IOT And AI Personal Security Monitoring

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ABSTRACT

SafetyNet is an intelligent personal security monitoring system that integrates IoT and AI technologies to provide real-time safety tracking and alert generation. The system is designed as a wearable device equipped with an NodeMCUmini microcontroller, sound sensor, MPU6050 accelerometer and gyroscope, GPS module, and a panic button. These sensors continuously monitor the wearer's surroundings and physical conditions such as sudden movement, abnormal sound levels, or manual panic activation. The collected data, including location and sensor readings, is transmitted to the Thing Speak cloud platform via Wi-Fi for real-time storage and monitoring. The cloud-stored data is then analyzed using machine learning algorithms on a laptop to identify abnormal patterns or possible danger situations. When an anomaly or emergency condition is detected, the system automatically sends instant alerts through Telegram to the registered contacts such as parents or police authorities, along with the user's real-time GPS location. By combining continuous IoT-based monitoring with intelligent AI-driven analysis, SafetyNet aims to provide an effective and proactive approach to personal safety, especially for women, children, and elderly individuals, ensuring timely assistance in emergency situations.

Keywords: Safety, IOT, Security, AI, Wearable, Monitoring, Emergency, Tracking, Alert Protection.

1. INTRODUCTION

Personal safety has become a critical concern in modern society, particularly for vulnerable groups such as women, children, and elderly individuals. Despite advancements in communication technologies and the availability of emergency helplines and mobile safety applications, incidents of harassment, assault, sudden health emergencies, and accidents continue to rise. Many existing safety solutions depend heavily on manual user intervention, which may not be possible during sudden attacks, unconsciousness, or medical emergencies. This limitation highlights the urgent need for an intelligent, automated, and reliable personal safety system.

With the rapid growth of the Internet of Things (IoT) and Artificial Intelligence (AI), it has become feasible to design smart systems capable of continuous monitoring, real-time data analysis, and intelligent decision-making. IoT enables the integration of multiple sensors to collect real-time information about a user's physical condition, movement, and surroundings, while AI techniques allow meaningful interpretation of this data to detect abnormal or dangerous situations. By combining these technologies, personal safety systems can move beyond traditional reactive approaches and offer proactive protection.

SafetyNet is an intelligent wearable personal security monitoring system that leverages IoT and AI to provide real-time safety tracking and automatic emergency alert generation. The system integrates multiple sensors—including motion, sound, health, and location sensors— controlled by a NodeMCU microcontroller. These sensors continuously monitor parameters such as body movement, heart rate, body temperature, ambient sound

levels, and geographical location. The collected data is transmitted wirelessly to a cloud platform for storage and realtime visualization.

To enhance reliability and reduce false alarms, the system employs a machine learning– based Random Forest model to analyze sensor data and identify abnormal patterns that indicate emergency situations. Upon detecting a critical event such as a sudden fall, abnormal health condition, panic situation, or distress signal, the system automatically generates alerts and sends notifications along with the user's live GPS location to registered contacts or authorities. By integrating continuous IoT-based sensing with AI-driven intelligence, SafetyNet aims to provide a proactive, efficient, and scalable solution for personal safety, especially for women.

In today's fast-paced world, ensuring personal safety has become as important as ensuring physical health and well-being. Increasing work pressure, late-night travel, and isolated living conditions further expose individuals to unforeseen risks. In such scenarios, immediate detection of danger and rapid communication with emergency contacts play a crucial role in minimizing harm and saving lives. Hence, modern safety systems must be capable of operating continuously, independently, and intelligently without demanding constant user attention.

Wearable technology offers an effective platform for implementing such safety solutions, as it allows continuous monitoring while being non-intrusive and portable. Unlike mobile phone–based applications, wearable devices remain active at all times and are less dependent on user interaction. When combined with cloud computing, these devices enable remote monitoring, long-term data storage, and real-time access to safety information from anywhere in the world.

Furthermore, the integration of machine learning enhances the system's ability to adapt to different users and real-world conditions. Human activities and physiological parameters vary from person to person, making fixed threshold-based systems unreliable. AI-driven models learn from historical data and recognize complex patterns across multiple sensor inputs, resulting in improved accuracy and reduced false alerts. This intelligent behavior is essential for safety-critical applications where reliability and timely response are paramount.

The proposed SafetyNet system is designed with scalability, affordability, and practical deployment in mind. Its modular architecture allows easy addition of new sensors and features in the future, such as mobile app integration or advanced analytics. By combining IoT connectivity, cloud platforms, and AI-based decision-making, SafetyNet represents a significant step toward next-generation personal safety systems that are proactive rather than reactive, reliable rather than manual, and intelligent rather than rule-based.

