WIRELESS LORA COMMUNICATION BASED SOLDIER SECURITY ALERT SYSTEM

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ABSTRACT

By utilizing IoT and advanced wireless communication technologies, the "LoRa-Based Soldier Security System Integrated with IoT" seeks to improve troops' safety and real-time surveillance while they are in the field. The two main components of the system are the transmitter (Tx) and the receiver (Rx). An LCD display, a buzzer, a LoRa transmitter module, a keypad emergency button, and essential sensors like SpO2 and cardiac sensors are all integrated into the Tx unit. The Rx unit has an LCD display, a buzzer, a LoRa receiver module, and Internet of Things integration for remote monitoring. On the Tx side, data from the sensors is continuously tracked, including vital health indicators. Both the Tx and Rx devices send out a warning through buzzers and LCD screens if any of the parameters exceed predetermined threshold levels or if the emergency button is touched. The alarm is sent to an Internet of Things server at the same time so that higher authorities are notified in real time. An ESP32 is used on the Rx side of the system for Internet of Things connectivity, while an ESP32 is used on the Tx side for sensor data collection. This project provides a long-range, dependable, low-power communication solution that will improve overall military safety and operational efficiency while guaranteeing prompt replies in emergency scenarios.

Keywords: Lo-Ra, IoT, Soldier, Security, Spo2, ESP32 Controller.

1. INTRODUCTION

It is essential to have a dependable and effective monitoring system in the dynamic and frequently dangerous environment of industrial operations. Safe and effective monitoring are critical in today's industrial settings.

Although efficient, traditional wired systems have many drawbacks. Furthermore, even though they are widely used, wireless technologies like LoRa have inherent drawbacks that reduce their usefulness in extensive industrial settings.

By combining wireless communication with cutting-edge IoT technologies, the project "Wireless LoRa Communication Based Industrial Sensor Monitor and Security Alert System" seeks to improve industrial safety and operational efficiency. Unlike traditional systems, our wireless approach does away with the need for extensive wiring, LoRa's drawbacks, and maintenance expenses.

There is a growing need for sophisticated multifunctional security systems as the Internet of Things (IoT) develops. With an extensive examination of its uses and advantages, this review article investigates the incorporation of Long Range (LoRa) technology into the security domain. Long range, low power consumption, and scalability are just a few of LoRa's remarkable qualities that make it a viable remedy for the drawbacks of conventional security systems. An overview of the present issues facing security systems and the demand for creative solutions opens the paper. After that, it explores LoRa technology in great detail, explaining its technical features and highlighting its benefits over traditional communication methods. An important part of the article is breaking down the components of a sophisticated multifunctional security system. It is carefully investigated how LoRa can be incorporated into access control systems, intrusion detection sensors, video analytics via security cameras, and smooth communication with smart home appliances. This thorough method attempts to demonstrate how adaptable and effective LoRa is in meeting a variety of security needs. It is explained in the section on communication architecture how LoRa functions as the main communication protocol. In order to improve coverage and dependability, mesh networking is emphasized, along with strong data encryption techniques to protect private data. Case studies and real-world implementations are an essential component of this review, offering concrete illustrations of effective LoRa-based security systems. Adoption of LoRa in security applications has practical benefits that are highlighted by performance measurements and comparisons with conventional security configurations. In summarizing the main conclusions, this research highlights how LoRa has revolutionized sophisticated multipurpose security systems. The incorporation of LoRa technology provides a secure, effective, and scalable answer to the changing security situation. A thorough investigation of LoRa's influence on the development of security systems in the future is preceded by the abstract. The search for cutting-edge multipurpose security systems has grown more crucial in the current environment of ubiquitous connectivity and growing security concerns. With an emphasis on the intersection of security applications and Long-Range (LoRa) communication technology, this study aims to investigate how LoRa-based systems might usher in a new era of intelligent and adaptable security solutions. As the number of Internet of Things (IoT) devices increases and security threats become more complex, new strategies that balance cost-effectiveness, scalability, and efficiency are required. Given its long-range capabilities, low power consumption, and adaptability to a variety of situations, LoRa technology appears to be a viable option for meeting these needs [1]. The goal of this study is to clarify the basic ideas of LoRa-based security systems and analyze their application in different fields in order to reveal their many facets. This review's first parts explore the fundamentals of LoRa communication and explain the principles that make it an appealing option for security applications. As we traverse the terrain of security issues, from traditional monitoring requirements to new dangers in residential, commercial, and environmental settings, LoRa technology's adaptability is evident [2]. A synthesis of previous research is contained in the literature review, which also gives a summary of significant studies and applications that have used LoRa for security. We want to extract key lessons from the achievements and difficulties of these initiatives that will guide the creation of upcoming LoRa-based security solutions. This evaluation continues to focus on new developments and creative integrations in the field of LoRa-based security, going beyond the traditional uses. This sophisticated system is based

