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Empowering Women's Safety with Smart IOT Technology

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ABSTRACT

The cases of missing children and women are a major concern now a days. This project talks about the android applications which has features of tracking the children and women the exact location of victim can be tracks by gps service. Gps will be used for network services and it also provides internet. The microcontroller that can sense and control object in the victim's module. The project is aimed to prevent child kidnapping and women trafficking and it monitors the mentally handicapped persons.

It is a real time implementation. This system is designed for parents and children. The system consists of gps node microcontroller and alert button also be included in the system. Child module and parent module will be connected to web server. Thus, the web server will act as a middle ware between two modules. Parents side is having an Android smartphone and child will have the tracking system. ESP32 microcontroller will be used for interaction between the tracking device and web server. The proposed work will monitor the child from any location and distance from the parent. With the use of an Android phone and gps tracking device the Android phone will be with parents which include the application and tracking device will be put firm in the child's backpack. An alert button will be installed on the tracking device which when pressed will send an alert to the parent indicating that the child is in danger.

1-INTRODUCTION

This chapter introduces the alarming rise in kidnappings and emphasizes the need for real-time tracking solutions for women and children using IoT technologies. The aim and motivation behind building a safety device using GPS and ESP32 are highlighted.

The primary aim of this project, titled "Empowering Women Safety with Smart IoT Technology," is to develop a smart GPS-based tracking and alert system to enhance the safety of women, children, and mentally challenged individuals. With an alarming rise in cases of abductions and trafficking, this system provides a reliable, portable, and real- time tracking solution. By utilizing GPS, ESP32 microcontroller, and a mobile application, the project bridges the gap between the user and their guardian through continuous location monitoring and instant alert notifications.

The system ensures that the exact location of a person in danger can be identified via GPS, which interacts with a web server to send real-time updates to a guardian's Android smartphone. An alert button in the device notifies guardians immediately in emergencies. This solution is envisioned to play a vital role in preventing unfortunate incidents and offering peace of mind to guardians.

84% over three years, with 180 children being kidnapped daily across India. This alarming statistic highlights the critical need for advanced safety mechanisms.

Parents and guardians face constant anxiety over their loved ones' safety, especially in urban areas. Existing systems often fail to provide real-time connectivity andemergency responses. This project seeks to create a cost-effective, user-friendly device that leverages IoT and GPS technologies to ensure safety, offering a much-needed technological intervention to mitigate the growing risks faced by women and children.

2-LITERATURE SURVEY

Introduction The Internet of Things (IoT) is the network of physical objects—devices, vehicles, buildings and other items embedded with electronics, software, sensors, and network connectivity that enables these objects to collect and exchange data. The IoT allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit; when IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, smart homes, intelligent transportation and smart cities. Each thing is uniquely identifiable through its.

The project "Empowering Women Safety with Smart IoT Technology" builds on advancements in the Internet of Things (IoT) and embedded systems to enhance personal security. IoT involves the interconnection of physical devices embedded with sensors, electronics, and connectivity for seamless data sharing. The global adoption of IoT is projected to expand significantly, with over 50 billion devices connected by 2025. This growth has revolutionized industries such as healthcare, smart cities, and security.

In this project, GPS technology is a cornerstone. Originally developed for military use, GPS now powers navigation, real-time tracking, and emergency services. Its ability to provide precise location data makes it ideal for personal safety devices. The ESP32 microcontroller was selected for its cost-effectiveness, versatility, and IoT-friendly features like WiFi and Bluetooth connectivity.

Studies highlight the increasing demand for smart safety solutions, especially for women and children. Integrating IoT, mobile apps, and affordable hardware addresses these challenges and creates a robust security framework.

3-INTRODUCTION TO EMBEDDED SYSTEMS

This chapter explains the concept of embedded systems and their critical role in real- time control applications like safety and automation. It covers microcontrollers, components, and their features.

Characteristics of an Embedded System

1. Single-functioned – An embedded system usually performs a specialized operation and does the same repeatedly. For example: A pager always functions as a pager.
2. Tightly-constrained – All computing systems have constraints on design metrics, but those on an embedded system can be especially tight. Design metrics is a measure of an implementation's features such as its cost, size, power, and performance. It must be of a size to fit on a single chip, must perform fast enough to process data in real time and consume minimum power to extend battery life.
3. Reactive & Realtime – Many embedded systems must continually react to changes in the system's environment and must compute certain results in real time without any delay. Consider an example of a car cruise controller; it continually monitors and reacts to speed and brake sensors. It must

compute acceleration or de-accelerations repeatedly within a limited time; a delayed computation can result in failure to control of the car.

