Access Vision

“A smart system monitors student entry based on face recognition technology”

By

Saud Ahmad

Project Overview

This project introduces a groundbreaking Face Recognition-Based Student Entry System designed to improve how educational institutions manage student access. By integrating sophisticated facial recognition technology with Arduino hardware, this system enhances both security and operational efficiency at school entry points.

At its core, the system uses cameras activated by ultrasonic sensors to capture images of students as they approach. These images are instantly checked against stored labeled images to confirm each student's identity, ensuring only recognized individuals can enter. This quick and accurate identification process not only boosts security but also speeds up entry, making it smoother for students to get to their institute/classes.

A significant advantage of this system is its compatibility with general-purpose computers. Schools can install it on their existing systems without needing extra hardware, making it an economical and practical solution for enhancing entry management.

Easy to set up and operate, the system can be up and running in no time, offering immediate improvements to a school's safety measures and entry procedures. This project exemplifies how advanced technology can be effectively used in educational settings to ensure a safe and efficient environment for students and staff alike

Key Features

- **Automated Face Recognition**: Central to this system is its high-tech facial recognition capability. The system has been meticulously trained using a database of student photographs to recognize individuals accurately. When someone enters the designated detection area, the system automatically captures a photo. If the system recognizes the individual as a registered student, it records their details; if it cannot identify the person, it displays "Unknown." This feature ensures quick and accurate tracking of all student movements without manual checks.

- **Entry and Exit Tracking**: The system uses separate setups of cameras and sensors at entry and exit points. These are specifically tailored to activate when a student approaches. The sensors trigger the appropriate camera to capture the student's image, which is then processed for identification. This method ensures that the system precisely monitors and records each entry and exit, maintaining an accurate log of student attendance.

- **Arduino Integration**: To enhance the system's efficiency, it includes Arduino microcontrollers equipped with ultrasonic sensors. These sensors are crucial for detecting someone's presence at entry and exit points. Upon detection, they immediately instruct the cameras to activate and capture the necessary images for facial recognition. This integration facilitates a smooth and automated operation, ensuring the system responds promptly to student movements.

- **Robust Data Management**: As the system recognizes faces, it immediately logs all pertinent information into a CSV file. This process occurs in real-time, ensuring that the attendance data is always current and accurately reflects student entries and exits. This robust data management is essential for maintaining reliable records, which can be used for administrative purposes and to enhance security protocols within the institution.

- **Cost effective:** This project is designed to work with general-purpose computers, which means that educational institutions can easily install it on their existing computer systems without the need for additional hardware investment. This feature makes it a cost-effective solution for enhancing entry management without incurring extra expenses.

Workflow

Image Encoding: Initially the system encodes faces from a collection of stored images located in a designated folder. These images must follow a specific naming convention that uniquely identifies each student. This encoding process involves analyzing each image and converting it into a data format that the facial recognition software can utilize for comparison purposes. This prepared data serves as a reference to accurately identify students when they pass in front of the camera.

Real-Time Face Detection: The system uses cameras placed at entry and exit points to monitor students. These cameras are activated by Arduino with ultrasonic sensors when they detect a student within a certain range. This setup ensures that the cameras only capture video when necessary, making the process more efficient. Once activated, the cameras capture images of the approaching or departing students. The facial recognition system then analyzes these images by comparing them to previously stored facial data. This comparison helps determine if the individual is a recognized student. If the person matches someone in the system, their movement is recorded; if not, they are marked as "Unknown." This process ensures accurate tracking of student entries and exits, keeping the entry records precise and up to date.

Attendance Logging: The integration of Arduino with ultrasonic sensors is pivotal in ensuring the accurate functioning of the facial recognition system, particularly in determining when to activate the cameras. The Arduino's role is to detect the presence of a student within a specific range using ultrasonic sensors. Once a student is detected, the Arduino triggers the cameras to start capturing images. This precise activation is crucial because it ensures that the cameras only record the faces of students actively entering or exiting, rather than capturing the faces of students passing by without the intent to enter or exit.

Installation Guide

This guide provides detailed instructions on how to set up and install the necessary components for the Face Recognition-Based Student Attendance System. By following these steps, you can ensure that your system is configured correctly and ready to accurately track student entries and exits.

Prerequisites

Before starting the installation, ensure you have the following software and tools:

1. **Python 3.8 or higher**: The core programming language used for the project.
2. **Libraries**: OpenCV, face_recognition, pywinauto, pandas, numpy, and matplotlib. These libraries are used for image processing, interface automation, and data handling.
3. **Arduino IDE**: Required for programming and configuring the Arduino device.
4. **CoolTerm software**: Used for managing serial communication between the PC and Arduino.

Environment Setup

1. **Install Python**: Download and install Python 3.8 or a newer version from the official Python website. Ensure Python is added to your system's PATH.
2. **Install Libraries**: Open your command prompt or terminal and install the required Python libraries by running:

Copy code

```
pip install opencv-python face_recognition pywinauto pandas numpy
```

This command will download and install all necessary libraries that the system needs to function.

Arduino Configuration

1. **Install Arduino IDE**: Download and install the Arduino IDE from the official Arduino website. This software allows you to write and upload code to Arduino hardware.
2. **Setup Hardware**: Connect your Arduino device to your computer using a USB cable.
3. **Load Sketch**: Open the Arduino IDE, load the provided Arduino sketch file into the editor, and upload it to your Arduino. This sketch will configure your Arduino to interact with the ultrasonic sensors and control the camera triggers.

CoolTerm Configuration

1. **Install CoolTerm**: Download CoolTerm from its official website and install it on your computer.
2. **Configure CoolTerm**: Launch CoolTerm and configure it to connect to the Arduino. Set the correct COM port and baud rate as specified in your Arduino sketch. This setup is crucial for ensuring smooth communication between your computer and the Arduino.

Project Configuration

1. **Clone the Repository**: Download or clone the project repository to your local machine. Make sure all files are intact and correctly organized in your chosen directory.
2. **Verify File Paths**: Check and adjust file paths in the scripts to match the locations on your computer where you've stored the project files and images. This step is crucial to avoid errors related to file not found or incorrect paths.

By carefully following these setup instructions, you will establish a solid foundation for your Face Recognition-Based Student Attendance System, ensuring it operates smoothly and efficiently.

Conclusion

This Face Recognition-Based Student Entry System marks a transformative step in managing and monitoring student access in educational environments. By utilizing advanced facial recognition technology paired with Arduino-driven hardware, the system provides a robust and automated method for controlling entry and exit points effectively. The straightforward setup and user-friendly operation allow institutions to implement this system efficiently, ensuring a secure and streamlined entry process. Overall, this project leverages cutting-edge technology to enhance the safety and operational efficiency of educational facilities, demonstrating a significant innovation in entry management systems.