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SAFETY DEVICE WITH GPS TRACKING, GSM ALERTS AND CAMERA INTEGRATION

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ABSTRACT

Women's safety has become a critical concern in today's world, necessitating the development of smart security solutions. This project introduces a Women Safety Device that integrates GPS tracking, GSM alerts, camera functionality, and a shock mechanism to provide an advanced real-time safety system. The device is built using a Raspberry Pi Pico, along with a MEMS sensor, which detects sudden movements or forceful impacts, indicating potential distress situations. Upon detecting unusual activity, the system automatically captures images through the integrated camera module and sends an emergency alert containing the victim's real-time location to predefined contacts via the GSM module. Additionally, the device features a shock mechanism that can deliver an electric shock to deter an attacker, providing an immediate self-defence capability for the user. The compact, wearable device is designed for ease of use, portability, and rapid response in emergency situations. This project aims to create an efficient, cost-effective, and reliable personal security solution for women, enhancing their protection and offering a proactive approach to emergency response and self-defense.

1. INTRODUCTION

1.1 Introduction:

We know that India is a most famous country all over the world for its great tradition and culture. It is the country where women are given most respect in the society from the ancient time. Women are given the place of Goddess Lakshmi in the Indian society. In India women works in many different fields like aeronautics, space, politics, banks, schools, sports, businesses, army, police, etc. All the above said are which we actually see in our daily life however behind this there are many crimes against women at home, offices, streets, factories etc. The safety of women is in doubt due to incidents happened in recent years like rape cases, acid attacks, etc. The more fact that "Women hold up half the sky"-they are not given a position of dignity

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and equality. Technologies used: Here we used technologies like, GSM technology, GPS technology, Raspberry Pi Pico software technology. Embedded systems are designed to do some specific task, rather than be a general-purpose computer for multiple tasks. Some also have real time performance constraints that must be met, for reason such as well being and usability; others may have low or no performance requirements, allowing the system hardware to be simplified to reduce costs. An embedded system is not always a separate block - very often it is physically built-in to the device it is controlling. The software written for embedded systems is often called firmware, and is stored in read-only memory or flash connector chips rather than a disk drive. It often runs with limited computer hardware resources: small or no keyboard, screen, and little memory. Wireless communication has become an important feature for commercial products and a popular research topic within the last ten years.

There are now more mobile phone subscriptions than wireline subscriptions. Lately, one area of commercial interest has been low-cost, low-power, and short-distance wireless communication used for \personal wireless networks." Technology advancements are providing smaller and more cost effective devices for integrating computational processing, wireless communication, and a host of other functionalities. These embedded communications devices will be integrated into applications ranging from homeland security to industry automation and monitoring. They will also enable custom tailored engineering solutions, creating a revolutionary way of disseminating and processing information. With new technologies and devices come new business activities, and the need for employees in these technological areas.

Engineers who have knowledge of embedded systems and wireless communications will be in high demand. Unfortunately, there are few affordable environments available for development and classroom use, so students often do not learn about these technologies during hands-on lab exercises. The communication mediums were twisted pair, opticalfiber , infrared, and generally wireless radio. An embedded system is a computer system designed to perform one or a few dedicated functions often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. By contrast, a general-purpose computer, such as a personal computer (PC), is designed to be flexible and to meet a wide range of end-user needs. Embedded systems control many devices in common use today. Embedded systems are controlled by one or more main processing cores that are typically either microcontrollers or digital signal processors (DSP). The key characteristic, however, is being dedicated to handle a particular task, which may require very powerful processors. For example, air traffic control systems may usefully be viewed as embedded, even though they involve mainframe computers and dedicated regional and national networks between airports and radar sites. (Each radar probably includes one or more embedded systems of

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its own.) Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.

1.2 Objective of the Project

The primary objective of this project is to develop a smart and efficient women protection device that provides real-time security and self-defence in emergency situations. The device integrates GPS tracking, GSM alerts, a camera module, a MEMS sensor, and a shock mechanism to ensure rapid response, evidence collection, and personal protection. By integrating these advanced safety features, this project aims to create a reliable, proactive, and life-saving solution for women, empowering them with an automated protection system that enhances personal security in critical situations.

2. LITERATURE SURVEY

Women's safety has become a growing concern worldwide, leading to the development of various technological solutions aimed at ensuring security and emergency response. Several research studies and technological advancements have focused on wearable protected devices, location tracking, GSM-based alert systems, and self-defence mechanisms. This literature survey highlights previous works and existing technologies that contribute to the development of this project. Numerous studies have explored the use of GPS and GSM modules to track an individual's real-time location and send emergency alerts.