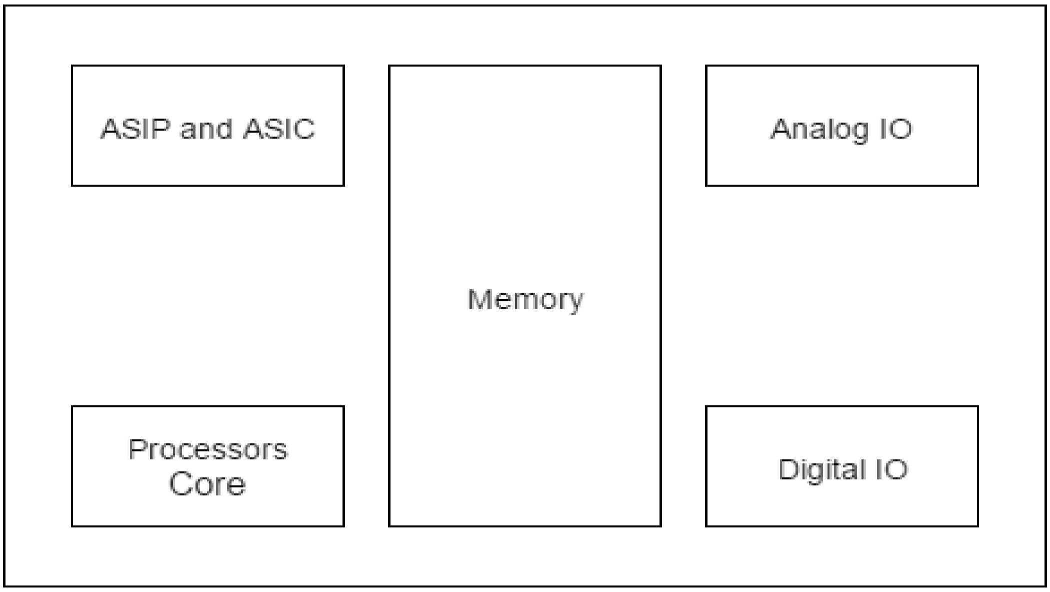

Fig 1 HW-SW Systems

3-BLOCK DIAGRAM

This chapter presents the overall block diagram of the safety device, detailing how each component interacts to provide tracking and emergency alerts.

Block Diagram

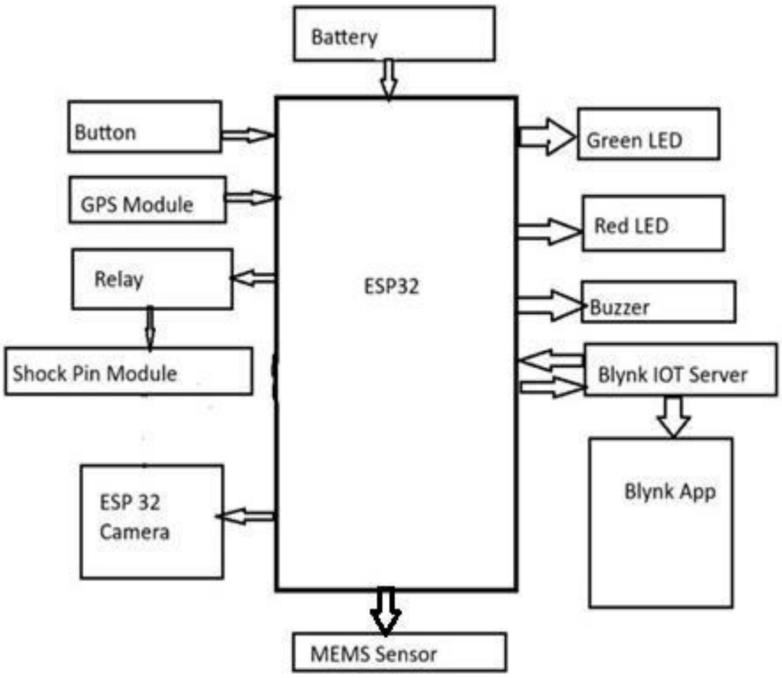

Fig 3.1 Block Diagram

Working

The project integrates IoT and embedded system components to provide real-time tracking and emergency alert services for enhancing the safety of women, children, and mentally challenged individuals. The system operates as follows:

1. Device Setup:

- The core components include an ESP32 microcontroller, GPS module, push button, LEDs (red and green), and a buzzer.
- The tracking device is compact and portable, designed to be carried in a bag or worn by the user.

