RESEARCH PAPER

Spy Shield: An IOT Wearable for Stress Reduction and Personal Security

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Abstract— Spy Shield is a new IoT-based personal safety device, which is aimed at ensuring quick response and security, especially in cases where a woman is at risk. The wearable device is an integration of camera and ultrasonic sensor to sense danger within the range of 10-15 cm to automatically take pictures, videos and audio of the victim and assailant. Spy Shield is an Arduino Uno-based device equipped with a GSM and GPS module to activate a loud alarm, and to send instant messages, including the accurate geographic position, to emergency contacts and local authorities pre-registered with SMS or email. The system expands the immediate response by enabling family and friends to be aware of the real-time location, access multimedia evidence, and coordinate the intervention by using Bluetooth or SIM connectivity. In addition to emergency response, Spy Shield can be used as a forensic tool, which will create essential evidence to identify and prosecute attackers. Its multi-layered safety system provides instant alerts, real time tracking and post attack forensic functions that enable users and their networks to respond promptly to a crisis. Spy Shield is a powerful and efficient security software that can be used to ensure personal safety, functioning independently and using GSM.

Keywords: Bluetooth, Distance Sensor, Emergency alert system, GPS Tracking, IoT-based personal safety, Multimedia evidence captures, Real-Time Monitoring, spy Shield, SIM connectivity, Threat detection system, Wearable security device, Mental health, psychological wellbeing, safety

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1. Introduction

Personal safety is an increasingly important issue, especially among women and the vulnerable population in recent years. As the rates of crime are growing [1], new innovative solutions aimed at delivering real-time protection, quick reaction in cases of emergency, and efficient collection of forensic evidence are in more and more demand. The introduction of the Internet of Things (IoT) [2] has created new opportunities to combine smart wearable technologies with security systems so that people can take the initiative in order to make sure that they are safe. Spy Shield is a wearable product [3] that is an IoT-based item that was to be used as a full-fledged personal safety product. It is designed to offer real-time security to its users through threat detection, acquisition of essential evidence, and real-time notification of emergency contacts. The machine has an inbuilt miniature camera and ultrasonic sensor, which helps it to recognize an impending attacker and automatically record a visual and audio record. An attached processing unit, which is driven by an Arduino Uno with GSM and GPS modules, will send alert messages, as well as the exact location of the user to pre-registered contacts and law enforcement agencies. As it currently stands, Spy Shield also means that the location and multimedia data is transmitted to registered mobile devices through SMS or email instead of relying on smartphone application. The strategy will be accessible [4] even where mobile applications may not be accessible or viable. Nevertheless, with the development of technology, the further implementation of Spy Shield [5] will incorporate a dedicated mobile application to add more functionality to it. This application would aid real time location tracking, secure storage of evidence and remote monitoring by trusted persons and other security settings that are user customizable. This study aim is to come up with a multi-layered security system that will not only keep off attackers but also assist law enforcement bodies in identifying and arresting the culprits. Real time threat detection, automated alert systems and forensic evidence collection make sure that users have a trusted mechanism to react well in cases of emergency. The introduction of IoT technology in personal safety is a major leap forward in decreasing the rates of crime and giving people greater power of security.

2. Literature Review

The wearable safety solutions have developed in order to enhance individual security. Smart safety wearables, which are currently in place, are the Guardian Angel [6], Safer Smart Jewelry [7], and Wear safe Tag [8]. These gadgets are mainly concerned with alerts on emergency contacts in case of distress. Nevertheless, it has been demonstrated that such solutions do not always involve the collection of evidence in real-time, which complicates the investigation of the incident after it occurs [9]. In order to overcome such shortcomings, the Spy Shield system incorporates multimedia recording (video, audio and image recording) and real-time notifications. This makes sure that the law enforcement agencies and the emergency responders get very important forensic data to intervene and analyze the event better. The ultrasonic sensors have various applications in the proximity sensing system and have been successful in security and surveillance system [10]. Studies indicate that ultrasonic sensors are highly accurate in the detection of the objects in a specific range [11]. The spySHEild system uses mini ultrasonic sensor to identify threats at 10-15 cm. Once an object goes out of the predetermined range, the device will be activated to record multimedia evidence and dispatches emergency notifications. This will build efficiency of the system in detecting possible threats without manually turning the system on [12]. The technologies of GSM and GPS are widely employed in security related tasks of real-time tracking and emergency communication. Research indicates that GSM-based alert systems are efficient in transmitting distress signals, which are crucial to give critical information like real-time location coordinates [13]. GPS tracking also contributes to the tracking of movement, as well as faster-response in case of emergency [14]. The Spy Shield system will combine GSM-SIM900A and Tiny GPS Plus modules to provide smooth emergency communications.

