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Design of Women Safety Device with Fingerprint Sensor

Alisha Srivastava[1], Arpit Bhatt[2], Ayush Kushwaha[3]
[1, 2, 3]*Department of ECE, JSSATE Noida*

Abstract: ***The safety of women has always been a global concern, and despite various measures adopted, the number of cases of misconduct against women is steadily rising. To address this issue, a new approach in the form of a device has been proposed. The purpose of this gadget is to give women a tool to safeguard their security and safety in the incident of an accident. To ensure that no woman feels helpless in the face of such crime issues, defense mechanisms must be proposed in large-scale productions. The suggested gadget is an embedded system designed on an Arduino board and a NodeMCU module with GPS that delivers a warning sound will be heard in the event of danger and an emergency message is sent with the user's location. To safeguard women's safety, this technology follows the location and transmits a message to the police control room, family, and friends. Moreover, a fingerprint module built into the system makes sure that only authorized users are utilizing the equipment. The smartphone will deem it dangerous and automatically send an SMS to the appropriate authority if the user does not touch their fingertips on the module that stores fingerprints within a predetermined amount of time.***
In conclusion, the proposed device could be a valuable tool in ensuring the safety and security of women. With the integration of technology, this device could provide a sense of security to women and help prevent crimes against them.
Keywords: Fingerprint sensor, GPS Module, NodeMCU Module, Buzzer, Arduino, women safety.

I. INTRODUCTION

The Women Safety Device represents a commendable effort aimed at promoting the safety and autonomy of women and children. In light of the increasing occurrence of crimes targeting this vulnerable demographic, such devices assume a pivotal role in safeguarding their well-being. Designed to be utilized during moments of distress, the device promptly transmits the user's location to both the nearest police station and their designated contacts. Additionally, the device incorporates a built-in buzzer that emits audible alerts, thereby notifying individuals nearby and summoning additional assistance.

It's essential to create a safer environment for women and children, and this device is a step in the right direction. The government must encourage the production and distribution of such devices to ensure that every woman can have access to them. In addition, awareness campaigns can also be conducted to educate women on how to use the device effectively and efficiently. Together with these initiatives, we can ensure that women and children can live a life free from fear and insecurity.

Women's security has been our top focus, which is why we have developed an integrated solution that combines both hardware and software components. Recognizing that comprehensive security cannot be achieved by relying solely on either hardware or software, our approach entails utilizing both in harmony. A band served as the hardware, and a smartphone app served as the software. Through Bluetooth, hardware and software are linked. A woman will touch the emergency switch attached to the band if she is in danger. Therefore, an emergency message will be sent to the user's family, police, and to personal contacts of the registered user. And through buzzer, available people can also reach out and help.

A Women Safety Device is used in a panic state. This device is activated by women itself when she feels scared and in case of any mishappening, the location is sent to the nearest police station and to the closed ones and at the same time the buzzer starts beeping so that the surrounding people can also reach there and help her out in that situation.

The GPS (Global Positioning System), the NodeMCU, and the alarm buzzer were all integrated within the band. The following sensors are all linked to the hardware board. A microcontroller board called the Arduino Uno is built around the ATmega328, which serves as the central controller. Additionally, A server page has been added to monitor the safety of the women, and an alert has been programmed to alert the people about the danger through a nodeMCU that receives a ring along with an emergency warning message that includes the location. This nodeMCU module handles communication and facilitates the emergency message. These sensors are all set up in advance. The objective is to create a tool and an all-in-one security system for women that is totally portable and offers self-defense to aid women in escaping dangerous situations. The location of the concerned woman can also be tracked remotely.

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II. LITERATURE REVIEW

In recent times, The number of programs made specifically for women's security and safety has increased. By delivering a message to them that includes the user's location as determined by GPS, these applications offer a way for users to inform and update their close friends and family. To build on this trend, our project is aimed at designing a Self Defense Device that incorporates fingerprint verification technology. The device will be activated upon the recognition of an authorized fingerprint. Once the device is activated, the user will be required to scan her finger at fixed intervals. If the device is unable to detect the user's fingerprint at the scheduled time, the buzzer will start beeping, and the live location will be sent to her contacts.

