LIFELINK: SMART IOT EMERGENCY HEALTH SUPPORT SYSTEM

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Abstract:

The increased usage of Internet of Things (IoT) technology has made healthcare monitoring smarter and more accessible, but dealing with emergencies in real-time is still a significant problem, especially for senior citizens and patients who require constant care. Emergencies such as accidental falls, unusual body movements, or sudden rises in body temperature can escalate quickly if assistance is not received on time. To overcome this problem, this project proposes the concept of Lifelink: Smart IoT Emergency Health Support System, a simple yet reliable system designed to instantly identify emergencies and send notifications over long distances. The system employs three NodeMCU (ESP8266) modules interconnected via the Blynk cloud using Wi-Fi connectivity, enabling communication from anywhere in the world with internet access. A wearable device placed on the patient's hand continuously tracks body temperature using a DS18B20 temperature sensor and fall or sudden body movements using an ADXL345 accelerometer. As soon as an abnormal situation is detected, the system instantly sends an alert notification via the cloud. At the base station, another NodeMCU module uses a GSM module to send SMS notifications and make emergency calls, and a GPS module transmits the patient's location as a Google Maps link. A separate audio alert device broadcasts an emergency message to alert nearby caregivers. The system is cost-effective, user-friendly, and reliable, providing multiple notification options such as cloud notifications, SMS, phone calls, GPS tracking, and audio alerts. It is highly suitable for senior care, hospital care, and home healthcare, and can be further developed in the future by incorporating heart rate sensors, SpO2 sensors, data logging, and AI-based fall detection for improved accuracy.

Keywords: Internet of Things (IoT), Smart Healthcare Monitoring, Emergency Alert System, NodeMCU (ESP8266), Wearable Health Device, Fall Detection, Temperature Monitoring, GSM Communication, GPS Tracking, Cloud-Based Monitoring, Blynk Platform, Remote Patient Care

1. INTRODUCTION

1.1 Importance of Smart Emergency Monitoring in IoT-Based Healthcare

The Internet of Things (IoT) has experienced rapid growth and has greatly enhanced modern healthcare systems by allowing real-time monitoring, remote surveillance, and intelligent emergency response systems [1], [12]. IoT-based healthcare systems combine wearable devices, sensors, and cloud servers to continuously monitor patients' vital signs and send crucial information to healthcare professionals. These systems are highly effective for senior citizens, physically impaired patients, and patients who need constant medical attention.

Among the various healthcare emergencies, accidental falls are one of the most dangerous for senior citizens [2], [3]. Falls can cause serious injuries, permanent disability, or even death if immediate medical care is not sought. Similarly, sudden irregular body movements or sudden spikes in body temperature can be symptoms of critical health conditions that need immediate medical attention. Studies have revealed that combining fall detection with real-time location and notification systems can greatly enhance the effectiveness of emergency responses [4], [11].

Although IoT-based fall detection systems have made tremendous progress in recent years [5], [9], existing fall detection systems still have limitations in terms of communication reliability and multi-level notification systems. Thus, there is a great need for a smart emergency monitoring system that can provide long-range communication, immediate notification, and accurate patient tracking.

1.2 Limitations of Existing Emergency Monitoring Systems

There have been several designs of wearable fall detection systems based on accelerometers, pressure sensors, and intelligent algorithms [6], [7]. Although these designs show promising detection accuracy, most of them are based on smartphone connectivity or single-channel alert notification systems, which may not work during critical emergency situations.

Recent IoT-based healthcare monitoring systems have tried to combine fall detection with alert notification systems [8], [10]. However, some of these systems do not support multi-layered communication systems like simultaneous SMS, phone calls, cloud notifications, and audio notifications. In practical healthcare applications, using only one form of communication can increase the chances of delayed medical support.

Moreover, some of these systems are only focused on fall detection without incorporating real-time GPS location tracking, which is necessary for providing immediate medical assistance [11]. Scalability, communication reliability, and continuous monitoring are also some of the real-world challenges of IoT healthcare system implementations [12].

