14 Women Safety and Monitoring System Using Geo-Fence

N Rajkumar[1], C Viji[2], R Jayavadivel[1], B Prabhu Shankar[1], E Vetrimani[1], and J Mary Stella[2]

[1]*Department of Computer Science and Engineering, School of Engineering, Presidency University, Bangalore, Karnataka, India*

[2]*Department of Computer Science and Engineering, HKBK College of Engineering, Bangalore, Karnataka, India*

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14.1 INTRODUCTION

Women's safety can be a social issue and needs to be monitored and resolved as soon as possible. Almost 50% of girls are physically, emotionally, and socially abused. This abuse can affect the development and progress of the country. According to statistics, every day and every minute, women of all disciplines are harassed, hurt, and assaulted in different parts of our country. Areas such as streets, public squares, and transportation hubs are the territory of girl hunters. Female students studying at school or college and interacting with women need to protect themselves by taking self-defense classes, dressing tightly, and learning various techniques to protect themselves from criminals. Criminals are trying to kidnap children and women. Kidnapped children and women face problems such as psychological aggression, physical violence, stalking, rape, and other sexual violence. According to the statistics shown in Figure 14.1, children and women are exposed to different levels of physical violence.

In India, women are raped by criminals every 20 minutes, and women are afraid to go out alone. Women's safety is steadily declining. Men and women have equal rights, and the majority of members of parliament are women. Women are one step ahead of senior men. Women are involved in all cutting-edge science and technology. Women cannot be considered without generalization. Women's safety is of paramount importance to our country. Figure 14.1 clearly shows domestic violence against women.

According to the National Girl Child Safety Policy, the Department of Home Affairs has acquired a Women's Safety Unit to focus on the protection of girls in the country. The future generation purely depends on women. They are all eyes of our nation. Figure 14.2 shows the statistics of a national criminal record. The level of wrongdoing against women has increased over the years, especially in our nation.

Today, parents cannot control and keep track of their children's various activities. Girl children are often kidnapped on the roadside, resulting in crimes like child

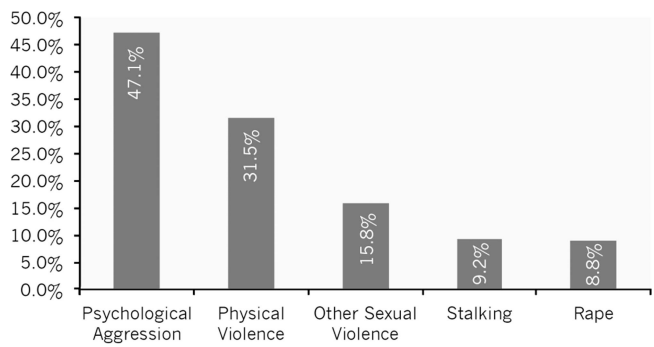

FIGURE 14.1 Domestic violence against women.

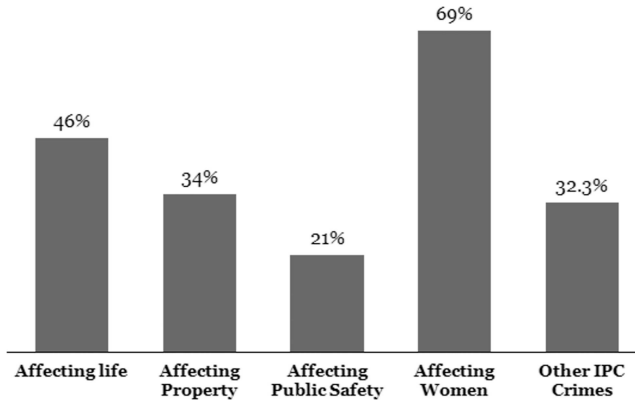

FIGURE 14.2 Decadal increase in IPC crimes.

trafficking, child work, sexual viciousness, etc. In the last 10 years, the recorded number of women and girls snatched is respectively 300,000 and 64,000. The total number of cases against females has increased by 11.73% per annum. Likewise, child abduction has increased by 23.2% annually, consistent with records provided by the independent government body, the National Crime Records Bureau (NCRB). Nearly 85% of all kidnapping cases occur everywhere in the country, consistent with records from the crime office. Figure 14.1 shows the steadiness of the impact on women's crime.

The National Crime Records Bureau report shows an increase in crime against females by 69% (10 years). The number of abductions and kidnappings of women and girls has increased to 163.8% since 2002. As per the National Crime Records Bureau's annual report, see Figure 14.3. The number of crimes against women increased in 2018 and 2019.

