

A Novel Multifunctional Women's Safety Device

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Abstract — Women's safety remains a significant concern worldwide, creating the need for personal safety devices that are reliable, easy to carry, and suitable for everyday use. Many existing safety products, including personal alarms, GPS trackers, SOS devices, and pepper spray, provide useful protection but often have limited functionality, depend on battery power or smartphone connectivity, or give limited attention to attractive and user-friendly designs that encourage regular everyday carrying. In addition, self-defense tools are often carried separately inside handbags, making them difficult to access quickly during emergencies. This paper presents a proposed multifunctional women's safety device based on a granted design patent. The proposed panda-shaped keychain is designed to integrate SOS alerts, emergency calling, live location sharing through a connected smartphone, a loud emergency buzzer, an LED flashlight, and an integrated pepper spray compartment into a single compact device. The proposed design aims to improve accessibility, encourage everyday carrying through its stylish appearance, and combine emergency communication with personal self-defense in one portable solution. This paper reviews existing women's safety solutions, identifies their limitations and market gaps, and discusses how the proposed design addresses these challenges. Future work will focus on prototype development, usability evaluation, and experimental validation of the proposed system.

Keywords: Women's Safety, Personal Safety Device, Multifunctional Safety Device, Emergency Alert System, Design Patent, Market Gap Analysis, Self-Defense, Portable Safety Device, Smart Safety Device

I. INTRODUCTION

Women's safety has become a significant social concern due to the increasing number of harassment, assault, and other crimes against women. As women actively participate in education, employment, business, and daily travel, the demand for reliable, portable, and easily accessible personal safety devices continues to grow. Although various safety products are available, ensuring immediate assistance and effective personal protection during emergency situations remains a major challenge. These challenges highlight the need for innovative, user-friendly, and practical safety solutions that women can carry confidently as part of their daily lives. [1]–[4].

Many women's safety products are currently available in the market, including personal alarms, SOS devices, GPS trackers, pepper spray, stun guns, emergency mobile applications, and safety keychains. Most of these products provide only one or a few safety features. Electronic safety devices stop working when their battery is discharged, making important functions such as emergency calling, live location sharing, SOS alerts, and electronic self-defense features unavailable. Self-defense tools such as pepper spray and an emergency knife do not require battery power, but they are usually carried inside a handbag or pocket, making them

difficult to access quickly during an emergency. As a result, users often need to carry multiple safety products to meet different emergency situations, which is inconvenient for everyday use.

These challenges create the need for a compact, multifunctional, and stylish personal safety device that women can carry confidently as part of their daily routine. A personal safety device should be easy to access during emergencies while also being attractive enough to encourage regular use instead of being treated as an emergency tool that is often left at home.

This paper presents a proposed multifunctional women's safety device based on a granted design patent. The proposed device is designed as a panda-shaped keychain that can be attached to a handbag, backpack, or key ring, making it easy to carry and quickly accessible. It is designed to integrate multiple safety features, including automatic SOS alerts, emergency calling, live location sharing, a loud emergency buzzer, an LED flashlight, pepper spray, and a concealed emergency knife within a single compact device. The proposed design aims to overcome the limitations of existing safety products by combining everyday portability, an attractive appearance, and multiple emergency response and self-defense features into one device.

The remainder of this paper reviews existing women's safety solutions, identifies their limitations and market gaps, presents the proposed design, and discusses its expected advantages and future development.

II. LITERATURE REVIEW

Women's safety has been an active area of research in recent years, leading to the development of various personal safety devices and mobile applications. Researchers have proposed different solutions, including GPS and GSM-based emergency alert systems, wearable safety devices, smartphone applications, smart keychains, biometric authentication systems, and IoT-enabled personal security devices. Most of these systems are designed to send an emergency message, share the user's live location, activate a buzzer, or notify family members and emergency contacts during critical situations. [1].

Several studies have focused on integrating multiple technologies such as GPS, GSM, Bluetooth, and mobile applications to improve emergency communication. Other researchers have developed wearable devices equipped with sensors, biometric authentication, health monitoring, and automatic emergency alert mechanisms. These studies have made significant contributions to women's safety by providing faster communication and location tracking during emergencies. [2].

