Using Convolutional Neural Networks for automated fault detection of Photovoltaic (PV) Cells.

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Introduction:

- PV degradation can lead to damages known as microcracks /microfractures , which can reduce the performance of the cell.
- Currently, fault inspections are carried out by Human experts, an AI solution aims to automate the process.
- Lightweight CNN model to have lower computational requirements to easily integrate into existing manufacturing equipment with minimal invasion/ downtime necessary for maintenance.

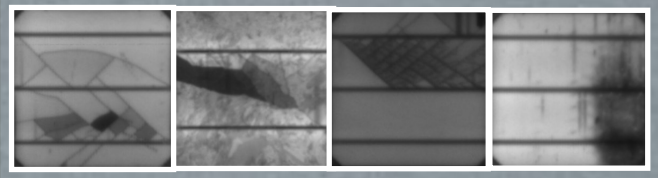
Literature Review:

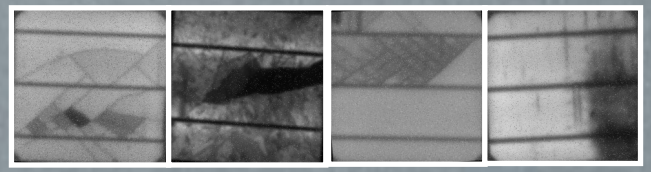
- M. Waqar Akram : CNN model : 93.02% accuracy, data augmentation increased accuracy by a further 6.5% —> 99.7%
- M R Ahan : CNN model : 95% accuracy. Operated on an electroluminescence (EL) image dataset.
- S Naveen Venkatesh: Deep Ensemble Learning Network : reports 99.68% accuracy
- Ahmed A. Al-Katheri AI application in PV Fault detection.

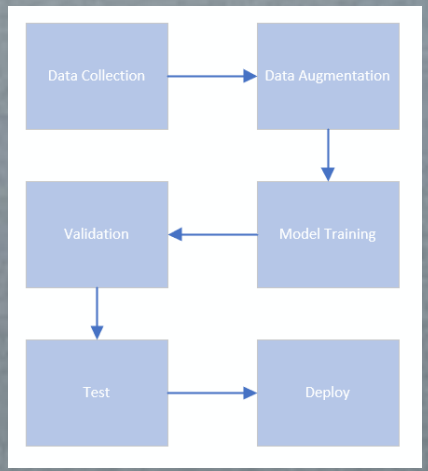
Methodology:

Data collection and augmentation:

Horizontal flip, crop, zoom, rotation (5 degree variance), exposure (25% variance) blue (2.5px max), noise (5% max)







Progress so far:

- Research existing literature, conducting PLESI analysis and reviewing CNN theory.
- Raw image data of PV cells to represent the variety of normal and damaged PV cells.
- Data categorized into normal and defective categories for both training and testing.
- Augmented the raw images to improve the model's performance by reflecting real world variance. Artificially increased the dataset.
- Started CNN model development

Next steps:

- Further develop the CNN model and test the accuracy ratings comparing the raw dataset with the augmented dataset.
- Focus on regularization techniques to improve accuracy and reduce overfitting.
- Compare accuracy levels of my CNN implementations with the existing proposed AI solutions for automated PV Fault detection.