Cognizable Crime Reported

UNIT NAME	2017	2018	2019	2020	2021
Tirupathi Urban	4437	3272	3428	2357	3715
West Godavari	8833	9764	9190	9975	14171
Vishakhapatnam City	6976	7233	6452	5912	8041
Vijayawada City	7096	6519	6205	6350	8243
Guntur Urban	4566	4868	5194	4287	5318
Prakasham	6857	7270	7588	7630	9015
East Godavari	9065	9167	7367	8087	8491
Guntur	12491	10973	9447	8573	8486
Krishna	6915	6477	7957	7471	7334
Rajamahendravaram Urban	2386	2380	3660	3564	3496
YSR Kadapa	14564	15211	11129	6778	6456
Sri Potti Sri Ramulu Nellore	11413	12796	6756	7897	7513
Chittoor	3827	3957	5462	6365	5873
Vizianagaram	9743	5829	4325	4817	4197
Kurnool	8616	7137	8335	9866	8572
Anantapur	8143	6067	8145	11120	9363
Srikakulam	3263	4483	4176	6081	4743
Vishakhapatnam Rural	3030	3012	5854	5857	4100
Grand Total	132221	126415	120670	122987	127127

FIGURE 14.3 The National Crime Bureau's annual report.

To enhance women's safety, this work provides a technology-based tracking model using GPS-based mobile technology and geo-fencing. This model includes a location-based application to watch the situation of girls or children. The foremost commonly used method of constructing a geo-fence system. Geo-fencing may be a method of monitoring geographical location with a clear fence that will automatically detect an individual occupation or outside of a virtual fence method [1]. Mobile application development introduced a method called geo-fencing, which will track the object's movement. [2], emergency applications for disaster relief [3], monitoring of people with Alzheimer's [4], or maybe monitoring agricultural sites [5].

Women feel insecure in these situations, and they want to avoid certain situations in general. A harmful gender comparison between males and females is depicted in Figure 14.4. Table 14.1 and Figure 14.5 reveal that women were more affected than men in terms of physical threats.

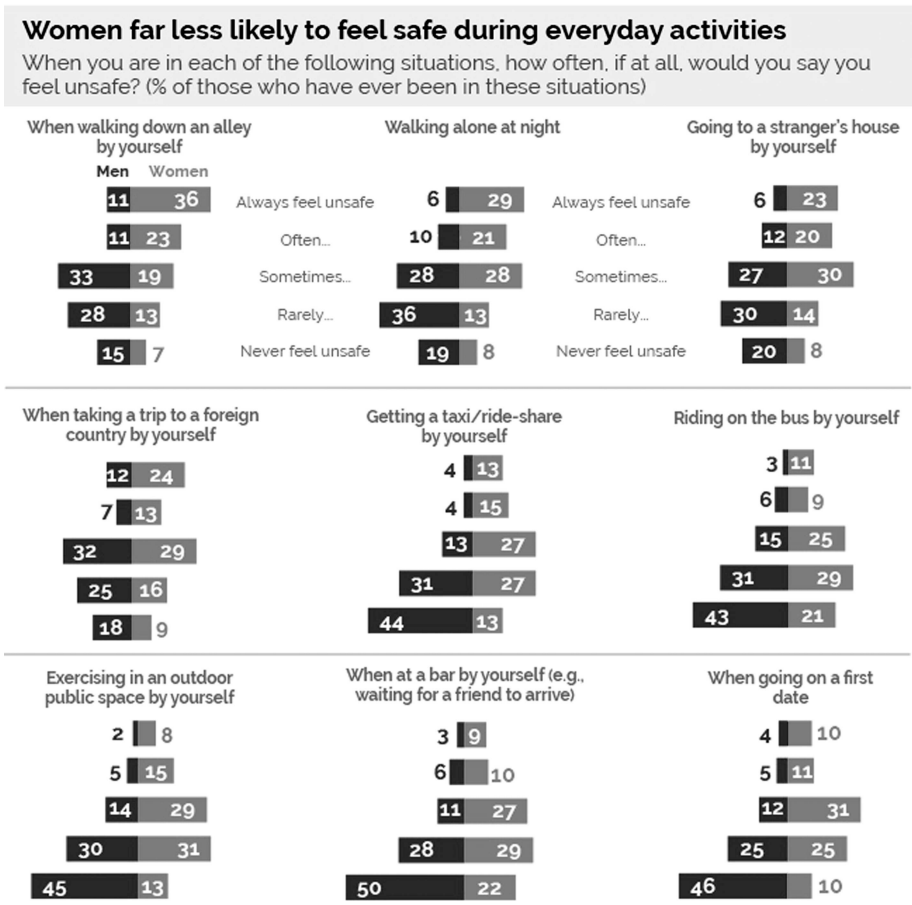

FIGURE 14.4 Gender-wise statistics feeling unsafe during everyday activity.

