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Female Security System Using IoT and Mobile Computing - FeSecure

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***Abstract*—** With the proliferation of crimes in today's world, safety of the women is one of the most serious and compulsive requirements. Number of crimes against women is increasing drastically and over 4 million rape cases were reported across India between 2001 and 2017. Not only just this number, innumerable number of women is becoming victims of harassments and violence. Considering this alarming situation in the country, a wearable women safety device is proposed in this paper. The proposed model of the device "FeSecure" consists of hardware and software modules. The hardware module is designed considering the scenario wherein the attackers seize the mobile phone from victim and victim is incapable of accessing her phone. The model of wearable device consists of GPS, GSM and sensors. Sensors read vital parameters from the victim such as body temperature and heart rate, and alerts will be sent to emergency contacts and nearby police station with the help of location tracker module if any irregularities are detected in the read parameters. To alleviate the false positive alerts, reverse alarm, and alarm fatigue is incorporated in the system. Along with this, android application is also built that has various features like panic button, fingerprint recognition and voice recognition which can be used by victim to send alerts.

Keywords—location tracker, safety, false positive, alarm fatigue, vital parameter reading, fingerprint and voice recognition.

I. INTRODUCTION

Safety of Women is the foremost distress in the country since the crime rates against women is rising significantly. Inestimable number of young adults, teens and even tweens are becoming the victims of vicious activities such as trafficking, kidnap, and other ruthless acts. Government has taken number of initiatives towards the prevention of crimes against women and despite this fact; the rates of cruel acts are not impending down. There are various security systems existing presently to curb this hostile situation in the country. Many systems involving various types of mobile applications, shock detecting jackets, GSM and GPS based models, manually triggered devices, unfortunately failed to provide complete security solution [4].

The main objective for the design of proposed FeSecure system is to come up with a robust solution to handle the multiple test cases that attempts to protect the victim. Some of the limitations of existing system are situation wherein the victim's mobile phone is seized by attackers leaving the victim incapable of accessing security mobile apps; manually triggered devices may also become inaccessible if the attackers seize those devices. Shock detecting jackets, or any other devices that read vital parameters and that are capable of sending the alerts automatically are most efficient, but may be susceptible to false positive cases. The proposed FeSecure model attempts to mitigate these limitations and also is reliable enough to secure the information of the user. Certain enhanced features are used in this system to establish reliable communication between victim and the rescuers without the attackers' knowledge. The proposed security system is only a model and executed on board. The same system can be miniaturized and made wearable anywhere near the chest area that can read vital parameters of the victim and alert if any irregularities are detected.

The GPS and GSM modules of the device can track the victim's location and the location is sent to the rescuers and nearby police station. The mobile application part of the system is capable of recognizing the distressed voice and activates the alert instantly. One of the key features of the proposed system is reverse alarm, which is used when the alert is false positive. False positivity can happen due to number of reasons, vital parameter irregularities can be found because of some other reasons like ill health and not because the person is in danger. To resolve false positive cases, the user will also get an alert message when the danger alert message is sent to emergency contacts or rescuers. If the danger message is false positive, user should click on the reverse alarm within the stipulated time so that it notifies emergency contacts and rescuers that there is no danger.

II. RELATED WORK

S. Juhitha et al [1] proposed a secure mobile application with aim of reducing the crime rate against women. This application involves initial registration and emergency contacts need to be included. When there is any expected

situation of emergency, the victim can vibrate the phone to a specific frequency or can long press the lower volume button. Following this action, an alert message that includes the victim's name, GPS location along with help message are sent via SMS to all the registered emergency contacts and a call is made to the master contact. The rescuer or the emergency contacts can supervise the location of the victim directly with the help of dynamic GPS tracking system if they have registered with the same application. If not, the location of the victim will be sent via SMS link. The rescuer can take charge instantly to help the victim. If the victim is not stationary, if victim is in motion, the live location will be updated periodically. This application is equipped with G-maps API that is turned on to view the user's location on a map. [1] System has 3 fundamental components such as sensing, tracking, and alerting. The sensing task is carried out by measuring device that is embedded in mobile phones. The measuring device is capable of detecting acceleration, vibration, and tilt to spot the movement and precise orientation on the 3 axes. The measuring device is facilitated to detect the vigorous motion of the mobile phone in linear direction. When the person shakes the mobile at the next frequency, this will be detected by measuring device with the help of x, y, z coordinates. GPS units in smart phone communicate with the satellites to work out our precise location on earth. This system does not address the situation if the attackers take hold of the mobile phone from the victim leaving the victim inaccessible to the developed app.

