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SHESHIELD: WOMEN'S SAFETY AND RISK MITIGATION

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Abstract-- In today's urban environments, the safety of women remains a significant concern due to increasing incidents of harassment and violence, often exacerbated by delayed or absent intervention. This paper presents SheShield, a real-time, AI-powered surveillance system designed to enhance women's safety through intelligent monitoring and proactive threat detection. The system integrates multiple computer vision modules including SOS hand gesture recognition via MediaPipe, facial distress detection using DeepFace, and gender classification through a custom-trained Convolutional Neural Network (CNN). Deployed through single or multi-camera setups, SheShield continuously analyzes visual input and provides immediate responses to emergencies. The platform is built using Flask and features a centralized web interface that supports real-time video streaming, safety hotspot mapping via Folium heatmaps, gender distribution visualization using Chart.js, and camera-specific alert monitoring. Critical events such as SOS gestures trigger alarms, pop-up notifications, and automatic screenshot captures, while prolonged emotional distress in women prompts alert logging and interface cues. A historical alert module facilitates review and reporting through downloadable CSV files. By integrating AI-based visual analysis with an interactive web dashboard, SheShield offers a robust, scalable solution for enhancing situational awareness and enabling timely intervention in public safety scenarios.

Keywords - Women safety, real-time surveillance, SOS gesture detection, emotion recognition, gender classification, computer vision, AI monitoring.

1. INTRODUCTION

In today's rapidly advancing technological landscape, ensuring public safety—especially for women—requires more than traditional security measures. Rising incidents of harassment, assault, and distress in both public and private settings have exposed the limitations of conventional surveillance systems. These systems often fail to detect emergencies in real time or require manual monitoring, leading to delayed responses and missed opportunities to prevent harm. This creates a growing gap between the need for proactive safety measures and the existing infrastructure's ability to provide timely assistance.

Modern advancements in computer vision, artificial intelligence, and real-time video processing offer promising solutions to address this gap. However, despite the availability of advanced tools and models, there is a lack of integrated systems capable of understanding complex visual cues such as hand gestures, emotional expressions, and gender-specific vulnerabilities—all of which are critical indicators of potential danger. Most existing safety solutions do not account for the psychological aspect of distress, nor do they provide intelligent alerts based on contextual understanding of the scene. The SheShield project aims to bridge this technological and social gap by developing a smart surveillance system that detects distress and SOS signals in real time. The system leverages MediaPipe for SOS hand gesture recognition, DeepFace for emotion detection, and a trained CNN model for gender classification. It goes beyond passive monitoring by actively identifying high-risk scenarios—such as a single woman showing signs of fear or distress—and generating intelligent alerts for intervention. Traditional methods of monitoring, which rely heavily on manual interpretation of footage, are no longer sufficient. SheShield introduces automation, real-time processing, and proactive alert mechanisms to ensure faster responses and enhanced situational awareness. It is designed to serve as a practical solution for law enforcement agencies, public transport systems, and high-footfall urban spaces where timely action can save lives. By combining multiple AI models into one streamlined system, SheShield represents a step forward in building safer communities through intelligent technology. The project not only addresses a critical social issue but also demonstrates how AI can be harnessed effectively for real-world impact.

2. LITERATURE SURVEY

Jerin Mahibha [1] presents a system for emergency signaling using hand gestures, particularly in situations where verbal communication or phone access is limited. The system captures predefined SOS gestures through a camera-equipped device, ensuring clear and accurate identification. Upon recognizing the gesture, it sends SMS alerts to

emergency contacts and services, along with the user's location. The system uses Convolutional Neural Networks (CNNs) for gesture recognition, achieving an accuracy of 0.95. The study emphasizes the system's reliability and usability through simulations that replicate emergency scenarios. This solution addresses critical communication gaps in emergencies, offering a potentially life-saving alternative when conventional methods fail. It draws on existing research in gesture recognition and real-time image processing, making it a significant advancement in enhancing emergency response systems.

