IoT based Patient Health Monitoring System

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Abstract

IoT is rapidly changing the healthcare industry and constantly expanding new healthcare technologies. Monitoring the patient's health at home is a difficult task due to the busy schedule of our daily work. Elderly patients in particular should be monitored regularly. Our model establishes a patient health monitoring system using a web server and IoT applications to measure patient health parameters such as heart rate (BPM) and blood oxygen level (SPo2) along with human body temperature from anywhere. According to our model, we will introduce the development of an IoT-based patient condition monitoring system. We will have a pulse oximeter sensor to measure heart rate (BPM) and blood oxygen level (SpO2). We will use a temperature sensor to measure body temperature. Therefore, it is necessary that the patient be kept in a room with normal temperature and humidity so that he does not experience any intolerance. To achieve this, we also need to monitor the temperature and humidity in the room. So, we will use a humidity and temperature sensor. In this intelligent patient monitoring system, patients' health is automatically measured through interconnected sensor-based networks. Various sensors are used to collect the patient's biological parameters. Meaningful biological information is then transmitted to the IoT server. Our system is so smart that it can detect the vulnerable condition of the patient by processing the data collected by the sensor. This system helps all doctors and their hospital faculties to virtually observe assigned patients without physical visit. The patient's relatives also benefit through this system.

Keywords: ESP32, Pulse oximeter (MX30100/102), Temperature sensor (DS18B20), Humidity temperature sensor (DHT11)

1. Introduction

The primary purpose is to coordinate communication between patient personnel and home or hospital monitoring equipment. This requirement can be met by using this system for monitoring the patient's condition. H. Clearly transmit heart rate, blood oxygen, body temperature, room temperature, humidity. Technology embedded in objects helps them interact with internal systems or external environments that influence decision-making. The Internet of Things can connect devices embedded in various systems over the Internet. If a device can represent itself in the digital world, it can be controlled from anywhere. Connectivity helps collect multiple data from multiple locations. With the help of the IoT cloud, the data of various measurement parameters are transmitted to responsible collaborating institutions.

2. Literature Review

The main purpose of this paper is to compare the authors' different approaches, overcome the limitations of previous approaches, and develop a system that provides the best possible solution.

In [1] Jorge Gomez et al. Operated by a guidance system and allowed to monitor your health. The company has developed an IoT-based health monitoring system for patients. Similarly, the goal of this suite of solutions is to not only monitor patients, but improve their quality of life by enabling them to improve their diet and exercise routines. The contextual model developed for the system proved efficient in contextual reasoning such as: B. Recommendations for performing necessary actions via sensors and recommendations and tips for exercise routines to improve the patient's diet.

In [2] Mohammad Salah Uddin et al. We proposed an intelligent patient monitoring system that automatically monitors patient health status through a sensor-based connected network. Several sensors are used to detect the patient's biological behaviour. Meaningful biological information is then transferred to her IoT cloud. The system is smarter because it can process sensor data to detect critical patient conditions and send instant push notifications to registered relatives, doctors/nurses and hospital staff in charge.

In [3] Peter Varady et al. In this paper, a new approach to patient monitoring is presented. The patient monitoring system was designed and implemented based on existing industry-standard communication networks using standard hardware components and software technology. A system design with an open architecture provides scalability, standard interfaces, and flexible signal interpretation options. The aim of this research was to develop a patient monitoring system with the following main features: open architecture, system scalability, scalable signal interpretation, and reasonable system cost.

In [4] Sherin Sebastian at el. developed a system that collects vital signs and parameters from webcam-equipped intensive care unit monitoring machines and makes this data available to general practitioners. Even in Japan. A webcam captures images from the bedside monitor screen at a rate of approximately one image every four seconds. These captured images are streamed to his MATLAB where they are processed and continuously uploaded to the application server. The ANDROID application is used to retrieve this data on the mobile phone from the user's server. If something goes wrong, doctors will be alerted by sending notifications to their mobile phones from the C2DM server.

