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Advanced Intelligent Assisted Home-HealthCare Monitoring System Using Internet of Things

***M.A. Mohamed Aslam, K. Jayant, C. Suresh, K. G. S. Venkatesan, S. Venkatesan**
Arasu Engineering College, Kumbakonam, Tamilnadu,612501, India
*Corresponding author Email: mohamedaslam99998@gmail.com

Abstract: In the field of remote monitoring systems, Internet of Things use is growing daily. The remote surveillance equipment includes those that keep an eye on things like vehicles or assets, children or pets, parking lots or fleets, water and oil leaks, and the energy infrastructure. In this research, we present an intelligent medical surveillance system that uses sensor-based linked networks to autonomously monitor the patients' state of health. For obtaining a patient's biological activities, many sensors are employed. The IoT cloud is then sent with the relevant biological data. The technology is more sophisticated and can instantaneously send push notifications to physicians, nurses, and hospital staff after analyzing sensor data to identify a patient's serious state. This technology helps physicians and nurses by allowing them to see their related patients without having to visit them in person. With restricted access, patients' families may also benefit from this system.
Keywords: Remote surveillance equipment, Real time patient monitoring, Health monitoring system, Intensive care, IoT device, Sensors, Mobile apps, sensors networks.

1. Introduction

InternetofThingsThe linked network of things (such as wearable, portable, and home appliances) was initially described by Prof. Aston in 1999 when he was working on research involving radio-frequency identification (RFID). IoT applications for a variety of use cases fully support the service composition. IoT makes it feasible for millions of devices (of any internet-connected sort) to communicate with one another. Fig. 2 depicts the Three Layer Architecture, which is the most common. Perception, Network, and Application Layers are the layers. Connected to the IoT system through the Perception layer are sensors, actuators, proximity tags (RFID, NFC, etc.), and other embedded devices like microcontrollers/microprocessors. Users (humans or customers) and Things may communicate with one another over the network layer. The application layer requires user interfaces and applications. The Internet of Things (IoT) standard and application domain are thoroughly defined in [2–6].

FIGURE 1. A Typical ICU unit [1].

Definitions and Terms**:** Internet of Things (IoT): A network of electrically powered, Internet-connected objects that can exchange data via sensors and actuators.Internet of Things (IoT) device: Any electrical

Internet-connected gadget that may be seen and/or operated remotely via the Internet.IoT ecosystem: Every element that enables individuals, organizations, and governments to interact with their IoT gadgets, which includes gateways, remote controls, networks, dashboards, storage, analytics, and security.Entity: mostly refers to IoT system users, such as citizens, corporations, and governments.The physical layer is made up of the hardware (sensors, actuators, and networking equipment) that makes up an Internet of Things (IoT) device.The network layer's primary responsibility is to transport data gathered from the infrastructure layer to IoT devices.The application layer includes all the interfaces and protocols that are utilized by linked devices for communication and identification.The dashboard is a tool for displaying data about the IoT ecosystem in a graphical way. It is also used for IoT ecosystem management. For IoT, it functions as a specific kind of remote control.Analytics: Computer programs that examine the information produced by IoT-connected devices. Numerous uses for the study are possible, including predictive maintenance.IoT storage: The data bucket or cloud storage where information generated by IoT devices is temporarily or permanently kept.Networks — Internet's communication layer, which facilitates interaction between the entity and its embedded devices and between the devices themselves.

