# Facial Expression Recognition System

This project is a deep learning-based system that recognizes four basic facial expressions — \*\*Angry, Happy, Neutral\*\*, and \*\*Surprised\*\* — from images. It was developed using a custom dataset collected from Bangladeshi volunteers and trained using the ResNet50 model.

## 📌 Features

- Real-time face detection using webcam

- Image preprocessing with data augmentation

- Deep learning model using ResNet50 (transfer learning)

- Emotion classification into 4 categories

- Custom dataset creation script

- Evaluation using accuracy and confusion matrix

## 🧠 Motivation

Facial expressions are a non-verbal way humans communicate emotions. Recognizing these expressions can enhance interactions in:

- Healthcare (detect discomfort in patients)

- Education (track student engagement)

- Security (identify suspicious behavior)

- Human-computer interaction (improve user experience)

## 📁 Dataset

- \*\*Source\*\*: 12 local volunteers

- \*\*Classes\*\*: Angry, Happy, Neutral, Surprised

- \*\*Images\*\*: 100 per class per individual (4,000 total)

- \*\*Split\*\*: 10 people for training, 2 for testing

> Note: "Sad" class was removed due to poor distinction from "Neutral".

## 🔧 Tools and Technologies

| Tool | Purpose |

|--------------------|-------------------------------------|

| Python | Main programming language |

| OpenCV + CVZone | Webcam and face detection |

| TensorFlow & Keras | Model building and training |

| Google Colab | Training with GPU support |

| Matplotlib | Visualization of results |

## 📈 Results

- Best accuracy: \*\*76%\*\* (after tuning ResNet50)

- Overfitting occurred when all layers were unfrozen

- Best performance on \*\*Happy\*\* and \*\*Neutral\*\*

- Harder to classify \*\*Angry\*\* and \*\*Surprised\*\*

## 🚧 Limitations

- Small dataset (only 12 people, indoor setup)

- Only 4 emotion classes

- Requires internet/GPU for training

- Evaluation limited to accuracy and confusion matrix

## 🔮 Future Improvements

- Add more diverse data (age, gender, lighting, accessories)

- Include more emotions (Sad, Fear, Disgust)

- Implement real-time emotion detection

- Test alternative models like EfficientNet or MobileNet

- Use advanced evaluation metrics (precision, recall, F1-score)

## ▶️ How to Use

1. Clone this repository:

```bash

git clone https://github.com/your-username/facial-expression-recognition.git

cd facial-expression-recognition