



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Guardian Shield: A Geolocation-Enabled Social Safety App for Real-Time Tracing

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Abstract: According to the recently released data by the National Crime Records Bureau, there has been a significant rise in the vulnerability of children, with a staggering 1.49 lakh cases of crimes against children registered in 2021. Out of the total six million crimes documented by the Indian police throughout the year from January 1st to December 31st, crimes against women accounted for 428,278 cases. The report highlights that the majority of the cases in 2021 encompassed offenses such as kidnappings, abductions, rapes, domestic violence, dowry deaths, and assaults.

Ensuring the safety of women, children, and senior citizens has become a critical concern in today's society. The rise in crimes against these vulnerable groups necessitates immediate action to address the issue. This research paper proposes an alert system for social safety that utilizes commonly available electronic devices to trigger emergency alerts and provide immediate location information. The system aims to not only assist the victims but also alert nearby individuals and emergency contacts in real-time. The proposed system leverages a mobile application integrated with an IoT module, enabling users to activate the alert system by pressing a panic button or shaking their phone. Additionally, IoT devices can be used as an alternative means to trigger the alert. Once activated, the system sends the user's location coordinates along with a distress message and health details to their registered emergency contacts via telegram and individuals within a 500-meter range. The system also incorporates various features such as fall detection, blood pressure monitoring, Spo2 levels, heart rate monitoring, and body temperature sensing through the IoT module.

The ultimate objective of this system is to ensure that victims receive timely assistance. Furthermore, future integration with other smart devices such as Bluetooth smartwatches is envisioned to expand the system's capabilities. The proposed system not only focuses on enhancing personal safety but also fosters a sense of community by alerting nearby individuals who can provide immediate help.

I. INTRODUCTION:

The alarming increase in the number of crimes against children throughout India has generated significant concern. In 2021 alone, there were 53,874 cases registered under the POCSO (Protection of Children from Sexual Offences) Act, as revealed by data released by the National Crime Records Bureau (NCRB). This surge in incidents has highlighted the urgent need for comprehensive measures to protect children

from such offenses. As per the data provided by the National Crime Records Bureau (NCRB), there were 1,167 reported cases of crimes against senior citizens (aged 60 years and above) in 2021. In comparison, 2020 witnessed 919 cases, while 2019 had 1,076 cases. The data analysis revealed that theft was the most prevalent crime, accounting for 659 cases, followed by forgery, cheating, and fraud, which comprised 153 cases. These figures highlight the need for heightened measures to safeguard the elderly population from such offenses.

Several systems have been developed to enhance women's security by utilizing GPS technology and Android-based applications. These systems incorporate a GPS device and provide alerts to nearby individuals while sending SMS notifications to emergency contacts. In some systems, a transmitter and receiver are employed to automatically trigger alerts and send messages when the RF signal strength between them decreases [11]. Additionally, certain applications continuously send messages to registered contacts at regular intervals, typically every five minutes, until the user clicks the "stop" button within the application. This continuous location tracking via SMS enables swift identification of the victim's location, facilitating prompt and safe rescue. Furthermore, some applications offer audio recording functionality and can be activated through voice commands, enhancing ease of use and accessibility.[16]

Our proposed application operates through three distinct stages: the input of emergency contacts, activation of the alarm, and the transmission of an emergency message along with the user's health parameters. When the SOS button is pressed, the alarm will sound loudly until the SOS button is pressed again to deactivate it. Additionally, the application includes sections dedicated to basic safety protection, privacy laws, and individual rights, ensuring comprehensive user support. Furthermore, we have implemented a feedback mechanism to gather user input, enabling us to improve the overall performance of the application and address any issues encountered by users.

Moreover, our project incorporates an IoT module capable of

collecting vital health parameters such as SpO2 levels, heartbeat rate, and blood pressure. The location coordinates are regularly updated at specific intervals. The existing challenges in current applications include a lack of situational awareness and effective communication protocols among relevant stakeholders. To ensure public safety, our application efficiently operates on Android phones with the support of network providers, effectively identifying and resolving issues stemming from unexpected incidents.

