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# SafeWomen:
## A Smart Device to Secure Women's Environment Using ATmega328 With an Android Tracking App

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### ABSTRACT

The security of women is of prime concern around the world. Women feel insecure while traveling out of the home due to the fear of violence. The fear of violence restricts women's participating in different social activities. So instead of becoming a victim of a violent crime such as domestic violence, robbery, or rape, women should call on resources to help her out of that situation. In this paper, the authors develop a women safety device, namely SafeWomen, which helps in reducing the crimes held against women. This is a new approach for providing security to women in any unsafe situation by sending an alert having geographical location along with emergency message to the registered contact numbers so that the incident could be prevented. Also, it can track the current location of the victim just by knowing the IP address of the device she is using. One can also use this system for the safety and security of kids and elderly people just by making some changes in the functionality of the system.

### KEYWORDS

Android, Arduino, GPS, GSM, Violence, Women Safety, Women Security

### 1. INTRODUCTION

Women security is the primary concern in India as well as around the world. According to the reports provided by WHO (World Health Organization) and NCRB (National Crime Record Bureau), 35% of Women all over the world are facing physical harassment in public places such as footpaths, bus stands, railway stations, lonely areas etc (Smith et al., 2008; Tiwari et al., 2014; Ryde et al., 2016; Gilchrist et al., 1998; Carcach et al. and Mukherjee et al., 1999; Chan et al., 2008; Stanko et al., 1996). Women feel insecure while travelling late at night due to the fear of violence or physical harassment (Bhilare et al., 2014). Their families and near ones get worried about their security. Everyone is aware of the importance of women safety, but we must analyze how they can be adequately protected. Even today in India, women can't go to crowded places in the daytime as well as at secluded places

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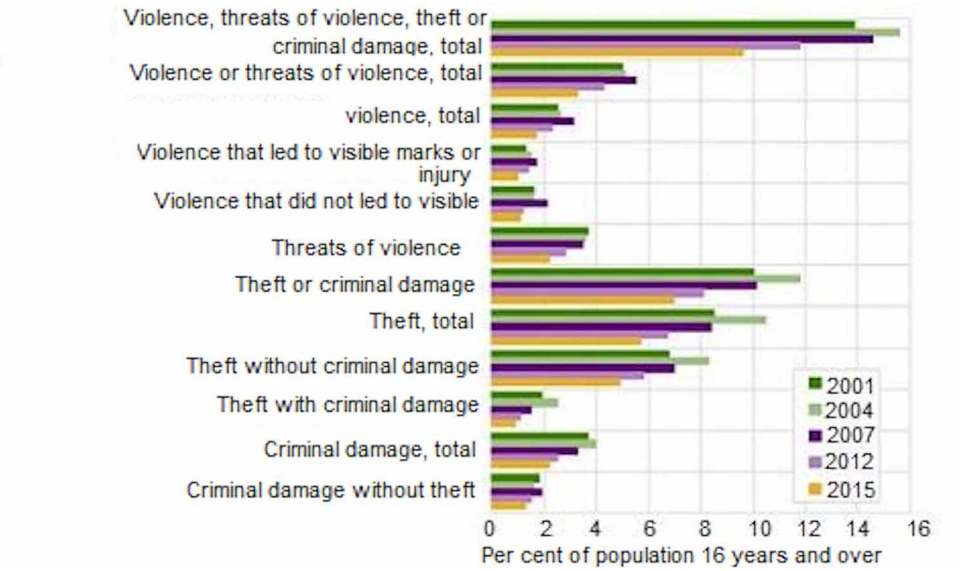
**Figure 1. Victimization by type of offence**




at night. The fear of violence restricts a woman's freedom and her ability to work and participate in different social activities.

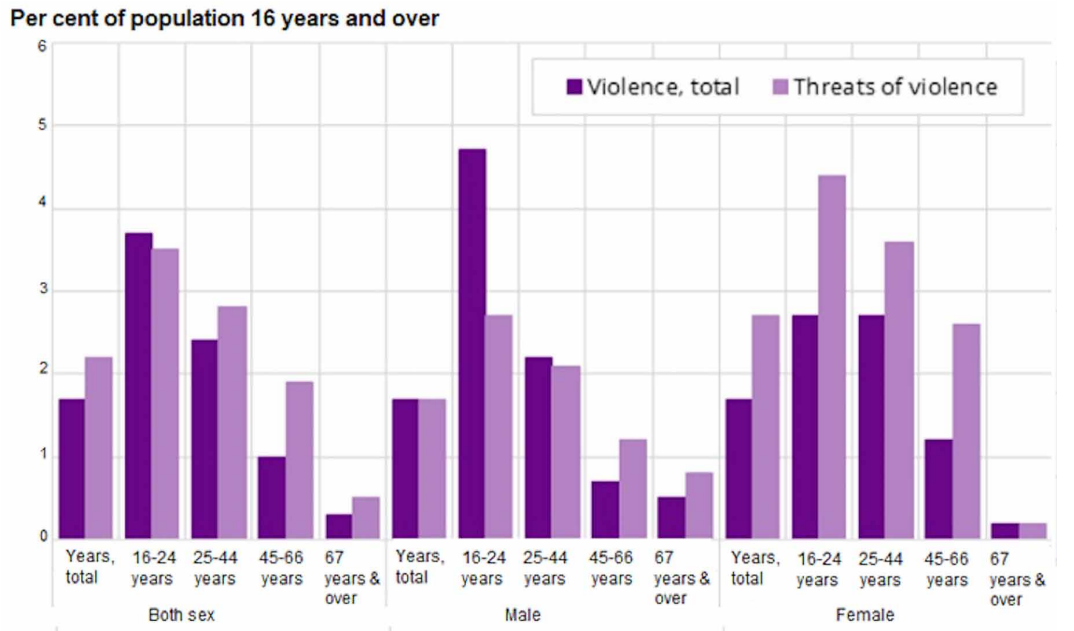
According to the WHO report[1] published in March 2015, due to the growing recognition of violence against women (García-Moreno et al., 2013), the United Nations Secretary-General, Ban Ki-Moon, launched the *UNiTE to End Violence against Women* campaign. This UNiTE session emphasizes on the Status of Women and the causes and risk factors in order to prevent violence against women and provide different services for the victims and survivors.