Table No. 1 Comparison of Spy Shield with Existing Solutions

Feature	Spy Shield	Existing Solutions
Emergency Alerts	Instant notifications to police & registered devices	Limited to calls/messages to emergency contacts
Media Capture	Automatic video, audio, and image recording	Mostly manual activation required
GPS Tracking	Real-time tracking with ±5m accuracy	Limited location updates
Threat Detection	Distance sensor-based proximity detection	No automatic detection
Independent Network	E-SIM connectivity (works without phone)	Depends on smartphone network

Table 1 includes a comparative study of Spy Shield and the current safety solutions with the advantages.
This allows automatic SMS notifications with location information be dispatched to registered contacts and law enforcement agencies without the need to connect to the internet via a smartphone [15]. The relevance of multimedia evidence in the investigation of crime is not a new development that has not been adequately reported in past studies [16]. VGA (640x480) compact CMOS cameras have been discovered to give sufficient clarity to be used in facial recognition and for forensic documentation [17]. Spy Shield is fitted with a small VGA CMOS camera that captures short video clips and images when there is a threat detected. An audio recording option is also present where it records the surrounding sounds that may act as important forensic evidence to identify and prosecute the attackers. Mobile applications have become increasingly important in the safety systems. Mobile applications also offer real-time alert management, tracking of locations and accessing evidence remotely [18]. It has been observed that Bluetooth and GSM-based integrations enhance the reliability of the systems and provide a reliable means of data transmission without any delay [19].

3. Methodology

The Spy Shield system is formed as a multi-layered system of security implementing the IoT-based threat detection and real-time notification, as well as the forensic evidence gathering. The process has five major elements, which are threat detection, capturing evidence, real-time communication, activating an alarm, and transmitting an emergency alert. These elements are interdependent to guarantee prompt response and intervention to address an emergency scenario as illustrated in Figure 1.

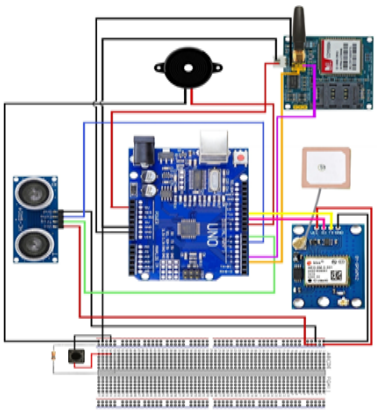

Fig. 1. Circuit Diagram of Spy Shield

Spy Shield has a wearable device, as depicted in Figure 3, which has a mini ultrasonic sensor that keeps tracking the environment of the user. In the case of an incoming threat with a distance of 10-15 cm, the sensor records the presence and activates the evidence capture system. This involves video recording using a VGA CMOS camera, as indicated in Figure 2, recording short video clips of the environment; image capture to give clear visual evidence on the possible threat; and sound recording by means of a microphone to record the sounds around such as voices or other signs of distress that can undergo forensic examination.

Fig. 2. Mini Spy Camera

The ultrasonic sensor distance measurement equation is: d =(v 2t)/4.

Where: d is the distance v is the speed of sound in air t is the time taken by the sound wave to bounce back. To enable responding promptly to an emergency, the external device, represented in Figure 4, by Spy Shield, combines GSM and GPS modules that will allow tracking in real time and sending automatic alerts to emergency contacts and law enforcement agencies previously registered. When a threat is detected, GPS coordinates are read out of the Tiny GPS Plus module and the SIM900A GSM module connects to transmit SMS alerts with live position of the user (available through Google Maps) and a distress message with the user in danger. These alerts are dispatched on pre-determined emergency contacts, such as family and police authorities. Also, the emergency button offers a manual option and the user can send an alert immediately in case he or she is unsafe.

