WIFI ENABLED ICU PATIENT MONITORING SYSTEM

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ABSTRACT

- In Intensive Care Units (ICUs), continuous monitoring of patients' vital signs is crucial for timely medical intervention. Traditional monitoring systems often require patients to be physically connected to monitoring devices, which can be uncomfortable and limit their mobility.
- This project proposes a Wi-Fi based ICU patient monitoring system that allows for wireless transmission of patients' vital signs, such as heart rate, temperature, and blood oxygen levels, to a central monitoring station. The system aims to enhance patient comfort, improve the efficiency of healthcare delivery, and ensure real-time monitoring and alerting for critical conditions.

INTRODUCTION

- Traditional ICU patient monitoring systems are often cumbersome due to the need for wired connections between patients and monitoring devices. These systems can limit patient mobility, cause discomfort, and pose challenges in terms of scalability and real-time data accessibility. There is a need for a more flexible, efficient, and patient-friendly monitoring solution that leverages modern wireless technology to provide continuous and reliable monitoring of patients' vital signs.

LITERATURE SURVEY

S-no	Author & Year of Publication	Journal	Title of the paper	Advantages &Limitations
1.	Itamir de Morais Barroca Filho, Gibeon Aquino, Ramon Santos Malaquias, Gustavo Girão, Sávio Rennan Menêzes Melo / IEEE Access (2021)	Conference on Emerging Devices and Smart Systems (ICEDSS)	"**An IoT-Based Healthcare Platform for Patients in ICU Beds During the COVID-19 Outbreak**"	**Advantages:** This platform can help in tracking vital signs, managing medication. **Limitations:** It does not provide a detailed analysis of the technical aspects of the platform, such as the communication protocols, security measures, and data storage.
2.	Sai Srinivas Vellela / International Journal for Modern Trends in Science and Technology (2024)	International Journal of Latest Trends in Engineering and Technology, (IJLTET)	"**IoT Based ICU Patient Monitoring System**"	**Advantage**: Reducing the workload of healthcare professionals by automating some tasks, such as recording vital signs and generating alerts when necessary. **Limitations**: The cost of implementing and maintaining the IoT-based ICU patient monitoring system can be high.

EXISTING SYSTEM

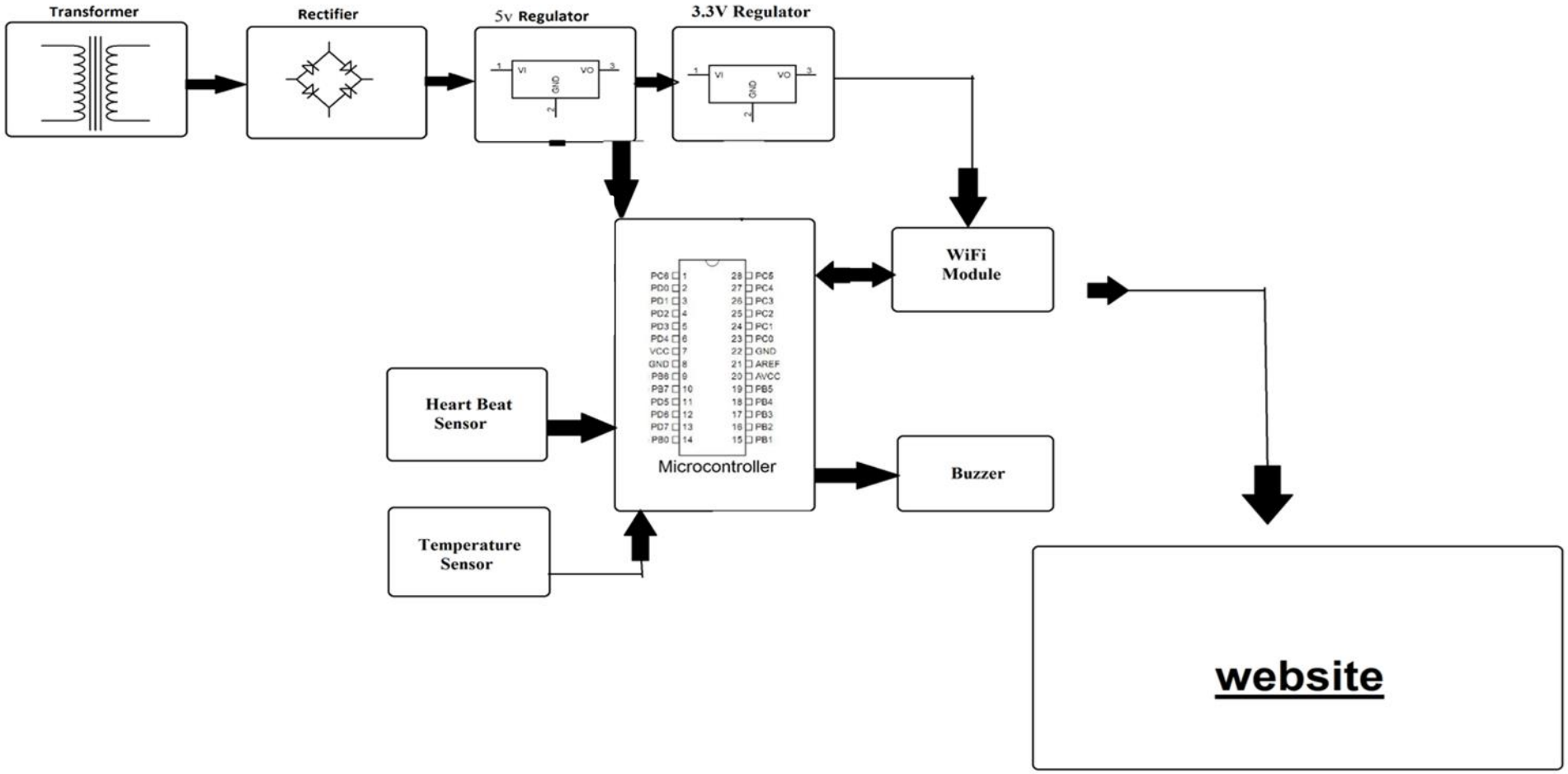
- The existing patient monitoring systems in Intensive Care Units (ICUs) primarily rely on wired devices to continuously track vital signs such as heart rate, blood pressure, temperature, and oxygen saturation. These systems involve attaching sensors directly to the patient's body, which are connected via cables to bedside monitors. While effective in providing real-time data to healthcare professionals, these traditional systems can cause discomfort and restrict patient movement due to the physical constraints of the cables and devices. Additionally, the reliance on wired connections can limit the scalability of monitoring and complicate patient care logistics, especially in situations requiring frequent repositioning or transportation of patients.