Despite these advancements, several limitations remain. Many existing systems rely entirely on battery power and become inoperative when the battery is discharged. Most available products provide only one or a limited number of safety features, requiring users to carry multiple devices for

complete personal protection. Self-defense products such as pepper spray and emergency knives are generally separate from electronic safety devices, making them less convenient to carry and access during emergency situations. In addition, limited attention has been given to designing personal safety devices that combine functionality, portability, and an attractive appearance suitable for everyday use. [3].

The literature indicates a growing need for an integrated personal safety device that combines multiple emergency response and self-defense features in a compact, stylish, and easily accessible design. These observations form the basis for the proposed multifunctional women's safety device presented in this paper. [4].

III. MARKET ANALYSIS OF EXISTING WOMEN'S SAFETY DEVICES

The demand for women's personal safety products has increased significantly in recent years due to growing awareness of personal security. A wide range of safety devices is available in the market, including personal alarms, GPS trackers, SOS keychains, pepper spray, stun guns, emergency mobile applications, and wearable safety devices. Each product is designed to provide assistance during emergency situations; however, their features, usability, and accessibility vary considerably.

Personal alarm devices generate a loud sound to attract nearby people but do not provide emergency communication or self-defense features. GPS trackers and emergency mobile applications allow users to share their location and send SOS alerts to family members or emergency contacts. These solutions depend on battery power, mobile network connectivity, and smartphone availability. If the battery is discharged, the smartphone is unavailable, or network connectivity is poor, emergency functions such as SOS alerts, emergency calling, and live location sharing may not operate as intended. Such situations can occur while traveling, in remote villages, forest areas,

trekking locations, underground parking areas, or places with limited network coverage.

Pepper spray and emergency knives are effective self-defense tools because they do not require battery power or network connectivity. However, they are generally carried inside handbags or pockets, making them difficult to access quickly during emergencies. Carrying these products separately may also be inconvenient for everyday use, as users already carry essential personal items such as smartphones, wallets, keys, and other belongings. As a result, many women may choose not to carry additional self-defense tools regularly.

Stun guns provide an additional self-defense option but require battery power or regular charging to remain operational. If the battery is discharged, the device cannot be used when needed. Similarly, many multifunctional safety devices combine features such as an SOS button, LED flashlight, and loud buzzer. While these devices offer multiple electronic functions, they still depend primarily on battery power and often do not include battery-independent self-defense options.

The current market indicates that no single product effectively combines reliable emergency communication, physical self-defense, quick accessibility, everyday portability, and an attractive design in one compact device. These observations highlight the need for a multifunctional personal safety device that integrates electronic emergency features with battery-independent self-defense tools while remaining easy to carry and readily accessible during emergency situations.

To further illustrate the capabilities of existing women's safety product categories, Table I presents a qualitative comparison based on publicly available product information. The comparison summarizes the common features offered by existing product categories and highlights how the proposed conceptual device aims to integrate multiple safety functions into a single compact design.

Feature	Personal Alarm	GPS Tracker	Safety Mobile Application	Pepper Spray	Proposed Multifunctional Device
SOS Alert	✓	✓	✓	X	✓
Live Location Sharing	X	✓	✓	X	✓
Emergency Calling	X	X	✓	X	✓
Loud Emergency Alarm	✓	X	✓	X	✓
LED Flashlight	Some Models	X	X	X	✓
Physical Self-Defense (Pepper Spray)	X	X	X	✓	✓
Compact Everyday Keychain Design	Some Models	X	X	X	✓

Table I: Feature Comparison of Existing Women's Safety Products and the Proposed Device

As shown in Table I, existing women's safety products generally focus on either electronic emergency communication or physical self-defense, but rarely integrate both functionalities into a single compact device. Personal alarms and safety mobile applications provide emergency alerts but lack physical self-defense features, while pepper spray offers physical protection without emergency communication capabilities. Similarly, GPS trackers provide location tracking but do not include audible alarms or self-

defense mechanisms. Based on this comparison, there is a clear need for a compact, multifunctional personal safety device that integrates emergency communication, physical self-defense, and everyday portability into a single product. These observations form the basis for identifying the research gap discussed in the next section.

Table I presents a qualitative comparison based on publicly available product features. It is intended for feature

comparison only and does not represent a performance evaluation or endorsement of any commercial product.

IV. RESEARCH GAP

The literature review and market analysis show that significant progress has been made in the development of women's personal safety devices. Several electronic safety devices available in the market combine features such as SOS alerts, GPS tracking, emergency calling, LED flashlights, and loud buzzers in a single product. These devices improve emergency communication and provide immediate alerts during critical situations.

