Guardian device for women - a survey and comparison study

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Abstract
Nowadays women are facing many problems; the most common problems are mental and physical harassment. In order to secure women from such harassments, we propose a novel device Guardian Device for women. The device works with a trigger, microcontroller, GSM module, GPS module, IoT module, Neuro Stimulator, Buzzer, Vibrating Sensor, Pulse sensor, Solar charging battery and a button sized camera. The women can switch ON the trigger whenever they feel danger. The device will activate the global positioning system (GPS), which obviously will track the exact position of the device. The device sends an emergency message to the registered mobile number and nearby police station. The button sized camera captures the image of an attacker and sends the copy to the police stations nearby. Neuro stimulator will give unethical shock to the attacker and a buzzer gives an alarm which alerts the people surrounding the victim.

Keywords: IoT, Sensor, Women, Device, Trigger

1. INTRODUCTION

Around the globe the crimes against women are increasing every day. [30] As per the gender survey worldwide, the female is about 50 percentage, which is at par with the country’s sex ratio. These women’s role is vital in developing any nation. Nevertheless, the rising harassments against women is a major problem that preventing any nation from developments. At present a woman is reportedly getting kidnapped at every 44 minutes and raped at every 47 minutes. Therefore, the women safety has become the major task in present scenario. At school, work places, and everywhere the safety of women is in danger. The sexual harassment is increasing day by day against women. Majority of these incidents are happening due to their superiors in the organisation or sometime by a close associate. [1] In 2016, the number of rape crimes reported was around 39000 in India. [5] According to reports of national crime bureau total cases report around the globe in 2015 was 327394; which is decreased by
3.1 percentage compared to 2014. By nature, the women are not so physically strong as compared to their men counterpart. Needless to mention that enormous innovations are being incorporated in many sectors. Hence, there is also a need to development of technology driven devices and systems for the use of women safety, which is a need of the hour. So, in case of such emergency, the proposed device guardian for women is an ultimate security device especially designed for women security purposes. The device should be designed in such a way to make it portable for use. The basic approach is to intimidate the exact location, messaging to registered mobile number and making calls police station and ambulance services, neuro stimulator gives shock of the attacker, pulse sensor measures the pulse rate, buzzer gives alarm sound and button camera captures the image of the attacker. [8] VithU is an emergency app used to send help emergency message with a frequency of 2 seconds continuously which can be activated by pressing power button 2 times successively.

The paper is segregated into 3 sections as follows. Section 1 presents a detailed literature review of the guardian device performance parameters are discussed in detail. Section 2 discusses the analysis of existing work and Section 3 deals with the proposed model, challenges, discussion and conclusion.

2. LITERATURE SURVEY

To prevent the attacking on women, so far many safety products are designed. These products are invented based on GPS (Global Positioning Systems) and GSM (Global System for Mobile Communications) modules, IOT (Internet of Things) module, Raspberry Pi model and with some hardware component applications. The authors have reviewed some of the papers based on the women safety.

Wasim Akram et al [1] they proposed the device with fingerprint sensor and shock wave generator using Atmega 328 microcontroller along with the voice recording ability. Then, the GPS and GSM are used to trace the location and sending emergency messages to contacts. B. Sathyasri et al [2] proposed a work with GPS and GSM which are used to track the exact location and send this location to contacts stored in microcontroller Atmega 2560. Neuro stimulator also activated once button is pressed to start a device its application is to give a shock to the attacker along with the buzzer beep sound to alert the surrounding people. D. G. Monishal et al [3] proposed a system based on android application using the ARM controller along with the GSM, GPS, Bluetooth, and RF detector. Working totally based on volume buttons of mobiles as follows if the button is pressed on time, then message alert, second if button is pressed two times, then message and audio and third if the button is pressed long time, then calls to police, message, and Audio.

