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A SMART PORTABLE EMERGENCY DISTRESS SIGNAL DEVICE

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ABSTRACT: In high-risk environments, quick and discreet distress signalling is crucial for personal safety and emergency response. This paper presents the design and development of a smart and portable emergency distress signal device that offers signalling modes for diverse emergency scenarios. The objective is to design a covert emergency signal device for soldiers, spies, and individuals in high-risk environments. This device allows the soldiers in war zones to send SOS signals to rescue teams for rescue operation. This device's Single-Click activation mechanism enables rapid distress signalling, including GPS alerts and LED flashes along with buzzer activation, while allowing silent SOS transmission with a double click where buzzer is turned off. A long press deactivates the device, ensuring user control. The GPS module allows the device to send the soldier's real-time location when activated and updates every few minutes. This is useful for rescue teams to locate the soldier in danger quickly. This Lightweight, Portable device utilizes Arduino Uno, a small buzzer, and an LED, making it cost-effective and easy to build. By eliminating the need for radio signals, this system enhances covert communication and emergency signalling, particularly in war zones and undercover missions. This paper discusses the device's technical implementation, hardware-software integration, and real-world applications, demonstrating its potential to enhance safety, security, and emergency preparedness.

Keywords - Emergency Distress system, Real Time Location, Portable Safety Device, Military Emergency Alert.

I. INTRODUCTION

Ensuring swift, reliable, and secure communication during emergency situations has become a major challenge, particularly in military, covert, and high-risk operations. In hostile environments, conventional communication methods such as voice calls or open radio transmissions may expose personnel to enemy detection, thereby compromising mission secrecy and individual safety. Consequently, there is a growing need for a smart, portable emergency distress signal device capable of operating autonomously and discreetly without attracting attention.

Soldiers, who form the backbone of any armed force, often face situations during combat missions or special operations where they become isolated or lose communication with command authorities. Similarly, civilians operating in dangerous conditions—including journalists, rescue workers, undercover agents, and individuals trapped in disaster-affected regions—may experience complete breakdowns in communication infrastructure. In such scenarios, a reliable distress signalling mechanism that can transmit real-time location data becomes a critical lifesaving tool, enabling rapid rescue and support.

Advancements in Global Positioning System (GPS) technology and microcontroller-based embedded systems have enabled the development of compact and efficient safety devices capable of transmitting location information with minimal user intervention. These systems are especially useful in warfare, espionage, and disaster management, where stealth, reliability, and independence from conventional communication networks are essential.

Several studies have explored the application of GPS-based emergency communication systems [1] presented a GPS–GSM-based tracking and alert system for emergency scenarios; however, their design relied heavily on GSM networks, limiting its effectiveness in network-denied or hostile environments. Lofland [2] introduced a patented emergency alert device that silently transmits GPS coordinates using a discreet activation interface, emphasizing the importance of non-verbal and non-audible communication during critical situations.

Building upon these existing works, this paper proposes a smart and portable emergency distress signal device with simple activation mechanisms and a compact Arduino-based architecture. The system is designed to discreetly transmit real-time location data, ensuring secure and rapid assistance while maintaining user safety. Its cost-effective and reliable design makes it suitable for soldiers, emergency responders, intelligence personnel, and civilians operating in high-risk or communication-compromised environments.

II. LITERATURE SURVEY

GPS and GSM technologies have been widely employed to transmit emergency location information effectively. Kumar and Thomas [1] demonstrated that GPS and GSM can be successfully coupled to communicate emergency location details via SMS, while Singh and Sharma [2] confirmed the reliability of GPS–GSM tracking for personal safety applications. Several researchers have leveraged Arduino-based embedded systems to develop portable safety devices that use GSM for rapid SOS alerts. Rahman and Farhana [3] and Priya and Latha [4] created such devices, emphasizing low-cost, accessible solutions for immediate distress signalling. Reddy [5] further enhanced usability by including direct Google Maps links in SMS messages, allowing rescuers to locate users quickly and accurately.

Wearable and IoT-enabled emergency systems have also received considerable attention. Tseng et al. [6] developed wearable devices with fall detection and real-time localization features, demonstrating the potential for continuous personal monitoring in high-risk situations. Mohsin et al. [7] extended emergency alert systems to IoT platforms, enabling ongoing tracking and supervision, which can be crucial in disaster management and healthcare contexts. These approaches highlight the importance of combining location tracking with automated alert mechanisms for faster and more reliable emergency response.

Building upon these advances, the current paper [8] develops a portable Arduino-based distress device that integrates GPS and GSM to transmit emergency notifications discreetly and in real time. The system focuses on simplicity, multi-mode activation, and cost-effectiveness, making it suitable for soldiers, emergency responders, and civilians in high-risk or communication-limited environments. By incorporating lessons from previous works, this device aims to provide a practical, reliable, and user-friendly solution for rapid emergency communication.

