Suraksha_Sakey - A Smart Keychain ensuring Safety for all ages

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***Abstract*—Women's safety is a significant global concern, with increasing cases of harassment and gender-based violence. Traditional safety solutions, such as mobile SOS applications and CCTV surveillance, rely on user intervention or passive monitoring, making them inefficient in real-time threat detection [1]. This paper presents Suraksha_Sakey, an AI-driven women's safety system that integrates real-time anomaly detection, gesture-based SOS alerts, and crime hotspot mapping. The system utilizes YOLOv3 for person detection [2], a CNN model for gender classification [3], and MobileNetV2 for gesture recognition. Additionally, an IoT-enabled smart keychain with GPS tracking extends safety measures to non-surveillance areas. The system has been tested on a dataset of over 10,000 images and real-world surveillance footage, achieving 92.5% accuracy in gesture recognition and 89% in gender classification by leveraging AI and predictive analytics, Suraksha_Sakey enhances proactive crime prevention and emergency response, ensuring swift action in distress situations [7].**

***Index Terms*—Women Safety, Convolutional Neural Networks, Smart Keychain,AI-based Surveillance, Gesture Recognition, Anomaly Detection**

I. INTRODUCTION

Women's safety remains a pressing issue due to the rising number of reported crimes, including harassment and assault. According to NCRB reports, crimes against women in India have increased by 20% over the last five years [8]. Traditional safety mechanisms, such as emergency helplines and mobile applications, require the victim to manually trigger an alert [9]. However, in many critical situations, individuals may be unable to access their phone or communicate their distress effectively. Furthermore, existing surveillance systems primarily function as passive monitoring tools, failing to provide real-time threat detection and prevention [10].

The Suraksha_Sakey system aims to bridge these gaps by leveraging artificial intelligence to autonomously detect distress situations, analyze environmental risks, and provide immediate alerts to law enforcement or emergency contacts [11]. The system integrates multiple advanced technologies, including real-time gender classification, gesture-based SOS recognition, and geospatial crime analytics. By analyzing surveillance footage and identifying unusual patterns, Suraksha Sakhi ensures automated and proactive intervention, unlike conventional safety solutions that rely on human-initiated alarms [13]. Moreover, the addition of a smart keychain allows users to trigger an SOS alert and share their live GPS location, ensuring protection even in areas lacking surveillance infrastructure [14].

To evaluate the system's efficiency, this research investigates the effectiveness of AI-based distress detection, compares it with existing safety solutions, and assesses its potential impact in reducing response time and improving law enforcement intervention. Through this study, we demonstrate how artificial intelligence can transform traditional security frameworks into intelligent, proactive systems that significantly improve women's safety in public and private spaces [4].

