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AI – Based Integrated Women Safety System Real -Time Monitoring, Mobile Application and Physical Emergency Unit

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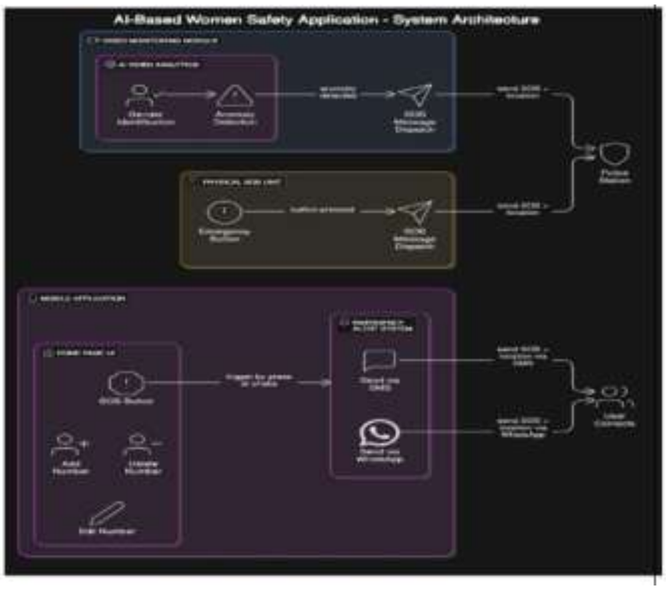
Abstract - This AI-based Women's Safety System is a comprehensive, real-time solution integrating **AI surveillance**, **mobile application**, and **IoT-enabled SOS hardware** to enhance women's security in both urban and rural areas. The **AI surveillance module** uses **computer vision** and **machine learning** to identify gender and detect **suspicious behavior** from live video feeds, triggering instant **SOS alerts** with location and video to nearby authorities. The **mobile app** enables users to store **trusted contacts** and send emergency messages via **SMS and WhatsApp** through a simple **button press or shake gesture**, sharing live **GPS location**. The **hardware SOS device**, installed in public places, features a **one-touch emergency button** with **GSM and GPS** support, ensuring help is accessible even without a phone. By combining **smart technology**, **predictive analytics**, and **real-time communication**, the system aims to create a **safe, responsive environment** and empower women against potential threats.

***Key Words*:** GSM , GPS ,IoT-enabled SOS

1.INTRODUCTION

Women's safety has become a pressing concern in today's society, both in public and private environments. Despite the presence of various security measures, incidents of harassment, violence, and unsafe situations continue to occur at an alarming rate. Traditional safety solutions often rely on manual intervention or delayed reporting, which may not always guarantee timely help or preventive action. In a world where rapid communication and real-time intervention are crucial, there is a growing need for intelligent systems that can proactively ensure women's safety. The rise of Artificial Intelligence (AI), the Internet of Things (IoT), and mobile technologies offers an opportunity to develop advanced safety solutions that are fast, smart, and reliable. By combining these technologies, it is possible to create a comprehensive ecosystem capable of monitoring real-world environments, detecting emergencies, and automatically alerting authorities and trusted contacts without the victim needing to take complex actions under distress. This project, titled **AI-Based Women's Safety Application**, introduces a three-module system that addresses the issue of women's safety from multiple perspectives. The first module utilizes real-time video monitoring to identify gender and detect anomalies in behavior patterns using AI models. Upon detection of suspicious activities, an immediate SOS alert with live location data is sent to the nearest police station, enabling rapid action. The second module is a mobile application developed to serve as a personal safety tool. The app allows users to add, edit, and delete emergency contacts, and features a large SOS button that can be activated by a simple tap or by shaking the phone. In case of an emergency, the app automatically sends the user's location and an SOS message through SMS and WhatsApp to the registered contacts, ensuring immediate communication even if the user is unable to make a call or type a message. The third module involves a physical SOS hardware unit installed in public places. This device, equipped with GPS and GSM technology, allows individuals to send instant emergency alerts to nearby police stations at the push of a button, providing a vital safety option in areas where mobile access might be limited.By integrating AI-based surveillance, mobile technology, andIoT solutions, this project aims to create a proactive, reliable, and easy-to-use safety network for women. It not only seeks to respond to emergencies but also to prevent dangerous situations through early detection and quick intervention. The system is scalable, flexible, and adaptable to various environments, ultimately contributing to the creation of safer cities and communities for women.

Fig.1.System Architecture



2.PROBLEM STATEMENT

Despite growing awareness and numerous initiatives aimed at enhancing women's safety, incidents of harassment, assault, and violence against women continue to rise across the world.

