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An IOT Based Smart Patient Health Monitoring System using ESP32

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Abstract **–** Human health is the entire state of being physically, socially and mentally effective becausef a medical condition. We must always be mindful for our health and remain vigilant if we experience any discomfort. To maintain our health, we should exercise frequently. Stress is the main thing to affect human health and create changes in our body conditions by affecting various parameters like temperature, heart beat and pulse rate. In order to check the health a simple module is developed using ESP8266. ESP8266 is used to monitor all the parameters and a system for monitoring attention on mobile devices is developed that may provide periodical online data about a patient's physiological parameter conditions. It is mainly composed of sensors, an information acquisition unit. Code was used to programme the Arduino. The system will monitors, displays and stores the patient's temperature, heart rate, blood pressure and graph knowledge. It also sends these data to the patient's and doctor's mobile device.Sensible Health Observance System will track and record the health status for the web page. The primary goal of this project is to create a rational and trustworthy Internet of Things patient health observance system so that healthcare providers can keep an eye on their patients.

***Index Terms*— Patient Smart Healthcare Systems, ESP8266,Cloud Computing Methodology, Implementation with IOT, Artificial Intelligence, Patient health monitoring.**

II. LITERATURE SURVEY

The objective of the subsequent segment is to aid in the advancement of theories associated with this research.

Numerous studies on the Internet of Things have been conducted, offering design recommendations for various fields. In the field of medicine, a design has been completed to measure patient temperature utilizing sensor network to track the patient's temperature in real time [6]. To maintain surveillance on students when they are physically exercising by taking their blood pressure, temperature, and heart rate [7].Fog-computing allows for the construction of medical facilities to promote health and save lives in intelligent environments [8].

A real-time health monitoring system for remote cardiac patients has been developed. Patients and doctors can connect with each other through the system using wearable sensors and smart phones [9]. A different study offered an Internet of Things framework for telemedicine and health monitoring systems with the goal of storing all pertinent patient data in the system. Three primary features are incorporated in the IoT health monitoring model: Evaluating and verifying, perceiving, obtaining data, examining a patient or an object[10].

Research is still being conducted at the moment, particularly in medical topic within a study that showcased an ontology design which can provide daily instruction, health monitoring, and advice for those with chronic illnesses. Patients can then be tracked at any time by using the smart phone app that has been loaded. The example created for the framework proved to be more useful in generating presumptions related to the problem [11].

Emphasis is on cloud technologies, short- and long-range communications protocols and sensors for tracking various health metrics [12].

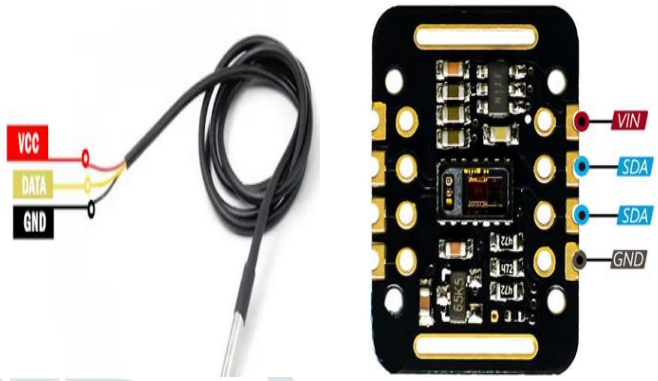

Fig. 1.Pin diagram of ESP32 Microcontroller

III. SYSTEM OVERVIEW

For Patient health monitoring system the Pulse sensor, Temperature sensor, Powersupply, Arduino UNO, LCD Display and ESP32 microcontroller chip is used.An electronic device known as a temperature sensor records, monitors, or signals changes in temperature through monitoring the ambient temperature and converting the measurement data into electronic data.

A kind of widely used temperature sensor that has an electrical output proportional to temperature (in degrees Celsius) is the LM35. Compared to a thermistor, it is more accurate at measuring temperature [13]. Compared to thermocouples, this sensor produces a higher output voltage, hence it might not require an amplifier. The output voltage of the LM35 is proportional to the temperature in Celsius.