II. SOFTWARE AND HARDWARE REQUIREMENTS:

Developer requirements:

Hardware used:

- Processor: Intel(R) Core (TM) i5-1035G1 CPU @ 1.00GHz 1.19 GHz Installed RAM 8.00 GB (

- System type: 64-bit operating system, x64-based processor

Software used :

- Android Studio Bumblebee 2021.1.1,
- JDK 16.1.0.1,
- Vs Code software v1.70,
- Anaconda Navigator Edition 2021.05,
- Jupyter Notebook 6.4.11-py3

User Requirements:

- Smart phone
- Android version above 7
- Good internet connection
- RAM min 2gb
- ROM min 8gb
- Processor min 1 GHz

III. RELATED WORK :

Sr. No	Description	Limitation/Future Work
1	This paper presents an alert system for social safety using common commercially available electronic devices to alert the emergency contacts and the nearby public by sending immediate location.	The app along with the IOT module in future would be integrated with other smart devices like Bluetooth smart watches that could act as an alternative. The app can ask citizens, users to submit their experiences about security in particular areas.
2	The paper focuses on the app Superwomen, which offers several noteworthy features such as voice-controlled lock screen access, one-click police and ambulance calls, online medical store facilities, and the ability to locate nearby hospitals. The primary objective of this app is to enhance women's security.	However, it heavily relies on internet connectivity for its proper functioning, which may pose challenges in situations where network connectivity is unavailable.
3	The paper titled "Women Safety Devices and Applications" presents the concept of a device equipped with 2 or 3 colored buttons that can be pressed during times of threat, each programmed with specific functions. However, the proposed device introduces the inclusion of 4 colored buttons: red, blue, green, and yellow. Pressing the red button activates the alarm sensor, the blue button sends emergency messages to designated contacts, the green button records audio, and the yellow button aids in detecting hidden cameras.	Nonetheless, the manual requirement of pressing the buttons may not always be feasible for victims in distress. Thus, there is a necessity for an automatic or semi-automatic mechanism that triggers the buttons when needed.
4	In this research paper, the IoT devices are designed to detect instances when a child is crying. When the crying is detected, the microcontroller is triggered, which subsequently activates the GSM modem to inform the parents about their child's crying. The parents can access this information through their Android phone or any other browsing-enabled device. Furthermore, the	However, it is important to note that not all instances of a crying child indicate distress, abuse, or harassment. There could be various reasons for the child's crying, such as being unwell or experiencing fear or uneasiness due to certain circumstances. Therefore, the device may send an alert to ensure that parents are aware of the situation and can appropriately respond to their child's needs.

	paper suggests that the child's location can be displayed to the parents on Google Maps.	
5	The paper titled "Emergency Contact and Location Sharing System for Women Safety" primarily emphasizes an IoT device that sends the user's location to emergency contacts. However, a significant drawback of the device is its large size, making it inconvenient to carry in a pocket or wear on the wrist.	Additionally, the device requires a continuous power supply and relies on battery or power backup connections, which may not always be available. Moreover, the user is required to manually trigger the button by physically pressing it, which may not be feasible in dangerous situations.

Table 1. Related work

IV. PROPOSED SYSTEM

To activate the alert in the application, the user has the option to either press the panic/SOS button or vigorously shake the app. Additionally, the alert can be automatically triggered by the integrated IoT module based on various health parameters such as fall detection, changes in blood pressure, pulse rate, spO2 levels, temperature, or humidity exceeding predefined thresholds. Once the alert is activated, the app buzzer emit a loud noise. Simultaneously, a request is sent to the server, which promptly sends an emergency message to the registered emergency contacts. Further a call is placed to the emergency contact in top of list. Also the message is sent to all

app registered people nearby to the victim. The message includes updated health measurements at specific intervals.

Furthermore, the app features a dedicated section that provides information on relevant laws related to women and child safety, including associated punishments. To continuously enhance the app's performance, a feedback section is available for users to share their input and suggestions. The IoT module is designed to work independently when the phone is lost and can send location coordinates to the emergency contacts via telegram.