TABLE 14.1 Significantly fearing each circumstance by gender

	WOMEN	*MEN*
Sexual assault	53.7%	24.2%
Physical attack	50.0%	34.5%
Dying	49.8%	43.9%
Burglary or Vandalism	46.0%	34.6%
Mugging	43.9%	35.2%

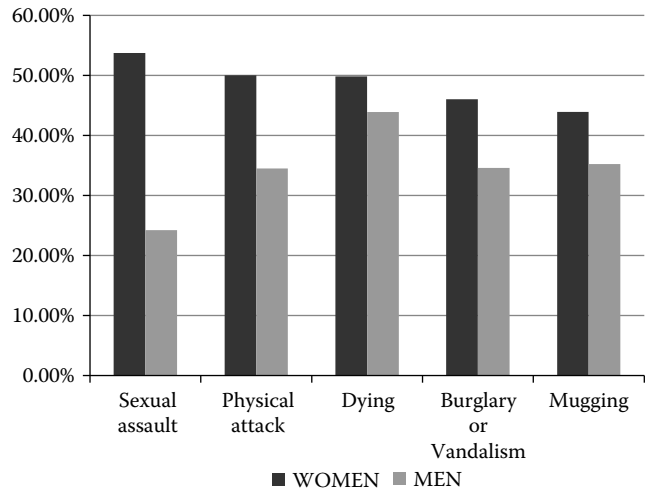

FIGURE 14.5 Comparision of significantly fearing each circumstance by gender.

In our proposed work, geo-fencing is employed to line women's workplaces. Parents put a label on places like schools, parks, friends' houses, nearby places, workplaces, etc. It includes their authorized and unauthorized areas. This application also supports motion detection and voice recording, and autonomously sends information to the servers and their parent's registered mobile. This work aims to supply technology-based security, which will facilitate parental monitoring. The utilization of the global positioning system (GPS) makes the proposed system send the current longitude-latitude information and record soundtracks from victims' mobile. The situation information and recorded voice are going to be sent to a highly secured centralized server and vary or registered on a mobile. Finally, this proposed system model of a technology-based secure tracking and monitoring system for young women and youngsters to deliver active and efficient monitoring and protection system.

14.2 RELATED WORKS

According to Ramachandiran et al., given the current circumstances, women's safety is a big concern in both urban and rural areas. Although changing the mindset of a whole culture is challenging, we can safeguard women by employing technology-enhanced safety equipment for women who are subjected to sexual harassment, acid assaults, harassment, and other forms of harassment. To improve women's safety and security, a variety of smart devices and mobile applications have been developed. The software repository contains a large number of apps. However, the majority of software solutions do not deliver better solutions. [6] Experts in the field must create a superior software solution that can be used both automatically and manually. This suggested project looks into several women's safety practices. It also goes over the benefits and drawbacks of women's safety gadgets.

The latest mobile phones, according to [7] Roselin G Leema et al.'s suggestion, are fitted with sensors and a global positioning system for routing systems that have been popular recently. Recent mobile phones can be used for personal safety and security, as well as other safety concerns, mostly for women. The Monolith for Women can achieve this with the use of technology-enabled items. The majority of software and programs are geared toward women in need. ARM controllers are most effectively employed in smartphone devices and require the least amount of power. To detect the hidden camera, use the radio repeat signal viewfinder. We've uncovered a security device that can enable all major functionalities with a single button press. Bluetooth employs an ARM interface to synchronize smartphones in this article.

R.A. Jain and colleagues' suggestion that women's safety is a serious concern. Rates of crimes against women are rising every day, therefore keeping women and girls safe at home, school, college, and the workplace is critical. Many steps have been taken to ensure women's safety and security. Even though various precautions have been put in place to protect women, there have been several crimes committed against women in recent years. In an emergency, smartphone applications allow users to reach emergency contact numbers in real-time. When users are in a risky scenario, mobile applications allow them to contact the appropriate authorities. The mobile application uses Map Box as the primary source to track the current exact location using the global positioning system and sends a message to the registered emergency numbers. This application was created using the Java database programming language and Firebase. When a victim approaches a possible attacker, this mobile application triggers the warning mechanism by shaking the smartphone repeatedly to inform the public. These kinds of features allow for day-to-day security and emergency response, making them the ideal choice for everyone. Victims can use this mobile application to not only warn others close to them about their situation but also to seek immediate support and action to avert undesirable situations [6].

