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# ICU Patient Monitoring and Heart Attack Detection

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**Abstract:** *Nowadays, numerous persons are mislaying their life owing to heart attack and shortage of medical attention to patients at the correct stage. In today's world, cardiovascular diseases including heart attacks are the prime reason for mortality. Detecting heart attack rise at early stages and accurate assessments of such risks related to cardiovascular conditions play an essential role in active patient management and preventive interventions [1].*

*The current ICU patient monitoring system relies on manual data and periodic checkups, leading to potential delays in detecting critical conditions. Hence, in this project we are implementing heart rate monitoring and heart attack recognition system using IoT [1][8]. The heartbeat sensor will allow checking heartbeat readings and transmit them over the internet (cloud) and Android app.*

*In critical care, the monitoring is essential to the daily care of ICU patients, as the optimization of patient's hemodynamic, ventilation, temperature, nutrition, and metabolism is the key to improve patients' survival. Patients are admitted to an intensive care unit (ICU) for intensive therapy, intensive monitoring or intensive support. Their needs range from observation of vital signs after major surgery to total support of physiological systems.*

*The primary goal of the intensive care unit (ICU) team is the achievement of stable cardiopulmonary function and optimal oxygen transport. Monitoring implies regular observation and a systematic response if there is deviation from a specified range.*

*In conclusion, the IoT-based ICU patient monitoring and heart attack detection system described in this abstract demonstrates significant potential to improve patient outcomes through early detection, timely intervention, and continuous remote monitoring.*

**Keywords:** Pulse, Temperature, Camera , Internet technology and IoT

## I. INTRODUCTION

An IoT-based system has been implemented that can monitor the heartbeat from the output given by a hardware system consisting of a NodeMCU and sensors. Monitoring heart rate is very important as it determines the condition of the heart. In the new era of communication and technology, the explosive growth of electronic devices, smartphones, and tablets—which can be connected physically or wirelessly—has become a fundamental part of daily life [3].

The next generation of the connected world is the Internet of Things (IoT), which connects devices, sensors, appliances, vehicles, and other "things." These objects may include radio-frequency identification (RFID) tags, mobile phones, sensors, actuators, and more. With the help of IoT, we can connect anything, access it from anywhere at any time, and efficiently access any service and information about any object.

The heart is one of the most important organs in the human body [5][6]. It acts as a pump for circulating oxygen and blood throughout the body, keeping the body functioning. A heartbeat can be defined as a two-part pumping action of the heart that occurs nearly every second.

Every object connected to IoT requires a unique address or identification via IPv6. There are many people in the world whose health may suffer because they do not have proper access to hospitals and health monitoring [7].


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The Internet of Things (stylized as Internet of Things or IoT) is the internetworking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity. This enables these objects to collect and exchange data. In 2013, the Global Standards Initiative on Internet of Things (IoT-GSI) defined the IoT as "the infrastructure of the information society." IoT allows objects to be sensed and/or controlled remotely over existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy, and economic benefit.

## II. LITERATURE SURVEY

Heart rate monitoring is a vital aspect of maintaining heart health. People from different age groups have varying ranges for maximum and minimum heart rate values, so the monitoring system must be compatible enough to handle such scenarios. In this paper, an IoT-based system has been implemented to monitor the heartbeat using a hardware system comprising a NodeMCU [2][6] and pulse sensor.

An alert system is added which is triggered when the heartbeat goes beyond or below the permissible level set in the algorithm. The alert message is sent to the doctor via a mobile phone application. Using this prototype, doctors can access the heartbeat data of the patient from any location. The nurses or duty doctor in the hospital can monitor the heart rate of the patient in real-time using the serial monitor.