Yuting Meng [2] addresses the challenges posed by the variability and diversity of hand gestures in real-world scenarios. Unlike traditional fixed gesture recognition systems, this study proposes a registerable hand gesture recognition approach that utilizes a Triple Loss function. By learning the differences between gestures, this method can cluster and identify newly added gestures, making it adaptable to personalized recognition. The authors introduce a new dataset, the Registerable Gesture Dataset (RGDS), to train models for flexible hand gesture recognition. Additionally, the paper proposes a normalization technique for transforming gesture data and a FingerComb block that combines and enhances features for faster model convergence. The model is built on an improved ResNet architecture and introduces FingerNet for efficient single-hand gesture recognition. The proposed system performs well on the RGDS dataset, allowing users to register custom gestures for personalized interaction.

Roberto Viejo-López [3] explores the use of computer vision techniques for detecting hand SOS gestures, a critical component in emergency response systems. The study focuses on leveraging real-time image processing to identify and interpret SOS gestures made by individuals in distress, enabling swift action in emergency scenarios. The authors use a combination of computer vision algorithms, such as hand detection and gesture recognition, to analyze and detect the SOS signal with high accuracy. The paper also discusses the challenges in handling varying lighting conditions, different hand positions, and motion artifacts, which can affect the reliability of gesture recognition systems. The proposed system aims to offer an alternative communication method for those who are unable to use voice or phone-based communication, contributing to more effective emergency interventions in critical situations.

Xiaoxiong Zhang [4] focuses on gender classification using RGB-D (Red, Green, Blue, and Depth) data combined with a self-joint attention mechanism. The study addresses the challenge of gender classification by incorporating both visual and depth information from RGB-D cameras, which provides richer and more reliable data for distinguishing between genders. The authors propose a novel self-joint attention model that dynamically selects important features from both the RGB and depth channels to improve classification accuracy. This method allows for better handling of variations in pose, lighting, and occlusions, which are common challenges in traditional gender classification tasks. The paper demonstrates that integrating depth data enhances the robustness of gender classification systems, making it more effective in real-world applications. This approach has significant implications for enhancing human-computer interaction systems and security applications.

Shtwai Alsubai [5] presents a novel approach to facial emotion recognition by integrating quantum computing with deep learning techniques. The study employs a modified

ResNet-18 architecture enhanced with a quantum convolutional layer, utilizing parameterized quantum filters to extract intricate facial features. Additionally, the model incorporates a Modified up Sampled Bottle Neck Process (MuS-BNP) to maintain computational efficiency while leveraging residual connections. This hybrid framework addresses challenges in distinguishing subtle emotional expressions, achieving superior performance metrics, including high accuracy, F1-score, recall, and precision. The integration of quantum computing not only accelerates computation but also enhances the model's ability to differentiate between closely related facial expressions. This research underscores the potential of combining quantum computing with advanced deep learning models to improve the accuracy and efficiency of facial emotion recognition systems, particularly in applications requiring real-time analysis and high precision.

3. PROPOSED SYSTEM

The SheShield platform is a modular, intelligent surveillance and alert system designed to enhance public safety with a special emphasis on women's protection. It provides real-time monitoring, alert generation, and evidence capture functionalities, supporting investigative departments in timely responses and decision-making. The proposed system architecture is illustrated in Figure 3.1, depicting the modular flow from user login to detection and responsive action, with each component integrated through Flask-based routing and backend logic.

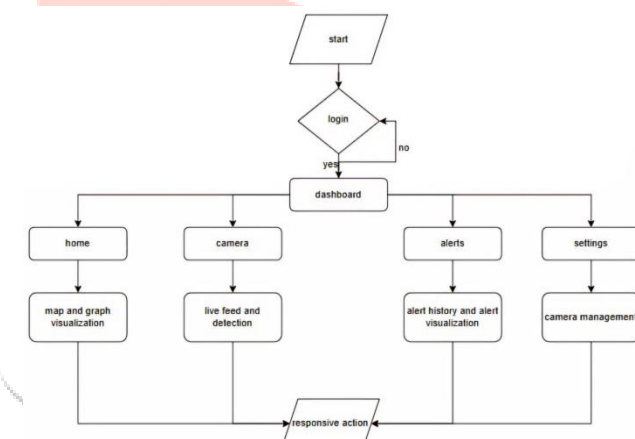


Fig 3.1. Flow Chart of SheShield

3.1. Login and Dashboard System

The system begins with a secure **Login Interface** (to restrict access only to authorized users. Once authenticated, users are redirected to the **Dashboard**, which acts as the central control hub. Developed using **Flask**, this dashboard enables seamless navigation to different modules such as **Home**, **Live Feed**, **Alerts**, and **Settings**. Flask's dynamic routing handles button-based navigation and ensures smooth transitions between modules. This modularity ensures that users have direct access to critical monitoring and administrative tools.