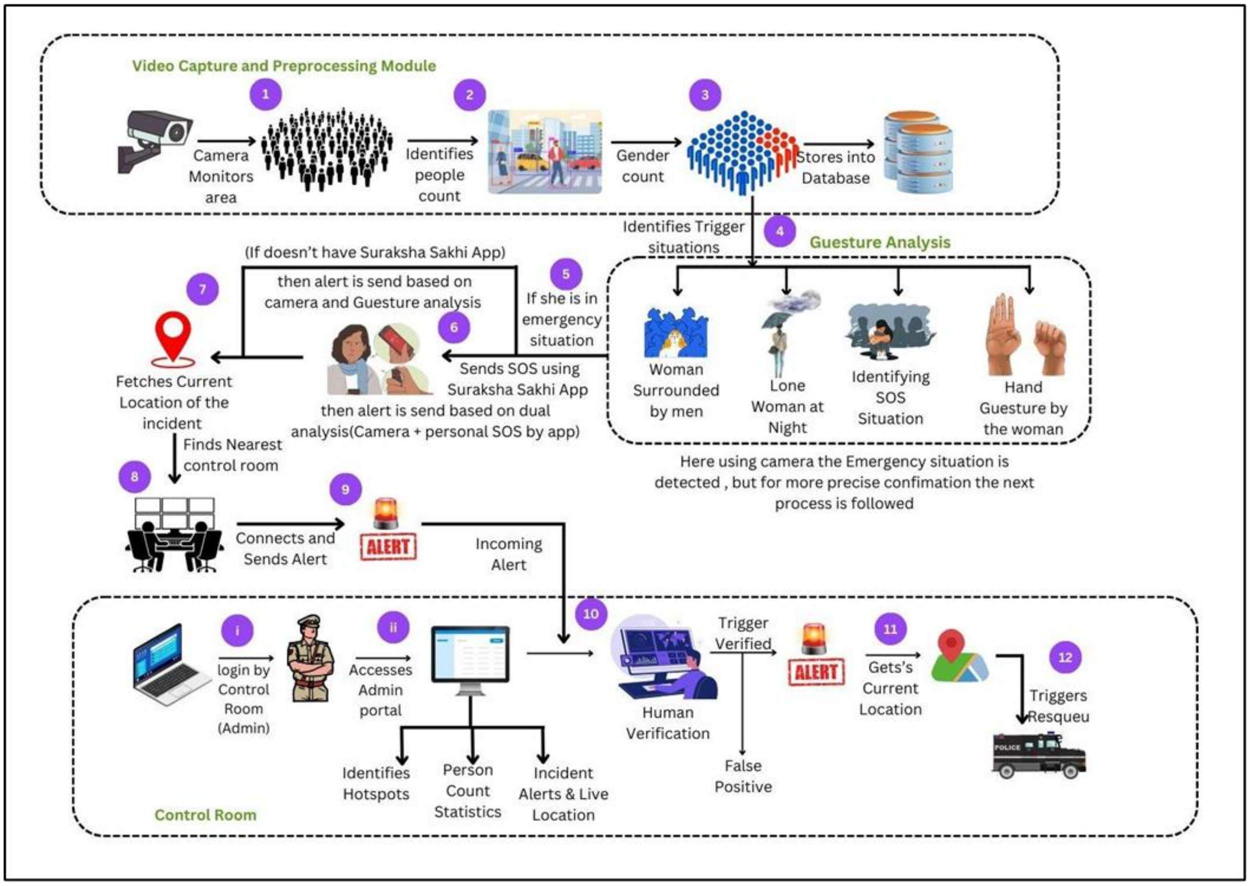

Fig 1.1 Block Diagram

II. MOTIVATION

Women's safety solutions often rely on manual intervention, making them ineffective in real-time crises. The Suraksha Sakhi system aims to bridge this gap by leveraging AI-driven proactive detection to ensure immediate and automated emergency response.

A. Enhancing Emergency Response

In high-risk situations, victims may be unable to activate an SOS manually. Suraksha Sakhi eliminates this dependency by using gesture recognition and anomaly detection to detect distress autonomously and trigger alerts in real-time.

B. Reducing Crime Through Predictive Analytics

Instead of reacting to crimes after they occur, our system uses crime hotspot analysis to predict and prevent incidents. By analyzing historical crime data, authorities can focus on high-risk areas and deploy resources more effectively.

C. Safety Beyond Surveillance Zones

Many unsafe areas lack CCTV coverage. The smart keychain extends protection to such locations by allowing users to trigger an SOS alert and share GPS location instantly, even in network-restricted zones.

D. Improving Detection Accuracy

False alarms in existing safety apps lead to alert fatigue and reduced response efficiency. Our system minimizes false positives by using AI-driven gesture recognition, ensuring alerts are triggered only in genuine distress situations as emergency helplines and mobile applications require the victim to manually trigger an alert [9].