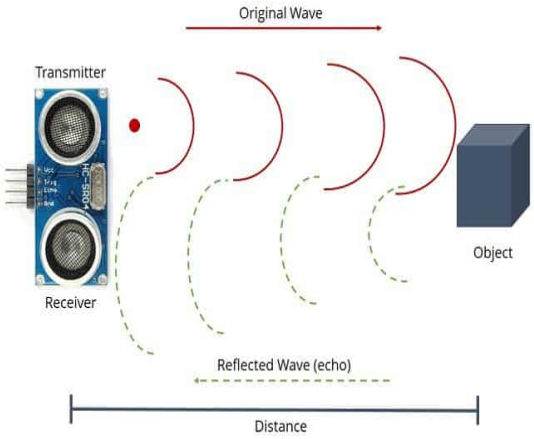

Fig. 3. Ultrasonic Sensor

***Fig.4**. External Device*

In addition to real-time notifications, Spy Shield has a loud audible alarm, which can be seen in Figure 5, to discourage the attackers and get the attention of people around them. The two main functions of this feature are threat deterrence, in which the loud alarm can shock and prevent the attacker to continue the attack, and attention drawing, where the loud noise can alert the nearby people, raising the likelihood of bystander intervention and help.

Fig.5. Buzzer

Spy Shield is built in such a way that captured multimedia evidence such as images, video clips, audio records are automatically transmitted to the specified email addresses as well as real time location information. A specific mobile application will be created in the future, which will allow giving emergency notifications through SMS and informing trusted people and law enforcement agencies in real-time. This will help in real time monitoring of the location by live GPS location updates and offer forensic evidence to detect the possible threats as depicted in Figure 6.

Mobile App

Fig. 6. Mobile Application

The Spy Shield system will work with seamless functionality with the help of IoT-enabled automation. The device can be used with a combination of embedded SIM (E-SIM) to facilitate constant connectivity in sending alerts, working with no smartphones to make it accessible in every scenario, and low power design to support the long working hours without the need to replace battery frequently. The Spy Shield system is based on a network system of a Spy Shield camera, an external device, and a mobile app.

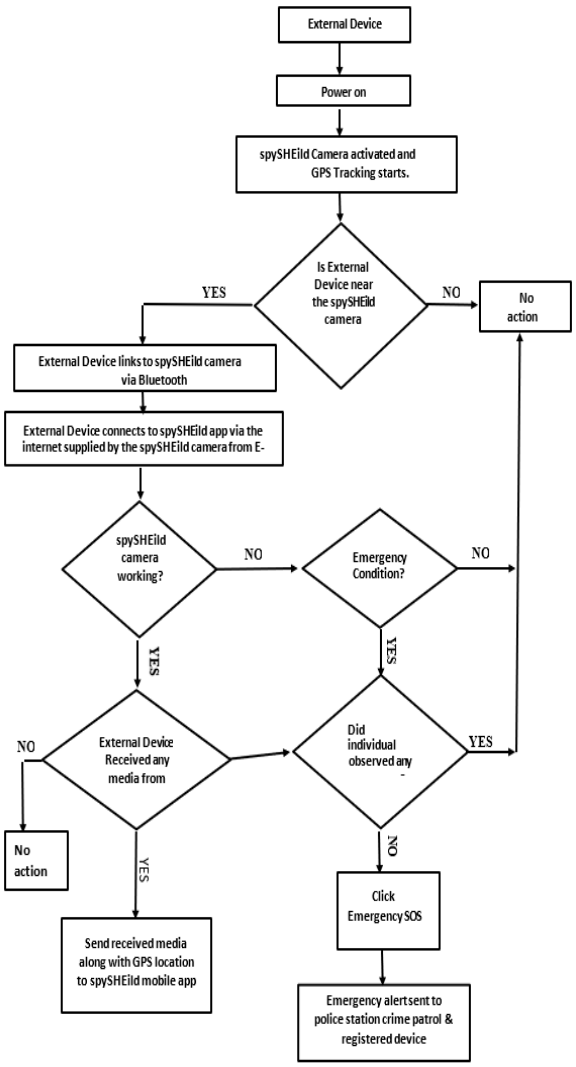

Fig.8. Workflow of Camera

Users can press an alert button on the camera or app in case of an emergency, which will automatically transmit their location and captured media to registered devices, law enforcement and crime patrol units as illustrated in Figure8.