Every day, women and children are becoming increasingly concerned about sexual harassment. Both developed and developing countries are facing dire circumstances.

As a result, women's empowerment and family expansion in the country face significant hurdles. They will continue to create IoT devices and mobile applications to make women's activities safer under this plan. By pressing the emergency button on their phone, women can receive immediate and comprehensive security assistance. The device can track the user's present location and relay location-related information to a local police station or volunteer in the event of an incident. Users can also use their phones to locate the closest safe zone [8–10]. This proposed system is unique in that it can operate in both online and offline modes. Even if their mobile phone does not have internet, users can utilize the gadget to contact the local police station or volunteer assistance. Arduino Nano, GPS, GSM, Bluetooth, and other components are included in this gadget. The combination of all of these features makes this device both inexpensive and simple to use.

Poonam Bhilare et al. discussed the importance of women's safety. They introduce the global positioning system enabled vehicle tracking and women employees that may track their situation. This can provide a mix of GPS devices and specialized software to trace women employees' vehicle locations, providing an emergency button that will provide additional security. By activating the emergency button, it will send an alert message to the concerned person. After they trigger the emergency button, it will send an alert SMS to the registered mobile numbers also [11–16].

Violence against women has been recognized as a worldwide problem that must be addressed in altogether countries. Maltreatment is additionally well-defined as a sort of social ill. There are four major categories of child abuse. Children are emotionally abused, physically abused, neglected, and sexually harassed [17,18]. Therefore, instant care and action must be taken from the independent governing bodies and caretakers. The kid protection commission is remitted to act as a central control for matters affecting women's protection by collecting information on sensitive problems, including family care. Women need more care and high protection in their working places, and children's rights must be strictly followed [19]. The government must introduce some autonomous bodies to require care of those sorts of issues. In our previous study [20], the government as a regulator and monitor must include the whole public, parents, children themselves, and neighbors. At home, parents must look out for their child, even when the child is near a workplace, a neighbor's home, or school. Additionally, to communicate, parents must actively participate in a program to stop maltreatment. Parents should monitor their working women's location-based activity.

However, this type of problem arises thanks to the unawareness of their parents like working, doing chores, etc. Recently, the technology boom will give attract additional importance. It helps us to make the interconnection of networks and share the knowledge effectively using the web anytime and anywhere as long as the needs are met [21]. By employing a Raspberry Pi, a monitoring system was developed that supports multimedia and mobility [22].

That system sequentially takes photographs, which are directly stored in Raspberry Pi, and it processes them and makes live video recordings. This system consists of a red box. The video recording and photos are stored in the centralized server through

Raspberry Pi. Receiving parental monitoring, this technique works as sort of a gadget working with an internet browser like Chrome, Edge, and Safari, which device must connect with the web. In another study [23–25], a mobile application is established to guard women and youngsters. That application uses motion detection using sensors and photo capturing using the interior camera [26–28]. If the smartphone gets moving, the appliance will send a notification to families or known relatives. The images are intended to prove abuse. Additionally, it'll store and forward those photographs and send the location-related information, which can help to rescue them.

The study of S. A. More [29] proposed a system that uses body temperature and pulse to detect the abnormal condition of the victim, sense the likelihood of an abnormality, and send notifications to the family members or relatives. They can monitor the current situation through the mobile application [30]. That system deals with digital image processing to spot any possible threat and suggests various possible solutions to guard women and youngsters. In [31], the authors have developed a tool that uses the PIC16F876A mini microcontroller, and therefore, the SIM808 module has some enhancement in the device. GSM, GPRS, and GPS support won't send notifications to their friends and family when victims press that emergency button within the developed system. In [1], a facial-based system is developed. It takes the facial reactions compared with the stored reactions. If the system found an abnormal facial reaction, then a report is submitted automatically to their parents or registered one.

For [2], we are building a highly secure device using GSM, GPRS, and GPS. The device communicates a message containing the target's body shape and height to the registered mobile number. [3] Android applications and arm devices are individually activated using a synchronized Bluetooth device connection. Audio and video tracks are sent to registered mobile numbers within the application and the site of the decision and alert message. In [4], a mobile application was developed that gives a location for a vulnerable woman by providing fake phone calls, video transfers, location, and care information. During this proposed method [5], vibrations, heartbeat rate, and blood heat are sensed using a temperature sensor, vibration sensor, and heartbeat sensor with the assistance of a uniform protected device that has a microcontroller with an Arduino Uno and some important sensors. During this system [32], three sensors are used: temperature, pulse, and accelerometer. These sensors are wont to detect an abnormal state, and therefore, the system will send a message and victim location-related information using GPS and GSM modules.

