Echosafe Smart Voice – Driven Personal Safety Device

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Abstract- *Women's safety remains a major issue in today's society, requiring effective and immediate response systems during emergencies. This project presents a SmartPortable SOS Safety Keychain designed to provide rapid assistance when a user is in danger. The system is developed using the ESP8266 SoC microcontroller, which enables wireless communication and real-time alert transmission.When the SOS push button is pressed, the device sends an emergency notification along with the user's live geographical location obtained through the NEO-6M GPSmodule to pre-configured contacts. To further strengthen security and provide evidence, the system integrates a MAX9814 microphone module for audio recording and includes a buzzer for alert indication. The recorded data can be stored in memory and accessed remotely when required.The device operates on a rechargeable 7V lithium-ion battery, ensuring portability, compact design, and low power consumption. Additionally, a 7-segment display is incorporated for status indication. A survey conducted within the campus indicated that nearly half of the students were unaware of existing SOS safety devices, emphasizing the necessity of implementing such smart safety solutions. The proposed system offers a reliable, portable and efficient approach to enhance women's personal security through instant alerting, live tracking, and evidence collection.*

Keywords: Women Safety, SOS Emergency System, ESP8266, NEO-6M GPS Module, MAX9814 Microphone, Portable Safety Device, Real-Time Location Tracking, IoT-based Security System, Emergency Alert System, Lithium-ion Battery Powered Device.

I. INTRODUCTION

Ensuring women's safety has become a significant challenge in today's society due to the rising incidents of harassment and violence. Although technology has advanced rapidly, many women still encounter unsafe situations in public areas, workplaces and educational environments. In emergency circumstances, immediate communication and quick response play a vital role in preventing harm and ensuring protection. The advancement of Internet of Things (IoT) technology and embedded systems has enabled the development of compact and intelligent safety solutions. This project proposes a **Smart Portable SOS Safety Keychain** that is lightweight, easy to carry and capable of delivering instant emergency alerts when required.The system is developed using the ESP8266 microcontroller, which supports wireless communication for real-time data transmission. Upon pressing the SOS push button, the device collects live location information through the NEO-6M GPS module and transmits an alert message to predefined contacts. Additionally, a MAX9814 microphone module is incorporated to capture surrounding audio during distress situations, while a buzzer provides an audible alert signal. A 7-segment display is used to indicate the device status, and the entire system is powered by a rechargeable 7V lithium-ion battery to ensure portability and efficient power usage.

In addition to location tracking, the system integrates a MAX9814 microphone module to record surrounding audio, which can serve as supporting evidence in case of investigation. A buzzer is included to generate an audible alarm, drawing attention from nearby people and potentially deterring attackers. The 7-segment display provides system status information, enhancing usability. The entire device operates on a rechargeable 7V lithium-ion battery, making it portable, energy-efficient and suitable for daily use as a keychain accessory.

A survey conducted among campus students indicated that nearly 50% were unaware of dedicated SOS safety devices, highlighting the lack of awareness and availability of such protective solutions. This finding reinforces the importance of developing affordable and easy-to-use safety technology.The main goal of this project is to create a reliable, compact and cost-effective safety system that combines emergency alerting, real-time location tracking and evidence recording into a single portable device. By integrating modern IoT technology with embedded hardware components, the proposed system aims to enhance personal security and provide women with greater confidence and independence in their daily lives.The device may be upgraded by integrating a compact camera module capable of capturing images or short video recordings during distress situations. This would strengthen evidence collection along with audio recording. Furthermore, cloud-based storage systems can be

introduced to automatically upload recorded data, ensuring secure backup and preventing data loss.

II. LITERATUREREVIEW

Alounehe*t al.,(2022)*designed System-of-Systems (SoS) offer unprecedented potential for new types of emerging services, which significantly exceed the capabilities of the constituting systems. It also introduces an algorithm for admission control and resources' allocation, which considers these requirements and the autonomy of the constituent systems. To simulate a realistic admission control and resources' allocation process of a typical SoS network, a simulated case study with eight constituent systems, six services, and twenty-five processes/requests is developed.

Abou-Tair *etal.,(2023)*implemented an SoS healthcare monitoring framework is proposed, where a wireless communication protocol is proposed that addresses the sensors' node network access contention and mitigates the bit errors of the communication channel by providing forward error correction bits to the transmitted packets. In addition, the protocol takes into consideration the sensors' importance and criticality, such that more important sensors are given more network access time and more error correction bits, which in turn results in a robust transmission process with low transmission delay.