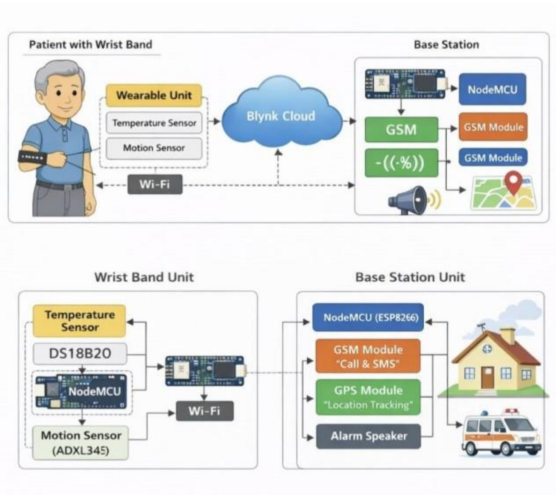

Fig. 1 : Overall Architecture of Lifelink Emergency Monitoring System

1.3. Research Contributions

To address these issues, this research work introduces Lifelink: Smart IoT Emergency Health Support System, a cloud-integrated and long-range emergency health monitoring system that aims to offer real- time health monitoring and multi-channel alert notifications. The proposed system uses three NodeMCU (ESP8266) devices that are interconnected through the Blynk cloud platform via Wi-Fi connectivity, allowing the devices to communicate over long ranges wherever internet connectivity is available.

The wearable device continuously tracks body temperature using a DS18B20 temperature sensor and fall-like motion using an ADXL345 accelerometer. Once an abnormal health condition is detected based on predefined thresholds, the system changes the value of a virtual cloud pin to send emergency alert notifications. At the base station, the system uses a GSM module for sending SMS notifications and making phone calls to pre-defined contacts, as well as a GPS module for sending real- time location updates as a Google Maps link. Moreover, the system uses an audio alert module to provide immediate local notifications to nearby caregivers.

Through the integration of wearable health monitoring, IoT communication, GSM alert notification, GPS location tracking, and audio alert notification systems, the proposed system provides reliable and multi-layered emergency health support. The system is cost-effective, scalable, and can be applied to various settings, including elderly care, hospital care, and home healthcare. Future works may include the use of AI-powered fall detection algorithms based on lightweight neural networks [7], and advanced health analytics for enhanced health monitoring accuracy.

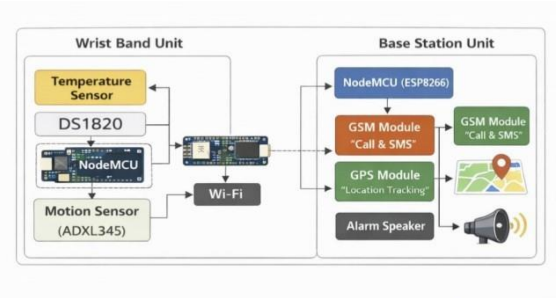

Fig. 2 : Hardware Block Diagram of Wearable and Base Station Units

2. LITERATURE SURVEY

The explosive growth of the Internet of Things has completely transformed the way we track health. There is a growing body of literature that focuses on wearables and intelligent monitoring to keep especially vulnerable seniors safer from falls and unexpected health problems.

Abdulmalek et al. suggested an IoT-based healthcare monitoring system that aimed to improve the quality of life by continuously monitoring health. This study demonstrates that integrating sensors with cloud technology facilitates real-time monitoring and rapid medical intervention. Likewise, Zhang et al. presented a thorough review of an IoT-based medical management system, emphasizing the need for data management, remote monitoring, and intelligent healthcare infrastructure.

Fall detection is one area that has been extensively explored in the field of senior care. Newaz conducted a review of IoT- based fall detection systems for seniors and emphasized that early detection can significantly lower the severity of injuries and increase the chances of survival. Ramachandran et al. examined wearable fall detection systems and emphasized the benefits of accelerometer-based systems that are inexpensive and easy to implement.

Recently, more sophisticated techniques for fall detection have been developed. Tseng proposed a wearable system that enhances emergency response by integrating real-time locationing and immediate notifications. Kaur discussed contemporary fall detection techniques, highlighting the difficulties of implementing them in practical scenarios. Yu et al. proposed a TinyCNN-based wearable fall detection system that employs miniature neural networks to enhance accuracy and conserve energy.