In 2015, a survey[2] was conducted by Norway on living conditions which show that around 9.6% of the population above age 16 were the victim of incidents of theft or violence. It shows that around 4,00,000 of the adult population in the course of a year are subjected to these types of offence. Some of the results of the survey conducted on living conditions are shown in Figures. Figure 1 shows the victimization by the type of offence for the population aged 16 or over. Figure 2 shows the victimization by sex and age of people over age 16. This survey also shows that women are more often victims of threats of violence. As shown in Figure 2, women are more exposed to threats of violence than men. So the total distribution of violence and threats of violence among women is 3.6% while that for men is 2.9%.

According to the Personal Safety Survey on violence[3] conducted by Australian Bureau of Statistics, (The national survey of Australian 16,400 adults aged 18 years and over), since the age of 15 there were 19.10% of women had experienced sexual violence while 33.30% of women had experienced physical violence. Among these victims, only 81.10% of women who experienced sexual assault and 64% of women who experienced physical assault still did not report it to the police (Watson et al. 2015; Uma et al., 2015).

India is one of the fastest growing countries in the world in terms of economy and infrastructure. But the crime rate has also grown at a faster rate. Even today in India, women can't go out during the daytime at crowded places as well as at secluded places at night. According to different reports, the most unsafe cities for girls and women in India are Bengaluru, Delhi - NCR, Kolkata, Hyderabad, and Gurugram. It shows that the developed cities in India witness more crimes against women (Agrawal et al., and Agrawal et al., 2015). In Delhi - NCR, the violence or crime against women is a national issue. So, it's the collective responsibility of the society to build a safer and secure environment for

**Figure 2. People exposed to Violence and threats of Violence by Sex and Age**




women (Kant et al., and Mehra et al., 2014; Tayal et al., 2015; Scott et al., 2003; Fox et al., 2009; Ceccato et al., and Bamza et al., 2016; Al-Anzi et al., 2014; Tayal et al., 2014).

According to the National Crime Records Bureau report[4], since 2009, the cases of violent abuse against women increased in India by 50%. In 2013, around 34,000 women were raped in India, which is 35.20% more than the year 2012. After going through all these reports statistics provided by WHO and NCRB, we realize that Women safety is a major issue nowadays and women need a helping hand in unsafe situations (Ahuja et al., 2012). So instead of becoming a victim of any violent crime such as robbery or rape or violence, it is essential to identify the situation and take help of resources for help to get out of that precarious situation.

## 2. LITERATURE REVIEW

As we all are aware of the importance of women safety, so we must ensure a safe environment for them. Few of such devices and applications that alert the family members through GSM and GPS are discussed below (Bhardwaj et al., 2014). Dongare Uma (2015) proposed an android app that gets activated by recognizing a particular saved voice keyword from the user. The limitation with this app is to remember the keyword for activation. And if the noise gets added with the voice, then the system may not recognize the user. Magesh and Raj (2014) developed an android app named as IPROB which gets activated just by shaking the mobile. The limitation with this app is that it gets activated only by shaking which user has to remember. Bhaskar (2014) also proposed an android app to provide security to women. Sridhar (2015) developed an android application that can also perform the audio-video calls along with sending the location to the guardian number. The limitation with this device is that it must be within reach of the user at emergency to press the SOS key. In some other existing devices women security device and sensors are placed in wearable dresses. Basavaraj Chougula, (2014) proposed a belt device that automatically gets activated when the pressure difference crosses the threshold in an unsafe situation. As the system gets activated by shock, it gets activated in crowded train or bus also. Nishant Bhardwaj and Nitish Aggarwal (2014) developed a women security

device, Suraksha that gets activated through - voice command, switch key and shock. The limitation of the device is that the entire system needs to be replaced if any module gets failed. Poonam Bhilare et al., (2015) proposed a vehicle tracking system that tracks the vehicle based on GPS and provides safety to women through an emergency button that is provided under the vehicle seat (Yarrabothu et al., 2015). It requires one button on every seat, and there are chances for by mistaken activation of the system. SHE (Society Harnessing Equipment) is equipment designed by Manisha Mohan et al., (2013). It is basically a garment that can generate up to 3800kv of current that helps the victim to escape from that precarious situation. But sometimes the device may harm other people also who are not attackers. A shocking personal alarm ILA security system is designed by McGivern, James Phillips, and Neil Munn (2015). But those alarms cannot be switched off without turning off the power button.

There are some other devices available also for the purpose of women safety such as tear gas spray, pepper spray etc. Most of these devices are manually activated and have their own limitations in terms of network unavailability, keywords remembering etc. It is difficult for the victim to remember the keywords in an unsafe situation, which may restrict her to alert her family members. In our proposed system, we provided three different ways to use it according to user requirement. The device can be used in three modes: hardware mode, Smartphone mode, and integrated mode. Here we are using Arduino IDE to program the hardware portion of the device and make it functional to provide women safety just by pressing the button which in turn sends the current location of the victim to her family members using GSM module and GPS module connected to ATmega328 microcontroller (Reddy et al. 2016). Nowadays, everyone has a Smartphone. So the Android App is easy to use in any unsafe situation. In Smartphone mode, the device provides the multiple functionalities like creating Emergency SMS, location services, sending SMS, Adding contacts, calling Emergency Contacts etc. While in integrated mode, by using both the Smartphone application (Shreyas et al., 2016) and hardware device, we can get the current location of the victim in case we lost connectivity with them just by knowing the IP address of the Hardware device she is using. So, this device is a multipurpose safety device and prevents the crimes held against women in a better way and made them feel safe when they are out. So this system can save women from any kind of danger and provides them more confidence about their safety and security at public places. This system can also be used for the safety of elderly people as well as kids. We can also use this system for luggage tracking in case we lose it.

We have compared our novel system with existing works in Table 1.

