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SAFEHER: WOMEN SAFETY AND THREAT ANALYSIS SYSTEM

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Abstract:
Ensuring women's safety has become a major concern in modern society. Many existing safety applications depend on manual SOS activation, which may not be possible during critical situations when the victim is unable to access the device. To address this limitation, the proposed system introduces SafeHer, an intelligent women safety platform that uses Artificial Intelligence and Machine Learning techniques to automatically detect potential threats.

The system continuously analyzes environmental audio signals, GPS location patterns, and risk levels of surrounding areas to identify abnormal or unsafe situations. The application interface provides a user-friendly platform that visually displays safe and risky areas using a color-coded map. The backend system processes data using machine learning models while securely storing user information and location history in a cloud-based database.

When the system detects a potentially dangerous situation, it automatically sends an SOS alert along with the user's real-time location to registered emergency contacts. By integrating real-time monitoring, intelligent analysis, and automated emergency response, SafeHer provides a proactive and reliable solution for improving women's safety.

I.INTRODUCTION:

Recent research on women's safety technologies has mostly been about devices and apps that send out emergency alerts, track GPS, and let people keep an eye on things.G. Monishaetal. made the FEMME safety device with an ARM controller that used Bluetooth and RF technology to send alerts and track location. However, it had some problems, like a short range, high battery usage, and the need for manual activation [1]. HruchaWankhadeetal made a safety device that uses GPS and GSM to send location alerts and health data over Wi-Fi. However, it relies heavily on network connectivity and user activation during emergencies [2].Sudhakar Alluri etal. suggested a portable hidden camera detector that uses infrared and RF signal detection to make women safer and more private. However, it has a limited detection range and can't find all types of cameras [3]. Muhammad Zamin Ali Khan et al. created a safety device with smart sensors, GPS tracking, GSM communication, and fingerprint authentication. It can automatically send emergency SMS alerts, but it still needs a working network and device to work [4]. S. V. Balshetwar et al. also made an IoT-based women's safety system with voice commands, heart-rate sensors, and cameras for real-time monitoring. However, it needs a stable internet connection and could raise privacy concerns [5]. In general, these studies show that safety technology is getting better, but there are still problems like needing people to do things, problems with connectivity, and hardware limits.

II.RELATED WORK:

Various technological solutions have been proposed to enhance women's safety through mobile applications, wearable devices, and IoT-based monitoring systems [1], [2], [6]. Some research studies have introduced safety devices capable of sending emergency alerts using wireless communication technologies such as Bluetooth and RF modules [4], [8]. These devices provide location tracking and emergency notification features, but their effectiveness is often limited by communication range and power consumption [9].Other systems utilize GPS and GSM technologies to transmit the user's location during emergency situations [10], [15]. While these solutions allow real-time tracking, they often require manual activation and depend heavily on network connectivity [12].Certain research works have focused on personal privacy protection by developing devices capable of detecting hidden cameras using infrared signals and radio frequency detection methods [5]. Although such systems enhance personal security, they typically have a limited detection range and cannot identify all surveillance devices. More advanced systems integrate smart sensors, biometric authentication, and IoT technology to automatically send emergency messages during dangerous situations [11], [14], [16]. However, these solutions may require specialized hardware components and continuous internet connectivity. Despite the progress made in these technologies, many existing solutions still rely on user interaction or dedicated hardware devices [3], [13]. Therefore, there is a need for intelligent safety systems that can automatically monitor the environment, detect threats, and respond quickly without requiring manual intervention [7].

II. PROPOSED SYSTEM:

The proposed system, **SafeHer**, is an intelligent safety platform designed to enhance women's security by automatically detecting potentially dangerous situations. Unlike traditional safety applications that rely on manual activation, SafeHer continuously monitors environmental conditions using built-in smartphone sensors.

The system captures environmental audio through the device microphone and analyzes it using machine learning models trained to detect distress signals such as screaming, panic voices, or aggressive sounds. At the same time, the system tracks the user's location using GPS technology to monitor movement patterns.