Some researchers have focused on sensor fusion to enhance accuracy. One such example is a wearable IoT system that integrates a barometric pressure sensor and a three-axis accelerometer, which enhanced accuracy in fall detection. To simplify emergency notification, IoT platforms such as an ESP32-based fall detection and notification system for caregivers and other IoT patient notification systems have integrated sensing with automated SMS notifications.

Location tracking is identified as a critical component for providing timely emergency medical assistance. The GPS fall detection system described in another research study highlights the importance of providing caregivers and emergency personnel with real-time location information, even when fall detection occurs.

Although the technology for wearable fall detection and IoT healthcare has progressed, many existing systems today rely on a single communication channel, limited notification systems, or a smartphone. In genuine emergency situations, such limitations can work against reliability. Some systems also focus narrowly on fall detection without considering temperature measurement or complex notification systems.

There, therefore, exists a need for a more reliable, comprehensive emergency health support system that combines wearable sensing, cloud connectivity, GSM communication, GPS, and local audio notifications. The LIFELINK solution addresses these issues by providing multi- channel emergency notifications and long- range communication, striving for faster and more reliable medical help.

3. PROPOSED METHODOLOGY

The Lifeline: Smart IoT Emergency Health Support System is based on a wearable device and a remote base station that pushes instant emergency notifications and monitors health in real-time. The system is based on multi-level alarms, cloud messaging, and constant updates from health sensors to provide a reliable emergency response.

The system consists of two primary components: a wearable wristband and a base station, which are connected through the Blynk cloud service via Wi-Fi connectivity.

3.1 Wearable Wrist Band Unit

This wearable wristband continuously monitors various health-related parameters. It comprises:
- NodeMCU (ESP8266)
- DS18B20 temperature sensor
- ADXL345 accelerometer for fall detection

The DS18B20 sensor continuously measures the body temperature. If it exceeds a certain safe limit, a possible health problem is indicated. At the same time, the ADXL345 sensor detects any sudden motion or unusual body position to indicate a possible fall.

NodeMCU analyzes the sensor data in real-time. If any abnormality is found, the system instantly updates a virtual pin on the Blynk cloud service. The base station receives this cloud update as a trigger signal.

3.2 Cloud Communication Mechanism

Communication between the wearable device and the base station is facilitated through the Blynk cloud service. When the wearable device indicates an abnormal situation, it sends an alert notification to the cloud through Wi-Fi connectivity. The base station continuously checks this cloud signal.

Cloud connectivity enables the system to work over long distances provided there is internet connectivity, thus ensuring that communication between the patient and base station is not interrupted even if they are not in the same area.

3.3 Base Station Unit

Located in a central monitoring area or outside the house, the base station consists of:
- NodeMCU (ESP8266)
- GSM module
- GPS module
- Speaker for audio alerts

After receiving an emergency notification from the cloud, the base station sends out various alerts. The GSM module automatically dials the number of emergency services (ambulance) and sends out SMS notifications to two family members, thus ensuring that professional help and loved ones are notified immediately.

The GPS module also sends out the patient's location at that time as a Google Maps link, thus enabling the ambulance to reach the patient quickly.

3.4 Emergency Detection and Alert Flow

In summary, the system is always on the lookout:
- Sensors monitor temperature and motion.
- NodeMCU receives and interprets the data.

If it appears to be an emergency:
- The Blynk cloud is updated.
- An alert is sent to the base station.

GSM module operations:
- Sends an SMS to Family Member 1.
- Sends an SMS to Family Member 2.

- Triggers an ambulance call.
- The GPS module sends the current location.
- The speaker sounds the emergency alarm.
- This multi-level alert system enables faster response times and increases reliability.

3.5 System Advantages This

configuration provides:
- Real-time monitoring
- Long-range communication
- Multi-modal alerts
- Automatic ambulance alert
- Location tracking capability
- In-region audio warning system

The system is cost-effective, scalable, and designed for hospital care, home healthcare, and senior care.

