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IoT-Based Women Safety Device

Sneha Bharambe[1], Akshita Baburajan[2], Vaishnavi Gaikwad[3], Dr. Rizwana Siddiqui[4]
Department of Computer Engineering, S.I.E.S Graduate School of Technology,Nerul

Abstract: ***Women's Safety has always been a major problem even in these modern times with a lot of advancements in technology. The existing system provides safety bands for women which can be activated either manually or automatically, but both options are not available leading to more chances of false alarms. The proposed system "IoT-based Women Safety Device" mainly focuses on providing a reliable, fast and very effective system for the safety of women. It provides a platform that will be actively available 24/7 for their help to avoid any unfortunate situations. The user can activate the device manually by pressing the activation button or automatically depending upon pulse rate and motion sensor value. On activation, the location of the user can be traced using the GPS module and alert messages will be sent to registered contacts using the GSM module. The mobile application remains connected to the Safety Device for User Authentication and storing user data in the Firebase real-time database.***

Keywords: Women Safety, Internet of Things (IoT), Smart Devices, GPS, GSM, Motion sensor, Pulse-rate sensor, Smartphone application

I. INTRODUCTION

Women's safety has always been a huge concern in India. It is an unfortunate and alarming situation. Every day we get to hear the news of crimes against women. Usually, attacks on women take place when they are traveling alone or in an unknown area at night where they are not able to find any help or proper assistance. Rape has always been the biggest problem; Hundreds of women, even girl children, are raped and sexually assaulted every year. Research shows that an approximate total of 2,50,000 cases of rape or attempted rape were recorded by police annually across 65 countries. Thus, women have to think twice before stepping out of their houses because of increasing crimes in our country like harassment, abuse, violence, etc.

Different rules are being made by the government to control crimes against women that are increasing daily. Additionally, there are many existing mobile applications such as VithUapp, Suspects Registry, and others that send alert messages with the victim's location, but the switch button needs to be pressed twice manually. Women can use smartwatches that are available to make their safety easier. But these smartwatches require women to activate them, say by pressing the button or shaking the device, etc after sensing danger. But in these situations, victims do not have time to activate the device, and thus the main goal of providing safety would not be achieved. So, women in society should have access to devices with the latest technology that provides them with safety in unfortunate circumstances without having to interact with them.

The proposed system resolves the problems faced by women in danger by providing a smart IoT-based device that sends alert messages containing the link of the current location of women to registered contact numbers. By providing the link of the location rather than its coordinates, it saves time and thus is user-friendly. Activation of the device is manual as well as automatic, so women's involvement is not necessary. Moreover, since the alert message is forwarded only to the registered contact, they will not be sent to people who are not registered by the user.

The main objective of the proposed system is to design an efficient, reliable and effective smart women's safety device with less power consumption utilizing different sensors.

II. RELATED WORK

We have analysed and conducted a comprehensive survey on several existing systems which showed the different factors affecting the effectiveness of women safety devices.

A. Sensors

The use of temperature sensors results in less accuracy in [1]. Tilt sensor and Vibration sensor used for the detection of emergency in [2]. Pulse rate sensor detects the pulse rate and sends an alert when the threshold value is crossed in [3]. Fingerprint sensor verifies after a minute of detecting a finger leading to false alarm and less accuracy in [4]. Use of Pulse rate and Temperature sensor for detecting situation in [5]. Acid and Tilt sensor used to provide safety in case of acid attack observed in [6].

Women Safety Device that can be clipped on to the footwear for triggering in case of an attack in [7]. A belt is proposed which gets activated by the use of Pressure sensor in [8]. Use of five sensors to reduce false alarm in [9].

B. Emergency Button

Emergency button triggers the complete women's security app automatically sending the real-time location of the victim to the nearest volunteer is provided by author [10]. Message with the current location is sent when triggered SOS button observed in [11]. Use of the Emergency button to alert along with the location in [12].

C. Space and Cost Efficiency

Device could not be carried as it occupies a large space in [1]. Use of Tilt sensor and Vibration sensor makes it costly compared to other sensors in [2]. Acid sensor and Tilt sensor make the device costly in [6].

D. Power Consumption

More power consumption has been observed due to use of LCD display by the author [13]. Use of Raspberry Pi increases the power consumption observed by the author [10].

