Portable Intensive Care Unit Equipment Using IoT

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Abstract. Many lives have been affected every day in remote areas mainly because the patients are not timely and properly treated by the healthcare centers, that unfortunately resulting in loss of human lives. In most of the rural hospitals, patients are unable to get the timely response because of lack of human resources and facilities. In some cases, it becomes even difficult for hospitals to frequently check patients’ conditions and update their record on a regular basis. To deal with these sort of real time problems, we have designed a portable healthcare system, which can be easily adopted in the health care centers. The proposed health care system can be used to measure and monitor various health indicators like temperature, ECG, Blood Pressure, heartbeat etc. The measured parameters of the patient will be recorded using ESP32 module and stored in the cloud server. The Doctors can login to the website, view the parameters and can take the necessary action.

Keywords: Health care system, Human Resource ECG, ICU, ESP32, IoT.

1. Introduction
Non-stop size of affected person parameters along with heart rate and rhythm, respiratory rate, blood stress, and lots of other parameters have grown to be a common function of the care of seriously sick sufferers. While correct and instant choice-making is critical for effective affected person care, electronic video display units often are used to collect and display physiological statistics. An expanding number of, such insights are assembled the utilization of non-intrusive sensors from substantially less seriously sick patients in an emergency clinic’s clinical careful units, work and conveyance suites, nursing homes, or sufferers’ very own homes to recognize astounding ways of life compromising conditions or to archive standard anyway required records successfully. We commonly consider a patient screen as something that looks for—and cautions against—genuine or presence compromising occasions in sufferers, truly wiped out or something else. Understanding checking might be thoroughly characterized as "rehashed or constant perceptions or estimations of the influenced person [1], their physiological capacity, and the capacity of presence help framework, for the explanation of directing administration choices, together with when to make mending mediations, and evaluation of those intercessions. An influenced individual screen may not best ready guardians to most likely perilous occasions; numerous furthermore offer physiologic enter data used to control straightforwardly associated ways of life bolster gadgets Right now, talk the utilization of PC frameworks to help parental
figures inside the arrangement, show, stockpiling, and dynamic, comprising of translation of logical insights, making recuperating suggestions, and disturbing and alarming. Inside the past, most clinical records had been inside the state of coronary heart and breath costs, blood weights, and streams, yet nowadays they envelop incorporating realities from bedside contraptions which degree breath gases, temperature, and haematology notwithstanding coordinating data from numerous assets outside the top to bottom consideration unit (ICU). In spite of the way that we manage sufferers who are in ICUs, the general ideas and techniques likewise are pertinent to other hospitalized sufferers. For example, tolerant checking might be executed for demonstrative capacities inside the crisis room or for restorative purposes inside the working room. Methodologies that solitary a couple of years back had been utilized most straightforward in the ICU right now are mechanically utilized on well-known sanatorium units and in certain circumstances by methods for sufferers at reception.

2. Literature Survey

In the present world, various IOT systems have been adopted for health monitoring systems. Wang et al [1] designed a compatible IOT system for medical devices which was having multiple communication standards. A resource-based data retrieving method (UDA-IOT) was proposed by Xu et al [2] for information-intensive health applications. Peer-to-Peer (P2P) and IoT technologies were combined in a medical system called as a smart box to keep the patients in control. Kolici et al [3] implemented that compared the experimental results for different scenarios. Web Real-Time Communication (Web RTC) was given by Sundholm et al [4] which focused mostly on the secured transmission of data multiple concurrent streams in an efficient manner. By enabling the electronic sphygmomanometer to communicate via Bluetooth, an Android application [5] was developed to record the data such as SBP- Systolic Blood Pressure, DBP - Diastolic Blood Pressure and Heart Rate. That application made it easy to transmit the recorded data using any mobile device and such data is then be recorded, abnormality is found out and message is conveyed to the people. A real-time application [6] was presented with distributed flow environment for the IoT healthcare. When the person under observation moves beyond range, data will be recorded in the local server and communicated later. A Galileo board [7] is a IoT-based device with embedded medical platform for the designed for electrocardiogram (ECG) signal analysis and based on an algorithm, heart function is monitored. In market, few IOT Portable Medical Devices [8] were introduced which upgraded the patient’s mobility. But the security threats and few drawbacks were also there while using Portable Medical Devices. When we started to consider light-weight IOT devices, using the existing databases, diseases were predicted. But while such predictions, issues were in storage of databases and analysis using those databases. A new cloud based fine-grained health information access control framework [9] was introduced which addressed the security challenges and the cloud reciprocity issues. A proxy-based approach for end-to-end communication between the IOT enabled living systems [10] was proposed to challenge the real world applications. A portable electric aid device was designed specifically for the blind people in which ultrasonic range finders are mounted on the belt to find the obstacles present in the users way and to direct the blind people through Bluetooth headphone. Another depth sensor based navigation system for the blind people with high accuracy and to alert user via vibrio tactile feedback in the hand gloves. When the previous works are addressed, there is a limitation of database connectivity between the different cloud environment in monitoring the data in constant time intervals and to analyze data. Considering this limitation, in this paper, we present a cloud-based Internet of Things system that can be implemented in different health monitoring systems.
3. System Architecture

