

Emotion Detection Using Neural Networks on Embedded Systems

Author

ENRICO ZANETTI

Organization

UNIVERSITY OF TRENTO

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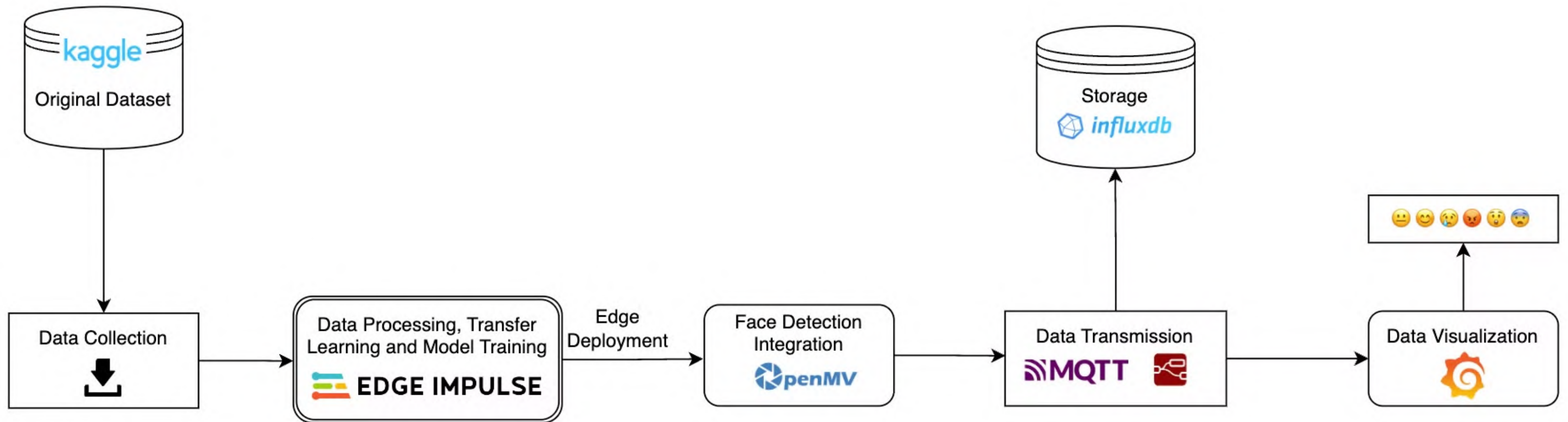
Introduction

APPLICATIONS OF EMOTION DETECTION

Fields of Application

- Human-Computer Interaction (HCI)
- Healthcare
- Security
- Marketing
- Education






















