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Elder Connect

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Abstract: Elder Connect is a smart health monitoring system created to support elderly individuals in their daily lives. Using wearable sensors, it keeps track of key health indicators like heart rate, body temperature, and movement. It also includes GPS technology to monitor the person's real-time location, helping caregivers and family members stay connected and reassured. In emergencies, the system automatically sends out alerts, ensuring that help can arrive quickly when it's needed most.By leveraging Iot and cloud computing, Elder Connect aims to provide a seamless, efficient, and cost-effective solution to enhance the safety, independence, and overall well-being of elderly individuals.

Keywords: Elder Connect, IoT, Health monitoring, Tracking system, Elderly individuals.

I. INTRODUCTION

As the global population grows older, ensuring the health and well-being of elderly individuals has become more important than ever. Many older adults face ongoing health challenges, such as chronic conditions, reduced mobility, or memory issues, that require constant attention and timely medical support. Traditional caregiving methods, however, often fall short when it comes to real-time health monitoring, which can lead to delays in treatment and increased risks. That's where Elder Connect comes in. It's a smart, connected system designed to keep a close watch on vital health indicators and quickly alert caregivers or healthcare providers when something needs attention. By combining wearable sensors with powerful cloud-based analytics, Elder Connect helps deliver fast, personalized care, giving seniors greater safety, comfort, and peace of mind in their daily lives.

A. System Architecture

At the heart of the system is the Wearable Device Layer, which features a range of sensorsincluding heart rate monitors, temperature sensors, motion detectors (like accelerometers and gyroscopes), and a GPS module—all connected to a central microcontroller. Worn by the soldier, these devices work around the clock to gather vital health and location data. This information is then made accessible through the Monitoring and Control Layer, which provides easy-to-use interfaces for commanders, medical teams, and support staff. With real-time web dashboards and mobile apps, they can monitor each soldier's condition and location instantly, ensuring timely decisions and support when it's needed most.

B. Problem Statement

Elder surveillance systems, while offering the benefits of adaptability and judgment, also have several drawbacks. Human operators can be prone to fatigue, error, and bias, potentially leading to inaccurate assessments or missed threats. They are also limited by their physical and cognitive capabilities, restricting their ability to continuously monitor large areas or process complex information. Additionally, human surveillance relies on personnel, which can be expensive to train, equip, and maintain, and may be subject to vulnerabilities such as capture, injury, or psychological stress.

C. Proposed System

The Health Monitoring and Tracking System for the Elderly Using IoT aims to enhance the safety and well-being of elders during operations by continuously monitoring their health metrics and providing real-time location tracking. The system utilizes wearable devices with sensors to track heart rate, body temperature, and movement. This data is then sent to a central cloud platform or command center for analysis. In case of abnormal readings, automatic alerts are triggered, enabling immediate intervention by medical personnel. This system improves mission success by allowing proactive health management, optimizing resource allocation, and ensuring timely responses to health emergencies.

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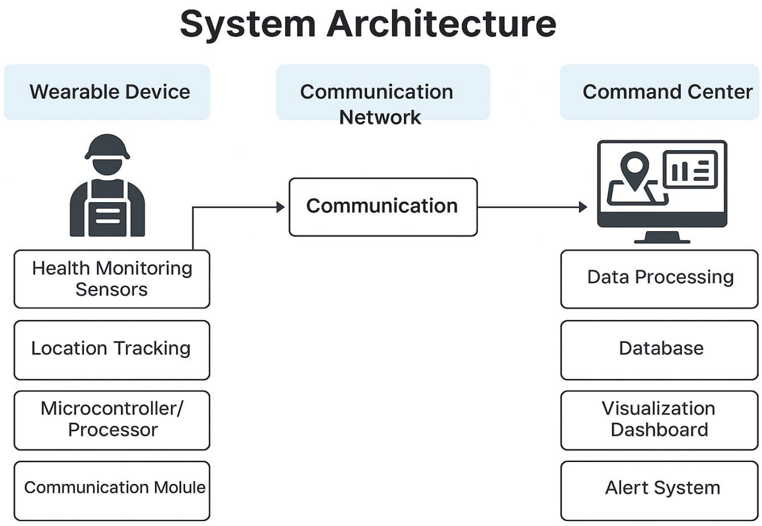