![Block Diagram of proposed system](image)

**Figure 1.** Block Diagram of proposed system

**Information about the components:**

- **Temperature Sensor:** Generally, these sensors are structured in a specific way to measure the variations of temperature in an object as well as in the human body. Particularly we have used this temperature sensor for measuring the variations of temperature in the human body. The series that is used for measuring the parameter is ds18b20 the sensor is a wearable gadget and it is made contact with the human body while measuring the parameter and its disconnected after noting down the respective reading. It is provided with pair of metals that produces electrical voltage with respect to variations in temperature.

- **ECG Sensor:** Normally these days due to pollution humans are in taking the toxic oxygen which is damaging the normal respiration cycle due to this various heart problem are arising firstly when patient consult the doctor about heart-related problem the advice given by the doctor is ECG test which plays vital role in generating the wave for every heartbeat. Since this sensor is also a wearable gadget comes with pair of electrode which arise wet regularly these electrodes are made in contact with human skin at the chest region for generation a wave of electrical activity in a human heart. The series that is used in our proposed work is AD8232.

- **Pulse Sensor:** Similar to the ECG sensor another sensor is introduced which is used to measure the accurate heartbeat of a person. The sensor is said to be a pulse sensor it comes with led bulb integrated with it which flashes by indicating each heartbeat when a finger is placed on it.
Respiration Sensor: The Sensor innovation gauges the avoidances of the chest and the gut that happen during breathing to straight forwardly quantify the respiratory rate. The single-use sensor changes over and yields the breathing redirections to the projection as a fluctuating low voltage signal when applied to the patient's skin.

Moisture Sensor: These days the number of old aged people that are getting bedridden are increasing due to various reason and they are unable to go for restroom sometimes due to less consciousness they discharge the urine where they are hence for detecting the moisture content of the bed moisture sensor is used. It makes use of dielectric permittivity of the medium where it is being placed and relates the voltage with dielectric permittivity and detects the wetness of the substance.

Thingspeak: The above operations performed by sensors are collected and stored in a cloud for reference and by analyzing this reference data the physicians will take the next step for resolving the problem that has occurred. The application used for storing and recovering this information is Thingspeak it's an open-source software it uses the internet for in taking the data that are provided by the sensor using internet standard protocols called HTTP and MQTT.

ESP32 Wi-Fi module: The above operations performed by sensors are collected and stored in a cloud for reference and by analyzing this reference data the physicians will take the next step for resolving the problem that has occurred. The application used for storing and recovering this information is Thingspeak it's an open-source software it uses the internet for in taking the data that are provided by the sensor using internet standard protocols called HTTP and MQTT. Generally, it is called as Wi-Fi module.
4. Implementation
Overview of the proposed system: The framework is intended to get wellness data of sufferers extraordinarily people who are in a broad consideration unit. By and by the structures are to be had that gathers measurements from different casing portions of the patients. The additional component conveyed in our machine is that it shops the gathered realities inside the cloud, which might be utilized likewise for preparing [7]. Arrangement of measurements is done by methods for individual sensors that are fit for estimating continuous parameters alongside temperature, pulse, electrocardiography, breathing charge, dampness level.

Internal operation of the machine: The machine incorporates particularly 3 layers real layer, network layer, and readiness layer.

Data Fetching: In the physical layer, the centerpiece of the framework ESP32 is associated with wearable gadgets. Sensors are starter dependable to catch constantly patient's wellness records. These sensors are a piece of wearable contraptions. These sensors estimate temperature, pulse, dampness level, and heart yield. Sensors are put in two or three pieces of the casing so right readings are measured. ESP32 is utilized to obtain the concentrating from the sensors and is low-quality machine on-chip with Wi-Fi and double mode Bluetooth.

Data Storing: System layer interconnection organizing grants sensors to transmit sufferer's wellness data to various frameworks like servers.