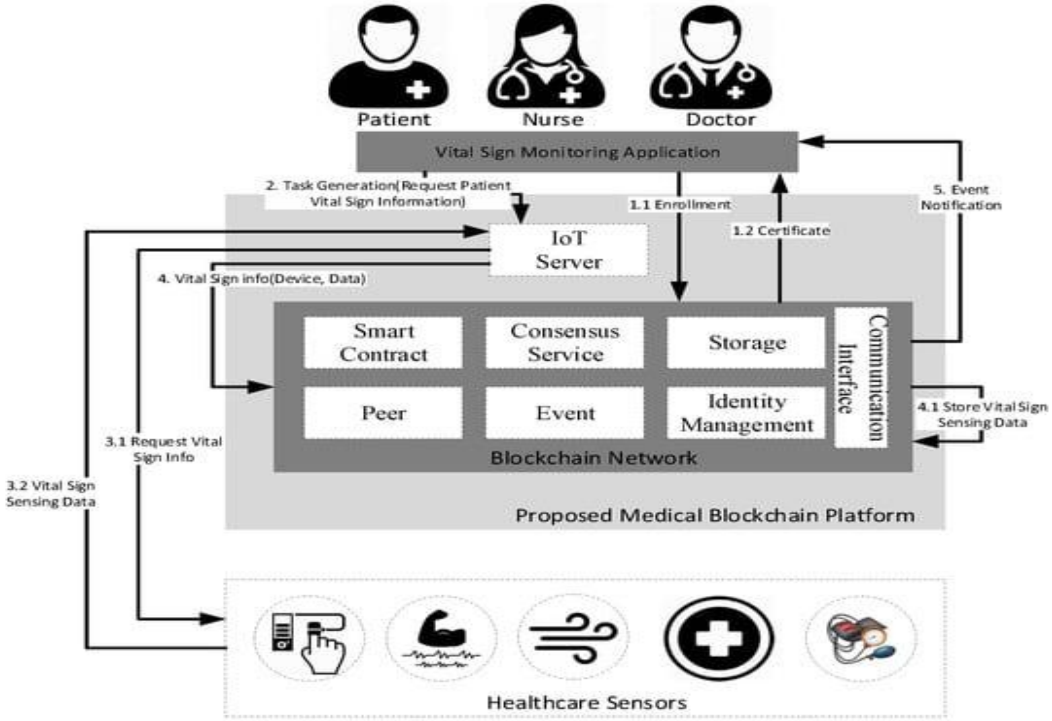

FIGURE 2. Architecture of Internet of things (most popular)

2. Literature Survey

The use of remote monitoring systems is one area where the Internet of Things is becoming more and more widespread. The remote surveillance equipment includes those that keep an eye on things like vehicles or assets, children or pets, parking lots or fleets, water and oil leaks, and the energy infrastructure.Lau has put out a fixed route, straightforward bus tracking system in [7]. The system displayed the position after a certain amount of time using an LED display screen and a smartphone application. For college and university students who take courses on large campuses, the system is incredibly helpful. As a consequence, rather of spending time waiting for a bus, they (students) may spend more time studying, sleeping, or resting. Almost all of the European Union's member states now use a comparable monitoring system for public transit.In [8], Rohit suggested using the Internet of Things to develop an automated intelligent house that includes a real-time e-metering system. By controlling the electrical equipment remotely, the technology lowers power usage. Laila introduced another IoT-based energy-efficient smart house design in [9], where several types of sensors are employed to regulate the electrical equipment.A water pollution detecting system is highly helpful in managing pollution. [7] talks about a real-time water monitoring system. The system is made up of many sensors, including pH, humidity,

temperature, and others. To track the amount of water contamination, sensor data is sent immediately to the base station. The test site was on the Indonesian island of Toba. Mohamed Aslam et al[2] IoT is also widely used in the medical industry. These days, many health monitoring technologies are becoming wearable or portable, including blood pressure monitoring systems, glucose monitors, ECG monitors, body temperature monitors, and pulse oximeters. ICU monitoring application prototype was unsatisfactorily described in [2]. Without using the appropriate sensors and leaving cloud connection for future development, a hardware solution for patient monitoring with embedded computer raspberry pi was demonstrated. Without adhering to correct IoT structure, another alternative was put out in [2]. A human fall detection device is quite useful for keeping an eye on elderly residents who live alone. [2] presents a working prototype of an Internet of Things-based fall detection system.

3. Proposed System

The suggested monitoring system is controlled primarily by an Arduino 101 (an Internet of Things development board). There is a comprehensive rundown of the Arduino 101 development board's detailed technical characteristics in (see [3]). A variety of sensors (detailed in Table-I) were wired directly to the main controller and sent data to the Arduino board, which was used to monitor the patient's vital signs. As seen on thinger.io [2] Our suggested solution makes use of an IoT cloud provided by a third-party IoT cloud platform. Equation-I is an easy-to-understand calculation for determining whether or not a patient need immediate medical attention; Table-II provides more nuanced graphical representation for the value that constitutes the threshold.

