

Intelligent Safety System for Women Using GSM and GPS Technology

Jukanti Varshith Rao, B. V. L. N Pavan Sai, M. Prince Nixon and Dr. K. Pranitha Kumari

Department of Computer Science and Engineering

Sreenidhi Institute of Science and Technology Hyderabad, Telangana, India

Abstract: *Women safety has become a critical issue in modern society. With increasing incidents crime and personal insecurity, there is a need for an intelligent and reliable safety system that can help individuals in emergency situations. This research presents the design and implementation of an Intelligent Safety System for Women and Children using GPS (Global Positioning System) and GSM (Global System for Mobile Communication) technologies. The proposed system is built using an AT89S52 microcontroller, GPS module, GSM modem, and an emergency switch. When the user presses the emergency button, the system immediately determines the geographical location using GPS and sends an SMS alert containing the latitude and longitude coordinates to predefined emergency contacts such as family members or nearby authorities. The system can also respond to SMS commands requesting the user's location. The main objective of this work is to provide a low- cost, portable, and reliable personal safety device that enables quick response during emergency situations. The results demonstrate that the system can accurately detect location and transmit it through GSM communication, making it a useful solution for women and child safety applications*

Keywords: Women Safety, GPS Tracking, GSM Communication, Embedded Systems, AT89S52 Microcontroller, Emergency Alert System

I. INTRODUCTION

Personal safety, particularly for women and children, has become a growing concern worldwide. Despite advancements in technology, crimes such as harassment, kidnapping, and physical abuse continue to occur. These incidents highlight the urgent need for technological solutions that can help protect vulnerable individuals.

The development of wearable safety devices has gained significant attention in recent years. Many devices currently available rely on wireless technologies such as Wi-Fi or Bluetooth, but these technologies have limited range and reliability. To overcome these limitations, this research proposes a safety system that utilizes GSM and GPS technologies, which provide wider coverage and reliable communication.

The proposed device functions as a personal safety tracker. When activated during an emergency, the device determines the user's geographical location and sends it via SMS to authorized contacts. Since GSM networks are widely available, the system can operate almost anywhere.

This project focuses on designing a compact embedded system that integrates microcontroller technology, GPS location tracking, and GSM communication to create an efficient and reliable safety device.

II. LITERATURE REVIEW

Various tracking systems have been developed using GPS and GSM technologies. Many of these systems are used in vehicle tracking, fleet monitoring, and asset tracking. However, adapting these technologies for personal safety devices presents unique challenges such as portability, power efficiency, and ease of use.

Existing wearable safety systems often depend on smartphone applications. However, smartphone-based solutions may fail due to battery drain, lack of network connectivity, or user inability to unlock the device during emergencies.



Research studies have shown that embedded GPS–GSM systems offer a more reliable alternative for real-time location tracking. Such systems can operate independently without requiring a smartphone, making them suitable for personal safety applications.

Women’s safety has become an important research area due to the increasing number of crimes and harassment cases worldwide. Researchers have proposed various technological solutions such as AI-based monitoring systems, IoT-enabled devices, wearable safety technologies, and intelligent mobile applications to enhance women’s protection and provide real-time emergency assistance.

Location tracking is a key component in many safety systems. The Global Positioning System (GPS) allows devices to determine their exact geographic position using signals from satellites. Kaplan and Hegarty explained the principles and working mechanisms of GPS technology, highlighting its capability to provide accurate location data for navigation and tracking applications. In women safety systems, GPS modules are used to continuously monitor the user’s location and transmit it during emergency situations to enable rapid response from family members or authorities [5].

Communication technologies also play a significant role in safety applications. The Global System for Mobile Communications (GSM) provides wireless communication services such as voice calls and Short Message Service (SMS). Mouly and Pautet described the architecture and functionality of GSM networks, emphasizing their ability to support reliable mobile communication across wide geographical areas. In safety systems, GSM modules are often used to send distress alerts and location information to predefined contacts when a panic button is triggered [7].