Location data is analyzed to detect unusual movement behavior, such as sudden route changes, unexpected stops, or entry into unfamiliar areas. The system also evaluates the safety level of different locations by comparing them with a database of previously recorded incidents.

Information obtained from audio analysis, GPS monitoring, and risk-zone evaluation is combined to determine an overall threat level. The system classifies the user's safety status into three categories: **low risk, medium risk, and high risk**.

If a high-risk situation is detected, the system automatically activates an SOS alert and sends emergency notifications along with the user's real-time location to registered contacts. This automated response mechanism ensures that assistance can be requested even if the user cannot manually trigger an alert.

III. SYSTEM ARCHIECTURE

System Architecture:

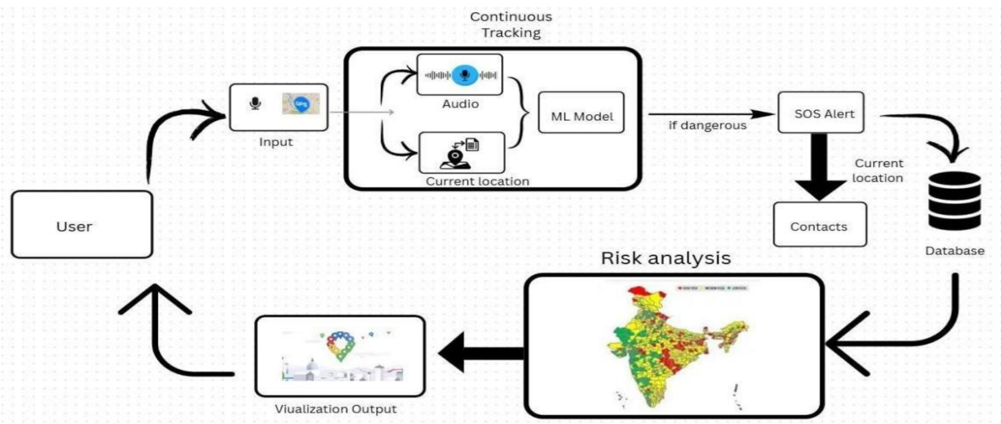


Fig 1: System Architecture

The architecture of the SafeHer system is designed to provide emergency response and threat detection in real-time using location tracking, audio analysis, and risk prediction.
1. Group of Users (Input Layer) - The process starts with a user who provides input through a mobile or web application, while SafeHer is continuously collecting:
a. Audio from the user's microphone
b. GPS location data from the user's device
The inputs from users are continuously collected without any manual intervention.
2. Continuous User Tracking (Continuous Tracking Module) - All data collected by SafeHer is routed to the continuous tracking module, which operates in real-time. The module has two main components:
a. Audio Processing (Audio Processing Unit) - Captures and preprocesses sounds in the user's environment.
b. Location Tracking (Location Tracking Unit) - Tracks the user's current location.
Both inputs (audio and location) will be continuously processed and sent to the next module for further analysis.
3. Machine Learning Model - Audio and location data that have been processed will be sent to the Machine Learning Model; this model will provide analysis based on the following:
a. Detection of screams or other loud panic voices
b. Identification of abnormal movement patterns
c. Evaluation of unwanted people or possible threats.
The analysis of all three data points will determine the user's current safety rating.
4. Decision and SOS Alert System - If unsafe or dangerous conditions are present:
a. All users will receive an automatic SOS alert.
b. The SOS alert will be accompanied by the user's GPS location.
c. All individuals that are identified as needing notification will receive notification of the alert.

