KLE TECHNOLOGICAL UNIVERSITY

Hubballi,Karnataka - 580 031

A Capstone Project Report on

Deep Learning Based Smart Glasses For Women Safety

Submitted in partial fulfillment of the requirements for the award of the degree of

Bachelor of Engineering

in

Electronics and Communication Engineering

by

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CERTIFICATE

This is to certify that the Capstone Project (Code: 20EECW402) work entitled **"Deep Learning Based Smart Glasses For Women Safety"** is carried out by **Sakshi Bagewadi(02FE21BEC080), Samdruddhi V S (02FE21BEC083), Srushti Pattanashetti (02FE21BEC100), Ujwala V T (02FE21BEC105)**, the bonafide students of VII semester of KLE Technological University Dr. M S Sheshgiri Campus, Belagavi in partial fulfillment for the award of "Bachelor of Engineering" in Department of "Electronics and Communication Engineering" of the KLE Technological University, Hubballi, during the year 2024-2025. It is certified that all the corrections/suggestions indicated for internal assessment have been incorporated in the report deposited in the departmental library. The project report has been approved as it satisfies the academic requirements in respect of project work prescribed for the said degree.

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DECLARATION

We hereby declare that the **Capstone Project** presented in this report, entitled **"Deep Learning Based Smart Glasses For Women Safety"**, submitted to **KLE Technological University** for the completion of the **Capstone Project (Code: 20EECW402)** in the **8th Semester**, is the original work carried out by us in the **Department of Electronics and Communication Engineering, KLE Technological University Dr. M S Sheshgiri Campus, Belagavi**, under the guidance of **S.M.Hunagund, Assistant Professor, Department of Electronics and Communication Engineering**.

We further declare that, to the best of our knowledge and belief, the work reported herein has not been submitted as part of any other project or for the award of any course, degree, or diploma at this or any other university or institution. The results presented in this report are solely the outcome of our efforts.

We also confirm that all the work documented in this report has been completed by us.

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ABSTRACT

The increasing concerns over women's safety have driven the development of innovative technological solutions aimed at providing real-time protection and rapid response during emergencies. This project presents a deep learning-based smart glasses system designed specifically to enhance women's safety through proactive monitoring and intelligent threat detection. The smart glasses are equipped with a miniature camera and sensors to continuously observe the surroundings, analyze visual and auditory data using trained deep learning models, and detect potentially dangerous situations such as the presence of weapons, suspicious behavior, or aggressive actions. Upon identifying a threat, the system can automatically trigger safety measures, including sending the user's live location and alert messages to emergency contacts, activating a buzzer or voice alert, and recording evidence for future use. By combining wearable technology with artificial intelligence, this project offers a hands-free, discreet, and efficient safety mechanism, empowering women with an added layer of protection in public and private spaces.The core of the system relies on advanced deep learning algorithms, specifically convolutional neural networks (CNNs), for real-time object detection and emotion recognition. The camera embedded in the smart glasses captures live video streams, which are processed either locally using a lightweight onboard processor like the Raspberry Pi or offloaded to a mobile device or cloud server for faster analysis. The system is trained to recognize potentially dangerous objects (such as knives or guns), detect distress in facial expressions, and identify unusual or aggressive movements. In the event of a threat, the integrated GPS module retrieves the user's location, and an emergency alert is instantly sent to predefined contacts via GSM or mobile internet. The wearable also features a buzzer and optional voice command functionality to enhance user control in high-risk situations. This blend of AI-driven surveillance and IoT connectivity makes the smart glasses a practical, real-time safety companion for women, offering both preventive and responsive capabilities.

Keywords: Obejct Detection,GPS tracking;

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Chapter 1

Introduction

In our project, we have developed a deep learning-based smart glasses system designed to address these challenges and enhance personal safety for women. We are using a Raspberry Pi 4B as the core processing unit, along with a Pi Camera for real-time video surveillance, a GPS module for location tracking, a GSM module for sending alerts, a microphone module for voice recognition, and a tactile push button and buzzer for emergency activation. The system processes live video footage using deep learning for threat detection, while the microphone allows the user to activate the safety protocol with specific voice commands. The GPS module tracks the user's location, and the GSM module sends alerts to emergency contacts in case of danger.

Personal safety, particularly for women, continues to be a major concern worldwide, with incidents of harassment and violence on the rise in public spaces. Traditional safety tools such as self-defense mechanisms, panic buttons, or mobile applications often rely on the user being able to act in stressful situations, which is not always possible. Moreover, these tools generally provide reactive solutions, requiring the individual to recognize a threat and manually engage the system. This highlights the need for a more proactive and intuitive approach to personal safety—one that can detect potential dangers before they escalate, while also enabling the user to remain calm and focused.

1.1 Motivation

1.Personal safety concern:

- Women often face the threat of harassment, assault, and violence in public spaces.
- The need for reliable, on-the-go safety solutions is greater than ever, particularly in urban environments.

