



The Face Recognition Smart Lock System

Revolutionizing access control with cutting-edge facial authentication, integrating IoT and computer vision for unparalleled security and convenience.

Addressing Modern Security Challenges

Traditional locks pose significant vulnerabilities, from theft and duplication to loss of keys, compromising security in an increasingly connected world. The demand for intelligent, user-friendly, and cost-effective contactless access control is critical.

Traditional Vulnerabilities

Prone to theft, key duplication, and loss, leading to compromised security and high replacement costs.

Rising Demand for Smart Solutions

Increasing need for intelligent, user-friendly, and contactless access control systems in modern environments.

Seamless, Secure Access

A solution that offers real-time facial authentication for enhanced reliability and peace of mind.

Why Face Recognition?

Face recognition technology is transforming secure access. Many current solutions are expensive or complex. Our project develops a smart, scalable, and educational system that combines facial recognition with IoT-based access control, offering practical experience in AI, IoT, and security.



Cost-Effective & Flexible

Designed to be an affordable and adaptable alternative to complex, proprietary systems.



Practical Learning Experience

Provides hands-on engagement with computer vision, real-time processing, and smart automation.



Real-World Implementation

Ideal for homes, offices, and institutional settings, demonstrating the power of AI and IoT in security.

Project Objectives & Core Features

Our primary objective is to develop a smart and secure IoT-based face recognition lock system. This system will authenticate users through facial recognition, providing a contactless, reliable, and user-friendly alternative to traditional locks with real-time feedback and access logging.



Real-time Recognition

Utilizes a camera and advanced computer vision algorithms for instant face detection.



Secure Access Control

Replaces physical keys and PINs with robust facial authentication.



Microcontroller Integration

Leverages Raspberry Pi/ESP32 for efficient processing and control.



Automated Lock Actuation

Activates a servo motor or electronic lock upon successful facial match.



Intuitive GUI & Logs

A graphical user interface displays system status, recognition results, and access logs.



Cloud Data Management

Optional cloud database integration for scalable user data storage and management.

Development Methodology

Our project development follows a structured approach, encompassing hardware setup, advanced face recognition programming, and robust control logic, ensuring a comprehensive and functional system.

Hardware Setup

Connecting the ESP32-CAM module, FTDI programmer, and SG90 servo motor for system foundation.

Access Control Logic

Defining rules for servo actuation based on recognition, handling unauthorized attempts, and maintaining detailed access logs.

Face Recognition & Web Programming

Deploying OpenCV for real-time detection, storing facial data, and developing a web-based control panel for remote access.

UI Integration

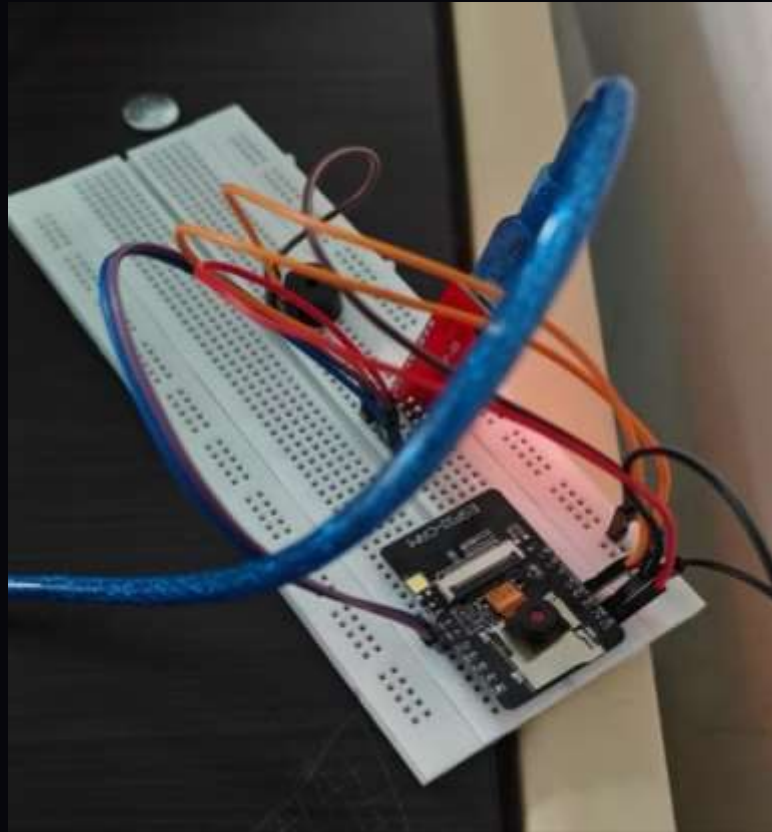
Enabling remote monitoring of logs, camera feeds, and user management through a browser or custom application.

Key Technologies & Components

This project leverages a combination of widely available hardware and open-source software, making it both practical and accessible for development and deployment.

Hardware

- ESP32-CAM (camera module & microcontroller)
- Breadboard & Jumper Wires (circuit assembly)
- SG90 Servo Motor (lock mechanism)
- FTDI Programmer (ESP32-CAM programming)
- Computer/Laptop (for UI interaction)



Software

- Arduino IDE (microcontroller programming)
- HTML, CSS (web interface development)
- Blynk IoT Application (IoT connectivity)
- Libraries: PySerial, Tkinter (GUI support)
- Code Editor: VS Code (development environment)



Robust Testing & Evaluation

Comprehensive unit testing ensures the system's reliability, responsiveness, and accuracy in various scenarios, while key metrics validate data flow and UI performance.

Unit Testing

- **Access Validation:** Confirm correct lock behavior for authorized and unauthorized faces.
- **Response Time:** Measure activation speed from detection to lock mechanism.
- **Auto-Lock Feature:** Verify the door relocks after a specified duration.

Evaluation Metrics

- **Data Transmission:** Verify seamless data flow between camera, recognition, and controller.
- **UI Accuracy:** Ensure real-time display of "Access Granted" or "Denied" messages.
- **Log & Error Handling:** Confirm proper updates and error triggers for system issues.



Future Prospects & Contributions

The Face Recognition Smart Lock System is a practical, real-world solution that integrates basic electronics with advanced software. It serves as an excellent foundation for future smart systems, empowering learners to explore advanced technologies while creating tangible solutions.

Enhanced Home Security

Offers a secure, keyless entry for residential properties.

Office & Institutional Access

Streamlines entry management in professional environments.

IoT Automation Learning

Provides a hands-on platform for understanding IoT integration and computer vision.

Scalable & Adaptable

Modular design allows for easy upgrades and new features, such as wireless communication or mobile app integration.