Fig. 1. System Architecture

II. RELATED WORK

Several research efforts and technological developments have been aimed at enhancing the safety, health monitoring, and situational awareness of soldiers in real-time. Previous systems have incorporated wearable sensors to monitor vital signs such as heart rate, body temperature, and physical activity, with early models using basic telemetry systems for data collection and manual review. More recent work has leveraged advancements in the Internet of Things (IoT), wireless communication, and cloud computing to create more responsive and scalable solutions. For instance, studies have proposed GPS-enabled tracking combined with health data monitoring to provide a comprehensive picture of a soldier's condition and location during missions. Research by defense institutions and academic groups has also explored the integration of machine learning algorithms to predict potential health risks based on sensor data trends.[1] Ensuring continuous and reliable health monitoring of elderly individuals is essential to prompt medical intervention in emergency situations. This article presents the research conducted within the framework of edge-computing-enabled Internet of Things (IoT) systems, aimed at enhancing remote elderly health monitoring. The study focuses on the integration of low-power wearable sensors with edge computing devices to collect and process physiological signals such as heart rate, blood pressure, and body temperature in real-time. The system's architecture is designed to analyse data directly on the device, which helps reduce delays and lowers the need for constant data transmission, without compromising accuracy. By using machine learning algorithms at the edge, the system can quickly detect warning signs of serious health issues. It also uses smart sampling techniques to conserve battery life, making the devices more efficient and longer-lasting. Tests showed that the system can spot early signs of health problems with very little delay. As outlined in this article, these results mark a meaningful step forward in smart healthcare, especially for supporting safer and more independent living for elderly individuals in remote or hard-to-reach areas.[2]

Recent advancements in Micro-Electro-Mechanical Systems (MEMS), integrated circuits, and wireless communication have paved the way for Wireless Body Area Networks (WBANs). These networks enable seamless, long-term health monitoring and deliver real-time patient status updates to healthcare providers. WBANs have gained widespread adoption in healthcare, entertainment, and military domains. This paper explores the fundamental aspects of WBANs across various applications, presenting an infrastructure designed to handle on-demand, emergency, and routine data traffic. Additionally, we examine in-body antenna configurations and energy-efficient MAC protocols tailored for WBANs. Moreover, we highlight several WBAN applications with relevant examples, emphasizing the need for innovative power-efficient solutions for both in-body and on-body sensor networks.[3]

Researchers have made various efforts to improve healthcare monitoring systems, especially for vulnerable groups like the elderly. Kumar and Garg (2022) proposed a wearable IoT-based healthcare monitoring system designed to continuously track vital signs and detect health anomalies in real time. The system utilizes lightweight, non-intrusive wearable sensors to collect physiological data, such thatheart rate, temperature, and oxygen saturation, which are then transmitted via secure wireless protocols to a centralized monitoring server. Special emphasis is placed on user privacy and data integrity, with encryption mechanisms implemented to prevent unauthorized access to sensitive health information. To notice the challenges of continuous monitoring, the system employs an adaptive alert mechanism and real-time analytics to notify caregivers and medical personnel during critical health events. Furthermore, the framework supports remote monitoring, enabling elderly individuals to maintain independence while ensuring a timely medical response. The proposed system marks a significant contribution to the development of reliable and secure IoT-based healthcare solutions tailored for aging populations. The Internet of Things (IoT) is revolutionizing how organizations communicate and manage daily operations across various industries. Its integration has proven highly effective in sectors that handle numerous assets and complex, distributed processes.

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This study explores the significant potential of applying IoT technologies, such as data-driven applications, embedded automation, and intelligent adaptive systems, to transform modern warfare and deliver similar benefits as seen in industrial sectors. It highlights how the Defense and Public Safety (PS) sectors could harness advanced commercial IoT capabilities to improve survivability for soldiers or first responders, while also cutting costs and boosting operational efficiency and effectiveness.[5] Wireless Body Area Networks (WBANs)utilize sensors placed on or within the human body to monitor health conditions. Efficient energy management of these sensors, while maintaining optimal performance, presents a significant challenge. To extend network longevity, energy-efficient routing strategies are developed. This paper introduces a routing protocol designed to assess soldier fatigue. Three sensors are strategically positioned on the soldier's body to track key parameters. The proposed protocol operates on an event-driven mechanism, considering all three distinct scenarios for fatigue evaluation. Our study assesses the protocol’s effectiveness in terms ofnetwork lifespan, data throughput, sensor energy retention, and fatigue measurement accuracy.[6]