In [5] Dimitri Konstantas at el. have developed a system that integrates various medical sensors via wireless connectivity and can transmit live vital signs measured over public wireless networks to healthcare providers. did. MobiHealth patients/users are equipped with various sensors that constantly monitor their vital signs. B. Blood pressure, heart rate, electrocardiogram (ECG). They are interconnected by the Healthcare Body Area Network (BAN). It basically consists of sensors, actuators, communication and processing devices connected by a wireless network. This is attached to the body and moves according to the movement of the person.

In [6] Alexander G. Logan at el. developed a remote home blood pressure management system that actively involved the patient in the care process. Developed using off-the-shelf hardware, the system includes a Bluetooth-enabled home blood pressure monitor, a mobile phone to send and receive data, a central server for data processing, a fax back system for sending doctor's reports, and sphygmomanometer - warning system. The system developed in this project can also serve as a template for remote monitoring and management of other physiological parameters (blood glucose, oxygen saturation, body weight), opening new approaches to chronic disease management. increase.

In [7] Akhbarifar et al. The patient's health status was determined by imagining a crisis situation through data mining. We analysed all data (biological data) collected by smart medical IoT devices. We ensured the security of patient personal data using lightweight and secure block encryption. Patient health status was then classified using the K-Star classification. K-Star classification achieved the best results among various classifiers. Accuracy is 95%. Therefore, the work achieved excellent accuracy. However, this approach lagged behind Safety Level (SL).

3. Existing Model

Systems used for health monitoring are fixed monitoring systems that can only detect when a patient is in the hospital or in bed. Currently available systems are huge and only available in ICU hospitals. Today, Zig Bee can be used to send patient information to relatives and related doctors.

Microcontroller: The microcontroller is the most important unit in the whole system. In fact, you are responsible for the entire process before that. Access and control peripherals and components connected to your system. The ESP32 is a low-cost system-on-chip (SoC) microcontroller from Espressif Systems, the creators of his famous ESP8266 SoC. This is the successor to his ESP8266 SoC and is available in both single-core and dual-core variants of his 32-bit Xtensa LX6 microprocessor in Tensilica with integrated Wi-Fi and Bluetooth. The nice thing about the ESP32 is that, like the ESP8266, it integrates RF components such as power amplifiers, receive low noise amplifiers, antenna switches, filters, and RF baluns. This makes it very easy to design hardware around the ESP32 as it requires very few external components.

Disadvantages: Existing systems require patients to be hospitalized for regular monitoring. After you leave the hospital, you will not be able to do this. This system cannot be used at home. Existing systems measure patient health parameters and transmit via Zig Bee, Bluetooth protocols, etc. They are only used for short-range communication to transmit data. Doctors are not always able to call these details.

4. Proposed System

The system we would like to develop will help monitor the health of patients not only when they are lying in bed, but also when they are out of bed. The main idea of this system is to send information to the website for continuous patient monitoring over the internet. Such systems continuously record vital body parameters such as temperature and pulse rate,

compare them to predetermined ranges, and notify a physician by email if those measurements exceed certain limits, then the system will send an immediate alert to the physician and send notification to their relatives also. This system uses a microcontroller to send data. Connected to IoT to provide information to doctors and caregivers. Patient health data is stored in the cloud. Physicians can easily access patient health status anytime, anywhere. In an emergency, it automatically alerts the patient's primary care physician and relatives. In such cases, the patient receives prompt medical assistance, saving time and energy for loved ones who may not always be near the patient.

4.1 Max30100 Pulse Oximeter Sensor

Fig1 : Max30100 Pulse Oximeter Sensor

This sensor is an integrated sensor solution for pulse oximetry and heart rate monitoring. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse and heart rate signals. It operates from 1.8V and 3.3V supplies and can be turned off via software with little standby power, allowing the power supply to remain connected at all times.

