

Suraksha: The Ultimate Self-Defense Kit for Women

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Abstract:- Women's safety is one of the critical social issues being faced today worldwide. Women have been victims of crimes against them for ages but given the present-day technological advancement, it's now time that we build powerful and effective safety systems for them to live a carefree life. This paper proposes an inexpensive and efficient wearable device that'll not just be capable of providing security to women through a self-defense mechanism but also help them seek justice later if need be. This system primarily consists of a camera camouflaged in a women's accessory - a necklace. The necklace is configured with a small button that when pressed, triggers the camera to start clicking pictures at regular intervals and then notifies a Bluetooth-connected app to send SOS messages to the saved contact list with the location coordinates. Another component of the system is a taser ring to attack the oppressor while defending oneself. Something as tiny as a ring would be a perfect gadget to implement this module.

Keywords:- Internet of Things (IoT), Smart Device, Women Safety, Android Application, Cloud Authentication, Bluetooth Module HC05, Arduino Nano, Camera Module ov7670, SD card reader, Taser

1 INTRODUCTION

Women's safety has always been a worldwide concern. Women across the globe continue to be victims of several cruelties such as Rape, murders, assaults, Domestic Violence, Trafficking, etc. According to a report "approximately 35% of women worldwide have experienced sexual harassment in their lifetime. In most countries with data available on rape, less than 40% of women who experience sexual violence seek help. Less than 10% seek assistance from law enforcement.". Reasons behind why most women dodge seeking justice are either because of lack of evidence or lack of faith in the judiciary. It is heart-wrenching to see how women fall prey to horrendous crimes and then never even seek justice due to lack of substantial proof. This delay or even no justice is the reason the culprits get away easily, are motivated to repeat such crimes, and also encourage others to do so. Another aspect of this issue is the incapability of women to fight back during the incident. A reason why women cannot resist such attacks on the spot is due to the lack of enough self-defense equipment with them at the time of the incident. It is impossible to carry a weapon each time you step out, and it is not even desirable. Nevertheless, the growing cases of crime against women have now made it crucial than ever before to develop systems that could pace such crimes down. This is not possible without the support from law enforcement agencies and the introduction of more severe law punishments for the offenders, however, this paper tries to apply some technological inventions to solve the issue.

There have been attempts in the past as well to bring innovative solutions to such critical issues. The majority of them suggest sharing the real-time GPS location of the victim with their relatives and capturing proof of the incident through cameras, just the style of implementing it varies. For example, in [1] a system that sends out alert messages to the sender's kin with their location coordinates has been proposed but with two different methodologies. First is a manual mechanism that simply consists of a button that when triggered sends out alert messages and second, an automatic mechanism that detects temperature, pressure, and pulse readings of the owner to detect tension in such a harsh situation and then send out messages. One drawback of such automatic systems is false positives. Thus, another system in [6], proposes a similar but customized device that learns an individual's pattern of their heartbeat and temperature and then determines a threshold value for each of them accordingly. This helps in identifying genuine emergencies and generating alarms in legitimate situations only. Other systems that generate SMSs with Real-time location coordinates and notify the victim's peers through different methodologies include [4] which uses GSM modems and a GPS, [5] which uses GPS, GSM, and GPRS technology that not only sends out location coordinates as SMSs to the emergency contacts and the police but also captures the pictorial proof of the incident in the form of images and forwards it as an Email alert to the emergency contacts, [7] that proposes another such tiny device to communicate with the law enforcement agencies and emergency contacts using GPRS technology. In [3] a Smart Ring (SMARISA), along with notifying the peers and police with real-time location, captures images of the offender via a Raspberry Pi Camera when triggered.