PROPOSED SYSTEM

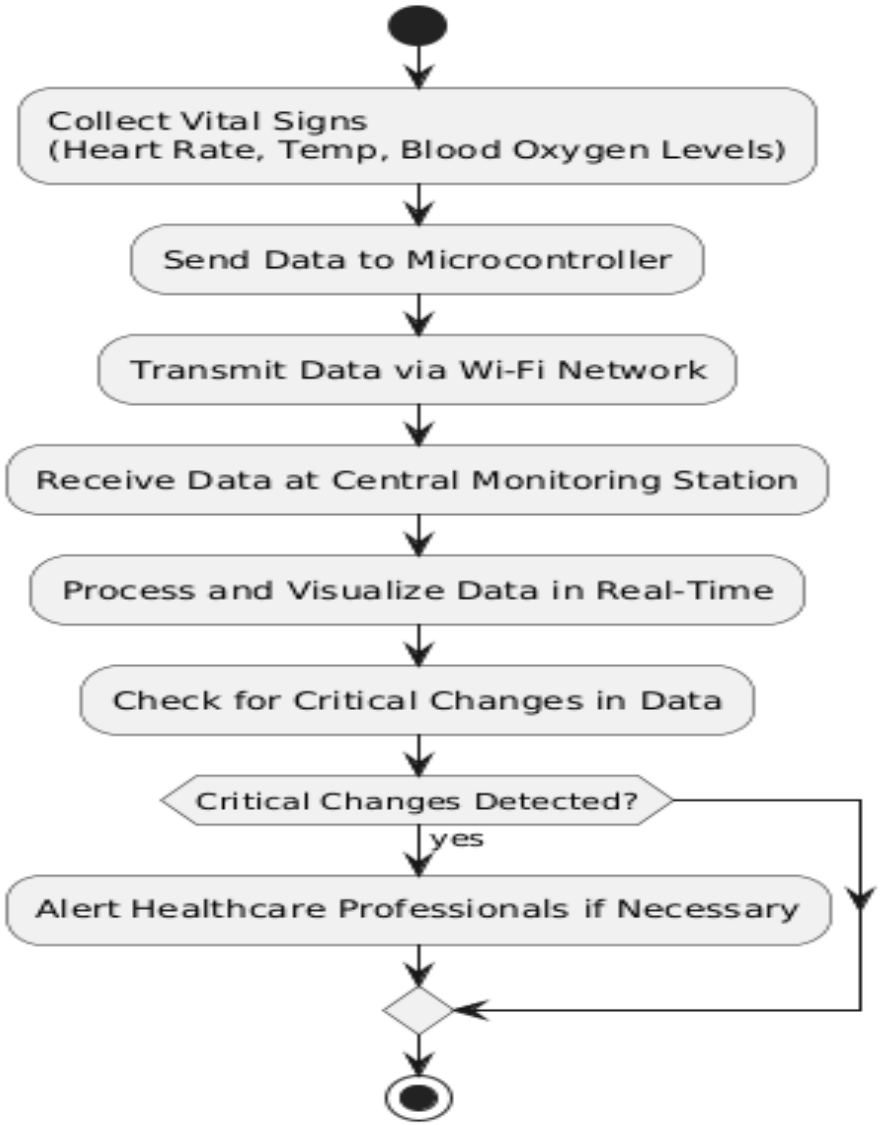
The proposed system consists of three main components:

- **Sensor Modules:** These modules are equipped with sensors to measure patients' vital signs such as heart rate, body temperature, and blood oxygen levels. Each sensor module is connected to a microcontroller with a Wi-Fi module for wireless data transmission.
- **Wi-Fi Network:** A robust Wi-Fi network ensures reliable and continuous data transmission from the sensor modules to the central monitoring station.Central
- **Monitoring Station:** This station receives the data transmitted from the sensor modules. It includes a computer or server with software that processes and visualizes the data in real-time. The software also includes an alert system to notify healthcare professionals of any critical changes in patients' conditions.

SOLUTION ARCHITECTURE



FLOW CHART


Collect Vital Signs
(Heart Rate, Temp, Blood Oxygen Levels)
Send Data to Microcontroller
Transmit Data via Wi-Fi Network
Receive Data at Central Monitoring Station
Process and Visualize Data in Real-Time
Check for Critical Changes in Data
Critical Changes Detected?
yes
Alert Healthcare Professionals if Necessary

MODULES SPLIT-UP

1. Patient Monitoring and Data Acquisition Module:

- Components: Heart rate sensor, temperature sensor, blood oxygen (SpO2) sensor, microcontroller.
- Function: This module is responsible for the real-time acquisition of vital signs from the patient. It includes the sensors that measure heart rate, body temperature, and blood oxygen levels, as well as the microcontroller that processes the sensor data.
- Objective: To ensure accurate, continuous, and non-intrusive monitoring of patient vitals with minimal discomfort..

MODULES SPLIT-UP

2. Wireless Data Transmission and Central Monitoring Module:

- Components: Wi-Fi transceiver, central server, data processing unit, user interface (UI).
- Function: This module handles the wireless transmission of vital signs data from the patient to a central monitoring station. It ensures that data is securely and reliably transmitted in real-time. The central server processes and displays this data on a user-friendly interface for healthcare professionals to monitor and respond to.
- Objective: To provide seamless and secure communication between the patient and the central system, ensuring healthcare providers can monitor patients in real-time and receive alerts for any critical conditions.

MODULES SPLIT-UP

3. Data Management, Alerting, and Security Module:

- Components: Database management system, alert algorithms, encryption protocols, cloud storage (optional).
- Function: This module is responsible for storing, managing, and securing the collected data. It includes generating alerts and notifications based on abnormal readings and ensuring data privacy through encryption and secure protocols. It also manages long-term storage, allowing historical data retrieval and compliance with healthcare data regulations.
- Objective: To ensure that patient data is stored securely, alerts are generated promptly for critical conditions.

ALGORITHM USED

- MQTT (Message Queuing Telemetry Transport) Protocol: An efficient lightweight messaging protocol designed for small sensors and mobile devices, ensuring reliable data transmission in IoT systems.
- Publish-Subscribe Model: Unlike the traditional request-response model, MQTT uses a publish-subscribe architecture, where devices (publishers) send messages on a specific topic, and other devices (subscribers) receive messages on topics they are interested in. This model decouples the sender and receiver, which makes the system more flexible and scalable.
- Lightweight: MQTT has a very small code footprint and minimal network bandwidth usage, making it ideal for environments with limited resources, IoT devices.