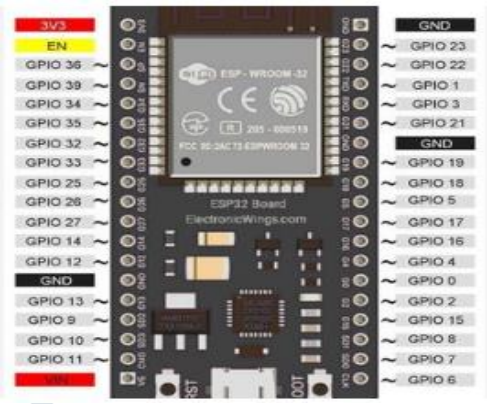

Fig. 2 .Temperature sensor and MAX30102 SPO2 Heart beat sensor

The change in blood vessel volume that happens during a heart pumping is termed as a pulse wave, and a pulse sensor is a tool that records this volume change. With a few jumper links, the sensor connects directly to the Arduino and connects onto the fingertip [14]- [15].

It also includes with an open-source monitoring programme that displays a real-time pulse graph. The sound of a person's heart contracting or expanding is known as their heartbeat. By developing larger they push blood over different areas. The heart's beat rate can be measured in beats per minute (BPM), and the pulse is the heart's beat that is felt in any artery that is beneath the skin [16].

An excellent plug-and-play heart rate sensor for Arduino is the Pulse Sensor. Students, artists, athletes, makers, and game and mobile developers may all use it to quickly and easily include real-time heart rate data into their creations. With a few jumper connections, the sensor snaps onto the tip of the finger and connects directly to Arduino. It also has an an open-source monitoring programme that displays a real-time pulse graph. The sound of a person's heartbeat is produced by the valves in their heart squeezing or expanding to move blood from one area of the body to another [17]. The pulse rate and heartbeat that are perceptible in any artery that is near the heart are measured in beats per minute (BPM). A power supply is, by definition, an apparatus that transforms an ac power line's output into one or more numerous outputs or a constant dc output. Prior to being filtered to create a smooth voltage, the ac voltage is rectified to create a pulsing dc. An external supply of 6 to 20 volts can power the board. However, the 5V pin may only give five volts if the supply is less than seven volts, which could cause instability on the board [18].

The voltage regulator may overheat and harm the board if more than 12V is used. A voltage range of 7 to 12 volts should be considered. Arduino UNO is an open-source electronics platform built on user-friendly hardware and software. Arduino boards have

the ability to read inputs and convert them into outputs, such as a light on a sensor, a finger on a button, or a tweet. Liquid crystals are the main component of LCDs, or liquid crystal displays, a type of flat panel display [19]. LEDs are widely used in computer monitors, instrument panels, televisions, cellphones, and other devices providing consumers and businesses a wide range of applications.

Espressif Systems developed a line of inexpensive system-on-a-chips (SoCs) called the ESP32. The ESP32 is a great fit for a variety of Internet of Things applications due to its affordability, compact design, and comparatively low power consumption [20].

IV. CIRCUIT DIAGRAM BY INTERFACING SENSORS WITH ESP32

Here, the three linked sensors provide the five health parameters that were covered in the overview. Let's examine their connection. First, A heart rate sensor and MAX30102 SpO2 connected to ESP32.Second, BME280 sensor for relative humidity and temperature connected to ESP32.Third, DS18B20 water resistant temperature sensor connected to ESP32. A heart rate sensor and MAX30102 SpO2 is connected according to the I2C communication standard, meaning that the ESP32's D21 and D22 pins receive the SDA and SCL pins from the sensor, respectively. The sensor is powered by a 5V power supply that is connected from the ESP32 VIN pin to the sensor's VIN pin.

The GND pin of the sensor is also connected to the GND of the ESP32. BME280 sensor for relative humidity and temperature sensor is linked in the same way as the sensor above and using the I2C communication protocol. The Sensors SDA and SCL are connected to D21 and D22 correspondingly. The power supply is the sole modification. Since BME280 can handle voltages of up to 3.3V, we are using the 3.3V pin of the ESP32 to power the sensor's VIN pin. DS18B20 water resistant temperature sensor is attached to the red wire and receiving 5V from the ESP32. The yellow wire is connected to the ESP32's digital pin D5 (GPIO5), and the black wire is connected to GND. To enhance the data signal, a 4.7 K.Ohm resistor is connected between the yellow data wire and the 5 volt supply. And ESP32 is coded using the arduino and then the ESP32 can be used to analyze the temperature, pulse rate and humidity using the various sensors. Then the patient health is being monitored from the remote place.