Another important aspect of personal safety systems is real-time responsiveness. Delayed detection or communication during emergencies can significantly reduce the effectiveness of rescue efforts. By using cloud-based platforms, real-time sensor data can be accessed instantly by authorized users, caregivers, or emergency responders. Cloud connectivity also supports data logging and visualization, which helps in analyzing past incidents and improving system performance over time.

The use of sensor fusion is a key feature of intelligent safety systems. Relying on a single sensor often leads to inaccurate results due to noise or temporary disturbances. By combining motion sensors, health monitoring sensors, sound sensors, and GPS data, the system can make more informed decisions. For example, a sudden fall combined with abnormal heart rate and high sound intensity strongly indicates an emergency situation, whereas any single parameter alone may not. This multi-sensor approach improves reliability and robustness.

2. LITERATURE REVIEW

Wagh et al. – IoT-Based Smart Safety System Using Machine Learning for Women and Children Wagh et al. proposed an IoT-enabled wearable safety system aimed at enhancing personal security for women and children. Their work focused on integrating physiological sensors such as heart rate and temperature sensors along with motion sensors and GPS for realtime monitoring. Machine learning algorithms including Support Vector Machines (SVM) and Naive Bayes were used to classify stress and abnormal activity patterns. The system demonstrated high detection accuracy and low response time, highlighting the effectiveness of AI-driven analysis in automated emergency detection.

Pathak et al. – Smart Shield: ESP8266-Based Wearable Fall Detection and Health Monitoring System Pathak et al. developed a wearable safety belt using an ESP8266 microcontroller to detect falls and monitor health parameters. The system utilized an MPU6050 accelerometer for motion detection and integrated heart rate and SpO_2 sensors for health monitoring. Embedded machine learning techniques were applied to classify fall events, and GPS was used for real-time location tracking. The study emphasized reducing false alarms through alert cancellation features and demonstrated the feasibility of wearable safety systems on resource-constrained hardware.

Sundar Bhuvaneswari et al. – Wearable Technologies for Assault Detection and Personal Safety Sundar Bhuvaneswari et al. presented a comprehensive review of emerging wearable technologies for assault detection and personal safety applications. The study analyzed various IoT-based wearable devices, mobile applications, and AI techniques used to improve real-time safety monitoring. The authors highlighted the importance of sensor fusion, automated alert generation, and intelligent pattern recognition in enhancing the effectiveness of personal safety systems.

Riahi et al. – IoT-Based Fall Detection Using Machine Learning Techniques Riahi et al. proposed an IoT-based fall detection system primarily designed for elderly safety but applicable to general personal security. The system combined motion analysis with machine learning algorithms such as Random Forest to accurately detect fall events. Real-time alerts were sent to caregivers using online messaging platforms.

Abedi et al. (2025) Abedi et al. conducted a review on the application of artificial intelligence in wearable health monitoring systems. The research discussed challenges related to continuous data collection, real-time processing, and hardware constraints in wearable devices. The study emphasized that AI-driven analysis enables early detection of abnormal health conditions and supports intelligent decision-making, which is crucial for safety-critical applications.

3. PROPOSED METHOD

The proposed method follows a systematic approach that integrates IoT-based sensing, cloud computing, and machine learning to ensure effective personal safety monitoring. The wearable device continuously collects real-time data related to body movement, health parameters, ambient sound, and location using multiple sensors. A NodeMCU microcontroller acts as the central unit, coordinating sensor data acquisition and managing wireless communication.

The collected sensor data is transmitted to a cloud platform through Wi-Fi connectivity for real-time storage and visualization. Cloud integration allows continuous monitoring and provides a reliable medium for accessing both live and historical data. Before analysis, the data is preprocessed to remove noise, normalize sensor readings, and extract meaningful features that represent user behavior and environmental conditions.

Machine learning techniques are then applied to analyze the processed data and detect emergency situations. A Random Forest classifier is trained using labeled datasets representing normal and abnormal conditions. During real-time operation, incoming sensor data is classified by the trained model. When an emergency is detected, the system automatically triggers alerts and sends notifications along with live GPS location details to registered contacts or authorities, ensuring quick response and enhanced personal safety.