E. User Friendly

Providing location in longitude and latitude which makes it difficult for the users to get to their location further causing delay observed in [14]. Holding a finger on the sensor for a minute can risk victim's life in [4].

III. PROPOSED SYSTEM

The proposed system focuses on providing reliable, fast and very effective smart band for the safety of women which will provide a platform that will be actively available 24/7 for their help to avoid any critical situations. Existing system provides safety bands for women which can be activated either manually through the SOS button or automatically through the single sensor leading to false alarms. The proposed system uses multiple sensors such as pulse rate and motion sensor to provide more efficiency and it gets activated in two ways automatically when the pulse rate crosses the threshold value or manually by clicking the SOS button. Motion of any intruder is detected after the pulse rate crosses a threshold value. The alert message along with the link of the current location is sent to the registered contacts whenever the system gets activated. The safety device is connected to the smartphone through bluetooth to store user details and display the current pulse rate of the user.

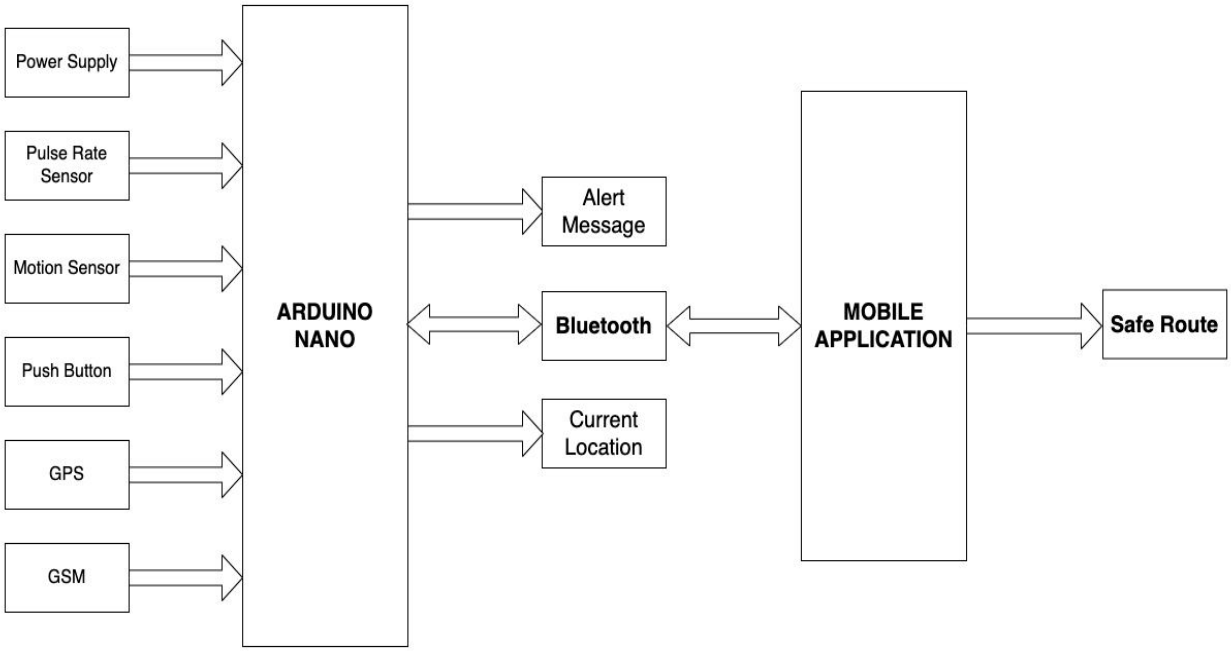

Fig. 1 Block Diagram of the Proposed System

The main components of proposed system are:

A. Arduino Nano

Arduino is a micro controller to which all sensors along with GPS module,SOS button are connected. The Arduino board is connected to the laptop through cable to get power.

B. Bluetooth Module

Bluetooth module HC-05 is designed for wireless communication. This module can be utilized in a master or slave configuration. HC-05 has a LED which shows the connection status ie. whether the Bluetooth module is connected or not by blinking continuously. The module works on 3.3 V. We can also connect 5V supply voltage as well, since the module has on board 5 to 3.3 V regulator.