B. Sathyasri et al [3] proposed a women safety system based on IoT technology. This system consists of GPS and GSM modules for location tracking, Neuro Stimulator, buzzer and vibrating sensor. In this project, when the women are endangered, she had to press the trigger button to activate the system. Following this trigger button press, the location of the victim will be sent to the registered mobile numbers and nearby police station. The location of the victim is tracked continuously and dynamically updated into the webpage using the IoT module. Neuro Stimulator will generate non-lethal electric shock in emergency situations to prevent the attacker from attacking.

Helly Patel et al [4] proposed a system for women system based on machine learning model. Along with GPS and GSM module, the proposed model implements CNN - machine learning algorithm to recognize the distressed voice. The attack or any kind of emergency is detected based on audio signals that are integrated in an embedded platform in its entirety. The distress voice or audio calls are captures in active operation mode of the system. On identifying the endangered situation, the alert message will be sent to the registered users and to the nearest police station along with the live location of the victim. Voice recognition module is used to identify the keyword from the input voice from the user side. That voice spoken by the victim in danger is compared with the registered different kinds of screams. The main drawback of this system is the application becomes inaccessible or unusable if victim's smart phone is taken custody by the attackers.

Dudyala Sunitha et al [5] proposed a women safety system based on IoT technologies. The proposed system is a portable one with sensors and a Matlab based camera to capture the image of the attacker. The system consists of WiFi module to provide affordable network connectivity and also it has the capability of performing independent of host controller, MEMS sensor a micro-electromechanical device that measures acceleration forces, and finally a flex sensor that is capable of measuring the amount of deflection or bending. The system can immediately intimate the danger scenario to the concerned people or the emergency contacts. The device's co-ordinates are captured by the GPS tracking of the smart phone. The Matlab based camera captures the image of the attacker and sends it to the emergency contacts and nearby police personnel. However, this technique is effective only with the availability of smart phone to the victim and the contact personnel.

Wasim Akram et al [6] proposed a design of a smart safety device for women using IoT. The connectivity of a device is established based on the fingerprint method and alert is sent to the emergency contacts. The device has to be registered with fingerprint of the woman and the same will be used for activating the device. When the device is activated, it starts scanning the fingerprint for every minute. The triggering point of the device is when fingerprint is not scanned by the scanner, and it alerts the nearby public. The system also equipped with shock wave generator that is used as weaponry and helps woman prevent an attacker from attacking.

III. PROPOSED SYSTEM

The main objective of the proposed system is to provide a safe and fastest way to reach the emergency contacts or rescuers for help. Women in danger can either make use of Android application built or the hardware device in absence of mobile phone for help. The basic approach in application is that the victim can use three features - voice recognition, fingerprint and panic button to send messages to emergency contacts. The proposed system "FeSecure" is intended to overcome the apparent drawbacks of the existing women safety systems. The proposed system consists of heart beat sensor, temperature sensor, GPS and GSM modules. Heart beat sensor senses and sends an alert if any irregularity in the heart rate of the victim is found. The irregularities in the heart rate in healthy person can occur due to some kind of distress. Studies say, majority of the time the body temperature of the person will moderately rise when he/she is in panic or distress. In such cases, the alert signal with victim's location will be sent to rescuers and nearby police station. Reverse alarm and alarm and alarm fatigue are the two main key features included in our project.

Figure 1 depicts the FeSecure architecture. The hardware module of the proposed model consists of GPS, GSM, buzzer, temperature sensor, heart beat sensor and Arduino UNO board. The software module of the system consists of

mobile application where registration is required. Once the victim gets registered to the application, it can be accessed from anywhere. Volunteer rescuers should also get registered with the application so that if the rescuer is in the vicinity of the crime, alerts will be sent. The application consists of voice recognition module, fingerprint module and panic button. When any impending crime in approach, victim can press panic button if victim possesses her phone or can scream "HELP", where the distress voice is detected by the voice recognition module. In such situations, alerts will be sent to rescuers in close vicinity and to the nearby police station. The technologies used are Machine Learning for voice recognition [4], mobile cloud computing for storage and IOT for building a hardware device.

