IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 2, November 2025
Impact Factor: 7.67

IoT-Powered Personal Emergency Safety System

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Abstract: *In a world where women's safety remains a major concern, there is an urgent need for proactive solutions that can provide real-time assistance during emergencies. Traditional mobile applications and emergency contact numbers, while useful, rely heavily on user interaction and internet connectivity, which may not always be accessible in high-stress situations. This project proposes a practical, standalone, and IoT-based solution titled "IoT Powered Personal Emergency Safety System", designed to address these limitations.*

Keywords: IoT Technology, Women Safety Device, ESP32, voice recording, GPS, Emergency situations

I. INTRODUCTION

Even in today's scenario, women's security is a serious global concern that needs urgent attention. Women are an integral part of society, and for the progress of society, the active participation of women is necessary. Today, women lead every sector of the world, including social, political, economic and cultural. Although the constitution provides equal rights to women in society but there is still a discrepancy exists in society. The violence against women is increasing both in urban and rural areas in every country across the globe. As per the report of WHO (World Health Organisation), 30% women worldwide have faced violence (UN News, 2020). According to NFHS (National Family Health Survey) 32% of married women in India have faced violence (IIPS, 2021). The National Crime Records Bureau of India showed an increase in crime against women by 15.3% in 2021 in comparison with the year 2020 (NCRB, 2021). These figures indicate the seriousness of the situation. The significant rise in crimes against women necessitates the development of an effective solution to provide complete safety to women. This work aims at developing the women's safety device, which requires a study of existing women's safety devices for identifying gaps to develop the hardware. The advanced technology can be utilised to develop the women's safety device. Internet of Things (IOT) is a new technology that has brought a paradigm shift in the modern world. IOT provides the physical network of connected devices and the exchange of data between these devices and the cloud.

II. LITERATURE REVIEW

V. Hyndavi et al in "Efficient tracking for women safety and security using IoT ". Specifies a smart intelligent device which automatically senses information and helps women in "Every single step of life". The device is the integration of multiple devices that comprises a wearable smart-band and a secret webcam via Bluetooth, which continuously tracks the information and communicates with smartphones that have access to the internet. The application is programmed and embedded in such a way that tracks information of the women, such as call log, messages, movement, pulse measurement, blood oxygen levels, heart beat rating and records continuously on the internet. When the SOS present in the smart band is pressed continuously, it automatically generates signals to the predefined smartphones and nearest police station along with location coordinates, and the secret webcam in the locket captures the culprit's photo, which is directly uploaded to the server [1]

S. A. More et al in "Smart Band for Women Security Based on Internet of Things (IOT)" specify a smart band and an Android application. This project works automatically based on the pulse sensor and the temperature sensor. This application uses pulse readings of that woman and protect her. If she is in danger, then an emergency message is sent to the 4 family members and the nearby police station with the GPS location of the victim. Also, this emergency message

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is sent on the application, so it provides a social platform. This paper includes comparing data from the sensors with the training dataset. If variation occurs, then a message will be sent to nearby police, family, and friends along with the GPS location to provide security to the women in danger. The women will be monitored with a wearable pulse rate sensor and temperature sensor. The values from the sensor per 10 seconds will be sent to the server. The server will consist of a training data set with normal values of pulse rate and temperature according to the age group. If any abnormal value is encountered, then an alert message will be sent to the woman holding the wearable device, considering a few situations, like she might be in stress or jogging [2]

Naeemul Islam et al in "Design and Implementation of Women Auspice System by Utilising GPS and GSM" specify a device that sends SMS and area directions of the client to the relatives of the client or a helpline number is proposed. In this system, we have used a GPS module to access the location of the user instantly. Three push buttons are implemented to define the types of accident victims is facing. When the user faces any hassles in any place, it can push any of these three buttons. The microcontroller will receive it and send an SMS to the specific phone number. The location of the user will be continuously traced until the user switches off the system when rescued. In addition, to control the whole system, we have used a PIC16F887A microcontroller powered by four AA batteries. The PIC16F876A microcontroller is the main driver of this system [3]

B. Vijaylakshmi et al, in "Self Defence System for Women's safety with Location Tracking and SMS alerting through GSM network", specify a smart portable device that can track the current location of the victim. When they feel insecure, their heartbeat increases, which can be measured by the pulse sensor and their stress level is monitored, and women may be able to convey the misery message through our smart device to the trusted contacts and the cops. Such smart security devices can give quick responses to emergencies and prevent women from potentially shocking experiences. In addition to this, it can monitor certain parameters like haemoglobin level of blood, the oxygen level in the blood, pulse rate, and stress. The main advantage of this device is small and easy to carry. The use of sophisticated components in this device gives more accuracy, and it is more reliable [4].