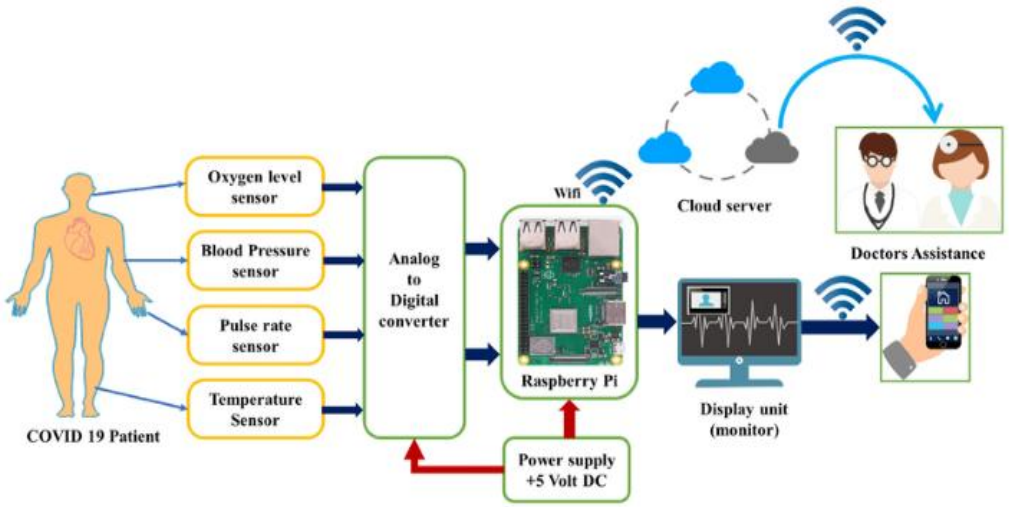

FIGURE3. Block diagram of proposed patient monitoring system.

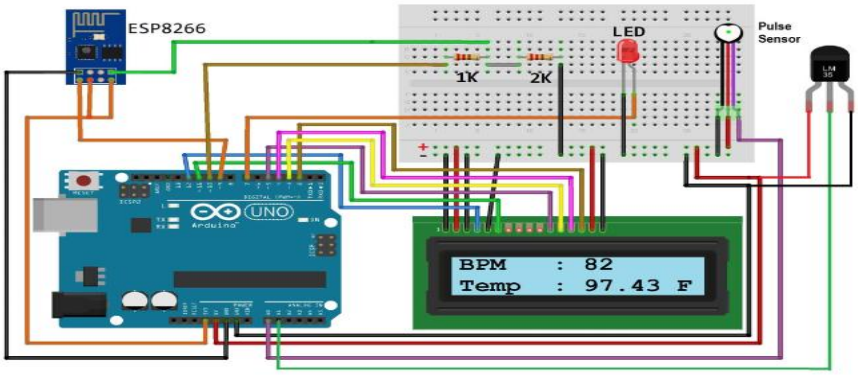

FIGURE 4. Hardware design of the system

TABLE1. Hardware Component List

Nameofthecomponents	Purpose
Arduino/Genuino101	The primary regulating circuit board
Arduino EthernetShield	The connection bridge between the cloud and the controller for measuring the inside temperature and humidity of the body
TemperatureandHumiditysensor	Forbodytemperatureandhumiditymeasurement
Heartratesensor(MAX30100)	Check the rate of the pulse.
ECG sensor	Perform the necessary measurements on the ECG.
Buzzer	EmergencyAlarm
LED	Emergencyindicator
Pushbutton	Signal of Urgent Need
Movementsensor	Signaling for aid in the event of an emergency find the movement that is unanticipated.
Bloodpressuresensor	Measurethebloodpressure
360Camera,Optional	Optionallystreamsthevideo
Otherssensors	Air quality sensor and room temperature sensorareusedformeasuringroomenvironment
12voltDCpowersupply	Power sources are used for the purpose of assessing the atmosphere of a space via the use of air quality sensors and room temperature sensors.

TABLE2. Mathematical Notation of Sensors Readings

Sensor(notation)	Thresholdlevel[1]
Heartrate,***hr***	lessthan50andgreaterthan120
Temperature,***tempbody***	lessthan35andgreaterthan39inCelsius
Humidity,***humiditybody***	lessthan 40%andgreaterthan 55%
Movements,***movebody***	Unexpected
SPO2,***spo2blood***	Under90 %
Upperbloodpressure, ***upperblood***	lessthan 120andgreaterthan180
Lowerbloodpressure,***lowerblood***	lessthan80andgreaterthan110
Pushbutton,***buttoncall***	On
ECG,***ecgheart***	N/A

$$T_{temperature} \vee T_{humidity} \vee T_{heart\ rate} \vee T_{movement} \vee T_{SPO2} \vee T_{upper\ blood} \vee T_{lower\ blood} \vee T_{button} \quad (1)$$

4. System Testing

In order to measure a person's health parameter, we employed some of the currently in use medical equipment that are mentioned in Fig. 10. The Blood Bp monitor gadget has previously been medically validated, and confirmation can be found in [2]. Other sensors, such humidity and ECG, are not evaluated since there is insufficient support for medical devices. It's crucial to identify the patient's bodily motions. In this aspect, a human movement detection system based on artificial intelligence (AI) is more precise than one that measures body motions using inexpensive sensors like accelerometers. Contrarily, integrating a vision-based system with a low-cost microcontroller is more difficult than integrating a system that relies on sensors. In [2], we find a method for measuring human body motion using sensors (accelerometers), which may be simply included into our suggested setup.