2.Limitations of existing solutions:

- Traditional tools like personal alarms or mobile apps often require the user to manually initiate them in a moment of panic.
- These tools are reactive, leaving users vulnerable before they can take action.

3.Proactive approach:

- Our system leverages real-time video surveillance and deep learning to detect threats automatically.
- Voice recognition and GPS tracking provide an immediate safety response with minimal effort required from the user.

4.Empowering women:

- The system is designed to give women a sense of control and confidence in potentially dangerous situations.
- It provides discreet, hands-free safety that doesn't draw attention or disrupt daily activities.

1.2 Objectives

- Detect potential threats in real-time using a Pi Camera and deep learning model for video surveillance.
- Provide a hands-free, proactive solution that utilizes voice recognition for emergency activation and GPS tracking for location monitoring.
- Ensure immediate assistance through GSM alerts to emergency contacts and a buzzer for manual activation of safety protocols.
- Offer a wearable, discreet solution that integrates seamlessly into everyday life, empowering users with a sense of security without drawing attention.

1.3 Literature Survey

1.3.1 Deep Learning based women smart glasses for women safety

To develop a wearable smart glasses system that enhances women's safety by detecting distress situations using deep learning and automatically alerting trusted contacts and authorities with the user's location.

- Review of existing smart wearables like pendants, smartwatches, and bands designed for women's safety. Most rely on manual activation; lack of AI-based automatic detection..
- Studies using CNN models (e.g., VGGNet, ResNet) on datasets like FER-2013, CK+, or AffectNet for detecting human emotions from facial expressions.Applications in surveillance and mental health monitoring.
- Use of audio spectrograms and RNN/LSTM models to detect emotions like fear, stress, or anger from speech.Emotion recognition systems trained on datasets like RAVDESS, TESS, or CREMA-D.
- YOLO (You Only Look Once), SSD (Single Shot Detector), and OpenPose for detecting suspicious behavior or people in close proximity.Application in security systems, crowd analysis, and anomaly detection.

1.3.2 Utilizing Deep Learning in Smart Glass System to Assist the Blind and Visually Impaired

YOLO (You Only Look Once) is a state-of-the-art object detection algorithm known for its speed and accuracy. YOLOv4-tiny is a lighter version optimized for embedded devices like Raspberry Pi. It divides an image into a grid and predicts bounding boxes and class probabilities, allowing the system to detect multiple objects in real-time.

- Real-time object detection using YOLOv4-tiny allows users to recognize obstacles and objects in their environment.Object detection models must be lightweight for deployment on edge devices like Raspberry Pi.
- Enables natural voice interaction with the device.Helps users understand visual content through audio feedback.
- Raspberry Pi processes data and runs AI models efficiently.

1.3.3 Enhancing Women's Safety - A Comprehensive Review of Emerging Technologies and Automated Crime Detection Using ML Algorithms

The increasing number of crimes against women, rising from 371,503 in 2020 to over 445,260 in 2022, indicates an urgent need for smarter safety interventions. These crimes include harassment, assault, stalking, and more, often occurring in public or isolated environments. This backdrop has pushed researchers and developers to design technology-driven safety tools.

- Escalation of crimes against women highlights the need for smart, proactive safety systems.WST includes mobile apps, wearables, GPS, surveillance, and IoT devices.The novel SIRIP strategy evaluates existing technologies for real-world effectiveness.
- AI-powered systems can detect crime automatically using image, voice, or motion data.CNNs, LSTMs, SVMs, and Autoencoders are key models for behavioral recognition and anomaly detection.Data privacy and real-time processing remain major challenges.
- Hybrid ML-DL models offer a promising solution for balanced performance and security.

1.3.4 Development of Visual Sensors and Augmented Reality Based Smart Glasses for Enhancement of Business Sustainability and Wellbeing of the Aging Workforce

A healthy workforce is essential for economic and societal development. With aging workers representing a growing portion of the labor force, maintaining their productivity and independence is crucial. Visual impairments are one of the most common chronic conditions affecting older individuals, reducing their ability to perform tasks efficiently.

- Aging workforce is critical for sustainable development, but vision impairment affects productivity.
- Features include brightness/contrast tuning, magnification, and object/text recognition.The glasses promote continued workforce participation, reduce isolation, and support lifelong learning.Integration of human-machine interfaces and smart sensors makes the device adaptive and user-centric.
- Integration of human-machine interfaces and smart sensors makes the device adaptive and user-centric.

1.4 Problem statement

Women's safety remains a major concern, especially in isolated areas and at night. Existing solutions require manual activation, which may not be possible in emergencies. They lack real-time threat detection, evidence collection, and work poorly without the internet. A hands-free, AI-powered smart glasses system can detect danger, record evidence, and trigger alerts automatically. This ensures faster response and enhanced security for women.