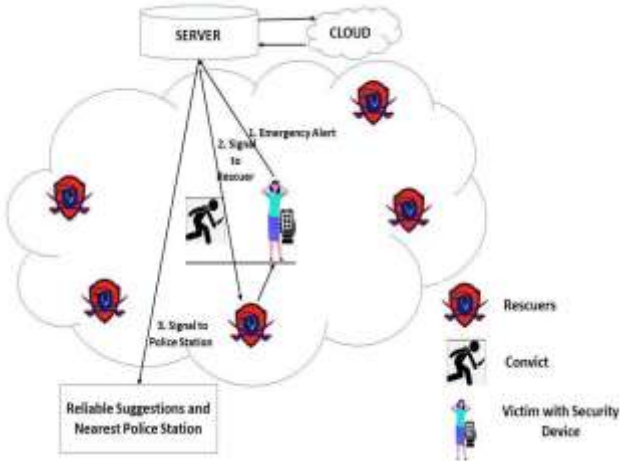

Figure 1. FeSecure Architecture

The modules implemented are: Voice recognition: The CNN machine learning based module identifies if the voice is normal voice or it is a voice in distress. This task is performed using the trained dataset. This module is availed from [4]. The woman in danger can use key words like "HELP" or scream so that the application recognizes the distressed voice and sends message automatically with location data using GPS and GSM modules. Fingerprint: The application senses the fingerprint of the victim and sends messages to emergency contacts. Power button/Volume Button: One another way of sending alert message is that the victim should press the power button or lower volume button thrice manually.

The above mentioned components part of software module of the system. The system is also made accessible if the victim does not possess her mobile phone at the time of attack. The wearable hardware device senses the body temperature and heartbeat of victim. If the read parameters are crossing the threshold, automatic alert messages are sent. Alternatively, if the victim is in a position to somehow use the push button of the hardware device manually, alerts will be sent. The location of the crime or the location of the victim can be tracked with the help of GPS. The emergency message sending part is taken care by GSM as these modules come into picture when the victim is unable to access her phone.

Reverse alarm: The system also incorporates alarm signal that will be sent back to the victim immediately after messages are sent to rescuers and police station so that the person who is using this system will get to know that messages are sent. If there is no danger, that is, if the alert is false positive then the same can be notified to rescuers and police station. buzzer The system also incorporates a buzzer so that whenever messages are sent the buzzer gets to ring alerting the victim that her location has been sent. Alarm fatigue: A False alarm algorithm is implemented so that whenever victim's body temperature crosses the threshold value and is constant or rises for some period of time only then the message is sent to the emergency contacts, if the temperature doesn't remain constant or immediately goes down, then the message will not be sent.

IV. METHODOLOGY

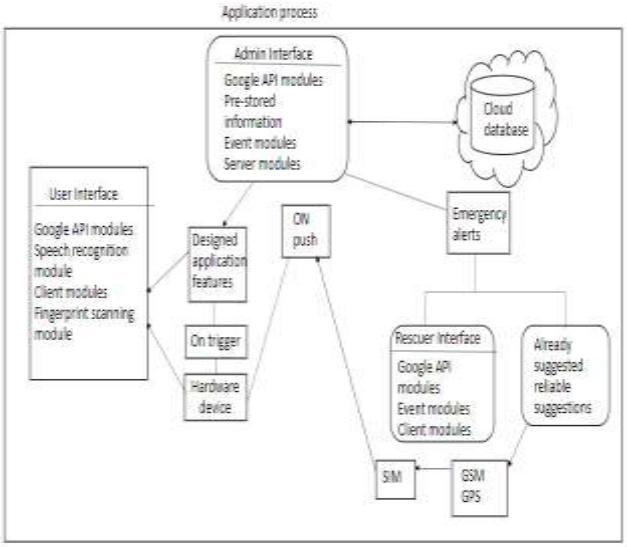

Figure 2. Software Design

Figure 2 depicts the software design of the proposed system FeSecure. The application consists of Admin interface, User Interface, and Rescuer Interface

Figure 3. Hardware Design

Figure 3 depicts the hardware design of the proposed system FeSecure. It consists of important modules such as GPS, GSM, sensors, push button/panic button, alarm, that are connected to main board Arduino UNO. Using push button, an emergency message will be transmitted when the victim does not possess phone with her or if the attacker seizes the phone. Location tracked by GPS module is transmitted to GSM module wherein the location and emergency message is dispatcher to rescuers. GPS system will furnish current location in the form of longitude and latitude. GSM will send message to contact number saved in that system.