Chaozhen Lan *et al.,(2020)*developed a different cases and scenarios to test the service, and the results show that the proposed service can effectively organize and express SOS knowledge in a complex spatio-temporal environment, provide an intermediate bridge between users and SOS knowledge, and promote users' cognition of SOS knowledge, nitrate and phosphate concentrations.

Kanishk Sharma *et al.,(2024)* provided the IoT- grounded Smart Water Bottle allows the stoner to track the quantum of water he drinks on a diurnal base, as well as the time he last drank water. It also reminds the stoner to drink water and refill the bottle when it's empty. This bottle is designed to track and help the stoner in analyzing and perfecting his water drinking habits.

Maheshwari. E *et al.,(2024)* developed a gadget for this project is an ATMEGA328P, together with GPS, GSM, and a pressure sensor. Although there were some discrepancies between the position that was received and the actual position, the GPS device was able to gather location data with a respectable degree of precision. This apparatus sends the control room the database, which includes the name, Aadhar number and residential area.

Masooma et al.,(2023) produced results revealed that different types of sensors are used to capture the state of women undergoing safety issues where the pulse-rate, and pressure sensors are most commonly used sensors in these devices. In addition, the devices used different technology to transmit the alerts including global positing system (GPS), global system for mobile communication (GSM), and Raspberry pi.

III. EXISTING SYSTEM

Current personal safety devices mainly concentrate on sending emergency alerts and sharing location details, but they often lack complete and independent functionality.Several existing women safety systems operate using Bluetooth or GSM communication. Bluetooth-based devices require continuous connection with a smartphone to transmit distress signals. If the mobile phone is switched off, out of battery or beyond Bluetooth range, the system fails to function properly. This dependency reduces reliability during critical situations.Similarly, GPS-enabled safety devices are designed to send real-time location coordinates through SMS or mobile applications. However, these systems rely heavily on cellular networks or internet connectivity, which may not always be available in remote or low-signal areas. Most of these devices focus primarily on alert transmission and tracking, without incorporating features such as environmental audio recording or on-board data storage for collecting evidence.

In addition, some existing safety devices are relatively expensive or bulky, making them less convenient for everyday use. Many systems require manual operation and lack automatic activation features. The absence of integrated evidence collection and independent communication capability are significant limitations of current solutions.Overall, the existing systems provide basic emergency alerting and tracking services but do not offer a fully integrated, portable, and reliable safety solution. These drawbacks create the need for a compact and cost-effective device that combines alert transmission, real-time tracking and evidence recording within a single standalone system.

Figure 1. Existing System

IV. PROPOSED SYSTEM

The proposed project introduces a Smart Portable SOS device developed to enhance women's safety by providing immediate support during emergency situations. The device is designed to be compact, lightweight, and convenient to carry, allowing users to access it quickly whenever required.

At the core of the system is the ESP8266 microcontroller, which controls the overall operation and enables wireless data communication. When the SOS push button is activated, the controller initiates the emergency process. To strengthen the security mechanism, the device incorporates a MAX9814 microphone module that captures surrounding audio during distress events. The recorded data can be stored for later use as supporting evidence. Additionally, a buzzer is integrated to produce an audible alarm, helping to attract nearby attention and potentially deter threats. A 7-segment display is included to indicate the operational status of the device, such as activation confirmation.

Upon activation, the NEO-6M GPS module retrieves accurate real-time geographical coordinates of the user. These coordinates are processed by the microcontroller and transmitted as an emergency alert message to pre-registered contacts. This ensures that family members, friends or authorities can track the user's exact location without delay, enabling faster assistance.To further improve security and evidence collection, the system integrates a MAX9814 microphone module. This module captures surrounding audio during distress situations, which can serve as valuable supporting evidence if required for investigation. The recorded data can be stored in local memory for secure access. Additionally, a buzzer is incorporated to produce an audible alarm that can attract nearby people's attention and potentially discourage attackers.

A 7-segment display is included to provide visual feedback regarding system status, such as power indication, GPS signal acquisition or SOS activation confirmation. This improves user awareness and device usability.The entire system is powered by a rechargeable 7V lithium-ion battery, ensuring portability and uninterrupted operation. Proper power management techniques are applied to maintain low energy consumption and extend battery life.