on LoRa technology, which is renowned for its long communication range and low power consumption [3]. The initiative intends to reshape security paradigms through the multifunctional integration of LoRa's capabilities. With features like environmental monitoring and intrusion detection, the system can handle a wide range of security requirements. A thorough picture of the user's environment is provided by key features like real-time monitoring, immediate notifications, and seamless connectivity. By integrating LoRa, dependable connectivity in difficult-to-reach places is guaranteed in addition to increased coverage. "LoRa, an acronym for Long Range, is a wireless communication technology that plays a pivotal role in the realization of advanced multipurpose home security systems. Specifically designed for long-range communication with low power consumption, LoRa facilitates seamless connectivity between various components of a home security network. In the context of home security, LoRa technology enables efficient and reliable communication between sensors, surveillance devices, and central control units over extended distances [4]. This wireless technology, operating in license-free spectrum bands, empowers the development of robust and scalable security solutions, ensuring the real-time transmission of data for intrusion detection, environmental monitoring, and other security-related applications. Its low-power characteristics make it an ideal choice for battery-operated devices, contributing to the sustainability and longevity of the overall security system. LoRa's capability to cover wide geographic areas and its adaptability to different deployment scenarios make it a key enabler for the implementation of advanced multipurpose home security systems, enhancing the safety and protection of residential environments [5]. In the realm of advanced multipurpose home security systems, parameters specific to LoRa technology play a crucial role in shaping the efficiency and effectiveness of the overall solution. Concurrently, when comparing these parameters with insights from existing review papers, a comprehensive understanding of the strengths and potential areas of improvement can be gleaned. 1) Communication Range: LoRa's inherent long-range capabilities set it apart in providing expansive coverage for home security networks [1]. This parameter, when compared to other technologies in existing literature, underscores LoRa's advantage in ensuring reliable communication over extended distances, contributing to a wider security perimeter. 2) Power Consumption: The low power consumption characteristic of LoRa devices is a pivotal parameter for sustainable and long-term deployment [6]. Comparative analyses with other review papers highlight LoRa's energy-efficient profile, essential for battery-operated devices in home security applications. 3) Data Rate: While LoRa typically operates at lower data rates, a nuanced evaluation against other technologies in the literature reveals a trade-off between data speed and power efficiency. Understanding this parameter assists in optimizing the balance between timely data exchange and prolonged device operation] 4) Security Protocols: LoRa's security protocols come under scrutiny in comparison with those of other wireless technologies. Insights from existing reviews aid in assessing the robustness of LoRa's encryption mechanisms and authentication protocols, crucial for safeguarding sensitive information in home security contexts. 5) Scalability: The scalability of a home security system is a key parameter, especially as residential needs evolve [6]. Comparative analyses gleaned from review papers shed light on how LoRa-based systems adapt to changing requirements, accommodating additional devices and functionalities seamlessly. 6) Reliability and Latency: LoRa's reliability and latency characteristics, when juxtaposed with findings from other review papers, provide insights into

the system's responsiveness to security incidents. Understanding these parameters aids in comprehending the real-time detection capabilities of LoRa-based home security solutions . Intelligent mining, characterized by the integration of information technology and industrial processes, and grounded in mechanized and automated mining technologies, has transformed the coal sector [4]. This groundbreaking technology enables automatic mining through intelligent environmental sensing at the work face, intelligent managementof each mining machine, and the automated navigation of mining equipment. Intelligent mining encompasses three key facets: Firstly, mining machinery demonstrates autonomous capabilities, allowing it tooperate independently. Secondly, the swift capture and updating of real-time data, including geological information, dynamic coal and rock boundary lines, Integral tothis are the positions of machines and mining processes. Finally, machinery, defined as a "intelligent mining work face," can automatically control and adjust its operations based on the conditions of the work face when decision-making and machine operation are automated