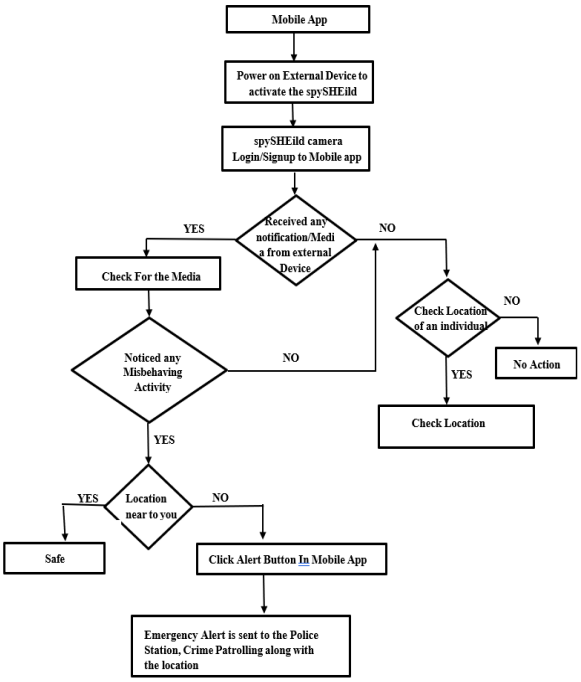

Fig.9. Workflow of Mobile App

The mobile application also provides the user with the opportunity to check received media on any malicious actions and provide an emergency alert, which is necessary, as illustrated in Figure 9. In case no emergency is registered, the system is in idle mode, which guarantees an effective and automated security system.

4. Results and Discussion

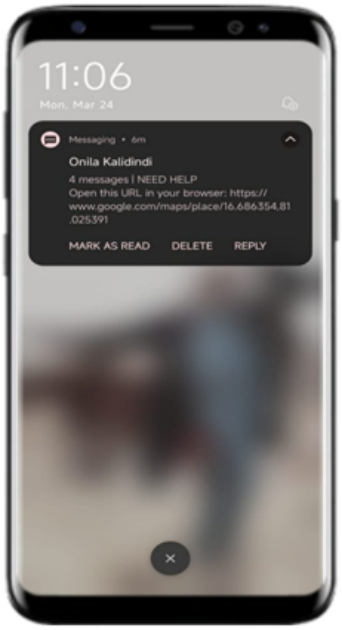

Fig.10. Emergency Notification via SMS

As indicated by Figure10, an emergency situation is detected when a real-time alarm is automatically displayed on the lock screen of a mobile device. The email notification contains an emergency message signifying a critical situation that was discovered. The user can also archive or reply directly to the notification screen to guarantee instant communication. The role enhances prompt emergency response, which leads to a faster response in emergencies.

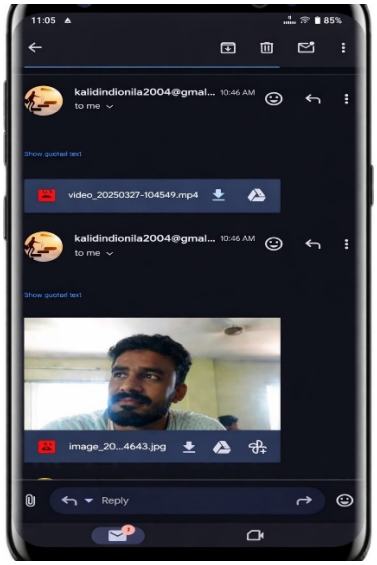

Fig.11.Transmission of Multimedia data to registered users via Email

Figure11indicates that the images and videos taken at the time of an emergency are effectively sent to the e-mail of the registered member. The email carries media attachments which contain real-time visual evidence and they assist trusted contacts and law enforcement in making an evaluation of the situation. This aspect provides instant delivery of critical information such as images, videos and alert messages which improves situational awareness and efficiency in response. The system allows reacting more quickly and enhancing personal protection with the help of this automated transmission.

5. Conclusion

Spy Shield is a bright example of the transformational capabilities of IoT-based security systems, which provide a stable and autonomous safety system that does not require any further use in the smartphone applications. Through GSM technology, real time tracking and capture of forensic evidence, it guarantees that the essential security information is communicated to emergency contacts within a short period of time. The model that it has today offers a solid base of personal protection, which is why it might be useful in various situations, even where the internet is not readily

available.

6. Future Scope

The future of Spy Shield is that it has the potential to become a security ecosystem. As the AI-based analytics, cloud computing, and improved mobile connectivity advance, the system is capable of providing predictive threat detection, automatic emergency response, and an integrated system with smart city infrastructure. Additional features could also be biometric authentication, voice recognition and increased forensic functions, making it a more proactive measure to personal as well as community security. Through constant innovation, Spy Shield will transform the contemporary standard of security and contribute largely in the crime prevention and emergency response systems.

7. Conflict of interest

No

8. References

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