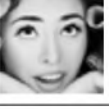






Project Pipeline

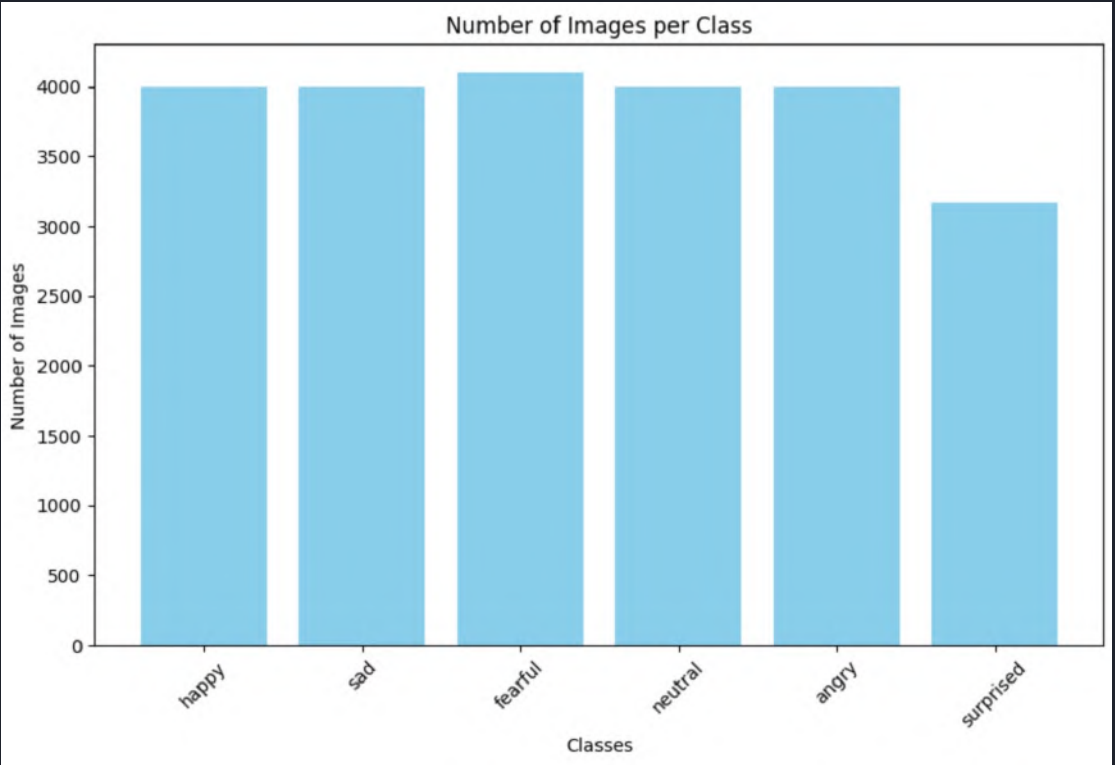
- Collection and preprocessing of facial images dataset from Kaggle.
- Transfer learning for emotion detection model adaptation.
- Optimization for efficient execution on OpenMV Cam H7 Plus.
- Emotion detection using fine-tuned model on OpenMV Cam.
- Integration of face detection for improved accuracy.
- Configuration of UART and MQTT for data transmission.
- Storage of results in InfluxDB and visualization with Grafana.

FACIAL EXPRESSION RECOGNITION 2013 DATASET

Class	Example 1	Example 2	Example 3	Example 4
Happy				
Sad				
Fearful				
Neutral				
Angry				
Surprised				

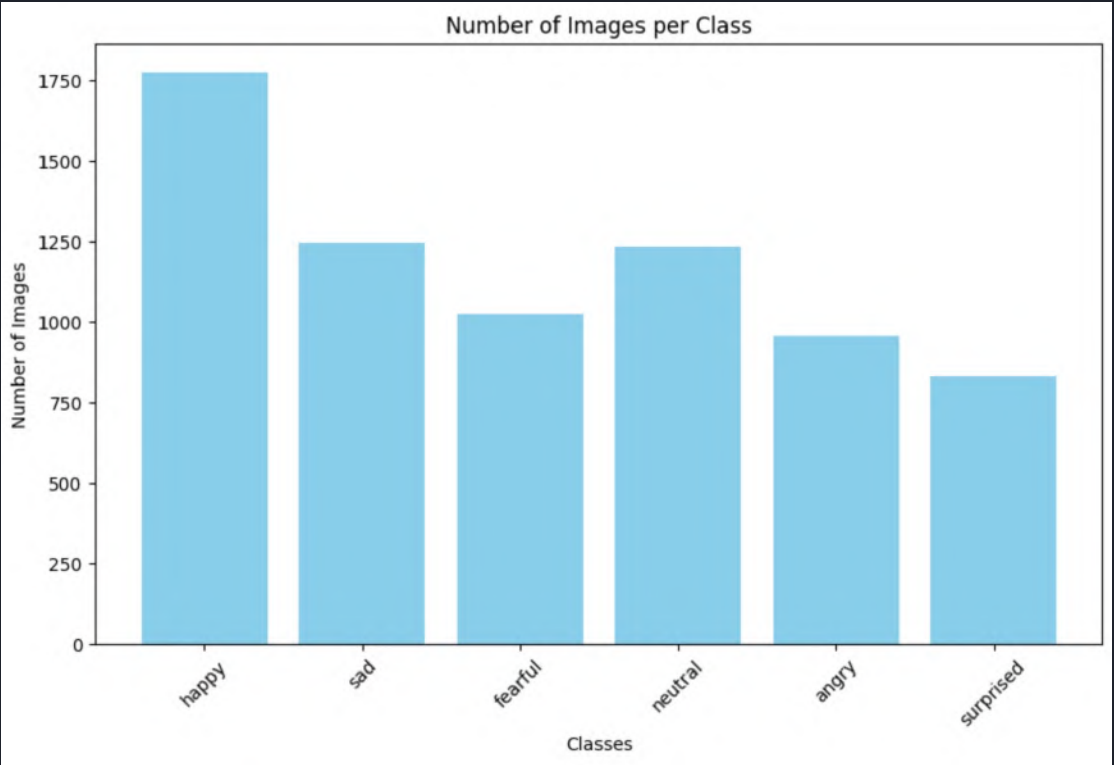
Examples of Different Emotion Classes

- 30,309 images
- Image size: 48x48
- 6 classes



Number of images per class in the Training Set (79%)