This innovative device will provide an added layer of security for women, allowing them to feel safer and more confident when out in public. By utilizing fingerprint verification technology, we can ensure that only authorized users can activate the device, adding an extra level of protection against potential attackers. In conclusion, the Self Defense Device with fingerprint verification technology is a much-needed addition to the current range of women's security applications. By incorporating advanced technology, we can create a safer environment for women and help to prevent incidents of harassment and assault.

As discussed in [1] by the authors about the women safety, so they have developed a device which a women wear on her feet. In case of threatening situation, women taps her feet four times. When that tapping sound count reaches four, a little foot-wearing gadget with a light-blue bean microcontroller sends an alert notification to the authorities by connecting through Bluetooth.

In [2] the authors focused on the rising violence against women since recent years. As a consequence, the aim of authors is to develop a wearable women's safety system that collects data while running on patterns like body temperature and heart rate. In order to give assistance to the person that is in need when the input data are higher than usual, the system will inevitably contact and send messages to multiple people as well as the location.

An idea presented in [3] suggests utilizing the machine learning Support Vector Machine (SVM) technique to distinguish the victim's screams from ambient noise detected by the sound sensor. Once the device identifies the scream, it promptly activates the camera module, capturing a 30-second video. Simultaneously, the built-in GPS system tracks the precise geographic location, while the nodeMCU module sends an alert message and initiates an emergency call to the nearest police station. This integrated approach enhances the device's capability to respond swiftly and effectively in critical situations, aiding in the protection of potential victims.

In [4] the authors discussed the case of panic situation in which the women does not get time to activate the device, this problem is solved by the device proposed by the author. The device is activated by shaking the phone, and the emergency contacts are informed of the location. The main shortcoming of this approach is that it causes confusion, even when a mobile phone trembles frequently.

According to [5], the author devised a wearable sensor that takes the form of a sticker and serves as an immediate alert system for sexual assault incidents. It emits a loud buzzer to notify nearby individuals as well as the victim's friends and family, urging them to seek help during the assault. The sensor, easily attachable to any garment, was designed to be trained in recognizing deliberate or forced undressing. This sensor-based project enables the identification of attack signals, even when the victim is asleep or unable to defend themselves, such as in cases involving hospitalized or disabled individuals. The wearable sensor connects to a smartphone via Bluetooth, which can produce a loud noise to warn people nearby to seek assistance. Additionally, the smartphone sends a message containing the victim's location to pre-defined contacts, such as family members, public cellphone numbers, or relevant authorities like the police. The sensor operates in two modes: passively and actively.

III. SYSTEM DESCRIPTION

For safeguarding the well-being of women, many security programs have been developed, and these applications offer the capability of updating and notifying their loved ones by delivering them an electronic message that includes their location via GPS.

This project intends to create a self-defense device with authentication of fingerprints that will activate upon detection of a valid fingerprint. As soon as an authorized fingerprint is recognized, the user has to scan her finger at every fixed duration of time if our fingerprint module is unable to detect the finger at time then the buzzer starts beeping and the live location of the user is send to her contacts.

A block diagram of a self-defense device with authentication of fingerprints is shown in Fig. 1. It also shows how the GPS, NodeMCU, and fingerprint modules are interfaced. The central microcontroller board is used to interface with and control a variety of external devices.

A fingerprint model called the R307 optical sensor uses fingerprint scanning and microcontroller communication. The family of the woman under threat might receive her distant location by using the UART.SIM 800 integrated GPS and NodeMCU module. The buzzer will become overheated and begin to sound, scaring those nearby.