At the same time, self-defense products such as pepper spray, emergency knives, and stun guns are generally available as independent devices rather than as part of an integrated safety system. While these products are effective for personal protection, users must carry them separately, making it less convenient for everyday use. In addition, these self-defense tools are commonly kept inside handbags or pockets, which may delay access during emergency situations.

Most multifunctional electronic safety devices depend entirely on battery power, mobile network connectivity, and smartphone availability. If the battery is discharged, the smartphone is unavailable, or network coverage is poor, important functions such as emergency calling, SOS alerts, and live location sharing may not operate effectively. In such situations, users may lose access to the electronic safety features when they are needed most.

Another limitation identified through the market analysis is that existing products give limited attention to everyday usability and user-centered design. Many devices are developed primarily as emergency tools rather than as accessories that women can comfortably and confidently carry every day. As a result, some users may choose not to carry them regularly, reducing their availability during unexpected emergencies.

Based on these observations, there is a need for a compact, multifunctional, and user-friendly personal safety device that integrates electronic emergency communication with battery-independent self-defense features in a single portable product. The proposed panda-shaped safety device aims to address these limitations by combining automatic SOS alerts, emergency calling, live location sharing, a loud emergency buzzer, an LED flashlight, pepper spray, and a concealed emergency knife within a stylish keychain design. The proposed design is intended to improve portability, accessibility, and everyday usability while encouraging women to carry the device confidently as part of their daily routine.

V. PROPOSED MULTIFUNCTIONAL WOMEN'S SAFETY DEVICE

To address the limitations identified in the literature review and market analysis, this paper proposes a compact multifunctional women's safety device based on a granted design patent. The proposed device is designed as a panda-shaped keychain that combines personal safety, emergency communication, and self-defense features within a single portable product. The compact design allows the device to be easily attached to a handbag, backpack, purse, or key ring,

ensuring that it remains readily accessible during emergency situations. [5].

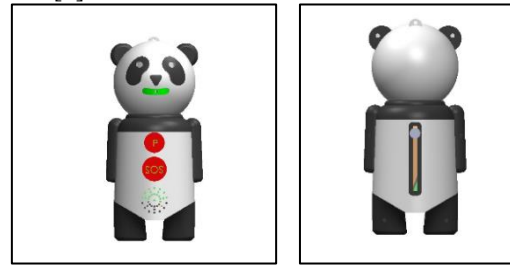


Fig. 1: Proposed Panda-Shaped Multifunctional Women's Safety Device.

Unlike many existing safety products that focus only on electronic emergency communication or physical self-defense, the proposed device is intended to integrate both approaches into one system. The device is designed to provide automatic SOS alerts, emergency phone calling, live location sharing, a loud emergency buzzer, an LED flashlight, pepper spray, and a concealed emergency knife. By integrating these features into a single device, the proposed design aims to reduce the need for carrying multiple independent safety products.

The proposed design also considers situations in which electronic functions become unavailable because of battery discharge or limited network connectivity. In such cases, the integrated pepper spray and concealed emergency knife can still provide physical self-defense. In addition, the built-in LED flashlight is intended to improve visibility during night-time emergencies and help the user locate the device in low-light environments.

The panda-shaped appearance is an important aspect of the proposed design. Instead of being designed only as an emergency tool, the device is intended to function as a stylish everyday accessory that women can confidently carry. Its compact keychain design encourages regular everyday use while ensuring that the device remains easily accessible during emergency situations.

The proposed multifunctional women's safety device aims to combine portability, accessibility, emergency communication, and battery-independent self-defense features into a single compact product, addressing several limitations identified in existing women's safety devices.

VI. WORKING PRINCIPLE OF THE PROPOSED DEVICE

The proposed multifunctional women's safety device is designed to provide immediate assistance during emergency situations by combining electronic emergency communication and physical self-defense features in a single compact device. The device is intended to be carried as a panda-shaped keychain that can be attached to a handbag, backpack, purse, or key ring for convenient everyday use.

During an emergency, the user can activate the device by pressing the dedicated SOS button located on the front side of the device. The proposed system is designed to communicate with the user's smartphone through a Bluetooth connection. Once activated, the connected mobile application is intended to send an emergency SOS message, make an emergency phone call, and share the user's live location with predefined emergency contacts.

