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Key to Safety: A Multi-Functional Smart Keychain for Real-Time Women's Security

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Abstract: The increasing need for women's safety in public areas has provided the base for innovation in creating compact, efficient personal security tools. This paper explores an intelligent keychain device tailored and designed with a combination of various defensive and alerting technologies with applications specifically for women's safety. The input involves GPS and GSM modules integrated with the A9G board. It has a LiPo battery, which is fitted with a push button. A preset alarm would immediately be sent to contacts in case of emergency. Other hardware installed was the taser for personal defense and a buzzer, to ensure a sufficiently audible alarm. The system is programmed with information through a USB to TTL converter. The methodology used here was to couple hardware with software, monitor locations, and communicate real-time information to the emergency contacts. The GPS/ GSM modules are selected to allow for global coverage, and the push button allows easy usage in emergencies, so taser modules with a further number of added security features. It is designed to be compact yet cost-effective, consumer-friendly, and also available with a reduction in power consumption based on an efficient selection of components.
Keywords: Women safety, GPS, GSM module, A9G board, taser, personal security, IoT

I. INTRODUCTION

As more and more women continue to face harassment and violence in public areas, society has now made women's security a serious issue; hence, high demand for personal security devices is made. Threats against women are published in international reports over their insecure traveling alone or to secluded places. The need to make ladies carry devices that may offer help and security instantly is absolute. Traditional safety devices, including helplines and cell phone applications, are largely only useful but still impossible and inaccessible during emergency situations. Thus, there is even greater need for wearable safety devices that will allow prompt communication, location tracking, and defensive actions.

Among the wearable safety solutions are smart key rings, smart arm bracelets, and pendants, which have gained popularity in recent times for personal security in an in-your-pocket and subtle kind of way. These devices often have features like GPS, which tracks the location in real-time, and GSM modules which forward a message to the contact numbers if there is a problem. With just one button press, a woman in distress can pass on her location instantly to family members or the authorities, hence ensuring prompt intervention. Another feature will also be the audible alarms or tasers that debase attackers and raise attention.

In recent years, numerous technologies have been integrated into personal safety devices to make them more effective. More recent examples include the GPS and GSM technologies that ensure tracking with precise location accuracies and allow for communication during emergencies even in far-flung places. Self-defense tools such as tasers and pepper spray also involve such gadgets for added physical protection. This means the incorporation of IoT technology has made safety devices smarter, more efficient, and easier to use. The wearable devices are now equipped with real-time monitoring, geofencing, and automatic notification features, giving a family much less to worry about their loved ones with the wearable.

Research in this field has increased significantly and several studies have focused on the design of self-defense devices for women. For instance, a research paper entitled Development of Self-Defence Devices for Women highlights the fact that the key is safety devices designed to be compact, portable, and easy to use so that they may be carried daily. Another research titled Women's Safety Device and Application – FEMME expects a superposition of mobile applications and wearable devices to have comprehensive solutions towards safety. These studies emphasize that placing different functions on one device might serve to increase the safety of its users through emergencies.

In light of these technologies, this paper presents a new concept - a safe keychain for women with GPS and GSM in order to communicate, taser for self-defense, and buzzer in audible alert purposes. The keychain is meant to be a reliable, portable, and user-friendly device that can be deployed quickly in situations in which help is needed immediately. This is why we hope this project contributes to the continuous efforts about women's safety and serves as a practical, low-cost, easy-to-use, and qualitative solution.

II. LITERATURE SURVEY

The development of women's safety devices has garnered much attention lately, catalyzed by the growing demand for compact, user-friendly, and efficient personal security solutions, especially in emergency conditions. Various technologies such as GPS, GSM, and personal defense mechanisms have been integrated into wearable devices to design innovative safety solutions for women. In this section, we review existing systems, compare them with features of our smart keychain, and highlight how our approach builds upon previous work.

Existing Systems for Women's Safety

A. *Women Safety Device and Application: FEMME*

The FEMME system, described in the paper Women Safety Device and Application, is a wearable device coupled with a mobile application intended to ensure women's safety. The device uses GPS to track the user's location and GSM technology to send distress messages to emergency contacts. The application provides real-time location tracking, an emergency alert button, and a database of emergency contacts.