## 3. SURVEY

According to different reports, the major unsafe cities for girls and women in India are Bengaluru, Delhi-NCR, Kolkata, Hyderabad, and Gurugram. It shows that the developed cities and metropolitan cities in India witness more crimes against women. Based on the study, we find out that there are many safety devices and applications available in the market. But people are not aware of them for using it in precarious situations such as robbery, physical violence, rape etc., and become the victim of crimes. So we have created an online survey on Women Safety: A Prime Concern[5]. This survey is primarily conducted to know the public opinion about women safety in Metropolitan cities and other parts of India and how much people are aware of using these safety devices and applications. Around 100 people have participated in that survey and provided their opinion about Women safety in India. We will now discuss the facts and figures generated from the survey.

Figure 3 shows that 63.64% people think that women are not safe in Metropolitan cities. It signifies the need of any such device that helps the women to prevent her from difficult situations.

Figure 4 shows that 75.76% people think that it is not safe for girls to go out late at night.

From figure 5, it is clearly depicted that the places where women or girls are mostly harassed include 30.30% lonely areas, 12.12% crowded areas, 36.36% any area, i.e., both lonely as well as crowded area, and 21.21% other areas such as home, theatres etc.

**Table 1. Comparison with Existing Systems**

| Device Name | Hardware Device | Android Application | GPS | GSM | Buzzer | Other Features |
|---|---|---|---|---|---|---|
| Nirbhaya | Yes | No | No | Yes | Yes | GPRS |
| Suraksha | Yes | No | Yes | Yes | No | Call Recording |
| Himmat App | No | Yes | Yes | Yes | No | Video Recording |
| Tear Gas Spray | No | No | No | No | No | Tear gas spray |
| Nirbheek | No | No | No | No | No | Gun |
| IPROB | No | Yes | Yes | Yes | No | App activates by shaking. |
| SCIWARS | No | Yes | Yes | Yes | No | Receiver profile converted to General |
| Women Vehicle Tracking | Yes | No | Yes | Yes | Yes | Require one switch per seat person. |
| **SafeWomen** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Emergency Contact calling, Device Tracking, Creating SMS, Location Services.** |