23,827 images



Number of images per class in the Test Set (21%)

6,428 images

EDGE IMPULSE

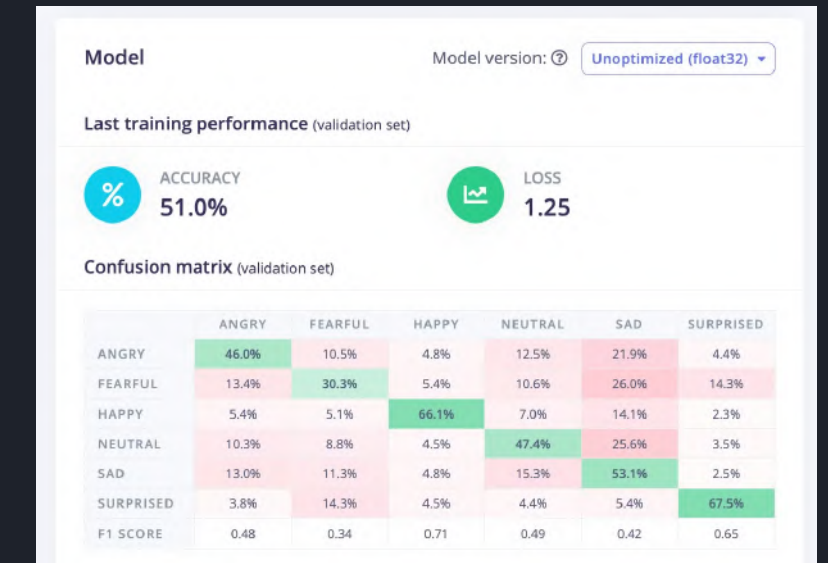
Output features



6 (angry, fearful, happy, neutral, sad, surprised)

TRANSFER LEARNING PARAMETERS AND PERFORMANCE

Experiment	LR	Training Cycles	Accuracy (%)	Loss
1	0.0005	27	39.5	1.51
2	0.0005	25	40.7	1.49
3	0.0005	20	39.6	1.52
4	0.0005	10	38.5	1.54



Impulse Design

Image size: 48x48

Color depth: Greyscale

Processing Block for image-specific processing

Learning Block to perform transfer learning

Transfer Learning

MobileNetV2

Dropout rate: 0.1

Data Augmentation

Training cycles: 25

Batch size: 32

Learning Rate: 0.0005

Accuracy: 40.7%

Loss: 1.49

Model Selection (EON Tuner)

To find the best embedded ML model for this application within the constraints of the OpenMV Cam H7 Plus

Model Retraining

Accuracy: 51.0%

Loss: 1.25

First Test

- Deployment onto the OpenMV Cam H7 Plus using OpenMV library
- Model downloaded from Edge Impulse and uploaded on the OpenMV Cam H7 Plus
- A first test is conducted



