

# IoT-Based patient Health Monitoring and Automation System

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## Project Overview

**Title:** IoT-Based Health Monitoring and Automation System

**Objective:**

The primary goal of this project is to design and implement an IoT-enabled system that combines health monitoring with home automation. The system integrates various sensors and actuators to monitor health parameters and control environmental conditions. Real-time updates and alerts are sent to a cloud platform for remote monitoring and control, ensuring a smart, responsive, and accessible solution. Additionally, voice-based control via Google Assistant enhances user interaction and convenience.

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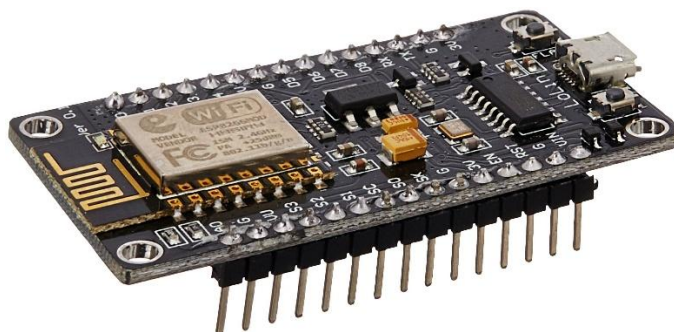
## Components Used

### 1. Microcontrollers:

- **Arduino Uno:**  
Manages sensor interfacing and LCD display.

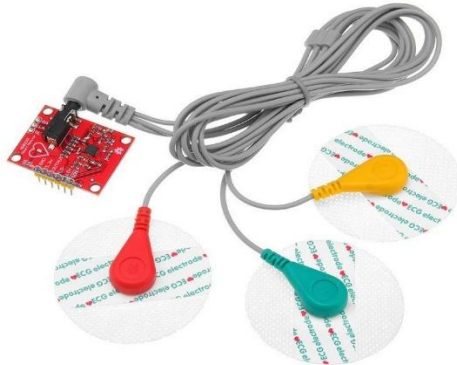


- **ESP8266 NodeMCU:**  
Handles cloud integration, IoT connectivity, and communication with Google Assistant.

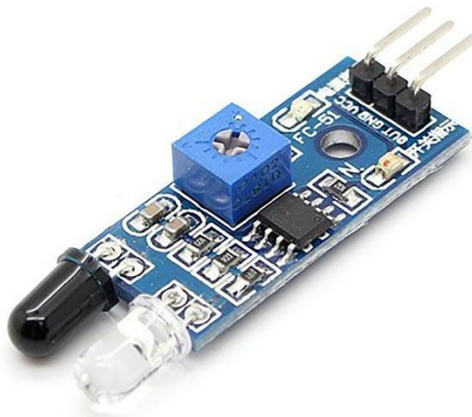


## 2. Sensors:

- **ECG Sensor:** Monitors heart rate signals.



- **IR Sensor:** Detects the patient's presence on the bed.



- **Light Sensor (LDR):** Monitors ambient light levels.

## 3. Actuators:

*(Insert an image of the relay module, DC motor, and buzzer together.)*

- **Relay Module:** Controls lighting.



4 .**DC Motor**: Operates as a prototype fan for temperature regulation.



5. **Buzzer**: Alerts in critical conditions (e.g., absence of the patient).



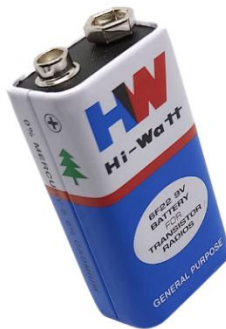
6.**Display**:

- **I2C LCD (16x2)**: Provides real-time status updates.