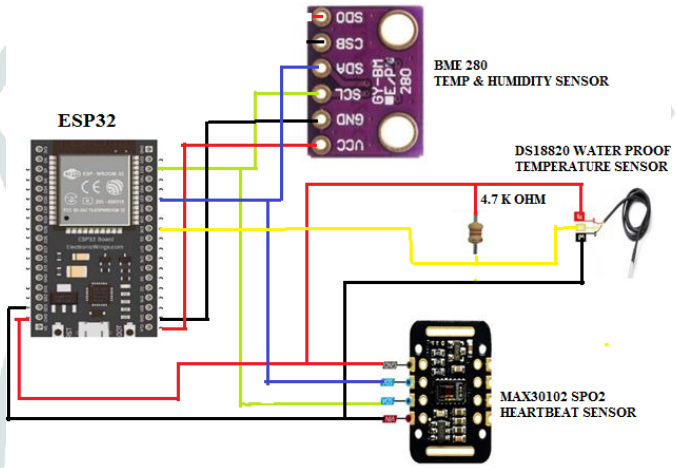

Fig. 3.Circuit Diagram by interfacing sensors with ESP32

V. HARDWARE IMPLEMENTATION

For hardware implementation the following components are required: Arduino, Temperature Sensor, Pulse Sensor, Wifi Module, IOT Module, Power Supply, Connecting Cable. Hardware components are used in combination to implement the system. The ECG data, body temperature, and pulse rate can all be detected by the sensors in the smart patient health monitoring system. The sensors for health monitoring are employed to gather health and relevant data. A controller can communicate in order to deliver wireless data over the internet. On the server, data processing has taken place. At the server location, all data is gathered and combined. Using Thing Speak IOT, health-related information may be displayed on a web page in an easily readable style. Every single one of these data points will be available in real time for ongoing observation.

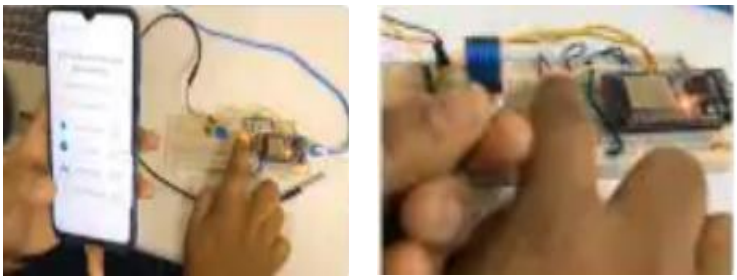

Fig.4 .Hardware Implementation of Smart patient Health Monitoring using ESP3

This project is Internet of Things (IoT)-based health monitoring system that tracks a patient's body temperature and heart rate and notifies them via email or SMS when those readings rise above certain thresholds. Thing Speak and Google Sheets are used to record body temperature and pulse rate information, enabling remote patient health monitoring from any location in the world. Using the HTTP and MQTT protocols, Thing Speak is an open-source Internet of Things (IoT) application and API that allows you to store and retrieve data from objects over a local area network or the Internet. Sensor logging can be created with the help of Thing Speak a social network of items with status updates, and location tracking applications.

VI.CONCLUSION AND FUTURE WORK

The design and execution of this paper is based on Internet of Things-based health monitoring system. Users can utilize this Internet of Things (IoT) device to find out their health metrics, which may assist them manage their health over time. Patients may eventually seek health care if required. They could quickly and conveniently share with the doctor their health parameter data using a single application. The key benefit is that any doctor can remotely monitor a patient's health since it ensures that the parameter data is safe on the cloud. By using ESP32 smart patient health monitoring system was developed based on IOT and the patient heartbeat, temperature, humidity and pulse rate parameters are analyzed.

There are several ways that the system could be modified and enhanced in the future. An ESP8266 and the Raspberry Pi can also be used in place of the system's microcontroller and it can be modified in many ways. By adding more sensors, we can measure more health factors and enhance the system's current set of sensors.

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