All the above solution systems aim to notify an emergency and collect ample proof of the incident; however, none deal with the idea of self-defense. Moreover, some of the systems require the victim to be equipped with some kind of extra gadgets like a phone or some other device, but, in case of an attack, it is very likely that either the phone falls off or is taken away. Another such attempt to give out alert signals and notifications to kins is made in [9] where the device is attached to the women's clothing in the form of a button, but this doesn't seem to be the most efficient manner of implementing such a system. One of the reasons is, it is quite natural to forget detaching such devices from the clothing daily. This may drastically increase the risk of the device getting damaged during washing or ironing activities. In [2] as well, a smart device is clipped to the user's footwear which on tapping one foot behind the other four times, sends out an alert along with the location to an application on the victim's phone. But in emergency cases like the ones, we are concerned about, the footwear can slip through the victim's foot while running. Thus, to address these aspects of the problem we propose SURAKSHA. The proposed self-defense kit consists of general accessories that women wear in their daily lives: a necklace and a bracelet, which to an extent overcomes the limitations of previous

works. The necklace envelopes a hidden camera to record any misshaping and saves it on an SD Card. It also consists of an SOS message service to send out emergency messages to the user's defined list of contacts and the nearest police station. The bracelet comprises taser equipment that produces non-lethal electric shock to save self from being attacked. The paper revolves around this solution and discusses in detail its implementation.

2 LITERATURE REVIEW

In this section, a survey of the actual problems and some innovative women's safety IoT applications to solve them has been carried out. Certain limitations of these conventional methodologies as well as wearable devices for women's safety are identified. The focus of the work proposed here lies in overcoming these challenges and also providing a self-defense mechanism for the user as she gathers some escape time by using a taser on the attacker.

[20] presents the issue of 'Violence Against Women' in general. It shows how it is a worldwide problem, discusses the basic definitions, explains VAW at different levels, and puts forth some prevention strategies. In the research of [11], efforts have been made to examine and understand the factors that encourage Street Violence against Women. The major findings of the study indicate that public places in India have a predominant 'Culture of Misogyny' which is a major driving force behind such a huge number of SVAW cases in India, the other factors include unemployment, deep roots of the patriarchal practice, poverty, and gender bias socio-cultural values. However, the central cause of SVAW stated here is – 'Failure of Governance'. Similarly [12] mentions that a House Committee in Karnataka, that dealt with the safety of women and children identifies the lack of coordination among the various government departments as a significant reason behind the frightful lower conviction rates in the state as well as its inability to prevent such crimes. Another reason pointed out by them was the failure of the authorities to protect the witnesses. Thus these papers make it clear that a good preventive strategy for VAW would need the government departments to take stricter actions on various levels and would also need a method to gather real-time pieces of evidence that are secured from any kind of tampering.

To implement such a Video Capturing feature (that gathers real-time evidence) for this system, an appropriate camera module needs to be identified. [13] outlines FPGA implementation of audio and video processing based on Zedboard which uses the OV7670 camera module for a video monitoring system. Its advantages are described as a low-cost CMOS device that captures the images of 0.3 MP and operates at lower voltages. These features make this camera module a fit for this system too.

Another component of this system is the development of an Android Application to caution the victim's kins of an emergency. The market already has some of such Android Apps for women's Safety and [14] describes the idea behind one such app. The app makes the use of sensors disguised inside a smartwatch to get triggered. The sensor senses severe conditions such as causality and the app then generates a high volume alarm as well as sends out Emergency messages to the registered contacts along with the GPS location. These messages are also sent out to the nearby users of the application who might be of help. [15] presents another SOS Software platform based on Android. The application developed enables users to send their location directly to the police system which accelerates the rescue process. The entire process proposed here is automated except for the manual decision of the police Operation Data Centre that determines and directs the nearest Police patrol to reach the site. But in an attempt to use mobile apps for women's safety, certain apps might rather interfere too much with their personal space. [18] discusses these hazards in detail. [18] describes apps that help women navigate through the paths that are considered safer compared to others, to reach out to their destination. The authors are however concerned that the use of such technologies might backfire by restricting the freedom of women tremendously. Thus, while developing this system, several features have been carefully analyzed that should be preferred to be included in the safety kit and the ones which should rather be left out.

