Emotion Detection Web Application Using Deep Learning

Project Report

Course Requirement:

Using one deep learning method to analyze one object or task

Submitted by

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Abstract

Emotion recognition is an important research area in artificial intelligence and human–computer interaction. This project presents a web-based Emotion Detection system that applies a single deep learning method, namely Convolutional Neural Networks (CNN), to analyze one specific task: human facial emotion recognition. The system detects facial expressions from either real-time webcam input or uploaded images and classifies them into seven universal emotions: Angry, Disgust, Fear, Happy, Sad, Surprise, and Neutral. The application integrates Deep Learning, Computer Vision, and Web technologies through a FastAPI backend and a modern user interface. The project clearly demonstrates how one deep learning technique can be effectively applied to solve a real-world analytical task, fulfilling the course requirement.

1 Introduction

Human emotions are commonly expressed through facial expressions, making facial emotion recognition an essential task in the field of artificial intelligence. Emotion-aware systems can improve human–computer interaction by enabling machines to better understand human behavior and responses. Applications of emotion detection include mental health monitoring, user experience analysis, intelligent tutoring systems, and interactive entertainment.

In recent years, deep learning techniques have shown significant improvements over traditional machine learning approaches for image-based tasks. Among these techniques, Convolutional Neural Networks (CNNs) have become the most widely used method for facial image analysis due to their ability to automatically learn spatial features.

This project focuses on applying a single deep learning method, CNN, to perform one analytical task: recognizing emotions from facial images. The purpose of this homework is not to compare multiple algorithms, but to demonstrate a correct and practical application of deep learning to solve a clearly defined problem.

2 Methodology and System Design

The system is designed using a simple yet effective pipeline that combines computer vision techniques with deep learning-based classification. User input is obtained either through a live webcam feed or by uploading a static image via the web interface.

First, OpenCV is used to detect faces from the input image or video frame using Haar Cascade classifiers. Face detection is an important preprocessing step, as emotion recognition focuses only on the facial region rather than the entire image. Once a face is detected, the region of interest is extracted and preprocessed by converting it to grayscale

and resizing it to 48×48 pixels. This format is chosen to match the input requirements of the CNN model.

A Convolutional Neural Network is used as the sole deep learning method in this project. The CNN analyzes the facial image and produces a probability distribution over seven emotion classes. The emotion with the highest probability is selected as the final prediction and displayed to the user along with visual feedback.

This end-to-end workflow directly satisfies the course requirement by clearly using one deep learning method to analyze one specific task.

3 Implementation Details

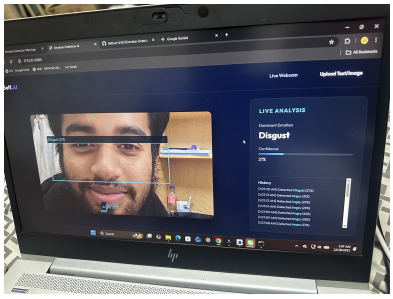
The CNN model used in this project is inspired by the VGG architecture and consists of multiple convolutional layers designed to extract hierarchical facial features such as edges, textures, and expression-related patterns. ReLU activation functions are applied to introduce non-linearity, while pooling layers reduce spatial dimensions and computational complexity. Batch normalization and dropout layers are included to improve training stability and reduce overfitting. The final classification is performed using fully connected layers with a Softmax output.

The backend of the system is implemented using FastAPI, which provides a fast and efficient framework for handling API requests. Two RESTful endpoints are designed: one for processing uploaded images and another for handling real-time webcam frames encoded in base64 format. This separation ensures efficient handling of different input types while maintaining system scalability.

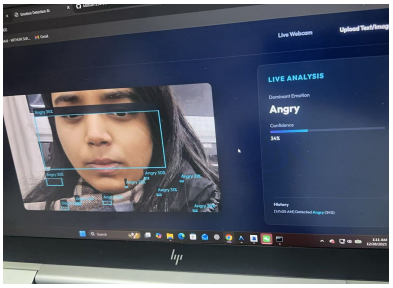
The frontend is developed using HTML, CSS, and JavaScript, with a modern dark-themed interface that enhances usability. Glassmorphism design elements are used to improve visual quality. The interface supports live webcam detection, image uploads with instant preview, loading indicators during processing, and an emotion history panel that records detected emotions over time.

4 Project Screenshots

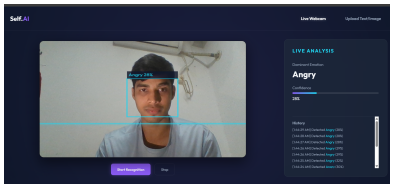
The following screenshots illustrate the main features and user interface of the Emotion Detection Web Application.



(a) Text/Image Upload Result



(b) Image Upload Result



(c) Webcam Emotion Detection

Figure 1: Screenshots of the Emotion Detection Web Application

5 Challenges and Learning Outcomes

During the development of this project, several challenges were encountered. Model input shape mismatches occurred initially and were resolved by maintaining consistent padding in convolutional layers. Face detection accuracy was affected under low-light conditions, which was improved by adjusting Haar Cascade parameters. Browser caching issues were handled by improving static file serving and refresh behavior.

Through this project, valuable practical experience was gained in applying CNN-based image analysis, integrating deep learning models into web applications, and managing real-time data communication between frontend and backend components.

6 Conclusion

This project successfully demonstrates the application of one deep learning method, Convolutional Neural Networks, to analyze one task: facial emotion recognition. The developed web application integrates Deep Learning, Computer Vision, and Web technologies into a stable and user-friendly system. The project fulfills the course requirement and provides a solid foundation for future enhancements such as emotion trend analysis, custom model training, and mobile optimization.