N.Harshitha et al [4] proposed product with temperature, heart sensor and motion sensor using Node MCU. Temperature sensor senses the body temperature, Heart sensors sense the pulse rate and motion sensors sense whether the device is in motion or not. The device detects these as soon as it is turned on along with the location. Geetha Pratyusha Miriyala et al [5] proposed a system with raspberry pi model when the device is turned on live streaming recording started and the stun gun with charges an attacker and GPS and GSM for getting the exact location. Sriranjini R et al [6] developed a device using PIC16F877A, GPS, GSM, and Speech circuit. As soon as the device turned on the speech circuit works as follows it designed with two triggers rec, play. When the rec trigger is turned on it starts recording surroundings words. This recording will take place with the MIC fixed in device. To listen the recorded speech play button is pressed, as long as button is pressed the device will play the recorded audio.
Nishant Bhardwaj et al [7] developed a device with microcontroller AT89S52 in which device unlocks with a simple voice command containing two sections transmitter and receiver. To start the functioning of the device force sensor is used, one can start the functioning just by throwing a device by force in case if doesn’t need to use voice command. Lanasa Rajan et al [8] developed a system with Programmable Interface Controllers (PIC) microcontroller with safety gun and audio playback and record (APR) circuit. Safety electric gun is used to give a shock to the attacker, while APR circuit is used to record the conversation. The device also consists of vibrating sensors in case any accident occurs to the user it sends location and helping message to ambulance and family members. G C Harikiran et al [9] designed a product for women safety in the form of a smart band with BLE technology using microcontroller. Device relates to the sensors like temperature sensor, pulse rate sensor for knowing the health conditions of user dual technology motion sensor is used to detect the moving objects.

Jismi Thoma et al [10] designed a women safety device with Arduino, SD card module and with spy camera. AS the device got activated tracing of the location starts and sends this location to registered contacts. Spy camera captures the image and stores in SD card. Buzzer gives alarm to alert nearby people. S.Sonali et al [11] designed a system with Arduino nano, GPS, GSM and LCD. To activate this, we need to press a push button then immediately the location is shared to family members the LCD display shows the location to the user for their reference. Sunil K Punjabi et al [12] developed a women safety product with microcontroller Arduino. When the device is turned on by pressing a pressure switch it works in a way that the buzzer turns on and find the GPS location of victim then it will send a message to the parent mobile along with the location through google maps link.

R.Balamurugan et al [13] designed a system with PIC16F877 microcontroller along with stun gun and voice IC. When the emergency button pressed voice IC records the conversation voice and stun gun gives shock to the attacker. As usual the GPS and GSM help in knowing exact location to mobile numbers registered in microcontroller. Rhythm Kr Das et al [14] developed a very portable device for the safety of women using Wi-Fi module ESP-8266-12F and Arduino code. The Wi-Fi module sends email or SMS to the family members. This is a very low-cost product and highly efficient and small. Dhruvii Parikh et al [15] proposed a system with GSR sensor along with heart rate and vibration sensor and micro controller NODE MCU. The GSR works on the measuring of unceasing variations in the electrical attributes of skin while sweating. The device is designed in such a way that if any wrong message sends to family members immediately it sends ‘iam ok’ message to the same numbers.

R.Sharmila et al [16] proposed a work working with ATMEGA 328P in transmitter section and ATMEGA nano in receiver section. The power supply and activation of device is made through Bluetooth. A comparator is used to check the connectivity between the ends of a copper thread. When the connections between the ends are terminated the transmitter module makes emergency calls and sends alert message to predefine numbers. V. Mareeswari et al [17] developed a woman protecting device with the help of android device. The device can be activated using voice command this command is sent to device through Bluetooth and captures the image of surroundings. Light source also connected to give shock attack to the attacker. Shirly Edward A. et al [18] developed a device using the Arduino UNO and electret microphone. The device works in two modes Default mode and Location send mode. In default mode delay of 3 seconds occurs between the time at which the message originally sent and the moment at which the call was initiated. Location send mode is activated by pressing push button, to obtain the coordinates it takes 7 seconds and helping message are sent to the predefine contacts within 4 seconds of intervals.
S Pradeep, Kanikannan et al [19] proposed a system with Arduino uno and adapters. Switch is used to turn on and turn off the device, GPS and GSM helping in knowing the location of the user by the family members in the form of helping message and location is shared in the form of link. K.Gopal Ram et al [20] developed a device with a micro controller Arduino. When the pressure sensor is pressed the device got turned on and sends a message and call to predefine numbers. In case if the call is not answered for a delayed time, a call will be diverted to the police and a similar message will be sent. If the individual crosses the territory, then a message is sent to parent mobile number in text format. K.Thavil1 et al [21] developed a smart band module using micro controller, sensors and BLE. In this the smart band is connected to the smart phone via Bluetooth. Data collected by the smart band like temperature and movement of body is compared constantly with the application that is already installed in mobile. Location coordinates are sent along with alert message in the form of Google URL to emergency contact and police station. Rachana B. et al [22] produced a device for the safety of women in which it can be activated in three ways, viz. manual switch (button), auto mode (using sensors) and by falling (fall detector) as soon as activation camera starts capturing the images, Shock circuit system generates an electric jolt. Sensors detect the health status of the user.