The SOS messaging service in the app would need a database that stores the contact information safely. [16] carries out a performance comparison between two kinds of databases, MySQL and Firebase Realtime Database for their mobile application using the Wilcoxon Signed-Rank Test. Their findings confirm better response time of the Firebase database and that Firebase simplifies the process of developing the applications. Thus, this database has been used to store the real-time data for the system. As a part of the Self – Defense component of the system, we studied [17] that compares Tasers against Oleoresin Capsicum (OC or pepper) spray. The study found tasers to be generally more effective (90.2%) than an OC spray (73.8% effective) for incapacitating the subject. The study also claimed similar effectiveness for a Taser even if the subject offered higher resistance or was armed, unlike OC spray, which resulted in much lower effective rates given such circumstances.

In [19], a survey related to the awareness women had about the online mobile apps that were intended for women's safety was conducted. The results of the survey indicated that though many of such apps seemed to be effective if used, they were not enough markets for the potential victims to be aware of them. Thus, one very important aspect of developing this safety kit is educating the end-users about its existence.

Women safety based wearable device:

The authors of [1] have worked on a smart wearable IoT device for women's safety. They have highlighted the development of a safety device that contains pressure, temperature, and pulse-rate sensors, thereby alerting the victim's relatives and nearby police about the incident, aided by GPS tracking and message services. This device can be operated both automatically and manually. In [2] the author talks about a smart device that can be clipped to the footwear. They talk about the clip-on device that can be discreetly triggered. Four taps will activate the device that will in turn send an SMS to the five registered numbers. The results obtained by using this device and the Naïve Bayes classifier had high overall accuracy. [3] talks about a smart ring that will gather help for the women in danger. It has a provision for taking a single picture that is sent along with the victim's location to the saved contacts or police. [3] also has a buzzer that would make a high-frequency sound to draw the attention of the people around.

In [4] the author uses GPS and GSM modems for receiving the victim's location and sending it over via message. The device has to be turned on in advance and when the user feels threatened, they can press the allotted switch to trigger the system and gain help. In [5] the author talks about a smart device built using Raspberry Pi3. [5] utilizes Global Positioning System to track the user and sends it to the registered contact or police by using the Global System for Mobile Communications. It also has a USB Web Camera to capture an image of the wrongdoer and a buzzer to alarm the surrounding people.

The author in [6] talks about a women's safety device based on IoT and machine learning. It uses a logistic algorithm to customize learning on the individual pattern of temperature and heartbeat and then it finds out the threshold for generating an emergency message. Temperature and pulse sensors are used to get the respective readings. [6] utilizes a ZigBee mesh network to avoid the issues raised due to the internet.

In [7] the author makes a device that can be used to place a call to the law enforcement agency who in turn would redirect the case to the right department. After the activation of the device, an emergency message with the victim's location is continuously sent to the reserved contacts. This device is highly user-friendly and cost-effective as well. [8] has the author talking about a three-way activating smart device for women's safety. This device can be manually triggered with a simple button press or a basic voice command. It can be also activated automatically using sensors that monitor the readings. After powering up the device an SMS is sent with the location of the victim and the buzzer is activated.

In [9] the author has developed a safety device that can be easily used for self-defense. It has a push-button that can be pressed once to send the victim's live location to the emergency contact via SMS. It also has a hidden camera that can be used to capture images that can be later used as evidence in the future. Finally, if the button is tapped twice then a buzzer is activated for three minutes to draw the attention of people nearby. In [10] the authors have tried to implement a system that uses a voice recognition module to activate itself and send out SOS messages to the user's relatives and the help center along with the GPS location of the device. The system also tries to gather image or video evidence to support future legal actions as soon as the voice triggers it.

In [21] the researchers have developed a smartwatch 'Watch Me' that senses a person's increased heartbeat in such scenarios and reacts accordingly. It generates an alarm to alert people in the surroundings, makes a call to all pre-registered contacts and locates as well as informs nearby police stations using GPS/GSM. In [22] another such approach is presented, where various sensors are used to detect the victim's body parameters for e.g. change in voice, temperature, and heartbeat rate. In case any of these parameters exceed the threshold values, a message with location coordinates is sent to registered contact numbers.