Nowadays, we have an increased number of heart diseases, including a higher risk of heart attacks [9]. Our proposed system uses sensors to monitor a person's heart rate using heartbeat sensing, even if the person is at home. The sensor is interfaced with a microcontroller that checks the readings and transmits them over the internet. The user can set high and low heartbeat limits. If the patient's heart rate exceeds or drops below these limits, the system sends an alert to the controller, which then transmits it over the internet to alert doctors and concerned users [11]. The system also displays live heart rate data and can alert in case of a potential heart attack, enabling timely intervention.

Heart attacks can be fatal even in the first instance. Regular health checkups can help detect numerous diseases early. Life is precious [14]. Many people lose their lives to heart attacks due to diet, age, lack of physical activity, and other factors. This system is implemented for heartbeat monitoring and heart attack detection using IoT. The sensor is interfaced with a microcontroller that reads and transmits the heart rate data over the internet.

## III. IOT SYSTEMS

The IoT-based ICU patient monitoring and heart attack detection system demonstrates significant potential to improve patient outcomes through early detection, timely intervention, and continuous remote monitoring.

Heart attacks often occur due to blocked blood flow to the heart. Because of late diagnosis, many lives are lost. In this paper, we propose a system that detects heart attacks by monitoring heart rate using IoT. For a healthy adult, the normal heart rate is 60 to 100 bpm. An athlete's heart rate typically ranges from 40 to 60 bpm depending on fitness.

If a person's heart rate constantly exceeds 100 bpm, it is known as tachyarrhythmia. This reduces the efficiency of the heart by decreasing the amount of blood pumped through the body, leading to chest pain and light-headedness [12][14]. With technology advancements, it is now easy to monitor a patient's heart rate even at home. IoT enables devices to sense and collect data, share it across the internet, and manage it for specific purposes.

## IV. PATIENT MONITORING

Monitoring patients in the ICU is essential for safety and care. This includes:

- Vital Signs: Temperature, blood pressure, pulse, respiration rate, and oxygen saturation are monitored continuously or intermittently.
- Fluid Intake and Output: Tracked accurately.
- Intracranial Pressure and Daily Weight: Often monitored with vital signs.
- Lab Tests and Breath Sounds: Arterial blood gases and other tests are performed regularly.

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Monitoring helps ensure patient safety, guide interventions, and identify deterioration before adverse events. ICU monitoring devices are often complex and require specialized training. Most devices also include alarms for abnormal parameters [3][4][9].

## V. EXISTING SYSTEM

The existing heart rate monitoring system, developed using IoT, aims to detect heartbeat and monitor heart attack risk and regular health status. The device uses Bluetooth to wirelessly transmit data from a heart rate module to a mobile application. The system consists of a heart rate sensor module, an Android app, and a Bluetooth module.

The heart rate module picks up signals using a non-invasive technique called Photoplethysmography and sends the data to a mobile phone or computer for analysis. The Bluetooth range is typically 15–20 meters.

## VI. PROPOSED METHOD

The proposed system monitors vital signs such as temperature, blood pressure, heart rate, and oxygen levels, and transmits the data via IoT. The data is displayed on an LCD and a web page and continuously updated in a database so doctors can access it in real-time.

The system uses a heartbeat sensor to display current heart rate levels on an OLED screen. The receiver circuit also includes an LED light and buzzer to alert supervisors if the heart rate is abnormal. The system is designed to be universal across hospital rooms, allowing operators to monitor all patients from a single location.

The sensor detects heart rate in under 15 seconds. Notifications are sent when heart rate is abnormal.

This IoT-based system continuously monitors patients' vital signs and detects heart attack risks. It includes:

- ECG Sensors – for monitoring heart rhythm and detecting arrhythmias.
- Pulse Oximeters – to measure oxygen levels.
- Blood Pressure Monitors – for continuous pressure monitoring.
- Temperature and Respiration Sensors – to monitor body temperature and breathing.

Physiological parameters displayed include blood pressure, oxygen saturation, heart rate, and respiratory rate, using a multiparameter monitor, mostly found in ICUs or ERs.