**Figure 3. Graph showing how much women are safe in Metropolitan cities**

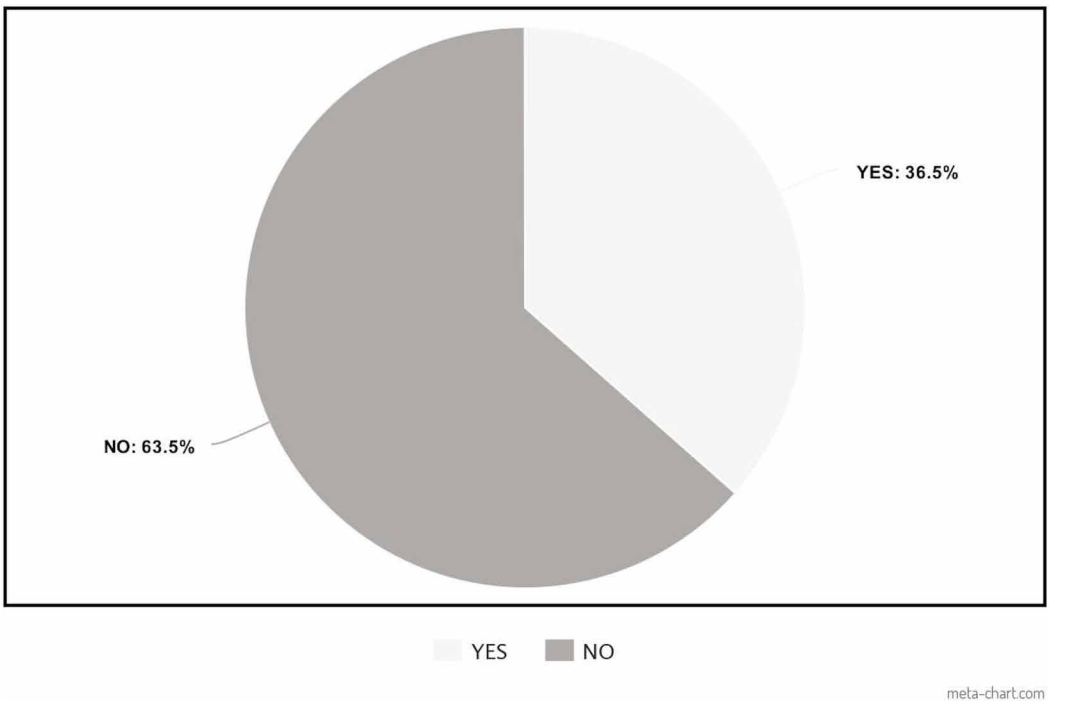


**Figure 4. Graph showing how much women/girls are safe while going out in night**

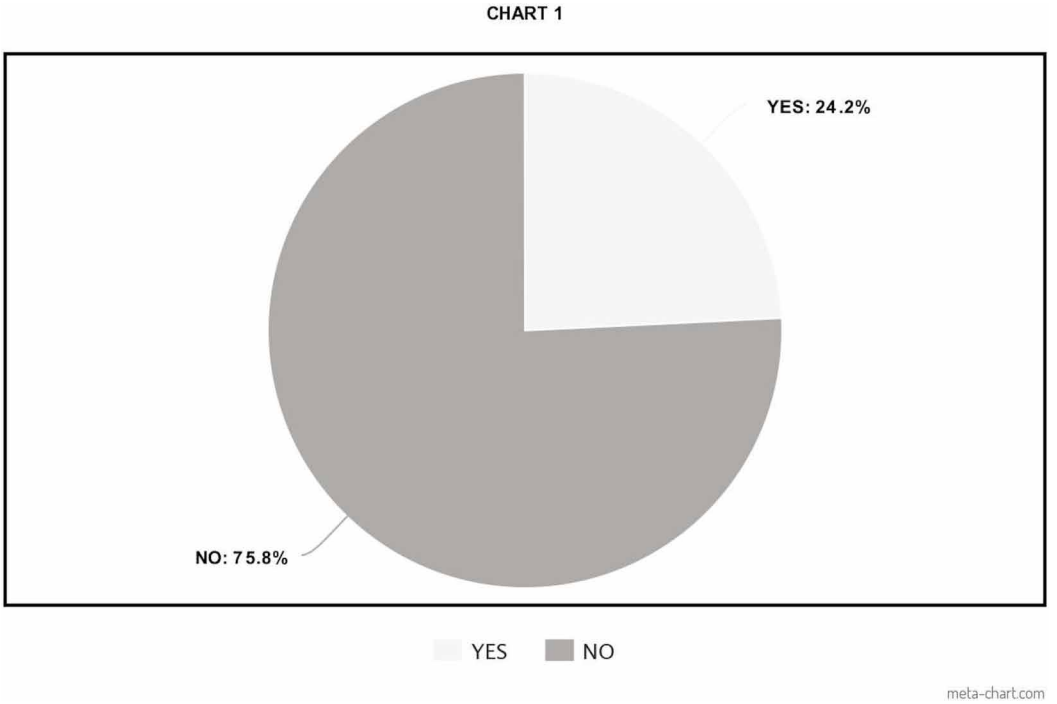
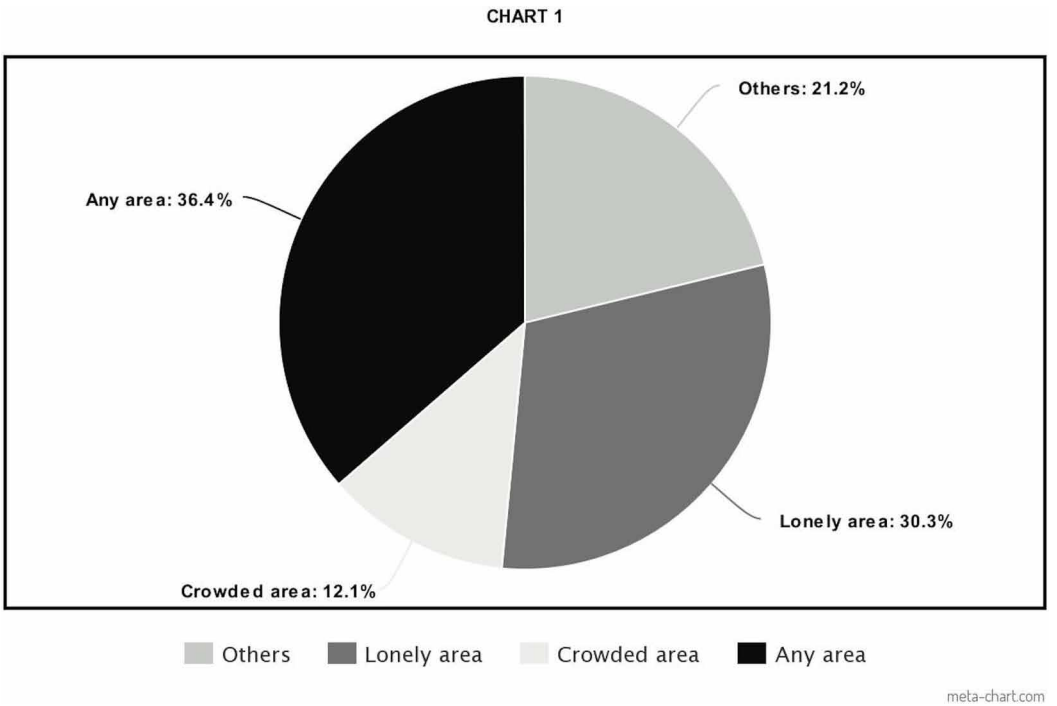



**Figure 5. Place wise analysis (Tayal, D. K., & Yadav, S. K. 2016a, Tayal, D. K., & Yadav, S. K. 2016b, Yadav, S. K. 2015) of Women Crime**



According to the survey results, as shown in Figure 6, 12.50% of crimes against women are committed in urban areas and 34.38% of crimes against women are committed in rural areas while 53.13% people alleged that the crimes against women are mostly committed in both rural areas as well as urban areas.

As in Figure 7, the survey results show that only 27.27% of people are aware of any kind of mobile app or women safety device that can be used for safety in public places.

Figure 8 depicts that 77.42% of the population say that they are going to use that device or app that provides women safety and help themselves get out of that situation of fear and violence.

So, the survey results show that there is a need for a device that helps women in precarious situations like robbery, violence or rape. The device should help in calling out the resources and prevent the incident to happen.

## 4. PROPOSED SYSTEM

This System named as "SafeWomen" is a Women Safety Device that is made on the top of Arduino UNO Development Board and Android application. The device consists of a GPS Module, a GSM Module, a Grove buzzer, Grove Button and Grove LCD connected to the ATmega Processor and an Android Smartphone (Gupta et al., 2018). The programming for the Arduino board is done in Arduino IDE using C language and to program the android application we used the Eclipse IDE. This device is a multipurpose safety device and prevents the crimes held against women in a better way and makes the women and family members feel safe when they are out. So this system can save women from danger and provide them more confidence about their safety and security at public places. Figure 9 shows the Block diagram of SafeWomen: A Women Safety Device using ATmega328 with an Android Tracking App.