III. PROBLEM STATEMENT

The existing security measures for women's safety face several challenges, primarily the lack of automated distress detection, reliance on manual user intervention, and ineffective surveillance monitoring. Current SOS applications and emergency helplines require users to physically activate them, limiting their usability in high-risk situations where immediate action is necessary. Furthermore, CCTV cameras, although widely deployed, function as passive monitoring tools rather than proactive intervention systems.

The problem intensifies in non-surveillance areas, where safety mechanisms are entirely dependent on mobile connectivity and user interaction. There is also an increasing need for crime pattern analysis to identify and prevent recurring incidents in high-risk areas [4]. This research addresses these challenges by introducing an AI-driven system that enhances proactive crime prevention, distress detection, and emergency response mechanisms.

IV. METHODOLOGY

The proposed Suraksha Sakhi system comprises multiple AI-driven components working together to enhance security. The first module, person detection and gender classification, uses YOLOv3 and a CNN model to identify individuals and determine their gender in real time [3]. This classification assists in detecting potential threats, such as identifying if a woman is in a high-risk situation based on environmental data.

The second module focuses on gesture-based SOS detection using MobileNetV2, which recognizes distress gestures such as raised hands or specific motion patterns. The system is trained on a dataset of over 10,000 labeled images to accurately classify emergency signals, ensuring a high detection rate with minimal false positives [9].

Additionally, the anomaly detection and alert system identify suspicious patterns, such as a lone woman in an unsafe area or a woman surrounded by multiple men. When such anomalies are detected, the system automatically triggers alerts to nearby authorities or emergency contacts.

