IoT-Enabled System For Real-Time Heart Attack Detection And Automated Emergency Response

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Abstract- *This project introduces a smart, real-time health monitoring system built using Internet of Things (IoT) technology to help respond quickly to cardiac emergencies. It uses a small sensor called the MAX30100 to track a person's heart rate and oxygen levels. These readings are processed by a compact microcontroller (NodeMCU ESP8266), which checks for any signs of abnormal heart activity like unusually fast (tachycardia) or slow (bradycardia) heartbeats.*

If something unusual is detected, the system automatically sends an emergency text message via a GSM module. This message includes the person's location, thanks to a built-in GPS module (NEO-6M). In addition, caregivers or family members can view the patient's live health data remotely using the Blynk app on their smartphones.

The system is designed to be portable, battery-operated, and reliable even in remote areas with limited medical access. Overall, it helps speed up emergency responses and could be a valuable tool for improving heart health monitoring on a larger scale.

Keywords*- IoT, cardiac monitoring, MAX30100, NodeMCU, emergency alert, GPS, GSM, Blynk.*

I. INTRODUCTION

Cardiovascular diseases are a leading cause of mortality worldwide, emphasizing the need for timely detection and intervention. Traditional systems for monitoring heart conditions often rely on in-hospital equipment and manual observation, which can result in delays during critical moments. With advancements in technology, there is a growing shift towards real-time, portable health monitoring solutions.

This paper proposes an IoT-enabled wearable system designed for continuous cardiac monitoring and rapid emergency alerting. By integrating biosensors, cloud-based platforms, and GPS-enabled communication, the system ensures round-the-clock tracking of vital parameters like heart rate and blood oxygen levels (SpO_2). In the event of

abnormalities indicative of conditions such as heart attacks, the system can autonomously alert medical personnel and caregivers through SMS and location-based services. This approach not only enhances response time but also provides a scalable solution adaptable to both urban and remote healthcare settings.

The remainder of this paper is structured as follows: Section II reviews existing research and technological approaches in cardiac monitoring using IoT. Section III presents the proposed methodology and system architecture. Section IV discusses the experimental setup and results. Finally, Section V concludes the paper with future prospects and improvements.

II. LITERATURE SURVEY

Effective real-time monitoring and early detection of cardiac emergencies have been a focal point in recent IoT-based healthcare innovations. Several studies have explored various approaches to addressing these challenges. A summary of key contributions is presented below:

[1] An Advanced Heart Attack Detection and Heart Rate Monitoring Alert System

This study presents an IoT-based solution combining wearable sensors with wireless communication to monitor heart rate and SpO_2. Using a threshold-based anomaly detection approach, it alerts caregivers via SMS and email upon detecting potential heart attacks. The system's cloud integration allows real-time data processing and remote accessibility, showing promising results in reducing emergency response times.

[2] IoT-Based Health Monitoring and Alert System for Cardiac Patients – Chowdhury M & Rahman M

This paper explores a comprehensive framework for monitoring cardiac patients through IoT. The system collects data such as heart rate, blood pressure, and ECG signals. Despite its strengths—such as scalability and real-time

monitoring—the authors highlight challenges related to sensor accuracy, data security, and system integration. Solutions proposed include adopting advanced sensors, ensuring data encryption, and improving system interoperability.

[3] SMS-Based Heart Attack Detection System

Focusing on accessibility and cost-effectiveness, this research utilizes the MAX30102 sensor and Kodular-developed mobile application for heart rate and oxygen monitoring. Upon detecting abnormalities, it sends SMS alerts to predefined contacts. The study demonstrates the value of simple, scalable IoT setups in improving emergency responses, especially in underserved areas.

[4] IoT-Enabled Emergency Detection for Heart and Asthma Attacks

This study expands IoT's scope by detecting both cardiac and respiratory emergencies. Using the MAX30100 sensor, it continuously monitors vital signs and transmits data to a microcontroller. If abnormalities are found, the system sends alerts to emergency services along with GPS data. The system emphasizes automation and real-time location tracking, critical for improving survival rates during life-threatening events.

[5] Heart Failure Patients Monitoring Using IoT-Based Remote Systems

Targeting long-term cardiac care, this paper proposes a system that monitors body temperature, oxygen levels, and even eye movement to assess the condition of heart failure patients. Data from wearable sensors is analyzed remotely to detect early warning signs. The system shows potential in reducing hospital readmissions through preventive care and remote intervention.