IV. MODULES:

A. Audio Monitoring Module
Through continuous recording of ambient sound at home using the device's microphone, this module takes in live audio and processes it before extraction of audio features such as frequency and amplitude. By analyzing the features through detection of sounds indicating distress e.g., screams, cries or panic voice, the system is able to identify possible threats proactively.
B. Speech Recognition & NLP Module
This module's function includes converting voice to text so that the audio captured can be processed using speech recognition techniques. All captured audio will also receive Natural Language Processing to identify emergency or crisis related words and phrases, which may include phrases such as "help me" or "danger." The module also analyses to better understand the content and context of the user's speech and, thereby, improves threat detection accuracy.
C. GPS Tracking Module
This module continuously tracks the user's location in real-time using GPS technology. User data will be stored, and records will be created to document location, speed and travel history. These records can be monitored and used to provide accurate location information in an emergency.
D. GPS Anomaly Detection
This module will evaluate location history for irregularities or out of the ordinary characteristics. Anomalies that can be detected include rapid stops, unexpected path changes, an inordinate period of inactivity, or erratic travel behavior that may lead to an increased possibility of potential risks.
E. Risk Zone Evaluation
This module will assess the risk level of the current location of the user and compare it to preset high-risk areas. This may utilize crime data from the past, will look at risk factors associated with different times of day (ex. being out late at night), as well as the patterns of crimes occurring in a particular area

to evaluate a low, medium, or high-risk profile for specific locations.

F. Decision Making

This is the primary processing unit that takes inputs from audio analysis, natural language processing, GPS location tracking, and risk evaluation to evaluate whether there is a risk posed to the user at his or her location. A multi-level logic or machine learning strategy is employed to minimize false positives and the final decision is not made until all inputs have been received and analyzed.

G. Automatic SOS Notifier

The Automatic SOS Notifier sends out emergency alerts as soon as threats are identified without requiring a user's direct input. In addition to notifying emergency contacts (via text, phone, etc.) of the user's current GPS location coordinates, it also notifies emergency contact via text messages about the existence of an emergency alert to enable rapid response.

H. Cloud/Database

The Cloud/Database handles data collection, storage, processing and synchronization. It will securely collect data about users, user's location history and user's emergency alert logs, all in the cloud, while processing data from users in real-time and ensuring complete scalability and systemic availability.

I. User Interface

The User Interface provides an incredibly simple yet fully functional web (or mobile) based user experience for users. Users will be able to create accounts, enter and edit their emergency contact list, activate/de-activate features and gain insight/knowledge on their current emergency alert status.

J. Face Verification

The Face Verification feature utilises facial verification technologies to authenticate a user's identity at the time of completing some actions. The feature collects, via the use of a webcam, a user's facial image and compares that image against other previously collected facial images, thereby confirming the user's identity for that particular transaction/action and providing an additional measure of security prior to completing any sensitive actions.

V. IMPLEMENTATION:

A. Development Environment

SafeHer system is a full-stack web application that provides real-time monitoring of women's safety through its interactive and responsive frontend (built with React.js) and its various modules such as SafeMap and SafeBot. The backend of the SafeHer system is built using Flask and Python and is responsible for API requests, threat analysis, SOS triggering, and the execution of various machine learning algorithms. SafeHer uses either MongoDB or MySQL as the storage backend for user profile information, user location history information, and user threat logs. SafeHer has been deployed on cloud providers such as Vercel for frontend development and Render/Railway for backend development so that SafeHer can be easily scaled and accessed continuously. Because the SafeHer system architecture is modular, the integration of additional safety features will be easy.

B. User Authentication and Language

Secure user registration and login are supported through user-specific authentication mechanisms. During the registration process, users can choose their preferred language (English, Hindi, or Telugu), which is dynamically stored in the database and subsequently applied through conditional rendering to the SafeHer interface. User session management processes ensure secure access to user-specific dashboards, user-provided location history, and all user alerts. Multilingual interfaces increase usability for all types of users, including users that may be from rural areas.

C. Audio Processing and Threat Detection

The SafeHer System continuously captures environmental audio using the user's device microphone. Preprocessing techniques are applied to captured audio signal data before performing any additional processing on the captured audio signal data by the SafeHer system.

D. GPS Tracking & Anomaly Detection

The system gathers real-time GPS location information to track the user's movement during designated periods of time. The current location is compared to historical movements and previous safe zones to spot the user's movement and track it through anomaly detection. An anomaly detection solution is then employed to determine if there is a risk associated with the user's current location. In this case, an anomaly score and risk score is created by the system for further investigation.