14.3 SYSTEM INFRASTRUCTURE

Our proposed application is beneficial for girl children's parents and dealing with women's parents, our system requires smartphones with GPS facilities that are used for location tracking. During this part, the infrastructure of the proposed system is engaging the utilization of recent technology like sensors, voice recorders, geo-fencing, and communication networks.

14.3.1 Geo-Fencing

Geofencing may be a location-based virtual fencing service where the developer uses wi-fi, GPS, or mobile internet to send/activate messages like email, SMS, or notifications or pre-defined actions where mobile devices enter, exit, or remain stationary during a particular fenced region. We will fix and mark the situation on a map and create a virtual fence around it. This 'fenced-in' area can now be monitored and communicated with mobile devices that violate its location. Geo-fence gives its developer the power to send email, SMS, or app-based notifications to mobile devices that enter, exit, or stay parked within the marked area (Figure 14.6).

14.3.1.1 How geo-fencing works

Geo-fencing is a method of creating a virtual boundary in a Google map. User can create their own trusted boundary in a simple map. That will help to monitor a person's location in the map if that person exits from the boundary region, the system will notify. These operations are performed with the help of the mobile application.

Geo-fencing is implemented with the help of mobile application code. Users need to choose the location service, and to do so, they must have a smart mobile phone with the geo-fencing application. This application is a smart solution for tracking a particular person within the fenced area. It will give a notification when the user enters/exit the fenced area. A geo-fenced application is the best, most flexible, and most efficient solution for individual tracking. It will notify the exact address or location

FIGURE 14.6 Sample geo-fencing.

when the user triggers the alert button. This is called the "if this, then that" command, where the application is programmed written to support this feature.

Geo-fencing is not a mobile application; it is a solution for creating virtual boundaries. Geo-fencing is implemented in our proposed system for women's or child live-location tracking. This system is useful for working women and school students for continuous monitoring of their location. This system makes them feel safe and secure. That will improve their self-confidence level. Geo-fencing has become a typical practice for several software and manufacturing industries. Geo-fencing is included different areas like marketing, social media, retail, hospital, and etc. Home delivery-related applications are also able to solve some delivery-related issues.

14.3.1.2 Common geo-fencing applications

- **Social networking:** Social media networking is one of the most identifiable user-related applications. It uses geo-fencing for notability, Snapchat, location-related filtering, stickers, and other location-related content sharing using geofencing. Location-related stories can be created for remembrance of happiness with the help of this virtual perimeter.
- **Marketing:** Geo-fencing is a popular way for a business to improve their sales to deliver in-store promotions. It alerts the customer who is entering into the shop boundaries and sending notifications related to offers and discounts. Geo-fencing is also useful to track their marketing executive and sales persons' present location and etc.
- **Audience engagement:** Geo-fencing is used to make open public interaction with a greater number of people in festivals, deals, events, contests, and more. For example, event location-related information may be shared with the help of geo-fencing.
- **Smart appliances:** Geo-fencing-enabled applications will be used to notify the shortage of groceries in your kitchen when you reach the boundary of the supermarket. For example, the system will notify you about the shortage of milk in your refrigerator.
- **Human resources:** Some industries use a geo-fencing to keep track of their employee location-related information. When the employee went for outsourcing, they need to keep track of their location, and they can some important location-related information.
- **Telematics:** Geofencing is also used in telematics. It allows the companies to draw virtual boundaries around their sites, work areas, and secure areas. When unauthorized trespassing happens in a secured area, that will send a notification to the security in charge.
- **Security:** Geo-fencing may sound invasive, and it may certainly have a desire to exaggerate how it is used. However, geo-fencing can also intentionally increase the security of mobile devices. For example, use a geofence to set your smartphone to unlock when you're at home, or alert you when someone goes in or out of your home.

14.3.2 Sensor Module

New smartphones have built-in sensors such as accelerometers and GPS technology. The proposed system uses these sensors. This proposed system includes geo-fencing technology for observing where children are using position sensors. Smartphones provide several ways to share current location information with latitude and longitude, such as global positioning system and internet-based location information. The proposed system uses GPS to identify the child/woman and their proximity to a particular location. A loved one describes these particular areas by specifying latitude, longitude, and radius. Position sensors continuously send current location information to determine if your child is in or out of the fenced area. Motion sensors are intended to detect the movement of mobile devices. This application uses a G-sensor to track the speed of your device. A G-sensor represents a flux sensor or accelerometer that detects the terrain, location, or height of your screen.

