

AI Final Project Presentation

Ring Camera with AI

Team Name: AI Hardware Team
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Overview

- Use the **Arduino Nano 33 BLE Sense Lite with OV7576 Camera Module** to detect specific human faces
- Identify known “Residents” from unknown “Intruders” through the use of facial recognition
- Simulate real world behavior of a Ring Doorbell Camera to associate different home visitors with specific labels



Team Roles

Name	Role	Responsibilities
Grayson Turner	Team Lead	Coordination, documentation
Nate Owen	Hardware	Setup, integration
Sammie Levine	Software	Model training, inference
Marissa Cash	Evaluation	Testing, benchmarking

Project Goals

- Train our model to accurately identify unique faces with an above 0.8 success rate in normal lighting conditions
 - Use group members as “known faces” to test facial recognition
- Maintain an average latency of 100ms from image capture to recognition
 - Simulate real world speeds needed to identify visitors at one's door
- Maintain a false positive positive rate of less than 2%
 - Create an accurate model that correctly detects known and unknown visitors

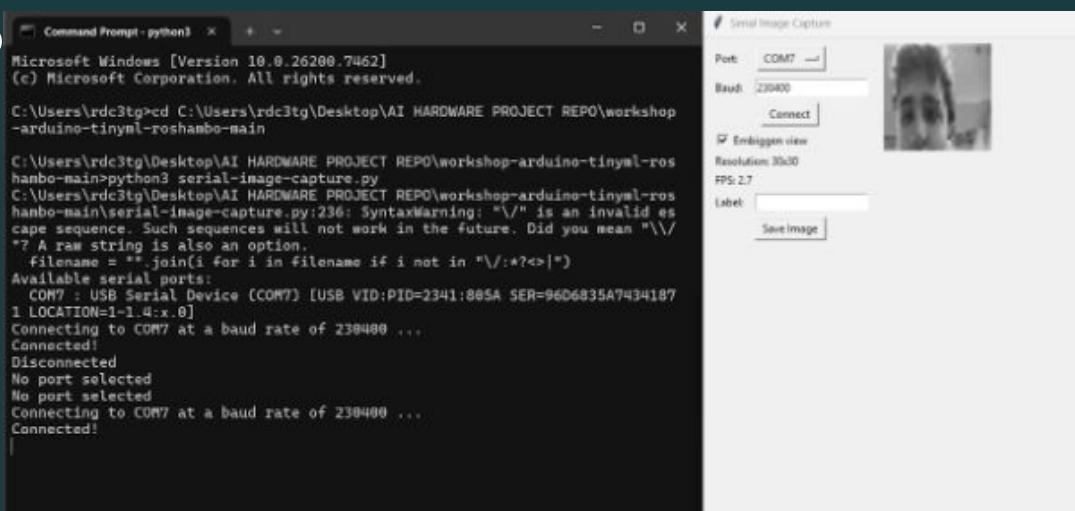
Software

- Built our project using an **Edge Impulse GitHub repository**
 - Repository link: [GitHub](#)
 - Adapted the original rock–paper–scissors recognition project to perform facial recognition
- Developed and deployed the software using:
 - **Arduino IDE** for device-side integration
 - **Python** for model handling, data processing, and supporting scripts



Data Collection

- **Data Collection:**
 - Captured images using the Arduino device camera (OV7675) included in the TinyML kit (Serial Image Capture)
 - Labeled images as:
 - Recognized person
 - Unknown
 - Background



Data Training

- **Data Training**

- Create an **Edge Impulse** project and a **Google Colab** project

- **Google Colab (Data Augmentation):**

- Generate new training images from each original image
- Techniques include: flipping, rotation, zooming, translation, and noise addition

