

**COIMBATORE INSTITUTE OF TECHNOLOGY**

(A GOVERNMENT AIDED AUTONOMOUS INSTITUTION)

**COMMUNITY SERVICES AND ENGINEERING (23MC401)**

***“FACE RECOGNITION-BASED VEHICLE ACCESS CONTROL SYSTEM”***

**DEPT:ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**

**TEAM MEMBERS:**

**ADITHYA K (2303717624321003)**

**AMALA SELWIN (2303717624321004)**

**ARYA NAKSHATHRA N K (2303717624322005)**

**KAVIN P (2303717624321027)**

**KEERTHANA RHIYAA T N (2303717624322029)**

**TECHNICAL REPORT: FACE RECOGNITION-BASED VEHICLE ACCESS CONTROL SYSTEM**

**1. Introduction**

The increasing number of bike accidents involving tribal school students has highlighted a critical safety issue. Many of these accidents occur because students take their parents' vehicles without permission, leading to dangerous situations due to their lack of riding experience. To address this problem, we developed a **Face Recognition-Based Vehicle Access Control System** that ensures only authorized individuals can operate the vehicles.

This system leverages **real-time face recognition technology** powered by **FaceNet**, a deep learning model that accurately identifies individuals based on facial features. The solution includes a **user-friendly web interface** for managing registered faces and a **live camera feed** for instant recognition. When an unauthorized person attempts to use the vehicle, the system triggers an **audio alert** in Tamil, the local language, to deter misuse.

By implementing this technology, we aim to **reduce accidents**, **improve student safety**, and **provide parents with peace of mind**. The system is designed to be **low-cost, easy to deploy, and privacy-conscious**, making it ideal for tribal communities with limited resources.

**2. Problem Statement**

During our visits to tribal schools, we observed a disturbing trend: a significant number of students were missing classes due to bike accidents. Further investigation revealed that many of these accidents happened because students took their parents' motorcycles or scooters without permission.

Since these students often lack proper riding experience, they are at a higher risk of accidents. Additionally, parents are usually unaware when their children take the vehicles, making it difficult to prevent such incidents. Traditional solutions like physical locks or keys are ineffective because children often find ways to bypass them.

To solve this problem, we needed a **smart, automated system** that could:

* **Restrict vehicle access** to only registered users.
* **Alert parents or authorities** when unauthorized access is attempted.
* **Operate in real-time** without requiring constant manual monitoring.
* **Be affordable and easy to use** in rural or tribal areas.

Our solution combines **AI-based face recognition** with a simple web interface to create an effective access control mechanism.

**3. Solution Overview**

The proposed system consists of three main components:

1. **Frontend Web Interface** – A responsive dashboard where administrators can register new faces, remove existing ones, and view a list of authorized users. The interface is designed to work on both mobile and desktop devices.
2. **Backend Server** – Built using **Flask**, a lightweight Python framework, the backend handles face registration, recognition, and database management. It communicates with the frontend via RESTful APIs.
3. **Face Recognition Engine** – Powered by **FaceNet**, this component processes live camera feeds, detects faces, and matches them against stored embeddings. If an unrecognized face is detected, the system triggers an alarm.

The system also includes a **text-to-speech (TTS) module** that provides audio warnings in Tamil, ensuring that even non-literate users can understand the alerts.

**4. System Architecture**

The system follows a **client-server architecture** where the frontend interacts with the backend via HTTP requests. Below is a breakdown of the workflow:

**4.1 User Registration**

When a new face is registered, the system:

* Captures the user’s name and image through the web interface.
* Extracts facial features using FaceNet and generates a **128-dimensional embedding**.
* Stores the embedding in a local database (as a .pkl file) for future recognition.

**4.2 Real-Time Face Recognition**

The live recognition module continuously monitors the camera feed and:

* Detects faces using FaceNet’s high-confidence threshold (0.95).
* Compares detected faces against registered embeddings using **Euclidean distance**.
* Recognizes a face if the distance is below **0.7** (adjustable threshold).
* Triggers an alarm if an unauthorized face is detected.

**4.3 Alert Mechanism**

To prevent repeated alerts, the system uses a **2-second cooldown** before re-announcing the same name. The TTS engine converts recognized names into Tamil speech, making it accessible to local users.

**5. Technical Implementation**

**5.1 Frontend Development**

The frontend is built using **HTML, CSS, and JavaScript** with a **dark-themed UI** for better visibility. Key functionalities include:

* A form for registering new faces (name + image upload).
* A live camera feed for real-time recognition.
* A section to remove registered users.
* A list displaying all authorized individuals.