C. Power Supply

It is used to power the circuit. The system gets power supply from the laptop.

D. Mobile Application

The women safety device is connected to the mobile application via bluetooth module which stores user details and register contact details. For user registration and login process, Firebase Authentication is used. The application continuously shows the current pulse rate of the user which is stored in the Firebase Real-time Database.

E. Pulse sensor

The Pulse Sensor is a pulse rate detecting device of a human which ranges from 70 to 90. Threshold value for pulse rate will vary from person to person based on their age.Whenever the threshold value is crossed the Arduino will send an alert message.

F. Motion sensor

It detects and measures moving objects in a specified area connected to it. So, if an intruder comes closer to the victim, the threshold value will be crossed and the device will be activated.

G. GPS Module

Global Positioning System (GPS) is connected to an arduino to determine the coordinates of current location, that is latitude and longitude of the receiver on Earth by calculating the time difference for signals from various satellites to reach the receiver.

H. GSM Module

Global System for Mobile Communication (GSM) is used to establish communication between a computer and a GSM-G\PRS system. It has a placeholder where a SIM card is inserted which is used to send and receive the messages using GPRS .GSM operates at either the 900MHz to 1800MHz frequency band.

I. SOS / Push Button

Push buttons work by touching two points when they are pressed, and the alert mechanism is activated. When the SOS button is pressed it allows the GSM module to send alerts to registered contacts.

IV. DESIGN AND METHODOLOGY

A. Design Details

A Data Flow Diagram (DFD) is a graphical tool that describes and analyzes how data moves through a system. DFDs capture the essential features of existing systems and those that will be implemented in the future. Fig. 2 indicates how the system models are structured. Fig. 3 indicates a visual representation of the relationships between modules and applications.

Fig. 2 Data Flow Diagram Level 0

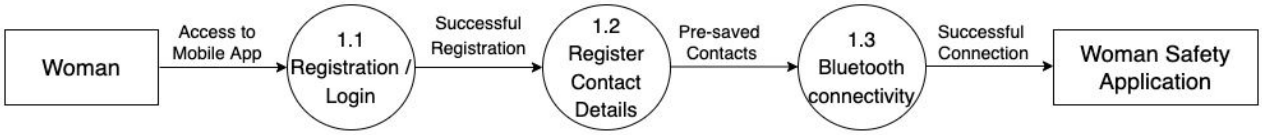

Fig. 3 Data Flow Diagram Level 1

B. Methodology

The proposed system comprises of two main parts ie. Mobile Application and Smart Device.

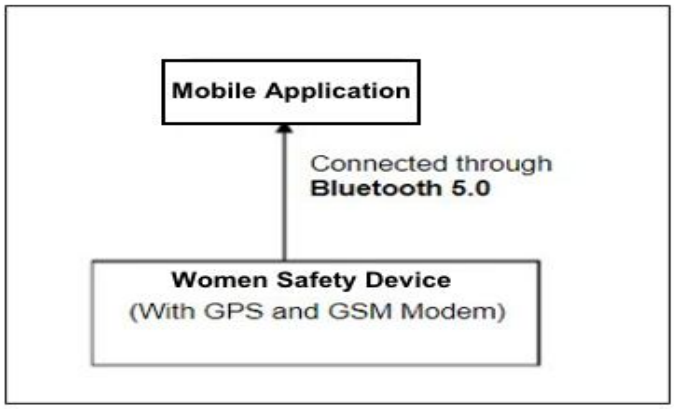

Fig. 4 Components of Proposed System

1) *Workflow of Mobile Application:* For the new user, the application consists of a registration process which includes entering details along with username and password and after successful verification, the user will be navigated to the Registered Contact Page where contact details will be stored to whom alert message will be delivered. After giving the registered contact details, the user will get access to the Bluetooth Connectivity page. It shows all paired devices as well as new devices. Here, we will connect Mobile Application to Bluetooth Module - HC-05 for communication between IoT device and application. After all these initial required steps, the user will be navigated to the home page. For already registered users, they will login to the system using username and password and after ensuring the user is authenticated, the user will be navigated to the home page.