Embedded systems are essential for implementing wearable safety devices. The AT89S52 microcontroller, developed by Atmel Corporation, is commonly used in embedded applications due to its simplicity, low power consumption, and efficient performance. According to the AT89S52 datasheet, the microcontroller provides multiple input/output ports, timers, and serial communication capabilities, allowing it to interface with external devices such as GPS receivers and GSM modules. This makes it suitable for building compact safety devices like smart wristbands and portable monitoring units [1].

To ensure proper communication between GPS modules and embedded systems, standard communication protocols are required. The NMEA 0183 protocol, developed by the National Marine Electronics Association, defines a standard format for transmitting navigation data such as latitude, longitude, speed, and time information. Using this protocol, microcontrollers can interpret GPS data and process it for tracking and emergency alert applications [8].

With the advancement of modern technologies, researchers have begun integrating Artificial Intelligence (AI), Internet of Things (IoT), and wearable technologies into women safety systems. Bhavani and Karthikeyan proposed an AI-based mobile application that analyzes environmental conditions and user behavior to detect potential threats and automatically trigger emergency alerts [2]. Similarly, Sharma and Gupta developed an AI and IoT-based mobile application that integrates smart sensors and communication modules to provide real-time monitoring and quick response during emergencies [11].

IoT-based safety monitoring systems have also gained significant attention in recent years. Ramesh et al. proposed a smart monitoring system that collects sensor data from wearable devices and transmits it through cloud platforms to provide real-time tracking and alert mechanisms [10]. Patel and Shah introduced an IoT-based safety analyzer that processes sensor data and identifies potential risk situations to improve response time and safety management [9].

Another important approach involves the use of computer vision and surveillance technologies to enhance public safety. Gupta and Jain developed an advanced surveillance system that uses computer vision techniques to detect suspicious activities and abnormal behavior in public areas, enabling faster intervention by security authorities [4].

Wearable technologies such as smart pendants and intelligent wristbands have also been proposed as effective personal safety devices. Sharma and Mishra designed an AI-driven smart pendant that monitors health parameters and detects emergency conditions, automatically sending alerts with location information to trusted contacts [12]. Similarly, Mehta and Patel developed an intelligent safety wristband that integrates sensors, GPS tracking, and communication modules to provide quick emergency response and improved personal security [6].



Recent studies have also explored the integration of AI, blockchain, and real-time monitoring systems to enhance data security and system reliability. Das and Kumar proposed an advanced personal security application that combines AI-based threat detection with blockchain technology to ensure secure storage and transmission of emergency data [3]. Furthermore, Verma and Singh discussed the role of AI-enhanced wearable technologies in revolutionizing women safety systems by enabling continuous monitoring and predictive analysis of potential threats [15]. Although significant progress has been made in the development of women safety systems, several challenges still exist, including false alarm detection, energy consumption of wearable devices, and privacy concerns related to data collection and monitoring. Therefore, future research should focus on developing integrated systems that combine AI, IoT, wearable sensors, secure communication technologies, and intelligent data analytics to provide more reliable and effective safety solutions.

III. SYSTEM ARCHITECTURE

The proposed system consists of hardware modules integrated to perform the safety tracking function.

Major Components

AT89S52, Microcontroller, GPS

Receiver, Module, GSM Modem, Emergency Push Button,

LCD Display, Power, Supply Unit, RS-232 Interface

Working Principle

1. The system continuously monitors the emergency switch.
2. When the user presses the switch during an emergency, the microcontroller activates the GPS module.
3. The GPS module determines the latitude and longitude coordinates of the device.
4. The microcontroller processes the location data.
5. The GSM modem sends an SMS alert containing the location coordinates to predefined phone numbers.
6. The receiver can use these coordinates in Google Maps to identify the exact location.

Fig 1 Shows the architecture of proposed model and it contains various modules :

Arduino, Gsm module, buzzer, key, heartbeat, sensor, gps module

Arduino (Main Controller)

Arduino is the brain of the system.