Traditional safety mechanisms such as manual alarms, police helplines, and surveillance cameras are often reactive rather than proactive. They typically depend on the victim being able to call for help, which may not always be possible during a crisis situation. Furthermore, existing surveillance systems lack real-time intelligence to autonomously detect threats or suspicious behaviors, often resulting in delayed responses. Mobile applications designed for women's safety mostly rely on manual input from the user, such as opening the app and sending a distress signal. In real emergencies, the victim may be unable to unlock the phone, open the application, or press multiple buttons under stress or physical threat. Additionally, there is a lack of unified solutions that connect personal safety tools with real-time law enforcement support. Public spaces, while monitored, are not equipped with direct and accessible emergency alert systems for individuals who may not have access to their mobile phones at the moment of danger. The absence of such systems limits the immediate help a victim could receive.

The critical problems identified are:

• Lack of intelligent, real-time surveillance systems capable of automatically detecting anomalies or threats without human intervention.

•Dependence on the victim's ability to manually initiate distress alerts during emergencies.

•Lack of an integrated system connecting victims directly and instantly to law enforcement authorities.

•Absence of physical emergency units in public spaces for individuals without immediate access to mobile communication.

•Inadequate use of AI, IoT, and automation to ensure rapid response and preventive action in high-risk situations. This project aims to solve these problems by developing an AI-based women's safety system that combines real-time anomaly detection from live video feeds, an easy-to-use mobile safety application with automated alert features, and a physical SOS device for public spaces. By integrating modern technology and intelligent automation, the system provides a holistic, proactive, and scalable solution to enhance women's safety in both private and public environments.

3.OBJECTIVES

The primary objective of this project is to develop an AI-based, multi-platform Women's Safety System that proactively monitors, detects, and responds to emergency situations to ensure the safety and security of women in real-time. The system aims to bridge the gaps present in current safety mechanisms by combining Artificial Intelligence, Mobile Technology, and IoT-based hardware solutions. The specific objectives of the project are:

3.1. Real-Time Gender Detection and Anomaly Identification

•To develop an AI-based surveillance system capable of identifying the gender of

individuals from real-world video feeds.

•To detect abnormal or suspicious behavior using machine learning models and

computer vision techniques.

•To automatically trigger an SOS alert when any anomaly or potential threat is identified.

3.2. Emergency Alert and Response Automation

• To design an automated alert system that immediately sends SOS messages to the nearest police station with accurate location details when a threat is detected.

•To ensure minimal human intervention is required during the alert process, enabling faster and more reliable responses.

3.3. Mobile Application Development for Personal Safety

• To create a user-friendly mobile application that allows women to:

• Add, edit, and delete up to three emergency contact numbers.

• Quickly trigger an SOS alert through a large on-screen button or shake detection.

• To automatically capture the user's current location and send an emergency SOS message via SMS and WhatsApp to the saved contacts.

3.4. Deployment of Public Physical SOS Units

• To design a simple, reliable, and durable SOS hardware unit for public spaces that allows individuals to send an immediate emergency alert by pressing a button.

• To integrate GPS tracking and GSM communication modules to ensure the alert reaches the nearest police station without requiring a mobile phone.

3.5. Seamless Integration of Technologies

• To integrate AI algorithms, real-time GPS tracking, cloud communication services (like Twilio and WhatsApp APIs), and IoT hardware into a single, unified safety system.

3.6. Enhancing Safety, Confidence, and Rapid Response

• To empower women with quick and accessible safety tools.

• To facilitate immediate law enforcement response, reducing the time between threat detection and action.

• To foster a safer environment in public and private spaces through proactive monitoring and instant communication technologies.

4.SCOPE OF THE PROJECT

The scope of this project extends to designing, developing, and deploying a comprehensive women's safety system that leverages modern technologies such as Artificial Intelligence (AI), Machine Learning (ML), Mobile Applications, and Internet of Things (IoT) devices. The project focuses on both personal safety for individuals and public safety in shared environments. The major areas covered under the scope are:

4.1. Real-Time Video Surveillance and AI Monitoring

•Implementation of live video monitoring systems in public or semi-public areas.

•Use of AI algorithms for gender detection and anomaly behavior recognition.

•Automatic generation of SOS alerts without human intervention in case of

detected threats.6

4.2. Personal Mobile Safety Application

• Development of a dedicated mobile application for women's personal safety.

• Allowing users to manage up to three trusted emergency contacts.

• Enabling emergency SOS activation through manual tapping or automatic shake detection. Instant transmission of the user's live location and SOS message via SMS and WhatsApp to emergency contacts.