Shivani R. Jadhav et al [23] designed a safety device in such a way that as soon as the button of ESP32 CAM pressed buzzer starts alert sounds, camera captures the image and send the captured image and location link to family and cops. B.Anil Kumar et al [24] proposed a women safety device in the form of glove which can produce an electric shock as the trigger is pressed. GPS and GSM send the location of the user via txt message to predefine numbers. K. Priyanka1 et al [25] designed a women safety device in this system power supply is turned on then the sensors sense the information like heartbeat rate, temperature, flexibility, gesture and sound of the user. These values are checked to the threshold values which are predefined in the microcontroller. The values are not exceeding the threshold value then the output status will show as Normal. If any one of the values is to be exceed then the status will turn into Abnormal, then the buzzer will be alarmed and GPS tracks the location, GSM send the emergency message to family mobile numbers. Kushagra Sahai et al [26] proposed a system with raspberry pi model along with camera module. When the device is turned on camera captures the image and GPS tracks the location GSM helps in sending emergency message to relatives and family.

V Hyndavi et al [27] developed a device using GPS, GSM, Arduino, pressure, pulse and temperature sensor. Device can be activated manually by pressing button or automatically. This automatic triggering starts when any one of the sensor value reads high. As soon as device turned on GSM sends alert message with location to saved numbers without internet connectivity. Dhiraj sunehra et al [28] designed a smart device using Raspberry Pi, GPS, Buzzer, Webcam and GPRS technology. As soon as device is turned on Webcam captures the image and send to email, GPS located the device location and send this location URL to guardian’s number in the form of text message. With the usage of Raspberry Pi no external wi-fi router is required for connection. Jayashree Agarkhed et al [29] proposed a system using microcontroller, touch sensor, shock generator, pulse sensor. When the key is pressed device is turned on danger message is sent to friends and family mobile numbers. Touch sensor records the physical touch of the device especially by a person. By keeping finger on pulse sensor, pulse rate of the user can be noticed. Buttons are pressed to on buzzer and GPS. Shock generator gives shock to attacker which aids in self-protecting to an extent.
3. Analysis of existing work

3.1. Technology Comparison

Since most of the devices are developed using Raspberry pi and Arduino let us look on comparing in terms of technology between them.

| Raspberry pi | Arduino |
|--------------|---------|
| 1. Control unit is derived from ARM family. | 1. Arduino controlled unit is derived from ATMEGA family |
| 2. Raspberry pi is typically based on a Microprocessor. | 2. Arduino is typically based on Microcontroller. |
| 3. Produces output after computing data and based on the computation outputs it controls the components in a system. | 3. Particularly designed to control electrical components connected in a system. |
| 4. Involves complex hardware and software structures. | 4. Involves simple hardware and complex structures |
| 5. Expensive | 5. Cheaper |
| 6. Consumes larger battery | 6. Consumes less power than Raspberry PI |
| 7. Requires heavy RAM memory. | 7. Requires less memory. |
| 8. Greater clock speed | 8. Slower compared to Raspberry PI |
| 9. Android installation is possible with Raspberry PI which comes with functional operating system. | 9. Arduino won’t have functional operating system. |
| 10. Works well in delivering software applications. | 10. Works good in interfacing with sensors and LEDs |
| 11. Can perform multiple tasks at a time. | 11. Able to perform single task at a time |

3.2. Overall drawbacks from Existing system

After analysing design of many devices, draw backs existing in many designs are Power, size and evidence constraints. Most of the devices are limited battery capacity so if the user forgets to charge it device will be completely powered OFF. Even though devices integrated with evidence collecting tools, design consumes large power and occupies heavier design space. No software data base or apps are involved for immediate storing of evidence, storing data immediately aids for further investigation purposes suppose if the device is damaged by attacker. When system is equipped with larger equipment, power issue here again rises even size constraint also. Cost constraints also come to rise when devices are developed with alert devices like Buzzer, neuro-stimulator etc. but these devices are necessary to give alert to surrounding citizens and devices like-neuro stimulator gives immediate protection and create a chance to escape. So, without this premium device is not possible. Since there is a chance in designing device precisely by including all kind of evidence tools and alerts battery, cost and size bouncing back the attempts. So better design and device is only possible with better battery and small device size.
This analysis gives largely on the various systems being used in different safety devices and the components interconnected with it for making it more feasible for an easy adoption.