- **Edge Impulse**

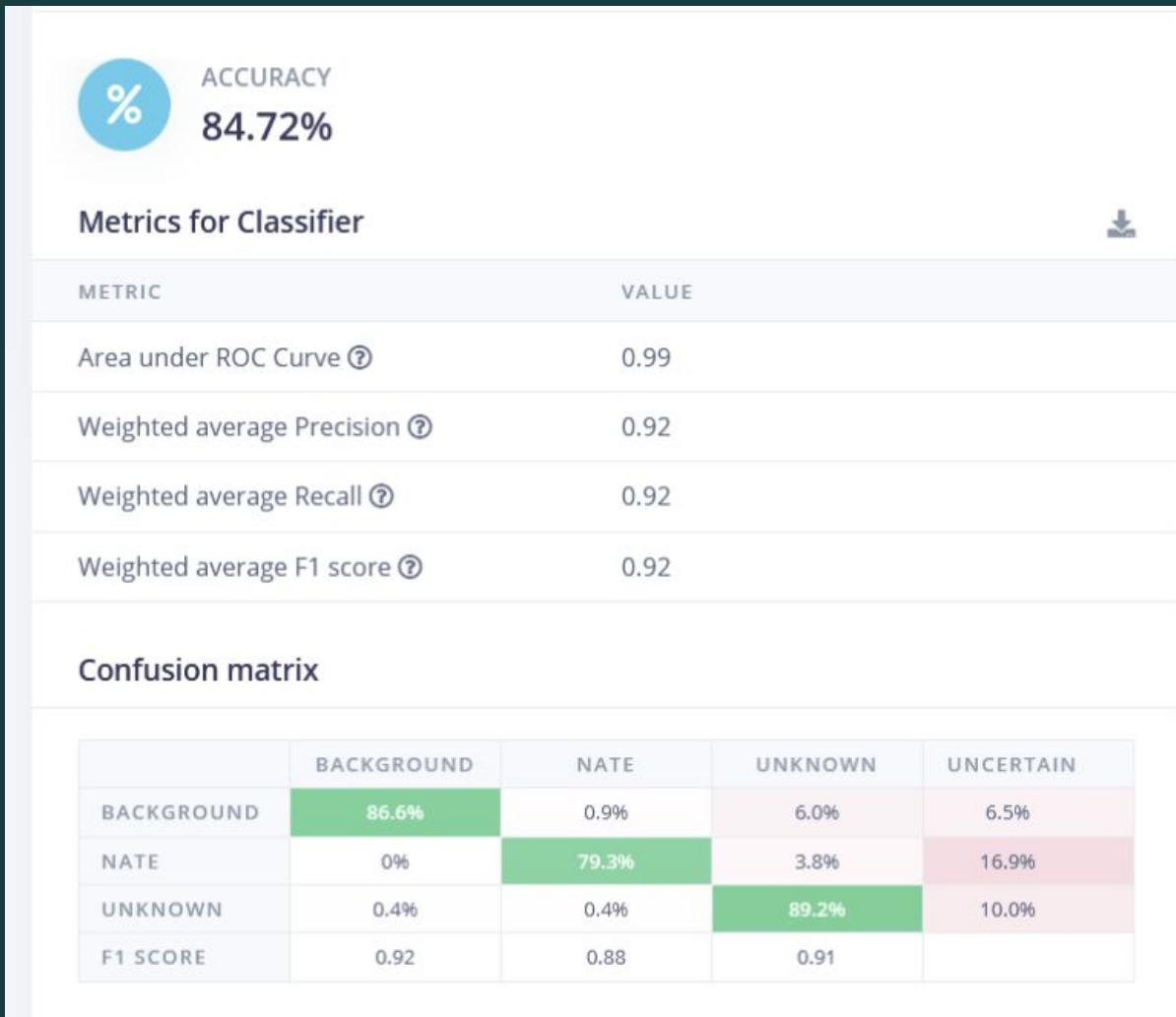
- Train the model and deploy it to run directly on the Arduino device

The screenshot shows the Edge Impulse web interface. On the left, a sidebar includes links for Dashboard, Devices, Data acquisition, Experiments, EON Tuner, Impulse design (Create impulse, Live classification, Model testing, Deployment), Versioning, and an Upgrade Plan. The main area displays a dataset summary: "DATA COLLECTED 4,371 items" and "TRAIN / TEST SPLIT 73% / 27%". Below this is a table of dataset samples:

SAMPLE NAME	LABEL	ADDED
UNKNOWN.ab2c449f0fe9_13	UNKNOWN	Today, 10:53:54
BACKGROUND.906b058b8e80_11	BACKGROUND	Today, 10:53:54
BACKGROUND.7092d3624bc5_14	BACKGROUND	Today, 10:53:54
BACKGROUND.1eefb0e077de9_12	BACKGROUND	Today, 10:53:54
UNKNOWN.f3e0d008adea_12	UNKNOWN	Today, 10:53:54
NATE.5ca810de829a_12	NATE	Today, 10:53:54
UNKNOWN.6eb799a9902a_10	UNKNOWN	Today, 10:53:54
BACKGROUND.87d69c56c1_10	BACKGROUND	Today, 10:53:54
NATE.9b30f61e6034_11	NATE	Today, 10:53:54

The screenshot shows the Edge Impulse web interface. On the left, a "Parameters" panel includes a "Generate features" button. The main area is divided into three sections: "Training set" (3,180 items, 3 classes: BACKGROUND, NATE, UNKNOWN), "Feature generation output" (listing file creation logs for 3,180 files), and "On-device performance" (showing processing time as 11 ms and peak RAM usage as 4 KB). A "Feature explorer" section contains a scatter plot of generated features.

Results



Results

- Arduino camera successfully identified our known resident (Nate), unknown residents, and background (no face)
- Approximate latency was calculated by adding the inference and DSP latencies together, which are printed in the terminal
 - **RESULT:** The total latency was 141 ms, as the inference latency was reported as 140ms, and the DSP latency was reported as 1ms
- False positive rate was calculated when model identified a face who is not Nate as Nate with ≥ 0.8 certainty out of 10 trials
 - **RESULT:** 1 instance (where the model identified unknown's face as Nate with 0.937 (93.7%) confidence) occurred out of the 10 trials
 - False positive rate occurs at approximately 10%

Future Improvements

Hardware

- Improved camera
 - The OV7576 lacked the resolution and color to accurately differentiate between faces
- More advanced microcontroller
 - Better model training and larger dataset could be used with more computation power

Software

- Larger dataset
 - Add more “known” people to the data