

## A review on notification sending methods to the recipients in different technology-based women safety solutions

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### ABSTRACT

Women have progressed a lot in terms of social empowerment and economics. They are going for higher education, jobs, and many other similar endeavors, but harassment cases have also been on the rise. So, women's safety is a big concern nowadays, especially in developing countries. Many previous studies and attempts were made to create a feasible safety solution for women. Out of various features to ensure women's safety in critical situations, location tracking is a very common and key feature in most previously proposed solutions. This study found mechanisms of sending the location to different types of recipients in various women safety solutions. In addition, the advantages and drawbacks of location sending methods in women's safety solutions were analyzed.

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## 1. INTRODUCTION

Women contribute to every sector of society in present times, but their security is still compromised in many countries when they go out of the home to work, higher education, business, and so on. The incident of harassment is increasing day by day, and its clear reflection is swelling in the news as well. There is also an increase in the number of incidents involving rape and murder. Bangladesh has recently witnessed many inhumane and violent incidents. According to the Dhaka Tribune, an average of four women are raped every day in Bangladesh, even during the pandemic of COVID-19. Between April and August of this year, more than 600 rapes took place in Bangladesh, killing 29 people and causing five to commit suicide [1]. Meanwhile, a rape incident at MC College in Sylhet on September 25, 2020 shocked the whole of Bangladesh [2]. After this incident, the administration became restless, and the culprits were caught. Even though the law was passed with the death penalty as the capital punishment for rape, this crime has become so widespread that there seems no way to eradicate it. Despite the administration and the general people being so vocal against harassment of women across the country in September, the number of incidents saw growth in the following month, October, 2020. More than a dozen such untoward incidents have already occurred [3]–[6].

Researchers have always come forward to solve different kinds of problems in society. These include prevention of fire accidents [7], prevention of vehicle accidents [8]–[11], security system [12], [13], different types of projects for humanity [14]–[16]. In continuation of this, various researchers proposed different kinds of women's safety solutions at different times, considering these types of incidents. Notable

among the types that researchers have focused more on, such as tracking apps [17], transport monitoring [18], road monitoring [19], device-based solutions [20], and a combination of app and device-based solutions [21]. A common yet very handy feature of the women's safety solution is location tracking. This study was conducted to understand the victim's location tracking or navigation system in a critical situation. Additionally, this study also focuses on finding out the advantages and disadvantages of previously conducted researchers regarding how their location tracking method operates.

There are already many solutions available with the concern of women's safety. Various technologies were involved while designing a robust solution. However, there are many disadvantages of these proposed solutions and also there are many positive aspects in the solution as well. To design the best solution considering the socio-economical condition of Bangladesh, this study attempts to configure an effective solution.

All of the existing solutions offer features of alarming or notifying about her endangerment. There were mainly two types of volunteers which are a. notifying the nearest volunteer about her situation and b. sending notification to pre-define/fixed contracts. In Figure 1 the scenarios are picturized. In the Figure 1(a) the nearest volunteer feature is shown where the system alerts the nearby people to a certain range. Furthermore, in Figure 1(b) it is seen that the victim is notifying to a remote contact through whichever system she is using.

