# Emotion Detection Using Neural Networks on Embedded Systems

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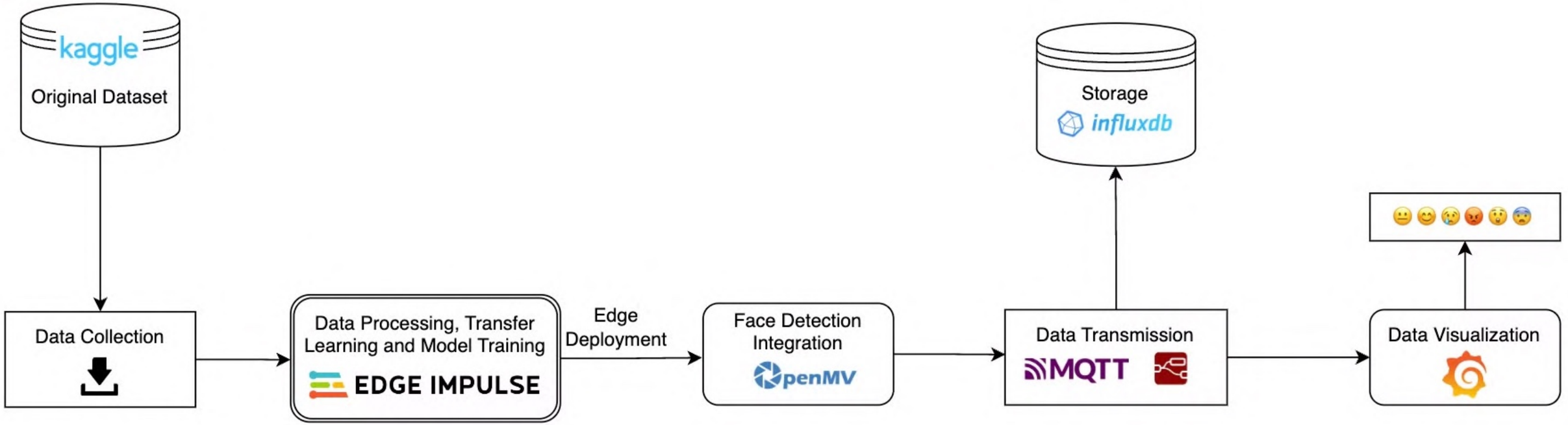
# Introduction

APPLICATIONS OF EMOTION DETECTION

**Fields of Application**

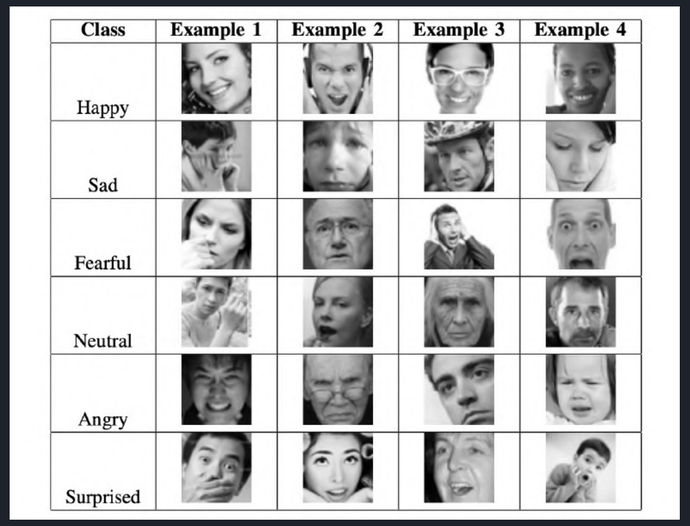
- Human-Computer Interaction (HCI)
- Healthcare
- Security
- Marketing
- Education




