AI/ML LAB PROJECT

TEMPERATURE DETECTION FROM CLOUD COVER

GITHUB REPOSITORY LINK

CLOUD COVER:
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PROBLEM STATEMENT

Cloud coverage prediction serves as a crucial intermediate step in our temperature prediction system. This phase focuses on developing accurate cloud coverage estimation using ground-based sky cameras and deep learning techniques.

Challenges Addressed:

- Variability in cloud patterns.
- Need for automated, accurate cloud coverage detection from images.

Goal:

- Develop a scalable and accurate system for temperature prediction.

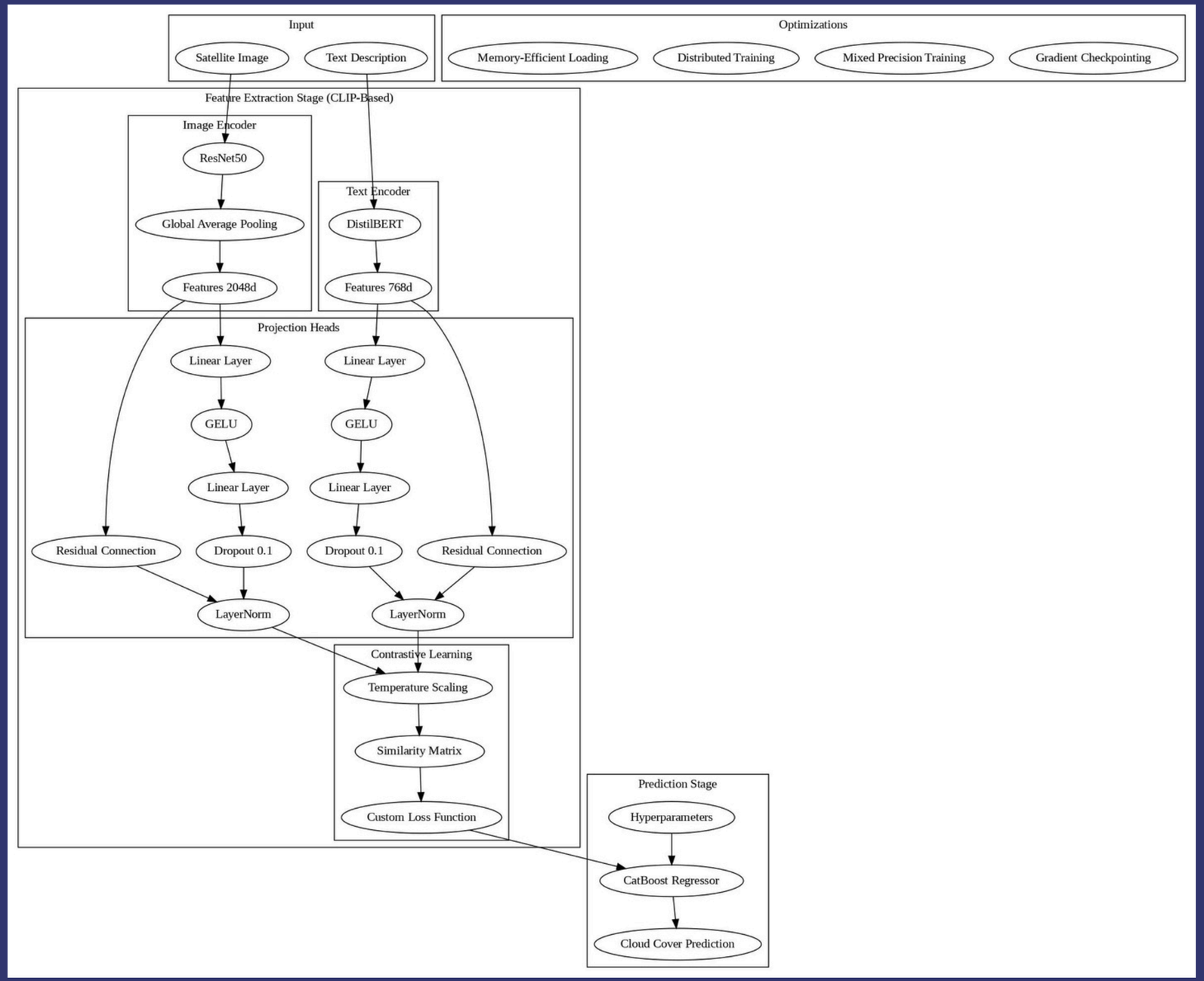
Dataset Overview

This dataset is created by collecting key attributes for detecting temperature from Weather.VisualCrossing.com, which we have aligned with cloud cover percentage for integration into our model implementation.

```python
def fetch_weather_data(location, date1, date2, api_key):

    url = f"https://weather.visualcrossing.com/VisualCrossingWebServices/rest/services/timeline/{location}/{date1}/{date2}?key={api_key}"
    response = requests.get(url)
```