Continuous Data Collection & Transmission

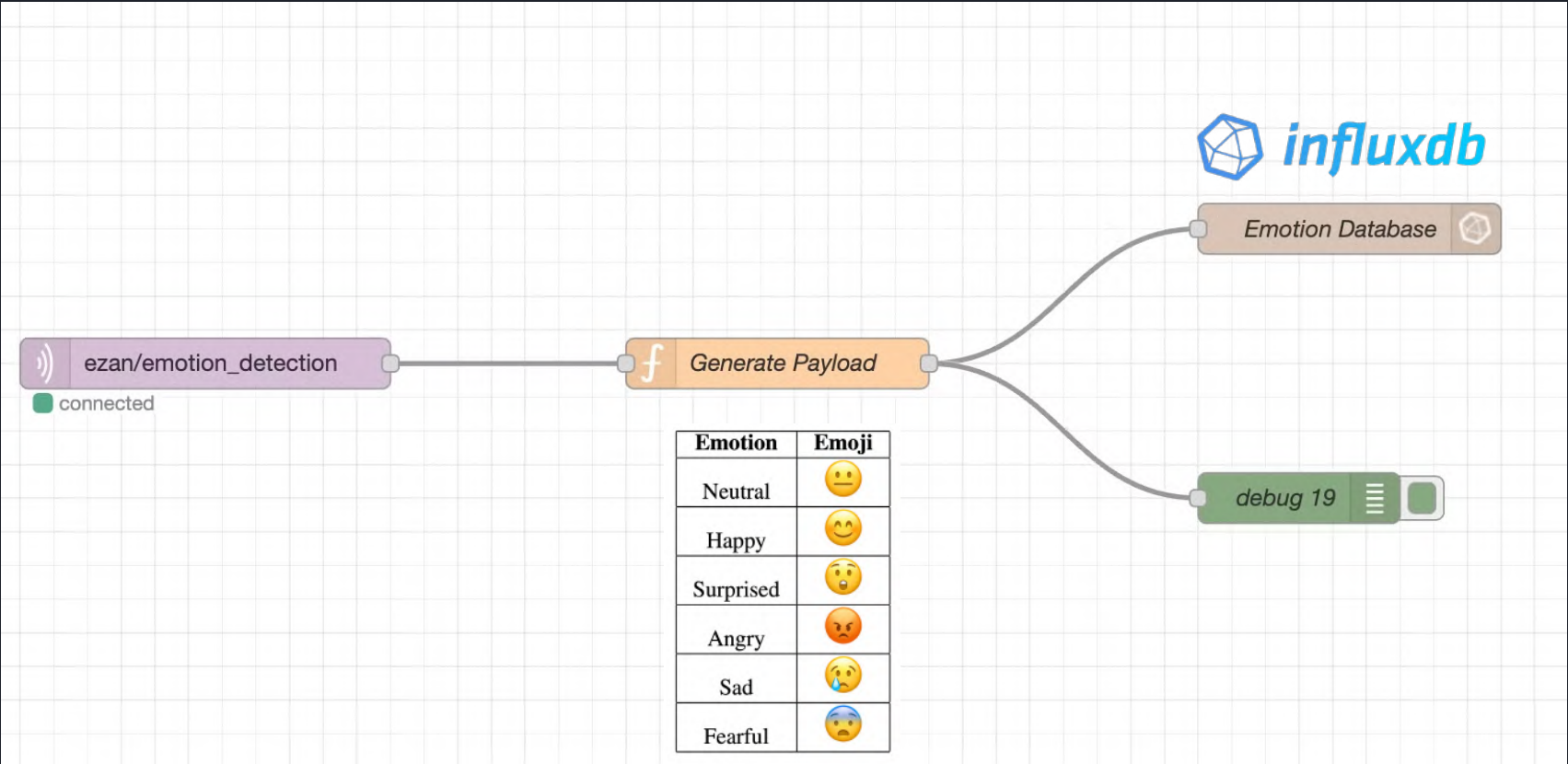
OpenMV Camera Script (main.py)

- Initialize camera, capture images in QVGA format
- Load pre-trained TensorFlow Lite model for emotion detection
- Capture images and detect faces
- Classify emotions of detected faces
- Send detected emotions via UART communication

