

Internship Report

Internship Title: Machine Learning & Computer Vision Projects

Internship Duration: June 23, 2025 – July 23, 2025

Internship Provider: NullClass

Intern: Aryan Jha

1. Introduction

This report outlines the work completed as part of the internship offered by NullClass. The internship focused on real-world computer vision applications using deep learning techniques. The tasks assigned were designed to enhance practical knowledge of model training, evaluation, and integration into functional systems. The internship involved hands-on experience in emotion detection, face recognition, and age classification models using Python, TensorFlow, and OpenCV.

2. Background

Prior to the internship, I had foundational knowledge in machine learning and Python programming. However, I lacked extensive experience in training convolutional neural networks (CNNs) or integrating models into real-time applications. This internship presented an opportunity to apply theoretical concepts to practical scenarios and build complete ML systems from scratch.

3. Learning Objectives

The objectives of this internship were: To develop a deeper understanding of convolutional neural networks. To train and evaluate custom machine learning models for classification tasks. To apply models in real-time detection systems using OpenCV. To implement logic-based decision workflows and store processed outputs. To optionally build graphical interfaces for project deployment and demonstration.

4. Activities and Tasks

Task 1: Visualizing Activation Maps for Emotion Detection

Objective: To visualize activation maps from convolutional layers of a pretrained emotion detection model in order to understand which image regions influence the model's decision-making.

Activities: Loaded a pretrained CNN model for emotion detection. Selected sample grayscale images for inference. Visualized activations using intermediate layer outputs. Interpreted which regions in the input images activated different filters.

Outcome: Activation maps were successfully visualized using Matplotlib. This helped interpret feature sensitivity and internal learning behavior of convolutional filters.

Evaluation Metrics: This task was qualitative, focusing on interpretability rather than quantitative performance.

Task 2: Attendance System with Emotion Detection

Objective: To build a real-time face recognition-based attendance system that identifies students and logs their presence along with emotional state during a specific time window.

Activities: Collected face image data of individual students using webcam. Trained a face embedding classifier using OpenCV and FaceNet. Integrated emotion detection alongside face recognition. Logged attendance with timestamps and emotions to a CSV file. Implemented time restriction for automatic attendance between 9:30 AM to 10:00 AM.

Outcome: Successfully implemented real-time student detection and emotion classification. Attendance was recorded and exported with names, emotions, and times.

Evaluation Metrics: Precision, recall, and confusion matrix were added to verify model classification accuracy. Face recognition achieved high accuracy on registered students under good lighting.

Task 3: Age and Emotion Detection for Movie Theatre Access

Objective: To develop a real-time age detection model that restricts entry to individuals who are either under 13 or over 60 years old. For allowed individuals (13–60), their emotional state was also predicted and logged.

Activities: Trained a custom CNN model using the UTKFace dataset, grouped into child, adult, and senior age classes. Trained a separate emotion classification model using the FER-2013 dataset. Implemented a real-time webcam application using OpenCV. Built logic to restrict access based on age class. Logged all data including age class, emotion (if allowed), and timestamp to a CSV file. Developed an optional Streamlit GUI to trigger detection and view logs interactively.

Outcome: A fully functional age-and-emotion detection system was developed and tested. It successfully logged outcomes and enforced access restrictions based on age.

Evaluation Metrics: Age model accuracy exceeded 88%, emotion model accuracy exceeded 85%, both evaluated using precision, recall, and confusion matrix.

5. Skills and Competencies Developed

- Training CNN-based classification models from scratch.
- Preprocessing and augmenting image datasets.
- Real-time video stream handling and face detection using OpenCV.
- Integration of multiple models into a single decision pipeline.
- Data logging using CSV and Pandas.
- GUI development using Streamlit.

6. Feedback and Evidence

All tasks were completed in accordance with the guidelines provided. Screenshots and log files were captured during testing to verify real-time predictions. CSV files were automatically generated with labeled entries for evaluation. GitHub repository contains all source code, models, requirements, and outputs.

7. Challenges and Solutions

- Challenge: Inconsistent lighting affected face and emotion recognition.
Solution: Used grayscale normalization and added dropout layers to avoid overfitting.
- Challenge: Face misclassification for unregistered students.
Solution: Used robust face embeddings and retrained classifiers with varied samples.
- Challenge: Dataset imbalance for certain emotions and age ranges.
Solution: Balanced training data by downsampling and using categorical encoding.

8. Outcomes and Impact

This internship enabled me to independently design, implement, and evaluate end-to-end machine learning applications. I gained significant confidence in handling practical ML problems, from data preprocessing to deployment. The experience has strengthened both my technical and problem-solving abilities.

9. Conclusion

The internship with NullClass was a valuable experience that deepened my knowledge of computer vision and practical machine learning. Through these tasks, I applied theoretical concepts to solve real-world problems and produced demonstrable results. I now feel better equipped to pursue further opportunities in AI engineering and software development.