E. Risk Area Prediction and Data Management

Based on a historical incident database, the system keeps track of areas that have a high potential risk associated with them. The current location of the user will be compared to previous incidents in those high-risk areas to determine if they are at risk. All the data gathered about the user (audio results, GPS, and risk scores), will be processed and stored in a format that allows for accurate predictions and visualization through preprocessing and data consistency.

F. Hybrid Threat Analysis & Decision Systems

Using a rule-based or a machine-learning-based decision-making process, the system uses audio threat scores, GPS anomaly scores, and risk scores to determine an overall threat level. Threat levels are categorized as low, medium, or high based on data from the previous three sources. Hybrid solutions provide an accurate method of detecting threats in real-time and improve overall accuracy.

G. Emergency Response System and SOS Alert

If at any time either the general public or the individual user has a sudden increased threat level(l to high level) then an SOS alert will automatically generate itself via the system without any user input. An SOS alert message will be sent via SMS or API messaging services to all of the registered contacts of the user with their real-time GPS coordinates. The system can also contact and alert any emergency response agencies(s) in the general area if the system is compatible with them. This will help ensure a fast response to critical emergency situations if it is impossible to manually alert you to that situation.

VI. ALGORITHM

Input Data:
- Audio Input: User's Surrounding Area
- GPS Location Data
- User Profile / History of Events Output Data:
- Level of Threat: Low / Medium / High
- Automatic Activation of SOS Alert with Location ID
- Recommended safety tips/strategies based on level of threat

Algorithm :

BEGIN

INITIALIZE system components: Machine Learning models (Audio Threat Detection, GPS Anomaly Detection, Risk Prediction), database (MySQL), GPS, and microphone access

IF system starts THEN CONTINUOUSLY collect input data: Audio input from surroundings

Real-time GPS location User profile and history STORE data temporarily END IF

IF audio data received THEN

PREPROCESS audio (noise removal, feature extraction) EXTRACT features (MFCC, frequency patterns) APPLY Audio Threat Detection Model

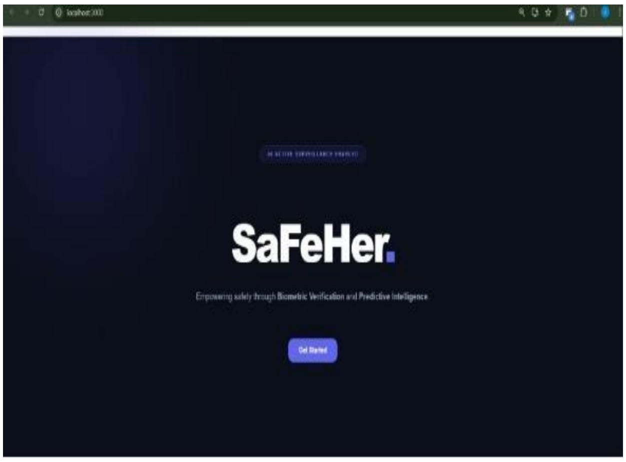
DETECT distress signals (screams, panic voice, aggression)

