Intrusion Detection With Face Recognition

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1 Problem Statement

In today's world, security threats are constantly evolving, making it crucial to enhance both digital and physical security measures. Traditional security systems often struggle to effectively detect and prevent unauthorized access attempts. Integrating face recognition technology into Intrusion Detection Systems (IDS) offers a promising solution to strengthen security. By leveraging face recognition, we can add an additional layer of authentication, making it harder for unauthorized individuals to gain access. However, this integration presents challenges such as ensuring accuracy, addressing privacy concerns, and seamless integration. This project aims to develop an Intrusion Detection System with Face Recognition (IDS-FR) that effectively detects and prevents unauthorized access attempts, enhancing overall security.

2 Goals of System

Better Security: Make a system that can spot and stop people trying to get in where they shouldn't.

Quick Detection: Set it up so that it spots intruders right away.

Face Check: Use face recognition to make sure only the right people can get in.

Easy to Grow: Make it so we can add more stuff to the system easily.

3 System Architecture

The system is designed to detect and recognize faces using a camera and notify when an intruder is detected. It consists of several components working together to achieve its objectives.

3.1 Overview

- The system captures video from a webcam and processes it in real-time to detect faces.
- If a recognized face is detected, the person's name is displayed on the screen.
- If an unrecognized face is detected, a beep sound is played to alert of a potential intruder.

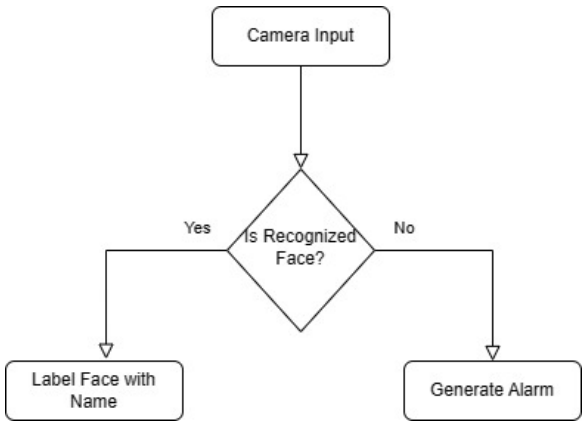

Figure 1: System flow overview

3.2 Dependencies

Our system relies on two main libraries:

- **OpenCV:** For webcam interface and image processing.
- **face_recognition:** For face detection and recognition.

Additionally, we use the **winsound** library to play a beep sound when an intruder is detected.

3.3 Data Flow

- Images captured by the webcam are processed by the face recognition module.
- The face_recognition library detects faces in the image and compares them with known faces to determine recognition.
- Detected faces are then displayed on the screen with their respective names or marked as "Intruder" if unrecognized.

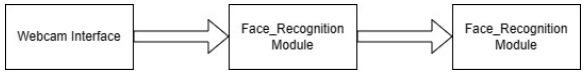

Figure 2: Data Flow Diagram

3.4 Classes

Our System has three major classes:

- Webcam
- FaceRecognition
- UserInterface

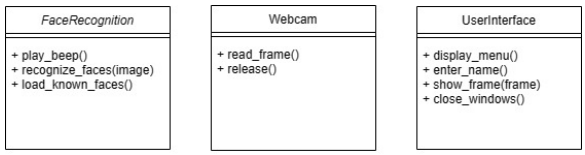

Figure 3: Class Diagram

3.5 Functionality

- **play_beep():** Plays a beep sound to indicate an intruder.
- **recognize_faces(image):** Recognizes faces in the given image and displays the name if recognized.
- **add_person(name):** Adds a new person to the dataset by capturing and saving images from the webcam.
- **load_known_faces():** Loads known faces and names from the dataset directory.

3.6 Integration

- The **main()** function serves as the entry point of the system.
- It offers two options through a console menu:
  - Continuation with face recognition (Option 1)
  - Adding a new person (Option 2)
- The **recognize_faces(image)** function integrates face recognition with webcam input and alerts.

4 Description of Algorithms and Techniques Employed

4.1 face_recognition Library

Purpose: Used for face detection and recognition.
Description: The face_recognition library is built using dlib's state-of-the-art face recognition built with deep learning. It uses deep neural networks to recognize and manipulate faces in images and videos.
Application: The library provides accurate face detection and recognition capabilities suitable for real-time applications.

4.2 OpenCV (cv2) Library

Purpose: Used for image and video processing.
Description: penCV (Open Source Computer Vision Library) is an open-source computer vision and machine learning software library. It provides various functions for image and video processing, including capturing video from webcams, image manipulation, and feature detection.
Application: OpenCV is widely used in computer vision applications for tasks such as object detection, image recognition, and video analysis.

5 Dataset

In the development of the Intrusion Detection System with Face Recognition, a dataset of known faces was utilized. This dataset consists of images of individuals whose faces the system should recognize. Each individual's images were stored in a separate directory within the dataset folder.

The dataset was used for:

- Images in the dataset were used to train the face recognition model. Each image was associated with the corresponding individual's identity.
- The model learned to recognize these individuals during the training process.

The dataset was carefully curated to include diverse images of individuals under different lighting conditions, angles, and facial expressions to ensure robustness and accuracy in face recognition.

This dataset was crucial in training and evaluating the performance of the face recognition system. It provided the necessary input for the model to learn and generalize patterns for accurate face recognition.

6 Implementation

6.1 Description of Tools and Technologies Used

The Intrusion Detection System with Face Recognition was developed using the following tools and technologies:

- Python
- OpenCV
- face_recognition

6.2 Details of the Development Environment

The system deployment is tested with:

- **Operating System:** Windows 10
- **IDE:** Visual Studio Code
- **Python version:** 3.11.9

7 Conclusion

In conclusion, the Intrusion Detection System with Face Recognition presents a robust solution for enhancing security in various environments. By leveraging the power of computer vision and machine learning, we have developed a system capable of accurately identifying individuals and preventing unauthorized access. The successful implementation of this project underscores the importance of technological advancements in improving security measures and lays the foundation for future developments in this field.