4.2 DS18B20 Temperature Sensor

Fig2 : DS18B20 Temperature Sensor

This is a pre-wired waterproof version of the DS18B20 sensor. It is convenient when you want to measure a distant object or a wet object. The sensor can measure temperatures from -55 to 125 °C (-67 °F to +257 °F). The cable is covered with PVC.

4.3 DHT11 Temperature and Humidity Sensor

Fig3 : DHT11 Temperature and Humidity Sensor

The DHT11 is a simple and very inexpensive digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the ambient air and output a digital signal on the data pin (no analog input pin needed).

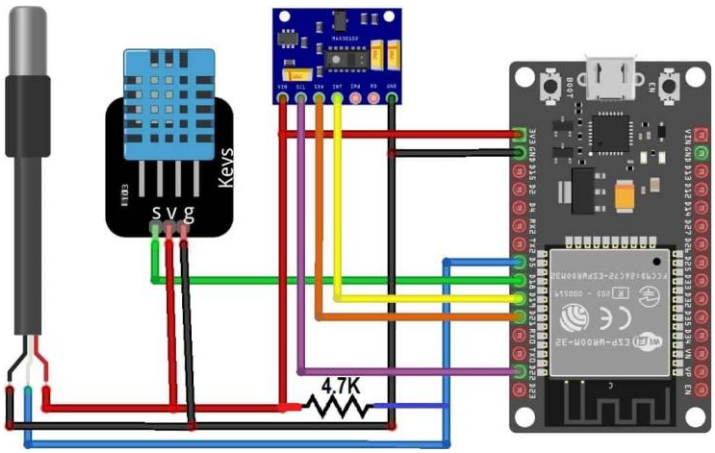

Fig4 : IoT Based Patient Health Monitoring on ESP32 Web Server

Let's start designing IoT based patient health monitoring on ESP32 Web Server**.** A wiring diagram for connecting the MAX30100, DHT11, and DS18B20 to the ESP32 is shown below. All sensors can operate with 3.3V VCC Connect VCC to a 3.3V power supply. Connect GND to GND. Since the MAX30100 is an I2C sensor, connect its SDA and SCL pins to GPIO21 and GPIO22. Connect its INT pin to GPIO19 on the ESP32. The output pin of DHT11 is connected to GPIO18 of ESP32. Similarly, the output pin of DS18B20 is connected to GPIO5 of ESP32. A 4.7K pull-up resistor is connected between the DS18B20 output pin and the VCC pin.

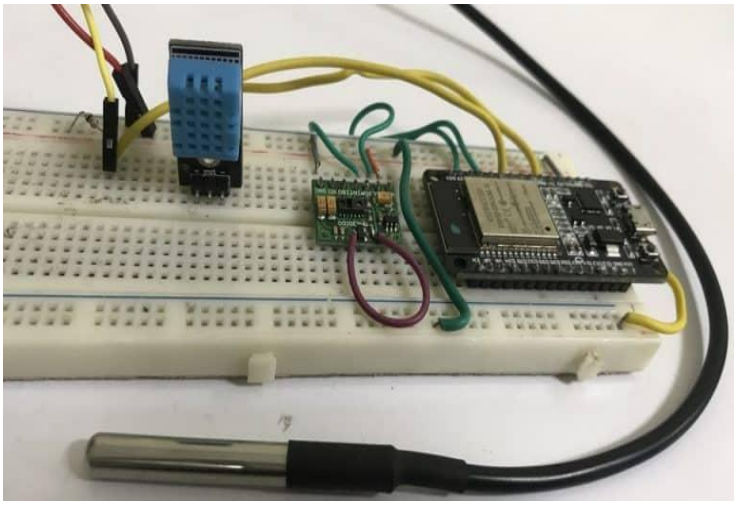

Fig5 : Connection Diagram of Patient Health Monitoring System

IoT the Internet of Things is usually thought of as connecting things to the Internet and using that connection to access individual objects. Otherwise remove built-in devices and objects sensors are connected to an Internet of Things platform, which collects the information from different devices and stores it in the cloud. And then transfers the data to that particular website.