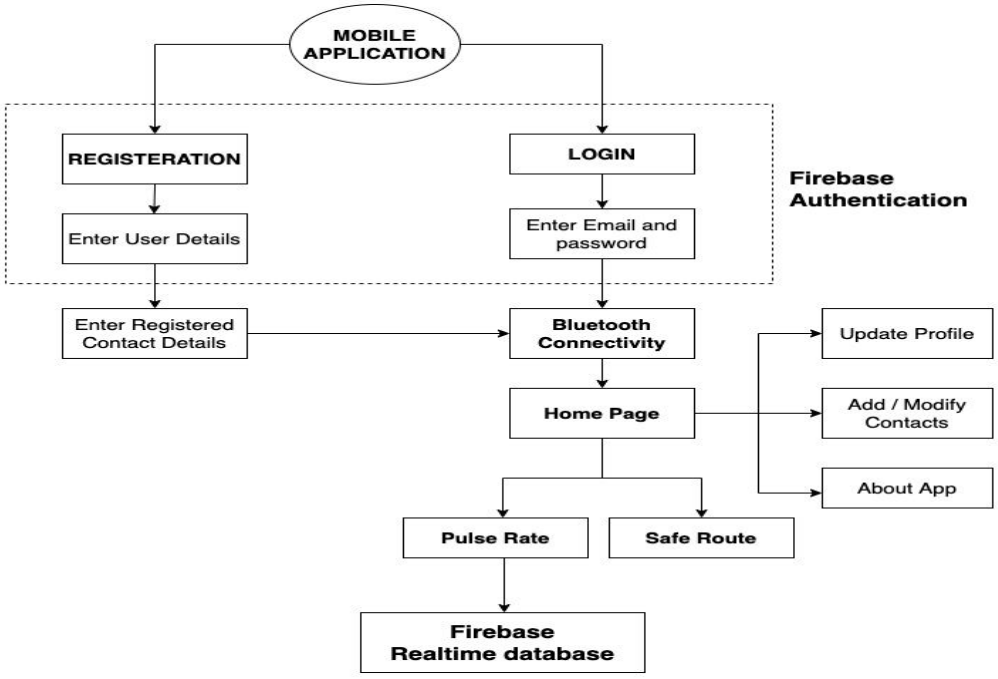

Fig. 4 Workflow of Mobile Application

2) *Workflow of Smart Safety Device:* The Safety Device consists of an Arduino board which is equipped with 14 digital input/output pins. Digital pins were used to connect to the GSM module through jumper wires. It can receive any GSM network operator SIM card and perform just like a mobile phone. After getting the current location of the user, GSM sent the acquired location to the web server through the Bluetooth module. The wristband can be activated in two ways. The manual mechanism is the process flow that occurs when the women are in a position to respond. When the user presses the SOS button, it generates a LOW signal, otherwise it always stays HIGH. After detection of a low signal from the SOS button, the pulse rate of the user is measured to check whether it crosses the threshold value and based on the result device gets activated. It is likely that the woman will be unable to react and use the manual mechanism in most circumstances. So, in that case an automatic mechanism will be used. Device continuously checks the pulse rate of the user. When the pulse rate meets a threshold value, the motion sensor activates automatically to detect intruders in a specified area, and a confirmation message appears on the application to let the user know if she's in danger or not. Suppose the user confirms the situation then an alert message will be sent to the registered contacts and if the user rejects the confirmation notification then the device will be deactivated. Even if there is no response to the notification within 1 min, in that case also the alert message will be sent. On activation of the device, the current location of the user is tracked using the GPS module and an alert message is sent to registered contact numbers using the GSM module. Also Safe Route will be suggested to the woman via mobile application.