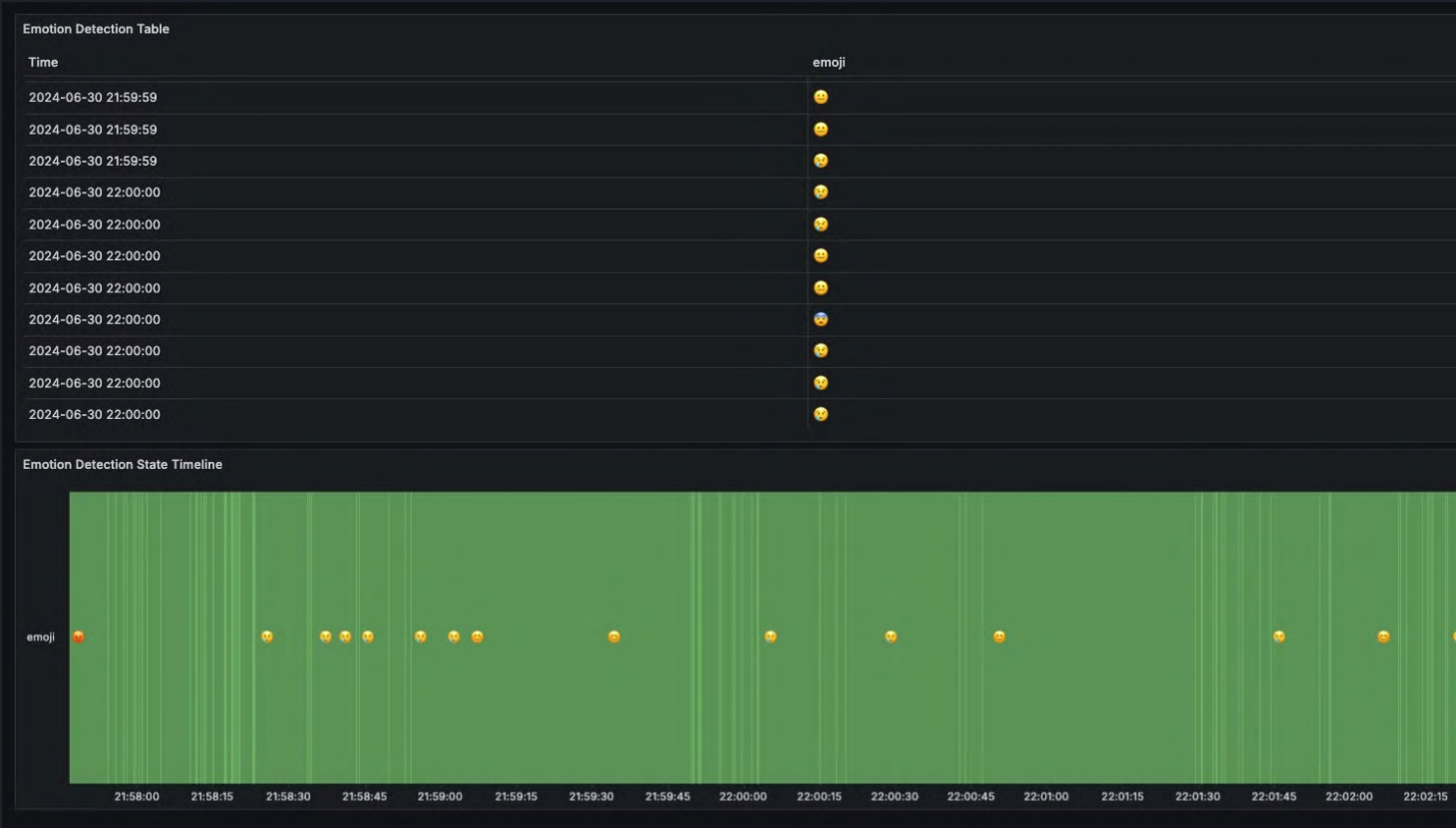
PC Script (openmv_emotion_mqtt_publisher.py)

- List available serial ports, select the correct one for OpenMV camera
- Initialize MQTT client, connect to specified MQTT broker
- Continuously read emotion data from serial port
- Publish detected emotions to MQTT broker under the topic "ezan/emotion_detection"

DATA STORAGE AND VISUALIZATION



Node-Red fetches and processes data, InfluxDB stores it



Dashboard on Grafana for Data Visualization

Results

FEASIBILITY OF EMOTION DETECTION ON
OPENMV CAM H7 PLUS

Feasibility and Performance

- Successful Deployment
- Model Selection: balance between accuracy and efficiency

Enhancements and Challenges

- Face Detection Integration
- Accuracy and Improvement Areas

Real-Time Data Transmission and Visualization

- System Components
- Dashboard Utility





A Future Vision

- **Advanced AI Systems**
- **Personalized Environments**
- **Ethical Considerations**
- **User Privacy and Freedom**
- **Balancing Advancements with Ethics**
- **Environmental Respect**



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