**Figure 6. Area wise analysis (Yadav, S. K., et al. 2015, Yadav, S. 2016a) of Women crime**

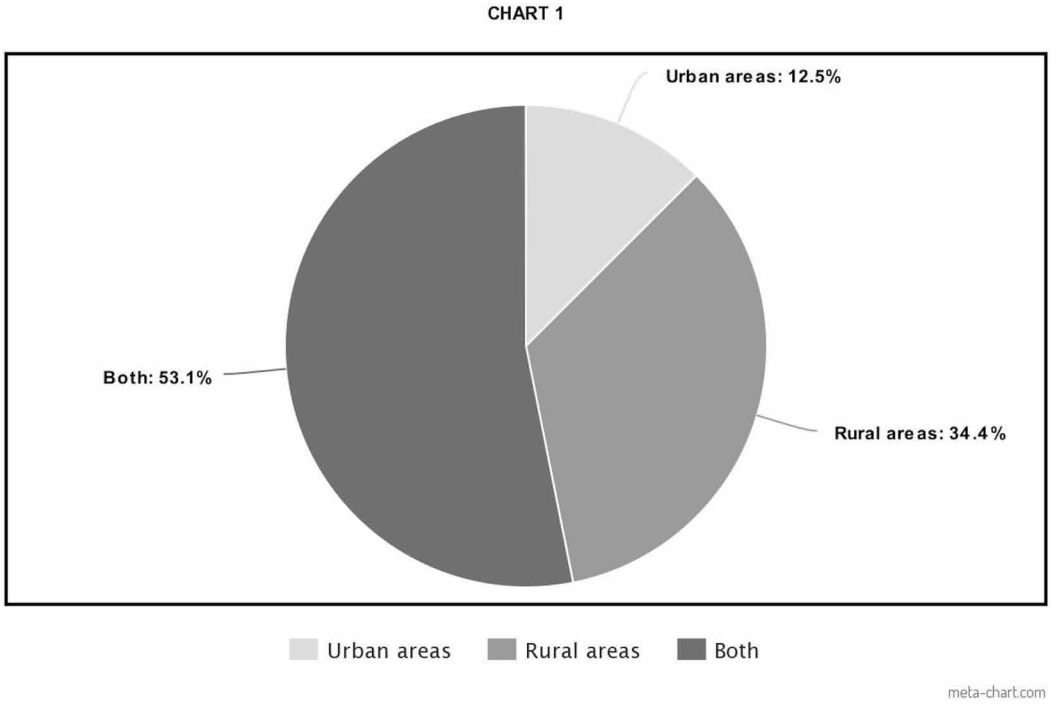


**Figure 7. Awareness of people towards women safety devices and apps**

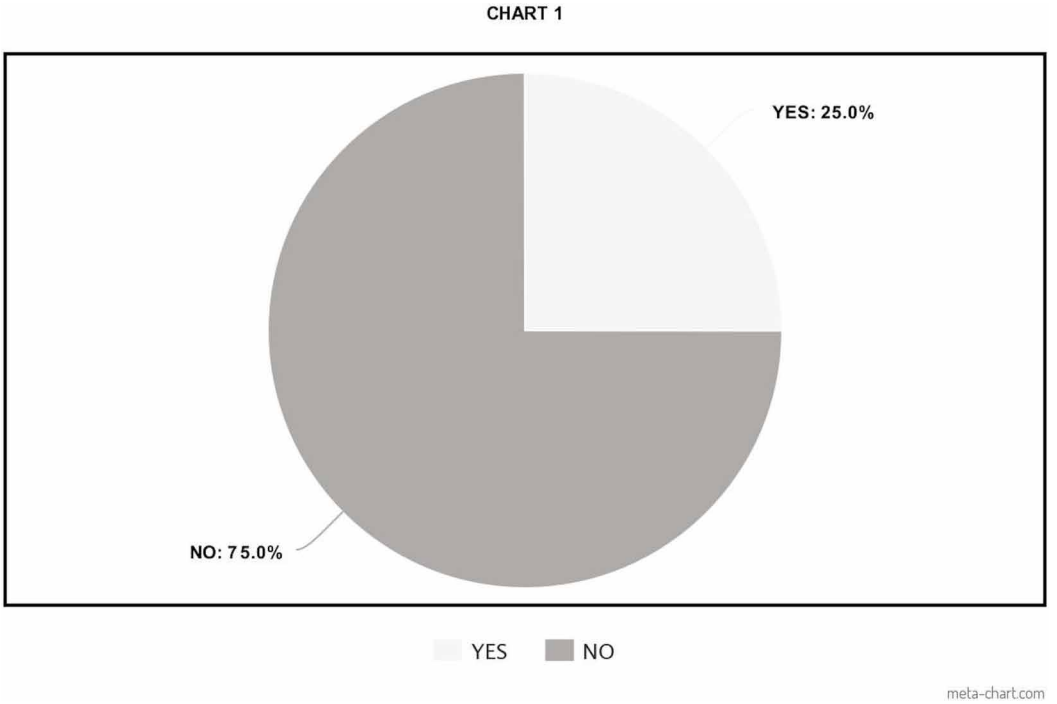



**Figure 8. Use cases of Women safety devices and apps**

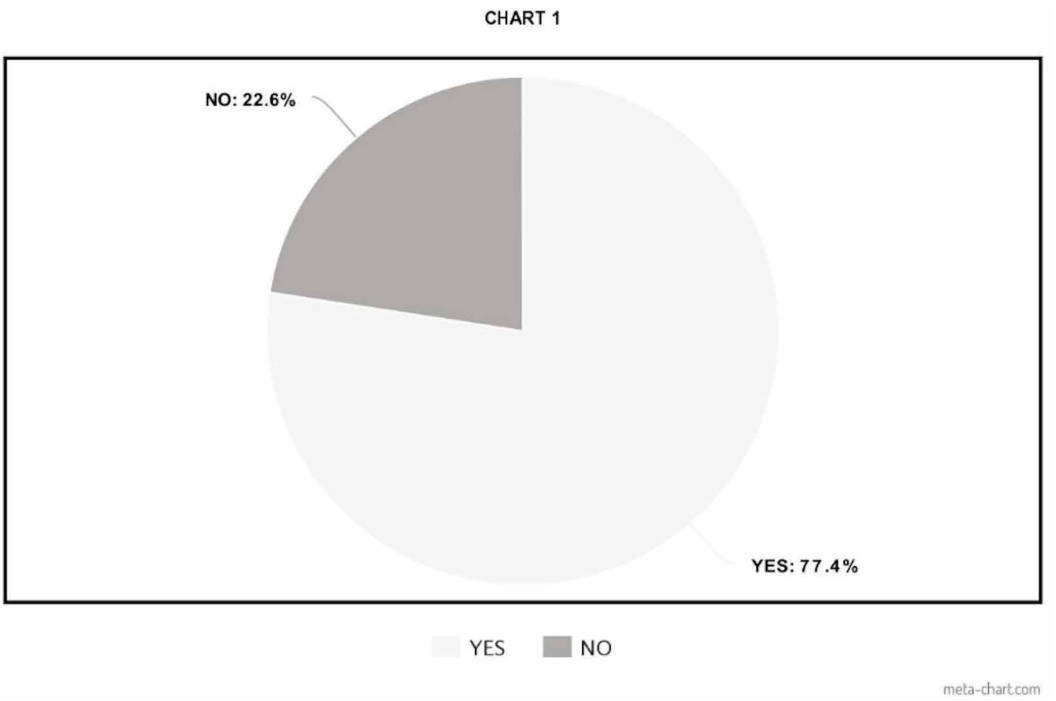
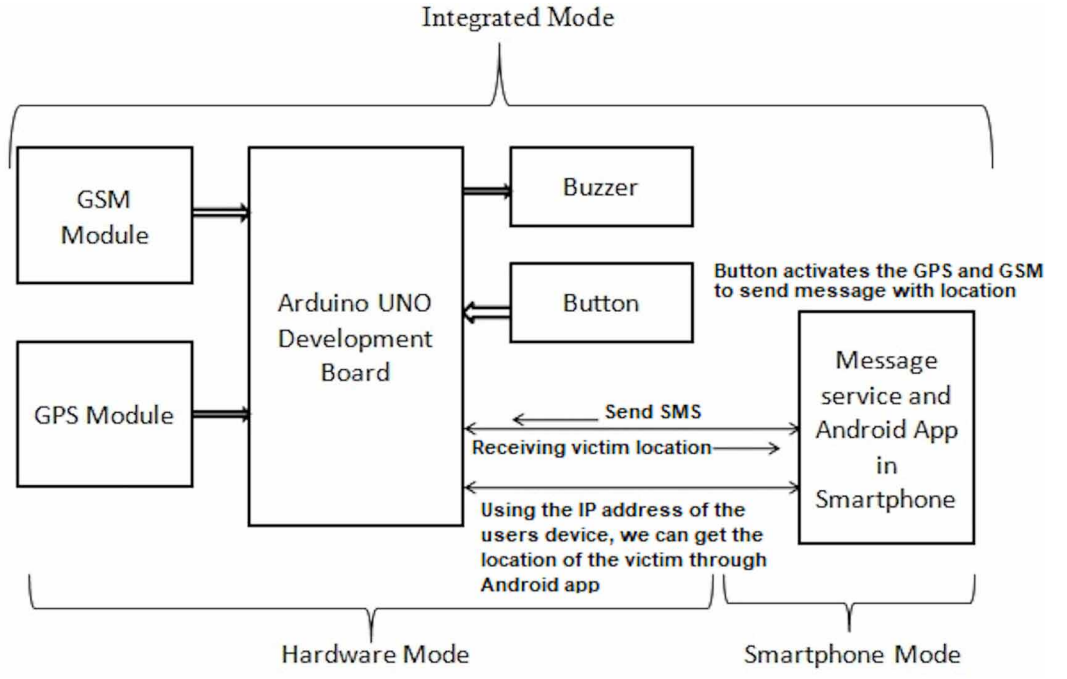


**Figure 9. The architecture of Proposed Women Safety Device**




Based on the study conducted, we have found that there are so many devices available that provide women safety in public places. But they have some limitations in terms of handling the problem because they are large in size, network problem in some areas, and most of these devices and apps are manually operated that can be restricted by the criminal to operate the device. So we developed a device that works in three different modes: The Hardware Mode, the Smartphone Mode, and the Integrated Mode. The user can use this device in any of the modes according to their requirement and easiness. In India, still around 34% of the population is not using Smartphone, so they can use this device in hardware mode (Sharma et al., 2018a).

In Hardware Mode, the device works through Button press by the person having it. When the person feels unsafe, then she can press the button provided with the device. On pressing the button, the Buzzer gets activated in its high pitch voice and gets the attention of the people around to rescue her. Apart from the buzzer, the button also activates the GPS Module connected to the device and records the current location of the user and sends that location along with the help message to the recorded number in the database. The person receiving the message can track the location by clicking on the GPS coordinates and provide help to her as soon as possible. In this mode, the family members can also track the location of the victim by sending "Track User" message