III. RESEARCH METHODOLOGY

3.1 Block Diagram

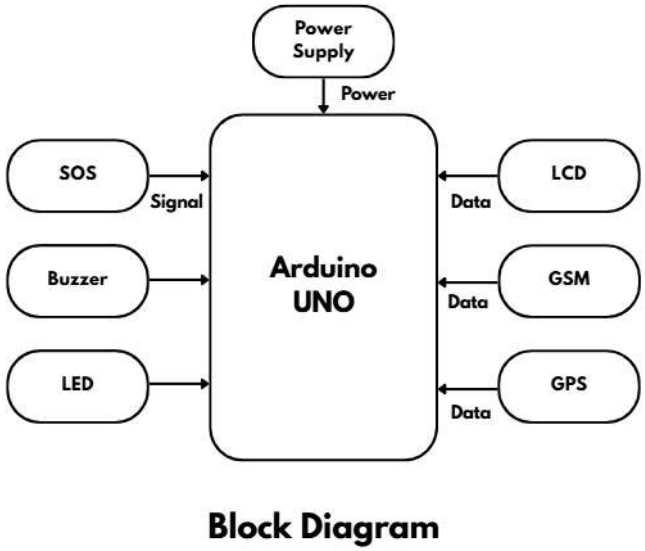

Fig.1. Block Diagram of Smart Portable Emergency Distress Signal Device

The block diagram represents a Smart Portable Emergency Distress Signal Device using an Arduino UNO microcontroller. The system is powered with 5V supply suitable for all modules.

The core of the system is the Arduino UNO, based on the ATmega328P, which acts as the central controller. It receives an input signal from an SOS push-button, processes it, and performs corresponding actions. On activation, the Arduino communicates with the NEO-6M GPS module, which provides real-time geographical coordinates (latitude and longitude). These coordinates are then transmitted via the SIM800C GSM module in the form of an SMS alert to pre-configured emergency contacts.

In addition to communication, the system provides visual and audio feedback through an LED and a buzzer. An LCD display is used to show emergency status messages and GPS coordinates. This modular and microcontroller-based approach ensures portability, real-time operation, and efficient emergency response.

This makes the system extremely useful in critical situations like accidents, natural disasters, or military operations where immediate help is required. The combination of alert mechanisms and communication modules ensures that the distress signal is both noticeable and effectively communicated.

3.2 Working Mechanism

The working mechanism of the Smart Portable Emergency Distress Signal Device is designed to be simple, efficient, and responsive to different emergency situations. The system uses a single SOS button to perform multiple actions based on the type of press — making it user-friendly and quick to operate under pressure.

The working of this device is based on the type of press input detected from a single SOS button. The logic is programmed into the Arduino UNO, which controls all connected components accordingly.

On a single-click, the device enters active alert mode: the LED starts blinking, the buzzer is activated to draw attention, and the NEO-6M GPS module sends location data to the Arduino. This data is then transmitted to emergency contacts through the SIM800C GSM module as an SMS. An SOS message like "Code1 Activated" is sent along with a Google Maps link sharing the user's live location.

In the case of a double-click, the device enters stealth mode, useful for situations where the user needs to stay hidden. In this mode, the GPS data is still collected and sent via SMS, but the buzzer remains silent, and only the LED might flash briefly, allowing discreet distress signalling. The SMS in this case shows "Code2 Activated", indicating that silent tracking is in effect.

A long-press on the SOS button turns the device off, conserving battery and resetting the system when the emergency is over or when not in use. These three modes—single-click, double-click, and long-press—make the device intelligent, adaptable, and ideal for both open and covert emergency responses.

3.3 Features & Functionality

The Smart Portable Emergency Distress Signal Device is equipped with several practical features that make it both effective and user-friendly in emergency situations and for real-world application. It utilizes a push-button interface, allowing the user to operate the device with simple physical interaction. A key highlight of the system is its stealth mode, which ensures silent emergency communication without triggering audible alerts — particularly useful in covert or sensitive scenarios.

The device supports single-click activation for immediate distress signalling, making it quick and reliable in critical moments. Built using widely available components like the Arduino UNO, SIM800C GSM module, and NEO-6M GPS module, the device is low-cost and easy to build, which makes it highly accessible for personal use, educational purposes, or deployment in large-scale safety applications.

Furthermore, the system is easy to use, even by non-technical individuals, due to its intuitive operation. Most importantly, it is GPS-enabled, allowing accurate location, real-time location tracking and automatic transmission of coordinates via GSM through SMS, ensuring timely assistance and location-specific responses during emergencies.

IV. HARDWARE IMPLEMENTATION

The hardware of the system consists of affordable, easily available components. The Arduino Uno acts as the central microcontroller, managing communication between the GPS and GSM modules. The NEO-6M GPS module provides accurate latitude and longitude data, while the SIM800C GSM module sends SMS messages containing a clickable Google maps link to recipient.

when there is no internet connectivity. During regular alert mode, an LED and a buzzer provide visual and auditory cues, respectively, while a 16x2 LCD display shows the method of activation, system readiness, and live GPS positions to give the user feedback and indicate status. The LCD display shows the device status and coordinates. A buzzer and LED serve as audio and visual indicators.