14.3.3 Voice Recording Module

The smartphone contains an audio recording that aims to record a sound near a lady or child during emergencies. Voice recording is taken into account because it can store evidence of abuse while the device is way away. Additionally, the voice recorder on smartphones doesn't require advanced data.

14.3.4 Communication Module

This module communicates the warning information to their relations using SMS, email, and notifications. The utilization of those will make sure that the message is going to be received by the family if relations haven't yet installed the application. Alternatively, the device sends location-related information to the server (Figure 14.7).

14.4 IMPLEMENTATION

The women's safety and tracking system is employed and tested in Android mobile phones. Figure 14.8 shows the flow of the women's safety and tracking management system application process. First, the relations will register who is going to be cared for. For every member, a registered loved one will erect a fence around a particular area. Fenced areas include areas that a loved one should monitor, like frequent visits or areas that a toddler shouldn't visit. The app will continuously monitor the situation. The GPS will send the location-related information continuously. The geo-fencing system is employed to watch user movements in fenced areas.

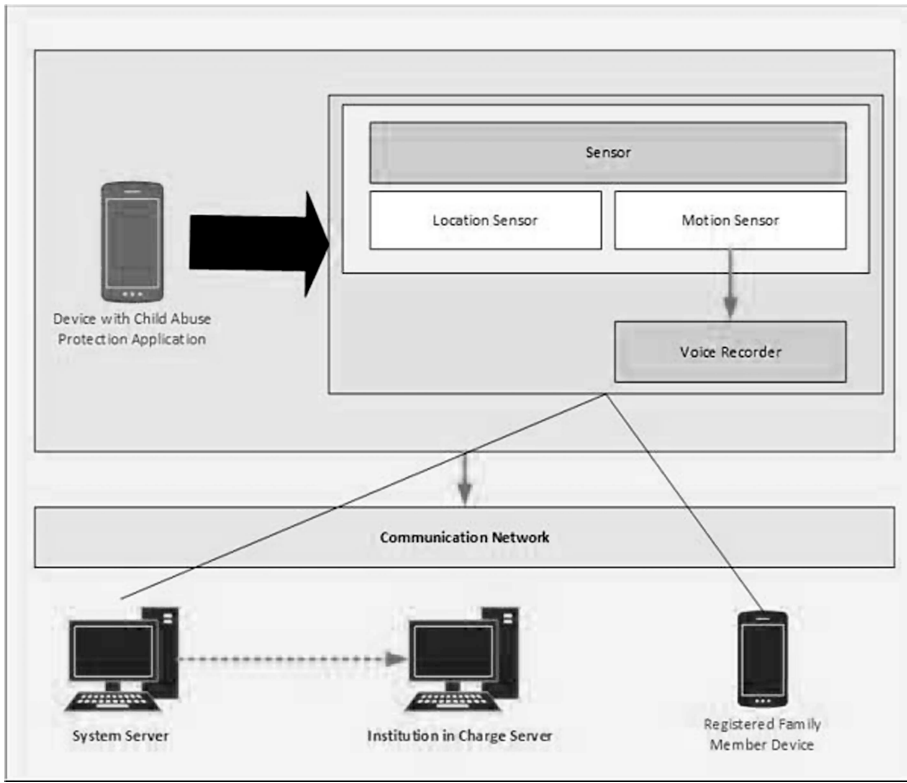

FIGURE 14.7 System model.

Now there could be two types of behavior segmentation here:

- Enter- Trigger sends a notification if the user enters the geo-fenced area.
- Exit sends a notification if anyone exits the geo-fence area.

Our proposed geo-fence-enabled system sends a notification to registered mobile phones. It also sends location-related information, such as someone entering into the fence or exiting the fenced area. This application continuously monitors the location-related information about the particular registered mobile. In an emergency, the user can move that device in some pattern. By monitoring the movement pattern, the system will detect that the user is in an emergency, and it will activate an alarm for their parent's and relatives' mobiles about possible maltreatment. Automatically, the sound and video recorder is activated. This recorded information is forwarded to the respective users. Voice messages are going to be communicated continuously for a particular period until the victim is safe (Figure 14.9 and Figure 14.10).