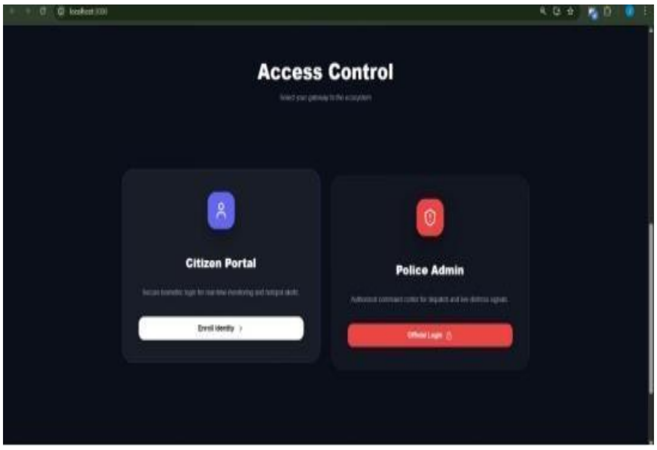
ASSIGN Audio Threat Score END IF

IF GPS data received THEN
TRACK user movement continuously COMPARE with safe routes and user patterns
DETECT anomalies (route deviation, sudden stop, unsafe entry) ASSIGN Location Risk Score
END IF
CHECK current location with risk database ANALYZE crime-prone areas and historical data GENERATE Area Risk Scor
COMPUTE overall Threat Level COMBINE:
Audio Threat Score Location Risk Score Area Risk Score
CLASSIFY Threat Level as: LOW
MEDIUM HIGH
IF Threat Level = LOW THEN CONTINUE monitoring

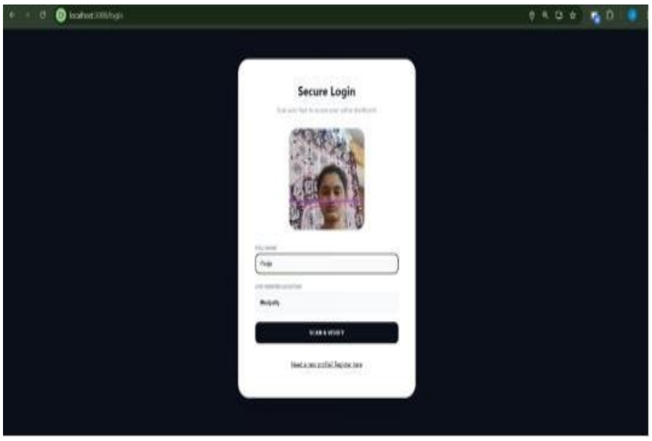
ELSE IF Threat Level = MEDIUM THEN SEND warning notification to user
ELSE IF Threat Level = HIGH THEN TRIGGER emergency actions
END IF
IF emergency triggered THEN
SEND SOS alert automatically SHARE live GPS location NOTIFY emergency contacts
OPTIONALLY alert nearby authorities END IF
ACTIVATE SafeBot module PROVIDE safety recommendations RESPOND to user queries
GUIDE user to safe location ACTIVATE SafeMap module
DISPLAY threat levels, heatmaps, and nearby safe zone REPEAT monitoring process continuously
IF user exits system THEN
TERMINATE system END IF
END