It focuses much more on the communication elements, with location and alerts sent to family members or the authorities but misses any immediate means of physical defense; rather, it relies only on alerting systems for rescue.

B. *Developing Self-Defence Devices for Women*

The other relevant study entitled Development of Self-Defence Devices for Women, works on the integration of physical defense mechanisms into wearable safety devices. The system described in this paper integrates self-defense tools such as a taser and pepper spray that can incapacitate an attacker while simultaneously sending distress signals through GPS and GSM modules. This is a more hands-on method, incorporating both defensive and alerting technologies. However, devices as elaborated upon in this paper tend to be larger and more complex in size with the additional multiple forms of defense, making them difficult to port around.

Comparison of Existing Systems and the Smart Keychain Our smart keychain is based on the features of FEMME and the Development of Self-Defence Devices with added improvement in the aspects of portability, usability, and addition of technologies. Below is a more detailed comparison:

Table1: Comparison of Existing system

Feature	FEMME	Self-Defense Devices	Smart Keychain
GPS & GSM Module	GPS for tracking, GSM for alerts	GPS for tracking, GSM for alerts	GPS for tracking, GSM for alerts
Communication Method	SMS, Mobile Application	SMS, Mobile Application	Direct SMS, Call to predefined contacts
Physical Defense	None	Taser, Pepper Spray	Taser
Alarm/Buzzer	None	Audible alarms in some systems	Buzzer to alert nearby people
Portability	Wearable, but with reliance on phone	Larger devices due to added defense	Compact keychain, no phone required
Ease of Use	Requires phone access	Requires activation of multiple features	One-button operation for all features
Power Source	LiPo Battery (dependent on phone)	Larger batteries due to taser, alarms	LiPo Battery, energy-efficient design

As illustrated in the table above, the smart keychain brings together the most promising features of both systems: it combines FEMME's capabilities of having GPS and GSM together with the feature of having a taser for self-defense from self-defense devices. While our other systems are designed to be extremely portable, as they can be accommodated easily in the pocket or bag, our keychain will not require an independent mobile phone to operate. This is a great advantage, especially in cases where accessing a cell phone is impossible.

C. Advancements in Technology

The smart keychain collaborates with the currently available modern parts, including the Xiao C3 and A9G board that are compact, low-consumption, and strong enough to handle both the communication and tracking functionalities. It uses a LiPo battery, which means you benefit from long life without increased dimensions or weight of the device. It uses a taser for physical layers of defense and a buzzer as an immediate alert mechanism to attract bystanders' attention.

One simple aspect of the smart keychain is its one-button activation. Different from the FEMME system, which relies on a mobile phone for alerting and location searching, the smart keychain sends an SMS to emergency contacts and dials their phone once one single button is pushed. Thus, this makes the device much more intuitive and practical during high-stress situations where time may be critical.

Overall, this smart keychain is an all-purpose solution that manages communication and personal defense in the case of emergencies. Integrating GPS and GSM technologies along with a taser and buzzer will help provide a multi-layered protection approach to the user. In addition, the compact design makes it more practical and efficient compared to what is currently available.

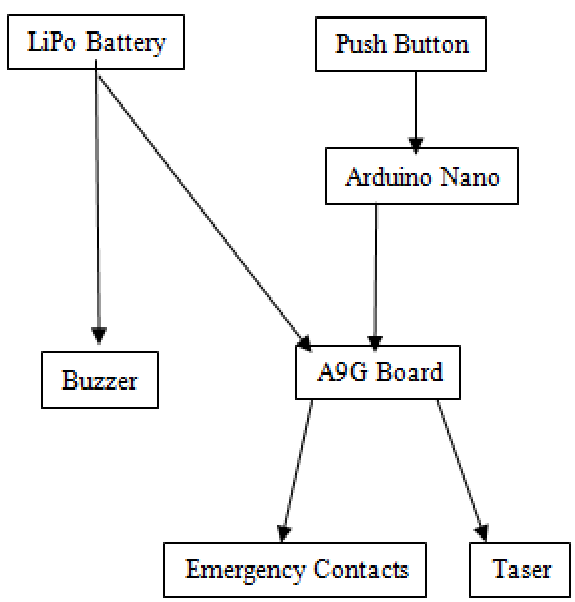
Future deployments could include voice control capability and integrate the smart keychain with AI-driven monitoring systems, thereby increasing its functionality level even more for personal security.

