IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 2, November 2024

Deep Learning-Based Detection of Solar Panel Faults

Gurhal Gayatri Ram, Dhage Akshay Namdev,
Suryawanshi Nandikishor Bapu, Prof. Y. G. Suryawanshi
Department of Computer Engineering
SGVSS Adsul Technical Campus Faculty of Engineering, Chas, Ahmednagar, India

Abstract: *As the global shift toward renewable energy intensifies, solar power has become an essential pillar of sustainable energy initiatives. Ensuring the efficient operation of solar panels is paramount, as these panels are often subject to environmental factors like temperature fluctuations, dust accumulation, and material degradation that can impair functionality and reduce energy output.*
Traditional methods of solar panel inspection can be time-consuming and labor-intensive, often requiring manual inspections that are impractical for large solar farms. This review explores recent advancements in deep learning (DL) approaches for automated fault detection in solar panels, with a particular focus on systems that employ unmanned aerial vehicles (UAVs) equipped with thermal cameras and GPS modules.
These UAVs enable efficient, large-scale data collection by scanning extensive solar fields and capturing thermal images to detect potential faults or inefficiencies.
An emphasis is placed on lightweight deep learning models, specifically enhanced versions of the You Only Look Once (YOLO) architecture, such as YOLOv3-tiny, which allow for real-time fault detection on limited computational resources, making them ideal for deployment on UAVs. Through DL-based analysis of thermal imagery, these models can pinpoint faults with high accuracy and at faster processing speeds compared to traditional approaches.
Additionally, integration with Long-Term Evolution (LTE) technology enables real-time data transmission, supporting immediate fault localization and reporting to a remote server, thus facilitating prompt responses that minimize panel downtime and associated maintenance costs.
This review presents a comparative analysis of various DL models in terms of accuracy, processing efficiency, and practical applicability for UAV-based systems.
Current challenges, including dataset limitations, model generalization, and environmental variability, are discussed, alongside potential directions for future research to improve fault detection and monitoring capabilities in solar energy systems.

Keywords: Solar Panel Maintenance, Deep Learning, Fault Localization in Solar Panels, Solar panels.