In [23] a portable, battery-powered device is housed inside a bag. It consists of a compressed gas can, a camera, an alarm system, and a GPS module, all interfaced together with a single control switch. As soon as the panic switch is pressed, the camera captures images of the crime scene, geo locations are sent to a web server for future retrieval, an alarm is generated and the gas is sprayed. The nozzle of the gas can be adjusted for a better target.

A self-defense device for women's safety is proposed in [24] which when triggered by a switch, automatically sends the location of the sufferer to their family members. In addition, the concerned ones can ask for the victim's live location as well which will be responded to by an SMS if the provided password is accurate. It also contains a shock mechanism that can be used to deter the attacker.

The device (FEMME) [25] proposed by the authors has an ARM controller and an android application. The functionality it provides is sending an SOS message with the current latitude and longitude to the pre-set contacts, and recording the audio of the entire incident to be used as evidence. Additionally, it has a module that can detect hidden cameras using a radio frequency receiver, which detects electromagnetic waves that are emitted from the spy camera.

From this, we can conclude that the existing methodology did not have a proper recording mechanism. We along with a mechanism to capture the assailant, also provide a taser mechanism to provide the victim some time to escape. The location can be tracked on the local server by the police so that help can be sent immediately.

3 PROPOSED ARCHITECTURE

3.1 Block Diagram

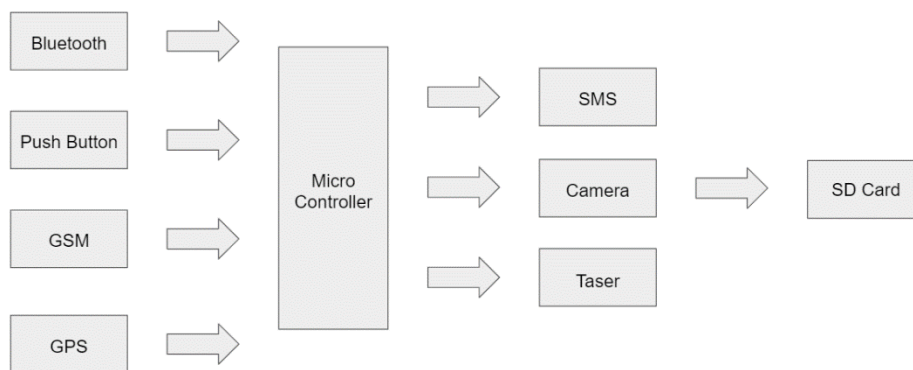


Fig. 1. Block diagram of the proposed system

The block diagram of the system in Fig.1 shows all the basic components that are present in the device. As soon as the victim taps the push button whenever she feels unsafe the device is activated. When the device is triggered, the camera is activated that

captures and stores the messages in the SD Card on the neckpiece. The taser on the wrist is also powered up so that the sufferer can use it for self-defense and gain some time to elope. The location of the woman is detected using GPS which is in turn sent to the saved contacts and police officials. The location of the victim is also visible on a local server present at the police stations to send assistance.