1.5 Application in Societal Context

1. **Empowering Women:** Provides a discreet and proactive safety tool that empowers women to feel more confident and secure in public spaces.Offers continuous protection, allowing women to move freely without fear of harassment or violence.

2. **Addressing Gender-Based Violence:** Helps tackle the growing concern of gender-based violence by providing real-time threat detection and immediate emergency response.Acts as a preventive measure, ensuring quick alerts are sent to emergency contacts, enhancing personal safety.

3. **Social Impact and Awareness:** Encourages the use of technology for societal good, raising awareness around the importance of women's safety.Sparks discussions on the need for better safety solutions in public spaces and the role of technology in addressing social issues.

4. **Autonomy and Confidence:** Offers women a sense of autonomy over their own security, reducing anxiety in uncertain environments. Promotes a sense of control, allowing users to activate emergency protocols without physically engaging in dangerous situations.

5. **Promoting Social Equality:** Contributes to the broader movement for gender equality, by addressing concerns about women's safety in public spaces.Supports the idea that technology can be a tool for social change, making environments safer for women everywhere.

1.6 Project Planning and Bill of the Materials

1.6.1 Project Overview:

1. **Objectives and Goals:** To develop deep learning–based smart glasses that enhance women's safety by detecting threats in real-time and enabling rapid alert mechanisms through integrated sensors and communication modules. Utilize deep learning models (e.g., CNN) to recognize suspicious behaviors or environments. Enable instant alerts via GSM/GPS modules and provide real-time location tracking during emergencies.

2. **Project Scope:** This project involves the development of smart glasses designed to enhance women's safety in public spaces by leveraging deep learning and sensor technologies. The glasses will use a Pi Camera to capture real-time video, allowing deep learning algorithms to analyze the surroundings and detect potential threats or suspicious behaviors. Integrated GPS and GSM modules will enable location tracking and emergency alerts, providing real-time data to authorities or designated contacts when a threat is detected. Additional features include a tactile push button for manual emergency activation, a microphone module for sound recognition, and a buzzer for audio alerts, ensuring the user is immediately notified. The system will work autonomously to ensure swift action in dangerous situations, thereby promoting personal safety and security.

3. **Project Timeline:**
   - Data collection
   - Processing
   - Model development
   - Testing and Evaluation
   - Deployment
4. **Visual Representation:** Gantt Chat illustrating the timeline for each phase.

Figure 1.1: Time line

5. **Resource Needed:**
   - Hardware:Raspberry pi
   - External Dataset : Taken data set from Kaggle

1.7 Bill of the Materials

COMPONENT	SPECIFICATION	AMOUNT
Raspberry PI	Model 4B	6000/-
GPS Module	NEO 6M	300/-
Pi camera	CSI Interface	250/-
Buzzer	--	20/-
Push Button	--	2/-

Figure 1.2: Result

Chapter 2

System design

In this Chapter, we list out the interfaces.

2.1 Functional block diagram

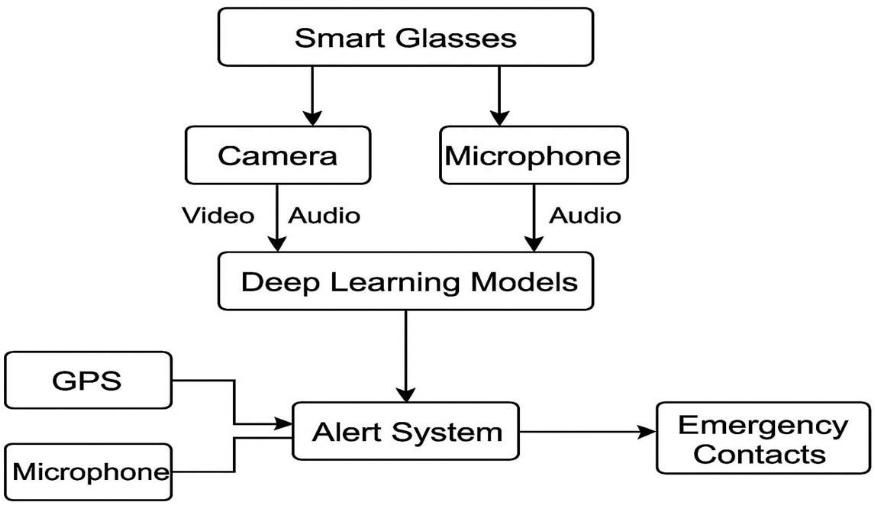

Figure 2.1: Block Diagram

The diagram represents the architecture of a Smart Glasses–based Women's Safety System that integrates deep learning and IoT components to detect and respond to emergencies. The smart glasses are equipped with a camera and a microphone, which continuously capture video and audio data from the surroundings. These inputs are fed into deep learning models that analyze the data in real time to identify potential threats such as physical violence, verbal abuse, or distress. If a dangerous situation is detected, the system activates an alert mechanism. The alert system receives additional inputs from a GPS module to determine the user's real-time location and from the microphone to capture contextual audio data. Once triggered, the alert system sends an emergency notification along with the location and possibly audio evidence to pre-registered emergency contacts. This setup ensures that immediate action can be taken to assist the user, providing a robust safety solution through wearable technology.