**Figure 1.** Pie chart analysis on Technology comparison

**Figure 2.** Smart analysis on devices
This section gives the type of technology used in devices and limitations of the devices.

| Ref. No. | Title                                                                 | Technology Used                                                                 | Limitations                                                                 |
|---------|----------------------------------------------------------------------|--------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| 1       | Design of a Smart Safety Device for Women using IoT [1]              | Fingerprint sensor, Shock generator and Microcontroller                         | No Spy camera and voice recording kit is available for evidence.               |
| 2       | Design and Implementation of Women Safety System Based On IoT Technology [2] | Vibrating sensor, Neuro stimulator Buzzer and IOT module.                      | Evidence recorders are missing for future investigation.                      |
| 3       | Women Safety Device and Application-FEMME [3]                       | Video and audio recorder and hidden camera                                      | All the existing systems must be connected to the GPRS service to work properly, hence cannot be used during the emergency if the internet connection is lost. |
| 4       | Smart Security Solution for Women Using IOT [4]                     | Temperature sensor, Heart sensor and Motion sensor and Node MCU                | No Shock generator is used for attacking of attacker.                         |
| 5       | Smart Intelligent Security System For Women [8]                     | Raspberry Pi, Live streaming video.                                            | Limited battery setup.                                                       |
| 6       | GPS and GSM Based Self Defense System for Women Safety [7]          | Speech circuit, Voltage regulator circuit and Microcontroller.                 | Shock generator and camera are not available.                                |
| 7       | Design and Development of “Suraksha”-A Women Safety Device [9]      | Force sensor, Speech Recognition system, Training words of recognition.        | Unlock can be done with voice in case attacker first close the mouth nothing can be done, no shock generators |
| 8       | Self Defense System for Women Safety Using Safety Electric Gun, Location Tracking and SMS Alerting [10] | Relay driver, Vibrating sensor APR circuit and PIC microcontroller.            | Spy camera is not available for capturing image of the attacker                |
| 9       | Smart Security Solution for Women based on Internet Of Things (IOT) [13] | Pulse rate sensor, BLE, Temperature sensor, Dual technology motion sensor.   | The device communicates with the smart phone if the smart phone lost can’t do anything at that scenario. |
| 10      | TOUCH ME NOT -A Women Safety Device [16]                            | Camera module, SD card module and microcontroller.                            | In case device is destroyed by the attacker SD card will also be destroyed.  |
| 11      | Women Security System Using GSM and GPS [17]                        | GPS, GSM, Arduino nano.                                                       | No shock generator and Camera.                                               |
| 12      | Smart Intelligent System for Women and Child Security [20]           | GPS, GSM, Pressure switch.                                                    | No sensors, Shock generators and camera.                                     |
| 13      | Women Safety Ensurance Device [24]                                  | Voice IC, temperature sensor, stun gun and buzzer.                            | The recorded evidence should be sending                                       |
|   |   |   |
|---|---|---|
| 14. | Women Safety device (IOT Based) [9] | Wi-Fi module, Powering system |
|   |   | immediately otherwise the attacker may damage it. |
| 15. | IoT based Wearable Safety Device for Women [12] | Galvanic skin sensor, vibration sensor and heart rate sensor. |
|   |   | No protective components are placed like stun gun or shock generators. |
| 16. | Women Safety Thread [25] | Microcontroller, RF transmitter and receiver, Comparator, Atmega nano |
|   |   | No evidence recording components are present. |
| 17. | Smart device for ensuring women safety using android app [21] | Voice kit, light source, Android smart device and Microcontroller. |
|   |   | If the android device is damaged or lost by the attacker than the user is helpless. |
| 18. | GSM Based Women’s Safety Device [5] | Arduino uno, Electret microphone, GPS, and GSM. |
|   |   | Sensors and shock generators are absent. |
| 19. | Implementation of Women Safety System using Internet of Things [11] | GPS, GSM, Microcontroller and Switch. |
|   |   | Evidence recorders and sensors are in attentive. |
| 20. | GO SAFE: Rapid Intelligent System for Women and Child Safety [6] | Pressure switch, GPS, GSM, and microcontroller. |
|   |   | Sensors, shock generators and camera are distracted. |
| 21. | Study on Smart Security Technology for Women based on IOT [15] | BLE, Temperature sensor, motion sensor. |
|   |   | The device is connected to smart phone if it lost the user may be helpless and shock generators are inattentive. |
| 22. | Smart Shield for Women Safety [23] | Shock circuit, fault detector, camera and microcontroller. |
|   |   | Limited battery. |
| 23. | A ESP Based Smart Device For Women Safety Using IoT [18] | Smart module, ESP32CAM, Camera and server. |
|   |   | Shock generators are absent. |
| 24. | Design of Smart Glove using GPS and GSM Based Defence System for Women Safety [19] | GPS, GSM, Microcontroller and Power circuit. |
|   |   | Evidence capturing components are absent. |
| 25. | Protection For Women Using IOT Smart Device with Location and Parameters [14] | Pulse sensor, Temperature sensor, Flex sensor, Sound sensor, Accelerometer, and mobile system. |
|   |   | To run all the sensors along with microcontroller huge power supply is recommended. |
| 26. | Smart Band Protector [22] | Pulse sensor, Raspberry Pi and Camera module. |
|   |   | Shock generators are inattentive. |
| 27. | Smart wearable device for women using IOT [29] | GPS, GSM, Arduino, pressure, pulse and temperature sensor. |
|   |   | Evidence recorders are absent. |
| 28. | Raspberry Pi Based Smart Wearable Device for Women Safety using GPS and GSM Technology [30] | Raspberry Pi, GPS, Buzzer, Webcam and GPRS technology |
|   |   | Battery and size constraints since raspberry pi consumes heavy power. |
| 29. | Women Self Defense Device [31] | microcontroller, touch sensor, |
|   |   | Key need to press to turn |
shock generator, pulse sensor on device which may delay to turn on device in emergency, again separate button need to be pressed to turn on GPS and buzzer.

