Cloud Detection and Classification in Radiance Sky Images for Solar Energy Optimization Using Attention-SolarNet

Author: Zhang.kaijie Jack
Supervisor: Dr. Grace Ugochi Nneji

Cloud Image

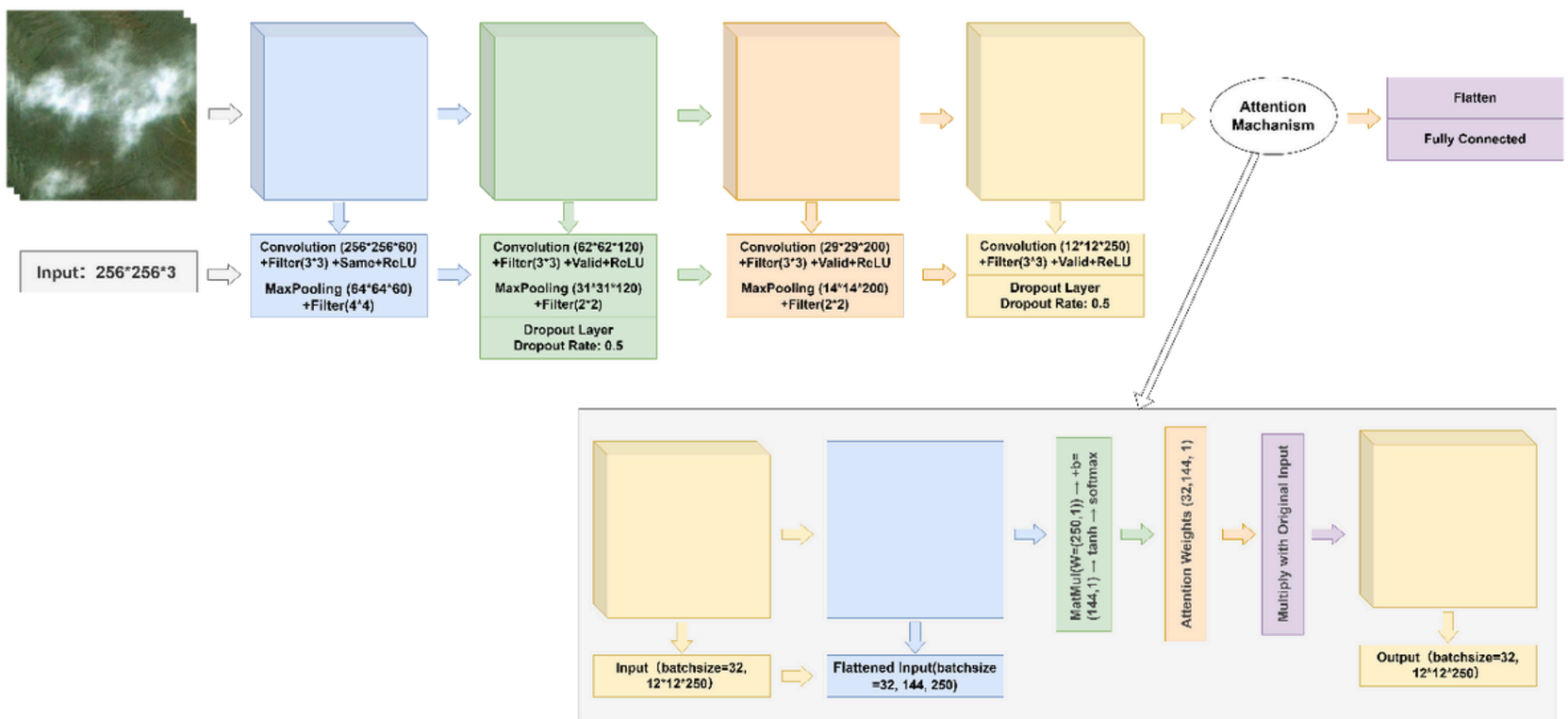
Introduction & Background

1. Clouds significantly influence solar radiation reaching Earth.
2. Fluctuations in irradiance affect PV efficiency and grid reliability.
3. Traditional methods are limited by subjectivity and speed.
4. ML and DL enable automated, accurate cloud classification.
5. CNNs and attention mechanisms enhance feature extraction.

No cloud Image

Methodology

Attention-SolarNet for cloud detection

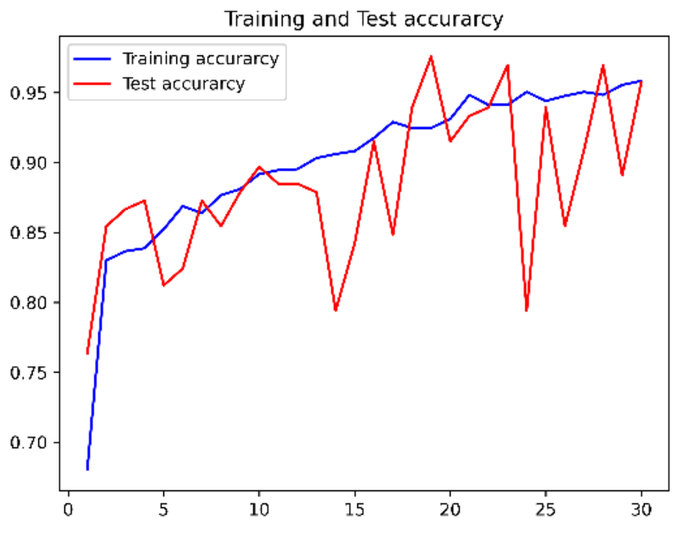


TN=73, FP=16, FN=0, TP=143. The perfect recall (FN=0) indicates that the Attention-SolarNet model is highly effective in identifying cloud images, providing solar energy systems with the accurate and timely data needed to optimize power generation and storage strategies.