Cloud Processing:
Wellbeing signs cautions are despatched to cloud carport the use of ThingSpeak. Thingspeak is an open inventory net of factors (IOT) application and API that is utilized to keep and recover records from sensors and utilizes the HTTPS convention over the web or close by place network [8]. The utilization of web this clinical data is made to be needed to Caregivers and clinical specialists for reference. Existing web from household or medical clinic can be utilized for this verbal trade. An alarm message is dispatched to overseers and friends and family when readings go the set edge esteem, considering an emergency [9]. When we mindfulness on low force consumption, limit stages ought to be set with the expectation to deal with the crisis conditions. At the point when we mindfulness on low force consumption, limit the indistinguishable time force might be put away by methods for turning off the sensors. At the point when power admission is confined, there will expand the need for low force conventions for conversation. In ESP32 we've worked in a Wi-fi module can transmit records of the use of HTTP protocol, with low vitality consumption.

![Figure 2.1. Health monitoring system.](image)

Data Receiving: Programming layer the utilization of web this clinical information is made to be needed to specialists and overseers for reference. An alarm message is dispatched to overseers while dissecting surpasses the set limit esteems considering it is a crisis.
A. Algorithm
- Arduino IDE is an open-source programming used to interface the improvement sheets like ESP32.
- The sensors utilized are associated with ESP32 and information is gathered by particular sensors. The processor persistently screens.
- The information is transmitted to the server utilizing thing speak application and put away utilizing one of the database the executive's framework.
- The put-away information can be seen by a client from any point in the world. On the off chance that edge estimations of the sensor surpass quickly the processor will tell the client about a crisis.

B. Flow Diagram
- The product structure has been planned the use of Arduino IDE. The open-source Arduino programming (IDE) is written in highlights from C and C++ which makes it clean to carefully record code and transfer it on progress board like ESP32 which accompanies in-developed Wi-Fi module and Bluetooth.
- Perceive 3 manages a short clarification roughly the product program engineering. The gadgets are imparting among each unique through Serial Port discussion. After the code is dumped into ESP32, the framework holds up till the system is being snared between the Wi-Fi module and sensor station.
5. Result

Figure 2.3. Software Architecture

Figure 3.1. Electrocardiograph
Figure 3.2. Temperature data graph

Figure 3.3. Heartbeat Data graph

Figure 3.4 Pressure Data graph
Figure 3.5. Moisture Data graph

- Figure (3.1) shows the perusing of the patient's ECG utilizing present-day hardware. An ECG is a test that identifies and information the power and timing of the electric action on your coronary heart. This records is recorded on a diagram that recommends each segment of the electric sign as it goes through your coronary heart.
- Figure (3.2) shows the perusing of the patient's temperature utilizing present-day hardware. Human outline temperature is likewise alluded to as euthermia. It can be estimated at numerous areas along the edge of the mouth, ear, armpit and forehead.
- In present-day medicinally time-remembered that common edge levels from 36.5-37.5 confirmation celcius. A temperature of more than 38 recognition Celcius most extreme regularly way you have a fever because of diseases or defilement
- Figure (3.3) shows the perusing of the patient’s temperature utilizing present-day hardware. It can quantify the exchange the volume of blood vessel blood with each heartbeat beat. If the assortment will increase, it shows an exchange the blood volume relationship. The blood float is typically appeared as a waveform utilizing a chart.
- Figure (3.4 and 3.5) shows the identified dampness of the patient's bed. The old matured individuals who are out of commission and not an incognizant state may release pee on the bed itself henceforth we have joined a sensor that can identify measure of wetness of bed. Hence the same is shown in the chart.

6. Conclusion
Considering the real time health care problems in remote areas, we have designed the portable health care unit. The main aim of our proposed work is to measure
The sensors study the records from the more than one pieces of a casing and sends it to the ESP32 where it contrasts the received insights and set edge esteems and works therefore. The received measurements are sent to the observing station which shops the realities. Tracking station contrasts the received records and the acquired records and evaluations if any mistakes realities is gotten the health indicators of the patient and to provide timely interaction between patient, caretaker and the doctor.
Our portable unit measures the health parameters frequently and updates the record on regular basis. These are records are made available to care takers and doctor using IoT and cloud computing technologies. We have included the parameters like body temperature, pulse and oxygen level, ECG and blood pressure as health indicators and also set the threshold level for each of these parameters. Every time the parameter is measured, it will be compared with set threshold values. If any parameter is not in the acceptable range, then immediately alarming messages will be sent to care takers and doctors to take up the necessary action.
Both specialist and patients can share their data through portable application and patient get recommendations or treatment data through the application as it were. The exactness of the web
application, execution of the framework and circuit are tested and verified. Estimated results are contrasted and standard hardware results and displays the presentation of the proposed circuit with the assistance of the webpage is generally excellent. The proposed portable system can be easily adopted in the remote health care centers to provide the timely response to their patients.

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