III. METHODOLOGY

The system is designed to continuously monitor vital cardiac parameters using a combination of IoT components and cloud-based visualization tools. At the core of the setup is the **MAX30100 sensor**, which accurately measures heart rate and blood oxygen levels (SpO$_2$). This data is processed in real time by the **NodeMCU ESP8266**, a compact and Wi-Fi-enabled microcontroller that handles both data acquisition and communication.

To enhance the system's responsiveness in emergency situations, a **GSM module** is integrated. When the system detects an abnormal heart rate—such as readings

indicative of a potential cardiac event—it immediately sends an alert via SMS. This alert includes the patient's **GPS location**, ensuring that caregivers or emergency responders can act promptly and accurately.

Remote monitoring is made possible through the **Blynk IoT platform**, which provides a user-friendly interface for visualizing real-time heart data on a smartphone or web dashboard. This ensures that caregivers and family members can track the patient's condition from anywhere.

The entire system is developed using the **Arduino IDE**, leveraging essential libraries like **MAX30100**, **TinyGPS**++, and **Blynk** for sensor communication, GPS tracking, and data visualization. Comprehensive testing was conducted under different conditions to evaluate the system's reliability, ensure accurate readings, and minimize delays in emergency alerts.

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The process is broken into a series of well-defined steps to ensure seamless operation, from initializing system components to detecting abnormalities and sending alerts.

1. **Start and Initialization**: The system begins with an initialization phase where the required components, including the Wi-Fi connection, MAX30100 sensor, GSM module, and GPS module, are set up and configured. This step ensures that all hardware and network elements are operational and ready to collect and transmit data. The Wi-Fi module establishes connectivity with the internet, enabling integration with cloud platforms, while the sensor and communication modules prepare to perform their respective roles.

2. **Data Measurement and Cloud Update:** Once initialized, the system proceeds to measure vital health parameters—specifically heart rate and SpO2 (blood oxygen saturation)—using the MAX30100 sensor. The NodeMCU processes this datauploads it in real time to the Blynk cloud platform, where it can be accessed through a mobile application. This step allows users and caregivers to monitor health data remotely, offering an intuitive and interactive interface for real-time visualization.

3. **Abnormality Detection:** The system continuously analyzes the collected health data to identify any abnormalities, such as irregular heart rates (e.g., tachycardia or bradycardia) or dangerously low SpO2

levels. A decision-making algorithm compares the measured values against predefined thresholds to determine if any critical condition exists. This step is pivotal as it ensures that the system can react promptly to potential emergencies.

4. **Alert and GPS Integration:** If an abnormality is detected, the system activates the GSM module to send an SMS alert to predefined emergency contacts. The message includes critical health information along with the user's live GPS location, obtained from the GPS module. The inclusion of location data ensures that emergency responders or caregivers can quickly locate the affected individual, significantly improving the chances of timely intervention.

5. **No Abnormality and Stop**: If no abnormalities are detected, the system loops back to continue monitoring, ensuring continuous real-time tracking of health parameters. The system stops only when it is manually powered down or disabled, maintaining an uninterrupted cycle of data collection and analysis under normal operation.

This flowchart provides a logical representation of the system's operation, highlighting its ability to monitor health parameters, detect emergencies, and communicate alertseffectively.
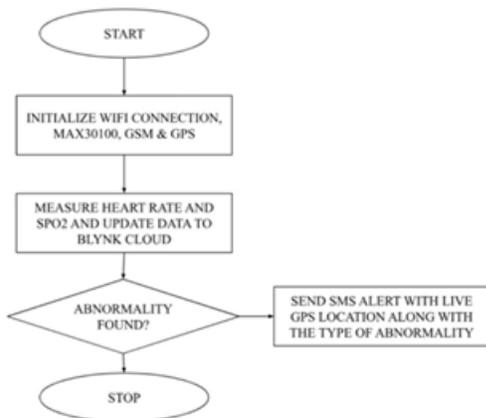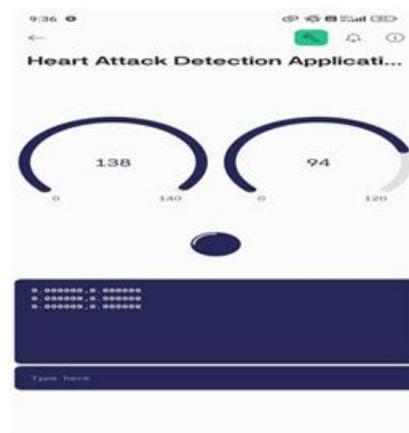

Figure1: Data Flow Diagram of IoT-Enabled System for Real-Time Heart Attack Detectio