According to this survey, integrating GPS tracking with GSM communication ensures immediate assistance by transmitting the victim's location to predefined contacts. Devices such as smart bands and emergency apps have been developed for this purpose. However, many of these systems lack automatic distress detection, requiring manual activation. Studies on Micro Electro Mechanical Systems (MEMS) sensors indicate their efficiency in detecting sudden movements, falls, and forceful impacts. Research from [Source] demonstrates how MEMS sensors can be integrated into wearable devices for automatic distress detection. Existing solutions, however, often suffer from false triggering issues, which this project aims to minimize through proper sensitivity calibration. Modern surveillance systems and safety applications utilize camera modules to capture real-time incidents. Research on embedded camera systems highlights their significance in providing visual proof in emergency situations. The integration of image processing techniques allows for automatic evidence collection, which is a crucial aspect of this project. However, a challenge in previous implementations is the delay in image transmission, which this system addresses by optimizing data handling. Several research papers discuss self-defence mechanisms, such as shock circuits and sound alarms, to deter attackers. Studies show that low-voltage electric shock mechanisms can effectively disrupt an assailant's attack momentarily, giving the

victim time to escape. While existing devices often include manual activation methods, this project improves on them by integrating automatic triggering based on distress detection.

3. PROPOSED SYSTEM

Thus our group actively with project, and we develop this project named as " Women protective Device with GPS Tracking , GSM Alerts & Camera Integration". This integrates GPS tracking, GSM alerts, a camera module, a MEMS sensor, and a shock mechanism to enhance personal security in emergency situations. Unlike traditional safety solutions that require manual activation, this system automatically detects distress using motion and impact sensors and triggers an immediate response.

3.1 WORKING METHOLOGY OF PROPOSED SYSTEM

The system is built using a Raspberry Pi Pico as the core controller, interfacing with multiple modules to perform security functions. A MEMS sensor continuously monitors the user's movement and detects sudden impacts, falls, or forceful struggles. Upon detecting distress, the system automatically triggers an emergency response by activating the following key functionalities. The GPS module determines the real-time location of the user, while the GSM module (SIM800L) sends an SOS alert via SMS and calls to predefined emergency contacts, ensuring immediate assistance. The camera module captures images or records short videos when the system is activated. This visual data serves as crucial evidence in case of an emergency. To deter an attacker, the device is equipped with a shock mechanism that delivers a nonlethal electric shock upon activation. This feature provides the user with a means of self-defence, increasing their chances of escape. The system can be triggered manually by pressing an emergency button or automatically based on MEMS sensor detection, ensuring quick activation even if the victim is unable to press the button. The device is designed to be compact, lightweight, and easy to wear, ensuring that it can be carried conveniently as a wristband, pendant, or clothing attachment.

The system is optimized for low power consumption, extending battery life for prolonged usage. Additionally, the components are affordable and easily available, making the device cost-effective and accessible to a larger audience. The proposed system addresses the limitations of existing safety devices by providing a fully automated, multi-functional, and realtime security solution. With its integrated well-being mechanisms, self-defence features, and real-time alert system, this device aims to enhance women's safety and provide a reliable, proactive approach to emergency response and personal protection.

3.2 BLOCK DIAGRAM

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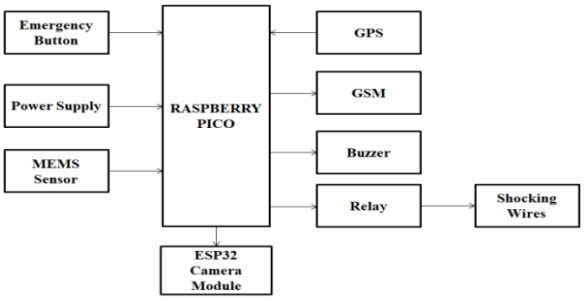

Fig 3.2 : Block diagram of Women Safety Device with GPS Tracking, GSM Alerts and Camera Integration.

4. HARDWARE DESCRIPTION

4.1 POWER SUPPLY

The power supply section is the section which provide +5V for the components to work. IC LM7805 is used for providing a constant power of +5V. The ac voltage, typically 220V, is connected to a transformer, which steps down that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also retains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This regulation is typically achieved using popular voltage regulator ICs.

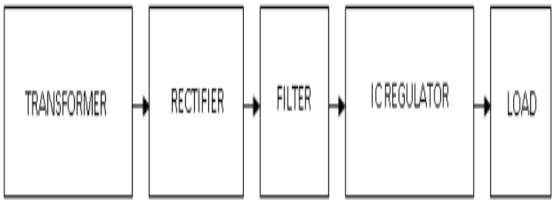

Fig 4.1: Block Diagram of Power Supply

4.1.1 TRANSFORMER

Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC. Step-up transformers increase voltage, step-down transformers reduce voltage. Most power supplies use a step-down transformer to reduce the dangerously high mains voltage (230V in India) to a safer low voltage.