2. Real-Time Location Tracking:

- The GPS module continuously tracks the user's location and sends the data to the ESP32 microcontroller.
- The ESP32 processes the data and transmits it to a web server through WiFi or mobile network connectivity.
- The web server relays the location data to a connected Android application on the guardian's smartphone, allowing them to monitor the user's exact location in real time.

3. Emergency Alert Mechanism:

- In case of danger, the user can press the alert button on the device.
- This action triggers the ESP32 microcontroller to send an emergency signal to the web server, which notifies the guardian via the Android app.
- Simultaneously, the red LED on the device lights up, and the buzzer is activated to attract immediate attention.

4. Safety Indication:

- The system uses LEDs to indicate the user's status:
  Red LED: Indicates the user is in danger.
  Green LED: Indicates the user is in a safe location

5. Communication:

- The ESP32 acts as the central processing unit, ensuring seamless communication between the GPS module, alert system, and Android application.
- The Android app provides a user-friendly interface for guardians to receive alerts and view the real-time location of the user.

6. Power Supply:

- A rechargeable battery powers the device, ensuring portability and continuous operation.
- The battery is designed to last for extended periods, supporting real-time tracking and emergency alerts.

ESP32 Microcontroller

Few years back, ESP8266 took the embedded IoT world by storm. For less than $3, you could get a programmable, Wi-Fi-enabled microcontroller being able to monitor and control things from anywhere in the world. Now Espressif (The semiconductor company behind the ESP8266) has released a perfect super-charged upgrade: the ESP32. Being successor to ESP8266; not only does it have a Wi-Fi support, but it also features Bluetooth 4.0 (BLE/Bluetooth Smart) – perfect for just about any IoT project.

When we think about using a microcontroller for a project, we usually consider an Arduino. It's inexpensive, easy to use and has a generous number of digital I/O ports, and a few analog inputs as well. But the Arduino, for all of its wonderful benefits, is lacking in a number of areas. The first one is speed, the popular Arduino AVR series of boards run at 16 MHz That's certainly fast enough to build thousands of applications, but it's a bottleneck for others.

The Arduino certainly has enough digital outputs and inputs to satisfy most requirements, and its analog inputs are also useful. But adding features like WiFi and Bluetooth requires external components. Let's face it, the Arduino has been around since 2005. That's fifteen years, which in terms of technology is one.

The ESP32 is actually a series of microcontroller chips produced by Espressif Systems in Shanghai. It is available in a number of low-cost modules. The development board equips the ESP-WROOM-32 module containing Tensilica Xtensa® Dual-Core 32-bit LX6 microprocessor. This processor is similar to the ESP8266 but has two CPU cores (can be individually controlled), operates at 80 to 240 MHz adjustable clock frequency and performs at up to 600 DMIPS (Dhrystone Million Instructions Per Second).

4-TECHNOLOGY

This chapter focuses on GPS technology and other supporting components like MEMS sensors and voltage regulators used in the safety device.

GPS (Global Positioning System)

The Global Positioning System (GPS) is a U.S. space-based global navigation satellite system. It provides reliable positioning, navigation, and timing services to worldwide users on a continuous basis in all weather, day and night, anywhere on or near the Earth.

GPS is made up of three parts: between 24 and 32 satellites orbiting the Earth, four control and monitoring stations on Earth, and the GPS receivers owned by users. GPS satellites broadcast signals from space that are used by GPS receivers to provide three- dimensional location (latitude, longitude, and altitude) plus the time.

Working:

GPS satellites circle the earth twice a day in a very precise orbit and transmit signal information to earth. GPS receivers take this information and use triangulation to calculate the user's exact location. Essentially, the GPS receiver compares the time a signal wastransmitted by a satellite with the time it was received. The time difference tells the GPS receiver how far away the satellite is. Now, with distance measurements from a few more satellites, the receiver can determine the user's position and display it on the unit's electronic map.

A GPS receiver needs only three satellites to plot a rough, 2D position, which will not be very accurate. Ideally, four or more satellites are needed to plot a 3D position, which is much more accurate.