SYSTEM REQUIREMENTS

Hardware Requirements:

- Heart Beat sensor
- Temperature Sensor
- ESP8266
- Microcontroller
- Power Supply

Software Requirements:

- Arduino IDE
- Embedded C
- Server

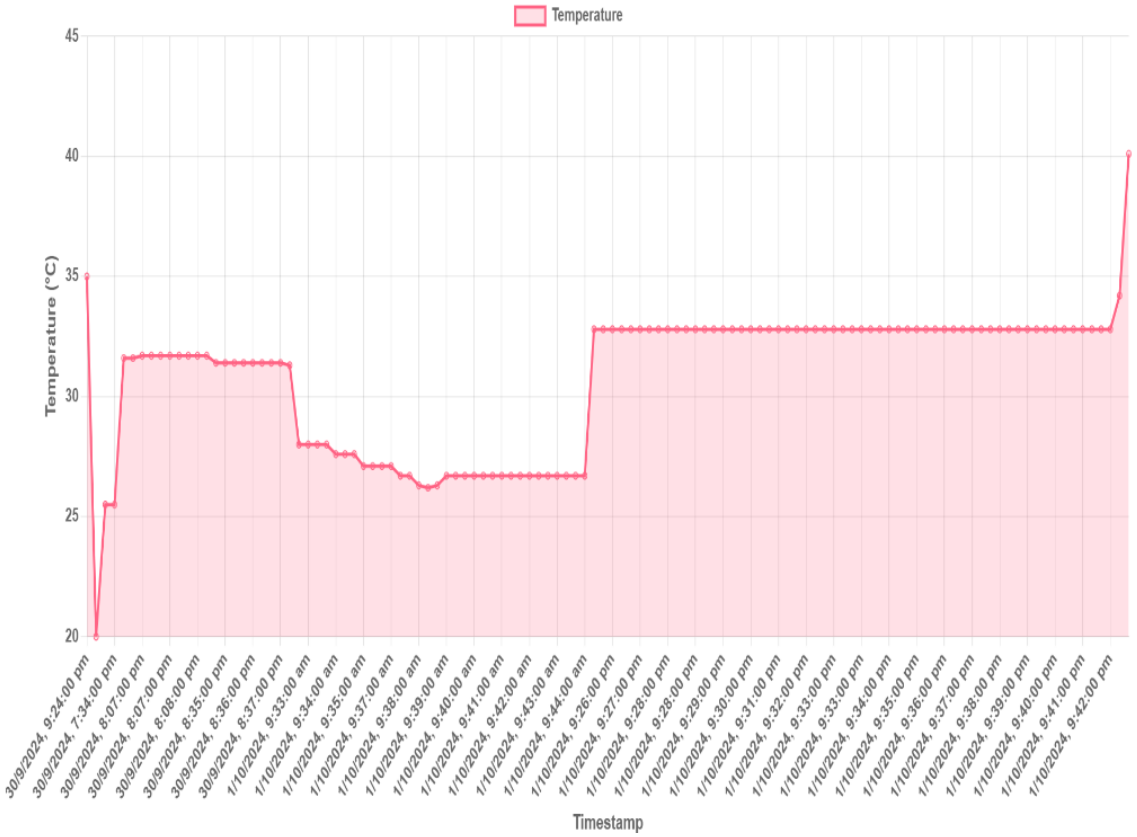
CODE IMPLEMENTATION

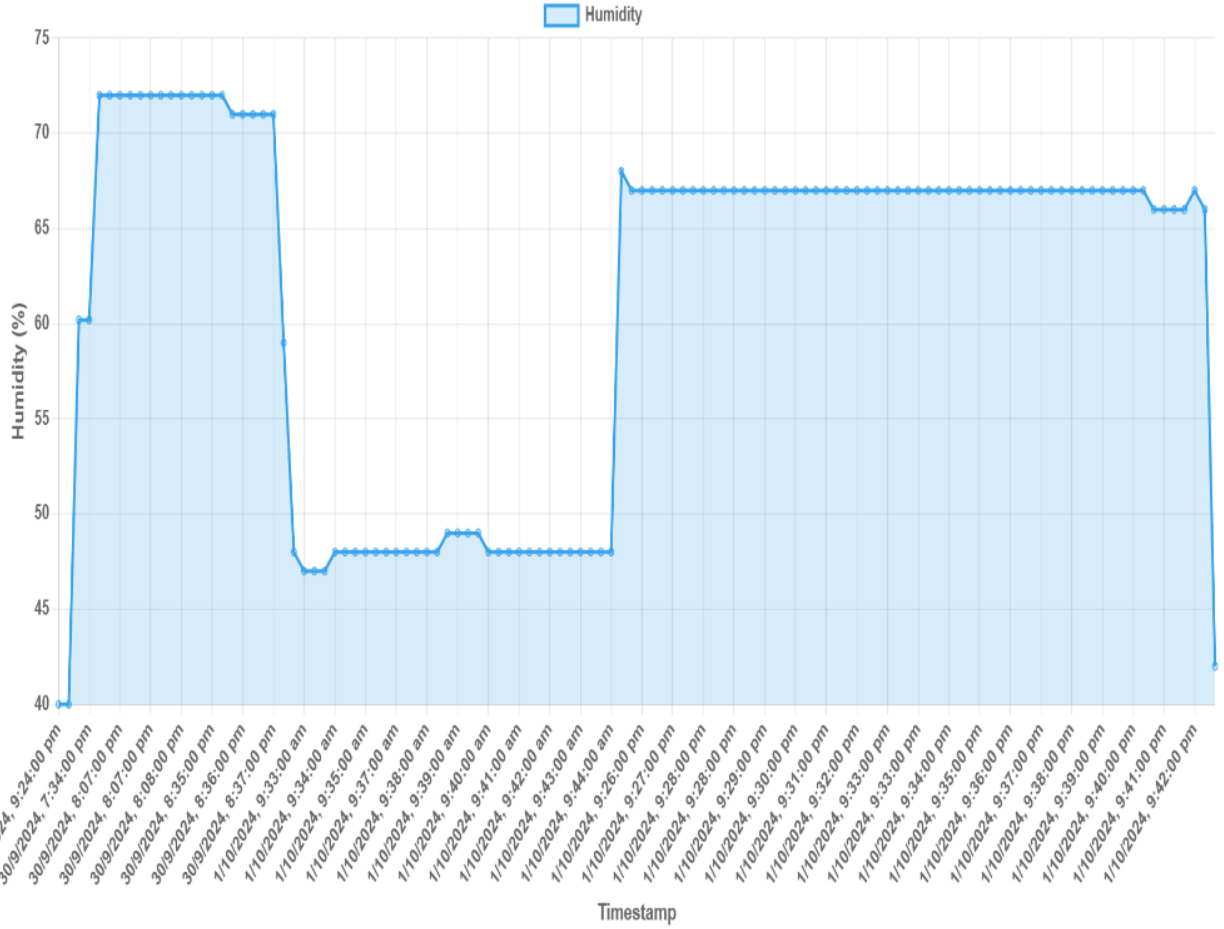
```
include <ESP8266WiFi.h>
#include <PubSubClient.h>
#include <Adafruit_Sensor.h>
#include <DHT.h>

// Wi-Fi credentials
const char* ssid = "Your_SSID";
const char* password = "Your_Password";

// MQTT Broker
const char* mqtt_server = "broker.hivemq.com"; // Public MQTT broker, use
your own for production
const int mqtt_port = 1883;

// MQTT topics
const char* heartRateTopic = "icu/monitor/heartRate";
const char* tempTopic = "icu/monitor/temperature";
const char* spo2Topic = "icu/monitor/spo2";

// Initialize DHT Sensor for temperature and humidity
#define DHTPIN D4 // DHT Sensor pin
#define DHTTYPE DHT11 // DHT 11
DHT dht(DHTPIN, DHTTYPE);
```

```
void loop() {
  if (!client.connected()) {
                reconnect();
  }
  client.loop();

  // Read heart rate, temperature, and SpO2 data
  int heartRate = readHeartRate();
  float temperature = dht.readTemperature();
  int spo2 = readSpO2();

  // Convert data to string for MQTT
  String hr = String(heartRate);
  String temp = String(temperature);
  String sp = String(spo2);

  // Publish data to respective MQTT topics
  client.publish(heartRateTopic, hr.c_str());
  client.publish(tempTopic, temp.c_str());
  client.publish(spo2Topic, sp.c_str());

  // Delay for a bit before next reading
  delay(2000);
}-
```