4.3. Public Physical SOS Hardware Units

Designing physical units equipped with GPS and GSM modules. Installation of SOS devices in high-traffic public areas like parks, bus stands, educational institutions, and urban centers. Providing an emergency alert mechanism for individuals without immediate access to mobile devices.

4.4. Communication with Law Enforcement

Direct transmission of alerts to nearby police stations or emergency response teams. Sharing critical data such as user identification (if available), real-time location, and the nature of the alert. Enabling faster police or emergency service response.

4.5. Scalability and Expandability

The system can be scaled across multiple cities, universities, transportation hubs, and public venues. Additional AI models can be incorporated over time to recognize different types of threats, such as theft, violence, or unauthorized access.

4.6. User Privacy and Data Security

Ensuring that the collection and transmission of user data (such as location) are done securely and only in emergency situations. Complying with data protection regulations and ethical standards.

4.7. Inclusivity and Accessibility

Designing the system to be easy to use, even by individuals with minimal technological experience.Making the physical SOS units accessible to everyone, including people with

disabilities.

5. IMPLEMENTATION DETAILS

The implementation of the Women's Safety Application involves a multi-faceted approach that combines AI-powered real-time video monitoring, a mobile app for emergency management, and physical SOS hardware units. Below are the detailed implementation steps for each module, covering both software and hardware aspects.

5.1. Module 1: Real-Time Video Monitoring and Anomaly Detection

AI Integration for Gender Identification and Anomaly Detection

• **Dataset Collection and Training**:

A robust dataset containing labeled images and videos for gender classification and anomaly detection is required. These datasets should include varied real-world scenarios, such as crowded environments and situations of aggression or distress.

• **Gender Identification**: Deep learning models such as **Convolutional Neural**

Networks (CNNs) are trained on this dataset to classify gender. Pre-trained models like

VGG16 or **ResNet** can be fine-tuned on the specific dataset to achieve higher accuracy.

• **Anomaly Detection**: Anomaly detection algorithms are implemented using models like **YOLO** or **Faster R-CNN** for real-time object detection. These models are trained to recognize abnormal behavior (e.g., pushing, hitting, running) or signs of distress.

Real-Time Video Feed Processing:

• The video stream from public surveillance cameras or personal devices is captured in real time.

• The video feed is processed in **frames** (e.g., 30 frames per second). Each frame is passed through the pre-trained CNN model to identify the gender of the individuals in the video and detect any unusual behavior.

• If the model identifies an anomaly, the system triggers an alert.

• **Anomaly Detection Alerts**:

• Upon detection of an anomaly (e.g., signs of aggression or a woman being followed),

the system calculates the location and triggers an **SOS message** to the nearest police

station, including location details and a description of the incident.

• This integration is facilitated using **cloud APIs** for alert transmission (such as

Twilio for SMS or WhatsApp integration).22

Implementation Challenges:

• **Model Accuracy**: Ensuring the accuracy of gender detection and anomaly

identification in various real-world environments with different lighting

conditions, clothing, and distances.

• **Latency**: Minimizing the processing time of the video feed for real-time anomaly

detection.

5.2. Module 2: Mobile App for Women's Safety

Mobile App Development (React Native)

• **User Interface Design**:

• A clean, intuitive, and user-friendly UI is designed using **React Native**, ensuring

cross-platform compatibility (Android and iOS).

• The app includes the following screens:

• **Home Page**: Contains the main interface with three buttons (Add, Delete, Edit Mobile Number), a large SOS button, and a real-time locationdisplay.

• **Add Mobile Number Screen**: Users can input phone numbers for emergency contacts. The number is stored in the backend database (e.g., **MongoDB**).

• **SOS Button Interaction**: A large, circular button is implemented to allow users to trigger an SOS alert. The app also supports **shake detection** to activate the SOS feature.

• **Backend and API Integration**:

• The mobile app communicates with the backend server built using **Node.js** and

Express.js. The backend stores user data, including mobile numbers, location information, and SOS alerts in **MongoDB** or **Firebase**.

• The app integrates with third-party **SMS (Twilio)** and **WhatsApp APIs** to send messages to emergency contacts.

• **Location Tracking**:

• The app uses the **GPS API** on the mobile device to track the user's real-time location. This data is sent automatically with the SOS message whenthe button is activated.

• **Google Maps API** or **Mapbox** is used to display location coordinates in a userfriendly format.

Features Implementation:

• **Shake Detection**: This is implemented using the **Accelerometer API** in React Native, which detects the physical shaking of the phone and triggers an event to send the SOS alert.