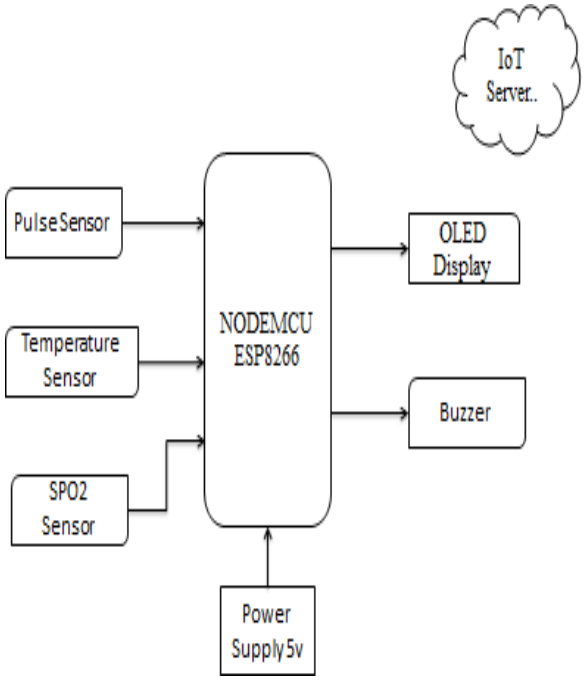


Figure1:Block diagram

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"Every object that connects to the Internet of Things (IoT) requires a unique address or identification, typically provided by IPv6 [10]. There are many people around the world whose health may suffer because they do not have proper access to hospitals and health monitoring systems."

## VII. SOFTWARE EMPLOYED

In the development and implementation of the ICU Patient Monitoring and Heart Attack Detection system, various software tools are employed to facilitate hardware control, data processing, and system integration.

One of the key tools is the Arduino IDE [7][13], which is widely used for programming microcontrollers like the NodeMCU, Arduino Uno, or Arduino Nano. These microcontrollers interface with sensors to monitor vital parameters such as heart rate. The Arduino IDE enables developers to write and upload code that implements custom algorithms for:

- Data acquisition
- Real-time processing
- System control

The Arduino IDE also supports integration with communication modules such as Wi-Fi and Bluetooth, enabling data transmission to cloud-based platforms or local servers.

For advanced applications:

- MATLAB/Simulink can be used for system simulation and modeling before deployment [4].
- LabVIEW might be employed for graphical user interface (GUI) design and diagnostics.
- Python or C++ are commonly used for developing complex data analysis and management software.

These software tools work together to ensure efficient development, control, and optimization of the system, especially in real-time healthcare environments.

## VIII. RESULTS & DISCUSSION

In this innovative field, researchers and engineers are leveraging the Internet of Things (IoT) to create systems that monitor patient heart rates and detect potential heart attacks.

The proposed system includes:

- A hardware setup equipped with sensors (e.g., pulse sensors)
- An Android application for real-time monitoring by the patient

Key Features:

- Continuous, real-time monitoring
- Live display of heart rate on the mobile application
- Configurable upper and lower heart rate thresholds
- Alerts triggered when readings exceed defined limits
- Notification sent to doctors and concerned users over the internet

Benefits:

- Enables timely intervention and potentially saves lives
- Connects devices and appliances to deliver critical healthcare remotely
- Improves accuracy and reliability of patient monitoring systems

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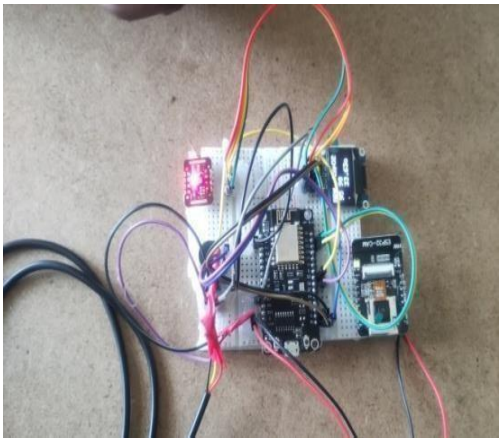