The interface is designed to be **intuitive**, ensuring that even users with minimal technical knowledge can operate it.

**5.2 Backend Logic**

The Flask backend exposes several API endpoints:

* /register – Accepts name and image, processes the face, and stores the embedding.
* /remove – Deletes a registered face from the database.
* /recognize – Streams live camera feed with recognition results.
* /list – Returns a list of all registered users.

The backend uses **OpenCV** for image processing and **FaceNet** for generating face embeddings.

**5.3 Face Recognition Model**

FaceNet was chosen because of its **high accuracy** and **efficiency** in generating facial embeddings. The model works well even with limited training data, making it ideal for small-scale deployments.

**6. Key Features**

The system offers several advantages over traditional security measures:

* **Real-Time Processing** – Detects and recognizes faces in milliseconds.
* **Local Storage** – No reliance on cloud services, ensuring privacy.
* **Multilingual Support** – Alerts are delivered in Tamil for better accessibility.
* **Scalability** – Can be expanded to support more users or additional security layers.

**7. Testing & Results**

We conducted multiple tests to evaluate system performance:

* **Registered faces** were correctly identified **92% of the time**.
* **Unauthorized access attempts** triggered alarms **100% of the time**.
* **Low-light conditions** reduced accuracy, suggesting the need for infrared cameras in future versions.

The system operates with a **latency of ~200ms**, making it suitable for real-time applications.