• **Push Notifications**: **Firebase Cloud Messaging (FCM)** is used to send real-time push notifications to the user and emergency contacts if the SOS alert is triggered.

Implementation Challenges:

• **Device Compatibility**: Ensuring that the app works smoothly across different devices and OS versions.

• **Battery Usage**: Minimizing the battery consumption of GPS and location tracking while keeping the system active and efficient.

5.3. Module 3: Physical SOS Hardware Unit

Hardware Setup

• **Microcontroller**:

A **Raspberry Pi** or **Arduino** board is used as the main controller for the SOS unit. These devices are affordable, powerful enough for handling communication tasks, and compatible with various sensors.

• **SOS Button**:

A large, physical **push button** is used to trigger the SOS alert. It is connected to the microcontroller, which detects the press and initiates the transmission of the emergency alert.

• The button is housed in a **tamper-proof casing** to prevent malicious interference.

• **GPS Module**:

The **Neo-6M GPS module** is used for real-time location tracking. When the SOS button is pressed, the GPS module transmits the coordinates to the microcontroller, which then sends the location to the cloud.

• **GSM Module**:

A **SIM800L GSM module** is used to send SMS alerts. The microcontroller communicates with this module to send a pre-defined message, including the SOS message and location coordinates, to emergency contacts or the local police station.

• **Power Supply**:

The SOS unit is designed to run on **DC power** (e.g., 5V USB power supply) or **battery-powered units** for installation in public spaces. Backup battery systems are included to ensure continued operation in case of power loss. ***Communication and Alert System:***

The system sends a **message with GPS coordinates** to the nearest police station or emergency response system, providing real-time alerts. This communication.can be facilitated via **SMS** or **API-based systems** if integrated with local authorities.

• The physical SOS hardware can be integrated with the mobile app and **cloud systems** for centralized monitoring and logging of incidents.

Implementation Challenges:

• **Power Supply Reliability**: Ensuring that the system works 24/7 without failure due

to power issues, especially in public spaces.

• **Signal Reception**: Ensuring the GSM module receives a stable signal in remote or

enclosed areas where reception may be weak.

5.4. Cloud Infrastructure

The entire system relies on **cloud-based services** for managing alerts, user data, and analytics.

AWS or Google Cloud: The application backend is hosted on a cloud platform such

as **AWS EC2** or **Google Cloud** to handle scalability and redundancy. The cloud is

used for data storage, real-time processing, and location tracking.

Databases:

MongoDB is used to store user information, emergency contact numbers, and SOS

history.

Firebase Firestore is used for real-time data syncing and push notifications.

Security Implementation:

HTTPS Encryption: All communication between the app, hardware units, and

cloud services is secured using **HTTPS** to prevent data interception.

OAuth 2.0: User authentication is handled using **OAuth 2.0**, ensuring secure

login and user data protection.

Summary of Implementation Process

1. **Video Monitoring and AI**: Collect and preprocess video data, train AI models,

integrate with real-time video feed processing.

2. **Mobile App Development**: Design UI, implement location tracking, integrate

emergency communication APIs, and enable shake detection.

3. **Physical SOS Unit**: Build and assemble hardware components, integrate with GPS

and GSM modules, and deploy in public areas.

4. **Cloud and Security**: Host services on the cloud, manage real-time data flow, and

ensure secure communication and data privacy.25

This detailed implementation ensures that the Women's Safety Application is a reliable,

secure, and effective solution for emergency situations.

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6. WORKFLOW DIAGRAMS

Module 1: Real-Time Video Monitoring and Anomaly Detection

Workflow Diagram for Anomaly Detection

This diagram will show the sequence of actions when the system is monitoring video and

detecting anomalies.

Steps:

1. **Start Monitoring** – The camera begins capturing real-time video.

2. **AI Processing** – The video feed is processed using AI models (e.g., computer

vision for gender identification and anomaly detection).

3. **Gender Identification** – The AI identifies the gender of individuals in the video

stream.33

4. **Anomaly Detection** – The AI detects any unusual behavior (e.g., aggression,

violence).

5. **Anomaly Detected?** – The system checks if an anomaly is detected.

• If **Yes**, proceed to step 6.

• If **No**, continue monitoring.

1. **SOS Alert Triggered** – The system generates an SOS message with location

details.

2. **Send SOS to Police Station** – The alert is sent to the nearby police station, along with

the location of the incident.

3. End

Fig.2.Module 1 Explanation

Module 2: Mobile App for Women's Safety

Workflow Diagram for Mobile Number Management (Add, Delete, Edit)

This diagram will illustrate the workflow for adding, editing, and deleting mobile numbers.