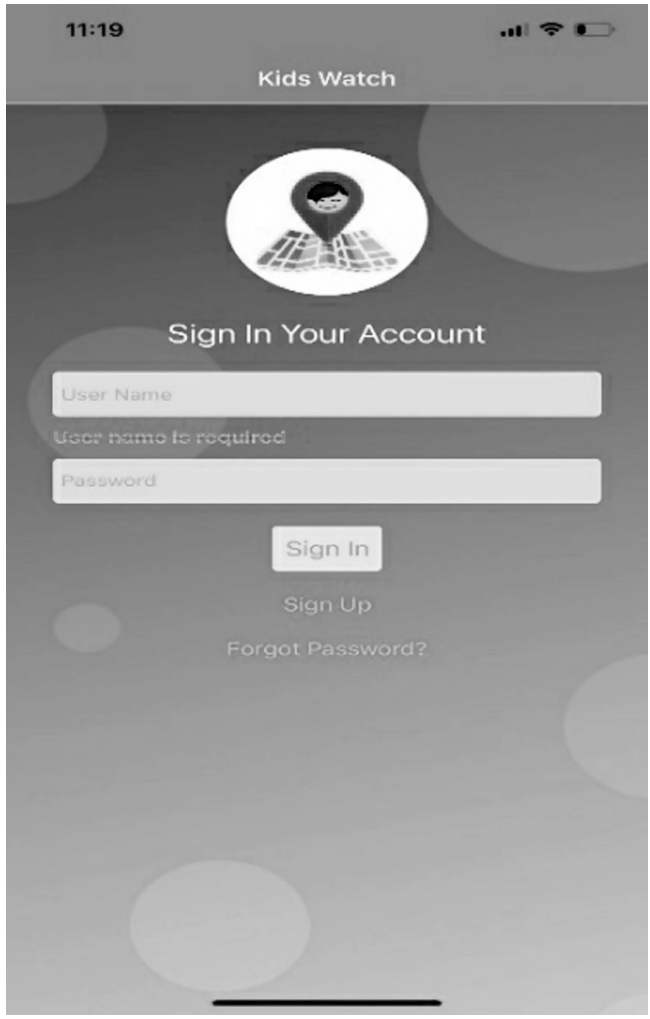

FIGURE 14.8 Login page.

14.5 WORKING

Our proposed work may be a mobile application that's used for women's safety and tracking management, which will ensure their safety and reassure their parent. It'll send notifications about the geographical location of their child. The workflow diagram of our proposed system is shown in Figure 14.11.

The toddler stepping out of the house is held with the GSM/GPS module with her, wedged in her pouch/backpack. The fence is then created within the toddler's

FIGURE 14.9 Registration.

boundary. The GSM module will continuously track the position of the toddler. When the toddler crosses the fencing area or encounters any troublesome situation, the tracker module consists of a push-button notification. The toddler can press the button during an emergency, sending a message to her parent. The notification will alert the parent to take necessary actions. This kind of geo-fencing logic is mostly applicable to school-going children.

The woman comes out of the house with a tracker module. Parents are ready to create virtual fences in a trusted area. Their location is monitored and tracked continuously using the global positioning system. The tracker module also ensures that the women or children don't leave the required phone without alerting the parent. The