R.A. Jain et al in "Smart Self-Defence Gadgets For Women's safety using IOT" specify a portable/wearable device, used to secure women in an emergency situation, either the design has an internet connection or without internet connection. Whenever the system receives an emergency alert, it is ready to send the received message using GSM to emergency contacts (neighbour's contact, friends, relatives, parents, cloud. Disadvantages of those gadgets used for safety are that without an internet connection, they don't have a chance to send an emergency message to emergency contacts like Police Station, Ambulance, Fire Station, Relatives, Friends, Neighbours and Parents. So in that case, IOT is very useful to connect a device and humans. But this proposed method and system overcome the need for an internet connection [5]

III. PROBLEM STATEMENT

The IoT-Powered Personal Emergency Safety System is a technologically advanced solution that combines multiple functionalities into a compact, user-friendly device designed to protect and assist users in times of danger.

IV. METHODOLOGY

The proposed IoT-powered personal emergency safety system is developed using a single-controller architecture centred around the ESP32 microcontroller, which manages sensing, processing, and communication tasks. The ESP32 is selected due to its integrated Wi-Fi/Bluetooth connectivity, low power consumption, and suitability for wearable embedded applications. A NEO-6M GPS module is interfaced with the ESP32 to obtain real-time location coordinates, while a MAX9814 microphone amplifier module is incorporated to record surrounding audio as supporting evidence during emergencies. A 12 V battery, along with a power regulation circuit, ensures portable and continuous operation of the wearable device.

A voice-triggered activation mechanism is implemented to enable hands-free emergency initiation. The system continuously monitors for a predefined keyword or distress command. When an emergency trigger is detected, the ESP32 immediately switches to SOS mode, captures live GPS location data, and begins recording ambient audio. The acquired data is then transmitted via Wi-Fi to a cloud server (Firebase/Google Cloud Storage), where both location

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coordinates and audio files are stored with time stamps. Simultaneously, the system sends real-time alerts to pre-configured emergency contacts through a mobile or web interface, enabling live tracking of the user's movement on a map.

To ensure secure and reliable data transfer, encrypted communication protocols and authenticated cloud access are employed. The system undergoes performance evaluation across different environments such as open outdoor spaces, semi-urban areas, and indoor conditions to analyse parameters including GPS accuracy, response latency, audio clarity, and battery efficiency. The results are used to fine-tune network handling and event-trigger thresholds to reduce false activations and improve consistency. Through this methodology, the system ensures reliable emergency alerting, continuous monitoring, and preservation of digital evidence to support personal safety in real-world scenarios.

V. SYSTEM ARCHITECTURE

Hardware Requirement :

Component	Function	Specification
ESP32 Development Board	Main microcontroller for system control, Wi-Fi, and data processing.	Dual-core processor, 240 MHz, 3.3V logic, Wi-Fi & Bluetooth support
GPS Module	Captures real-time geographic location	Accuracy ±2.5 m, Baud rate 9600, Supply 3.3–5V
Sound Sensor	Detects loud sound or voice for automatic trigger	Adjustable sensitivity, Analog output
Push Button	Manual trigger for emergency alert	Normally open type, 5V logic input
Audio Recorder Module	Records audio evidence during an emergency	I2S interface (INMP441) /Standalone mic recording
Relay Module	Controls connected output devices (e.g., buzzer, siren)	5V coil voltage, 10A current rating
Power Supply (LM2596 Buck Convertor)	Converts 12V input to 5V regulated output	Input: 7–35V, Output: 5V
Cables And Connectors	Connects all components safely	Jumper wires, soldered joints

Software Requirements:

Software	Purpose
Arduino IDE	Used to program the ESP32 microcontroller
Firebase Cloud Database	Stores SOS alerts, coordinates, and status data
Telegram / WhatsApp API	Sends alert messages to registered contacts
Google Apps Script	Automates message delivery via Email or WhatsApp
IoT Dashboard	Visual display for monitoring system logs
Serial Monitor / Debug Tools	Used for data testing and debugging