N. Swetha and T. Sreenivasulu Reddy submitted a work titled "IoT-Based Healthcare and Monitoring Systems for the Elderly," which focuses on leveraging IoT technology to enhance continuous health surveillance for aging populations. The proposed system is engineered to monitor vital health parameters such as pulse rate, body temperature, and blood oxygen levels in real time using wearable biomedical sensors. These sensors communicate with a central server via wireless protocols, enabling seamless transmission of health data. The architecture supports remote access and monitoring through mobile applications, offering both convenience and security. This work contributes significantly to the field of IoT-driven elderly care by ensuring real-time health assessment and facilitating preventive interventions. Mahammad Eliyas recommended producing a paper titled "Health Monitoring and Tracking System for Soldiers" using LabVIEW. They offer a technique that is developed for military applications. This technology continually monitors the health-based concerns and the specific position of the soldier throughout combat time. Soldiers always lost their liveson war battlefield owing to bad communication. It is necessary to know the health state as well as the position or the base station. Pavan Kumar [3] "Health Monitoring and Tracking of Soldiers Using GPS" was the study that he was assigned. Medical staff and center personnel may also determine the patient's exact location and provide the necessary medical care by using Google Maps and online apps on the server. The base station will be able to detect the soldier's exact position using GPS-provided SMSs, and their health condition will be established using GSM-provided SMSs. Additionally, they utilized a Google Map, which reveals the soldier's whereabouts. [8]

R. Shaikh et al. [9] presented a Synchronous Monitoring platform with ARM processing capabilities for patients’ temperature, heartbeat, and Cardiac waveform characteristics,incorporating ZigBee and GSM wireless solutions to relay updates to doctors for immediate action.To resolve the problems, our proposed system is divided into two units: the Soldier wearable IoT technology, or Smart ensemble, and the Centralized control station. A Google Maps-based approach was introduced for tracking the user's personnel location or Troop coordinates. Since these systems face challenges such as costly implementation, delayed response, and the use of various biomedical sensors for observing a soldier's health parameters and surrounding environmental conditions. It utilizes Physiological parameter detectors, or Temperature, Pulse, and O2 level detectors, specifically called LM35, pulse tracker, and oxygen concentration probe, for continuous health inspection of soldiers. [9] The study, "Internet of Things (IoT) Monitoring System for Elderly," [2018], which was published in the IEEE Journal of Embedded Systems, introduces an innovative approach to elderly healthcare management using IoT-enabled technologies. The system is built toprovide real-time health monitoring and environmental sensing for elderly individuals, aiming to support independent living with enhanced safety. Utilizing microcontrollers such as Raspberry Pi and Arduino, the system integrates biomedical sensors to measure critical parameters such as heart rate and body temperature, and fall detection. Wireless communication modules enable seamless transmission of data to a centralserver or a caregiver’s mobile device. The architecture is further equipped with emergency alert functionality, activating notifications when abnormal health readings are detected. The results demonstrate effective real-time monitoring and the delivery of timely alerts during test scenarios. Future enhancements, including AI-powered health prediction models and improved sensor integration, are proposed to further optimize its performance. [10]

III. IMPLEMENTATION

A. Implementation

The "Elder Connect" system was implemented using the ESP32 microcontroller due to its built-in Wi-Fi and Bluetooth capabilities, enabling wireless data transmission. A DS18B20 temperature sensor and a pulse sensor were connected to monitor body temperature and heart rate in real time. The NEO-6M GPS module was integrated via UART to track the user’s location during emergencies. A push button was added to allow the elderly user to send emergency alerts manually. An active buzzer provided audio notifications for critical health conditions. A 16x2 LCD display was used to show live readings of temperature and pulse. The system was programmed by using Arduino IDE with relevant libraries for each component. Alerts and location data were transmitted through a Telegram bot to ensure quick caregiver response.

B. Module description

1. The Fig. 2 ESP32 module is a compact, single-chip solution that integrates 2.4 GHz Wireless technologies such as Wi-Fi and Bluetoothconnectivity. Built using TSMC's ultra-low power 40 nm technology, it is optimized to deliver exceptional power efficiency, robust RF performance, and versatile functionality.