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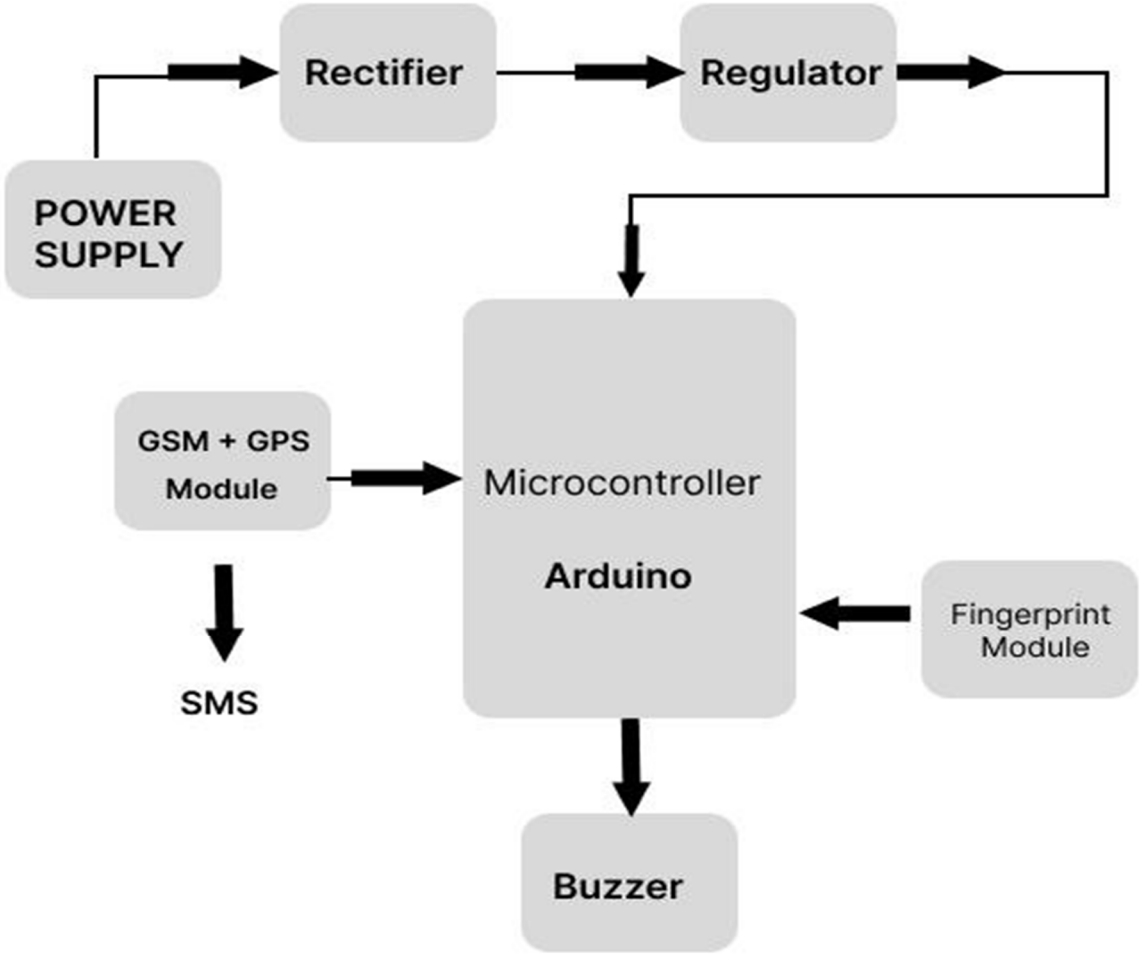


Fig. 1

1) *Interfacing Fingerprint module with microcontroller*: Two procedures are involved with fingerprint scanners: fingerprint enrolment and fingerprint matching. Each module in this R307 scanner needs to recognize the address. Every source of data is transferred in the form of a data package comprising the address item when this module interfaces with the system. Only data packages whose value corresponds to the scanner's address value are responded to by the scanner.
   Connection details:-The GND connection of the Arduino board is established by connecting the BLACK wire from the Fingerprint sensor. To provide power to the Fingerprint sensor, the RED wire is joined to the Arduino's 5V pin. The GREEN wire from the Fingerprint sensor is linked to digital pin 3 on the Arduino board, while the YELLOW wire is connected to digital pin 2, enabling data transfer between the Fingerprint sensor and the Arduino.
2) *Software Implementation:* The necessary libraries required by the fingerprint scanner are installed which is the Adafruit GFX library, which must be downloaded.

3) *Coding and fingerprint verification:* When the libraries are added to the system, open the Arduino software. We must upload the code to our Arduino board. In the code, we are taking fingerprints of the user and storing it in memory. After successful fingerprint enrollment, this fingerprint will be used for further verification of the user's safety.
4) *NodeMCU*: It combines the ESP8266 Wi-Fi module with a microcontroller, making it an all-in-one solution for wireless communication and embedded systems. With its compact size and user-friendly design, the NodeMCU provides an ideal platform for building IoT devices and applications.
5) *GPS*: This module is utilized to accurately determine the victim's location by utilizing longitude and latitude values from the sensors. The GPS system tracks the sufferer's location and generates a location link that will be appended to the message whenever any of the sensors detect abnormal values.