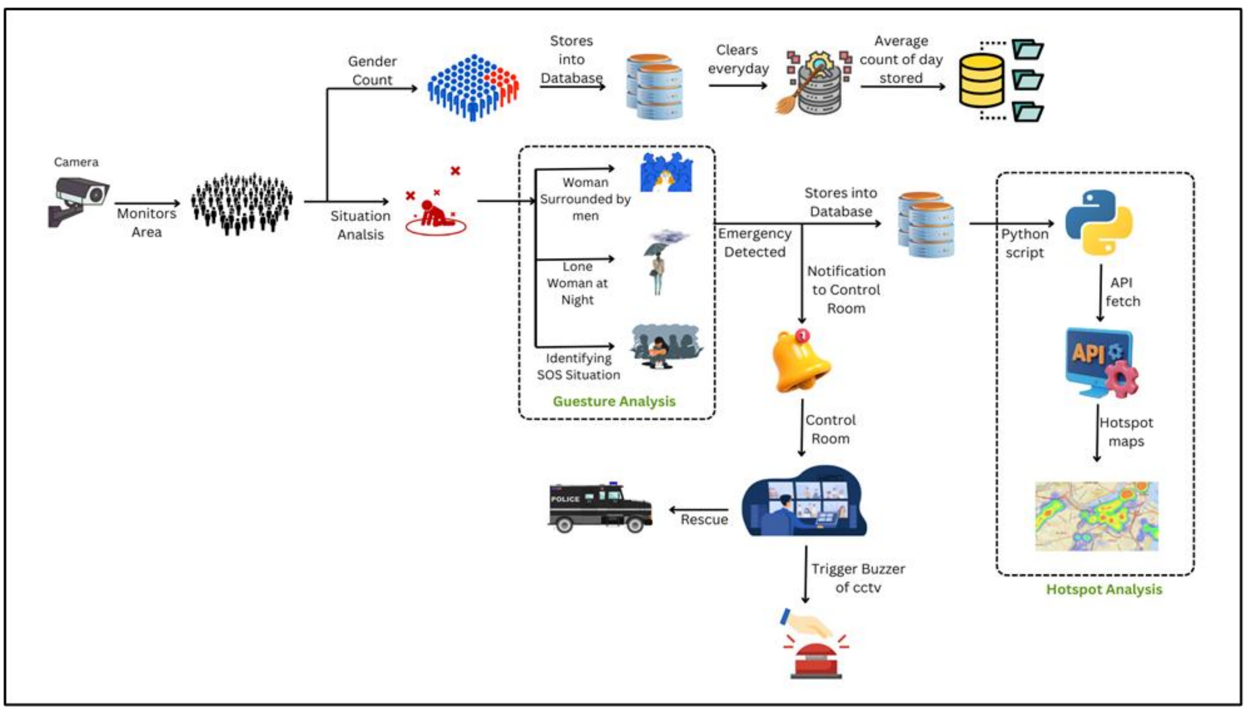

Fig 4.1 Methodology Employed

To further enhance safety, crime hotspot analysis is implemented using historical crime data. By mapping crime-prone locations through GIS-based heatmaps, authorities can optimize patrols and security deployments in high-risk zones. The system is also complemented by a smart keychain, which enables users to send an SOS alert along with their live GPS location in real-time.

V. IMPLEMENTATION

A. Software Stack:

- Python (TensorFlow, OpenCV) for AI modeling.
- Flask for backend API development.
- Flutter for mobile app interface.

B. Hardware Requirements:

- High-resolution CCTV cameras for video analysis.
- GPS-enabled smart keychain for emergency tracking.
- MPU6050 motion sensor for sudden movement detection.
- SIM800L GSM module for real-time emergency SMS/calls.
- ESP32 microcontroller for IoT-enabled safety features.

C. Model Training:

- Gesture recognition model trained on 10,000+ labeled images.
- Anomaly detection model trained on real-world surveillance footage.

VI. RESULTS & DISCUSSION EXPERIMENTAL ANALYSIS REVEALED:

A. Hardware Implementation:

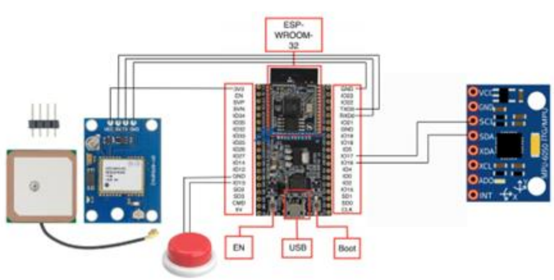

Fig 6.1.1 Hardware Architecture

MPU6050: 6-axis motion sensor (accelerometer + gyroscope) for motion tracking.
SIM800L: GSM module for SMS, calls, and mobile data.
Accelerometer: Measures acceleration in X, Y, Z axes.
ESP32: Wi-Fi + Bluetooth microcontroller for IoT applications.
Button: Simple switch for user input and control.

The MPU6050 works by measuring acceleration and angular velocity using its built-in 3-axis accelerometer and 3-axis gyroscope. It communicates with microcontrollers via I2C, where VCC is connected to 3.3V or 5V, GND to GND, SCL to the microcontroller's SCL (GPIO22 in ESP32), and SDA to SDA (GPIO21 in ESP32). The SIM800L functions as a GSM module, enabling devices to send SMS, make calls, and use mobile data over 2G networks through UART communication. It requires VCC (4.2V regulated), GND to GND, TX to RX (ESP32 GPIO16), and RX to TX (ESP32 GPIO17). An accelerometer detects acceleration in X, Y, and Z axes by sensing changes in capacitance due to motion, with similar I2C connections as the MPU6050[1]. The ESP32 is a Wi-Fi and Bluetooth-enabled microcontroller, where sensors and modules interface through GPIO pins [2]. A button operates as a simple mechanical switch that completes or breaks a circuit when pressed, typically connected with one pin to GND and the other to a GPIO pin (e.g., GPIO4 in ESP32), often requiring a pull-up resistor for stable operation.