Steps:

1. **Open App** – The user opens the mobile application.

2. **Access Mobile Number Management** – User navigates to the "Mobile Number

Management" section.

3. **Add Mobile Number** – User adds a mobile number (up to 3 allowed).

4. **Edit Mobile Number** – User edits an existing mobile number (if needed).

5. **Delete Mobile Number** – User deletes a mobile number.

6. **Save Changes** – Changes are saved and reflected on the home page

7. **End**

Workflow Diagram for SOS Button Activation

This diagram shows how the SOS button works, either through a manual press or shake

detection.

Steps:

1. **Open App** – The user opens the mobile application.

2. **SOS Button Active** – The large SOS button appears on the home page.

3. **Press Button / Shake Phone** – User can press the SOS button or shake the phone to trigger an alert.

4. **Location Fetching** – The app retrieves the current GPS location of the user.

5. **Generate SOS Message** – The app generates an SOS message with location details.

6. **Send SOS Message** – The message is sent via SMS and WhatsApp to the saved mobile numbers.

7. **Send Alert to Police** – The system sends an SOS alert with location details to the nearby police station.

8. **End**

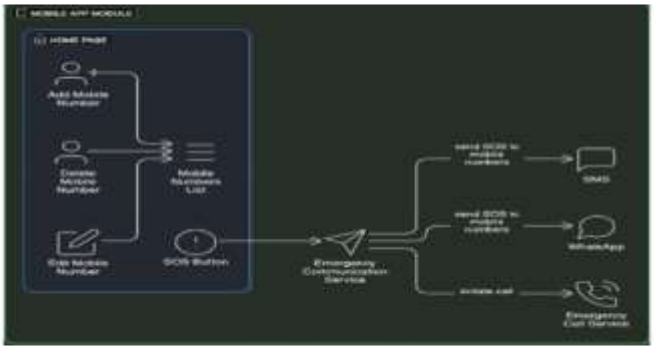

Fig.3.Module II Explanation

Module 3: Physical SOS Hardware Unit

Workflow Diagram for SOS Alert Trigger (Hardware Unit)

This diagram will show the workflow of how the physical SOS unit operates in case of an emergency.

Steps:

1. **Place the Unit** – The SRU unit is placed in a public area (e.g., bus stop, mall, park).

2. **User Presses the SOS Button** – In case of emergency, the user presses the SOS button on

the SRU unit.

3. **Fetch Location** – The unit retrieves the GPS location of the unit.

4. **Generate SOS Message** – The system creates an SOS message containing the location

details.

5. **Send SOS Message to Police** – The SOS message is transmitted to the nearest police

station with the GPS location.

6. **End**

7.CHALLENGES FACED

Developing the **AI-Based Women's Safety Application** posed multiple challenges across video processing, mobile development, and hardware integration. In **real-time video processing**, high computational needs, lighting variations, and limited anomaly datasets impacted performance. Mobile app issues included ensuring **SOS triggers in the background**, managing **GPS accuracy**, **permissions**, and **WhatsApp API** limitations. The **SOS hardware unit (SRU)** faced challenges in **button detection**, **GPS locking**, **power stability**, and **SMS reliability**. Integrating all modules (video, app, hardware) required smooth communication and **scalability** planning. Testing real emergency scenarios and maintaining a **simple user interface** were additional hurdles.

7. SOLUTIONS IMPLEMENTED

Solutions included using **lightweight AI models** (e.g., MobileNet, TinyYOLO), **brightness correction**, and **synthetic data** to enhance model performance. Background services via **Android WorkManager**, fallback **network-based location**, and **WhatsApp intent messaging** improved app reliability. Hardware reliability was improved using **debounce logic**, **high-sensitivity GPS**, **battery optimization**, and **SMS retry mechanisms**. A **central messaging system** ensured seamless cross-module integration, while **cloud scalability** and simulated testing ensured robust deployment. **Fail-safe mechanisms**, user feedback, and **modular design** helped refine the solution.

8. FUTURE ENHANCEMENTS

Planned upgrades include **deep learning models** (e.g., LSTM, Transformer) for advanced anomaly detection, **voice-activated SOS**, **wearable integration**, and **cloud analytics** for risk mapping. Other features under consideration are **AI-powered predictive alerts**, **multi-language support**, **blockchain for data security**, **direct integration with emergency services**, **solar-powered SRUs**, and **community alert networks**. These enhancements aim to improve **accuracy, accessibility, and scalability**, making the system a **holistic women's safety platform**.

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