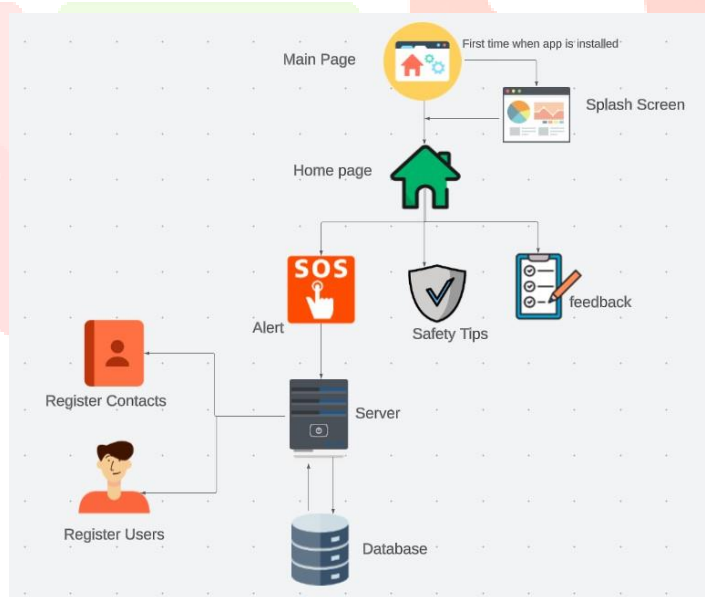


Fig1. System Architecture

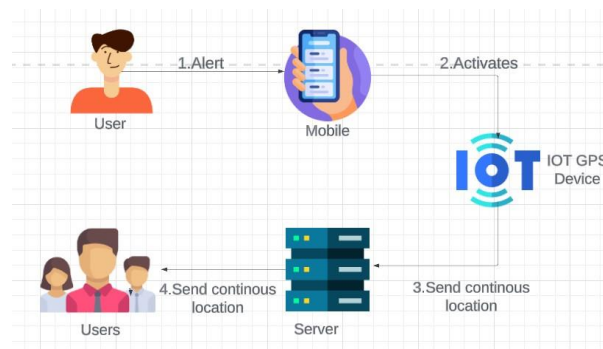


Fig2. Architecture of IOT

V. METHODOLOGY

Geohashing is a geocoding technique that converts geographic coordinates (latitude and longitude) into a concise alphanumeric string. This string represents a specific area on a map, known as a cell, with varying levels of precision. The length of the string determines the uniqueness and level of detail of the location. Geohashes employ a Base-32 alphabet encoding, which includes digits from zero to nine

and letters from A to Z (excluding "A", "I", "L", and "O"). The geographical area is divided into a grid consisting of 32 cells. The first character of the geohash identifies the initial location within one of the 32 cells. Each subsequent character further subdivides the cell into another set of 32 cells, allowing for progressively zooming in on a more specific areas.

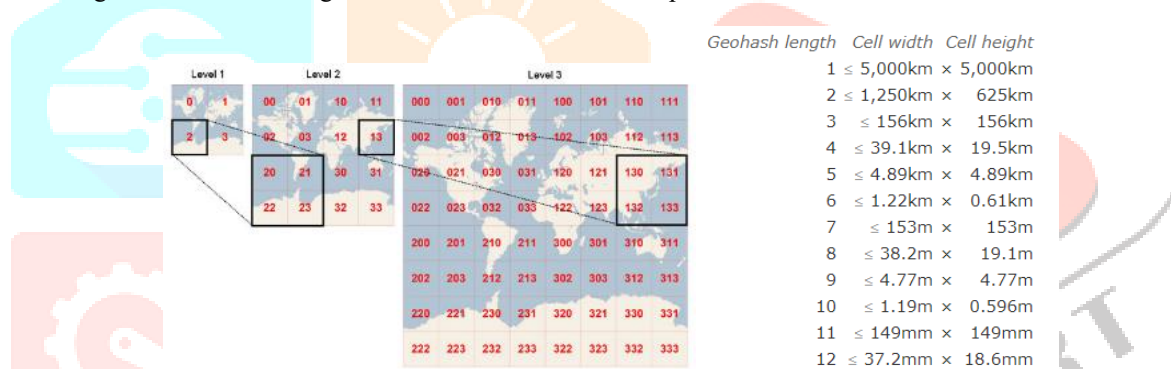


Fig 3. Geohashing

Python Flask is a popular web framework used for building web applications and APIs using the Python programming language. It is lightweight, easy to use, and provides a flexible environment for developing web applications.

Use of SQL Alchemy as ORM: SQL Alchemy is a popular Object-Relational Mapping (ORM) library for Python that provides a high-level interface for interacting with databases. It simplifies the process of database operations by allowing developers to work with database entities as Python objects. We have used SQL alchemy as an Object Relationship Mapper to interact with the database.

SQLite3 is a lightweight, file-based relational database management system (RDBMS) that is widely used for embedded systems, mobile applications, and small-scale projects. It provides a self-contained, serverless, and zero-configuration database engine that operates directly on disk files. Zero-Configuration, Lightweight and Fast, ACID Compliance, SQL Support, Cross-Platform are some of the features.

PythonAnywhere is a popular platform for hosting and running Python applications in the cloud. It provides a fully configured Python environment, web servers, and database support, allowing you to deploy and run your Python applications without the need for complex server setups.

Firebase Cloud Messaging (FCM) is a cross-platform messaging solution provided by Google. It enables developers to send push notifications and messages to their users' devices, including Android, iOS, and web applications. FCM is a powerful and reliable service that simplifies the process of sending real-time notifications and engaging users.