2.2 Design alternatives

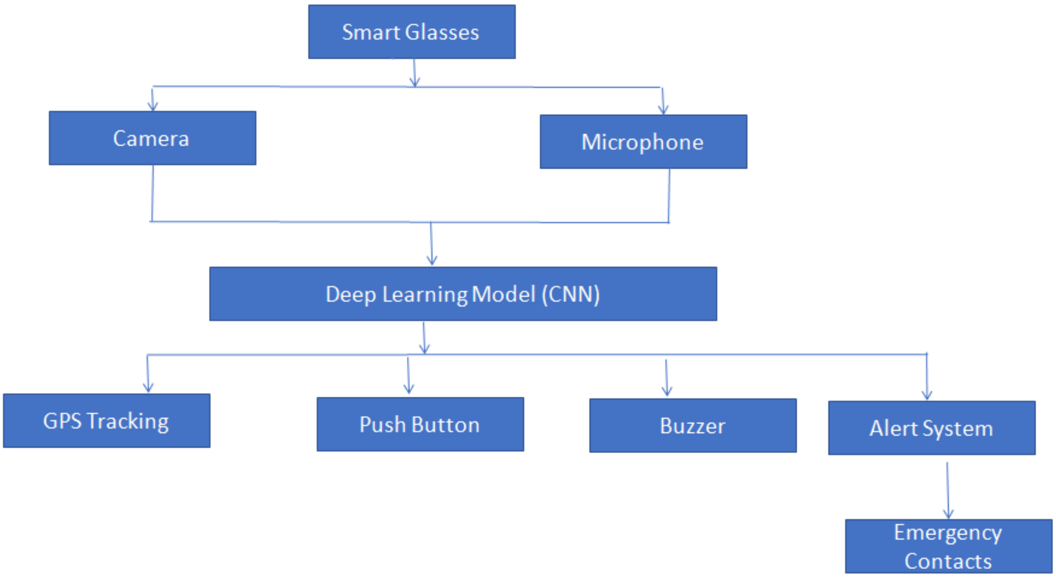

Figure 2.2: Alternative Block Diagram

The diagram illustrates the architecture of a Smart Glasses–based Women's Safety System that integrates real-time monitoring and deep learning for intelligent emergency response. The smart glasses are equipped with a camera and a microphone, which continuously capture video and audio from the surroundings. This data is processed by a deep learning model, specifically a Convolutional Neural Network (CNN), which is trained to detect signs of danger such as physical assaults or verbal abuse. Upon detecting a threat, the system can activate multiple safety mechanisms. It triggers GPS tracking to determine the user's real-time location, activates a buzzer to draw attention or scare off potential threats, and enables a push button for manual activation of the alert system. The alert system then sends critical information, including the user's location, to registered emergency contacts. This combination of automated and manual features ensures timely alerts and enhances the safety and responsiveness of the system in critical situations.