# Project Pipeline

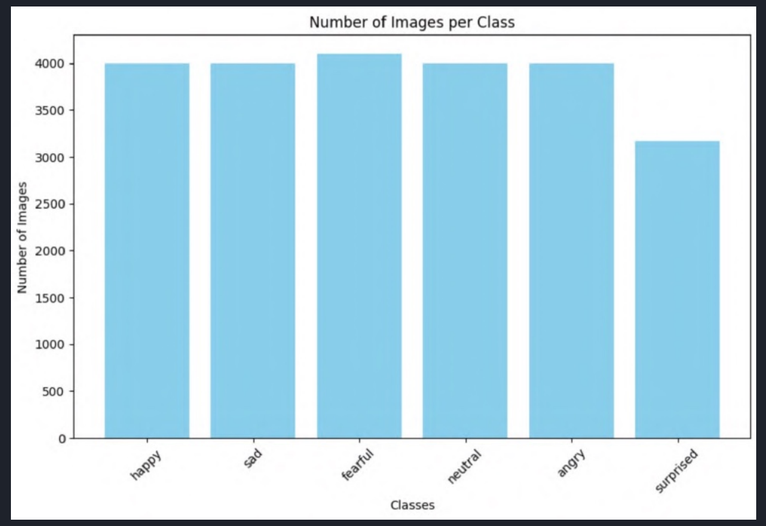
- Collection and preprocessing of facial images dataset from Kaggle.
- Transfer learning for emotion detection model adaptation.
- Optimization for efficient execution on OpenMV Cam H7 Plus.
- Emotion detection using fine-tuned model on OpenMV Cam.
- Integration of face detection for improved accuracy.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

# FACIAL EXPRESSION RECOGNITION 2013 DATASET



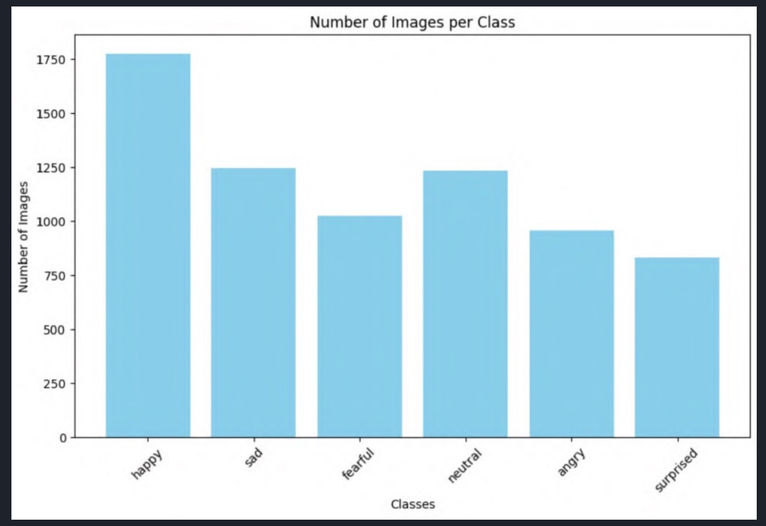

**Examples of Different Emotion Classes**

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




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

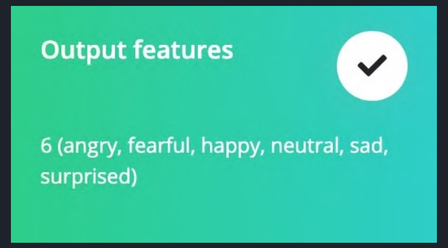
23,827 images




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

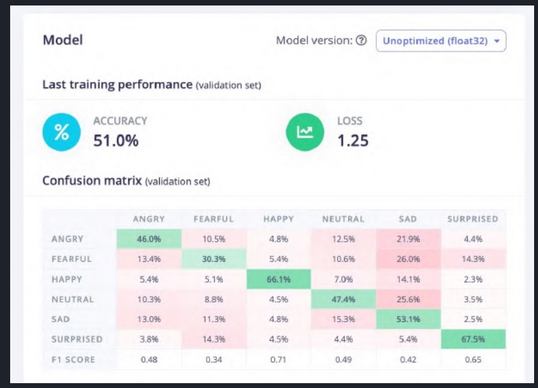
6,428 images

# EDGE IMPULSE




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 constrains 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