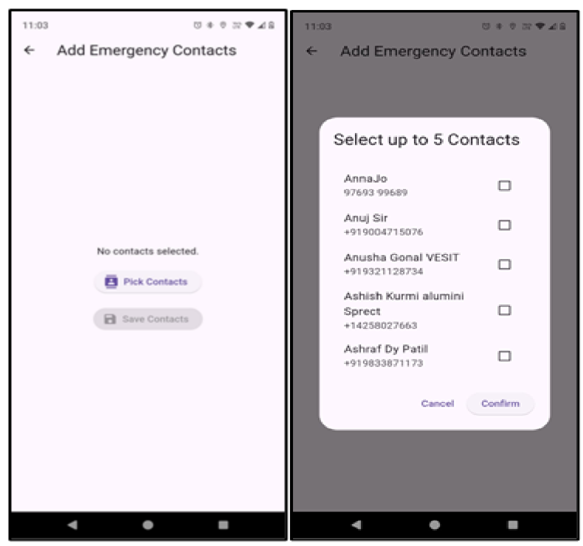

Fig 6.1.2 Contacts addition to Hardware

The Emergency Contact Selection page allows users to add up to five trusted contacts for emergencies. The Fake Call & Guide Page enables simulated calls for safety and emergency guidance. Hardware integration with MPU6050 and SIM800L can automate alerts via ESP32, enhancing security.

B. Admin Dashboard:

The Admin Dashboard is a centralized monitoring interface where law enforcement and security personnel can track real-time SOS triggers, alerts from CCTV cameras, gesture analysis results, and hotspot data. This ensures a proactive response by security teams, allowing them to monitor high-risk zones and take action before incidents escalate [13].

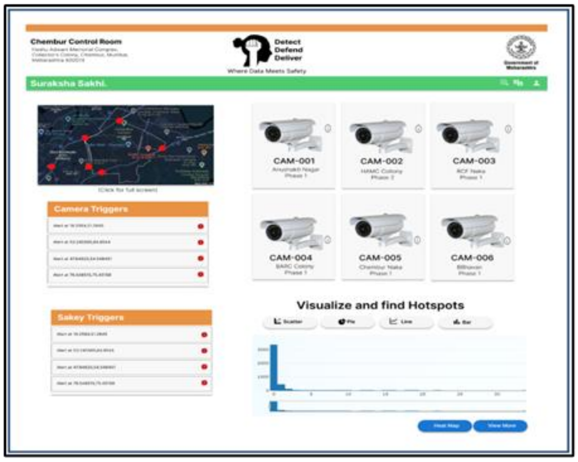

Fig 6.2.1 Admin Dashboard

Fig 6.2.2 Hotspot Analysis

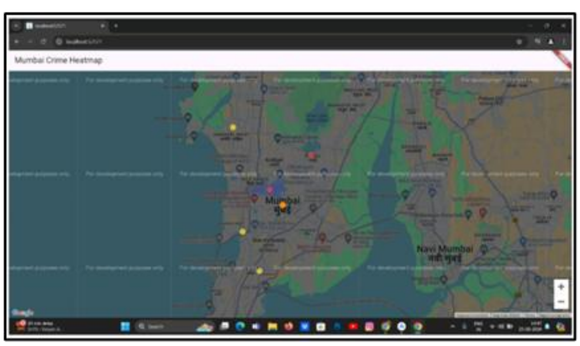

Fig 6.2.3 HeatMap

C. Models trained:

A. People Count

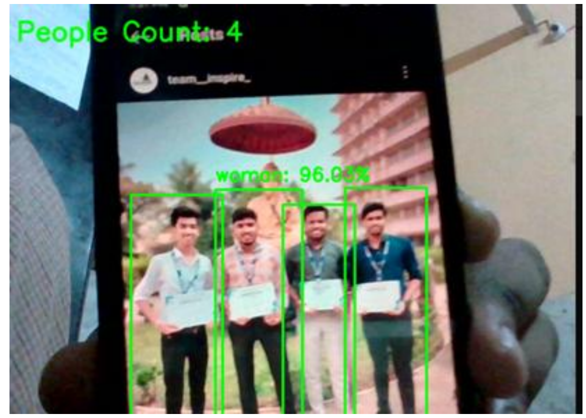

Fig 6.3.1 People Count

The model analyzes and counts the number of individuals in a specific area to detect overcrowding or identify isolated individuals in potentially unsafe locations. This feature enhances public space surveillance, enabling effective crowd monitoring and optimized security deployment [6].