5. Software and Apps

FIGURE 5. Mobile application of patient monitoring system for doctors and nurses.

The application is immediately linked to the cloud and may display the data in real time using a variety of charts. The gadget continually transmits the sensor data to the Internet of Things cloud. An application for mobile devices that we created is seen in Figures 5 and 6. The real-time sensor data, which includes the patient's current medical parameters (currently health state), has been shown using a variety of visualizations and indicators. Without physically visiting the ICU unit, physicians or nurses may remotely monitor their patients using this program. Equation -I, which assesses the emergency state of a patient by analyzing the sensor data, causes the system to send the push message about the patient's emergency situation to the appropriate physicians or nurses due to the nature of intelligence. Through our web-based, cloud-connected desktop program (shown in Figure 7), the hospital's in-charge personnel (the ICU in-charge person) could also continuously monitor many patients at once, which would increase the ICU unit's efficiency. Using various types of charts, including gauge, spark-line, and text, all of the applications were linked to the IoT cloud and displayed real-time data.

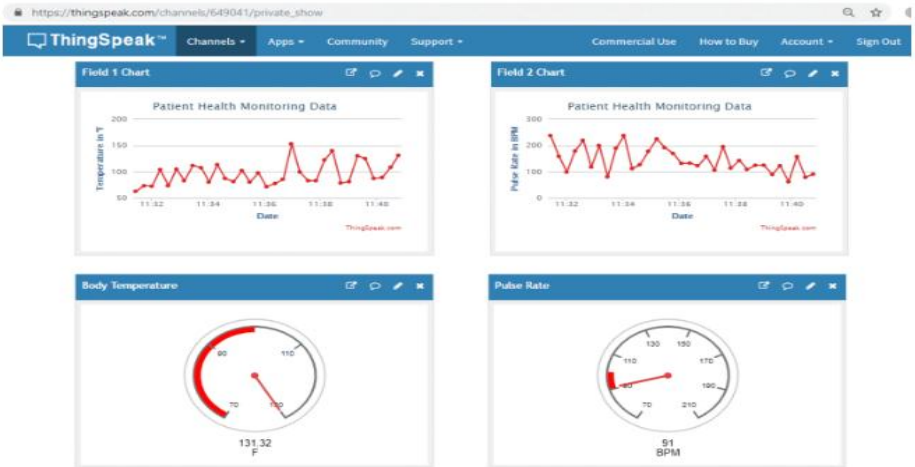

FIGURE 6. The Desktop application for monitoring the patient.

6. Conclusion and Future Plan

Because of the negligence of the staff in charge, several patients in the ICU perished. Traditional systems are unable to provide possibilities for continuous monitoring. Our suggested approach, which is outlined in this article, enables hospital staff members in charge to monitor patients in ICU units in real time, which boosts productivity and service quality. This technology has a great potential to be modified into a wearable gadget that would enable remote baby or elderly monitoring from any location.

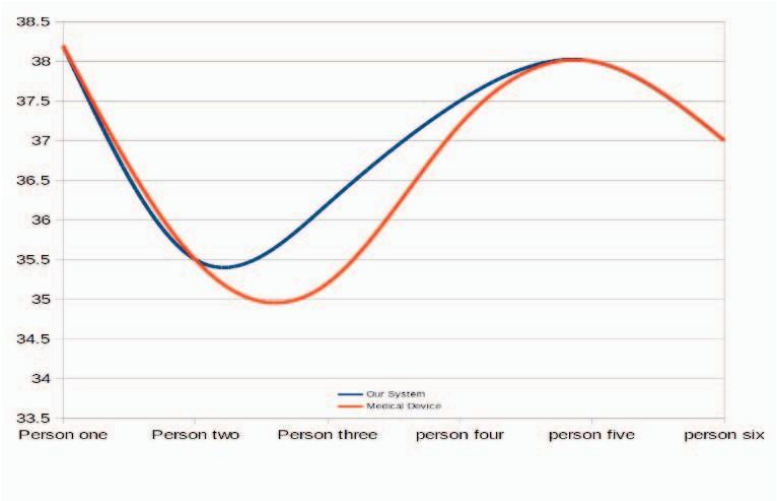

FIGURE 7. Blood Oxygen-Level (SPO2)& Body temperature measurement data.

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