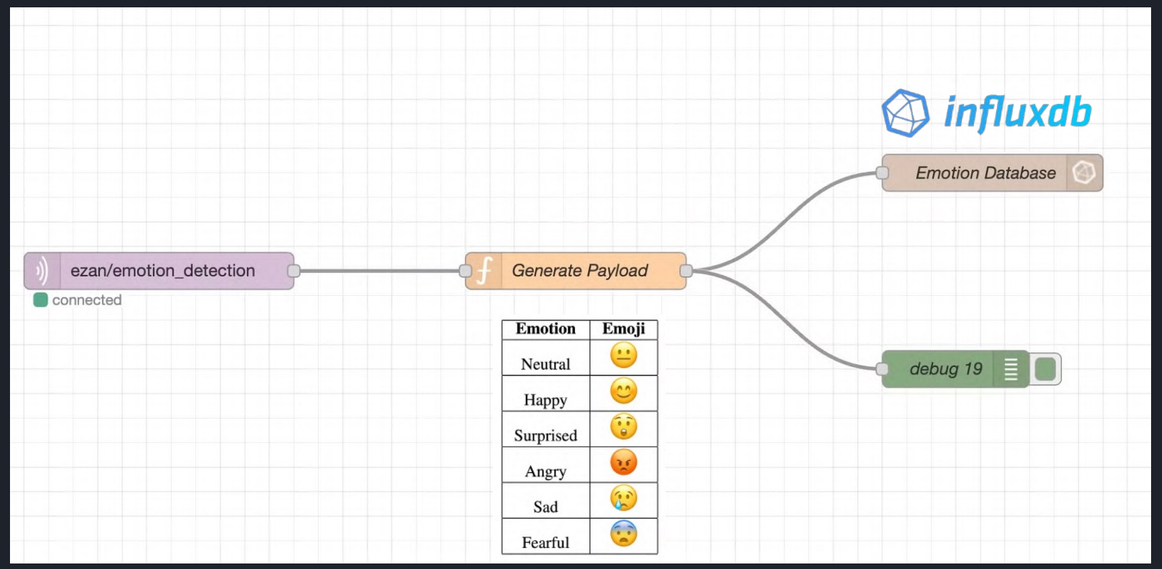
**OpenMV Camera Script (main.py)**

- 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

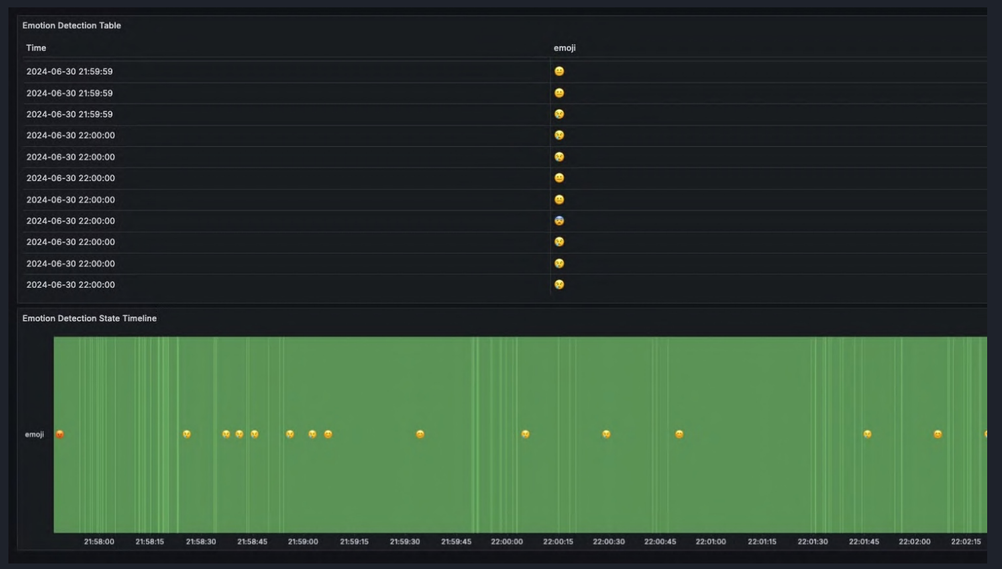
**PC Script (openmv_emotion_mqtt_publisher.py)**

- 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

Pitch

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