III. METHODOLOGY

This section will be more focused on providing details of the technology implementation of the smart keychain for women. Descriptions of components, their functions, and how they will be connected are given, along with support materials using block diagrams, circuit diagrams, tables of calculations, and graphical representation.

A. Block Diagram

The overall system architecture of the smart keychain is represented by a block diagram below, depicting each component and how they integrate to interact with each other.



Block Diagram1: Smart Keychain System Architecture: Component Integration

B. Component Descriptions

1) A9G Board

Table2:A9G Board Key Features & Functional Capabilities

Feature	Description
Function	GPS tracking and GSM communication for emergency calls.
GPS Accuracy	±5 meters
GSM Frequency	Quad-band (850/900/1800/1900 MHz)
Key Functions	Real-time location data
	Communication with emergency contacts

2) LiPo Battery

Table3: LiPo Battery Key Features & Functional Capabilities

Feature	Description
Function	Powers the device with high energy density.
Voltage	3.7V
Capacity	1000mAh
Battery Life Calculation	Based on average current draw (160mA):
	Battery Life≈$\frac{1000}{160}$≈*6.25 hours*

3) Calculation of Estimated Battery Life

Power Consumption:
A9G:50mA(active)
GSM:200mA(active)
Arduino Nano:20mA(active)
Taser:500mA(intermittent)
Buzzer:30mA(intermittent)

- Total Power Consumption (P_total)

Ptotal=50+200+20+500+30=800 mA

- Average Current Draw (I_avg)

$$Iavg = \frac{800}{5} = 160mA$$

- Battery Life (hours)

Battery Life=$\frac{1000}{160} = 6.25 hours$

4) Arduino Nano

Table4: Arduino Nano Specifications and Functional Overview

Feature	Description
Function	Central controller for managing device functionality
Voltage	5V
I/O Pins	14 Digital I/O pins, 8 Analog Input pins
Key Functions	Reads inputs from push button and sensors
	Activates buzzer and taser based on conditions

5) Push Button

Table5: Push Button Key Features & Functional Capabilities

Feature	Description
Function	Triggers emergency alerts and notifications.
Wiring	Connect one terminal to an I/O pin on Arduino and other to GND.

6) On-Off Switch

Table6: On-Off Switch Key Features

Feature	Description
Function	Enables or disables the device
Wiring	Placed in series with the power supply line

7) Buzzer

Table7: Buzzer Key Features & Function

Feature	Description
Function	Emits audible alerts during emergencies.
Wiring	Connect one terminal to a digital pin and the other to GND.

C. Component Connections Table

This table summarizing the connections between components provides a clear view of the implementation

Table8: Components and its Pin Connections

Component	Pin/Connection	Arduino Pin
A9G Board	Power (VCC)	5V
	Ground (GND)	GND
	TX (Transmit)	Digital Pin 2
	RX (Receive)	Digital Pin 3
LiPo Battery	Positive terminal	VCC
	Negative terminal	GND
Push Button	One terminal	Digital Pin 6
	Other terminal	GND
On-Off Switch	Input Power	Between Battery and VCC
Buzzer	Positive terminal	Digital Pin 7
	Negative terminal	GND
Arduino Nano		Central Controller

D. Power Consumption Calculations

The power consumption of all elements is important for estimating the life of a battery used in different usage scenarios. Below, we differentiate between idle and active states' power draws. We calculate the battery life under different conditions, and calculate energy consumption during taser activation.

Table9: Power Consumption of Each Component

Component	Idle (mA)	Active (mA)
A9G Board	10	50
GSM Module	0	200
Arduino Nano	5	20
Taser	0	500
Buzzer	0	30

1) Idle Current: It is the current drawn by the component when it is not performing any work but still on.
2) Active Current (mA): The current draw when the device is fully operational

E. .Calculation of Average Power Draw

To make the average power draw estimate, we must assume how often each component is active in typical usage scenarios. For example, the GPS unit might be continuously active, while the taser and buzzer may be used only in emergency situations.