It receives data from sensors and controls other modules.

It processes the heart rate data and decides when to send alerts.

Functions:

Reads heart rate sensor data

Controls GSM and GPS modules

Activates buzzer in emergency

Reads input from the key button

Heart Beat Sensor

This sensor measures the heart rate (pulse) of the person.

It sends the pulse signal to the Arduino. Working:

Sensor detects heartbeat using light reflection through skin.

Signal is sent to Arduino.

Arduino calculates BPM (Beats Per Minute).

If BPM is too high or too low, Arduino triggers an alert.

GPS Module

GPS (Global Positioning System) provides the location coordinates of the patient.



Data Provided:

Latitude

Longitude

Location information

This location is used when sending emergency messages.

GSM Module

GSM module sends SMS messages or calls using a SIM card.

Purpose:

Send emergency SMS to family or doctor.

Message may include:

Heart condition alert

GPS location link

Example message:

Emergency! Trapped In An Unknown Location:

<https://maps.google.com/?q=LAT,LO NG>

Buzzer

The buzzer acts as an alarm system.

It alerts people nearby when an abnormal heart rate is detected.

When it activates:

Abnormal heart rate

Emergency button pressed

Key (Emergency Button)

This is a manual switch.

If the person feels unwell, they can press the key.

When pressed:

Arduino activates the buzzer.

GSM sends emergency SMS.

GPS location is attached. Overall Working of the System

Heart Beat Sensor measures the pulse continuously.

Sensor sends data to Arduino.

Arduino checks if the heart rate is normal.

If abnormal:

Buzzer turns ON

GPS gets location

GSM sends SMS alert

If the Key button is pressed, the same emergency process starts.



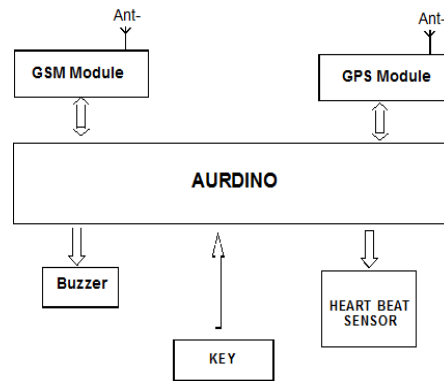


Fig 1 : Architecture of ISSWS

This architecture ensures fast emergency communication and accurate location tracking.

IV. METHODOLOGY

4.1 Microcontroller Interface

The AT89S52 microcontroller acts as the central processing unit of the system. It coordinates communication between the GPS module and GSM modem using serial communication.

Key features include:

8 KB Flash memory

256 bytes RAM

32 I/O pins

Full duplex UART communication

Low power operation

4.2 GPS Module

The Global Positioning System (GPS) is used to determine the precise location of the device. GPS satellites transmit signals that allow the receiver to calculate its position using trilateration.

The GPS module provides data in NMEA format, including:

Latitude

Longitude

Time

Satellite information

The system extracts only the latitude and longitude coordinates for transmission.

4.3 GSM Communication

The GSM modem enables communication through SMS. It receives commands from the microcontroller using AT commands via serial communication.

The GSM module performs two primary tasks:

Sending emergency SMS alerts

Receiving SMS requests for location information

4.4 Serial Communication

Communication between modules uses the RS-232 protocol. A MAX232 converter is used to convert voltage levels between the microcontroller and GSM modem.



V. IMPLEMENTATION

The hardware prototype integrates all components into a compact module. The device can be designed in wearable form such as a wristband or portable gadget.

The operational steps include:

1. Powering the device using regulated DC supply.
2. Initializing GPS and GSM modules.
3. Monitoring the emergency switch.
4. Collecting GPS data upon activation.
5. Sending the location information via GSM SMS.

The device can also respond to SMS commands such as "LOCATION" to provide real-time coordinates.

VI. RESULTS AND DISCUSSION

The proposed system was tested under different environmental conditions. The results indicate that the GPS module successfully detects location coordinates with reasonable accuracy. The GSM module reliably sends SMS alerts within seconds after activation.