1	Date	Condition	Cloud Cover (%)	Max Temp (°C)	Min Temp (°C)	Humidity (%)
2	July 26 2019	Overcast	94.27	32	25	95
3	July 27 2019	Overcast	100	31	25	95
4	July 28 2019	Overcast	100	31	24	95
5	July 29 2019	Overcast	100	32	24	94
6	July 30 2019	Overcast	100	32	25	96



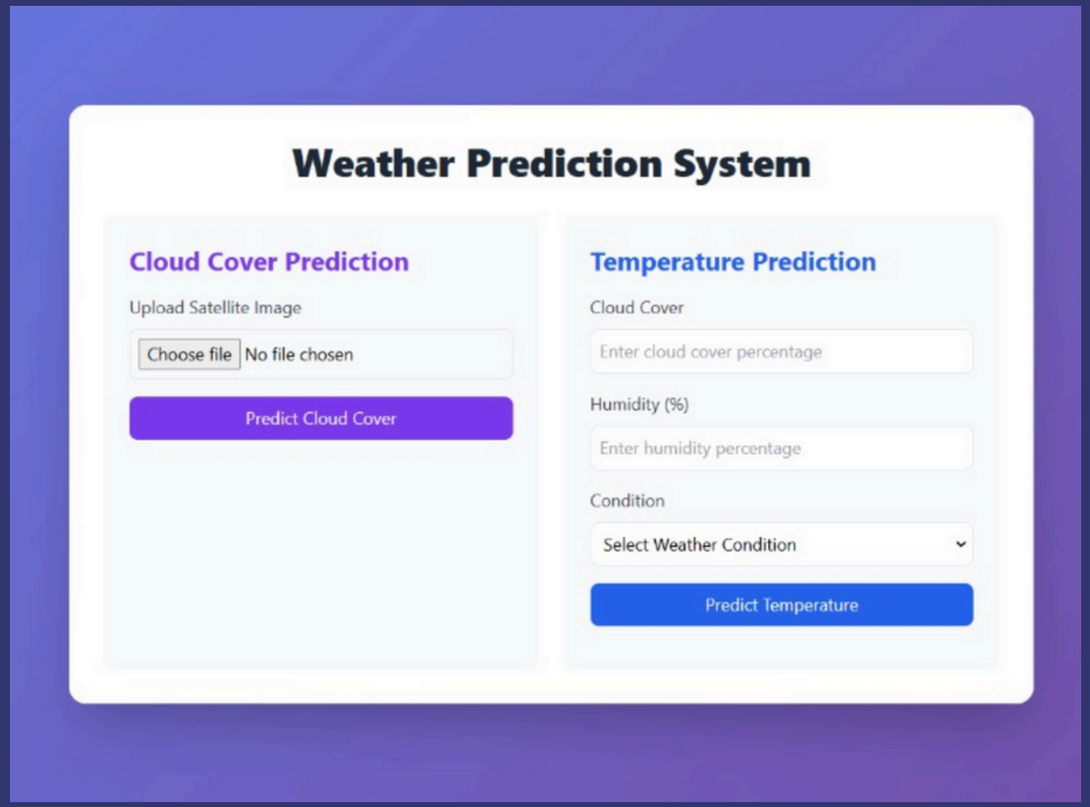
Model Architecture

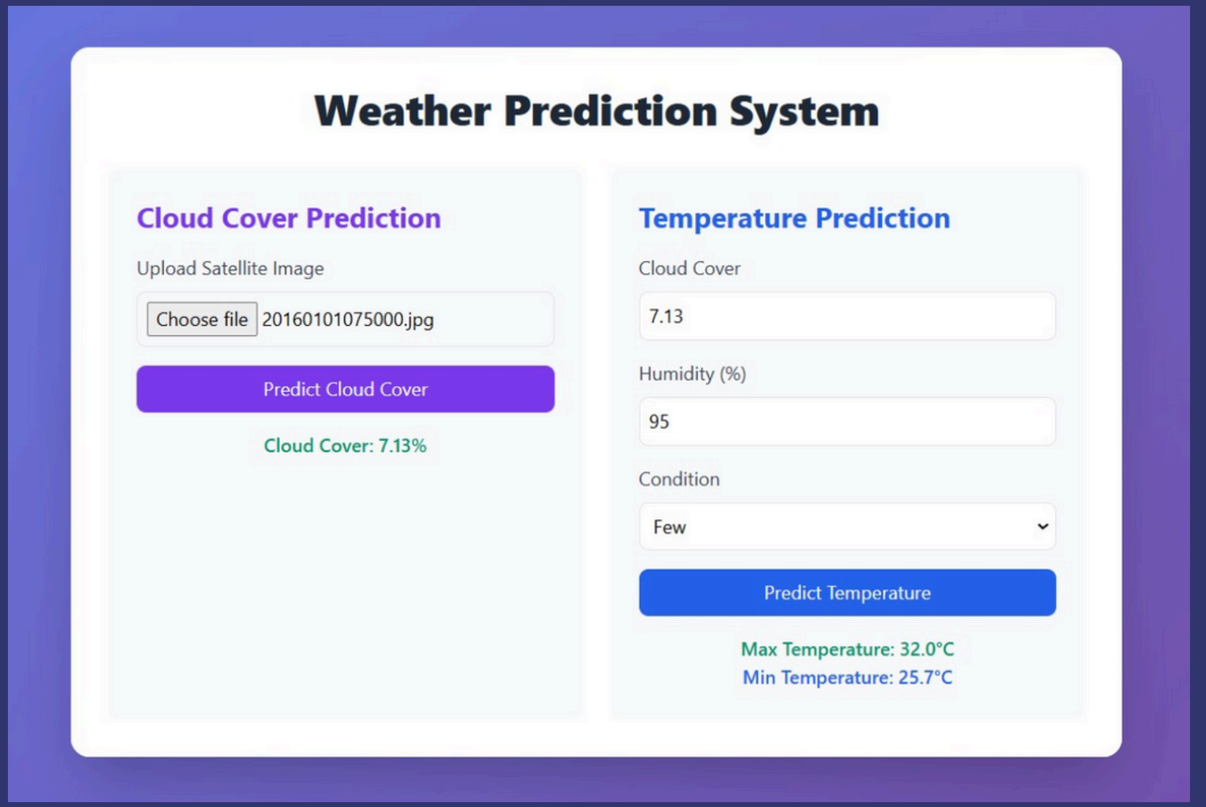
The pipeline combines CLIP-based feature extraction with CatBoost regression for cloud cover prediction:

1. Feature Extraction:
   - Image Encoder: Pre-trained ResNet50 (2048-dim features) with configurable layers.
   - Text Encoder: Pre-trained DistilBERT (768-dim features).
   - Projection Heads: Align image and text features into a 256-dim shared space using linear layers, GELU, and residual connections.
   - Loss Function: Temperature-scaled contrastive learning.
2. Prediction:
   - CatBoost Regressor: Trained on extracted features with 700 iterations, learning rate 0.1, and max depth 8 (RMSE optimized).
3. Optimizations:
   - Memory-efficient training, gradient checkpointing, and mixed precision support.

This modular pipeline efficiently predicts cloud cover using transfer learning and optimized regression.

INFERENCE


Weather Prediction System
Cloud Cover Prediction
Upload Satellite Image
Choose file
No file chosen
Predict Cloud Cover
Temperature Prediction
Cloud Cover
Enter cloud cover percentage
Humidity (%)
Enter humidity percentage
Condition