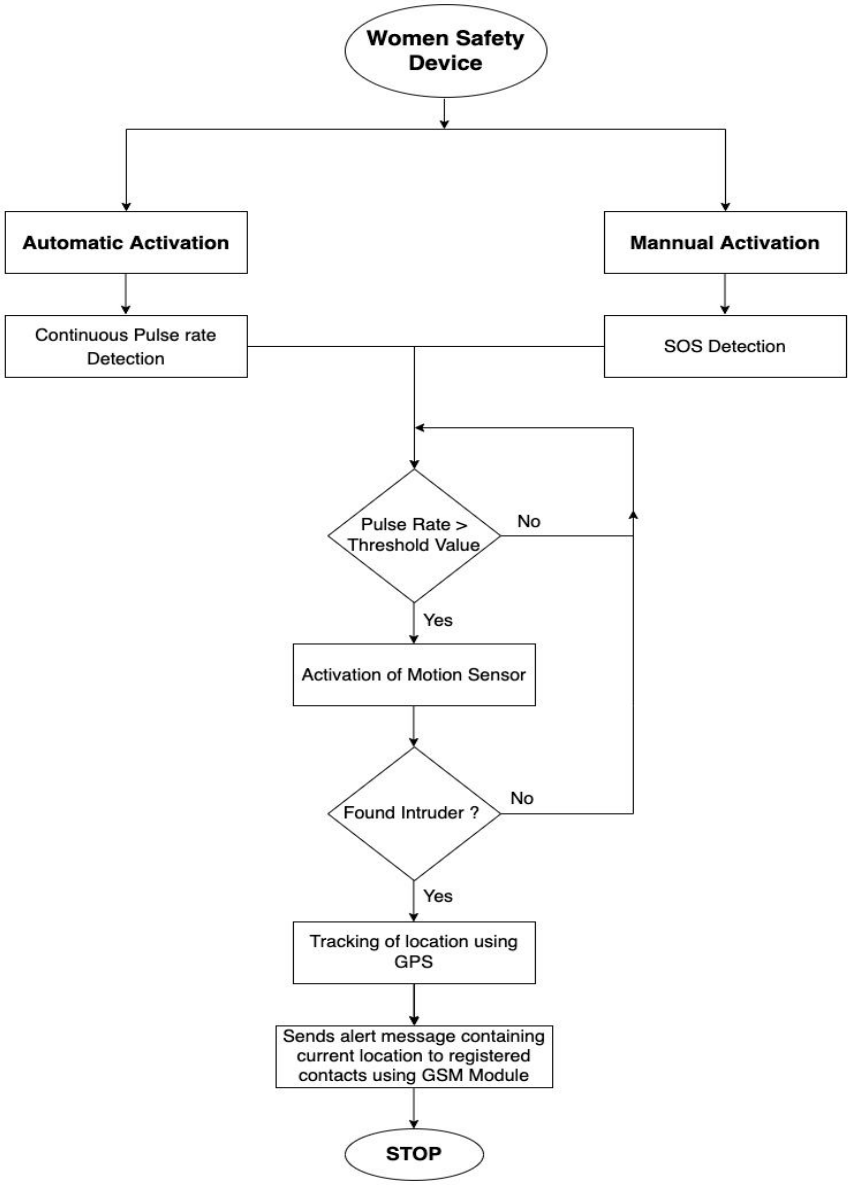

Fig. 5 Workflow of Smart Safety Device

V. RESULTS AND DISCUSSION

A. Implementation

Fig. 6 shows GPS – GSM Connection with Pulse rate sensor, Motion Sensor and Bluetooth Module