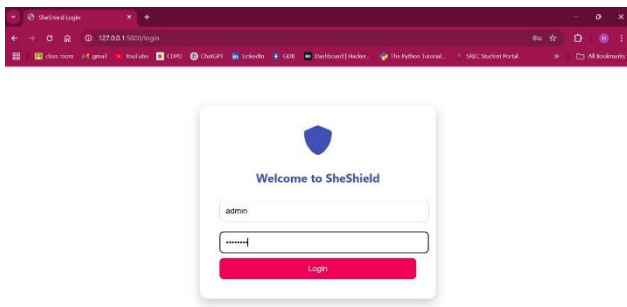


Fig 3.2 SheShield Login Page

3.2. Home Page

The **Home Page** serves as a consolidated visualization interface, offering insights into surveillance data and alert trends. It provides both geographic and statistical overviews that aid in decision-making and monitoring.

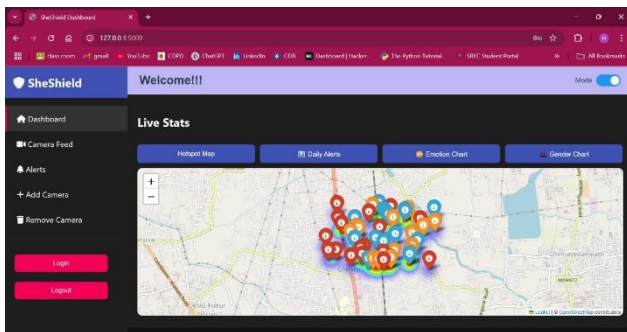


Fig 3.3 Home Page Dashboard

Map Visualization:

The homepage incorporates a **dynamic heatmap** powered by the **Folium** library. This map highlights geographic regions based on real-time alert intensity using GPS-tagged camera locations:

- Red or orange zones indicate frequent SOS gestures or distress detections.
- Blue zones represent safer areas with minimal alerts. The map supports interactive features such as zooming, panning, and street-level camera inspection, allowing investigation teams to quickly identify and respond to emerging safety concerns.

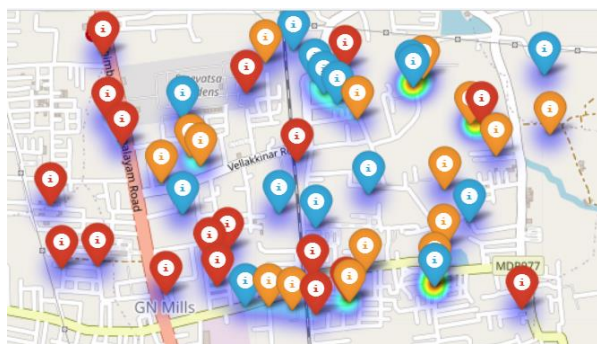


Fig 3.4 HeatMap of Monitoring Area

Chart Visualization:

Integrated **Chart.js** dashboards present key surveillance metrics:

- Gender distribution** across different camera feeds.

- Emotion trends**, focusing on distress-related expressions.
- SOS alert frequencies**, presented in hourly, daily, or weekly formats. These visual summaries support **predictive monitoring**, **trend analysis**, and help authorities allocate resources strategically.