2. LITERATURE SURVEY

Huili Zhang et al. [1] have extensively utilized IoT technology in underground mines to facilitate real-time monitoring of environmental conditions, safety measures, and productivity levels. The article describes the basic structure ofa MIot system for mining employs astandardthree tier IoT architecture. This categorizes sensor types frequently utilized in underground mines based on their specific applications and provides a summary of both physical and wireless connectivity solutions, along with applicable network topologies suitable for use in underground mining environments. This article offers an in-depth evaluationof the latest progress in utilizing IoTapplications to monitor various environmental factors in underground mines. The characteristics include mining gas and dust concentrations, temperature,humidity, airflow, groundwater levels, ground support, and seismic activity. Furthermore, MIoT applications have been examined for activities such as fire and hazard detection, personnel and equipment location monitoring, and industrial safety oversight. The article identifies key obstacles hindering the widespread adoption of IoT technology in underground mines, such as operational disruptions, increased costs, limited battery life, suboptimal underground connectivity, and challenges in data management. The research conducted by KaiZhan and Jian-guo Li [3], the current state of intelligent technology developmentspecifically designed for underground metal mines in China is evaluated. These technologies aim to facilitate the extraction of mineral resources in a manner that prioritizes safety, efficiency, andenvironmental responsibility. The authors conduct an analysis and concise overview of the existing research landscape in underground metal mining technology, both within China and internationally. We showcase state-of-the-art machinery and tech for self-directed mining operations featuring advancedcontrol systems for various equipment like rock-drilling jumbos, DTH drills, underground scrapers, mining trucks, andcharging vehicles. Each of these systems is developed with exclusive intellectual property rights. Our focus lies on three key platforms – precise positioning and navigation, efficient data gathering andcommunication, and optimized scheduling and management of operations [3]. In the last five years, notable progress in technological innovations within the realm of intelligent mining has been observed in China. This involves the integration of longwall automationtechnology, a system endorsed by the Longwall Automation Steering Committee, as highlighted by Jinhua Wang and Zenghua Huang [4]. During this period, China successfully completed

the development of an intelligent system featuring hydraulic-powered supports, showcasing proprietary intellectualproperty. An enhanced intelligent mining model was created, enabling for automated operations while expediting single-person inspections at the work site. As a result of these technological developments, the number of miners required at the worksite has decreased significantly. Miners may now supervise mining machinery from either the highway or the surface control centre, demonstrating the viability of intelligent mining for extracting middle- thick or thick coal seams. In this paper by ZhigaoLiu[5], apioneering personnel positioning system is introduced for tunnel networks featuring blind spots. This scheme, in contrast to many existing alternatives, presents a combination of cost-effectiveness and high precision. The Internet of Things (IoT) paradigm refers to a network of interconnected things, that is, devices such as sensors and/or actuators, equipped with a communication interface, and processing and storage units [1] One of the most extensively researched topics under IoT is smart cities. Citizen security, green environment,increased operational efficiency with the help of smart sensors and actuators are considered as some of the primary aspects of smart cities. Wireless sensor networks are fundamental for these services as they offer very low cost of deployment, low power consumption and maintenance cost. Smart innovative cities should provide data about the impact of human activity to the environment and services related to health, transportation, sustainability, economy, law enforcement, community and others affecting the overall wellbeing of the residents. Ideally smart city should be able to smartly secure its inhabitants. Smartphone based emergency alert system is a good start towards reaching this goal [3,4]. The system may fare up well in a place where everyone has a smartphone and has ample knowledge of its usage. However, in developing countries and rural areas everyone does not posses a smart phone and even if they do, they are not so proficient in handling it. So, smartphone basedapproach is futile in such cases. Thus, there is a need for alternative communication standard that can provide us the range needed in a citywise concept. This brings us to various surveillance systems like CCTV, WiFi-based monitoring etc. Child observation system using information terminal bus stops is on the rise in developed countries like Japan [5, 6]. In India CCTV surveillance is a fast growing security measure especially in crowded places like bus stops, railway stations and airports [7]. The drawbacks of these methods are– cost of deployment and difficult set-up. Using WiFi for wireless surveillance, limits the range upto less than 50 meters. The probable solution to this is LoRa RF. LoRa physical layer is specially built for use in developing IoT sensor networks [8,9]. In general LoRa RF can broadcast signal upto around 2km radius, but is shown to acheieve range upto 10km in line of sight(LoS) with receiver using directional antennas [10]. In this paper we propose a novel closed loop security system using LoRa RF as the communication interface. We have designed a custom PCB for making the end device. Wehavealso developed an android application to show real time navigation to alerted node. The proposed network is evaluated in terms of cost estimation and power consumption. The use of LoRa RF enables long range and low power, which is its primary advantage over existing wireless communication standards.