4. Overview and Proposed solution

After the survey of research works on women safety projects the authors got some queries on the device and hence the challenges are identified such as
1. What happens if the battery is drained, or the user forgot to recharge it in case of rechargeable batteries?
2. The device must be robust, even if the attacker tries to damage it.
3. The user acquaintance on the operating methods and the user friendliness.

We are seeing in our day-to-day life the crimes against women are increasing. Even though the government is implementing many positive sectors for the security of women, Crimes are not minimized. These days, the technology has improved in a greater extent by making the use of this technicians are developing a device for the security of the women linking with IOT, Android apps and devices and many. For filling this development, the literature survey of five-six years of research paper review has been done in context of women security. After analysing the challenges involved in the security of women, the authors propose the following design to be realized in making the device more efficient and useful. The device should be made as small as possible for an easy portability and deployment in such a form, like a wrist band with the IOT Module, GPS and GSM and sensors like pulse sensor neuro stimulator and with the microcontroller. A spy button camera should be fixed to capture the image of the attacker. The solar recharging battery should be used so the battery won’t die even if the user forgot it to charge.

![Block diagram of proposed system.](image-url)
When the trigger is pressed to activate the device, the GPS tracks the location of the user and GSM gives this information to the predefined mobile numbers in the forms of emergency message and nearby police station. Buzzer starts beep sound to alert the surrounding people, this can deviate the attacker to a larger extent. Neuro stimulator gives electric shock to the attacker which may provide some chance to escape, pulse sensor checks the pulse rate of the user, in case if the pulse rate goes abnormal GSM sends text message to family contacts and make a call to ambulance this can save the user by providing immediate medical treatment if any attack happened. IOT module provides a path in connecting the microcontroller with GPS, GSM and with other sensors in device. It aids in immediate transmission of data to data base like image of attacker. Spy camera captures the image of the attacker and sends this image immediately to the cloud server using ESP32 CAM, so the attacker may not escape from the police investigation. This proposed design limits the space constraints of device also the device is designed in such a way to transfer the image immediately to data base attacker can’t escape from inquiry even the device got damaged by him.

5. Results

To find the limitations in existing models analyses of various existing designs are observed and classified using different analysis methods. At initial all the existing models along with components used and limitations of the design developed in individual idea are arranged in the form of table. This gives the idea on limitations and equipment used in each design. Commonly used processors specifications and differences are notified in the form of table. So, the designers can choose the suitable processor based on the required constraints of design. In smart analysis processors along with the components widely incorporated with them are specified. This analysis gives an eye on the equipment integrated with processor. For better analysing purpose of pre-owned equipment Pie chart model is implemented along with table. Drawbacks in current models are specified. Challenges are identified and to overcome at-least some major challenges future design of model is determined. By knowing the challenges and draw backs developers are able to predict the range of research need to be done in further process.

6. Conclusion

This paper shows the survey work on women safety devices and the limitations existing in proposed ideas. The critical analysis identifies the scopes which need to be incorporated in the new proposed device, as the existing devices neither have the component which can provide evidence of the culprit nor integrated with shock generators. This can largely save the women in many cases of missing or abduction. Nevertheless, the major drawback could be as many devices are running with limited power supply, it may drain fast. Further, this can be overcome by incorporating the chargeable battery plus the solar battery charger, neuro stimulator and spy camera may be integrated in order to submit the captured image to the nearest (or registered) police station, along with the location credentials by the GPS. The authors are confident of rectifying the limitations in the existing system to a larger extent by incorporating the proposed idea, and to save the women from violence or abduction going against them.

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