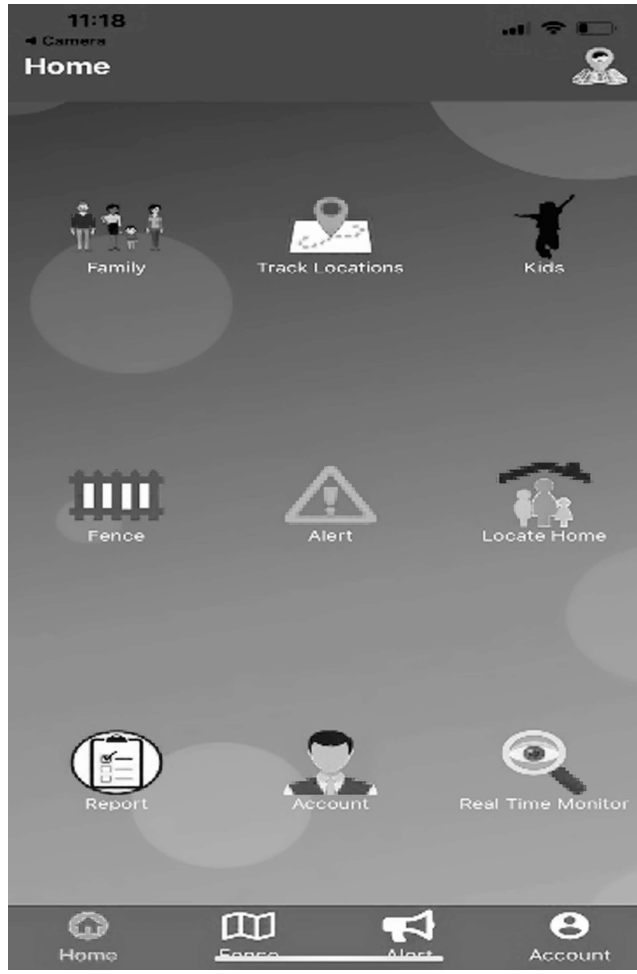

FIGURE 14.10 Add kids.

tracker module includes a push-button notification that will be used when they're in an unsafe situation.

14.6 CONCLUSION

Our proposed method is meant to trace kids and women. The answer represented during this work makes good use of smartphones that provide efficient features like Google maps, global positioning systems, short messaging systems, etc. Several simple jobs depend upon nonessential SMS-based tracking to urge an exact location. Our

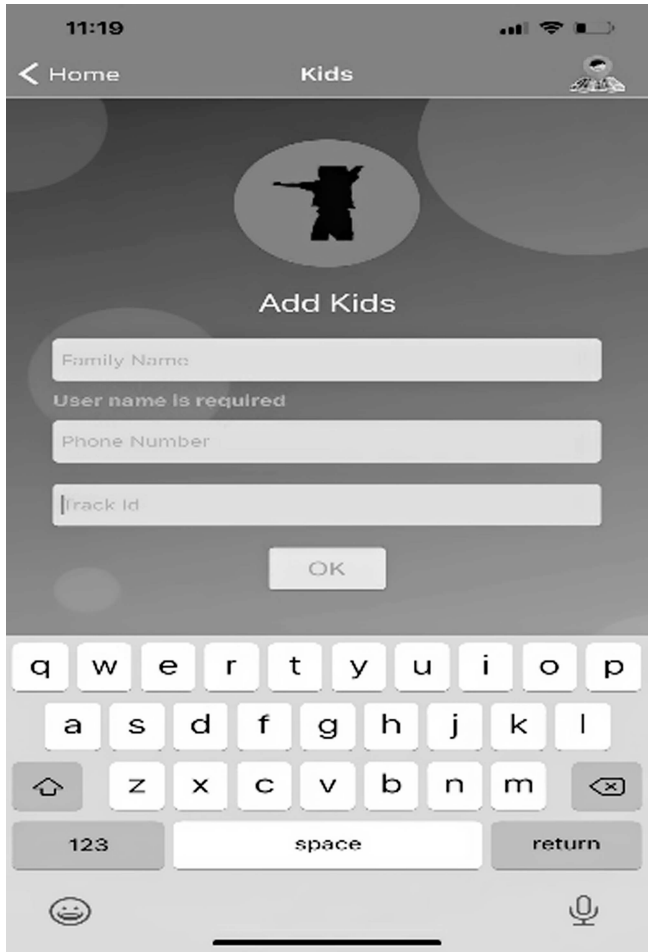

FIGURE 14.11 Proposed framework.

proposed system provided live monitoring and tracking system. Include more geo-fencing features, a panic alerting system, and emergency messaging services to enhance the protection. Other additional features like home access, location tracking, fence construction, warning, and reporting; to ensure the security of youngsters and extend their confidence, a security plan is proposed. Using the inspiration of this technology, the novel system is proposed to revamp existing systems by adding new features while making them safer. In the future, an equivalent solution could also be applied to smartwatches or small integrated devices. Child and women's safety and security are key issues in all. Our geo-fence-enabled system will help provide enhanced security and monitoring system for the working women and children by using geo-fencing for current location identification and a panic button to provide a sense of security. Previously proposed systems provide the technology-enhanced solution to track the women's vehicles. The victim tracking system includes additional features

like alert messages and a panic button with our proposed model to overcome the problem of women's security. It can be implemented for children and working women in night shifts by the parents who are situated away from the working places. In the proposed method, the panic button is activated, and the alarm sends SMS to the relatives and a centralized server. The image capturing, sound recording, and video recording are done by connecting a hidden miniature device and sending this information when the victim triggers the panic button, providing a monitoring of their exact current location usng easily available geo-fence-enabled Google maps. All the images record voice, and video are stored in the centralized server. They provide security seamlessly at any time, but any functional or physical device failure interventions remain a future issue that needs to be resolved.

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