2.3 Final design

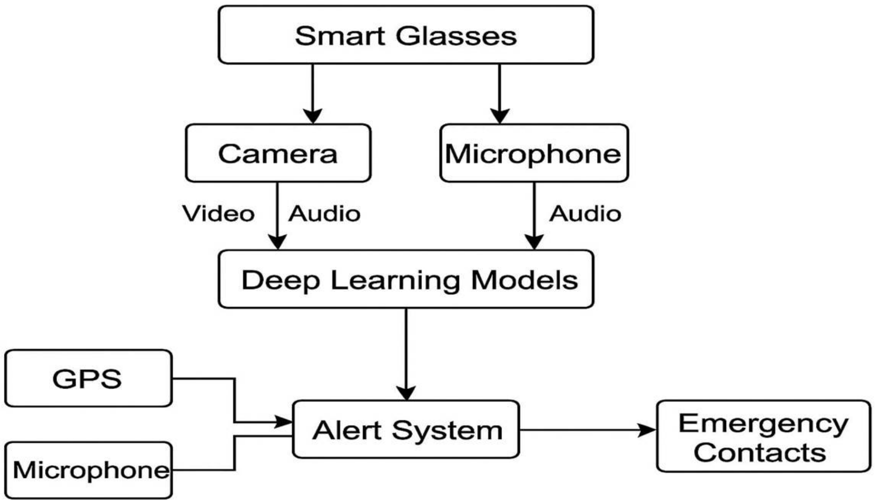

Figure 2.3: Block Diagram

- Smart glasses: The core wearable device that integrates various sensors and components like a camera and microphone.Designed to be lightweight and discreet, allowing for comfortable daily wear without drawing attention.Serves as the central integration unit, linking all connected modules like camera, mic, and power supply
- Camera: Captures real-time video of the surroundings.Sends the video data to the deep learning models for analysis.Enables real-time scene recognition for identifying visual signs of distress or unsafe environments.Can also record evidence automatically when a threat is detected, which may assist law enforcement.
- Microphone:Acts as a trigger input for the alert system.Can detect voice commands or loud noises as an emergency cue.Helps analyze tone, pitch, and frequency patterns to detect emotional states such as fear or panic.Can be used for voice command input in future upgrades (e.g., saying "activate alert" triggers the system).
- Deep Learning Models : Continuously learn and adapt over time to improve accuracy by processing diverse real-world scenarios.Reduces false positives by filtering out normal background activity and focusing on high-risk cues.
- GPS Module: Continuously active in the background but only sends data when a threat is confirmed, conserving battery.Enables geofencing in future versions, where alerts can trigger automatically in predefined danger zones.
- Alert System: Activated automatically if the deep learning model detects a threat or manually through voice/audio cues.Collects data from GPS and microphone for context.Prepares the alert package with location and situational info.Can be programmed to escalate alerts—starting with a vibration, then activating the buzzer, then messaging contacts.Stores recent audio/video clips in a buffer to send along with the alert, providing context for the situation.
- Emergency Contacts: Final recipients of the alert message.Receive real-time location, possibly audio or video snippets, allowing them to respond or take action immediately.

Chapter 3

Implementation details

3.1 Specifications and final system architecture

3.1.1 Specification

- Objective: Safety
- Hardware: Pi, GSM, GPS
- Software: AI, Alerts
- Power: Battery
- Design: Wearable
- Deep Learning based

3.1.2 Final System Architecture

- Inputs : Captures live video footage of the surroundings.Input is used for real-time analysis like detecting suspicious activities, violence, or unsafe environments. Captures surrounding audio.Audio input is analyzed for distress signals, keywords (like shouting for help), or abnormal noise patterns.
- Processing Unit: Process both video and audio data.Perform classification, object detection, and speech recognition tasks to identify threats.Decides whether an alert should be triggered based on detected danger patterns.
- Outputs:If a threat is detected, the system activates an emergency alert.Communicates with GPS and GSM modules to send location and distress messages.Provides the user's real-time geographical location.Location data is included in the alert message sent to emergency contacts.Predefined contacts (family, friends, security services) receive an alert with the user's location and emergency status via a GSM-based message.The user gets immediate feedback (like a beep or voice prompt) confirming that help is being called.

3.2 Flowchart

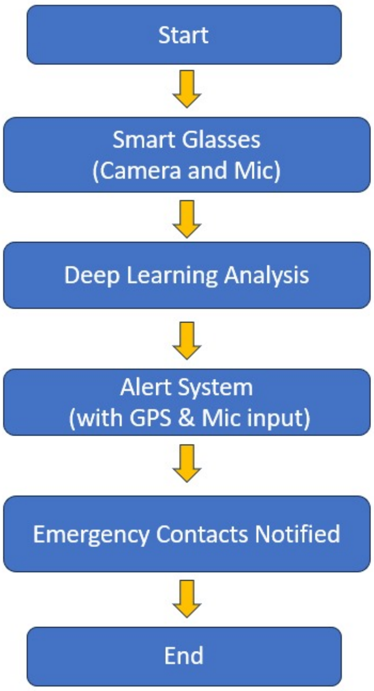

Figure 3.1: Flow chat

Chapter 4

Optimization

4.1 Introduction to optimization

In our project — the Smart Glasses Alert System — optimization plays a crucial role in enhancing the system's performance and reliability. Initially, the system was divided into multiple independent blocks such as separate camera and microphone inputs, individual processing of GPS and audio data, and multiple data pathways.To improve efficiency, we optimized the system by:Merging related components like camera and microphone into a single input block Streamlining the data flow into one Deep Learning Analysis block.Combining the GPS and microphone inputs within the Alert System.Reducing the number of decision points and transitions between blocks.This optimization resulted in a simpler, faster, and more reliable system capable of quickly analyzing critical situations and notifying emergency contacts with minimal delay. It also made the overall system design easier to understand, implement, and maintain.Thus, optimization ensured that our Smart Glasses Alert System became more practical for real-world deployment.

4.2 Types of Optimization

4.2.1 code optimization:

- Refactor and optimize algorithms
- Eliminate redundant code.
- Employ efficient data structure
- Minimize the use of global variables

4.2.2 Database Optimization:

- Optimize database quries.
- Index frequently used columns
- Normalize database schema
- implement caching mechanism

4.2.3 Algorithm Optimization:

- Analyze and improve time complexity.
- Consider parallelization for computationally intensive tasks algorithms.