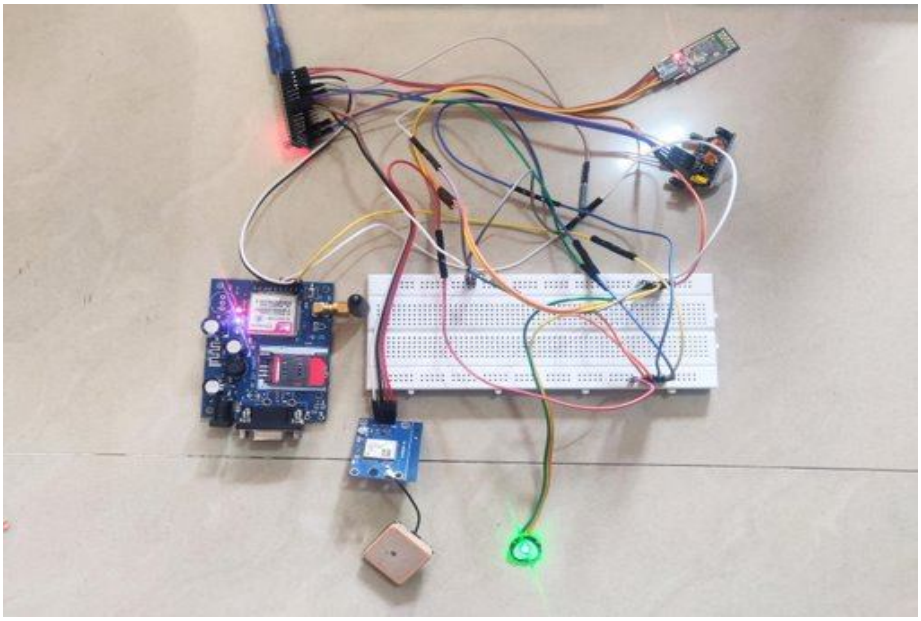

Fig. 6 Smart Safety Band Connections

B. Mobile Application Implementation

Fig. 7 shows registration activity on the mobile application where new user can register by entering the user details. Fig. 8 shows the login page where the user can login using username and password. Fig. 9 shows the home page of Women Safety Application which displays current Pulse Rate of the user. Fig. 10 shows the implementation of firebase authentication. Fig. 11 and Fig. 12 shows the implementation of firebase real- time database for the user details and the pulse rate values. Fig 13 shows the alert message template containing the current location of the victim which is sent when the threshold value of pulse rate is crossed and motion of intruder is detected.

