Face Recognition using Portenta H7

Vatsal Mahajan, Manoj Selvaraju & Vijay Singh

University of Applied Sciences
HOCHSCHULE EMDEN·LEER

Topic Description

The goal of our project is to develop a face recognition-based access control system using machine learning. The project involves capturing facial images using the Vision Shield, preprocessing the data, training a CNN-based model with Edge Impulse and optimizing it for real-time inference on the Arduino Portenta H7. The system includes profile management functionalities such as adding and deleting users to enhance security and flexibility.

Description of our Application

Dataset: Three distinct images representing Person1, Person2, and Person3.

Features:

Facial features which are used to distinguish between individuals.

Image Type:

The images used are grayscale, simplifying the model's task of feature extraction.

Model:

A CNN-based MobileNetV2 model is used, capable of distinguishing between different people for accurate classification.

Hardware:

The system uses an Arduino Portenta H7, Vision Shield and a USB-C cable to facilitate the recognition process.

Software:

Arduino IDE, Edge Impulse CLI, Python and Node.js for implementing and deploying the model.

Challenges

Optimised Image Resolution:

Building the model using higher resolutions, such as QVGA (320x240) or lower than QQVGA (128x96) from the Vision Shield camera, led to significant overfitting issues.

Profile Management:

Attempted to add new profiles and retrain the model in Edge Impulse Studio using API keys, but faced challenges with API integration.

Model Accuracy vs. Size:

Keeping the model lightweight for deployment while maintaining high accuracy was a challenge.

Lighting and Environmental Conditions:

Struggled with varying lighting conditions (e.g., too bright or too dark) and environmental factors (e.g., glare or shadows).

Solution

Optimised Image Resolution:

Choose QQVGA (160x120) resolution to balance image quality, which reduces overfitting during model training while ensuring accurate recognition.

Profile Management:

Manually update the dataset and retrain the model in Edge Impulse Studio [1], prioritizing accuracy over automation.

Model Accuracy vs. Size:

Apply model quantization (int8) [2] techniques to reduce model size without compromising accuracy.

Lighting and Environmental Conditions:

Ensure optimal hardware placement in environments with balanced lighting to minimize the effects of glare, shadows, and extreme brightness.

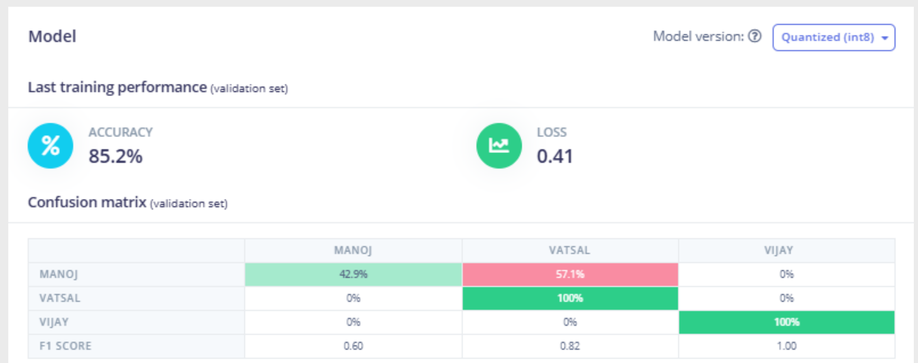
Model Evaluation Metrics

Performance Metrics

Accuracy: 85.20%

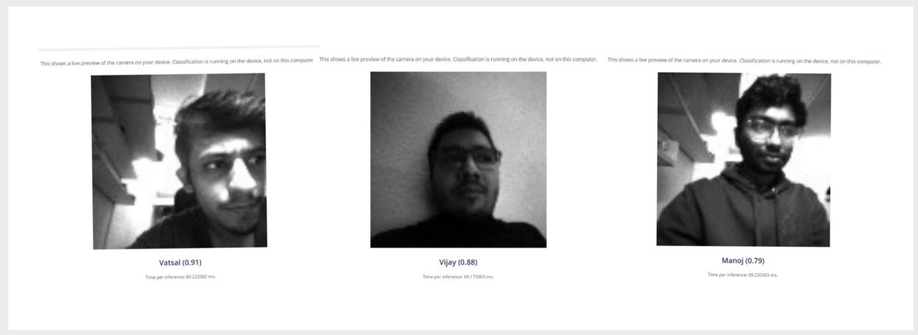
Confusion Matrix

<F1 Score> Harmonic mean of precision and recall.



Results

- Once the model is successfully uploaded to the device, inference is triggered using the Edge Impulse command.
- This process generates local visualizations on the host machine, providing a graphical user interface (GUI) for face recognition, as illustrated below.



Recognised Facesets:

- Vatsal (0.91)
- Vijay (0.88)
- Manoj (0.79)

Conclusion

- Developed a face recognition system for access control using the Portenta H7 and Vision Shield.
- The optimized model achieved an accuracy of 85.2% during testing, effectively recognizing faces across all trained profiles.
- The system successfully handled varied lighting conditions with the balanced dataset.
- Supported profile updates and deletions, ensuring flexibility and efficient access control.

References

References

[1] Edge Impulse. Api and sdk references, 2025.

[2] MathWorks. Quantization techniques, 2025.