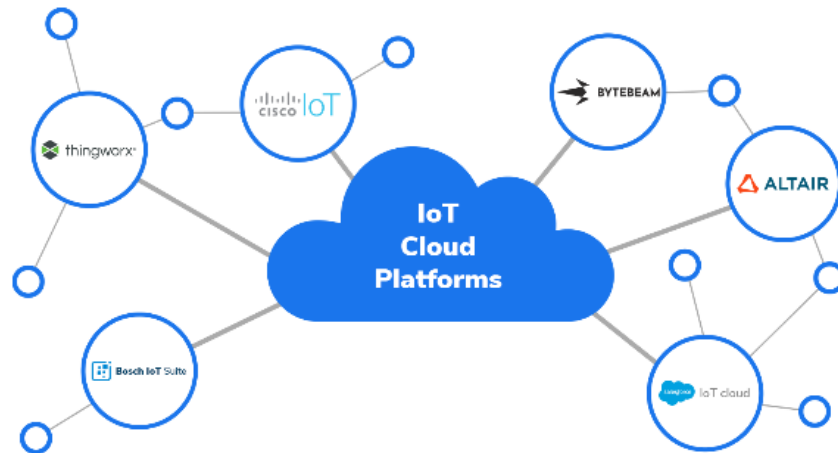
7.**Power Supply**:

- External power supplies (e.g., 9V batteries for Arduino Uno and ESP8266).



## 8. IoT Cloud Platform:

- **Arduino IoT Cloud:** Facilitates real-time monitoring and control via a web dashboard.



## 9. Voice Assistant:

- **Google Assistant:** Enables voice-based control of lights and fan through integration with ESP8266 using IFTTT.



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## System Design

### Health Monitoring

- **Setup:**  
ECG sensor, DHT sensor, and IR sensor are interfaced with the Arduino Uno. Data from these sensors is processed and displayed on the LCD.
- **Functionality:**
  - ECG sensor monitors heart rate signals.
  - DHT sensor records temperature.
  - IR sensor detects the patient's presence on the bed.
  - The buzzer is activated if the patient is absent from the bed for a specified time.
  - Data is transmitted to the IoT Cloud via ESP8266.

### Home Automation

- **Setup:**  
The relay module and DC motor are connected to the ESP8266.
- **Functionality:**
  - Relay controls light based on cloud commands or voice commands.
  - DC motor simulates a fan that operates automatically when temperature thresholds are exceeded or via voice commands.

### Voice Control

- **Integration:**
  - Google Assistant is connected to the ESP8266 using IFTTT applets.
  - Commands such as "Turn on the fan" or "Turn off the light" are processed via Google Assistant and trigger appropriate actions on the ESP8266.

### Integration

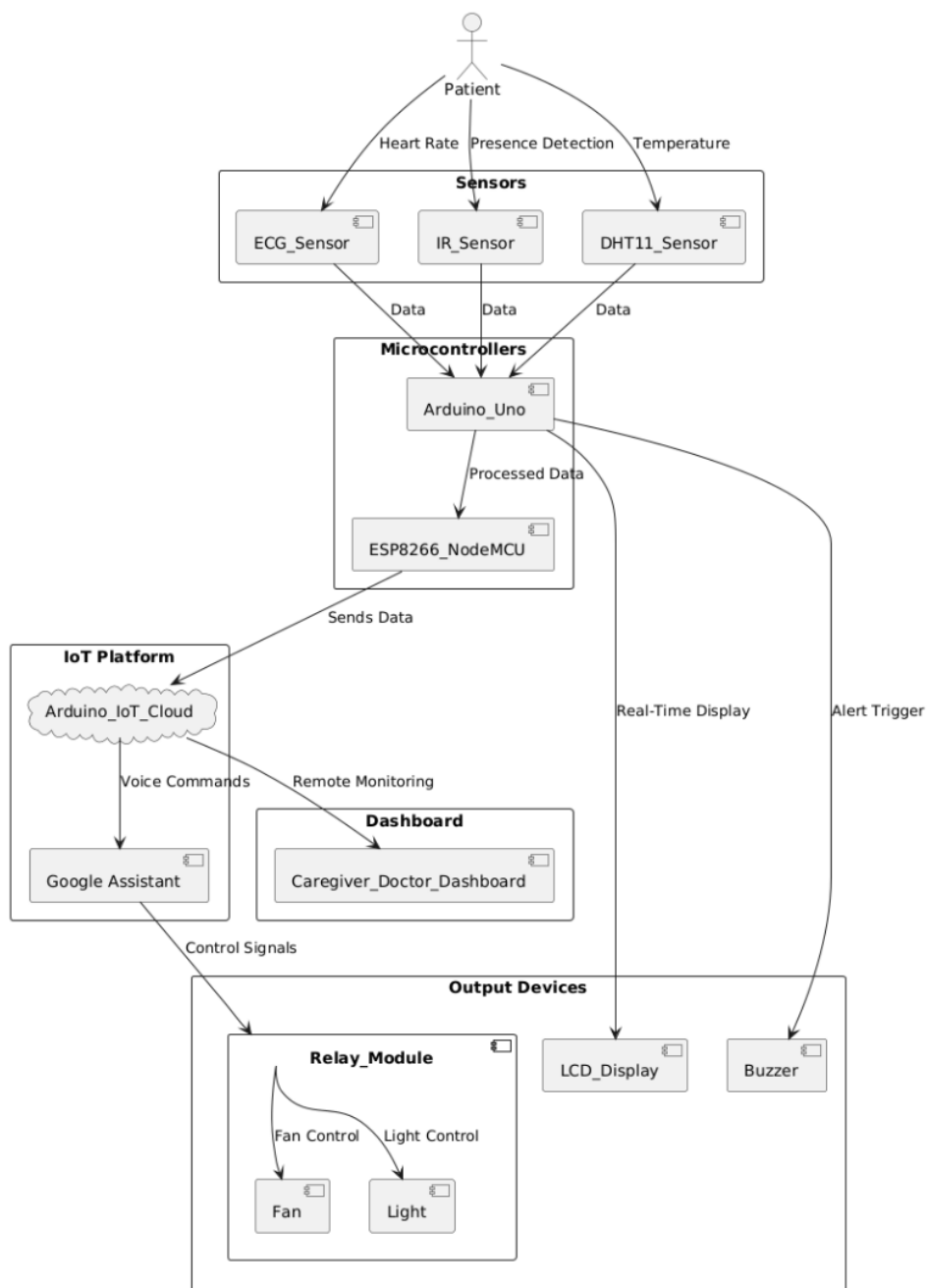
- Communication between Arduino Uno and ESP8266 ensures seamless sensor data transfer and cloud updates.  
*(Insert an image showing the serial connection and voltage divider circuit between Arduino Uno and ESP8266.)*
- The Arduino IoT Cloud provides a unified dashboard for real-time updates and device control.