to the user's device. After receiving the message, the device will automatically detect the location by using GPS connected to it and send that location to the registered contacts added by the user. This will help the registered contacts when they are unable to contact their child or family members.

In Smartphone mode, there is an android app on the phone, that helps the women when she is in trouble and sends a notification to the contacts added by her in the contact list by pressing the power button three times (within 2 seconds). Also, we can call on the women helpline numbers and emergency numbers added in the app, just in case of any unsafe situation, so that the police can reach to the point and rescue her from that situation (Sharma et al., 2018b).

In Integrated Mode of women safety device, the hardware device, and the Smartphone application both work together. Sometimes there may be chances when there is a networking problem and we are not able to connect to our contacts. So this mode is helpful to the parents and family members when they lost connectivity with their loved ones. In this mode, the Android app is used to track the hardware device by using the IP Address of it. With this, the family members can directly get the location of the hardware device user in case of emergency and reach to the point as soon as possible.

Figure 10 shows the workflow of the device in the Hardware Mode. In this mode, when the user detects any unsafe situation, she must press the button connected to ATmega328 microcontroller. When the button is pressed, it turns ON the buzzer, so that the people nearby may listen to it and come forward to help. Along with that, it also activates the GPS and GSM module connected to the microcontroller. The GPS will gather the current location of the user in terms of Latitude and Longitude format and send them along with Emergency help message to the user's contacts added by her using GSM module.