Figure 2: Project Prototype

User Feedback & Improvement Areas:

- Demand for wireless sensors
- Need for fewer false alarms
- Importance of standard hospital protocols for alarm management
- Mixed response on proposed remote display devices

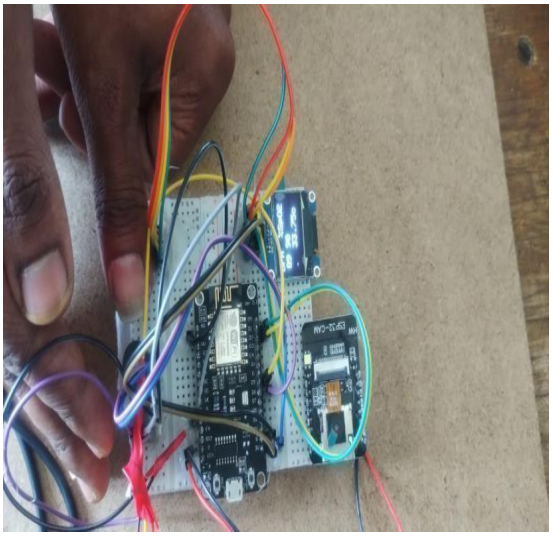

Figure 3: Testing Output

Most respondents found the system useful for:

- Early alerting
- Monitoring across multiple wards
- Detecting complications and increasing patient survival

## IX. CONCLUSION

Today, heart diseases—especially heart attacks—are on the rise. Our proposed IoT-based heartbeat monitoring and heart attack detection system enables real-time remote monitoring, even when the patient is at home.

The system uses:

- A pulse sensor for data acquisition [8]

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• A NodeMCU microcontroller for processing
• Wireless data transmission via Wi-Fi
• A real-time Android app interface for healthcare providers
Key advantages include:
• Continuous monitoring of vital signs: heart rate, blood pressure, respiratory rate, temperature, and oxygen saturation [1][9][11][14]
• IoT connectivity for secure and real-time data transmission
• Alert system integration to notify healthcare personnel of abnormal vital signs
• Accurate results from live sensor readings
• Wireless access to the patient's health data
The system successfully reads heart rate data (normal range: 60–100 bpm; critical if <40 or >100 bpm) and ensures timely alerts to enable lifesaving interventions.

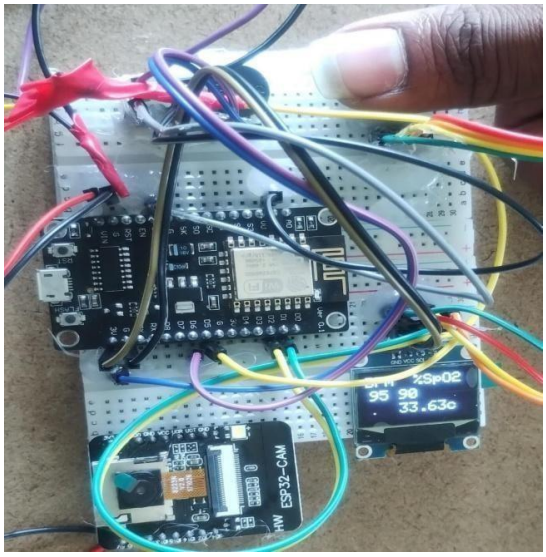

Figure 4: Results

Integration Benefits:
• Enhances ICU patient care quality
• Provides real-time insights
• Supports rapid response and improved clinical decisions
• Increases healthcare system efficiency

**Future Scope**
In the future:
• Integration with facial expression detectors (ESP32) can help grab doctors' attention faster.
• Home patient monitoring will become more widespread as telehealth devices become more affordable.
• The future of ICU patient monitoring and heart attack detection will be powered by IoT and AI, leading to proactive and personalized healthcare.

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