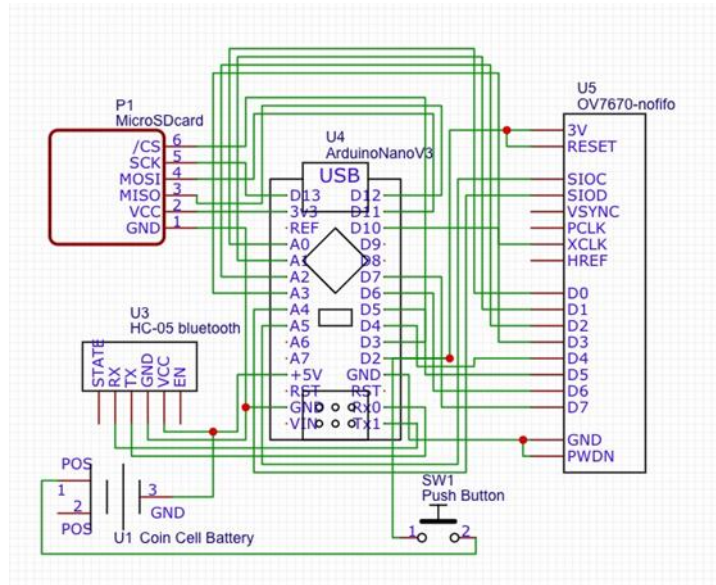


Fig. 2. Architecture diagram of the proposed system

In Fig.2 the architecture of the proposed system along with the required components attached to the microcontroller.

3.2 Components

1. Arduino Nano

The Arduino board serves as the microcontroller for the entire circuit. When the button on the neckpiece is pressed (input), the camera module is instigated for continuous photo capture (output).

2. Camera module ov7670

The OV7670 CAMERA module is a compact package that provides the complete functionalities of an image processor and a single-chip Video Graphics Array (VGA) camera. Here, we capture 8 images every 2 seconds to maximize the probability of capturing the culprit's face.

3. Bluetooth module HC05

HC-05 is a Bluetooth module with a range of up to 100 meters. The button on the neckpiece triggers the Bluetooth module which then establishes a connection with the app on the victim's smartphone.

4. SD card and SD card reader

SD card is a small-size storage device with the ability to transfer data quickly, thus a preferable choice for this project. The SD card reader is a device used specifically for reading and writing the data to an SD card.

5. Taser

A taser is a less lethal, electroshock weapon that can be used to incapacitate the target by exposing them to short, low-energy electrical pulses that can temporarily impair their physical functions to an extent that allows the victim to escape.

6. SMS Sending Package - Flutter

This is a library for sending out SMS using an Android phone.

7. Geolocator 7.6.2

This is a geolocation plugin that provides easy access to platform-specific location services. It is a very useful tool for collecting continuous location updates, with the best accuracy of 0-100 m in Android and 0 m in IOS.

4 METHODOLOGY

4.1 Activation Mechanism

Activation mechanism (see Fig. 3.) is the process flow that occurs when the woman feels threatened. It contains a button that is present on the neckpiece that can be pressed by the woman in case of an emergency. When the button is pressed, the camera is activated to capture images of the aggressor. Then the alert mechanism is triggered to send a message along with the location to the registered contacts.

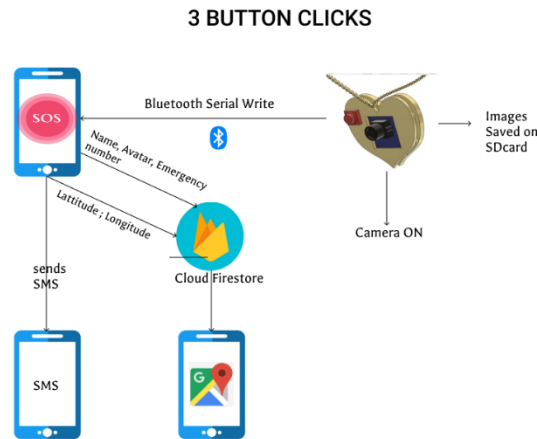


Fig. 3. Flow chart of the proposed mechanism for camera activation and sending the alert message.

4.2 Message Mechanism

If the victim feels that they are in danger, they tap the pushbutton on the neckpiece three times. This activates the HC05 Bluetooth module, which sends a character to the app through serial communication. The app/phone is already connected to the Bluetooth of the neckpiece. This activates the app, which proceeds to send SOS messages to the two emergency contacts which have been previously entered. It also sends the location coordinates. Live location tracking can be carried out through the app itself. The alert message mechanism is triggered through one of the above mechanisms during an unsafe situation. When the mechanism is triggered, Geolocator 7.6.2 and SMS Sending Package are used to send the message containing the location of the victim to registered contacts and Police officials. The location is sent as coordinates that can be easily accessed.