4. RESULT

The emergency detection and notification feature of the Lifelink system was tested using various real-time scenarios. The system consisted of a wearable wristband and a remote base station that was linked using the Blynk cloud platform. Various scenarios were created to test the system's reaction to them, including sudden hand movement, fall simulation, and above- normal temperatures.

During the testing process, the temperature sensor functioned effectively to monitor body temperature, which sent notifications whenever the values exceeded the set threshold. The motion sensor also detected abnormal movements and patterns that were similar to falls. Whenever a fall simulation exceeded the set limit in the accelerometer values, the system immediately updated the cloud platform.

Fig.3 : Wrist Band which consists of Temperature and NIM Sensor

There was no delay when the cloud warning alarm went off. The GSM module initiated an emergency call and sent SMS notifications to the two family members who had been predetermined. The GPS module located the patient's exact position and transmitted it as a Google Maps link so that the emergency personnel or caregivers could easily locate the patient.

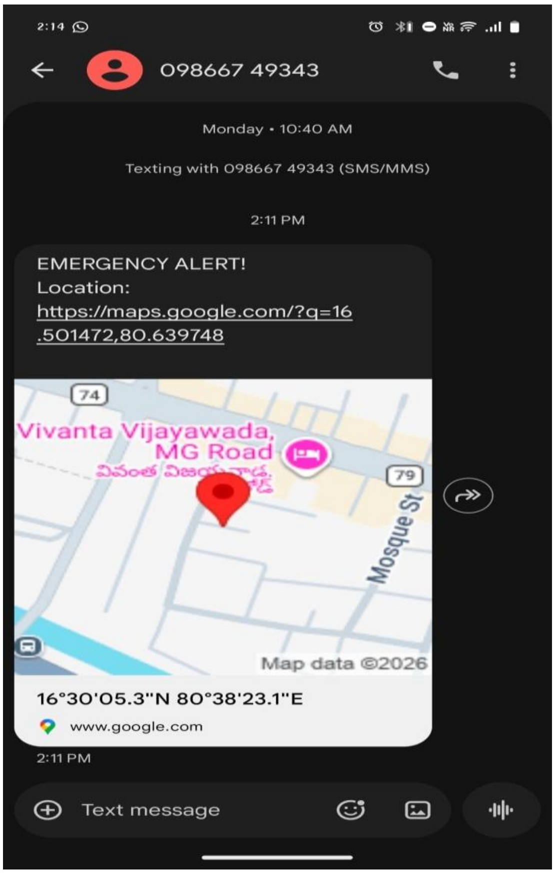

Fig. 4 : SMS Screenshot

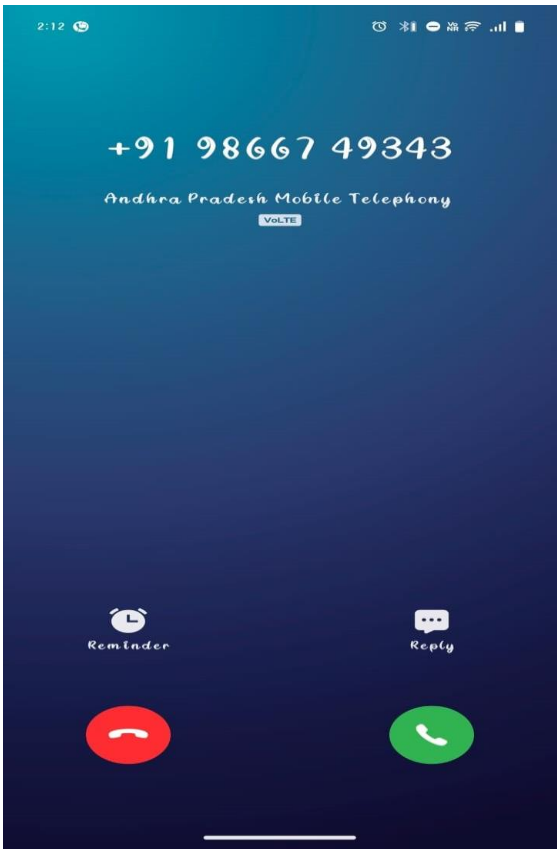

Fig. 5 : Call Screenshot

In addition, the speaker functioned exactly as expected, broadcasting an emergency audio alert continuously to make sure that everyone in the surrounding area was notified immediately. The reliability of the system was greatly improved by incorporating SMS notifications, calls, GPS, and audio alerts.