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## Features

- Real-time health parameter monitoring (ECG, temperature, presence detection).
- Alerts via buzzer and cloud notifications for critical conditions.
- Automated and remote control of home devices.
- Voice-based control of fan and light using Google Assistant.
- LCD display for immediate local feedback.

## Block Diagram:



**Components Table :**

<i>Component</i>	<i>Type</i>	<i>Key Features</i>	<i>  Function in Project</i>
<i>Arduino Uno</i>	<i>Microcontroller</i>	<i>14 digital I/O pins, 6 analog input pins, operates at 5V, supports multiple communication protocols.</i>	<i>  Interfacing sensors and output devices, processing data, and sending it to ESP8266 for cloud integration.</i>
<i>ESP8266 NodeMCU</i>	<i>Microcontroller/IoT</i>	<i>Built-in Wi-Fi, supports TCP/IP, 4MB flash memory, operates at 3.3V.</i>	<i>  Enables IoT functionality by connecting to Arduino IoT Cloud and controlling devices remotely.</i>
<i>ECG Sensor</i>	<i>Sensor</i>	<i>Measures electrical activity of the heart, provides analog output.</i>	<i>  Monitors heart rate signals of the patient for real-time health tracking.</i>
<i>IR Sensor</i>	<i>Sensor</i>	<i>Detects presence or proximity using infrared light, operates at 3-5V.</i>	<i>  Checks if the patient is on the bed; triggers alerts if absent.</i>
<i>DHT11 Sensor</i>	<i>Sensor</i>	<i>Measures temperature and humidity, digital output, low power consumption.</i>	<i>  Monitors ambient or body temperature for health data and automation.</i>
<i>LCD Display (I2C)</i>	<i>Display Device</i>	<i>16x2 characters, I2C interface for reduced pin usage, operates at 5V.</i>	<i>  Displays real-time data such as temperature, heart rate, and system alerts.</i>
<i>Buzzer</i>	<i>Output Device</i>	<i>Generates audible alerts, operates at 3-5V, low power consumption.</i>	<i>  Provides alerts in critical conditions (e.g., patient absence from the bed).</i>
<i>Relay Module</i>	<i>Actuator</i>	<i>Operates at 3-5V, allows high-voltage device control, supports multiple channels.</i>	<i>  Controls fan and light based on commands from Google Assistant or automation conditions.</i>
<i>Fan (DC Motor)</i>	<i>Actuator</i>	<i>Operates at low voltage (6-12V), adjustable speed, lightweight and compact.</i>	<i>  Provides a prototype cooling solution controlled by environmental temperature data or Google Assistant.</i>
<i>Light</i>	<i>Actuator</i>	<i>Can be connected to the relay, operates on household AC or DC voltages.</i>	<i>  Provides automated or voice-controlled lighting functionality.</i>
<i>Arduino IoT Cloud</i>	<i>IoT Platform</i>	<i>Offers real-time monitoring, dashboard creation, cloud storage, and remote control via mobile/web apps.</i>	<i>  Acts as the centralized platform for data monitoring, control, and voice commands integration.</i>
<i>Google Assistant</i>	<i>Voice Assistant</i>	<i>Supports natural language processing, integrates with IoT platforms, provides hands-free control.</i>	<i>  Enables voice commands to control fan and light, enhancing accessibility for patients with mobility issues.</i>