**Figure 10. Workflow of Device in Hardware Mode**

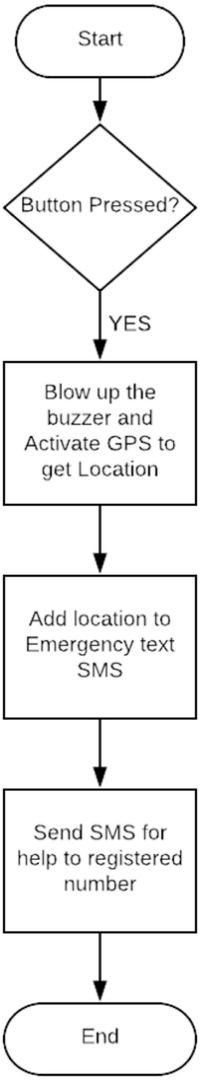
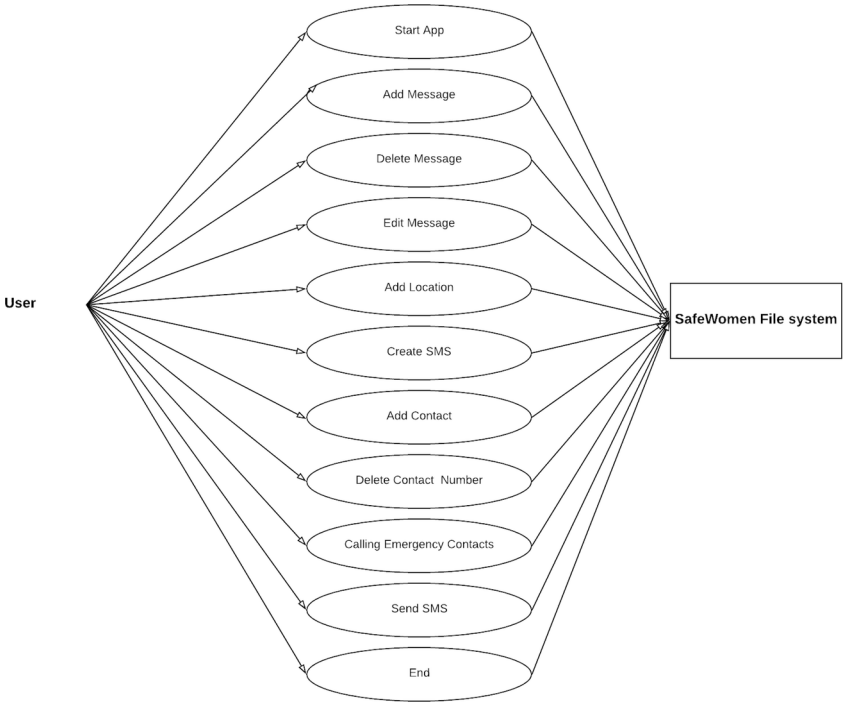


**Figure 11. The use case of Device in Smartphone Mode**



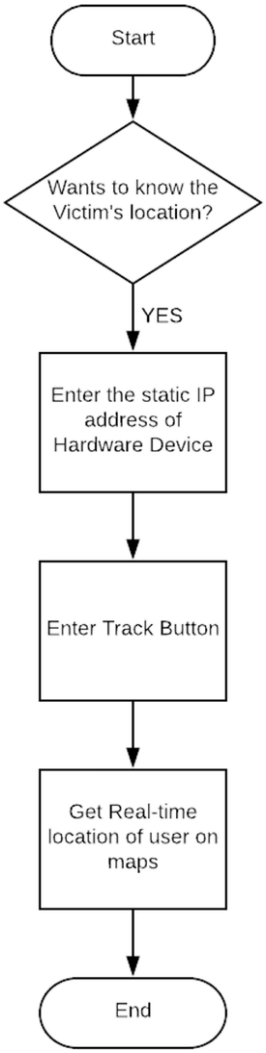

The SMS to be sent to the registered mobile number contains:

$$\text{SMS} = \text{Emergency Text} + \text{Location Coordinates}$$
$$\text{SMS} \xrightarrow{send\ to} \text{Registered Number}$$

Figure 11 shows the use case of the SafeWomen device in the Smartphone mode. In this mode, an android app namely SafeWomen is developed using Eclipse IDE and debugged on android phone. The app supports Android OS version 4.0 (KitKat) to Android OS version 6.0 (Marshmallow). This App provides various functionalities to the user such as Adding Emergency SMS, deleting SMS, Adding contacts, Deleting contacts, sending SMS, Location services, Calling Emergency contacts etc. First of all, we have to turn ON the location services of the mobile so that the app gets the current location of the user. After that, we need to add the contacts on which we want to send the Emergency SMS. Now create the Emergency SMS that we want to send to our added contacts. We also provide Emergency contacts such as Women helpline numbers of any selected area and police contacts to call on when we find any unsafe situation. In our case, we have selected the city like Delhi, so it displays all the women helpline numbers of the Delhi area, to call on the resources. The app also works in the background; whenever a woman feels unsafe, she doesn't need to open the app and then send SMS. She just needs to press the lock button thrice and the app will detect the keyword and send the Emergency message directly to the added contacts. The Emergency message contains the address of the current location along with its GPS coordinates and the message saved by the user (Shrivastava et al., 2018).

Figure 12 shows the workflow of the device in the Integrated Mode. In this mode, we can track the current location of the hardware device user just by knowing the IP address of that device. This is helpful to the parents and family members in case they lose connectivity to the victim and want to know her current location.

**Figure 12. Workflow of the device in Integrated Mode**

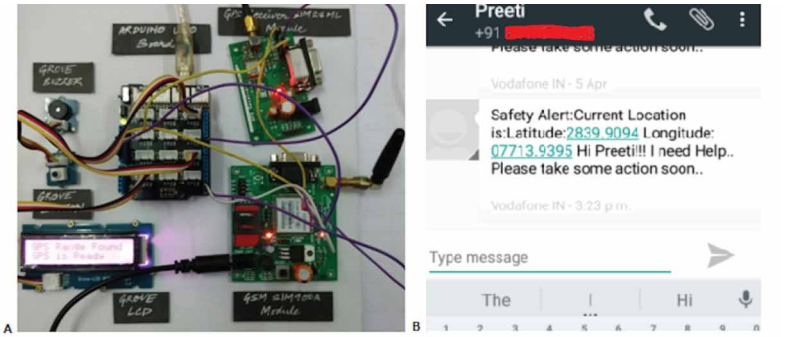



In this section, we discussed the entire working and implementation of the proposed device. Now we are headed towards the results obtained by this device in all the different modes to check the functionality of the device and validate the proposed architecture.

