Internship Final Report

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Major: AI ML
Internship Duration: 2nd January to 31st January
Company: ShadowFox
Domain: AI ML
Mentor: Mr. Hariharan
Coordinator: Mr. Aakash

Objectives

BEGINNER LEVEL

During my internship at ShadowFox, I worked on a **Facial Emotion Recognition** project using deep learning and computer vision. The goal of the project was to develop an AI system capable of detecting human emotions from facial expressions in real time. The objectives were:

- To build a deep learning model for classifying facial emotions into predefined categories.
- To create a real-time application that integrates the model for live emotion detection.
- To improve the model's accuracy using data augmentation and retraining techniques.
- To enhance user experience by integrating a **Streamlit-based UI**.
- To explore potential applications of the system in mental health analysis, human-computer interaction, and emotion-based analytics.

Tasks and Responsibilities

During this project, I was responsible for multiple tasks, including:

1. Data Collection and Preprocessing

- Used **Haar Cascade classifiers** to detect faces in real-time from a webcam.
- The dataset used for training was the **FER 2013 dataset from Kaggle**, which contains labeled facial expressions.
- Applied **image augmentation** techniques such as rotation, zoom, and flipping to improve model performance.

2. Model Development and Training

- Designed a **Convolutional Neural Network (CNN)** to classify emotions into categories such as **angry, happy, sad, neutral, surprise, fear, and disgust**.
- Used **TensorFlow and Keras** to develop and train the model with an optimized learning rate.
- Implemented **EarlyStopping and ModelCheckpoint** to improve efficiency and prevent overfitting.
- Applied **dropout layers** and **batch normalization** to enhance generalization and prevent overfitting.
- Evaluated the model's performance using **classification reports and confusion matrices**.
- Achieved an overall model accuracy of **89%**.

3. Real-Time Emotion Detection App

- Integrated the trained model into a **Streamlit-based web application**.
- Developed a **camera loop** to capture live video frames and process them in real time.
- Displayed detected emotions using corresponding **emojis and scores**.

4. Model Retraining and Performance Enhancement

- Created a feature that allows saving new face images to improve the dataset.
- Implemented a function to retrain the model dynamically with newly collected data.

Application and Features

Applications:

- **Mental Health Monitoring:** Can help detect signs of emotional distress or mood changes.
- **Human-Computer Interaction:** Enhances user experience by enabling emotion-aware AI systems.
- **Customer Sentiment Analysis:** Can be used in retail and marketing to understand customer reactions.
- **Security & Surveillance:** Helps in identifying unusual emotional patterns in public areas.
- **E-learning & Education:** Assists in monitoring student engagement and emotional responses.

Unique Features of the Application:

- **Real-time Emotion Detection:** Works efficiently on live video streams.
- **Streamlit UI Integration:** Provides an intuitive and interactive user interface.
- **High Accuracy (89%):** Achieved by optimizing CNN architecture with dropout and batch normalization.
- **Dynamic Model Retraining:** Allows continuous improvement by incorporating new user data.
- **Lightweight and Efficient:** Optimized for low-latency real-time inference.

Learning Outcomes

This internship provided me with valuable hands-on experience in:

- **Computer Vision**: Working with OpenCV for face detection and real-time processing.
- **Deep Learning**: Designing and training CNNs for classification tasks.
- **Model Optimization**: Using techniques like EarlyStopping, dropout layers, and batch normalization.
- **Application Deployment**: Developing and deploying an interactive AI application with **Streamlit**.
- **Problem-Solving**: Debugging errors in model training and performance issues.

Challenges and Solutions

1. Insufficient Training Data

- **Challenge:** The dataset initially had limited images for each emotion category.
- **Solution:** Used **image augmentation** techniques to artificially expand the dataset.

2. Model Overfitting

- **Challenge:** The model performed well on training data but struggled with unseen images.
- **Solution:** Implemented **dropout layers**, **batch normalization**, and **early stopping** to generalize better.

3. Real-Time Performance Issues

- **Challenge:** The real-time camera feed had latency when processing images.
- **Solution:** Optimized model inference using **NumPy-based array operations** and minimized computation per frame.

4. Integration of UI with Model

- **Challenge:** Displaying real-time emotion detection results on Streamlit with smooth performance.
- **Solution:** Used **Streamlit containers** to dynamically update the UI efficiently.

Conclusion

Through this project, I gained deep insights into **AI-powered emotion recognition** and its potential applications. The final system successfully detects human emotions in real-time with high accuracy and offers a user-friendly interface for interaction. Future improvements may include **expanding the dataset**, integrating **multimodal inputs (speech + text + facial expressions)**, and optimizing performance for mobile devices. This project has significantly contributed to my learning journey in **AI and machine learning**.

Acknowledgments

I would like to express my sincere gratitude to **ShadowFox**, my mentor **Mr. Hariharan**, and my coordinator **Mr. Aakash** for their continuous support and guidance. Their insights helped me navigate challenges and complete this project successfully. I also appreciate the opportunity to work on such an impactful project, enhancing my knowledge and skills in **computer vision and deep learning**.