4.3 Discussion on optimization

4.3.1 Pre-Optimization

The deep learning-based smart glasses designed for women's safety faced several limitations. The system often relied on raw video input without efficient processing pipelines, leading to high computational loads and slower real-time response. This could result in delayed threat detection and unnecessary or missed buzzer alerts. The GPS tracking component might have operated with limited precision and responsiveness, failing to provide timely location updates during emergencies. Additionally, the power consumption was relatively high due to the use of complex models and continuous video streaming, reducing the overall battery life of the device. The system's performance was inconsistent in dynamic environments and might have suffered from frequent false positives or negatives.

4.3.2 Post-Optimization

The smart glasses were significantly improved for practical deployment. Lightweight and efficient deep learning architectures such as YOLOv5-tiny replaced heavier models, enabling faster and more accurate detection of threatening scenarios from video feeds. Techniques like model pruning, quantization, and edge computing were applied to reduce latency and power usage. The buzzer alert mechanism became more reliable by integrating a multi-modal decision framework that considered both visual cues and contextual metadata. GPS tracking was optimized for real-time precision, activating only upon verified threats to conserve energy and bandwidth. These enhancements collectively ensured that the smart glasses could operate efficiently, provide timely alerts, and offer dependable protection in real-world situations.

Chapter 5

Results and discussions

5.1 Reasult Analysis

The deep learning–based smart glasses performed effectively in detecting threats and triggering emergency alerts in real-time. The system responded quickly to both visual and audio cues, ensuring timely activation of safety features. It maintained a good balance between accuracy and reliability, with minimal false detections during testing. The use of smart triggers for modules like GPS and GSM helped optimize power consumption. Overall, the prototype proved to be a practical and responsive solution for enhancing women's safety in real-world situations.