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6) *Arduino*: This comprises of a user-friendly microcontroller board and a dedicated development environment for software programming. For our project, we have chosen to utilize the Arduino Uno model. It is centered around the ATmega328 microcontroller and offers an array of features, including 14 digital input/output pins (6 of which can function as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. These components encapsulate all the necessary elements to support the microcontroller's functionality. To initiate its operation, one can easily connect the Arduino Uno to a computer using a USB cable or power it through an AC to DC adapter or battery.
7) *Bluetooth Module:* The Bluetooth specification is designed to offer an inexpensive and compact radio system solution that facilitates connections between various portable devices such as mobile computers, smartphones, and other handheld devices. Its purpose is to provide seamless connectivity to the Internet, allowing users to effortlessly link a diverse range of computing and telecommunications devices without the necessity of purchasing, carrying, or physically connecting cables. In our application, we employ a Bluetooth module to establish a connection between our device and a mobile device.
8) *Buzzer*: It makes sound by using the piezoelectric effect in reverse. A piezoelectric material is crossed by an electric potential in order to produce pressure changes or strain. These devices are capable of notifying users about events linked to sensor input, and are commonly integrated into alarm circuits. When it comes to swiftly locating a victim, buzzers play a crucial role in alerting individuals and mobilizing the community, aiding in the prompt notification of potential suspects and enabling a collective response.

IV. DESIGNING OF THE SYSTEM

When the power is turned on, the device takes the fingerprint of the user and register that person. After the successful registration, the user needs to scan the finger in every 1 min. The user needs to wait for 1 min after that she has to place her finger on the sensor again for scanning. If some or the other how she is unable to scan in that time period then the message/call will go to it's registered contact numbers and to the police and also the buzzer will be activated so that the nearby people can come for help.

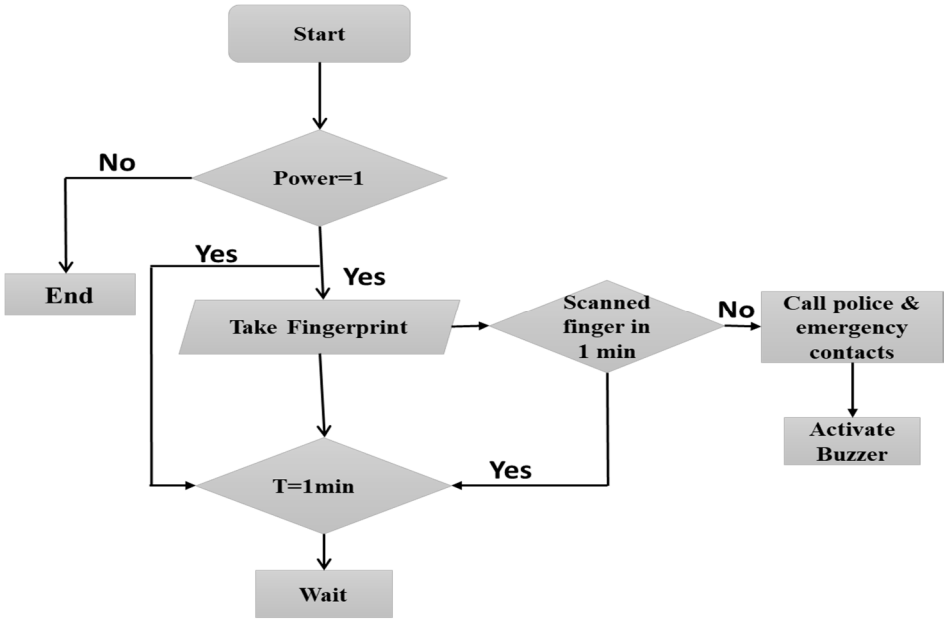


Fig. 2

Pseudo Code:
Initialize software serial ports for the GPS and NodeMCU modules
Initialize the TinyGPS object for parsing GPS data
Initialize the Adafruit_Fingerprint object for fingerprint scanning
Initialize the NodeMCU object for sending SMS messages
Initialize the pin for the buzzer
Setup function:
- Initialize the modules and store the authorized fingerprints
Loop function:

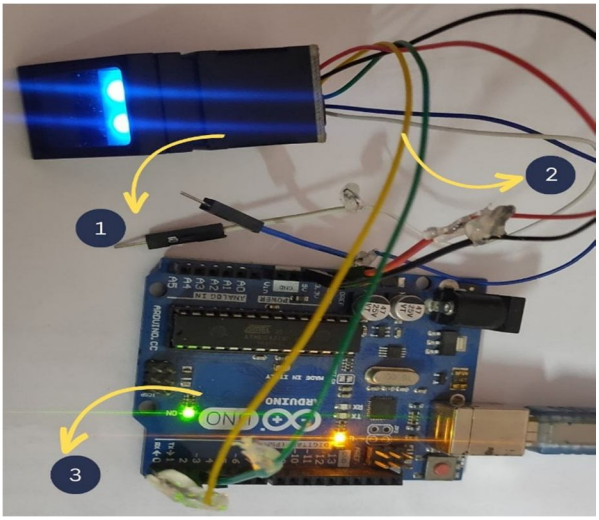
If (the user has scanned their fingerprint within the last 30 or 50 seconds)
If (fingerprint sensor is unable to read the user's fingerprint)
- activate the buzzer and obtain the current GPS location using the TinyGPS library
- Construct an text message with the current coordinates
- Send the text message to the three saved contacts using the NodeMCU module

Else
- continue with the rest of the loop function
- Repeat the scanning process every 30 or 50 seconds

The provided code snippet sets up a security system by initializing various modules and components:-

1) The first step involves setting up software serial communication for the GPS and NodeMCU modules. It enables communication between the microcontroller and these modules using specific pins designated for receiving (RX) and transmitting (TX) data.
2) In the next part, a TinyGPS object is created to handle the parsing and extraction of GPS data. It provides functionality for retrieving and processing the current GPS location.
3) Then, an Adafruit_Fingerprint object is initialized. This object utilizes a library designed for interacting with a fingerprint sensor, enabling fingerprint scanning functionality.
4) A NodeMCU object is initialized, which allows the system to send SMS (text) messages. This module handles communication and facilitates the transmission of messages.
5) The specific pin on the microcontroller board that connects to the buzzer is initialized. This pin will control the activation of the buzzer when necessary.
6) Setup function:
a) The setup function carries out the necessary initialization tasks and prepares the system for operation.
b) It includes initializing the software serial ports, creating the TinyGPS and Adafruit_Fingerprint objects, initializing the NodeMCU object, and storing authorized fingerprints.
7) Loop function:
a) The loop function is a continuous loop that runs repeatedly after the setup function.
b) It checks if the user's fingerprint has been scanned within the last 30 or 50 seconds.
c) If the fingerprint sensor fails to read the user's fingerprint, the buzzer is activated to provide an audible alert. The current GPS location is obtained using the TinyGPS library.
d) An SMS message is then constructed, incorporating the current GPS location.
e) Finally, the constructed SMS message is sent to three designated contacts using the NodeMCU module.
f) If the user's fingerprint has not been scanned recently, the loop continues executing the remaining code.
g) The system repeats the scanning process every 30 or 50 seconds, depending on the specified delay.

V. HARDWARE MODEL



1) *Fingerprint Sensor:* Scans the finger for Verification of the registered user in every T min.
2) *Jumper Wires:* Used for establishing connection between different components of the device. Green Wire is used to connect Digital Pin 3 and Yellow Wire is used to connect Digital Pin 2.
3) *Arduino Uno:* It is an ATmeaga328P-based microcontroller board. This board is used to interact with sensors, GPS units and even with mobile phones.

VI. CONCLUSION

Ensuring safety of the women has always been a matter of concern, and with the advancement of technology, we have come across various safety devices for women. However, most of these devices require manual operation, which may not be possible in a panic situation. This is where the innovative project comes in, providing a solution that enables women to turn on the device in advance and have the freedom to go anywhere without any fear.

The construction of the device is made easy to use and carry, allowing women to carry it with them wherever they go. It comes with a variety of features that help in ensuring their safety, including an alarm system, GPS tracking, and a panic button. The alarm system can be triggered by the woman in case of danger or any unusual situation, and it will alert the people nearby to take necessary action.