Figure 4 shows the hardware connectivity of the FeSecure model. As mentioned earlier, this paper proposes only a model of the system and the same can be miniaturized and made wearable. This wearable device can be placed in a pocket made of velcro material and can be worn anywhere near the chest area from inside so that device can be well-hidden. This device can be used by victims in danger to protect themselves. Heart beat sensor and temperature sensors will be constantly monitoring the parameters. The average of these values is measured for certain amount of seconds and automatically the device is able to send SMS to the registered contacts or rescuers without victim intervention. Also there is push button in the hardware device which can be activated by victim whenever she feels she is in danger. Reverse alarm is included which will ring whenever SMS is sent to emergency contacts. Alarm fatigue algorithm is implemented to minimize false positive rate. When victim's body temperature crosses the threshold value and is either constant or rises for some period of time only then the message is sent to the emergency contacts, if the temperature does not remain constant or immediately goes down, then the message will not be sent..

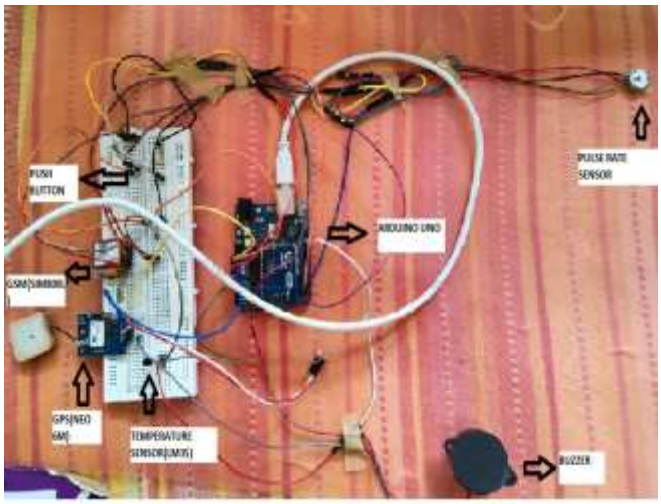

Figure 4. Hardware Connectivity

V. RESULTS AND DISCUSSION

Android application module has got registration page and login page. This registration is required for both the user and rescuer. Once the registration is done, the application needs user and rescuer to be logged in to avail the facility.

The page for sending alert signal or pressing of trigger button by a victim when is danger is showed in Figure 5 and messages that are sent along with the location of the victim in response to the click of trigger button is shown in Figure 6. Temperature sensor senses temperature values. The snapshot of the temperature values are shown in Figure 7. When the values are beyond threshold values, alert message with location details are sent. This message snapshot is shown in Figure 8. Heart rate sensor values read are shown in Figure 9. If the values are beyond threshold, location details will be sent with the help of GSM module. This snapshot is shown in Figure 10. Alternatively, if the victim is still able to access her phone when the attackers are attacking, she can use push button of the hardware device to send the alert messages with location details. This message snapshot is shown in Figure 11. As it is seen the figure, there are no vital parameters read because alert is triggered through push button.