Observed Performance

GPS location accuracy: 50–100 meters

SMS transmission time: 5–10 seconds

Reliable GSM communication coverage

The system effectively provides real-time location tracking during emergency situations. It is suitable for use in urban as well as rural environments where GSM coverage is available.

VII. APPLICATIONS

The system can be applied in several areas including:

Women safety monitoring

Child tracking systems

Elderly care monitoring

Personal emergency response devices

Security tracking systems

It can also be adapted for vehicle tracking, asset monitoring, and rescue operations.

VIII. ADVANTAGES

Low-cost implementation

Real-time location tracking

Wide communication coverage using GSM

Portable and wearable design

Easy to operate during emergencies

IX. CONCLUSION

This research presents the design and implementation of an Intelligent Safety System for Women and Children using GPS and GSM technologies. The system provides a reliable and efficient method for transmitting location information during emergency situations.

The integration of GPS tracking and GSM communication ensures that the user's location can be quickly shared with authorized contacts or authorities. The proposed system is affordable, portable, and easy to use, making it suitable for real-world safety applications.



Future improvements may include integrating mobile applications, IoT connectivity, and advanced sensors to enhance the functionality and accuracy of the system.

REFERENCES

- [1] Atmel Corporation, "AT89S52 Microcontroller Datasheet," Atmel Corporation, 2008.
- [2] R. Bhavani and P. Karthikeyan, "AI-based mobile application for women safety," *International Journal of Computer Applications*, vol. 178, no. 7, pp. 30–34, 2019.
- [3] K. R. Das and P. Kumar, "Advanced personal security application for women using AI, blockchain and real-time monitoring," *IEEE Internet of Things Journal*, vol. 10, no. 8, pp. 6543–6551, 2023.
- [4] A. Gupta and S. Jain, "Advanced surveillance system for women safety using computer vision," *IEEE Access*, vol. 9, pp. 145231–145240, 2021.
- [5] E. Kaplan and C. Hegarty, *Understanding GPS: Principles and Applications*, 2nd ed. Boston, MA, USA: Artech House, 2006.
- [6] D. Mehta and S. Patel, "Intelligent safety wristband designed for women protection," in *Proc. International Conference on Embedded Systems and IoT*, 2022, pp. 67–72.
- [7] M. Mouly and M. B. Pautet, *The GSM System for Mobile Communications*. Telecom Publishing, 1992.
- [8] National Marine Electronics Association, "NMEA 0183 Standard for Interfacing Marine Electronic Devices," National Marine Electronics Association, 2002.
- [9] N. K. Patel and S. Shah, "IoT-based smart safety analyzer for women," *International Journal of Advanced Computer Science and Applications*, vol. 12, no. 3, pp. 321–326, 2021.
- [10] M. V. Ramesh, S. Anand, and R. Chandra, "IoT-based smart safety monitoring system for women," in *Proc. IEEE International Conference on Smart Technologies*, 2020, pp. 245–249.
- [11] S. K. Sharma and A. Gupta, "AI and IoT based mobile application for women safety," *International Journal of Engineering Research & Technology*, vol. 9, no. 6, pp. 850–854, 2020.
- [12] R. K. Sharma and P. Mishra, "AI-driven smart pendant for women's safety and health monitoring," *International Journal of Smart Sensor and Ad Hoc Networks*, vol. 2, no. 4, pp. 15–20, 2022.
- [13] P. Singh and R. Verma, "Design of real-time intelligent system for women safety," in *Proc. International Conference on Computing and Communication Systems*, 2021, pp. 112–116.
- [14] W. Stallings, *Data and Computer Communications*, 8th ed. Upper Saddle River, NJ, USA: Pearson Education, 2007.
- [15] S. Verma and N. Singh, "AI-enhanced wearable technologies: Revolutionizing women's safety with real-time monitoring," *IEEE Sensors Journal*, vol. 23, no. 4, pp. 3210–3218, 2023.