Figure 2. Proposed System

V. DEVELOPED MODEL

5.1 Working model

The Smart Portable SOS Keychain functions as an embedded emergency safety system that is designed to provide quick assistance during critical situations. Its operation is based on instant activation, real-time location trackingand automatic evidence recording.When the device is switched ON, the control unit initializes all connected modules and checks their functionality. The location tracking module begins receiving satellite signals to determine the current position of the user. Once the coordinates are successfully obtained, the system remains in standby mode until the emergency button is pressed.Upon pressing the SOS button, the system immediately activates the emergency response process. The control unit collects the real-time latitude and longitude information and generates an alert message containing the user's location details. This alert is then transmitted wirelessly to the predefined emergency contacts.At the same time, the audio recording unit starts capturing surrounding sounds, which may serve as supporting evidence if needed later. The buzzer is also activated to produce a loud alarm sound, helping to draw attention from nearby people and potentially discourage attackers.

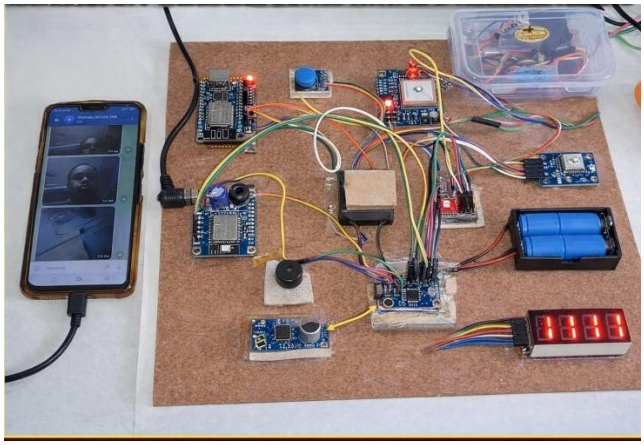

Figure 3. Snapshot of the Working Model

5.2 Hardware Components

A. ESP8266 MicroController

The ESP8266 is a low-cost System-on-Chip (SoC) microcontroller with built-in Wi-Fi capability. It acts as the main controller of the entire system. It processes input signals from the push button, communicates with the GPS module to obtain location data, controls the buzzer and display and transmits emergency alerts through wireless communication. Due to its compact size, low power consumption and internet connectivity support, it is suitable for portable IoT-based safety devices.

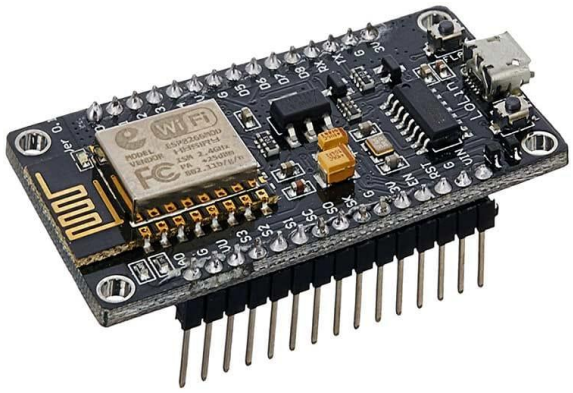

Figure 4. ESP8266

B. GPS MODULE NODE-6M

The GPS module is responsible for determining the real-time geographical location of the user. It receives signals from satellites and calculates latitude and longitude coordinates. These coordinates are transmitted along with the emergency alert message to pre-registered contacts for accurate tracking.The module communicates with the controller using serial communication (UART).It continuously receives satellite signals.Once valid coordinates are obtained, they are sent to the controller.

Figure 5. GPS Module

C. 7V Lithium Ion Battery

The **7V lithium-ion battery** provides stable and rechargeable power for the entire circuit. Lithium-ion technology offers high energy density, low self-discharge rate, and longer lifecycle compared to conventional batteries. Proper voltage regulation is necessary to ensure safe operation of 3.3V components like the microcontroller. The battery supports portability and allows the device to function independently without external power supply. It also contributes to the compact nature of the device.

Figure 6. Lithium Battery

D. Microphone Module (MAX9814)

The **microphone module (MAX9814)** is equipped with automatic gain control (AGC), which dynamically adjusts sound amplification levels. This ensures that both low and high intensity sounds are captured clearly without distortion. The module converts sound waves into electrical signals that can be processed or stored. In emergency

scenarios, recording environmental audio can serve as supporting evidence and enhance the security capability of the device.