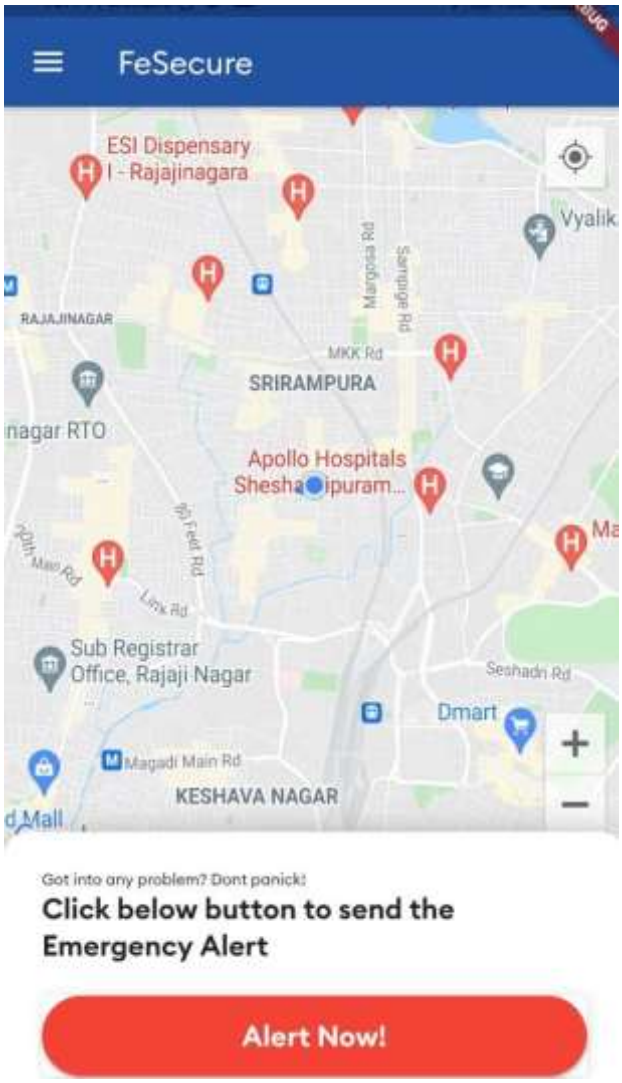

Figure 5. Alert Button

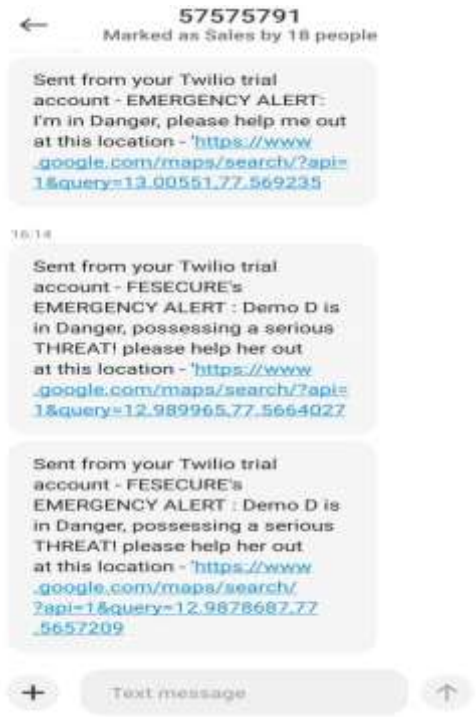

Figure 6. Sent message with location detail

Figure 7. Temperature Sensor Values

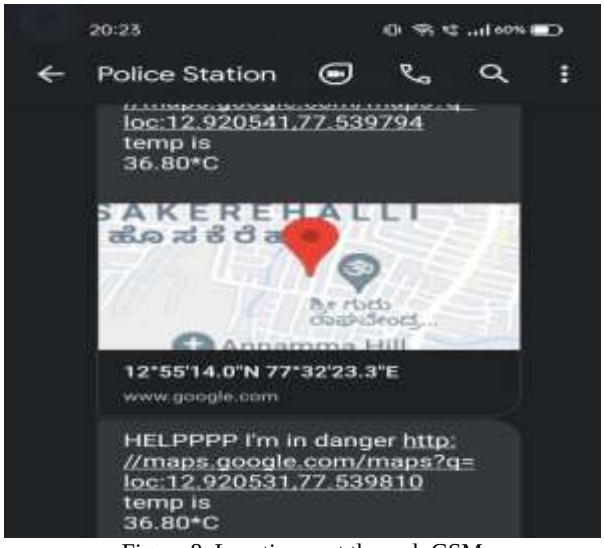

Figure 8. Location sent through GSM

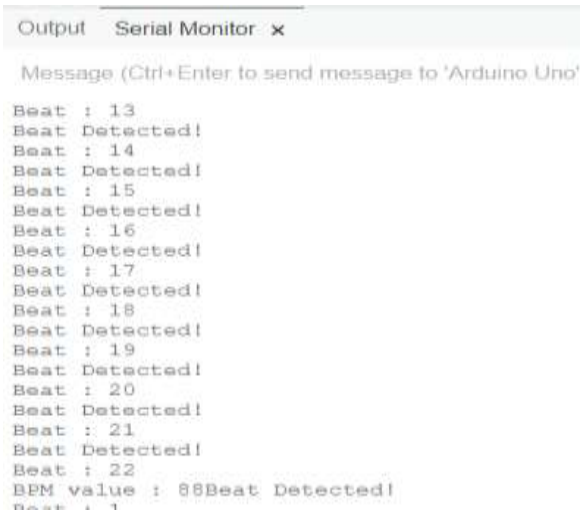

Figure 9. Heart Rate Sensor Values

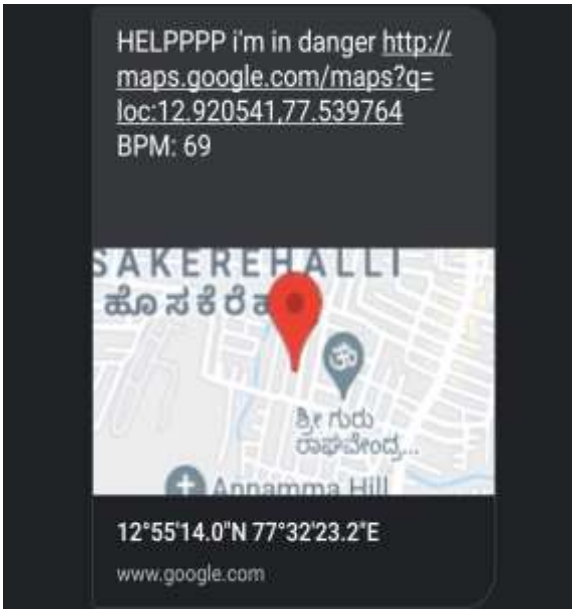

Figure 10. Location sent through GSM

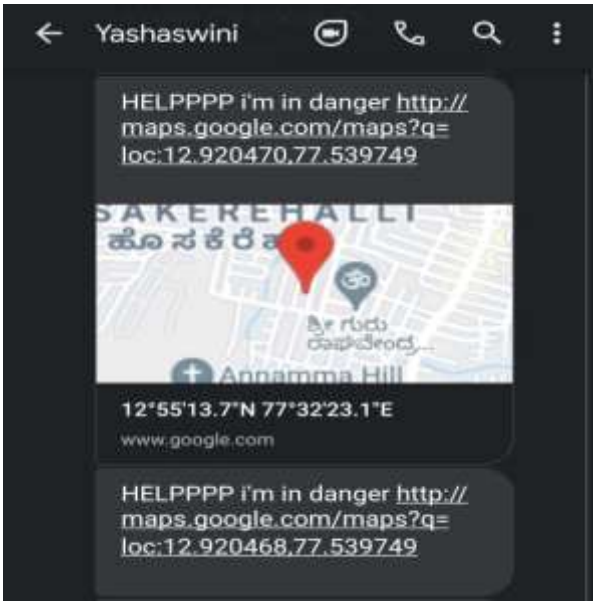

Figure 11. Location sent as a result of push button press

VI. CONCLUSION AND FUTURE SCOPE

A robust female security system is proposed in this paper which contains both software and hardware modules. The software module is developed using Android mobile application to facilitate the user or woman in danger to send alert messages to rescuers and nearby police station when she is in danger. Either she can press trigger button on the application or she can scream key words to trigger the application. The hardware module of the proposed system can be used when attackers seize the victim's mobile phone and because of which she cannot use the application. The hardware device is able to sense vital parameters of the victim such as temperature and heart rate and alert signals with location details will be automatically sent to the rescuers and nearby police station. Further, this system can be miniaturized to make it wearable and hidden. The software part of the system can be enhanced by incorporating much effective machine learning algorithm to detect the distressed voice with larger datasets. Additional sensors can be incorporated in the hardware module like pressure sensor, vibration sensor, and motion sensor to detect vicious activities and thus enhance the protection.

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