The three segments of GPS are the space, control, and user.

a. Space Segment — Satellites orbiting the earth

The space segment consists of 29 satellites circling the earth every 12 hours at 12,000 miles in altitude. This high altitude allows the signals to cover a greater area. The satellites are arranged in their orbits so a GPS receiver on earth can receive a signal from at least four satellites at any given time.

The main purpose of these coded signals is to allow the GPS receiver to calculate travel time of the radio signal from the satellite to the receiver. The travel time multiplied by the speed of light equals the distance from the satellite to the GPS receiver.

b. Control Segment – The Control and monitoring stations

The control segment tracks the satellites and then provides them with corrected orbital and time information. The control segment consists of five unmanned monitor stations and one Master Control Station. The five unmanned stations monitor GPS satellite signals and then send that information to the Master Control Station where anomalies are corrected and sent back to the GPS satellites through ground antennas.

c. User Segment – The GPS receivers owned by civilians and military

The user segment consists of the users and their GPS receivers. The number of simultaneous users is limitless.

GPS Receiver Specifications

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Navigation Features:

Waypoints/icons: 500 with name and graphic symbol, 10 nearest (automatic), 10 (proximity)

Routes: Automatic turn-by-turn routes; 20 manual point-to-point routes with up to 50 points each.

Tracks: Automatic track log; 10 saved tracks let you retrace your path in both directions

Trip computer: Resettable odometer, timers, average and maximum speeds

Alarms: Anchor drag, approach and arrival, off course and proximity waypoint **Tables:** Built-in celestial tables for best times to fish and hunt, sun and moon rise/set based on date and location

Position format: Lat/Lon, UTM/UPS, Maidenhead, MGRS, Loran TDs and other grids, including user grid performance.

Receiver: WAAS enabled, 12 parallel channel GPS receiver continuously tracks and uses up to 12 satellites to compute and update your position.

GPS Accuracy:

1. < 15 meters, 95% typical*
2. Velocity: 0.05 meter/sec steady state

WAAS accuracy:

1. Position: < 3 meters, 95% typical
2. Velocity: 0.05 meter/sec steady state

Dynamics: 6g's

Interfaces: RS232 with NMEA 0183, RTCM 104 DGPS data format and proprietary Garmin

Antenna: Detachable with standard BNC connector

Differential: RTCM-104, WAAS

Physical Size: 5.0"W x 2.3"H x 1.6"D (12.7 x 5.9 x 4.1 cm)

Weight: 9 ounces (255 g) w/batteries

Display: 2.2"W x 1.5"H (5.6 x 3.8 cm), 256 x 160 pixels, high-contrast FSTN with bright backlighting. Switchable orientation.

Case: Fully gasketed, high-impact plastic alloy, waterproof to IEC 529 IPX7 standards

Temperature range: 5° F to 158° F (–15° C to 70° C) **User data storage:** Indefinite, no memory battery required **Power Source:** 8-35v DC, 4 “AA” batteries (not included)

MEMS

MEMS (micro electro-mechanical systems) technology has gone from an interesting academic exercise to an integral part of many common products. But as with most new technologies, the practical implementation of MEMS technology has taken a while to happen. The design challenges involved in designing a successful MEMS product (the ADXL2O2E) are described in this article by Harvey Weinberg from Analog Devices.

In early MEMS systems a multi-chip approach with the sensing element (MEMS structure) on one chip, and the signal conditioning electronics on another chip was used. While this approach is simpler from a process standpoint, it has many disadvantages:

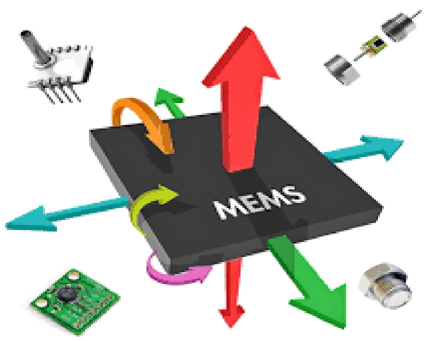

Fig 4.2 MEMS Sensor

5-IMPLEMENTATION

Schematic Diagram and Pin Description

The schematic mainly consists of ESP32, Battery, Push button, GPS tracker, Buzzer, Red LED, Green LED has been used.