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Designed for reliability across diverse applications and power profiles, the ESP32 is especially well-suited for use in mobile devices, wearable technology, and Internet of Things (IoT) applications.

Fig. 2. ESP32 Wi-Fi Module

2. The Fig. 3 Heart Rate Sensor is a versatile and user-friendly device designed for monitoring heart rate accurately and efficiently. This sensor is often utilized in health monitoring systems, wearable devices, fitness applications, and academic projects. Below is an overview of its key features, working principles, and applications.

Fig. 3. Heart Rate Sensor

3. The Fig 4 DS18B20 Temperature Sensor is connected to the ESP32 via a digital pin.A sensor is used to measure the user's body temperature accurately. It provides digital output, which simplifies the reading and conversion process. The sensor supports one-wire communication, enabling multiple sensors on the same data line. The measured temperature is then sent to the ESP32 for real-time processing and display.

Fig. 4. DS18B20 Temperature Sensor

4. The Fig. 5 Emergency Push Button is a digital input device connected to one of the ESP32's GPIO pins and is used to trigger emergency alerts. When the button is pressed, it sends a signal to the microcontroller, indicating a distress situation. The ESP32 then activates the emergency protocol by sending a message via the Telegram bot. This helps ensure timely assistance in critical situations.

Fig. 5. Emergency Push Button

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5. The Fig.6Global Positioning System (GPS) is a satellite-based navigation system that delivers location informationand time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites. It is maintained by the state government and is freely accessible to anyone with a GPS receiver. These receivers passively receive satellite signals; they do not transmit and require an unobstructed view of the sky, so they can only be used effectively outdoors.

Fig. 6. GPS Receiver

6. The Fig. 7 16x2 LCD Display shows the user's real-time pulse rate and body temperature, making the system's data visible at a glance. It uses a parallel interface and is connected to the ESP32 through multiple GPIO pins. This display provides a convenient way to monitor vital signs without requiring a separate device. The display updates dynamically based on sensor input for continuous feedback.

Fig. 7. 16x2 LCD Display

III. METHODOLOGY

This study utilizes both primary and secondary sourcesresearch methods to gather data on the elderly's needs and digital inclusion. Surveys and conversations were held with older adults as part of the study, and stakeholders to collect firsthand insights, and data were sourced from government publications, research articles, and related reports. The findings were analyzed qualitatively to identify patterns, challenges, and opportunities for Elder Connect.

A. Hardware components required:

1. Power Supply
2. ESP 32 Wi-Fi Module
3. DS18b20 temperature sensor
4. Heart sensor
5. GPS Receiver
6. Emergency Switch
7. Buzzer
8. LCD Display
9. Switch.
10. Printed circuit board

B. Software components required

1. Arduino IDE
2. Embedded C

IV. RESULTS AND EVALUATION

The Elder Connect system was successfully implemented and thoroughly tested, showing dependable performance across all its integrated components. The DS18B20 temperature sensor provided accurate body temperature readings with only minimal variation, ensuring reliable health monitoring. The pulse sensor effectively detected changes in heart rate, delivering real-time data crucial for identifying any early signs of health issues. The GPS 6M module maintained accurate location tracking, even in areas with moderate obstructions, making it possible to locate users quickly during emergencies. Emergency alerts, activated by a push button, were instantly transmitted to a designated Telegram bot, confirming smooth cloud-based communication and prompt data delivery. In emergency situations, the buzzer offered instant audible alerts, confirming the hardware's responsiveness and drawing the attention of nearby individuals. Notifications sent via Telegram were both timely and well-formatted, ensuring that caregivers received essential updates without confusion or delay. The entire system was efficiently integrated into a compact, user-friendly design.

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Its fast response time and minimal data transmission delay further highlighted the system's effectiveness and reliability. As shown in Fig. 8,overall, the results validate the design's effectiveness in real-world conditions, showcasing its potential for large-scale deployment in elderly care scenarios.The following are the observed outcomes:

A.Effective Health Monitoring

1. The DS18B20 temperature sensor and Pulse Sensor consistently provided accurate and stable readings during trials.
2. The LCD displayed real-time values clearly, allowing local monitoring by the user or nearby caregiver.
3. All sensor data was successfully transmitted to the Telegram bot, confirming proper functioning of the ESP32's data handling and Wi-Fi communication.