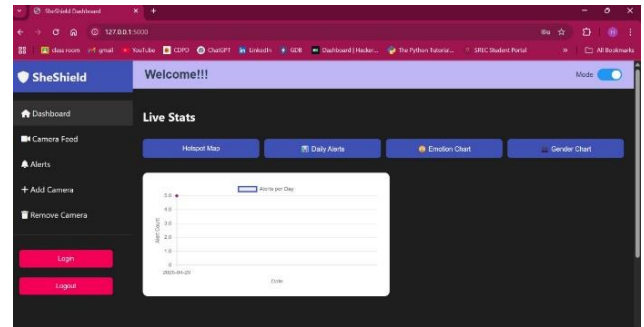


Fig 3.5 Dashboard – Daily Alerts Chart

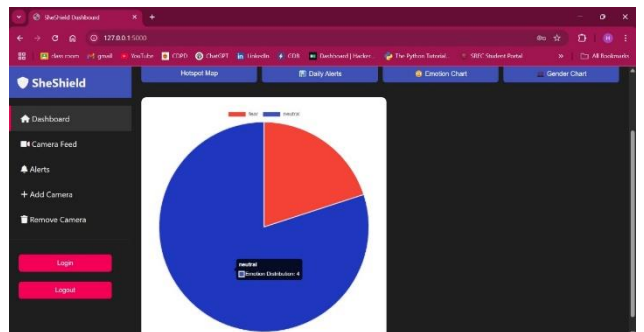


Fig 3.6 Dashboard – Emotion Distribution Chart

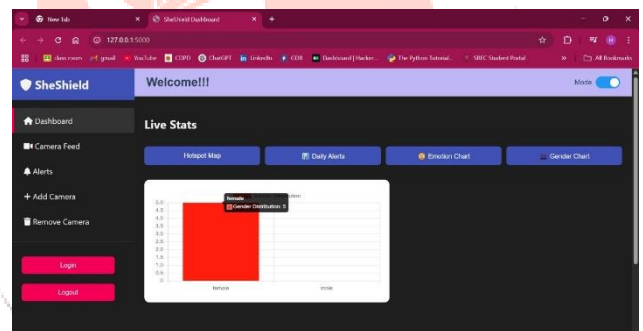


Fig 3.7 Dashboard – Gender Distribution Chart

3.3. Live Feed and Detection Module

This module is the core of SheShield's real-time detection capability. It continuously processes video feeds from active surveillance cameras and performs multi-modal detection, including:

- Real-time frame capture using OpenCV.
- Hand gesture detection using MediaPipe, focusing on SOS gestures with handedness classification.
- Facial emotion analysis using DeepFace, identifying distress or fear.
- Gender classification via TensorFlow/Keras models loaded through `load_model()`.
- Human detection using CVlib to associate gender and emotional state with individual subjects.

All detections are overlaid on the live video feed and streamed back to the frontend via Flask, allowing monitoring

personnel to observe ongoing events with contextual awareness.

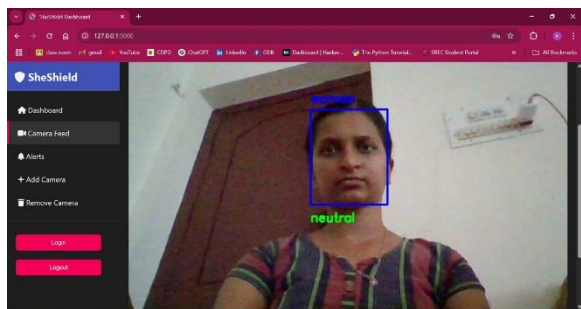


Fig 3.8 Camera Feed

3.4. Alert History and Visualization

The **Alert History Module** logs all detection events, such as SOS gestures and prolonged emotional distress. Each entry is timestamped and associated with camera identifiers and alert types. The data is stored in **CSV files** for long-term archival and can be visualized through integrated dashboards that summarize:

- Temporal alert patterns.
- Location-specific alert densities.
- Event type distributions.

These summaries allow investigators to perform **retrospective analysis** and identify long-term safety trends in specific areas.