IV. SNAPSHOTS

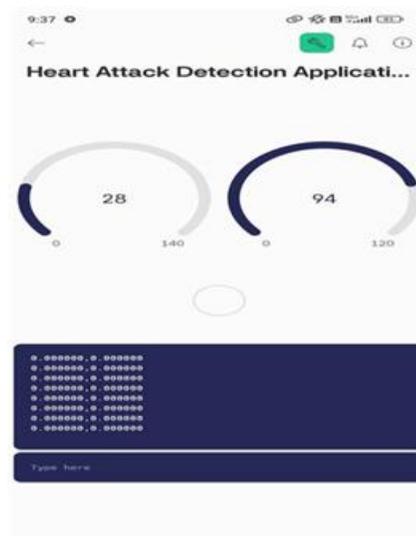Normalheartratedetectedinheart patient.Tachycardiaorhighheartratedetectedinheart patient.

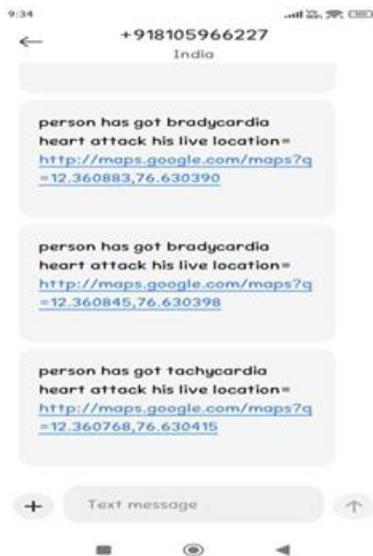**Snapshot1:**Normalheartrate.

Snapshot2:Tachycardiadetected.

Bradycardiaorlowheartratedetectedinheartpatient.LocationofthepatientsenttotheEmergency Contactforbothconditions.
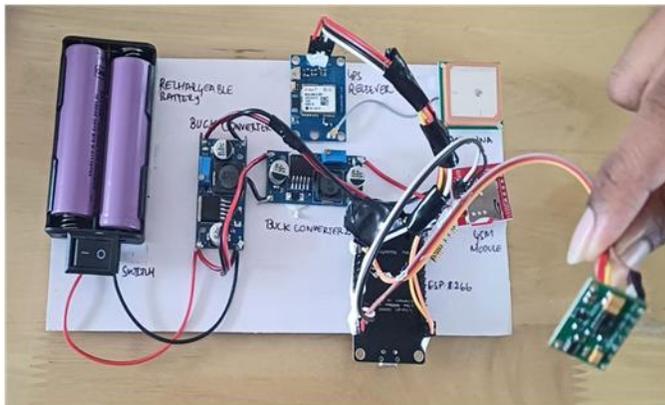

Snapshot3: Bradycardiadetected.

Snapshot4: LocationsenttoEmergency Contacts.

IoT-enabledheartattackdetectionhardwaresystem.

Snapshot5: Heartattackdetectionsystem

V. CONCLUSION

The IoT-based Heart Attack Detection and Emergency Response System offers a practical and transformative approach to modern healthcare by combining low-cost hardware with real-time monitoring capabilities. Using components like the NodeMCU, MAX30100 sensor, SIM800L GSM module, and NEO-6M GPS, the system continuously tracks heart rate and oxygen levels, detecting early signs of cardiac distress. When an abnormality is identified, it sends instant alerts along with the patient's GPS location to emergency contacts and services, ensuring timely intervention—even in remote areas. The integration with the Blynk app further enhances user experience, allowing patients and caregivers to view live health data through a simple, smartphone-friendly interface. This is especially valuable for individuals at high risk for heart disease, enabling them to proactively monitor their condition without the need for bulky or expensive equipment. The system's portable design also supports wearability and scalability, making it suitable for both personal use and integration within larger healthcare systems.

What truly sets this system apart is its accessibility and potential to democratize healthcare. By relying on affordable components, it provides a life-saving solution to populations that may lack access to advanced medical infrastructure, particularly in rural or underserved areas. As IoT continues to shape the future of healthcare, solutions like this one will pave the way for smarter, more responsive patient care. The ability to monitor vital signs in real time, issue automated emergency alerts, and assist in rapid medical response not only improves outcomes but also saves lives. This project highlights how interconnected technology can bridge gaps in healthcare delivery, offering both preventive and reactive care in a user-friendly, cost-effective manner. It represents a significant step toward a future where personalized, continuous, and accessible healthcare becomes the norm.

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