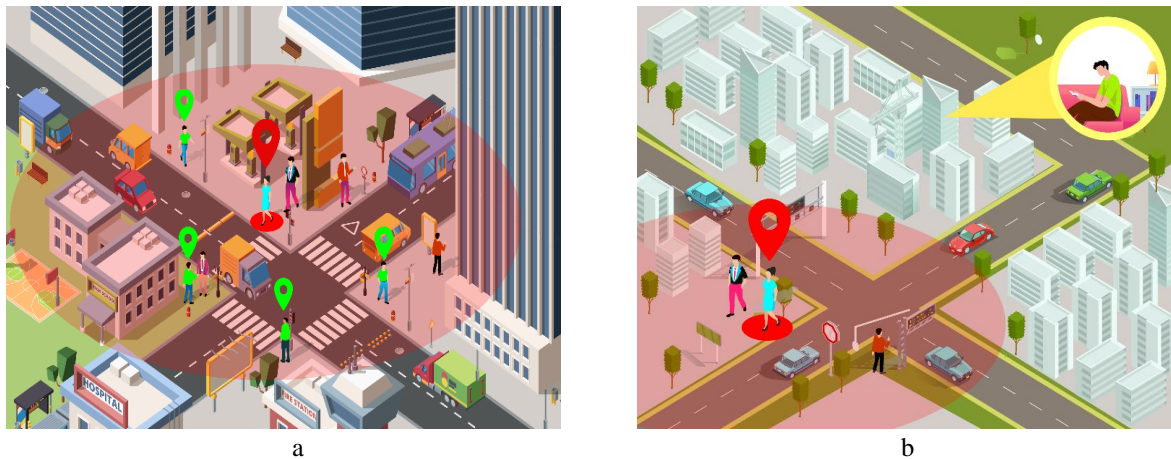


Figure 1. Scenarios feature alarming or notifying about her endangerment by (a) visualization of nearest volunteer, (b) visualization of fixed/distant volunteer

## 2. LITERATURE REVIEW

The authors of the paper [22] generated a method of building a safety solution for women where the user can get help during an emergency event. In addition to that, the user can look at various constitutional laws for women, health-related issues, and many other related topics. In paper [20], a solution was proposed that required radio-frequency identification (RFID) and a global positioning system (GPS). The system works with the idea that the RFID stores the user information, and it is passed to the AT89C52 microcomputer that can use notify some trusted contacts to send the location of the user. In the study [23], the authors introduced a system that reads the GPS value from the sensors, and on a press of an emergency, the button activates shock gloves for the primary protection and sends the location to pre-saved contacts via short message service (SMS), and initiates a buzzer. In the paper [24], the authors used RFID, GPS, and global system for mobile communication (GSM) technologies. It used these modules and connected it with a microcontroller. During an emergency event, this microcontroller compares various situations and tries to do a task best fitting to the situation. This situation differs from the SMS message sent to the emergency contacts. In the paper [25], the authors developed a unique way of notifying nearby registered contacts with a URL using WiMAX technology. The system also has a call record and SMS sending option when a woman is in an endangered situation. In the research [21], the authors have come up with a wearable ring as a safety device. The system works with the press of a button. Upon the button press, the image of the criminal is sent to the server. After that, the server sends an image link with the GPS location of the phone and sends it to trusted contacts.

The researchers of the paper [26] found a way to automatically kick start an emergency mode without any human interaction. It measures heart rate, pulse rate to make the automated triggering. In the

paper [27], the authors came up with a system that works on voice recognition. Upon hearing various prefixed command that matches various cases, the application performs tasks accordingly. The system in this study worked with both devices and mobile applications [28]. The device and app can be connected via Bluetooth. So, if the victim presses the emergency button on the device, the mobile app sends GPS coordinates to the trusted contacts.

In paper [29], introduced a system that can be activated on different push types. On different push strokes, the user can send different types of notifications, and the notification is sent constantly until the device is switched or after the rescue. The authors of the paper [30] used Artificial Intelligence to identify women in danger. They have proposed a system that uses voice recognition Human activity to identify a critical moment. Upon pressing the emergency button, the GPS coordinate and record video are sent as a push notification. In the study [31], the system had a pressure switch that could be easily pressed in times of danger. Upon press, the trusted contacts are notified. In the study [32], the authors designed a device that can be fitted in shoes. The device can be activated by tapping her feet 10 or more times. After that, the device is in emergency mode. In this mode, a buzzer is triggered, and there is a knife for self-defense and an app that can have audio recording capability for future proof.