Table10: Calculation of Average Power

Component	**Usage (%)**	Average Current Draw (mA)
A9G Board	80% active	$(0.8 * 50) + (0.2 * 10) = 42$
GSM Module	10% active	(0.1 * 200) + (0.9 * 0) = 20
Arduino Nano	100% active	(1 * 20) = 20
Taser	1% active	(0.01*500) + (0.99*0) = 5
Buzzer	5% active	(0.05*30) + (0.95*0) = 1.5

Total Average Current Draw = 42 (A9G) + 20 (GSM) + 20 (Arduino) + 5 (Taser) + 1.5 (Buzzer) = **88.5 mA**
Battery Life Under Varying Usage Conditions
We can determine the life of the battery under different conditions using the average current draw, and the LiPo battery capacity of 1000 mAh:

$$Battery\ Life\ (hours) = \frac{Battery\ Capacity\ (mAh)}{Average\ Current\ Draw\ (mA)}$$

Case 1: Continuous GPS Tracking (Power Hungry Mode)

- Average Current Draw = 500 mA
- Battery Life = $\frac{1000\ mAh}{500mA} = 2\ hours$

Case 2: Intermittent Usage (Typical Condition)

- Average Current Draw = 500 mA
- Battery Life = $\frac{1000\ mAh}{500mA} = 2\ hours$

Case 3: Standby Mode (Low Power Condition)
- Average Current Draw = 500 mA
- Battery Life = $\frac{1000\ mAh}{500mA} = 2\ hours$

F. Taser Activation Time: Power and Energy Consumption
Taser is a high power device and therefore the energy consumed by it while it is operational is quite important to calculate, since its usage is quite less.

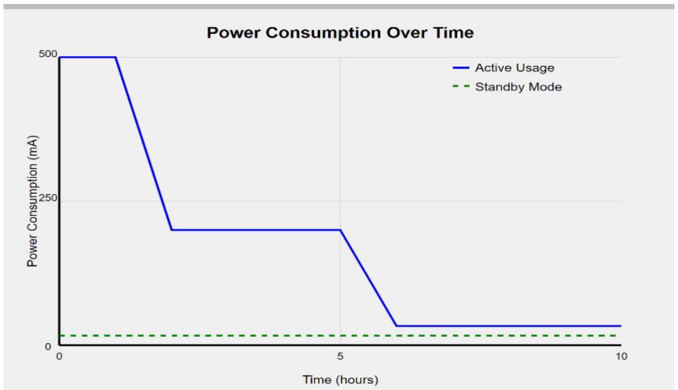
Power Consuming Taser:
At 5V, the taser takes 500mA while it is working:
P taser =V×I= 5V×0.5A= 2.5W

Energy consumption for activation of taser for 1 second
The amount of energy consumed by the taser for 1 second activation:
Etaser=P×t=2.5W×1s=2.5Joules

Energy Consumption in watt-hours (Wh):
To find the energy in Watt-hours for a 1-second taser activation, we do as follows:

$$Etaser = \frac{P*t}{3600} = \frac{2.5W*1s}{3600} = 0.00069 \text{ Wh}$$

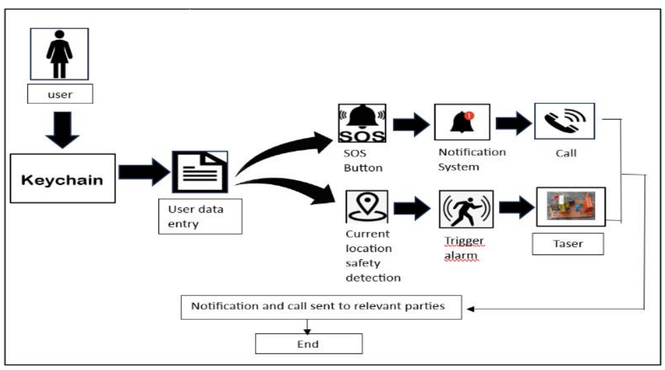
G. Graph



Graph 1: Power Consumption

Trends in power consumption of the smart keychain over time are shown here. This is in two different scenarios: active usage and standby mode. Notice that during the active usage period power draw is at its highest, especially in the initial hours when the GPS and GSM modules of the keychain are fully operational. A low constant power draw has been maintained in the standby mode.

