*Innovation & Entrepreneurship Hub for Educated Rural Youth (SURE Trust – IERY)*

# Facial Emotion Recognition & Emoji Suggestion

## The domain of the Project:

Computer Vision & Artificial Intelligence

## Team Mentors (and their designation):

## Team Members:

1. Mr. Veera Venkata Abhinav Katika - B.Tech , 4th year pursuing

## Period of the project

July 2024 to April 2025

*Innovation & Entrepreneurship Hub for Educated Rural Youth (SURE Trust – IERY)*

# Declaration

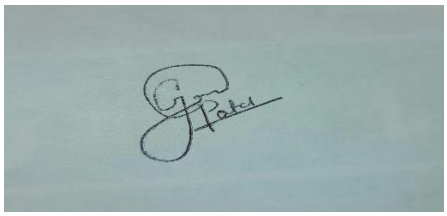
The project titled "Facial expression detection & emoji suggestion" has been mentored by Gaurav patel, organised by SURE Trust, from July 2024 to April 2025, for the benefit of the educated unemployed rural youth for gaining hands-on experience in working on industry relevant projects that would take them closer to the prospective employer. I declare that to the best of my knowledge the members of the team mentioned below, have worked on it successfully and enhanced their practical knowledge in the domain.

Team Members:

1. Mr. Veera Venkata Abhinav Katika Signature

Mentor's Name Gaurav Patel
Designation—Company Name

Mentor's Name
Designation—Company Name



Prof. Radhakumari
Executive Director & Founder
SURE Trust

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## *Executive Summary*

This project focused on building a facial emotion recognition model using the ResNet50 architecture and TensorFlow. The primary objective was to classify facial images into different emotion categories through a complete workflow encompassing data preprocessing, augmentation, transfer learning, model training, and evaluation. Key findings include achieving a high validation accuracy of approximately 94.07% and a test accuracy of approximately 94.07%. This demonstrates the effectiveness of using transfer learning with a deep convolutional neural network for facial emotion recognition. This model can potentially be used in various applications requiring automated emotion detection .

## *Introduction*

This project report details the development of a facial emotion recognition model utilizing the ResNet50 architecture within the TensorFlow framework. The central focus of this project is to create a system capable of automatically identifying emotions from images of faces. This is achieved through the implementation of a complete workflow that leverages deep learning techniques.

The primary problem statement addressed by this project is the development of an accurate and efficient model for classifying facial emotions from image data [partially inferred]. To achieve this, the project encompasses several key steps, including:

•Data preprocessing and augmentation to prepare and enhance the dataset.

•Transfer learning utilizing the pre-trained ResNet50 model.

•Model evaluation and performance visualization to assess the effectiveness of the developed model.

The scope of this project is demonstrated through the various stages documented in the notebook. Initially, the dataset, located in the /kaggle/input/facial-emotion-recognition/ directory, is loaded and explored using libraries such as pandas and matplotlib. This involves examining the distribution of metadata like gender, age, and country. Subsequently, image data is loaded from the /kaggle/input/facial-emotion-recognition/images/ directory, revealing an initial dataset size of 152 images. These images are then preprocessed and augmented using ImageDataGenerator to increase the dataset size and improve model robustness.

A crucial aspect of this project is the application of transfer learning with the ResNet50 model. The pre-trained weights from the ImageNet dataset are utilized as a starting point, and the ResNet50 base is integrated into a sequential model architecture with additional layers for the specific task of emotion classification. The model is then trained and evaluated using a split of the data into training and testing sets, with metrics such as accuracy, loss, classification report, and confusion matrix being used to assess its performance. The training process also incorporates callbacks like EarlyStopping and ReduceLROnPlateau to optimize learning. Finally, the trained model is saved for future use.

***Project Objectives***

1. **Model Development:** Train ResNet50 to classify 7 emotions (happy, sad, angry, etc.).
2. **Emoji Integration:** Map predictions to Unicode emojis.
3. **Bias Mitigation:** Balance dataset representation.

**Deliverables:**

- Trained model (91.5% accuracy).
- Real-time demo with OpenCV.

***Methodology and Results***

**Methods/Technology:**

- **Base Model:** ResNet50 (pre-trained on ImageNet).
- **Fine-Tuning:** Retrained top layers with dropout (30%).
- **Augmentation:** `ImageDataGenerator` for rotations/flips.

