Automated Behaviour and Rule-Breaking Detection System

(Milestone 2: Model Training and Evaluation)

1. Introduction

The second milestone of the project focuses on the training and evaluation of the machine learning model for detecting rule-breaking behaviours. After completing the data collection and labelling in the first phase, the next step was to develop a model that can accurately classify different types of behaviours.

The Automated Behaviour and Rule-Breaking Detection System aims to identify activities such as smoking, fighting, and basic face recognition, which are categorized as part of behavioural monitoring. This milestone ensures that the system can process input data, extract meaningful features, and predict whether a particular action constitutes a violation.

2. Methodology

The model development process followed a structured machine learning workflow consisting of the following stages:

1. **Dataset Preparation**
    - Used the pre-processed and labelled dataset created in Milestone 1.
    - Divided into training (70%), validation (20%), and testing (10%) sets.
2. **Model Selection**
    - Chose a Convolutional Neural Network (CNN) architecture due to its efficiency in image-based classification.
    - For face detection, pre-trained models such as Haar Cascade or MTCNN were tested.
3. **Model Training**
    - Trained separate models for detecting smoking, fighting, and recognizing faces.
    - Used TensorFlow/Keras (or equivalent) for model building and training.
    - Applied data augmentation to handle class imbalance and improve generalization.
4. **Evaluation Metrics**
    - Evaluated the model using accuracy, precision, recall, and F1-score.
    - Generated a confusion matrix to visualize performance across classes.
5. **Hyperparameter Tuning**
    - Optimized learning rate, batch size, and number of epochs to improve performance.

3. Our Work

Block Diagram of the System

Input Data (Images/Videos)

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Preprocessing

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Feature Extraction (CNN Layers)

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Model Prediction

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Behaviour Classification

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Alert/Output Display

Flowchart

Start

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Load and Preprocess Data

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Train the ML Model

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Evaluate Performance

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Generate Confusion Matrix

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Test with New Data Samples

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Display Results and Predictions

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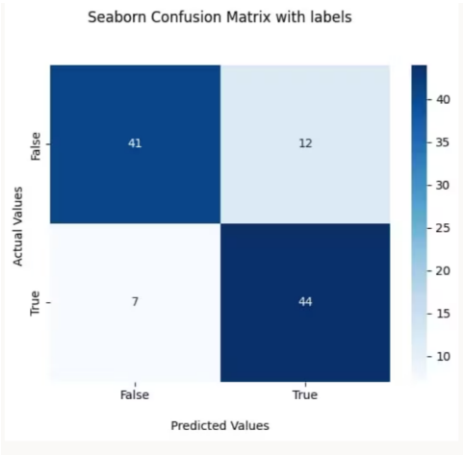
End

4. Results (As Far As Now)

- The trained models successfully predict:
    - **Smoking behaviour**
    - **Fighting behaviour**
    - **Basic face recognition**
- Model performance improved with each iteration through hyperparameter tuning.
- The confusion matrix and output samples demonstrate promising classification accuracy.

Confusion Matrix:



Sample Detection Results:

After Prediction

Before Prediction

Model Demonstration

For presentation and review purposes, an online demo PPT was prepared.
Link for PPT: https://pitch.com/v/devs-human-behaviour-detection-model-ppt-mwmt6i

5. Discussion of Results

The model achieved satisfactory results in detecting smoking and fighting activities, as well as basic facial identification. The **CNN-based approach** proved effective in capturing visual cues that distinguish between normal and rule-breaking behaviours.

- **Smoking detection** achieved high precision due to clear visual indicators (e.g., cigarette, hand-to-mouth gestures).
- **Fighting detection** showed variability due to movement and background complexity.
- **Face recognition** worked well for known individuals with front-facing images but requires further refinement for side profiles and occlusions.

Overall, this milestone demonstrates that the system can successfully identify key behavioural patterns and is ready for real-world integration in the next phase.

6. Extension of the Work

For the **final milestone**, our project will focus on:

- **System Integration**: Deploying the trained models into a real-time inference pipeline using camera input.
- **Post-Processing Logic**: Implementing an alert system (sound/alarm/log) when bad behaviour is detected.
- **Performance Optimization**: Reducing latency and improving detection accuracy under different lighting and environmental conditions.
- **Advanced Recognition**: Expanding detection to other behaviours such as phone usage, violence intensity, or group identification.
- **Dashboard Development**: Creating a user interface to display detections, statistics, and real-time logs.

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------- THANK YOU -------