The SOS mechanism of the application is shown in Fig. 4. The location coordinates are received from the geolocator whenever the mechanism is triggered. The GPS gets the location coordinates from the phone's location. These coordinates can be easily put down on the google maps link for easy access to the victim's location. After the coordinates are received that contain the victim's location, it is sent to the registered numbers with the help of the SMS Sending Package in Flutter.



Fig. 4. Application for the camera mechanism.

4.3 Local Server Mechanism

Once the coordinates are generated with the victim's location it is sent to the local server present at the police station. The coordinates of all the victims are plotted on the map as shown in Fig. 5. The police can use the map to locate the victims and send help to the sufferer. The map has a cumulative show of all the women who have asked for help and send the forces to provide them with aid.

The location that is generated by the geolocator is stored in the cloud. The is later retrieved by the website to display it on the google map. All the coordinates generated are stored in the Firestore database and are displayed on the website with the help of Google Maps API.

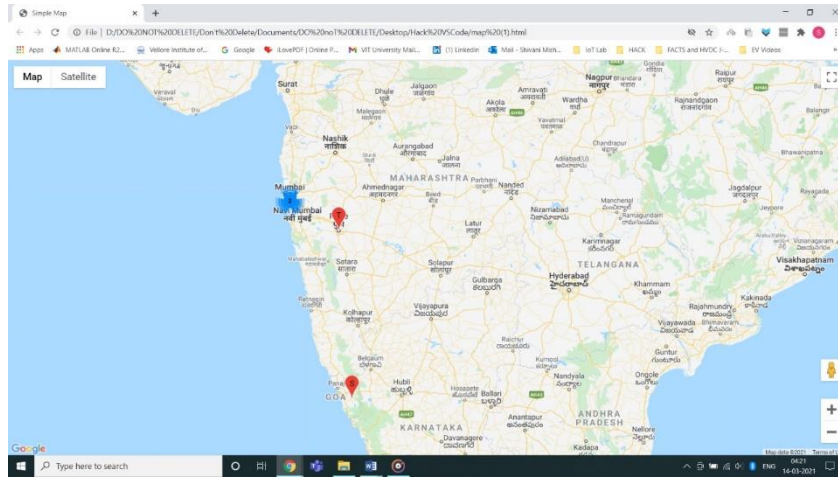


Fig. 5. Map for tracking.

4.4 Camera Mechanism

The three-tap trigger activates the camera module in the neckpiece. The OV7670 camera module is used here. This is an SD Card breakout board that has an SD card inserted in it. The camera module has been calibrated to generate color images in bitmap(.bmp) format. It is set such that it generates 8 photos at a gap of two seconds each, for demonstration purposes. This can be adjusted for real-time situations. These photos are stored on the SD card. We can remove the SD card to view the photos on a PC or any other device.

These images can be used as evidence against the assailant and provide the victim with the justice that she deserves.

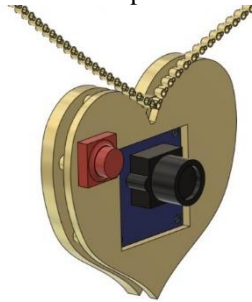


Fig. 6. CAD design for the camera mechanism.

4.5 Taser Mechanism

The taser can be activated by the victim whenever she feels threatened. It can generate up to 400kV. The tasing mechanism and charging circuit will be embedded in the wearable, so the taser will be entirely hands-free which will be deployed using a push button.

A miniature DC boost converter will be attached to the ring to step up the voltage discharged by the capacitor and generate enough voltage to tase an individual.

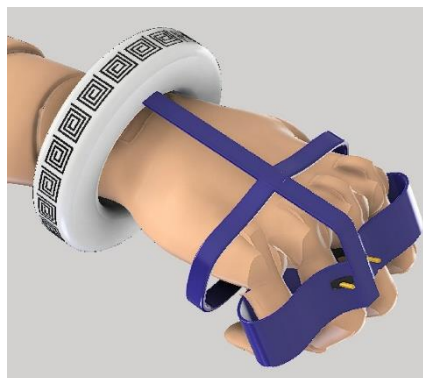


Fig. 7. CAD design for the taser mechanism.