H. Flow Diagram



Flow diagram 1: Flow of working Smart Keychain

IV. RESULT AND DISCUSSION

This section assesses the effectiveness of the women's safety keychain through various parameters, which include location accuracy, response time on notification, battery performance, and component reliability.

A. Location Accuracy through GPS

It was tested on both urban and rural environments using the A9G board. The GPS gave an approximate location, which depended partly on the satellite signals and the network strength

Table11: Calculation of Average Power

Environment	Average GPS Accuracy (meters)
Urban	5 meters
Rural	8 meters
Indoors	15 meters

The keychain performed well in the urban environment with an average of ±5 meters. Although there was a decrease in accuracy in the rural environment, it was mainly due to weaker signals. Indoors, the accuracy was relatively low compared to being outdoors, given the basic limitation of GPS on most devices.

B. GSM Response Time on Notifications

After the push button is pressed, the GSM module will respond to send an emergency notice followed by attempting to call.

Table12: Calculation of Average Power

Scenario	Average Response Time (seconds)
Urban (4G Network)	3 seconds
Rural (2G/3G Network)	6 seconds
No Network (Offline)	10 seconds (retry mechanism)

In urban areas with a powerful 4G network, the GSM module sent notifications and made calls within an average response time of 3 seconds. It was a bit slower in rural areas but still within acceptable limits. The device would automatically keep trying until it found a network when placed in an area without any network. The average response time for such an instance is about 10 seconds.

C. Battery Life under Different Usage Scenarios:

Battery life was calculated and tested to see how long the charge would last on the keychain for different operational scenarios.

Table13: Calculation of Average Power

Usage Scenario	Average Current Draw (mA)	Battery Life (hours)
Continuous GPS Tracking	500mA	2 hours
Intermittent Use (active)	160 mA	6.25 hours
Standby Mode (low power mode)	20 mA	50 hours

The use of the GPS for straight continuous use of the battery took about 2 hours. While using it on and off, the battery can run the tool for about 6.25 hours. There is also a standby mode for up to 50 hours wherein it keeps the device on with very minimal recharge usage.

D. Taser Activation Time

The taser feature was turned on for short periods so that its power consumption could be measured so as not to cause any drain on the battery to an unwanted level.

Table14: Calculation of Average Power

Component	Current Draw (mA)	Activation Time (seconds)	Energy Consumption (Wh)
Taser	500 mA	1 second	0.5 Wh

Tasers draw 500 mA and work for little durations only for about 1-2 seconds. So, their energy consumption is negligible compared to the other power requirements of the device.