VII. RESULTS:

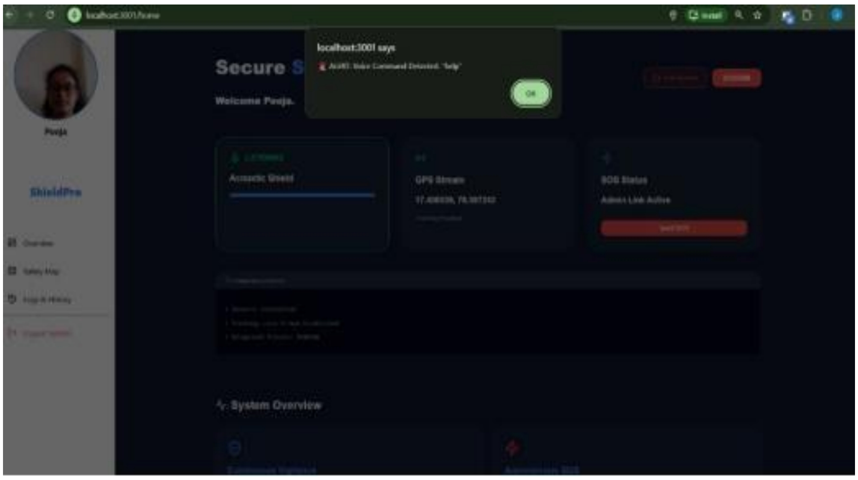




A. HOME PAGE
B. SECURE LOGIN

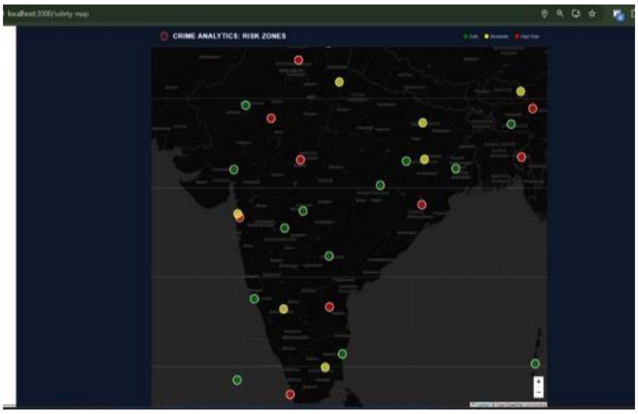


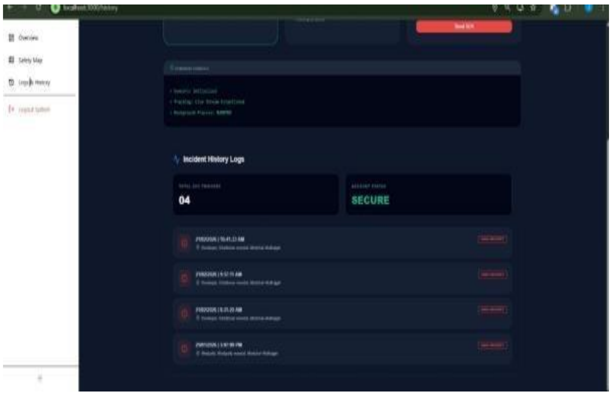
C . ALERT MESSAGE



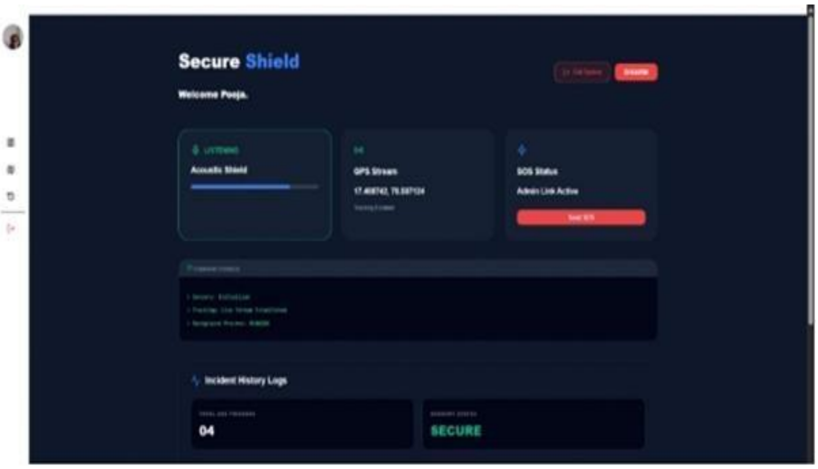
D. DASHBOARD

E. RISK ZONE ANALYTICS AND INCIDENT LOGIN HISTORY

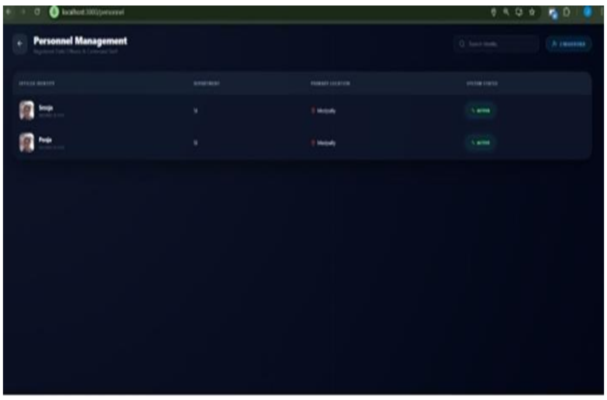


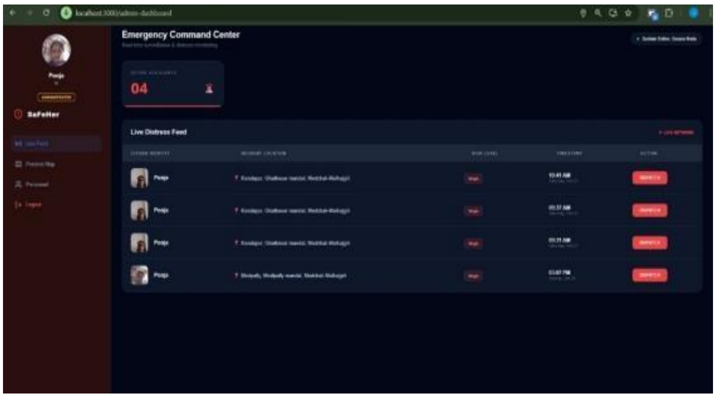


F. VOICE RECOGNISATION

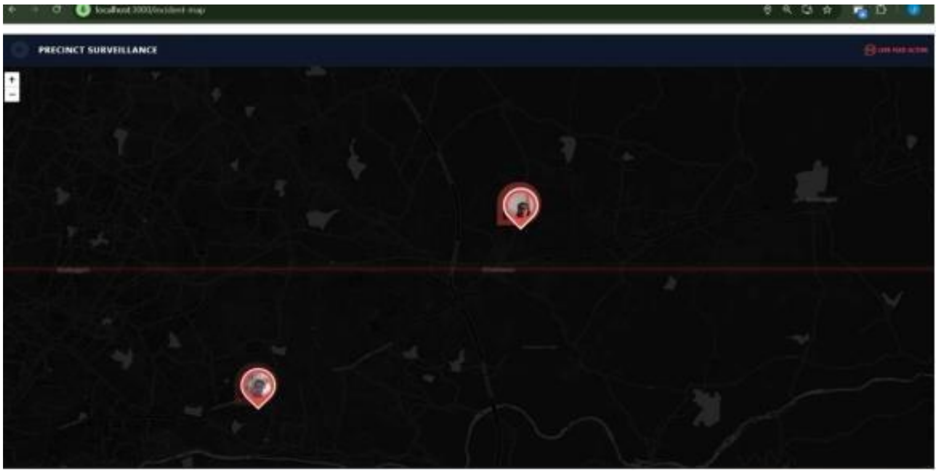


G. POLICE DASHBOARD AND THE PERSONNEL MANAGEMENT





H.PRECINCT SURVEILLANCE



VIII. CONCLUSION:

The SafeHer system demonstrates how modern technologies such as Artificial Intelligence, Machine Learning, and mobile computing can be used to improve women's safety. By combining real-time audio monitoring, GPS tracking, and risk analysis, the system can automatically detect potential threats and respond quickly during emergency situations.

Unlike traditional safety applications that rely on manual SOS activation, SafeHer continuously monitors environmental conditions and generates alerts automatically when a dangerous situation is detected. This proactive approach significantly improves the reliability and effectiveness of personal safety systems.

The integration of intelligent threat detection, automated emergency alerts, and real-time location sharing makes SafeHer a powerful solution for enhancing women's security and providing timely assistance when needed.

FUTURE ENHANCEMENT:

The SafeHer system can be further enhanced by incorporating additional advanced technologies to improve its accuracy and usability. One possible improvement is the integration of **wearable IoT devices** such as smart bands, rings, or pendants that can monitor physiological signals like heart rate, sudden body movements, or abnormal physical activity.

Future versions of the system may also use advanced sound classification algorithms capable of identifying aggressive speech, violent sounds, or distress signals more accurately. This would improve the system's ability to detect emergencies in real time.

Another potential enhancement is the use of facial recognition technology integrated with secure cloud databases to assist law enforcement agencies in identifying potential attackers. Predictive analytics based on historical crime data could also be implemented to warn users when they enter high-risk areas.

Additional features such as voice-activated SOS commands, multilingual interfaces, offline functionality, and integration with surveillance systems could further improve the reliability and effectiveness of the platform.

By incorporating these technologies, SafeHer can evolve into a more comprehensive and intelligent safety solution that provides stronger protection and faster emergency response.

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