4.1.2 BRIDGE RECTIFIER

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners. Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. the positive potential at point A will forward bias D3 and reverse bias D4.

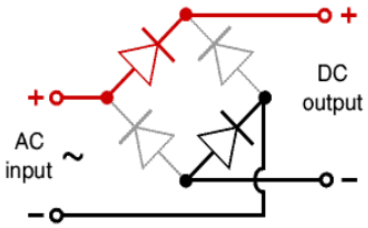

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Fig 4.2 : Bridge Rectifier

The negative potential at point B will forward bias D1 and reverse D2. At this time, D3 and D1 are forward biased.

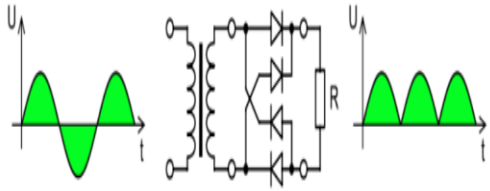

Fig 4.3: Output Waveform of DC

4.1.3 VOLTAGE REGULATORS

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustable set voltage. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts to tens of watts.

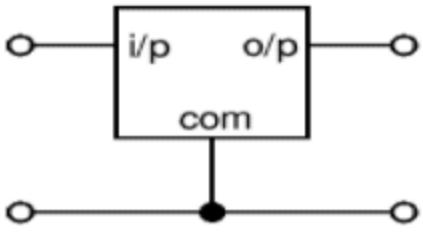

Fig 4.4 : Regulator

4.2 RASPBERRY PI PICO

The Raspberry Pi Pico has proven to be one of the most popular and sought-after versions of the Raspberry Pi since it came out in November 2015. However, many people thought it lacked one very important feature: inbuilt wireless internet. As of today, the Pi Zero lacks it no more: let us introduce you to Raspberry Pi Pico W. The first product introduced from the Raspberry Pi foundation was the size of a credit card, and was designed to plug into a TV or HDMI monitor. The foundation has kept this form factor over the revisions but have increased the performance while keeping the relatively low price point. The GPIO pins on each board allow the use of optional expansion boards. The current price for the model A+ is $20, while the model B+ and Raspberry Pi 2 are both $35 each. Several different minor hardware versions/revisions RaspberryPi Boards have been found probably from different assembly lines. Try to identify your board for better troubleshooting and update it if you have one which is not mentioned. Those who are looking to set up a Raspberry Pi for the first time, see RPi Hardware Basic Setup.

Fig 4.5: Raspberry Pi Pico Board

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4.3 MEMS SENSOR

An accelerometer is an micro-electromechanical device that measures acceleration forces. These forces may be static, like the constant force of gravity pulling at our feet, or they could be dynamic - caused by moving or vibrating the accelerometer. There are many types of accelerometers developed and reported in the literature. The vast majority is based on piezoelectric crystals, but they are too big and to clumsy. People tried to develop something smaller, that could increase applicability and started searching in the field of microelectronics. They developed MEMS (micro electromechanical systems) accelerometers. MEMS accelerometer use nanotechnology in order to enhance the natural abilities common between all accelerators; hence, these devices are extremely fine-tuned and accurate. MEMS stands for Micro Electro Mechanical Systems, and when discussing the technicalities of accelerometers it refers specifically to a mass-displacer that can translate external forces such as gravity into kinetic motion energy. This part of the accelerometer usually contains some type of spring force in order to balance the external pressure and displace its mass, thus leading to the motion that produces acceleration.

Fig 4.6: MEMS Sensor

4.4 GLOBAL POSITIONING SYSTEM(GPS):

(GPS) The Global Positioning System (GPS) is a satellite based navigation system that can be used to locate positions anywhere on earth. Designed and operated by the U.S. Department of Defense, it consists of satellites, control and monitor stations, and receivers. GPS receivers take information transmitted from the satellites and uses triangulation to calculate a user's exact location. GPS is used on incidents in a variety of ways, such as: 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.

Fig 4.7: Global Positioning System

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4.5 GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS (GSM)

Global System for Mobile Communications (GSM) modems are specialized types of modems that operate over subscription based wireless networks, similar to a mobile phone. A GSM modem accepts a Subscriber Identity Module (SIM) card, and basically acts like a mobile phone for a computer. Such a modem can even be a dedicated mobile phone that the computer uses for GSM network capabilities. Traditional modems are attached to computers to allow dial-up connections to other computer systems.