B. Gender Detection

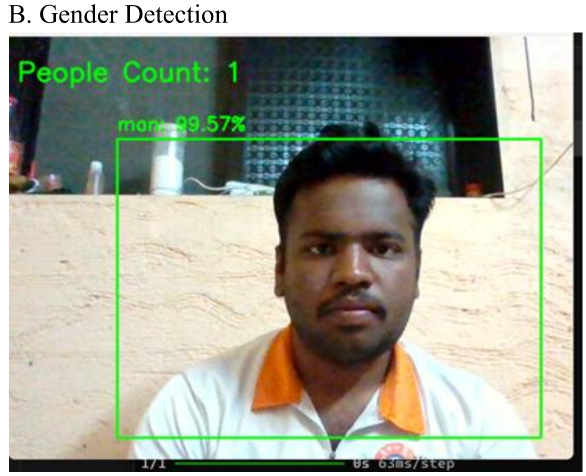

Fig 6.3.2 Gender Detection

The model achieves 89% accuracy on real-world datasets, effectively identifying situations where a lone woman may be in a potentially unsafe environment. This capability assists law enforcement in prioritizing patrols and implementing safety interventions in high-risk areas.

C. Lone Woman Detection

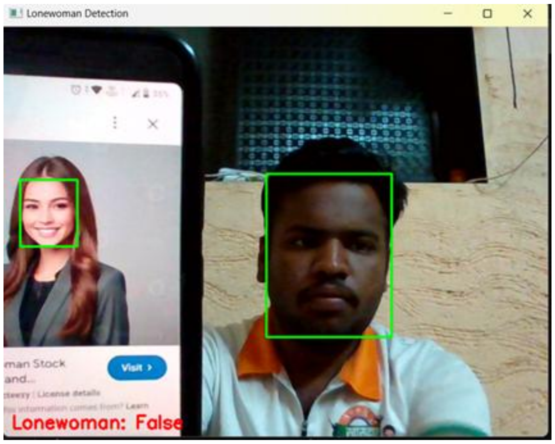

Fig 6.3.3 Lone Woman Detection

The model detects if a single woman is present in a low-visibility or high-risk zone. When combined with crime hotspot data, it helps predict and prevent potential threats, enhancing proactive security measures.

D. Gesture Analysis

Fig 6.3.4 Gesture Analysis (Safe Sign)

The gesture recognition model achieved 92.5% accuracy in controlled settings. It recognizes specific distress gestures and automatically triggers SOS alerts when a distress signal is detected [11]. This feature is crucial for individuals who may not be able to press a button manually during an emergency.

Fig 6.3.5 Gesture Analysis (Unsafe Sign)

E. Kawach Application

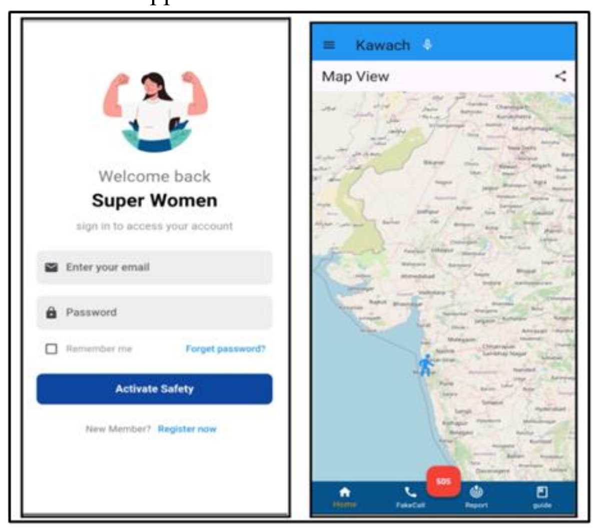

Fig 6.4.1 Login Screen and Location Tracking

The application provides a secure login mechanism along with a GPS-based tracking system for real-time location monitoring [14].