An android application [33] was designed to perform various activities like direct calling, emergency message, direct police calling, and having an audio-video capturing feature. This study [34] proposed a portable IoT-based technology device that can send beacon information that must be located in a prominent position of the village. The victim's location will be sent to the place after pressing an emergency button on the device. In the paper [35], the author built an android app that will send the location of the sender to the cloud, and the location will be sent to the user via this cloud server to contacts that are pre-fed to the system. The author of the paper [36] also designed a mobile app that is almost similar to the previous one. The authors of the study [37] designed a very simple and effective system. There is a panic button, which sends the victim's latitude and longitude to the pre-fed mobile number.

In the paper [38], the author came up with a system that combines both mobile applications and hardware devices. They proposed various features like a camera, audio record, and GPS, which will be triggered by an emergency button. Although it has many features, it has no connection to the internet for better remote communication, and the latency or notification time delay was mentioned. The authors of the paper [39] came up with an environment for women outside the house. The system has a copper thread that can be stitched in the dress. In the system, a microcontroller is equipped with various sensors that can communicate with the application via Bluetooth. When the comparator is high, it sends GPS location, calls, and sends alert messages to preferred numbers. Although the concept is unique, the reliability of the thread is not implicit, and it might lead to a lot of false alarms because of the alarm being triggered by the presence of the thread. The author of the paper [40] included a pressure sensor in the system where the system doesn't need any manual interaction to get activated. The system looks for pressure, and through logical regression, it tries to identify if the situation is unsafe, then the system alerts the trusted contacts and authorities. This system is very efficient in terms of functionality, but it has to wait for an incident to occur.

An early measurement, even some moments before the incident occurs, can help avoid catastrophe. In this paper, the author [41] developed a wristwatch type of device that can communicate with the mobile application. During a crisis moment, the victim has to click a button on the wristwatch, and the application will get activated. After activation, the system will notify the nearby volunteers and trusted contacts. The system is very effective for ensuring the women in a crisis moment, but it might not be effective during a sudden attack when the user might not be in a condition to press the button. Here the authors [42] had an integrated device with a jacket. With a button press, the jacket can notify the nearby user with a buzzer, and through the mobile application, the system can send a remote notification to police, and friends. There is also a shock mechanism to take a primary measurement. But the system is integrated as a jacket, which is not suitable for every season and some counties where the major season is summer.

In paper [43]–[45], the authors proposed a safety device for women, which monitors various human vitals such as heartbeat, sound sensor, touch sensor, pulse sensor. If multiple values of the value from the sensor, the shock circuit is activated, and the GPS module sends the location via SMS. In paper [45], the authors designed a smart shoe that has a manual control shock circuit. Despite the system being well made, the device might not be effective if there are multiple offenders and the victim is far from the trusted contacts. No proper immediate mechanism to get help is implied. The paper [46] demonstrated a system with voice recognition technology to the women's safety system. On Identifying various specific voice commands, different methods are activated to notify against violation. This method needs voice command to take further steps during a hazard. This might lead to the criminals being aware of the situation, and the damage of the heinous act may increase. In paper [47], the authors developed a rescue system for women's safety. The authors have developed a system that notifies the nearby users and also helps to generate a safety mechanism for self-defense. In the study [48], the researchers developed a system where an endangered woman can

notify nearby application users for help. Along with that, the victim's message will also be sent to the nearby police station and authority in need of help.

In the study [49], the author has combined an IoT device and an android mobile application. The android mobile application is connected with firebase for data processing. In this system, the guardian of a person can track the location of the user and also call various authorities like hospitals, and police, for emergency purposes. Through the mobile application [36], the user can alert the nearby police station by shaking the mobile phone in order to activate the emergency mode. Also, a message to pre-stored contacts will be sent from the application. The developed system [50] in this study is an android application that is integrated WhatsApp messages with the application. The user portal can track the current location of the registered user, send SMS and current geolocation from the application. The messages and location information can be via WhatsApp messenger. Table 1 shows different device features.

Table 1 Data visualization of types of technology and recipient.