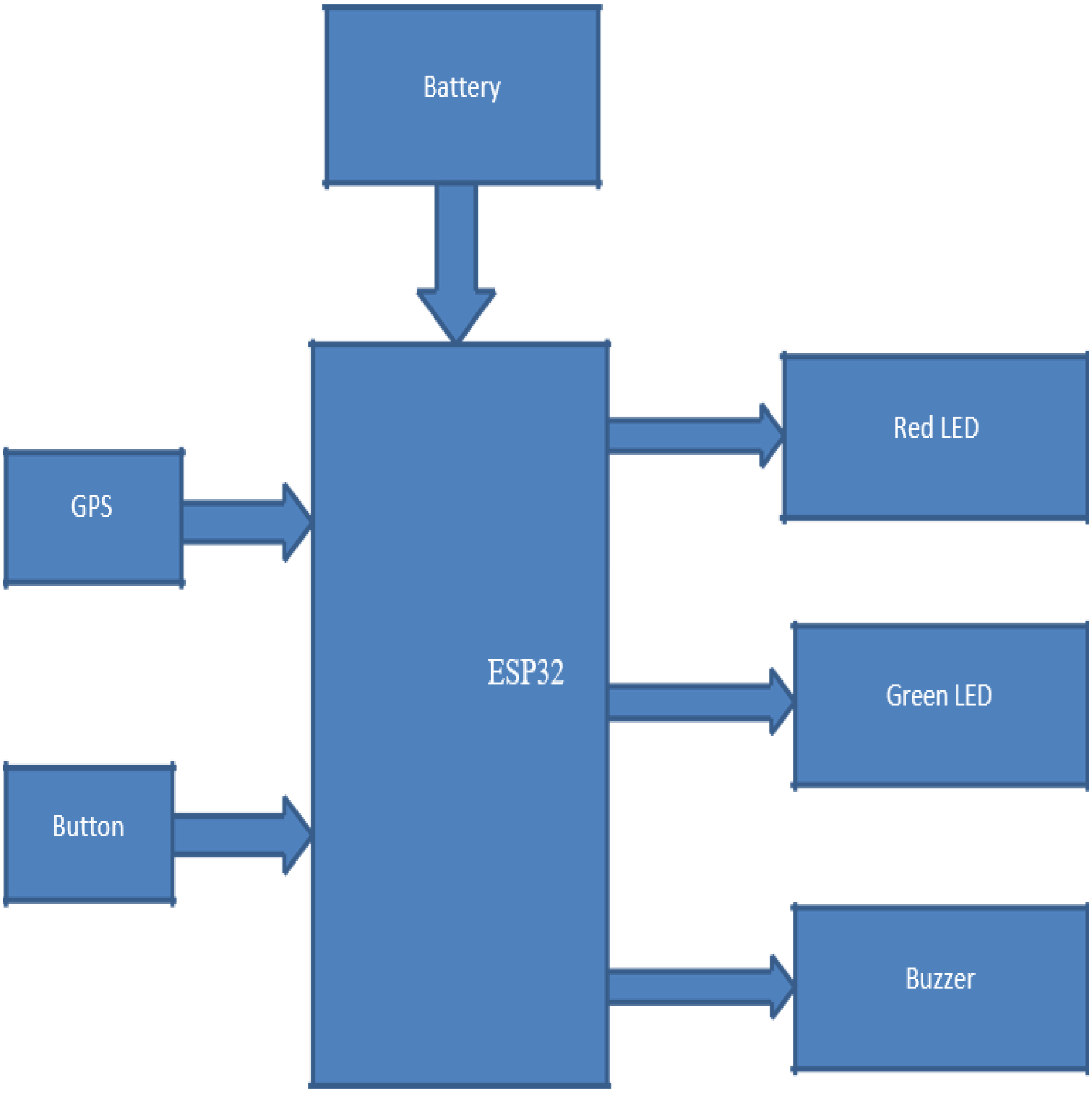

Fig 5.1 Schematic Diagram

GPS Tracker

1. GPS positioning and GPS real time location report to platform server
2. Send location via platform and SMS.
3. Real time tracking for car, truck, motor cycle

Battery

1. A battery is a power source consisting of one or more electro chemical cells with external connections for powering electrical devices such as flash lights, mobiles and electric cars.
2. In this project 9v battery is required.

