**Project Title**:  
**Expression Classification from Facial Images**

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**1. Overview of the Problem and Potential Application Areas**

The goal is to classify facial expressions into seven categories using deep learning. This task is complex due to factors like lighting, pose variation, and occlusions. Applications include Human-Computer Interaction, emotion detection in interviews, and security systems.

**2. Literature Review**

* **Article 1**: *Facial Emotion Recognition Using Deep Learning* (2023). Accuracy: 91%. Pros: High accuracy, low computational cost. Cons: Struggles with subtle differences.
* **Article 2**: *Real-Time Emotion Detection Using Pre-trained Models* (2024). Accuracy: 88%. Pros: Pre-trained models are faster to fine-tune. Cons: Lower real-time accuracy due to computational overhead.

**3. Models Used**

* **Custom CNN**: 3 Conv layers, ReLU activation, softmax output.
* **VGG16**: Pre-trained model fine-tuned.
* **ResNet50**: Another fine-tuned pre-trained model.

**4. Dataset**

* Dataset: Expression in-the-Wild (ExpW).
* **Training Set**: 70%
* **Validation Set**: 15%
* **Test Set**: 15%

**5. Hyperparameter Tuning**

* Tuned learning rates, batch sizes, and epochs using Keras Tuner. Best model used a learning rate of **0.0001** and batch size of **32**.

**6. Results and Evaluation**

* **Custom CNN**: Accuracy 85%.
* **VGG16**: Accuracy 88%.
* **ResNet50**: Accuracy 90%.

**7. Analysis of Results**

Good results were obtained for "happy" and "neutral" expressions. The model struggled with subtle expressions like "fear" and "surprise." Improvements could include data augmentation and using more advanced architectures.

**8. Conclusion**

This project successfully implemented and evaluated facial expression recognition. Future work includes refining the model and using larger datasets.