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## Implementation Details

### Circuit Design

- **Arduino Uno Connections:**
  - ECG sensor to analog pins.
  - IR sensor and temperature sensor to digital pins.
  - LCD connected via I2C interface.
- **ESP8266 Connections:**
  - Communication with Arduino via voltage divider to match logic levels.
  - Relay and motor connections for light and fan control.

### Code Explanation

- **Arduino Code:**
  - Initializes sensors and reads data.
  - Displays data on the LCD.
  - Sends data to ESP8266 via serial communication.
- **ESP8266 Code:**
  - Establishes cloud connectivity.
  - Receives data from Arduino Uno.
  - Processes voice commands received via Google Assistant.
  - Controls actuators based on cloud inputs and sensor thresholds.

### Power Management

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## Testing and Results

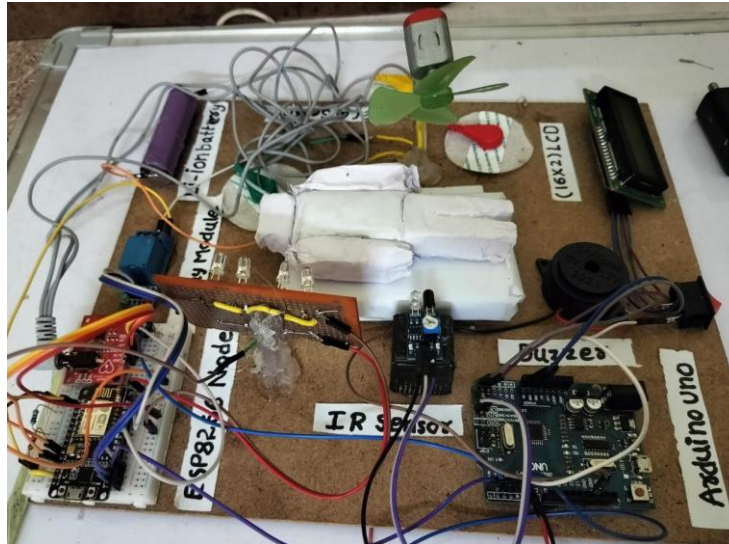
### Testing Scenarios

1. **Health Monitoring:**
  - Patient absence triggers a buzzer alert.
  - ECG and temperature data displayed on LCD and IoT Cloud.
2. **Home Automation:**
  - Fan activates when temperature exceeds the threshold or via voice command.
  - Light controlled remotely or through voice commands.



## Results

- Successfully integrated health monitoring with home automation and voice control.
- Accurate real-time updates on IoT Cloud dashboard.
- Immediate alerts and controls for critical conditions.



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## Future Enhancements

- Addition of advanced health sensors (e.g., SpO2, blood pressure).
- Development of a mobile app for enhanced user experience.
- Solar-powered energy system for sustainability.

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## References

- Datasheets for ECG, DHT11/DHT22, IR sensors, and ESP8266.
- Arduino and ESP8266 library documentation.
- Official Arduino IoT Cloud setup guide.
- Google Assistant and IFTTT integration guides.

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This document serves as a comprehensive guide to replicate the IoT-Based Health Monitoring and Automation System with voice control.