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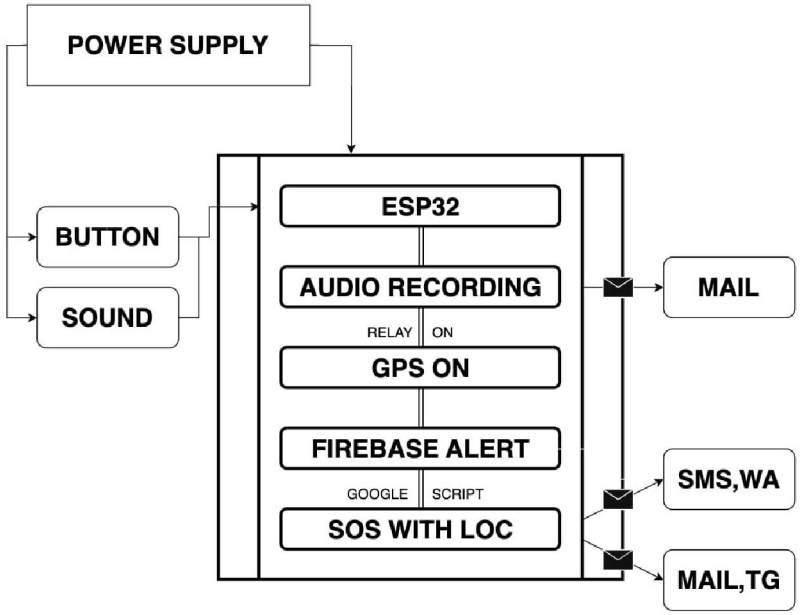
VI. BLOCK DIAGRAM

The block diagram of the proposed IoT-Powered Personal Emergency Safety System is shown in Fig. below.



VII. RESULT

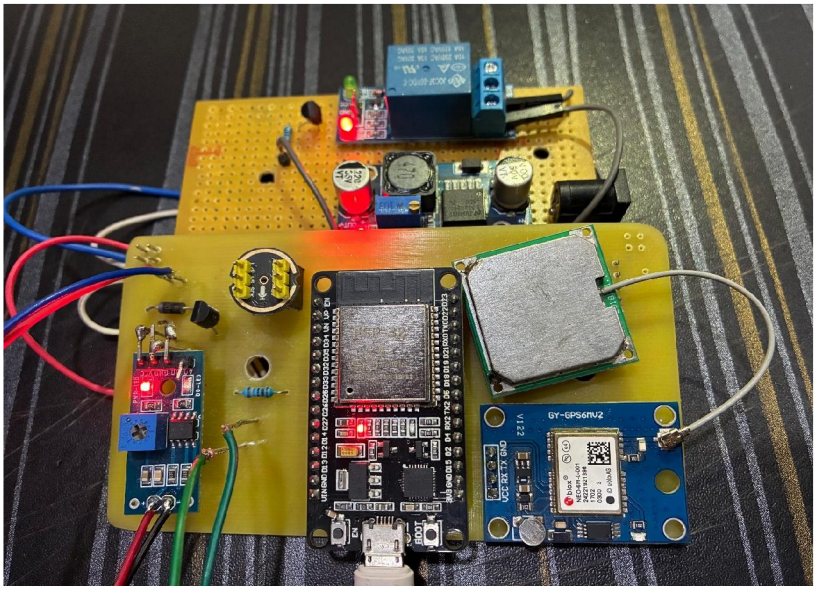


Fig7.1: Final Result

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VIII. CONCLUSION

This study focuses on the development of a women's security system that provides safety to women so that women can use these devices as and when required while facing social challenges.

It was observed that IoT-based devices offer innovative features, including sensors for making them smart devices. Still, there are a few gaps that affect the widespread use of these devices. To address those gaps, the solution is provided in this paper to make the device more effective. Furthermore, the developed paper provides a self-defence tool to women to move confidently in society. This device is developed by taking into account all possible ways of attack and possible ways for easy defence. The device is automatically operated by sound or can also be activated using the manual button. The text messages and location details will be sent to the registered mobile no. along with a 20-second voice recording upon activation of the device using the GPS technique. Thus, this device will provide enhanced protection to women.

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