VI. HARDWARE USED

A. ESP8266:

The ESP8266 module facilitates the connection of microcontrollers to 2.4 GHz Wi-Fi networks, utilizing the IEEE 802.11 bgn standard. It offers the flexibility to be employed in two ways: to provide Wi-Fi connectivity to external host microcontrollers through ESP-AT firmware, or as a standalone microcontroller unit (MCU) capable of running a Real-Time Operating System (RTOS)-based Software Development Kit (SDK).



Fig 5.ESP8266

B. Pulse Sensor

This is an integrated pulse oximetry and heart-rate monitor biosensor module. It includes internal photodetectors, LEDs, optical elements, and low-noise electronics with ambient light rejection. It provides a complete system solution to ease the design-in process for mobile and wearable devices.



Fig 6. Pulse sensor

C. NEO-6M

The NEO-6M is a popular GPS (Global Positioning System) module commonly used in various applications to obtain accurate positioning and timing information. It is a compact and affordable module that combines a GPS receiver and an integrated antenna, making it suitable for portable and embedded devices.



Fig7. Neo 6m GPS

Features listed in App:

- Login/Register new users
- Buzzer/Alert making loud noise and sending location coordinates to emergency contacts and registered people nearby.
- News section for updated news related to women's, children's crimes, schemes etc.
- Laws and regulations section made for women, children, senior citizens.
- Tips and facts section.
- Nearby hospital and police station via Google Maps.
- Alert phone call to one of the emergency contacts.
- Feedback section for collecting user's feedback.

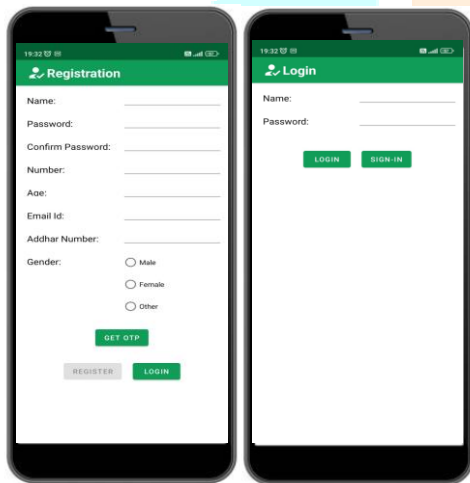
VII. EVALUATION METRICS

Benchmark Criteria	Evaluation
App startup	1 sec
Battery time while using an app	1 sec
Memory consumption	0.2% per hour
Internal storage used	13 mb
Hardware software variations	Support 98% android devices
Lag or sluggish response	Not encountered