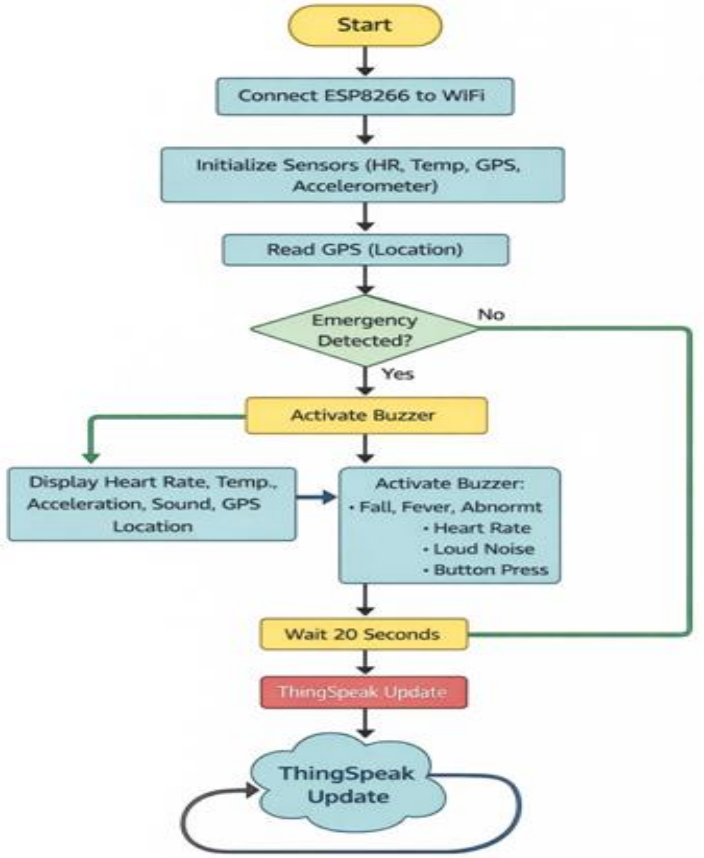

Figure 1: Flow of the Proposaed Model

4. RESULTS AND DISCUSSION

The SafetyNet intelligent personal security monitoring system was successfully implemented and evaluated to verify its effectiveness in detecting emergency situations using IoT and AI technologies. The integrated sensor module continuously collected real-time data related to motion, sound intensity, heart rate, body temperature, and location. This data was transmitted to the ThingSpeak cloud platform and later analyzed using the Random Forest machine learning model. The trained model demonstrated reliable performance in distinguishing between normal and abnormal conditions, confirming the feasibility of using machine learning for real-time personal safety monitoring.

The Random Forest model showed high accuracy in identifying emergency scenarios such as sudden falls, abnormal heart rate conditions, and panic button activation. By combining multiple sensor inputs, the system reduced false alarms that commonly occur in thresholdbased systems. The cloud visualization provided clear insights into real-time sensor trends, and alert generation was triggered instantly when abnormal patterns were detected. The inclusion of GPS data ensured that every alert contained precise location information, enabling quick response from registered users or authorities.