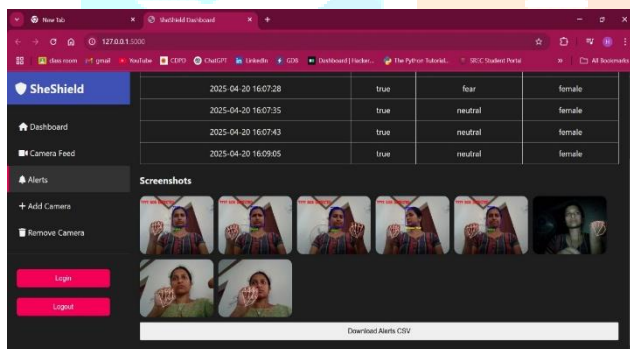


Fig 3.9 Alerts record page



Fig 3.10 Sample Alert with Information

3.5. Camera Management Module

The **Camera Management or Settings Module** allows administrators to dynamically manage surveillance feeds. Camera configurations are maintained in a **JSON file**, enabling:

- Addition of new camera feeds.
- Removal or update of inactive/defective feeds.
- Real-time update of the monitoring interface without restarting the backend.

This ensures high scalability and adaptability of the system as more areas are brought under surveillance.

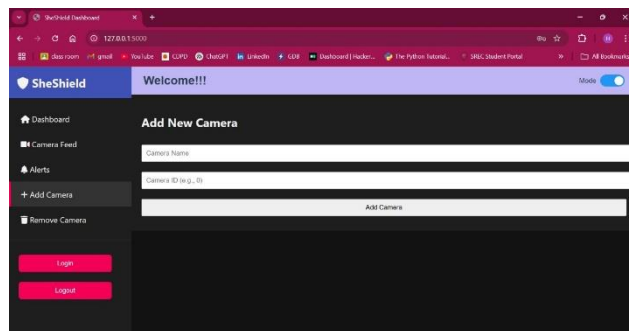


Fig 3.11 Camera Addition

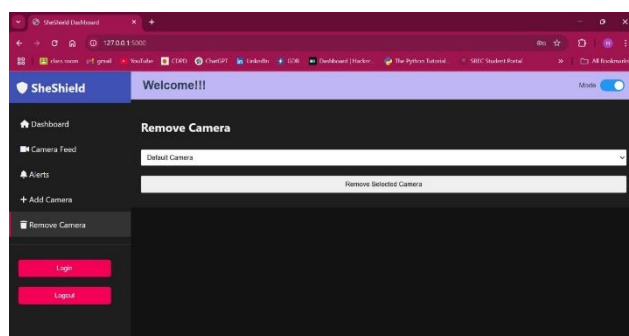


Fig 3.12 Camera Removal

3.6. Responsive Action System

The **Action System** is designed to respond appropriately to detected threats:

- On **SOS gesture detection**, an **alarm** is triggered using **Pygame**. The system ensures that the alarm audio plays fully without interruption before restarting, preventing overlapping alerts.
- In the case of **emotional distress**, if the emotion persists for more than **5 seconds** and the detected subject is a **female**, a **screenshot** is captured, and an **on-screen popup alert** is displayed, indicating the specific camera feed.
- All actions are handled using **Python threading** to maintain uninterrupted detection performance and real-time responsiveness.

4. METHODOLOGY

This project consists of six core modules that work together to enhance women's safety in public spaces includes Safety Hotspot and Risk Mapping, SOS Hand Gesture Detection, Facial Distress Detection, Person Detection and Gender Classification, Detection Integration and Monitoring, Responsive Action System.

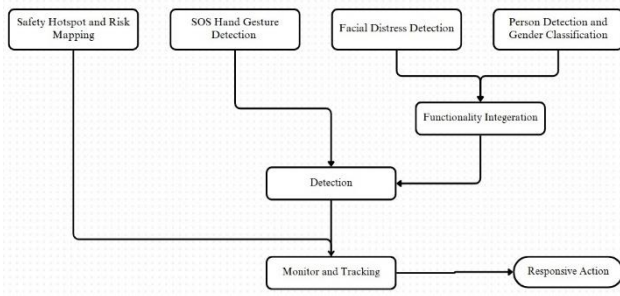


Fig 4.1 Block Diagram of SheShield

4.1. Safety hotspot and risk mapping

The SheShield system aims to create a safer surveillance infrastructure by identifying high-risk areas through real-time data collection and visualization. Each camera deployed in different locations continuously feeds gender data to the central dashboard. This data is used to update a heatmap, which visualizes the male-to-female ratio across regions. Higher concentrations of female presence in isolated or risky areas are flagged as potential hotspots. This component enables law enforcement to monitor activity levels, predict safety vulnerabilities, and deploy resources more effectively.