Buzzer

1. A buzzer or a beeper is an audio signalling device, which may be mechanical, electro mechanical or piezo electric
2. Typical uses of buzzers and beepers include alarm devices, timers, and conformation of user input such as a mouse click or key stroke.

Push Button

1. A push button or simply button is a simple switch mechanism to control some aspect of a machine or a process.
2. Buttons are typically made out of hard material, usually plastic or metal.

LED's

1. When the red led is on, then we have to conclude that the person or children either woman in danger. Otherwise, when green led is on, the person is in safe location.

Arduino IDE Installation

Creating Project in Arduino 1.7.11 Version

In this we will get know of the process of installation of Arduino IDE and connecting Arduino uno to Arduino IDE.

Step 1 – Arduino Board

First, we must have our Arduino board (we can choose our favorite board) and a USB cable. In case we use Adriana UNO, Arduino Duemilanove, Nano, Arduino Mega 2560, or Diecimila, we will need a standard USB cable (A plug to B plug). In case we use Arduino Nano, we will need an A to Mini-B cable.

Step 2 − Download Arduino IDE Software

We can get different versions of Arduino IDE from the Download page on the Arduino Official website. We must select wer software, which is compatible with wer operating system (Windows, IOS, or Linux).After wear file download is complete, unzip the file

Step 3 − Power up our board.

The Arduino Uno, Mega, Duemilanove and Arduino Nano automatically draw power from either, the USB connection to the computer or an external power supply. If we are using an Arduino Diecimila, we have to make sure that the board is configured to draw power from the USB connection. The power source is selected with a jumper, a small piece of plastic that fits onto two of the three pins between the USB and power jacks.

Check that it is on the two pins closest to the USB port.

Connect the Arduino board to wer computer using the USB cable. The green power LED (labeled PWR) should glow.

Step 4 − Launch Arduino IDE

After our Arduino IDE software is downloaded, we need to unzip the folder. Inside the folder, we can find the application icon with an infinity label (application.exe). Double click the icon to start the IDE.

6-RESULT

Phase 1 Output

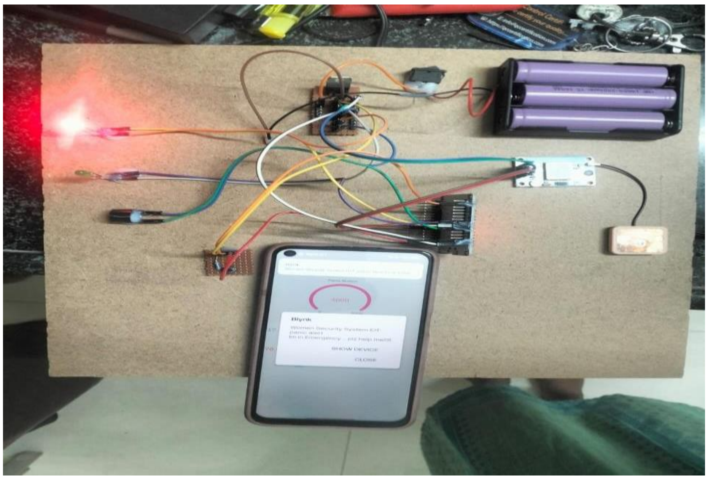

Fig 1 Blynk App Notification

1. When the red led is on, then we have to conclude that the person or children either woman in danger.
2. Otherwise, when green led is on, the person is in safe location.
3. When the child is in danger situation the buzzer will turned on and GPS shows the location of the child.

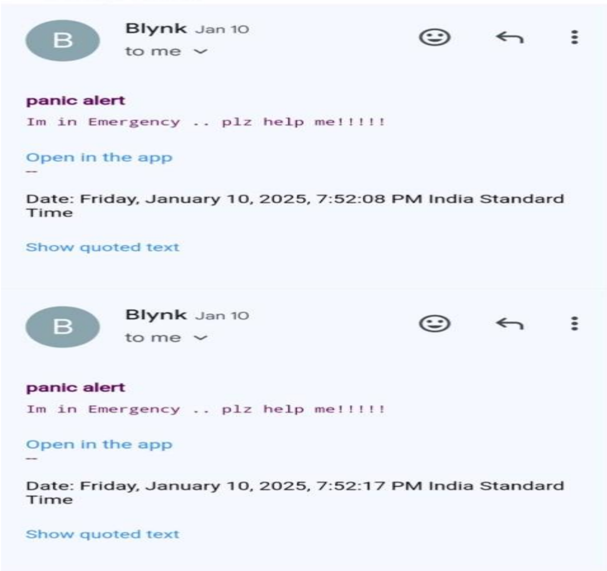

Fig 2 Alert Notification to Email

In Phase 1, we created the basic version of our safety device.