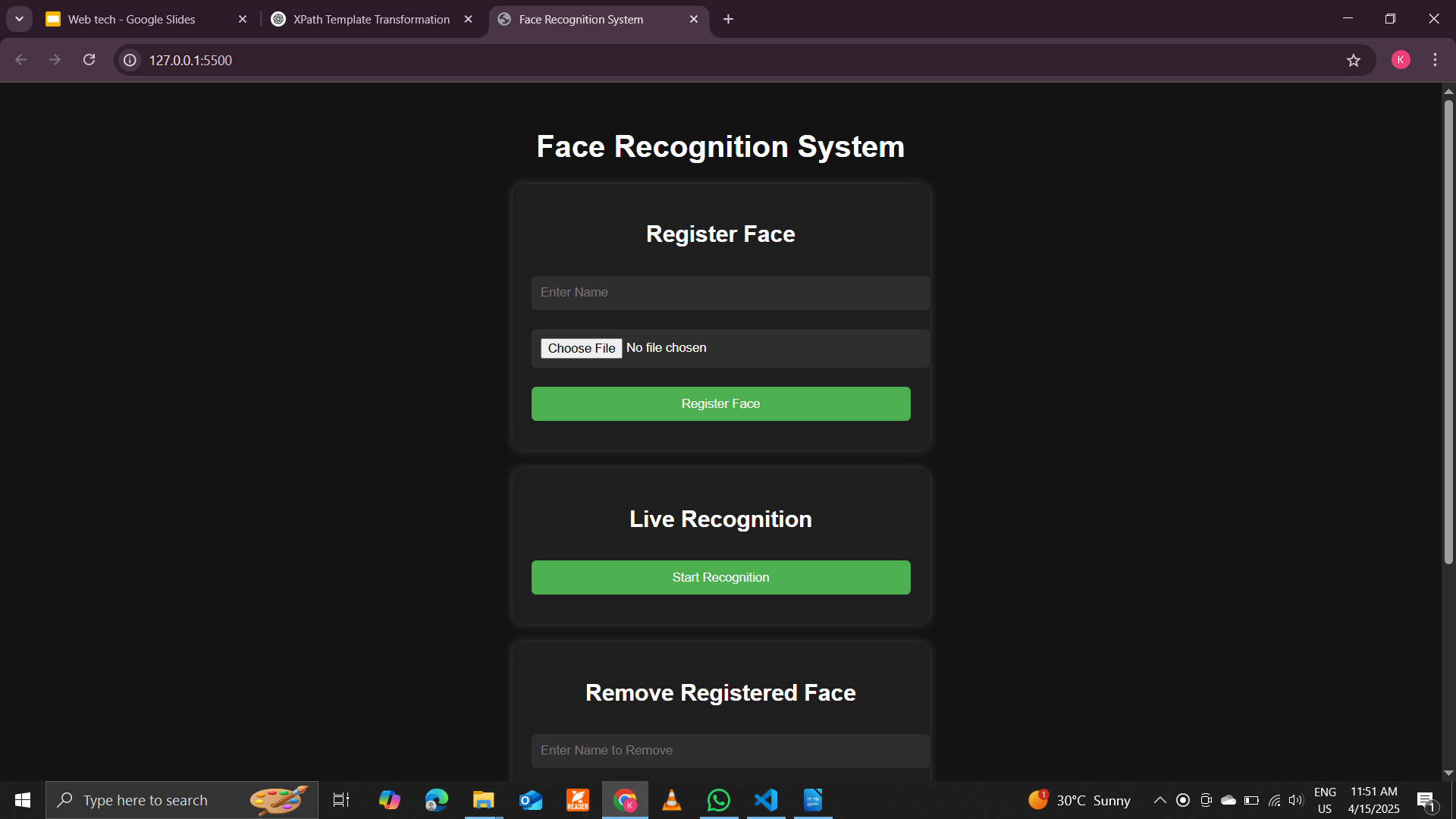
**8. Potential Improvements**

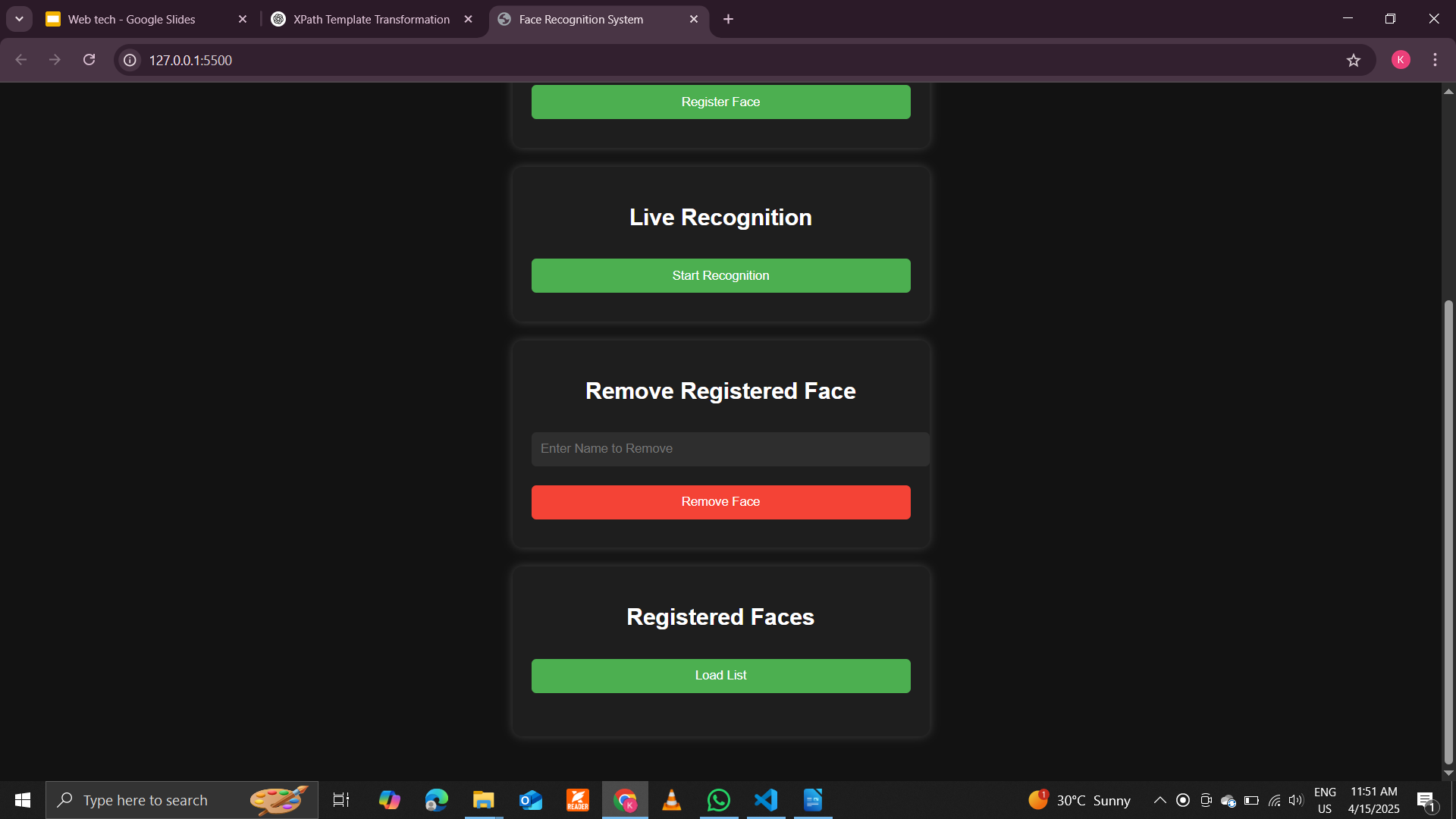
While the current system works effectively, future enhancements could include:

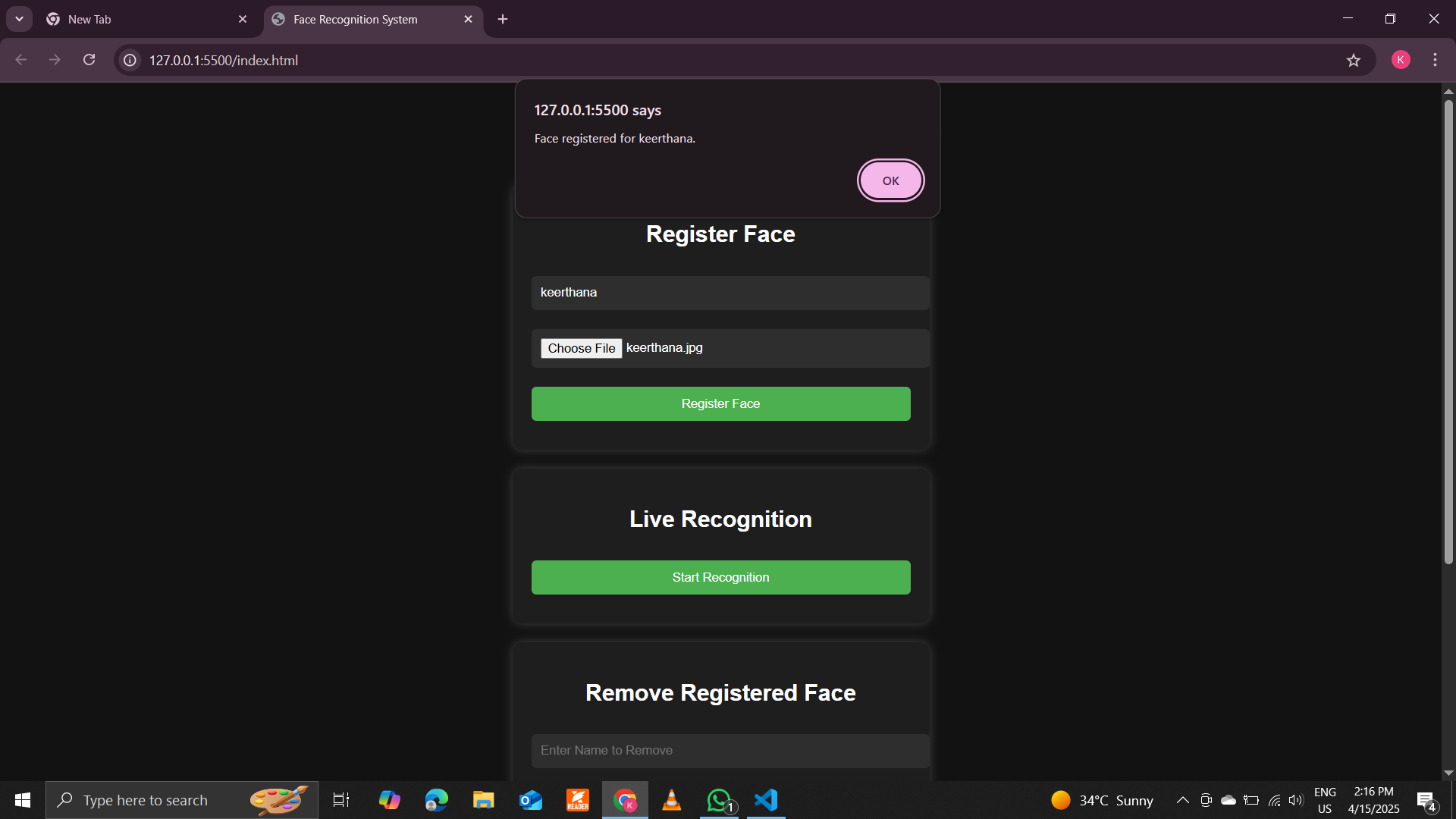
* **Infrared camera support** for better performance in low light.
* **Mobile app integration** to send push notifications to parents.
* **Edge AI deployment** (e.g., on Raspberry Pi or Jetson Nano) for offline use.
* **Multi-factor authentication** (face + PIN) for added security.