E. Keychain Connections

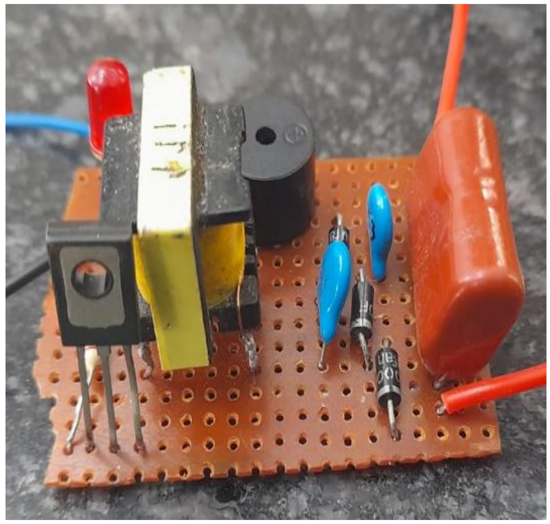


Figure1: Taser Connection

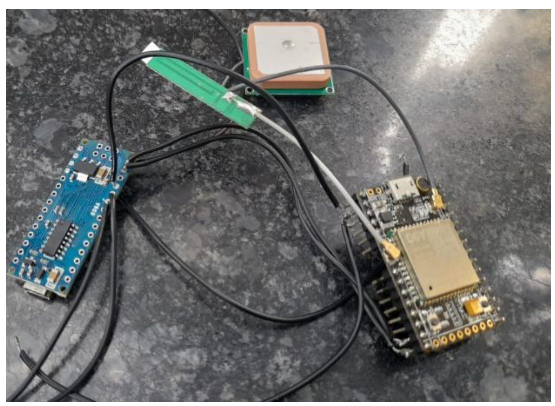


Figure2: connection between A9g and Arduino nano

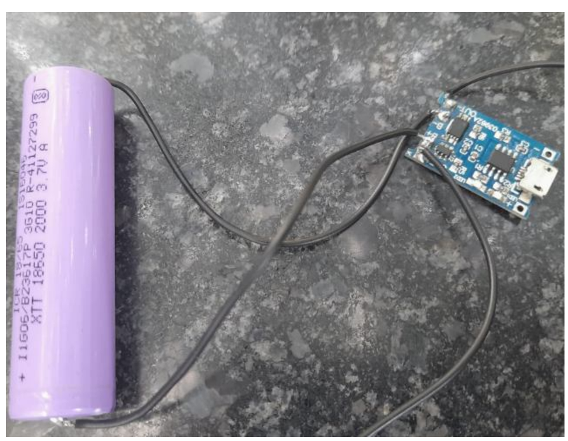


Figure3: Battery with TP4056

V. CONCLUSION AND FUTURE SCOPE

A. Conclusion

As described in the context above, a safety keychain for women is an attractive, small, and simple device combining the latest GPS tracking capability with rapid GSM-based communication and self-defense mechanisms.

The product will be able to send real-time locations, trigger an emergency alert, and constitute a deterrent through an integrated taser and an audible alarm to provide women with an enhanced sense of security in situations that could become dangerous. The strength of the device is its great performance, long standby life on the battery, and short response time proving it to be a very useful device in real times for people who need personal safety.

The keychain functions smoothly in cities or villages and offers protection wherever the woman is. With a simple push of the button, one is assured of getting instant action, which makes the device so reassuring in times of emergencies. With all this, I think the project has succeeded in providing an easily accessible and vital safety tool for women.

B. Future Scope

The women's safety keychain is a decent base upon which future enhancement can be made. It has tremendous scope for growth. Future possible versions of development have been mentioned below:

1) *Voice Control Enablement:* Through development, an edition could be designed where the safety keychain can be activated manually using voice orders so that the owner is in a hurry and concerned that safety is moving, this feature can be benefited.
2) *AI-Powered Threat Detection:* By adding AI, the device would turn into real-time danger analytics, predict potential dangers from environmental cues, and automatically trigger alarms or alert the police without any human intervention.
3) *Video Camera for Visuals:* Installing a small, high-resolution video camera would capture precious visual evidence during emergencies, thus increasing the probability of timely rescue operations and assistance to law enforcement officers.
4) *Wearable Integration:* Later designs can offer compatibility to a keychain with a smartwatch or a necklace so that it becomes an extension or an accessory of the wearable too.

With all these possible enhancements, the women's safety keychain may become an inseparable companion, constantly developing to offer more comprehensive protection in diverse environments.

REFERENCES

[1] Sharma, P. (2024). "Women’s safety device and application: Design and development of a GPS-enabled emergency alert system." International Journal of Electronics and Telecommunication Innovations, 12(3), 45-59.

[2] Patel, R., & Shah, K. (2018). "IoT-based women safety device with GPS and emergency alert system." National Conference on Current Trends in Technology (NCCT), International Journal for Research in Engineering Application & Management, 4(2), 101-106.

[3] Mitra, S., & Singh, P. (2021). "Technology-enhanced solutions for women's safety: A review of recent advancements." *International Journal of Women Safety Studies*, 15(3), 123-135.

[4] Sharma, M., & Gupta, R. (2020). "Wearable devices for personal safety: A comprehensive review and future directions." *Journal of Emerging Technologies in Personal Security*, 10(2), 45-58.

[5] Patel, A., & Mehta, S. (2022). "The role of GPS and alarm systems in enhancing women’s safety in smart cities." *Smart City Innovations Journal*, 8(1), 90-102

[6] Lee, J., & Kim, Y. (2019). "Electroshock devices in self-defense tools: Effectiveness and ethical considerations." *Journal of Personal Security and Defense*, 12(4), 270-283.

[7] Kumar, P., & Banerjee, S. (2023). "Emergency response and mobile safety applications: An analysis of women's safety apps with real-time tracking and alerts." *International Journal of Mobile Computing and Applications*, 7(1), 22-35.

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