Scope and Applications:

IoT Healthcare is the newest branch of the medical field. This project is primarily aimed at older people who are alone at home. It is also helpful for elderly people who live alone or live with 1 or 2 people. It is very useful when relatives or family members have to go out due to unavoidable reasons. By this we can also measure our health conditions, which is also in surveillance of our concerned doctor by the web server using internet during the pandemic situation like corona that happened in near past and we can guarantee that this system will help if there will be any pandemic like this in future. This system also ensures the safety and guarantees the less spread of any kind of contact diseases. Multiple people with disabilities can use this project. Patients with disabilities that make it difficult to see a doctor regularly, or patients who require constant supervision by a doctor. IoT tracking has proven to be very useful when changes in patient health parameters need to be recorded, monitored and tracked. This allows physicians to easily spot changes in patient health parameters and medical history and suggest patient treatments and medications. Remote monitoring of patients shortens hospital stays. Visits to the hospital for regular check-ups are also kept to a minimum. Therefore, it is more beneficial to keep the printed paper record in a separate file, or in a digital computer, laptop, USB stick or specific storage location. In such cases, data may be lost. For IoT, data is stored in the cloud with minimal risk of data loss.

Healing can be provided in the early stages. In critical conditions, the patient cannot provide information, but a notification is sent to the doctor.

5. Results

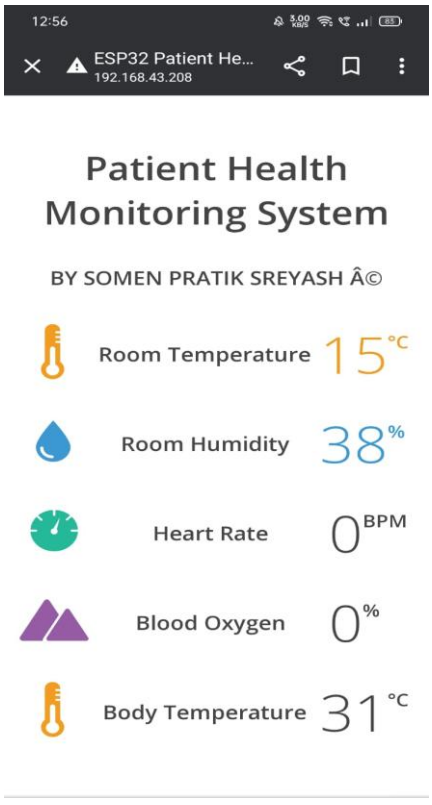

Fig6 : Web Server Output Screen on Mobile and Real Time Model

6. Conclusions & Future Work

With the spread of the Internet, this work will focus on implementing Internet technologies to establish systems that communicate over the Internet for better health. The Internet of Things is dominating the whole world in various fields, especially in healthcare. Therefore, current work is performed to design an IoT-based intelligent patient health tracking system using an Arduino microcontroller. A pulse sensor reads your heart rate, a temperature sensor reads your temperature, and the data is sent to the cloud via the internet. This information is also sent to the LCD display, so patients can easily know their health status. Alert the doctor in critical situations, an alert message will be sent to the doctor's phone. The doctors can see the data sent by logging a specific website or IP address. Continuous patient monitoring systems are therefore designed.

Future work on the project is very important for further development of the design system. The designed system will improve by connecting more sensors that measure different health parameters. You can also add a GPS module to your IoT-based health monitoring system using an Arduino and a Wi-Fi module. The GPS module determines the patient's location or position based on the received longitude or latitude. That location is then sent to the cloud via IoT so doctors can locate the patient if they need to take precautions. Alternatively, the nearest hospital will be automatically notified via GPS and an ambulance dispatched to the patient.

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