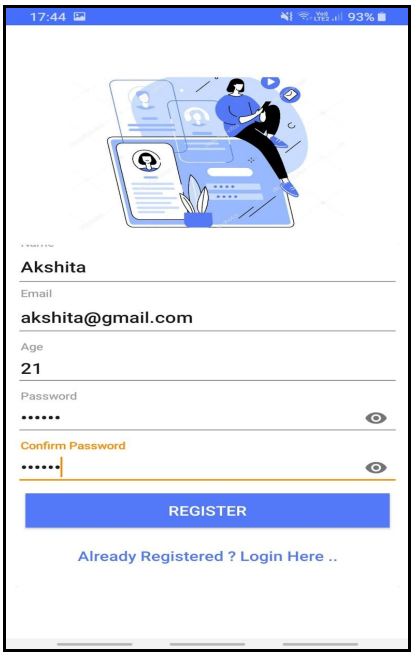

Fig. 7 Registration Page of Women Safety Mobile Application

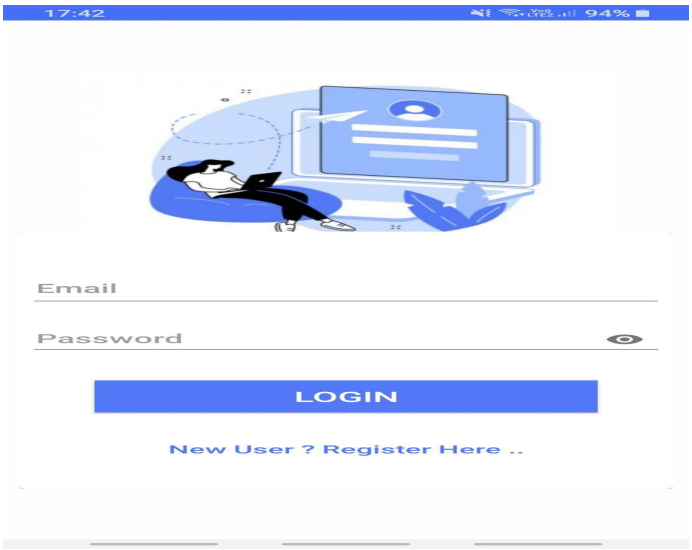

Fig. 8 Login Page of Women Safety Mobile Application

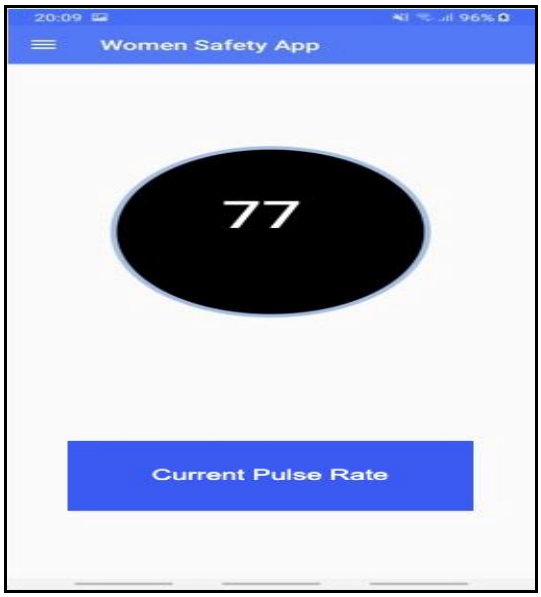

Fig. 9 Home Page of Women Safety Mobile Application

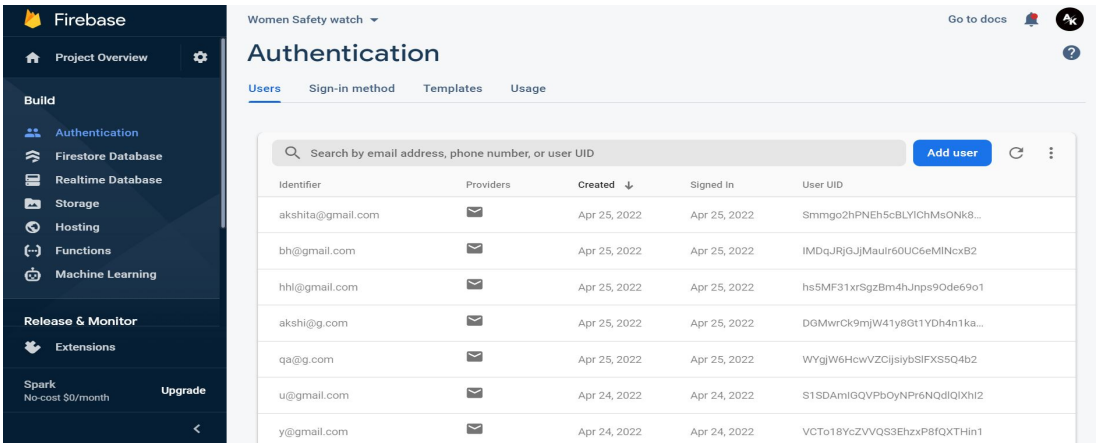

Fig. 10 Firebase Authentication

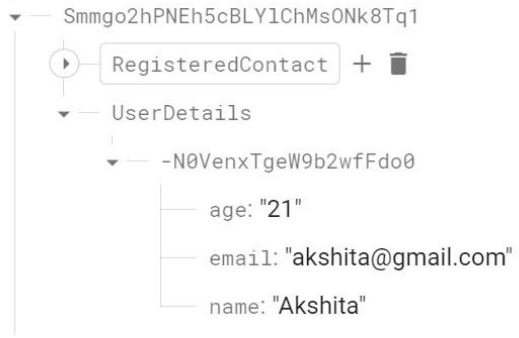

Fig. 11 Firebase Real-time database for User Details

Fig. 12 Firebase Real-Time Database for Pulse Rate

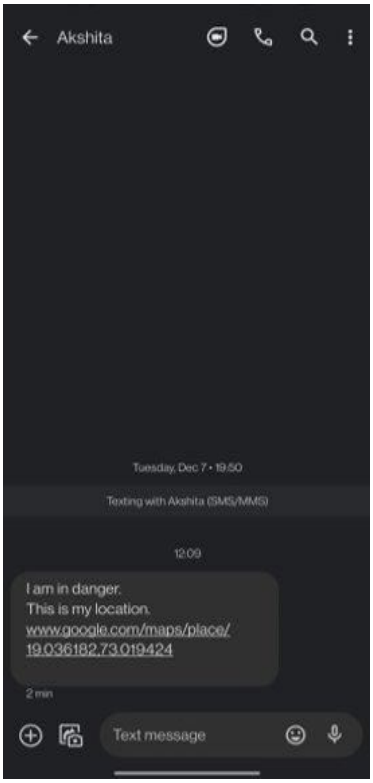

Fig. 13 Message template sent with location

VI. CONCLUSION AND FUTURE SCOPE

Women's safety has always been a huge concern in India. So to provide a solution to this problem, the proposed system develops an effective smart safety device for women that can help them in unsafe situations. It makes use of Internet of Things and Cloud Storage - Firebase for the implementation purposes which saves the device contacts at a remote location and makes them easy to update. Besides the hardware design, an android application is developed in which Firebase Authentication and Firebase Realtime Database is used. Thus, the device becomes more efficient and scalable.