Select Weather Condition
Predict Temperature


Weather Prediction System
Cloud Cover Prediction
Upload Satellite Image
Choose file
20160101075000.jpg
Predict Cloud Cover
Cloud Cover: 7.13%
Temperature Prediction
Cloud Cover
7.13
Humidity (%)
95
Condition
Few
Predict Temperature
Max Temperature: 32.0°C
Min Temperature: 25.7°C

Results and Findings

Performance:

- MAE for Max Temp Prediction: 1.33°C
- MAE for Min Temp Prediction: 1.69°C

Insights:

- Accurate predictions for both max and min temperatures, with slightly better performance for max temperatures.
- Demonstrates acceptable approach for meteorological applications if worked on.

```
# Evaluation
max_temp_mae = mean_absolute_error(y_max_test, y_max_pred)
min_temp_mae = mean_absolute_error(y_min_test, y_min_pred)

print(f"MAE for Max Temp Prediction: {max_temp_mae:.2f}")
print(f"MAE for Min Temp Prediction: {min_temp_mae:.2f}")
```

```
MAE for Max Temp Prediction: 1.33
MAE for Min Temp Prediction: 1.69
```

Future Scope:

- Incorporate additional weather features to enhance accuracy.
- Test on diverse datasets for broader applicability.

References

Cloud Coverage Prediction using Skycam Images
CLIP (Contrastive Language-Image Pretraining)

Team Contributions

- AYUSH KUMAR MISHRA: Model architecture and code, and training.
- AKSHAT KUMAR: Project design and code, report preparation.
- ADITYA PRAKASH: Data scrapping and preprocessing .

THANK YOU!

TEAM CLOUD COVER