A lithium Ion Battery is used as the primary power source and provides 5V. Since the device is designed to be compact, lightweight, and portable, the lithium-ion battery is the most suitable choice due to its high energy density, long backup time, and rechargeable nature. The lithium-ion battery ensures uninterrupted operation of the Arduino Uno, GPS module, GSM module, LED, Buzzer, and LCD even in remote or hostile environments.

V. SOFTWARE IMPLEMENTATION

The Arduino IDE is required to program the Arduino Uno board used in the emergency distress signal device. It supports a programming language based on wiring, which is similar to C/C++. This makes it easy to control hardware components such as sensors, communication modules, buzzers, LEDs, and memory devices used in the distress system. A significant portion of the software is devoted to deciphering user interactions with the SOS button. In that case, the code counts button activations inside a specified window and measures time intervals to distinguish between a single click, double click, and long press. The program initiates the appropriate response mode for example, turning on the LED and buzzer patterns in regular alert mode or turning off sound in silent mode after detecting the button input.

The prototype was able to accurately record and transmit location data via SMS in all three modes of operation. The LCD displayed unambiguous status updates, and both the LED and the buzzer functioned appropriately in relation to the mode of activation. Overall, the system's goal of providing fast, portable, and reliable distress alerts was accomplished.

VI. RESULT

The Smart Portable Emergency Distress Signal Device was successfully designed, implemented, and tested using an Arduino Uno, GPS module, GSM module, LED, buzzer, and LCD display. The developed prototype functioned as intended, responding accurately to different SOS button activation modes. Upon single-click activation, the device enters active alert mode: the LED starts blinking, the buzzer is activated to draw attention, and the GPS module sends location data to the Arduino. This data is then transmitted to emergency contacts through the GSM module as an SMS. An SOS message like "Code1 Activated" is sent along with a Google Maps link sharing the user's live location. This confirmed the reliability of the GPS–GSM integration for real-time location-based distress communication.

During double-click activation, the device operated in stealth mode by disabling the buzzer while still transmitting location details via SMS. This mode proved effective for covert situations where silent communication is essential. The long-press functionality successfully deactivated the system, conserving power and resetting the device. The LCD display provided clear status messages and location feedback, ensuring ease of use even in high-stress conditions.

Overall, the prototype demonstrated stable performance, accurate location tracking, and reliable message delivery. The compact size, low power consumption, and cost-effective components make the device suitable for real-world deployment. The results validate that the proposed system is effective for soldiers, emergency responders, and civilians operating in high-risk or communication-compromised environments.

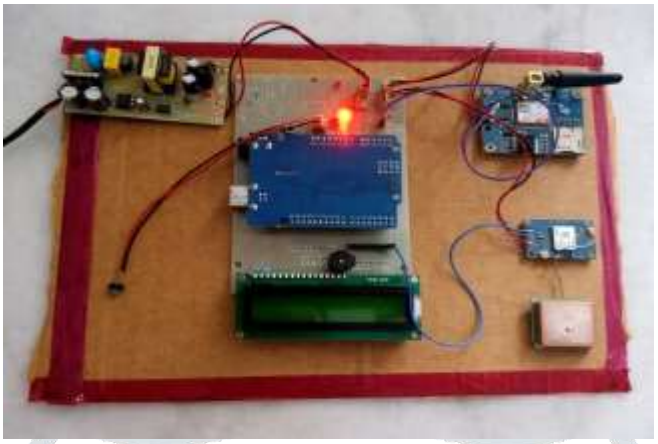

Fig 2: Buzzer Activation During Emergency Alert Mode

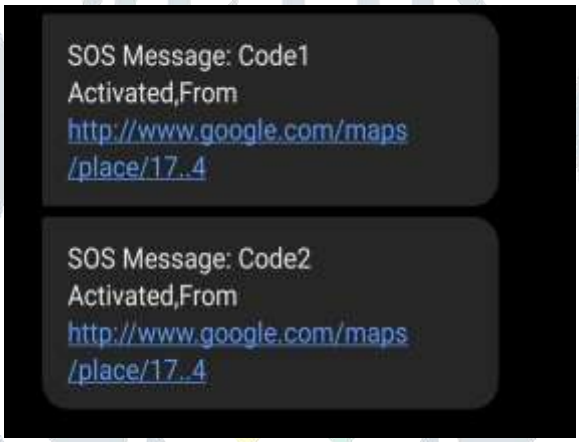

Fig 3: Emergency SMS Alerts with GPS Location Link

VII. CONCLUSION

The Smart Portable Emergency Distress Signal Device successfully addresses the need for a quick, reliable, and discreet method of communication in high-risk environments. By integrating simple hardware components like the Arduino UNO, GPS module, GSM module, LED, and buzzer, the device offers an efficient solution for sending real-time SOS alerts. Its intelligent design allows the user to trigger different emergency modes—alert, stealth, and shutdown—using a single-button interface, making it highly practical during stressful or dangerous situations.

This device demonstrates the effectiveness of combining embedded systems with location-based services for personal safety. With its lightweight, portable design and battery-powered operation, it is well-suited for soldiers, undercover agents, or individuals in emergency-prone areas. The paper showcases how low-cost, easily available components can be used to build a life-saving tool that enhances situational awareness and improves emergency response times.

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