5 RESULTS

The components and modules used for building the module have been shown in figure 8 below, the Camera module ov7670 for capturing the images are shown in front of the model along with the other hardware required like Bluetooth module HC05, SD card, and SD card reader along with the Arduino are present inside the model. When the victim is in danger and pushes the button,

an alert message is sent to the registered mobile numbers (see Fig. 10). Once the camera is triggered it will capture images and store them in the SD card on the neckpiece.

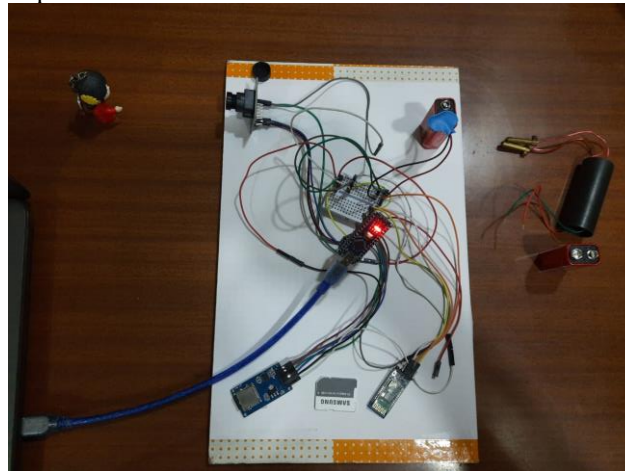


Fig. 8. Prototype.

The major advantage of the proposed system is that it is compliant in situations where it is humanly impossible to reach the device, it allows activating the alert mechanism through a simple button. The proposed system is also lightweight, cost-efficient, and easy to carry. It can be easily inferred and is highly pliable. It doesn't require any internet connection. The only requirement is that the area should have mobile signals to send the message.

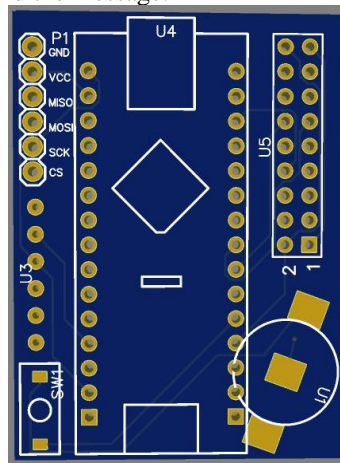


Fig. 9. PCB design of the proposed architecture.



Fig. 10. Message sent to the emergency contacts.

6 CONCLUSION AND FUTURE SCOPE

This paper attempts to develop a cost-effective, 2-fold women safety kit that aids the victim with a self-defense device in case of violence as well as aims at gathering proof of assault for seeking justice later on. The system uses a taser ring to debilitate the attacker along with another integrated circuit that is disguised as wearable accessories to capture live evidence, thus making the kit a combination of attack and defense mechanisms. Furthermore, the system also sends out alert messages along with the victim's geo-coordinates to their emergency contacts as well as the nearest police station to assist them with immediate help. Most of such existing help kits for women include buzzers to cause noise and draw attention in times of attack, but this work avoids any such feature as it may rather caution the attacker, and thus alert him about all the other safety devices that the woman has been carrying. Moreover, the majority of crimes against women take place in deserted and shady areas, so such a buzzer might not seem useful at all. Another drawback of other existing systems was their method of deploying the defense kit. Concealing the ICs in an everyday casual accessory makes the system a lot less susceptible and suspicious.

As a part of the future scope, the microcontroller can be replaced by a Raspberry Pi to generate better and sharper images. The Raspberry Pi also has its separate camera module, and the video can be live-streamed to a central police database or the app, thus ensuring that prompt actions are taken.

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