Figure 7. Microcontroller Module

E. 7 Segment Display

The **7-segment display** provides visual feedback to the user. It can indicate system status such as device power ON, SOS activation, GPS signal lock or battery condition. Visual indicators improve usability and allow the user to confirm whether the device is functioning properly. It also assists during testing and troubleshooting.This visual feedback helps the user understand the system's condition instantly.

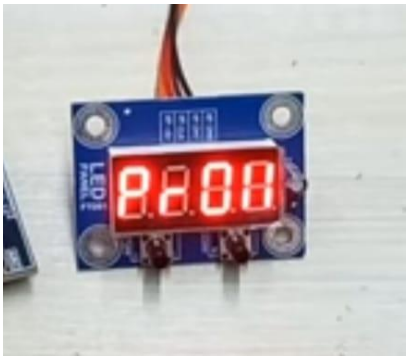

Figure 8. 7 Segment Display

F. Buzzer

The **buzzer** serves as an audible alert system. Once triggered, it produces a loud sound to draw attention from nearby people. This can help scare away potential threats and alert others in the surroundings. The buzzer operates using electrical signals from the microcontroller and requires minimal power. It plays an important role in increasing the effectiveness of the safety device.

Figure 9. Buzzer

G. Push Button

The push button functions as the primary emergency activation switch. When the user presses it, a signal is sent to the ESP8266, which immediately initiates the alert process. The simplicity of the push button ensures that it can be operated quickly during panic situations. It is reliable, cost-effective, and easy to interface with the microcontroller using digital input pins.

Figure 10. Push Button

VI. RESULT AND DISCUSSION

Figure 10. DevelopedModeloftheProposedSystem

The Smart Portable Safety Device for Women SOS Keychain was successfully designed and tested under different operating conditions. Upon pressing the SOS push button, the system responded immediately by activating the buzzer and initiating the emergency alert sequence. The device was able to obtain real-time location coordinates from the NEO-6M GPS module with satisfactory accuracy in open environments. The location data was processed by the ESP8266

microcontroller and prepared for transmission.The microphone module MAX9814 effectively captured surrounding audio signals with clear sound quality due to its automatic gain control feature. The system demonstrated stable operation when powered by the rechargeable lithium-ion battery, confirming its suitability for portable use.

The 7-segment display successfully indicated system status, and the buzzer produced a loud alert sound during emergency activation. Testing showed that the device operated reliably with low power consumption and maintained proper communication between modules. The system successfully performed real-time alerting, location tracking and environmental recording as intended.The experimental results confirm that the proposed safety device provides an effective and compact solution for personal security. The integration of real-time GPS tracking with alert notification improves response time during emergencies. The inclusion of audio recording enhances the device's functionality by enabling evidence collection, which is often missing in conventional safety systems.

The use of a Wi-Fi-enabled microcontroller ensures faster communication compared to traditional GSM-based systems. The rechargeable battery improves portability and makes the device suitable for daily use as a keychain accessory. However, GPS accuracy may slightly reduce in indoor or highly congested urban areas due to signal obstruction. Network availability also influences the speed of alert transmission.Compared to existing systems that only send location alerts, this project provides a multi-functional approach combining alert sound, tracking, and evidence recording in a single compact device.

The system is cost-effective, easy to operate, and practical for real-world implementation.Overall, the project demonstrates that integrating modern embedded systems and communication technologies can significantly enhance women's personal safety.

VII. CONCLUSION

The Smart Portable Safety Device for Women SOS Keychain was successfully developed to provide an effective personal security solution using embedded and communication technologies. The system combines a Wi-Fi-based microcontroller with the NEO-6M for real-time location identification and the MAX9814 for capturing surrounding audio during emergency situations. The emergency push button and buzzer mechanism ensure quick activation and immediate alert generation.When the SOS button is pressed, the device promptly collects location coordinates, triggers an audible alarm, and records environmental sound to enhance safety and evidence support.

The rechargeable lithium-ion battery enables portable and continuous operation, making the system convenient for everyday use.The implementation results confirm that the device is economical, dependable, and user-friendly. By integrating alert notification, live tracking, and audio recording into a compact unit, the proposed system overcomes many shortcomings of conventional safety devices. Even though factors such as indoor GPS signal limitations and network dependency may slightly affect performance, the overall system demonstrates practical applicability and efficiency.

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