3. EXISTING SYSTEM

The system was created with LoRa for wireless connectivity, and it is now used in an industrial sensor monitor and security alert system.

Using radio frequency (RF) transmission, LoRa is a wireless system that enables small, inexpensive devices to send small amounts of data rapidly.

We have two LoRa modules here: one at the sensors' side and one at the monitoring side. The monitoring module is positioned at the laptop or PS side, and the sensors are positioned according to the needs.

Using a LoRa module, the sensors system transmits data to a remote server for real-time inspection. Sensors include temperature, gas, ultrasonic, current, and voltage sensors.

A 16x2 LCD displays all of this information, and software on the monitoring side allows the user to view data on the serial port.

4. PROPOSED SYSTEM

Because there are numerous technologies for industrial monitoring, but they all have shortcomings in terms of short-range and wiring installation, we developed this new technology called Lora.

The Arduino IDE is the software tool and Embedded C is the programming language utilized in this Lora, IoT, and Arduino system.

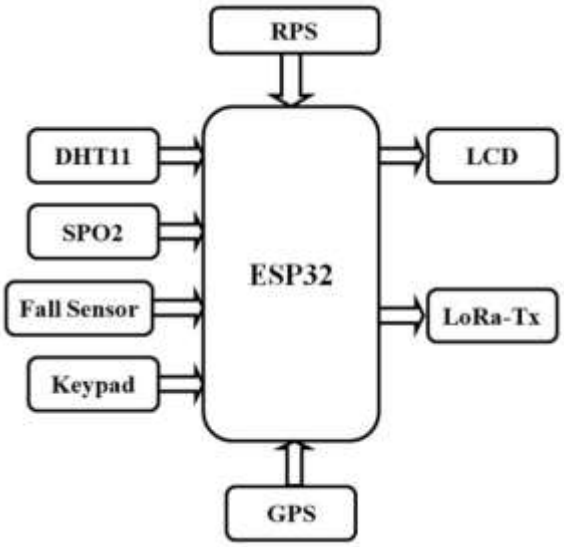
Our suggested system will install a number of sensors across the building to continuously check security and environmental conditions.

The data will be processed in real-time and alarms will be sent to a central base station upon detection of any anomalies.

IoT technology will also be utilized to ensure prompt responses to possible threats by sending push notifications to pertinent parties.

In order to improve industrial safety and operational efficiency, this project intends to develop a scalable, effective, and dependable monitoring system without requiring complicated wiring infrastructure.

Transmitter:



Reciever:

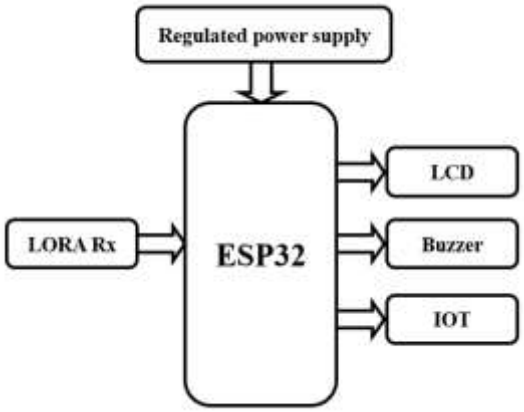


Fig.1. Proposed block diagram

WORKING MODEL:

The proposed LoRa Soldier Security System is intended to continuously monitor soldiers' health and safety in remote or battlefield environments while ensuring long-range communication using LoRa technology. The ESP32 microcontroller, which acts as the central processing unit and gathers, processes, and transmits data from various sensors, is at the heart of the system. It is powered by a Regulated Power Supply (RPS) to ensure stable voltage and dependable operation of all components in harsh conditions. In terms of health monitoring, the DHT11 sensor measures environmental parameters like temperature and humidity, the SPO2 sensor tracks vital signs like heart rate and blood oxygen levels, a Fall Sensor detects sudden movements or falls that may indicate an injury or critical situation, and a Keypad enables the soldier to manually send distress signals or input commands when necessary. The LoRa Transmitter (LoRa-Tx) is the key component. It transmits the collected data over long distances with low power consumption, ensuring reliable communication even in areas without cellular or internet connectivity, which allows army control centers to receive continuous updates about the soldier's condition and location in real time. By combining IoT sensors, GPS tracking, and LoRa communication, this system improves the safety, monitoring, and rapid response capabilities for soldiers in critical missions and remote areas and is effective in ensuring women's safety.

5. RESULTS

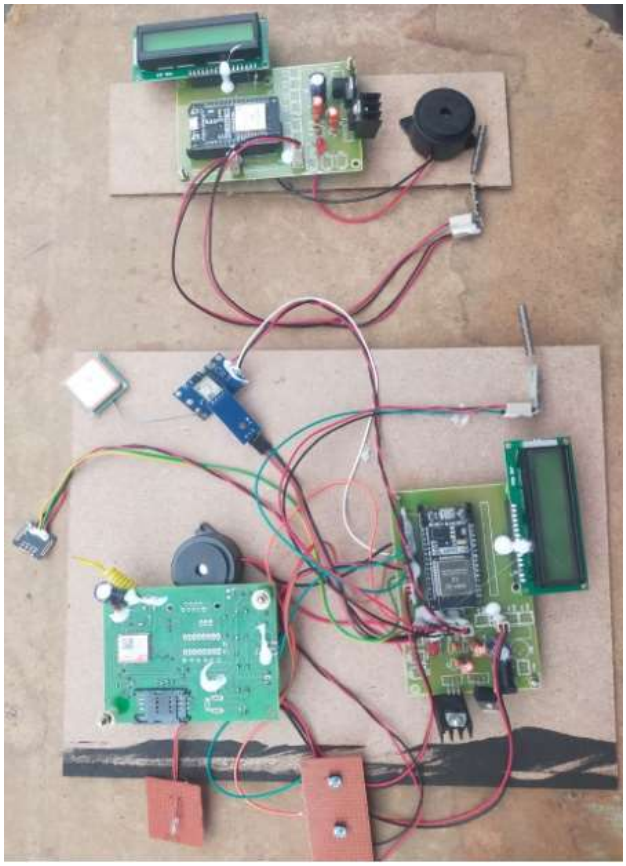


Fig.3. Proposed Output model

Here, the circuit is turned on by a 12 volt regulated power supply that is converted to 5 volt direct current. Because the LED is a 5 volt current indicator, it will automatically light up when there is 5 volts of current. The vibration sensor acts as a switch in the circuit, warning the doctor of a possible fall. The controller's data is transferred from the satellite to the IOT server, which uses a piezoelectric buzzer and an IOT server for the output. The IOT server uses a WiFi network to send data to the webpage, and the webpage changes every 5 seconds.

Fig.4. LCD Output

Real-time sensor readings and notifications are displayed on the LCD screen:

6. CONCLUSION

By combining sensors like DHT11, SPO2, and fall detection with GPS tracking and ESP32 processing, the LoRa-based Soldier Security System offers a dependable and effective way to keep an eye on soldiers' health, safety, and location in remote and critical environments. The system's integration of LoRa communication technology allows for long-range, low-power data transmission, which makes it ideal for battlefield conditions where cellular networks and the internet are unavailable. All things considered, the system improves situational awareness for army control centers, speeds up emergency response times, and makes a substantial contribution to the safety and protection of soldiers during missions.

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