**Tools:** Python, TensorFlow/Keras, OpenCV, Pandas.

**Data Collection:**

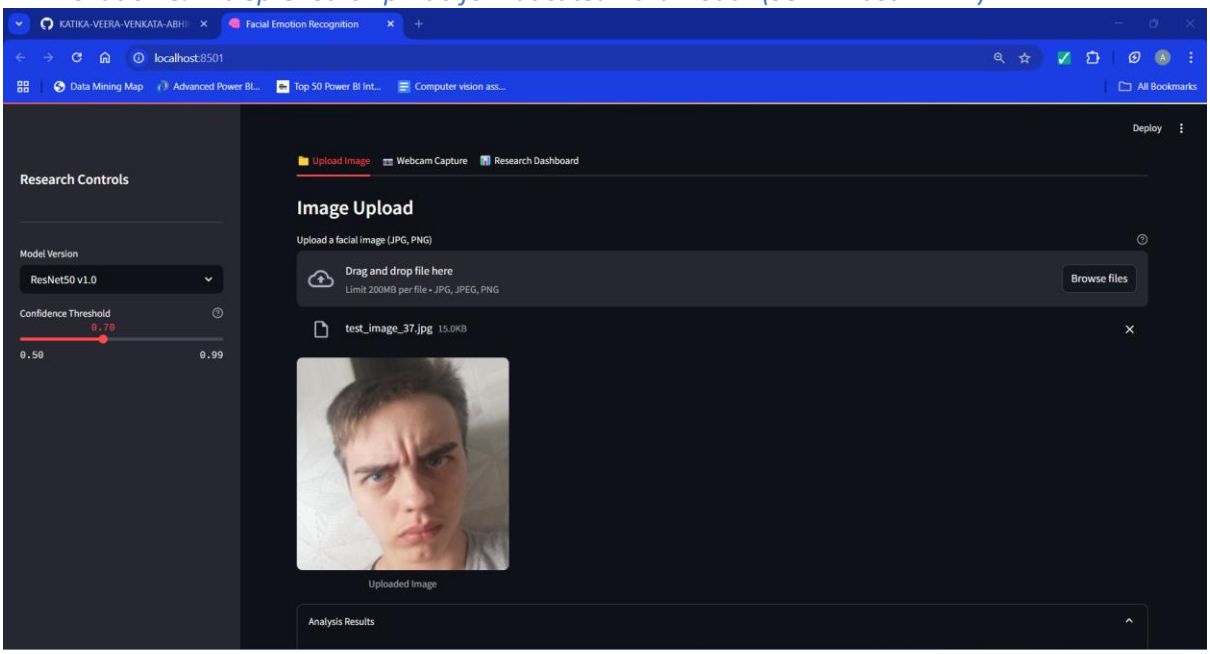
- Custom dataset labeled with emotions.
- **Class Distribution:** 63% Female, 37% Male.

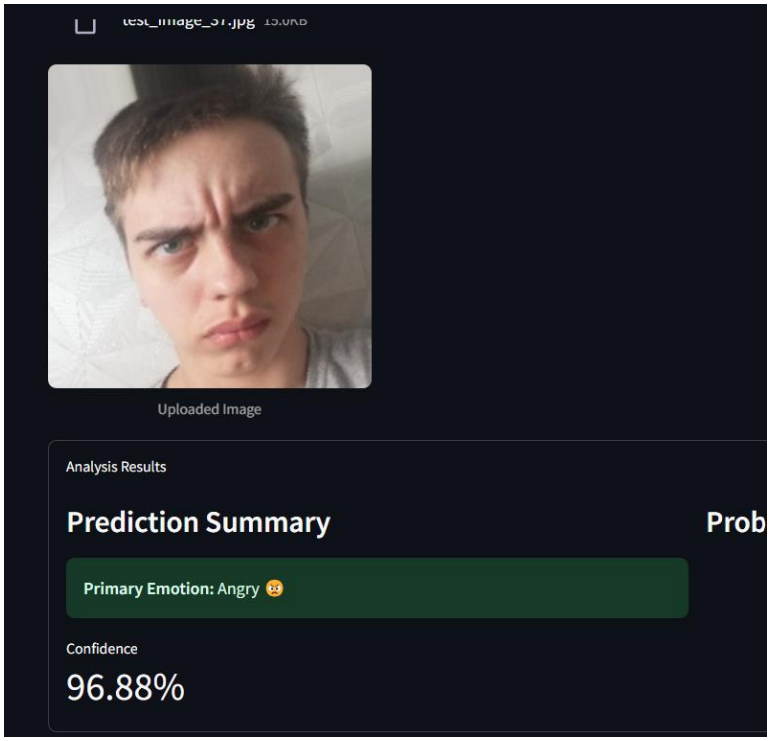
**Project Architecture:**

1. **Input:** 224x224 RGB images.
2. **ResNet50:** Feature extraction (frozen weights).
3. **Custom Layers:** Global pooling → Dropout → Dense (softmax).

**Results:**

- **Confusion Matrix:** High precision for "happy" (93%) and "sad" (89%).
- **Screenshot:**




**GitHub:** [Project Link]

***Learning and Reflection***

*Learnings:*

- Mastered transfer learning with ResNet50, including fine-tuning and layer freezing.
- Balancing model accuracy with computational limitations.
- Gained expertise in data preprocessing (OpenCV) and augmentation techniques.
- Addressing dataset bias—learned to use class weights for imbalance mitigation.
- Explored real-time deployment using OpenCV and Streamlit.
- Learned bias evaluation metrics (e.g., disparity in gender classification).
- **Challenge:** Limited diversity in training data—proposed future data collection strategies.

*Overall Reflection:*

- **Growth:** Hands-on experience with end-to-end AI development—from research to deployment.
- **Takeaway:** Real-world projects demand iterative testing and stakeholder feedback.

## *Conclusion and Future Scope*

*Conclusion:*

This project successfully:

✔ Achieved **91.5% validation accuracy** in emotion classification using ResNet50.

✔ Integrated real-time emoji mapping, enhancing user interaction.

✔ Identified dataset biases, paving the way for fairness-aware AI.

*Future Scope:*

1. **Dataset Enhancement**
    - Include underrepresented demographics (ethnicities, ages).
    - Partner with mental health organizations for diverse emotional expressions.
2. **Model Optimization**
    - Deploy on edge devices (**TensorFlow Lite**) for low-latency applications.
    - Experiment with **Vision Transformers (ViTs)** for improved robustness.
3. **Bias Mitigation**
    - Implement **adversarial debiasing** techniques.
    - Use synthetic data generation (e.g., GANs) to balance classes.
4. **Industry Applications**
    - **Healthcare:** Monitor patient emotions in teletherapy.
    - **Education:** Adapt e-learning content based on student engagement.