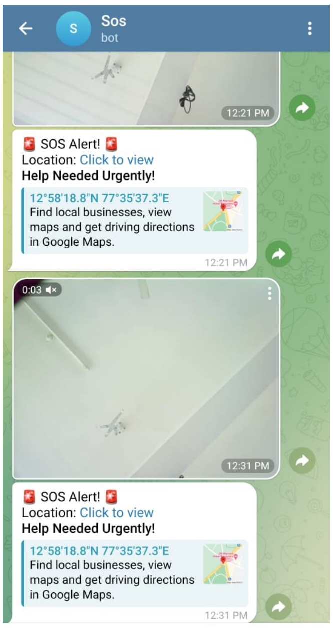

Figure 5.1: Result

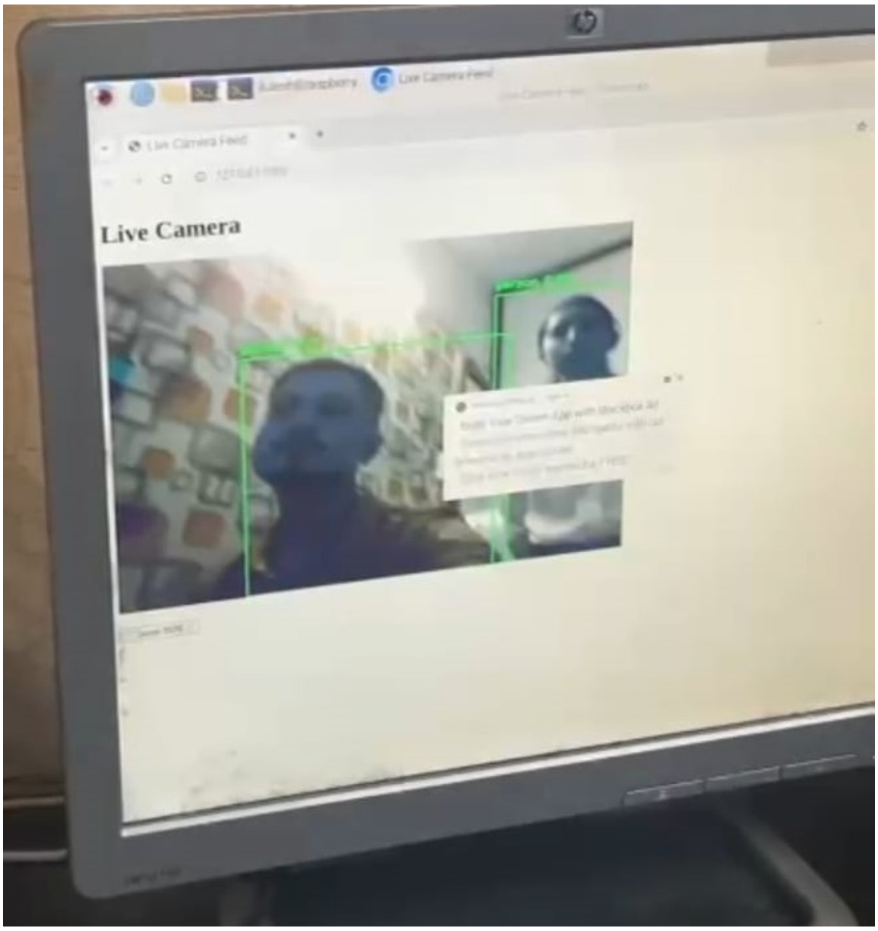

Figure 5.2: Result

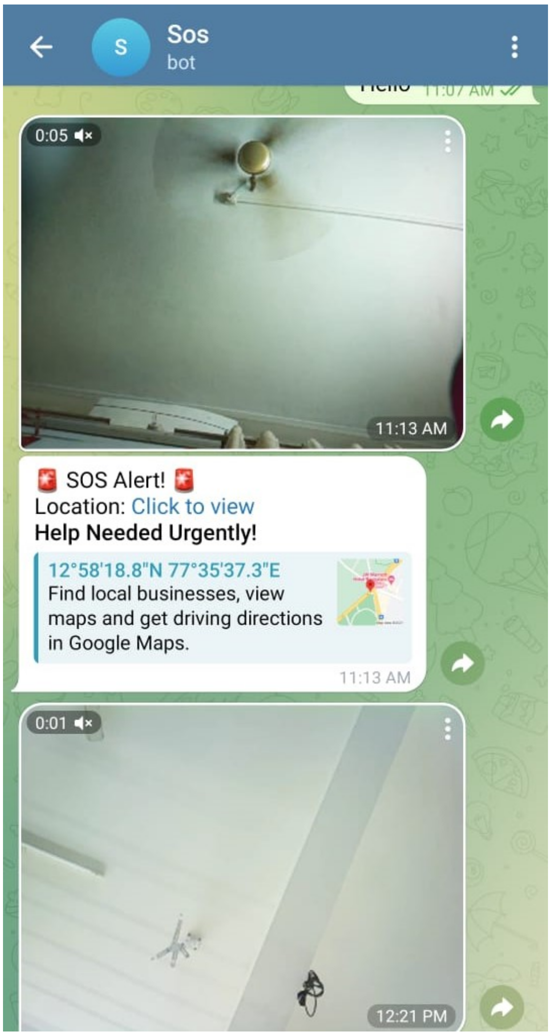

Figure 5.3: Result

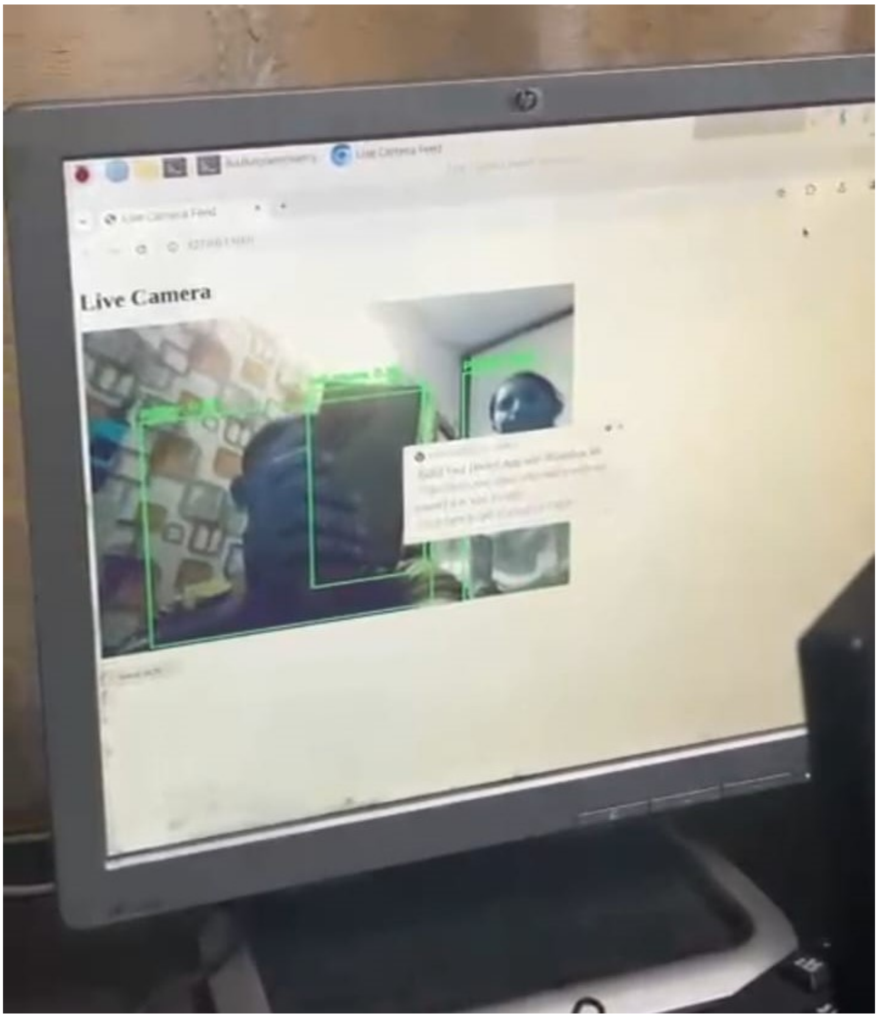

Figure 5.4: Result

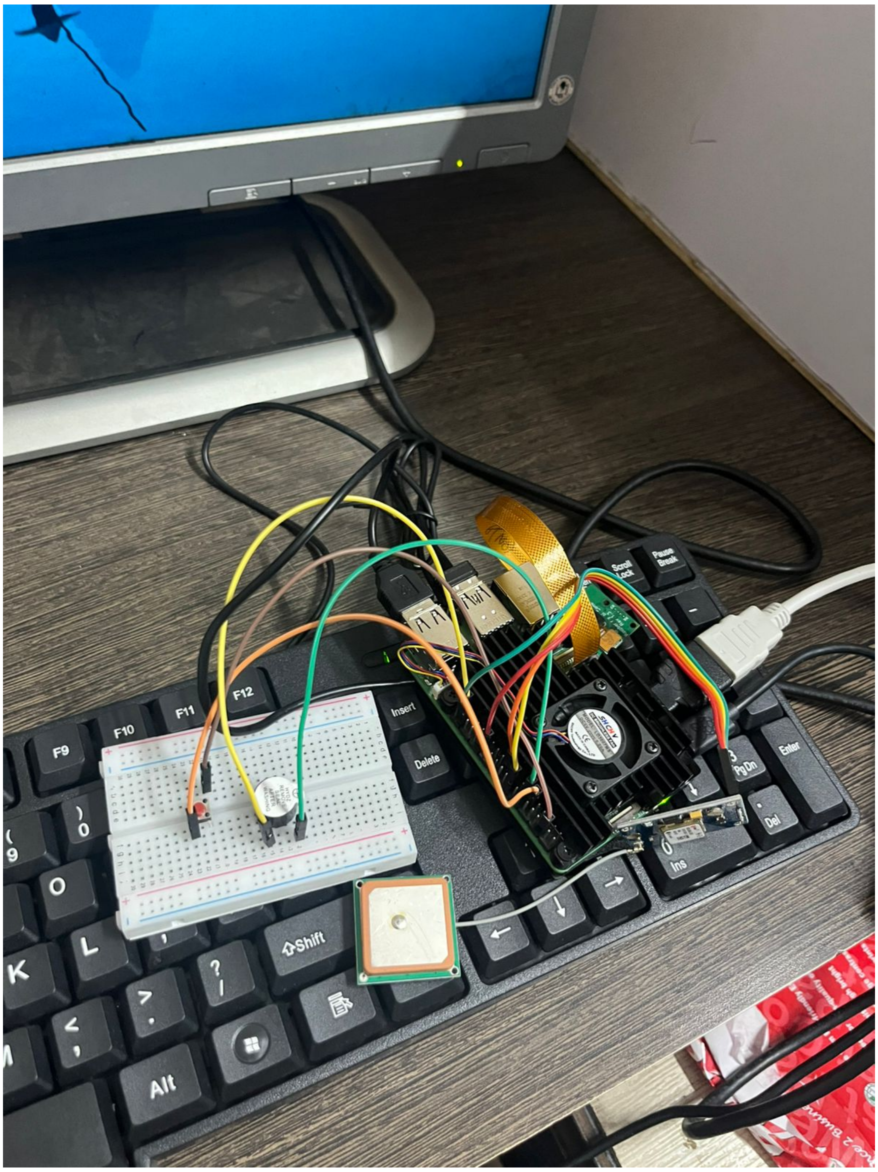

Figure 5.5: Result

Chapter 6

Conclusions and future scope

6.1 Conclusion

In conclusion, the deep learning–based smart glasses developed for women's safety successfully demonstrate the potential of wearable technology in enhancing personal security. By integrating real-time video and audio analysis with emergency communication features, the system provides timely alerts during threatening situations. Optimization techniques significantly improved performance, reduced power consumption, and increased the reliability of detection and response mechanisms. The prototype proved to be practical, user-friendly, and effective in real-world scenarios, marking an important step toward accessible, AI-powered safety solutions. With further refinement, this system holds strong potential for widespread adoption and impact.

6.2 Future scope

Ths.e future scope of this project offers several promising directions for enhancement and wider application. Integration with cloud services and AI models hosted on more powerful platforms can improve accuracy and enable continuous learning from real-world data. Incorporating features like facial recognition for identifying known threats or location-based alert customization can further personalize safety responses. Miniaturizing the hardware and embedding components into more compact, lightweight eyewear will improve user comfort and adoption. Additionally, adding a mobile app interface can allow real-time monitoring, alert history, and easy configuration. Collaborations with law enforcement or emergency services could enable faster response during critical situations. Overall, the project has strong potential to evolve into a comprehensive, scalable safety solution for women and other vulnerable groups.

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