RMSprop optimizer (1e-4 learning rate), batch size (32), and 30-epoch duration.

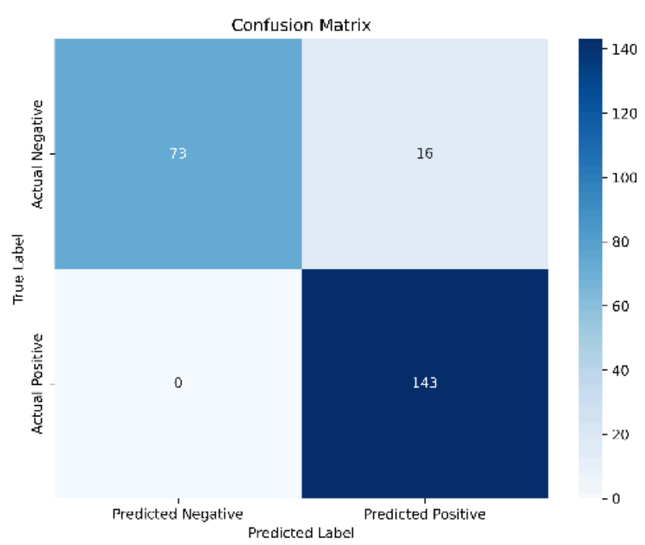
Results & Deployment

Experiment and result analysis

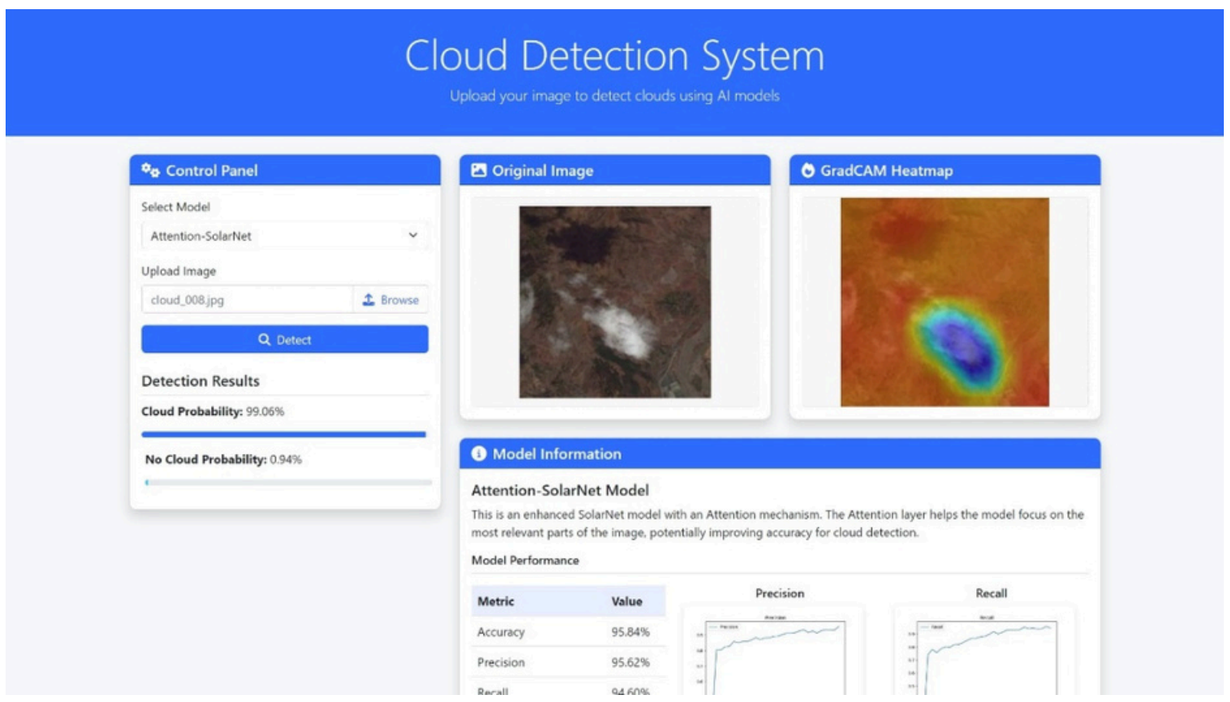


Train acc=95.84%, Test acc=95.76%

Train loss=12.17%, Test loss=14.89%



Attention-SolarNet model confusion matrix



Conclusion

- SolarNet and Attention-SolarNet models developed.
- Attention-SolarNet achieves 95.76% test accuracy and 100% recall.
- Effective for solar irradiance prediction and energy optimization.
- Foundation laid for scalable, intelligent renewable energy systems.