Fig 4.8 : Global System for Mobile Communications

A GSM modem operates in a similar fashion, except that it sends and receives data through radio waves rather than a telephone line. This type of modem may be an external device connected via a USB cable or serial cable. More commonly, it plugs directly into a USB port or card slot on a computer or laptop.

5. RESULTS

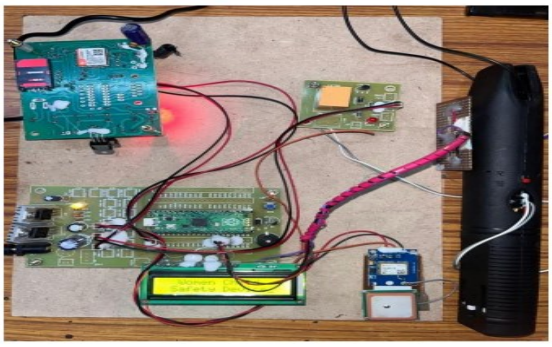

Fig 5.1: Interface of kit

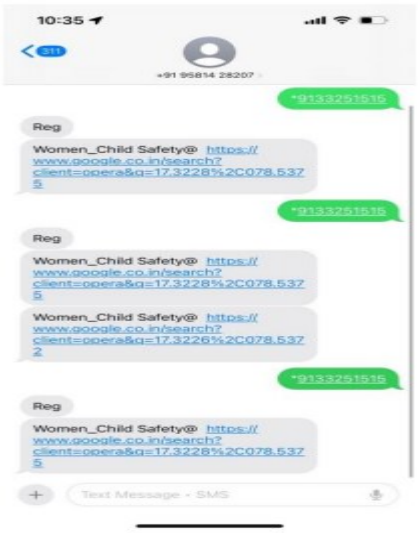

Fig 5.2: SMS sent to mobile

The results of this project demonstrate that when the device detects an emergency, it automatically sends an SOS message via the GSM module. The SMS contains real-time GPS coordinates, allowing emergency contacts to track the victim's location instantly. The GPS module continuously fetches the user's live location. In case of distress, the device sends the location coordinates via SMS to predefined numbers. This enables live tracking and allows responders to reach the location quickly.

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Upon activation, the camera module captures images or records short videos. The images or video data can be stored or sent to emergency contacts, providing visual proof of the incident. This feature helps in post-incident investigations and legal proceedings. If an attacker is detected, the shock mechanism delivers an electric shock, temporarily incapacitating them. This self-defence feature gives the victim a chance to escape from danger. The shock intensity is kept at a safe yet effective level to ensure security without causing serious harm. The device includes an LED indicator and a buzzer to provide audio-visual feedback during activation. Short beep when the emergency button is pressed. Continuous beeping when an SOS alert is sent. If integrated with a mobile application, the device can send alerts as push notifications.

6. CONCLUSION

The Women Safety Device with GPS Tracking, GSM Alerts, Camera Integration, MEMS Sensor, and Shock Mechanism is an innovative and proactive solution designed to enhance personal security in emergency situations. By integrating automatic distress detection, real-time location tracking, emergency alerts, evidence collection, and self-defence mechanisms, this system provides a comprehensive safety solution for women and other vulnerable individuals. Unlike traditional safety devices that rely solely on manual activation, this project automates the emergency response using a MEMS sensor that detects sudden movements or impacts. The GPS module ensures real-time tracking, while the GSM module instantly notifies emergency contacts via SMS and calls. Additionally, the camera module captures crucial evidence, and the shock mechanism provides an effective self-defence measure. The device is compact, wearable, and energy-efficient, making it suitable for daily use in various situations. By addressing the limitations of existing safety solutions, this project significantly improves personal security, providing rapid assistance, real-time monitoring, and active self-defence. The integration of multiple technologies into a single, cost-effective device makes it a reliable and practical safety tool.

7. FUTURE SCOPE

The system can be expanded by connecting the device to the Internet of Things (IoT), location data, distress signals, and images can be stored in the cloud. This enables real-time tracking and access to emergency data from anywhere, ensuring faster response times. A dedicated mobile app can be developed to provide a user-friendly interface for managing device settings, tracking location history, and receiving emergency alerts. The app can allow authorized contacts to monitor the user's safety in real time. AI algorithms can be used to analyse motion patterns and distinguish between normal movement and genuine distress situations. This would help in reducing false alarms and improving automated emergency detection. The device can be equipped with voice recognition technology, allowing users to trigger an SOS alert by saying a predefined "help" command. This feature is beneficial if the

user is unable to press a button during an emergency. The device can be embedded into smart jewellery, watches, rings, key chains, or clothing accessories, making it more discreet and convenient to wear. Ensures continuous accessibility without drawing attention.

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