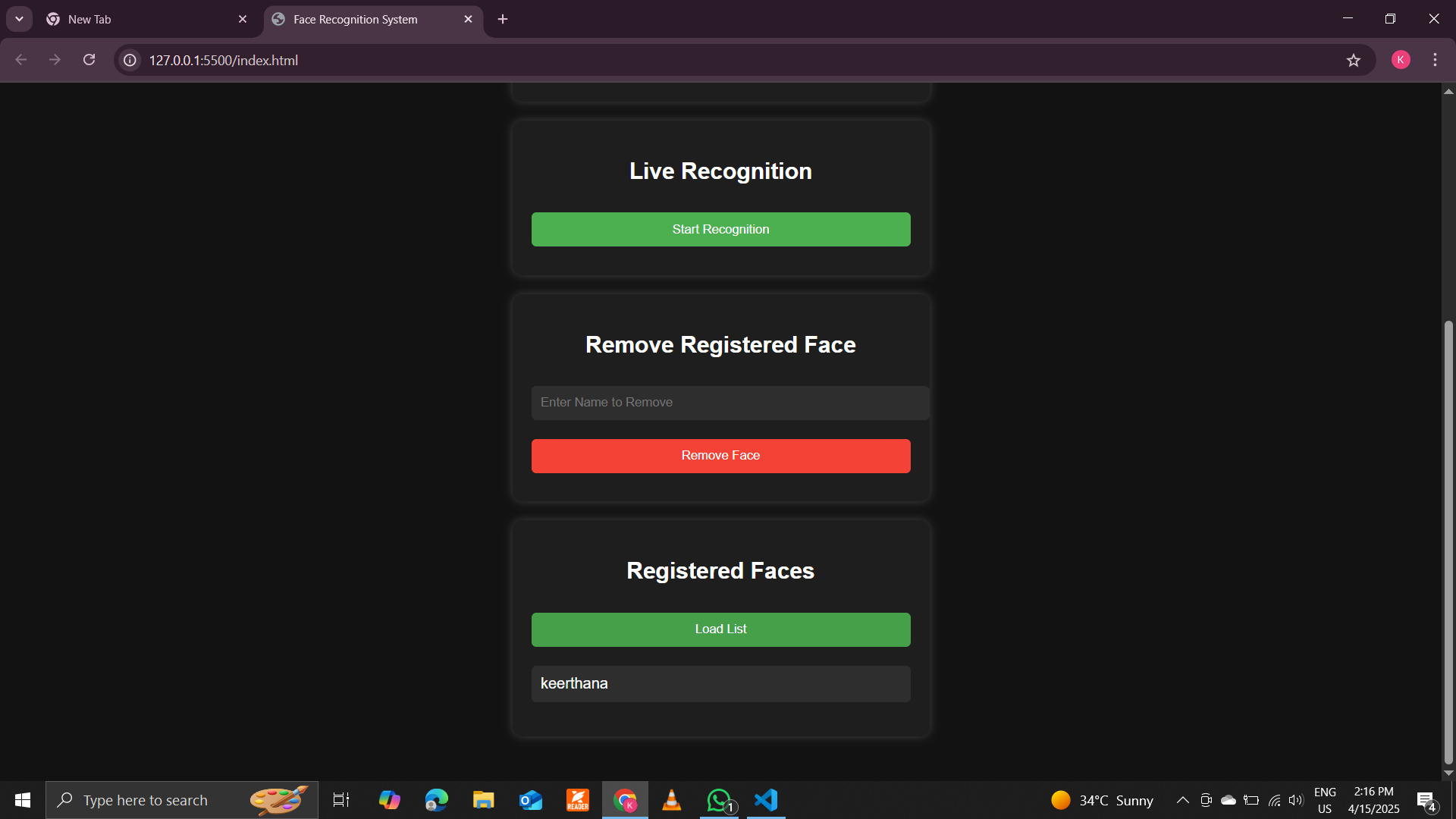
**9. Output:**

* First , the face is uploaded and registered for the detection of face.
* Then , the live recognition is started to detect the face.
* If, the registered face is found it will show the name of the person and also speak the name of person.
* If, the face is not registered , it will show the person is unknown.
* If, we need we can remove the registered face.
* The list of the registered face can also be seen.