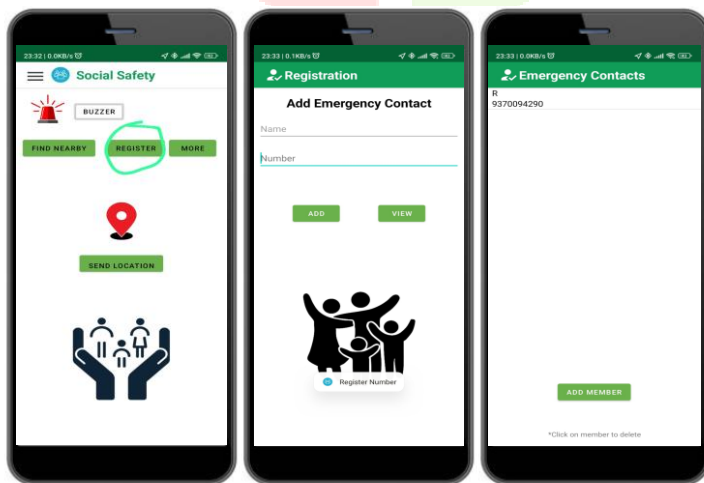
Fig 8. Evaluation metrics

VIII. RESULTS :

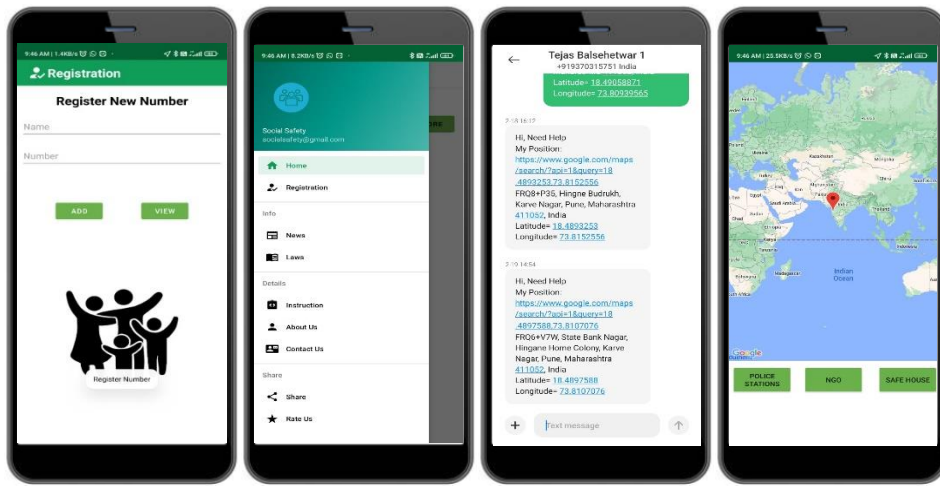
Registration and Login



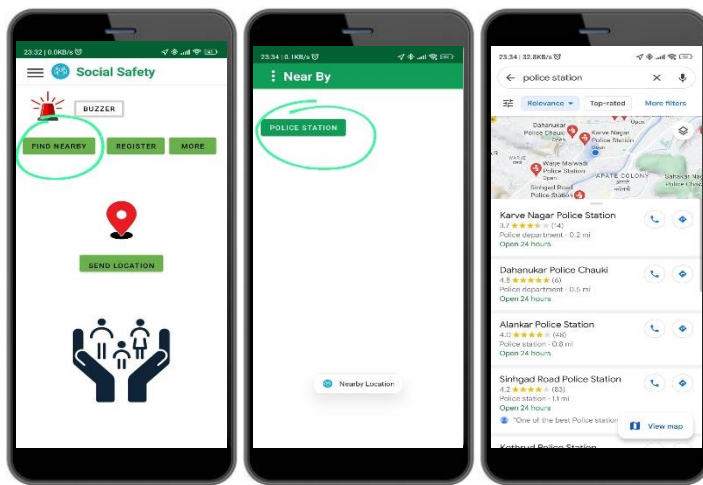
Register contacts:



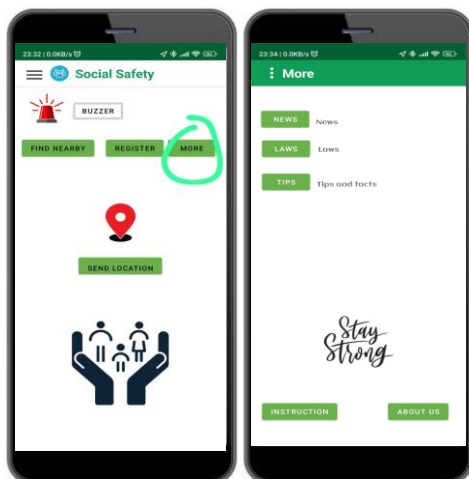
Send location:



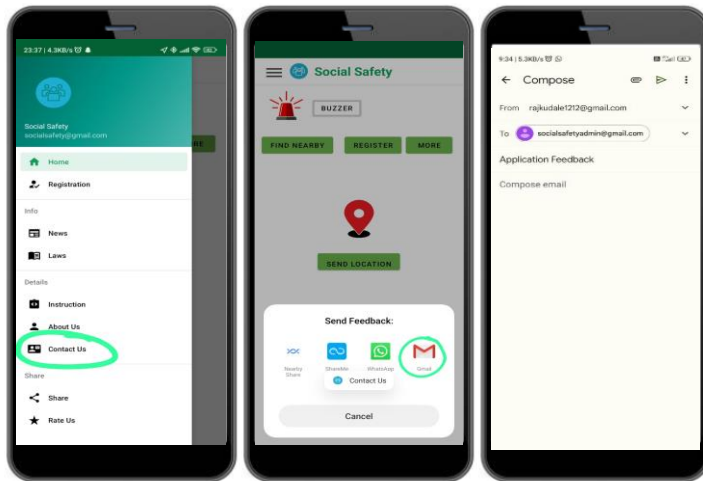
Nearby Location:



More section:



Feedback Module:



IX. Conclusion:

This research paper emphasizes the collective responsibility of society towards the safety and security of individuals. It introduces an Android application integrated with IoT technology that enables real-time tracing of a user's location. In emergency situations, the application automatically communicates the victim's location and health status to their family and nearby individuals. Furthermore, the paper envisions future integration of the application with smart devices like Bluetooth smartwatches as an alternative. The application also encourages citizens to contribute by sharing their personal security experiences in specific areas. By mapping these experiences, areas with higher harassment cases are visually highlighted, allowing users to assess the security of those locations and make informed decisions about visiting them.

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