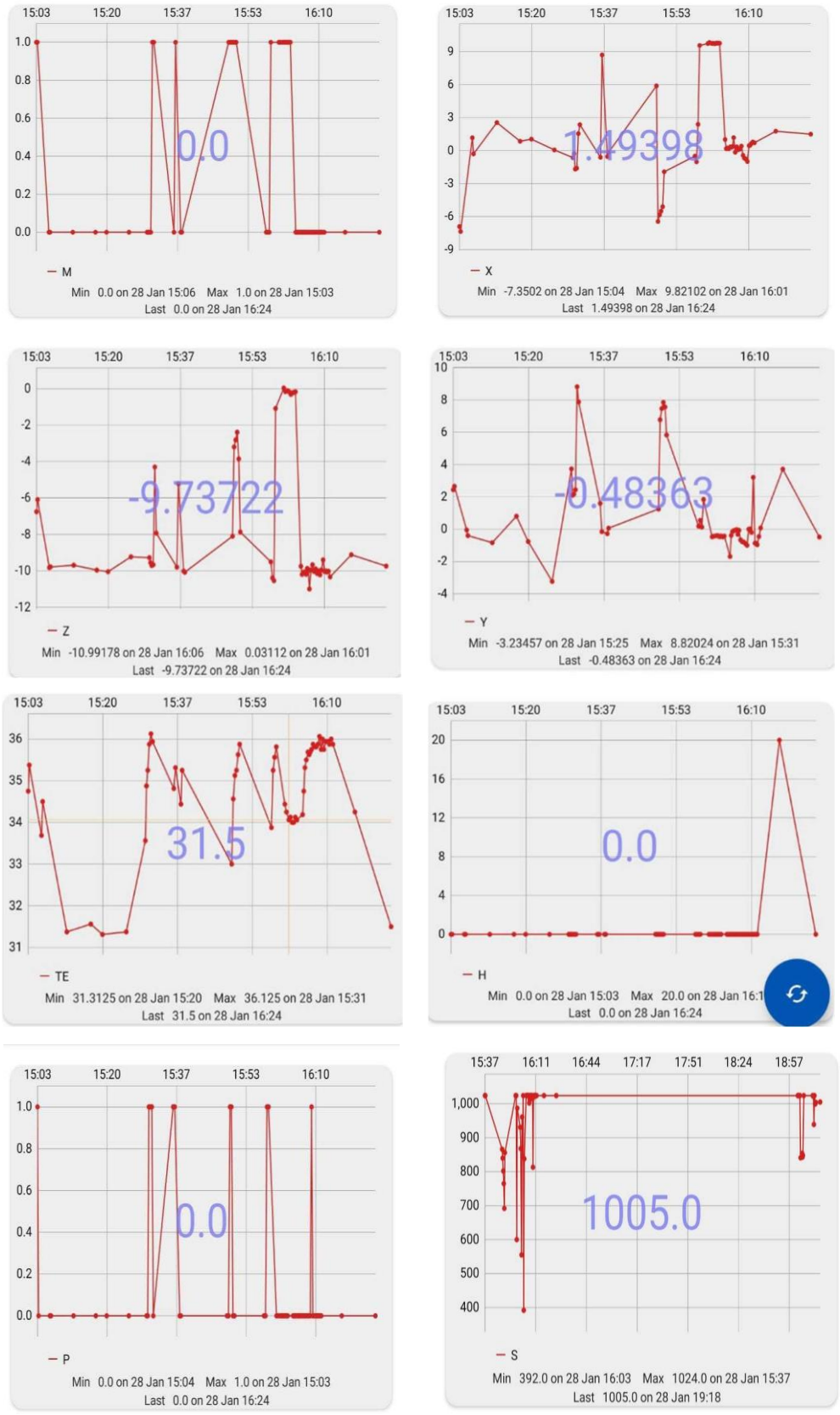

Figure 2 : Real-Time Sensor Data Visualization on ThingSpeak

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Starting real-time prediction (every 10 seconds)...
{'button_status': 0.0, 'fall_status': 0.0, 'acceleration_x': 1.49398, 'acceleration_y': -0.48363, 'acceleration_z': 0.7372200000000007, 'sound_sensor': 1
024.0}
Prediction: 0 | Confidence: 0.51
NORMAL
{'button_status': 0.0, 'fall_status': 0.0, 'acceleration_x': 1.49398, 'acceleration_y': -0.48363, 'acceleration_z': 0.7372200000000007, 'sound_sensor': 1
024.0}
Prediction: 0 | Confidence: 0.51
NORMAL
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Figure 3: Random Forest Model Output – Normal vs Emergency Detection

Figure 4: Emergency Alert Notification with GPS Location

This Figure4 shows the emergency alert notification generated when an abnormal condition is detected by the system. The alert includes a warning message along with the user's live GPS location displayed on a map. The figure demonstrates the system's capability to automatically notify registered contacts or authorities. This result validates the timely alert generation and accurate location-sharing functionality of the proposed system.

CONCLUSION

The SafetyNet project successfully demonstrates the integration of Internet of Things (IoT) and Artificial Intelligence (AI) to create an intelligent personal security monitoring system capable of real-time safety tracking and emergency alert generation. By utilizing a wearable device equipped with multiple sensors such as an accelerometer, sound sensor, heart rate and temperature sensor, GPS module, and a panic button, the system continuously monitors both the physical condition of the user and their surrounding environment.

The collected sensor data is efficiently transmitted to the ThingSpeak cloud platform, enabling real-time visualization and remote monitoring. The use of a Random Forest machine learning model significantly enhances the system's ability to detect abnormal situations accurately by analyzing multi-sensor data patterns rather than relying on fixed threshold values. This approach reduces false alarms and improves reliability in real-world conditions. The system is capable of automatically generating instant alerts along with real-time GPS location information, ensuring timely assistance from guardians or authorities. Overall, SafetyNet provides a scalable, reliable, and proactive personal safety solution, particularly beneficial for women, children, and elderly individuals. The project highlights the effectiveness of combining IoT-based continuous monitoring with AI-driven intelligence to improve personal security and emergency response systems.

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