Although the system is complete and working efficiently, there is a need for new functions which will enhance the system. One of the functions can be to detect the spy cameras at a hotel or changing room, and inform the user about them, protecting her from capturing offensive photographs or videos. Also voice recorders can be added to record evidence of the criminal.

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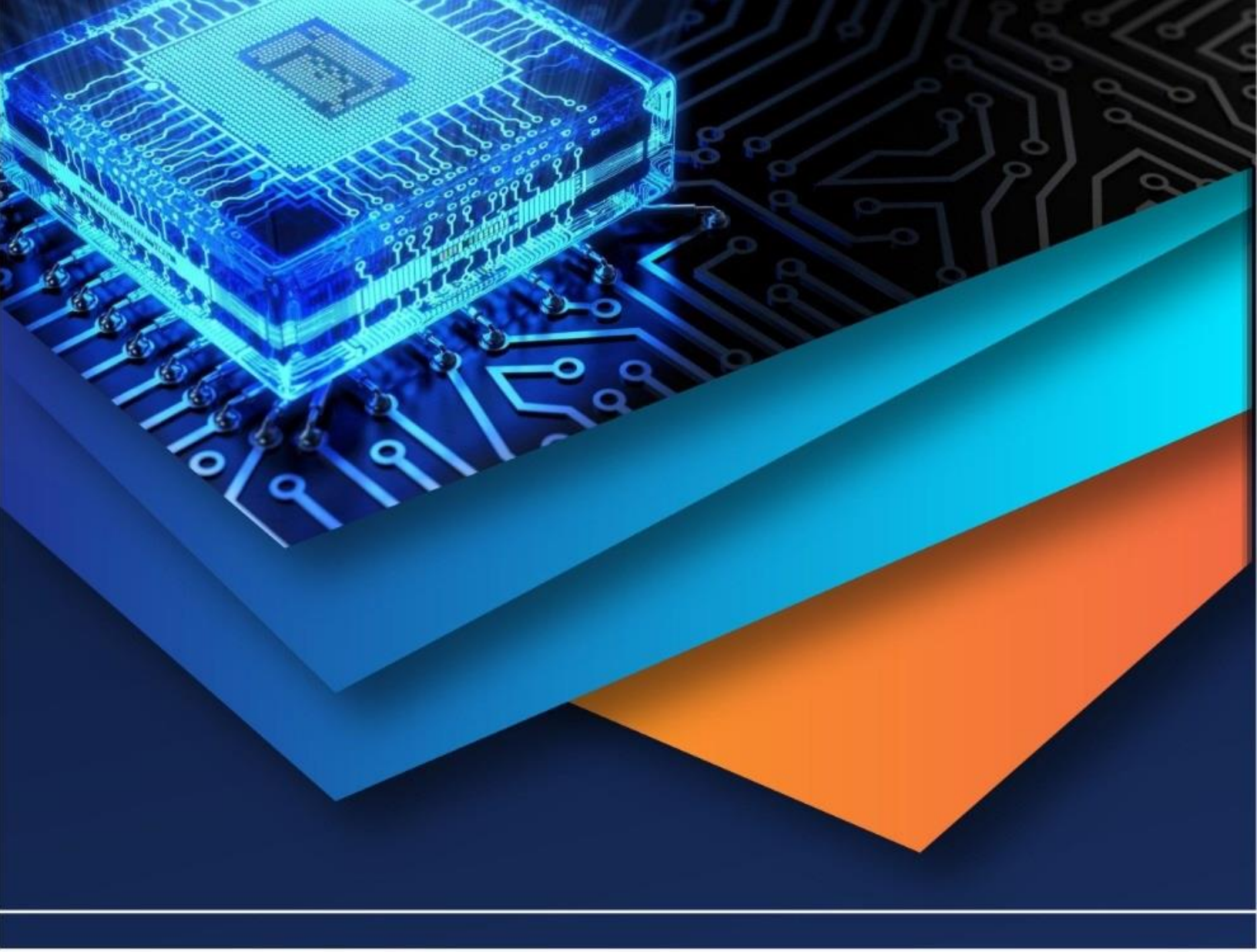

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