Paper No	Nearest volunteer	Fixed volunteer	Application	Application & device	Device
[20]	No	Yes	Yes	No	No
[21]	No	Yes	No	No	Yes
[22]	Yes	Yes	No	No	Yes
[23]	No	Yes	No	No	Yes
[24]	Yes	Yes	No	No	Yes
[25]	No	Yes	No	Yes	No
[26]	No	Yes	No	No	Yes
[27]	No	Yes	Yes	No	No
[28]	No	Yes	No	Yes	No
[29]	No	Yes	No	No	Yes
[30]	No	Yes	Yes	No	No
[31]	No	No	No	No	Yes
[32]	Yes	No	No	Yes	No
[33]	Yes	No	No	Yes	No
[34]	Yes	Yes	No	No	No
[35]	No	Yes	Yes	No	No
[36]	No	Yes	Yes	No	No
[37]	No	Yes	No	Yes	No
[38]	No	Yes	No	Yes	No
[39]	Yes	No	No	Yes	No
[40]	Yes	No	No	Yes	No
[41]	Yes	Yes	No	Yes	No
[42]	Yes	Yes	No	Yes	No
[43]	No	Yes	No	Yes	No
[44]	No	Yes	No	Yes	No
[45]	No	Yes	No	Yes	No
[46]	Yes	No	No	Yes	No
[47]	Yes	Yes	No	No	Yes
[48]	Yes	Yes	No	Yes	No
[49]	No	Yes	No	Yes	No
[50]	No	Yes	Yes	No	No

### 3. TYPE OF VOLUNTEER

The underneath Table 1 visualizes previous safety solutions done in the last few years. The table shows the used technology by the researchers and the targeted people or authority to receive the sent notification. The target people to receive the notification are generally divided into two categories. The first one is the nearest volunteers. The nearest volunteers are registered users who are committed to helping if they receive any notification from the system. Nearest volunteers could also be a person who is nearby the user who extends their helping hand in an emergency case. On the other hand, the fixed volunteers have trusted contacts of the system user like guardians, friends, relatives, or authorities like police or hospital. In terms of technology, there are three types of solutions found, namely mobile phone application, some sort of device, and the combination of both device and mobile app.

### 4. RESULTS AND DISCUSSION

Finding quick help in an emergency can sometimes even save the lives of a victim. When an emergency occurs, the victim becomes very vulnerable without any help. Without instant help, the life of the victim may be at risk. If quick help is ensured, the victim's survival rate will increase drastically.

There were a lot of previous incidents where the victim had to suffer a lot because of not finding quick help. Such incidents were covered by local and international news platforms. A Dhaka university student was raped in one of the most business routes in Dhaka. She was brutally raped and tortured by a deranged person at 7 p.m. She was rescued unconscious from an isolated place at 10 p.m. [51]. Another victim in India was found 15 days after she was raped and tortured. The victim died suffering in a hospital in Delhi [52]. These are a few of the stories where the victim suffered because of not finding quick help. Our literature study shows that there were many studies [23], [25], [47], [48], [32]–[34], [39]–[42], [46] done on finding quick help from the nearby volunteers. Again, the other studies that were demonstrated in the literature review also had some sort of navigation system or sending current location as notification to either their trusted contacts or authorities. If authorities or trusted contacts are close to the victim's location, then quick help can be ensured; otherwise, the victim's life might be at risk for not getting quick help.

## 5. CONCLUSION

From the above discussion, we have discussed various women's safety solutions. The focus was especially on the navigation or location tracking mechanism of existing researches. Location sending is an important and very common feature in a safety solution. However, make sure that the notification containing the location is sent to the correct audience, who can quickly take action. Quick action can save the victim's life as well. Out of various types of candidates to receive the emergency notification, the nearby volunteers can act upon the quickest. From that information, a system can be designed in such a manner that the system must-have features to notify nearby volunteers first. A proposed system can have various people receiving the message, but it has to ensure that the location is sent to nearby volunteers or nearby help first. Else, the aforementioned cases where the victim had to endure for not receiving quick help will continue.

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