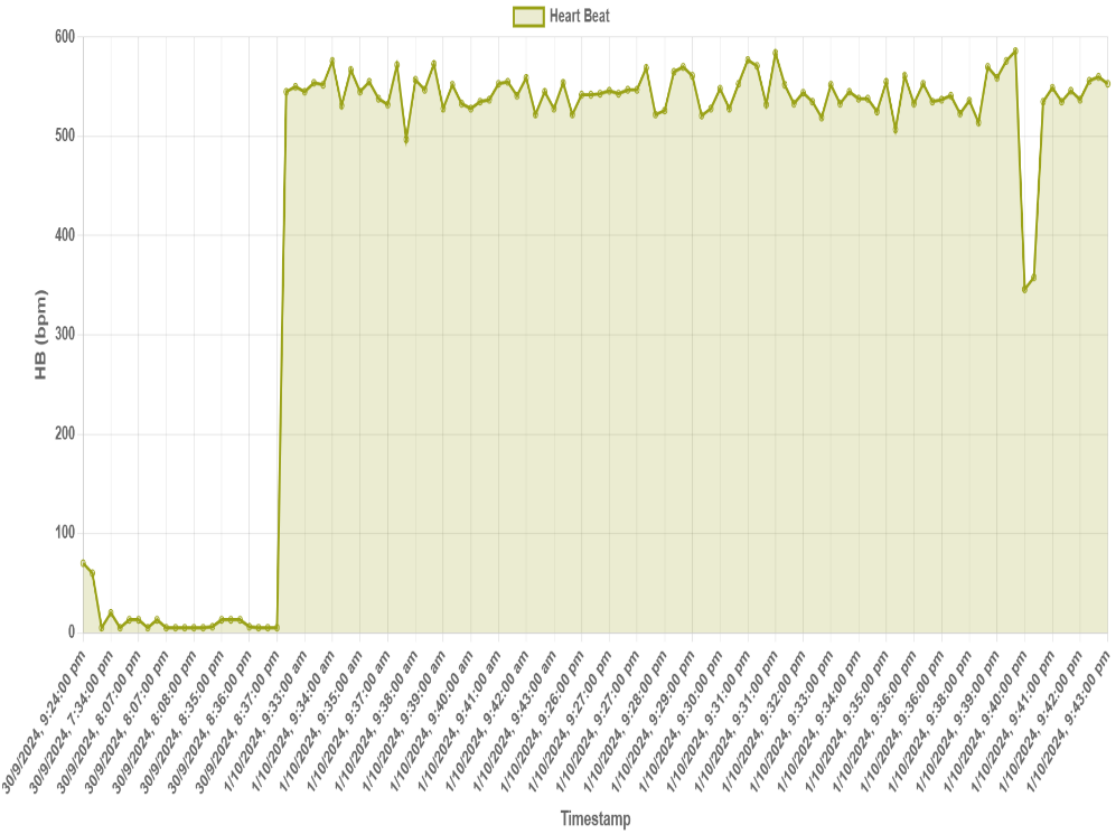
EXPECTED OUTPUT

Sensor Data





EXPECTED OUTPUT



ID	Temperature	Humidity	HB	Timestamp	Actions
1	45.0	60.5	13.0	2/10/2024, 8:08:00 pm	Edit Delete
2	20.0	40.0	60.0	30/9/2024, 4:48:00 pm	Edit Delete
3	25.5	60.2	5.0	30/9/2024, 5:12:00 pm	Edit Delete
4	25.5	60.2	20.0	30/9/2024, 7:34:00 pm	Edit Delete
5	31.6	72.0	5.0	30/9/2024, 8:06:00 pm	Edit Delete
6	31.6	72.0	13.0	30/9/2024, 8:06:00 pm	Edit Delete
7	31.7	72.0	13.0	30/9/2024, 8:07:00 pm	Edit Delete
8	31.7	72.0	5.0	30/9/2024, 8:07:00 pm	Edit Delete
9	31.7	72.0	13.0	30/9/2024, 8:07:00 pm	Edit Delete
10	31.7	72.0	5.0	30/9/2024, 8:07:00 pm	Edit Delete
11	31.7	72.0	5.0	30/9/2024, 8:08:00 pm	Edit Delete
12	31.7	72.0	5.0	30/9/2024, 8:08:00 pm	Edit Delete
13	31.7	72.0	5.0	30/9/2024, 8:08:00 pm	Edit Delete

CONCLUSION

- The Wi-Fi based ICU patient monitoring system presents a significant advancement over traditional wired systems, offering enhanced patient comfort, mobility, and real-time data accessibility. By leveraging modern wireless technology, the proposed system ensures continuous monitoring of vital signs and timely medical intervention in critical situations. The successful implementation of this system can improve the efficiency of healthcare delivery in ICUs, ultimately leading to better patient outcomes. Future work will focus on optimizing the system for scalability, security, and integration with existing hospital information systems.

REFERENCE

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THANK YOU!!!