A Fake Call feature to help users handle unsafe situations by simulating an incoming call. Additionally, the Guide Page provides essential safety resources, including general safety tips, self-defense techniques, emergency contacts, and chatbot assistance [15].

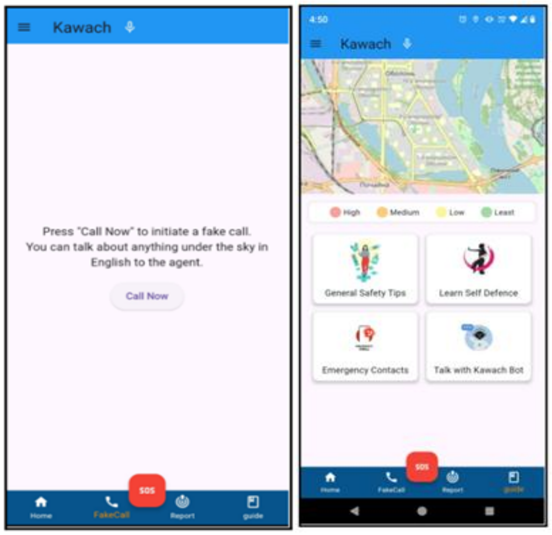

Fig 6.4.2 Fake Call and Guide Page

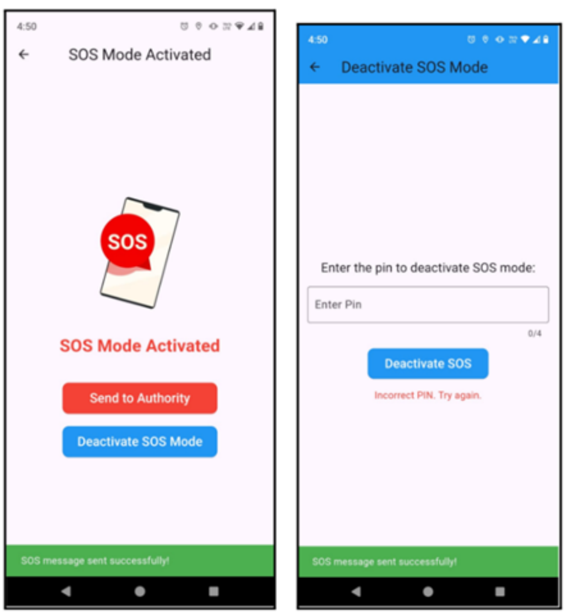

Fig 6.4.3 SOS Activation Page

The SOS feature allows users to send emergency alerts to authorities with one tap. A secure PIN is required to deactivate it, preventing unauthorized access. A confirmation message ensures the SOS request is successfully sent.

VII. CONCLUSION & FUTURE WORK

This research highlights the potential of AI-driven women's safety solutions in addressing critical security concerns. The Suraksha Sakhi system enhances real-time threat detection, distress recognition, and crime prevention by leveraging computer vision, machine learning, and predictive analytics. Through automated anomaly detection, gesture-based SOS activation, and GPS-enabled safety measures, the system ensures faster emergency response and proactive security interventions. The integration of crime hotspot analysis further strengthens law enforcement efforts by identifying high-risk areas and optimizing resource allocation.

While the system demonstrates significant improvements in safety measures, further advancements can enhance its effectiveness. Future work will focus on:

Voice-based SOS detection, enabling users to activate emergency alerts through voice commands for hands-free distress signaling.

Expanded AI models to improve situational awareness, enabling more accurate recognition of threats in diverse environments.

Integration with law enforcement databases, allowing authorities to access real-time crime data and streamline investigations.

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