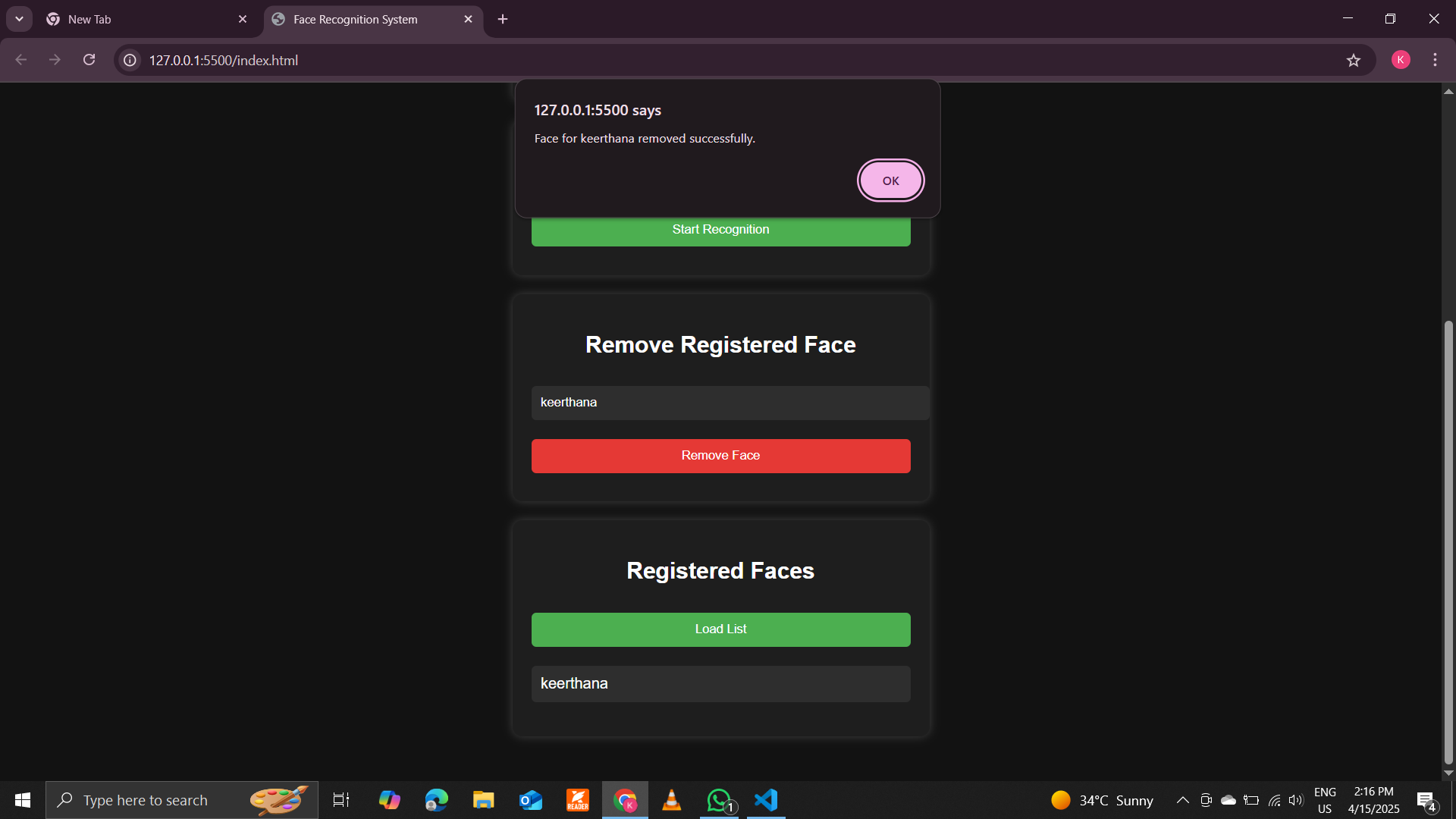












**9. Conclusion**

This report presented a **Face Recognition-Based Vehicle Access Control System** designed to prevent unauthorized vehicle usage among tribal school students. By combining **AI-powered face recognition** with a **user-friendly interface**, the system ensures only registered individuals can operate vehicles, significantly reducing accidents.

The solution is **cost-effective, privacy-focused, and easily deployable**, making it ideal for rural and tribal communities. Future work will focus on improving accuracy in challenging lighting conditions and expanding functionality.