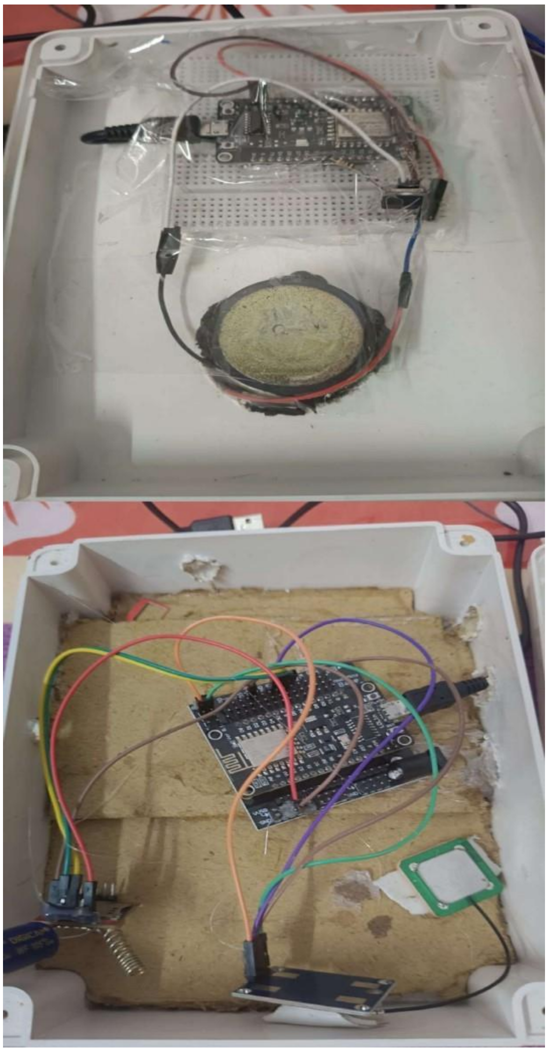

Fig. 6 : Base Station which consists of GPS and GSM Modules

When internet connectivity was available, the system remained in contact mostly through Wi-Fi and cloud connections. Its multi-layer alert system configuration ensured quicker responses and fewer chances of missed alerts. The prototype ensured low power consumption without compromising functionality, thus making it practical for use.

The results indicate that the proposed Lifelink system is capable of offering reliable emergency notifications and real- time health surveillance. It improves patient safety by combining sensing and communication technologies, which overcome the limitations of single-channel alerting systems.

5. CONCLUSION

The Lifelink: Smart IoT Emergency Health Support System was designed to meet the increasing demand for a trustworthy and real-time emergency health monitoring system, particularly for the elderly and patients who need constant surveillance. Falls, unusual body movements, and unexpected rises in body temperature can be fatal if urgent assistance is not sought. The goal of this project was to minimize response time and ensure patient safety with a smart, networked health monitoring system.The system successfully combines a wearable wrist band unit with a remote base station via cloud communication. The wearable unit continuously tracks temperature and motion, and when an unusual situation is detected, it immediately sends out an alert signal through the Blynk cloud service. The base station immediately launches several emergency response systems, including the transmission of SMS alerts to relatives, the initiation of a call to the ambulance service, the sharing of real-time GPS location, and the broadcasting of an audio alarm signal to alert others in the vicinity.The outcome of the project clearly shows that the system is dependable, cost-effective, and capable of launching multi-layered emergency notifications. With its wearable sensor technology, Wi-Fi connectivity, GSM notification systems, GPS location sharing, and audio warning signals, the LIFELINK system provides faster and more reliable emergency support. The project clearly illustrates that IoT-based health monitoring can greatly enhance patient safety and quality of life.The system can be improved in the future by incorporating other health parameters such as heart rate and SpO2 monitoring, as well as AI-powered fall detection to enhance accuracy. With further development, this system has great potential for implementation in senior care, home health care, and hospital health monitoring settings.

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