tests in the diagnosis of cardiovascular disease cannot be overstated. It's critical to keep an eye on changes in heart rate to avoid overworking the body, especially during sports. The pulse sensor is an analog sensor that uses the photoplethysmography method to detect a change in the optical density of blood volume in the measurement area (for example, a finger or earlobe) as a result of a change in blood flow through the vessels depending on the phase of the cardiac cycle.

VI. SOFTWARE

The Arduino IDE is a C++ development environment that can be used to program any Arduino board. This software, which is both a text editor and a compiler, allows you to program and pass code to the Arduino board. Required Libraries for Arduino IDE: • Pulse Sensor Library; • Wi-Fi Library; • ThingSpeak Library. The ThingSpeak platform and ThingView mobile application were used to collect and display the data obtained from the sensors. ThingSpeak is a cloud-based IoT analytics tool for collecting, visualizing, and analyzing real-time data streams. ThingSpeak enables computers to store data in the cloud, in either private or public networks. ThingSpeak feeds are by default private, but you can make them public if you like. You can visualize, analyze, and transform data once it's in the ThingSpeak feed. You may also use ThingSpeak to communicate with social media, online services, and various devices.

VII. RESULTS

In this paper we had focused on the health condition of the patients by using sensors like temperature, pulse rate, spo2 and humidity. If the patient's temperature rises above the threshold of 99 degrees Fahrenheit, the buzzer sounds and alerts the doctor, allowing him to save the patient's life in emergency situations.

Fig.7.Result

VIII.FUTURE SCOPE

We can use numerous sensors to develop this system in the future to acquire additional information about patients. And making plans to improve quality in order to get more efficient results while collecting massive amounts of data. A future version of this system might include additional technology to help ensure data security, such as defence against hackers. In the future, data may be protected via a variety of cloud computing technologies.

IX.CONCLUSION

In this paper a wearable health monitoring system that guarantees a constant monitoring of various health parameters and prevents the patients from frequent visit to the hospital Our suggested system is comprised of low-cost medical devices linked towards a low-cost health platform that sends emergency notifications to medical practitioners.

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