B. Emergency Alert System

1. Pressing the emergency push button instantly triggered a Telegram alert, showing minimal delay.
2. The buzzer activated immediately upon button press, providing local audio feedback to indicate help is on the way.
3. The emergency feature functioned reliably across multiple tests, making it dependable for real-life use.

C. Accurate Location Tracking

1. The GPS 6M module delivered precise latitude and longitude coordinates in open areas.
2. Location data was shared directly to the caregiver via Telegram, making tracking quick and simple.
3. The module was responsive and consistently maintained a satellite lock when tested outdoors.

D. User-Friendly Communication

1. The Telegram bot interface required no advanced technical skills, making it easy for caregivers to use.
2. Health information and emergency alerts were presented clearly and neatly, making them easy to read and understand at a glance.
3. The system focused on the most important information, cutting out unnecessary clutter tocreate a smoother and more user-friendly experience.

E. Real-Time Updates

1. Sensor readings appeared almost instantly on both the LCD and Telegram, showing strong real-time performance**.**
2. Emergency alerts were triggered within seconds, making sure help could be sent right away.
3. The system maintained a reliable connection throughout, minimizing delays and keeping communication smooth and consistent.

F. System Integration and Stability

1. All hardware components worked smoothly together, showing that they were well integrated.
2. The ESP32 managed inputs from multiple devices with ease, demonstrating its strong multitasking capabilities.
3. Even during long periods of testing, the system remained stable, with no crashes, resets, or data loss, highlighting its reliability..

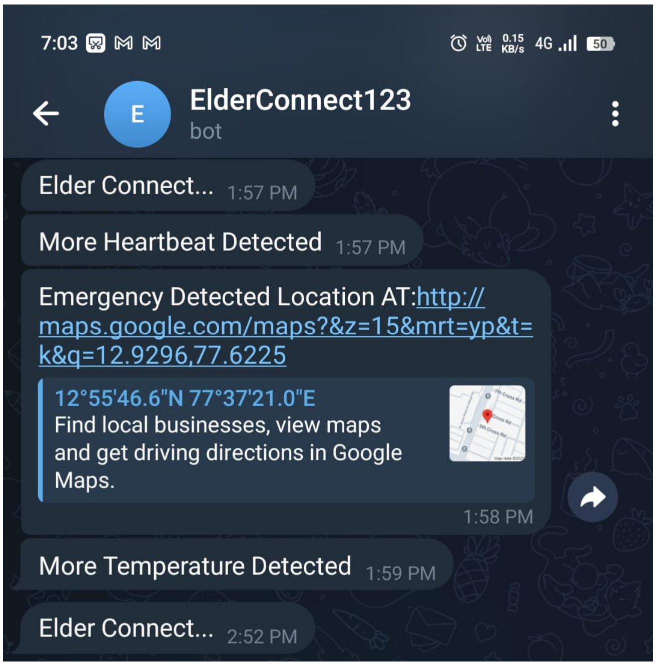

Fig. 8. Output

CONCLUSION

The elder tracking and health monitoring system offers a well-rounded technological solution to the challenges of ensuring safety and continuous care. By combining advanced sensors, GPS tracking, and real-time communication, the system makes it easy to detect health issues early and respond to emergencies quickly. Its thoughtful design and smart implementation represent a major step forward in using technology to enhance safety through continuous health monitoring and intelligent data collection.

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At the core of the system is the ESP32 microcontroller, which seamlessly manages all connected components including a temperature sensor, pulse sensor, GPS module, and LCD display. This ensures smooth integration, reliable operation, and efficient data sharing, all without the need for constant supervision. This project showcases the powerful potential of IoT and embedded systems in developing advanced support tools. It effectively bridges the gap between high-tech innovation and real-world needs in areas such as healthcare, surveillance, and operational tracking. By combining autonomous sensing with secure wireless communication, the system proves useful not only for elder care but also in broader applications like intelligence and field operations. Looking ahead, future upgrades such as integrating diagnostic algorithms and enhancing GPS accuracy will make the system even more adaptable in complex environments. Its modular design means it can be easily customized or expanded based on user-specific needs. Additionally, power-saving features extend battery life, reducing the need for frequent charging. With built-in support for mobile and cloud platforms, users can monitor the system remotely and access data from a centralized location. These features make it a scalable and sustainable solution for real-time health and safety management.

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