We used an ESP32 board, GPS module, panic button, LEDs, and a buzzer.

When someone presses the panic button, the red light turns on, the buzzer makes noise, and a message is sent to the guardian's phone using the Blynk app. This message includes the person's location, so help can reach them quickly.

This phase helped us check that the alert system works correctly, and that the device can send a message to a phone when there is an emergency.

Phase 2 Output

In Phase 2, we made the system smarter and more protective.

We added a shock pin module that gives a small electric shock. This can scare or stop an attacker if someone is in danger.

We also added a camera to take a picture or short video during the emergency, which can help later as proof.

We included a fall detection sensor that can automatically send an alert if the person suddenly falls or faints — even if they can't press the button.

So, Phase 2 makes the device more advanced and helpful in real-life situations.

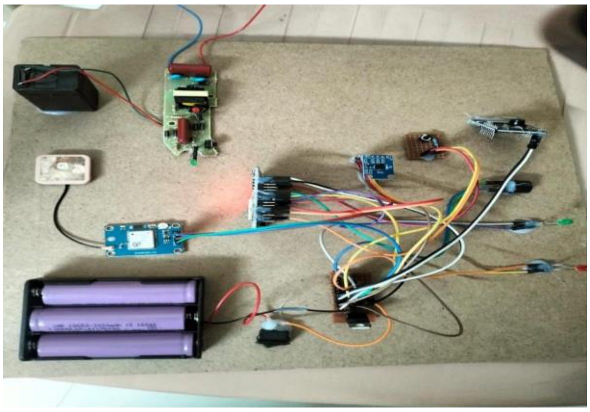

Fig 3 Shock Pin Module

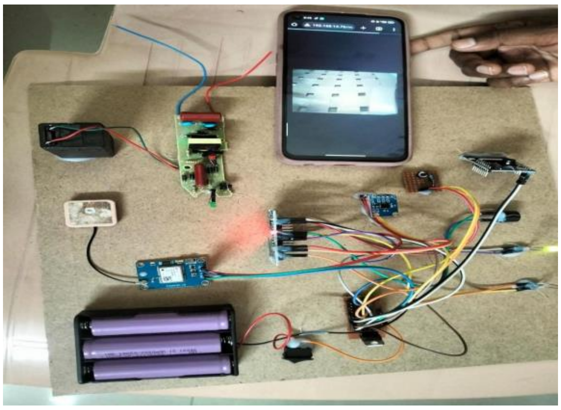

Fig 4 Camera On

In Phase 2 of the project, the safety system was upgraded to offer more advanced protection and responsiveness in critical situations. The enhancements included the integration of a shock pin module, an ESP32-CAM camera module, and a fall detection sensor. These additions transformed the device from a basic alert system into a smart, responsive safety solution capable of acting independently during emergencies. When a person is in danger and either presses the panic button or falls unexpectedly, the device automatically activates multiple components. The red LED lights up, the buzzer starts ringing to alert nearby people, and simultaneously, the ESP32-CAM camera module is turned on. This module is programmed to power up upon detecting an emergency trigger. It then captures an image or begins a live video stream using Wi-Fi, allowing guardians or authorities to visually assess the situation. The visual data can be sent to a linked server or accessed via an IP address, depending on the implementation.

7-CONCLUSION

The Women Security System project provides an efficient and practical solution for enhancing the safety of women, children, and vulnerable individuals. By combining GPS tracking, real-time alerts, and an easy-to-use mobile application, the system enables guardians or authorities to monitor the user's location and respond quickly in case of emergencies. The integration of ESP32, GPS, and essential indicators like LEDs and a buzzer ensures both affordability and functionality.

Through testing, the system demonstrated reliable performance in accurately locating the user and sending alerts with minimal delay. Although the project has certain limitations such as network dependency and battery constraints, its benefits far outweigh the drawbacks. The device is compact, low-cost, and user-friendly, making it highly suitable for real-life implementation in schools, corporate environments, and personal safety use cases. This project thus represents a meaningful step toward using embedded IoT technology to improve personal security in today's world.

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