At the same time, the built-in buzzer is designed to produce a loud alarm to attract the attention of nearby people. The integrated LED flashlight is intended to improve visibility in low-light environments and assist the user during night-time emergencies.

The proposed device also incorporates physical self-defense features. Pepper spray is positioned behind the panda's mouth, allowing quick deployment when required. A concealed emergency knife is located on the rear side of the device and can be accessed using a sliding mechanism. These features are intended to provide an additional layer of personal protection when electronic communication is unavailable or immediate self-defense is required.

The proposed working principle combines emergency communication, audible alerts, illumination, and physical self-defense into a compact and portable design. As this work presents a conceptual design, future development will focus on hardware implementation, mobile application development, and experimental validation of the proposed system.

VII. EXPECTED ADVANTAGES OF THE PROPOSED DEVICE

The proposed multifunctional women's safety device is expected to provide several advantages over many existing personal safety products by integrating emergency communication and physical self-defense features into a single compact device.

The compact panda-shaped keychain design is intended to make the device easy to carry every day by attaching it to a handbag, backpack, purse, or key ring. This improves accessibility during emergency situations compared to products that are usually stored inside a handbag or pocket.

The proposed device combines multiple safety features, including SOS alerts, emergency calling, live location sharing through a connected smartphone, a loud emergency buzzer, an LED flashlight, pepper spray, and a concealed emergency knife. Integrating these features into a single product may reduce the need for carrying multiple independent safety devices.

Unlike electronic safety features that depend on battery power and smartphone connectivity, the integrated pepper spray and concealed emergency knife are intended to remain available for self-defense even if the electronic functions cannot be used because of battery discharge or communication limitations.

The proposed design also emphasizes user-centered product design. The panda-shaped appearance is intended to function as a stylish everyday accessory rather than only as emergency equipment. This approach is expected to encourage regular use and improve the availability of the device whenever an emergency occurs.

Overall, the proposed device aims to provide a practical, portable, and multifunctional solution that combines emergency communication, self-defense, and everyday usability in a single compact product.

VIII. LIMITATIONS OF THE PROPOSED SYSTEM

The proposed multifunctional women's safety device is currently presented as a conceptual design based on a granted

design patent. Therefore, the complete hardware system and mobile application have not yet been developed or experimentally validated.

The proposed emergency communication features, including SOS alerts, emergency calling, and live location sharing, are intended to operate through a Bluetooth connection with a smartphone. As a result, these functions depend on the availability of a connected smartphone, sufficient battery power, and mobile network connectivity.

The physical self-defense features, including pepper spray and the concealed emergency knife, are intended to provide additional protection when electronic communication is unavailable. However, their effectiveness depends on proper user handling and responsible use during emergency situations.

The performance, reliability, response time, battery life, and usability of the proposed device have not yet been evaluated through laboratory testing or real-world user studies. These aspects require further investigation before practical deployment.

IX. FUTURE WORK

Future work will focus on developing a functional hardware prototype of the proposed multifunctional women's safety device and integrating it with a dedicated mobile application. The proposed system will be evaluated for emergency response time, Bluetooth communication reliability, battery performance, and usability under different operating conditions.

Future research will also include user studies to evaluate comfort, portability, ease of use, and overall user acceptance of the panda-shaped design. Additional safety features, such as fall detection, voice activation, AI-based emergency detection, health monitoring, and cloud-based emergency notification, may also be explored to further improve the effectiveness of the proposed system.

The proposed design can be further enhanced by optimizing power consumption, improving communication reliability, and integrating additional smart technologies while maintaining the compact and portable form factor.

X. CONCLUSION

This paper presented a proposed multifunctional women's safety device based on a granted design patent. The study reviewed existing women's safety products, analyzed their limitations, and identified the need for a compact, portable, and user-friendly personal safety solution.

The proposed panda-shaped keychain integrates emergency communication features, including SOS alerts, emergency calling, live location sharing, a loud emergency buzzer, and an LED flashlight, together with physical self-defense features such as pepper spray and a concealed emergency knife. The proposed design aims to improve accessibility, portability, and everyday usability by combining multiple safety functions into a single compact device.

As this work presents a conceptual design, future research will focus on prototype development, hardware implementation, mobile application integration, and experimental validation. It is expected that the proposed

design will contribute to the development of practical, user-centered personal safety solutions for women and encourage further research in this area.

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