## 5. RESULTS

In this section, we will explain the different results obtained by the device and discussing their working in all the three modes, i.e., the hardware mode, the Smartphone mode and the integrated mode. Figure 13 shows the results provided by SafeWomen device in Hardware mode. Figure 13(a) displays the connections between different hardware components such as GPS module to retrieve the current location of the user, GSM module to send the alert message to the registered contacts and buzzer to blow up, so that people present nearby can come forward to help the victim after listening to it, with ATmega328 microcontroller to make the complete system work according to our

**Figure 13. Screenshots showing location received by added contact on pressing the button in Hardware Mode**




requirements. The ATmega328 microcontroller is programmed in C language using Arduino IDE (Integrated Development Environment) that makes it communicate with all the components. Figure 13(b) shows the screenshot of the message receiving device. When the button is pressed, the device gets the current location through GPS Module in Latitude and longitude format and adds it with the emergency text and sends that SMS to registered mobile number saved in SIM memory with the help of GSM module connected to it. After the message is received by registered contact numbers saved by the user, they can go to that location to rescue her from that precarious situation.

Figure 14 shows the screenshots of SafeWomen device in Smartphone Mode. Figure 14(a) shows the main screen of the android application having different options like send SMS, create SMS, Location Service, Emergency Contact and Settings (Shrivastava et al., 2017). Here we can add our contacts, create our own personalized SMS, enable the location service if it is already OFF and also call on the Emergency contact numbers such as police, hospital, and women helpline numbers of the selected area. In our case, we select the city as Delhi-NCR, so it shows all the women helpline numbers of Delhi area respectively. Figure 14(b) displays the Emergency SMS to be sent to the contacts added by the user when we click on the send SMS tab available on the main screen of the app. Figure 14(c) shows the screenshot of calling on Emergency contact when the user of the device feels unsafe.

Now in integrated mode, we have to use hardware device along with the Android application to get the current location of the user. Figure 15 shows the results gathered from the device in integrated mode. Figure 15(a) displays the IP address of the hardware device whose location is needed to be

**Figure 14. Results in the Smartphone Mode**

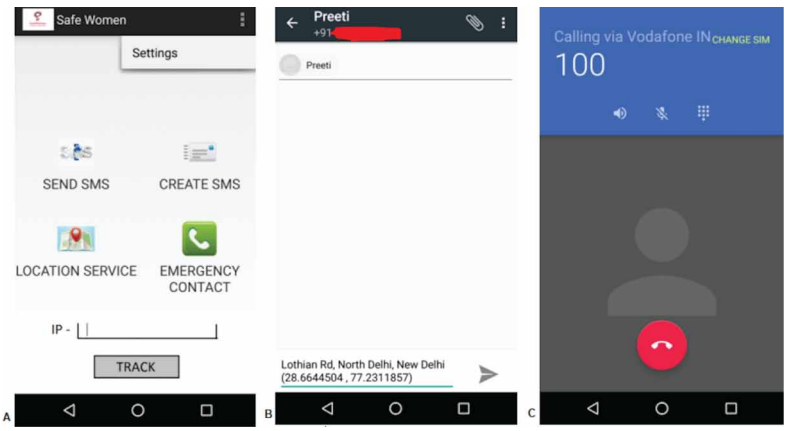
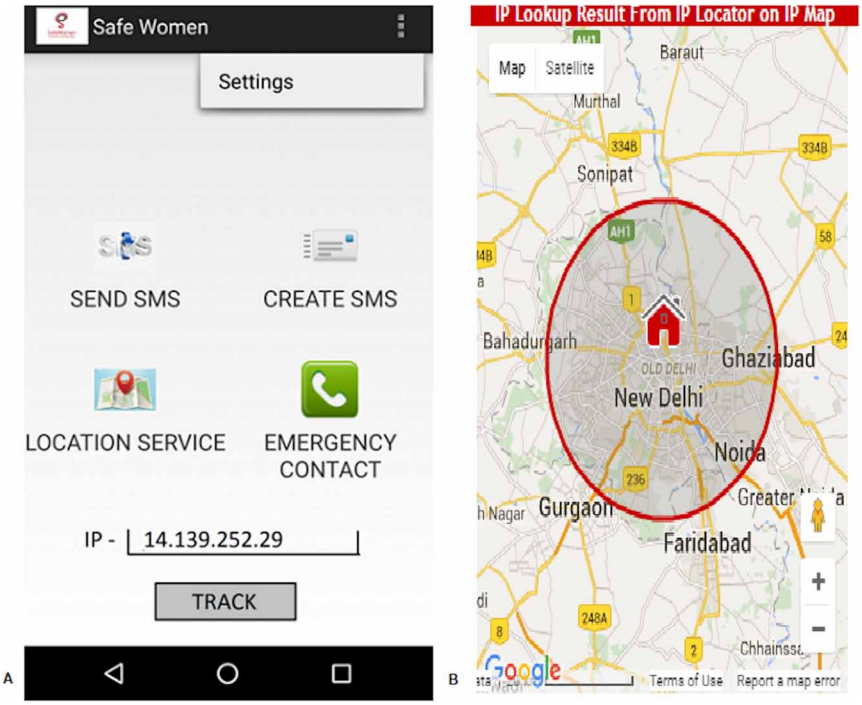


**Figure 15. Results obtained from the device in Integrated Mode**




tracked. After entering the IP address, when we click on the Track button, the app will direct us to the IP lookup page and will display the current location of the user directly in maps as shown in figure 15(b). So, we obtained the results from all the three working modes of the Women safety device namely "SafeWomen".

## 6. CONCLUSION AND FUTURE WORK

This system prevents the crimes held against women in a better way and made women and their family members feel safe when they are out. The survey results show that only 27.27% of people are aware of any kind of mobile app or women safety device that can be used for safety in public places. According to the Women safety survey conducted by us, 77.42% people said that they are going to use that device or app that provides women safety and help them to get out of that situation of fear and violence. So this system can save women from any kind of danger and provides them with more confidence about their safety and security at public places. This device is a multipurpose safety device that can also be used for the safety of the elderly and kids. We can also use this system for luggage tracking in case we lose it.

As the system takes care of few of the drawbacks of the existing system, there is scope for further improvement and expansion of this work. In future, it is recommended to develop a wearable model which is smaller in size. Our present device is a scaled up model. It needs to be compressed to style it into a proper wearable. We can also add a camera and voice feature in the app. This could be done so as to record the voice as well as take the images, so that if we feel unsafe, then we can send them to our contacts. We can also extend this system by using some other services such as cloud computing services which can be used to store the real-time location of the device user in a particular time interval that can be further utilized in case of crime scenes.

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## ENDNOTES

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