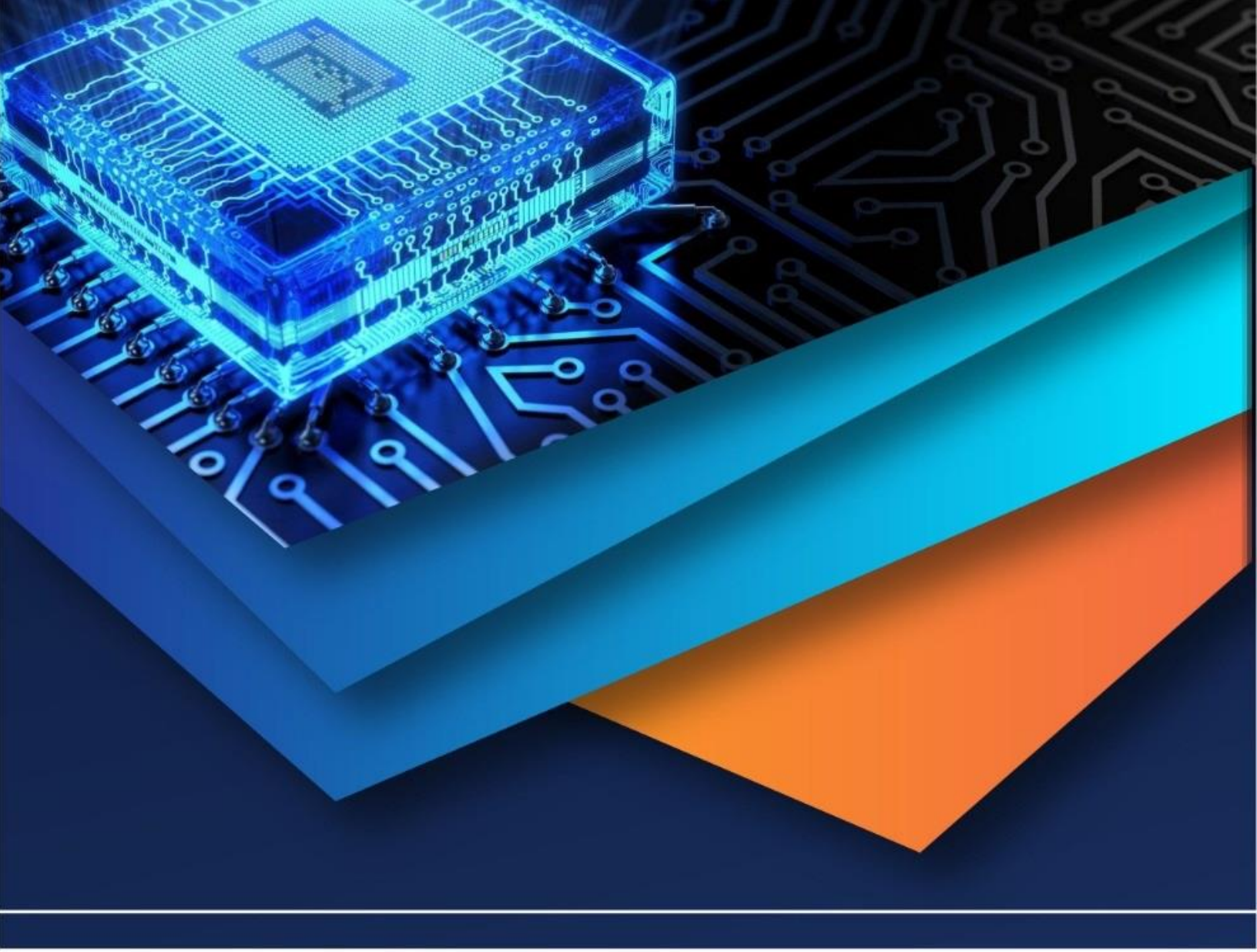
The GPS tracking system allows the woman to be located in case of emergency, enabling the authorities to reach her quickly. The panic button, on the other hand, can be used to send out an SOS signal to the contacts saved in the device. This feature ensures that help is just a click away.

The device is designed to provide women with the feeling of security and independence, allowing them to go anywhere they want without worrying about their safety. It is an excellent solution for working women who travel alone, students who go to college, or women who are out late at night.

In conclusion, the project is a game-changer in ensuring women's safety, providing them with a device that can be operated in advance, preventing any mishap. Its features make it an excellent choice for any woman looking to ensure her safety and have the freedom to go anywhere she wants.

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