4.2. SOS hand gesture detection

To provide a non-verbal method of seeking help, the system includes a real-time SOS hand gesture recognition module. MediaPipe is used to extract 21 hand landmarks from the webcam feed. These landmarks are then processed and classified using a machine learning model trained on a custom dataset consisting of SOS and Non-SOS gestures. Once an SOS gesture is detected, the system automatically initiates safety protocols by triggering an audible alarm, saving a screenshot of the frame, and displaying a real-time popup alert on the web dashboard.

4.3. Facial distress detection

The facial distress detection module is designed to catch emotional cues from facial expressions that may signal fear, sadness, or panic—especially useful when a user cannot raise a hand gesture. Using the DeepFace library, the system analyzes each detected face in real time and classifies the emotional state. If a woman is continuously detected in a state of distress for more than 5 seconds, the system treats it as a potential safety threat and immediately displays a popup alert pointing to the exact camera location. This ensures subtle calls for help are not missed.

4.4. Person detection and gender classification

The person detection system identifies individuals in the camera feed and uses a Convolutional Neural Network (CNN)-based gender classifier to differentiate between male and female subjects. This module contributes to demographic analysis, safety mapping, and targeted response planning. The gender counts are updated dynamically on a central heatmap interface, allowing the system to track real-time gender distribution per street or area. This module helps in identifying gender-skewed zones that may require added surveillance or intervention.

4.5. Detection integration and monitoring

All detection modules—SOS gesture, emotion (distress), and gender—are integrated into a single real-time pipeline built with OpenCV and Flask. The modular design allows each component to run in parallel while communicating with the central server. The processed results are streamed to a responsive web dashboard using HTML, CSS, and JavaScript, enabling seamless monitoring of camera feeds and alerts. The integration ensures that each module contributes to a unified safety analysis system that responds intelligently to real-time events.

4.6. Responsive action system

The responsive action system ensures that appropriate alerts and actions are taken based on the severity and nature of the detected event. When an SOS is detected, a loud alarm is played, a popup window appears, and a screenshot is captured. If emotional distress is detected in a female for more than 5 seconds, a silent popup alert is shown to avoid panic while still drawing operator attention. The system is also designed to prevent alarm repetition by allowing one alarm to finish before retriggering, ensuring clarity and controlled responses. This real-time action mechanism ensures swift yet non-intrusive interventions in potential emergency situations.

5. CONCLUSION

In an increasingly complex and vulnerable urban environment, the need for innovative public safety solutions has become more critical than ever. Traditional surveillance systems, though widespread, often lack intelligent automation and real-time responsiveness to urgent threats, especially for women and vulnerable groups. Addressing this gap, SheShield was conceptualized as a proactive surveillance system capable of real-time SOS detection, emotional distress recognition, and gender-based analytics to provide focused and actionable alerts. At its core, SheShield empowers safety by recognizing critical visual cues—such as a distress-laden facial expression or an SOS hand gesture—and immediately alerting authorities for timely intervention. Unlike passive systems, SheShield actively monitors the environment using advanced computer vision techniques. By identifying high-risk zones and maintaining live gender distribution analytics, the system enables law enforcement agencies to deploy resources strategically and maintain vigilance in sensitive areas. The system architecture combines multiple AI models into a unified monitoring dashboard. With features such as heatmap-based risk visualization, real-time alert popups, and audio alarms, SheShield delivers a holistic situational awareness platform. Its web-based interface allows police departments or investigative bodies to oversee their designated regions efficiently, offering real-time response capabilities to incidents as they unfold. The successful integration and testing of SheShield highlight its practicality and social value. It offers not only a technological solution but also a societal promise—to enhance safety, encourage rapid intervention, and serve as a deterrent to potential harm. As a result, SheShield stands as a valuable tool for public safety officers, particularly in densely populated or crime-prone areas.

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