Automated Detection of Defective Photovoltaic Panels Using Drone Thermal Imaging

Figure 1: View of the application displaying panel classification results

Multispectral Orthophoto

- Open Drone Map

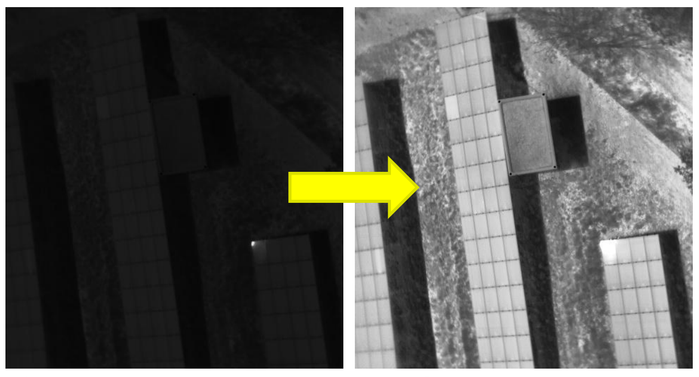

Figure 2: Thermal image before & after normalization

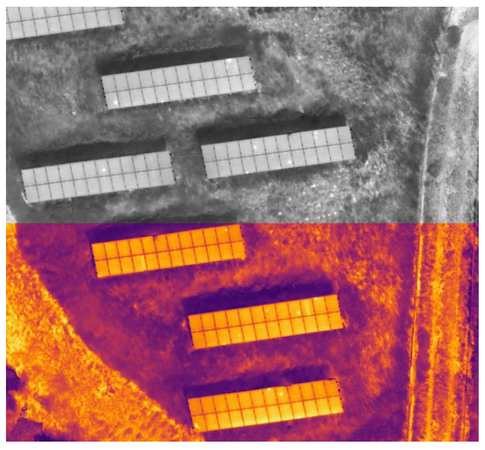

Figure 3: Multispectral orthophoto

Panels Segmentation

- Mask-RCNN

Metric	Result
AP	82,59%
AP50	96,99%
AP75	96,99%
Aps	82,14%
Apm	91,89%

Table 1: Evaluation results

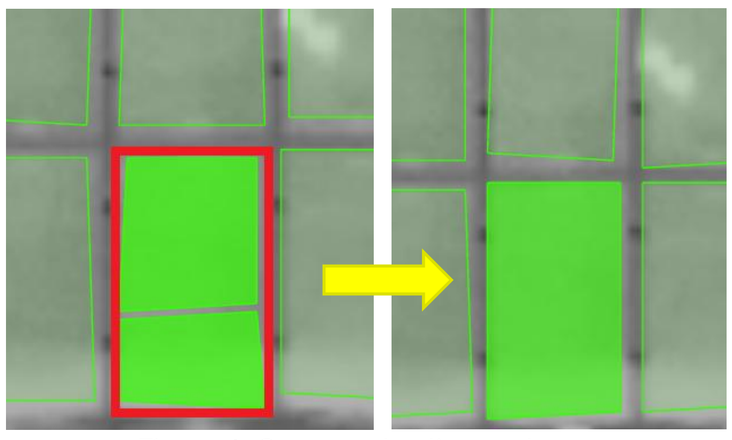

Figure 4: Corrected split panel error.

Panels Classification

- Vision Transformer
- Convolutional network

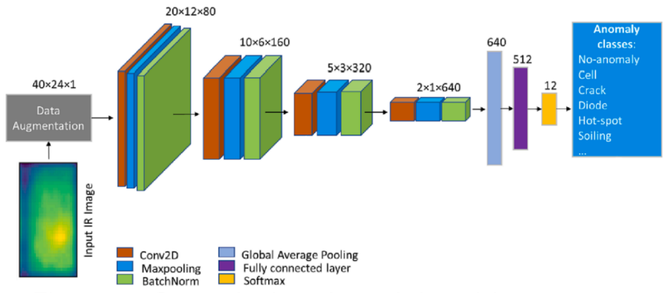

Figure 5: Convolutional model architecture.

Class	Vision Transformer Precision	Vision Transformer Recall	Convolutional Precision	Convolutional Recall
Cell	0,82	0,71	0,73	0,81
Cell-Multi	0,54	0,62	0,67	0,47
Cracking	0,72	0,71	0,76	0,79
Diode	0,99	0,97	0,97	0,97
Diode-Multi	0,95	0,99	0,99	0,97
No-Anomaly	0,96	0,99	0,94	0,96
Offline	0,94	0,8	0,91	0,81
Shadowing	0,88	0,7	0,83	0,77
Vegetation	0,75	0,79	0,77	0,76

Table 2: Evaluation results

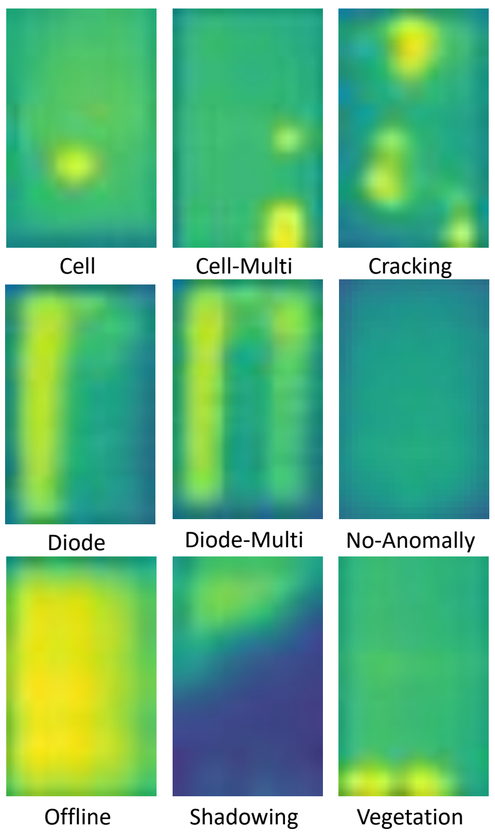

Figure 6: Panel classes

User Review

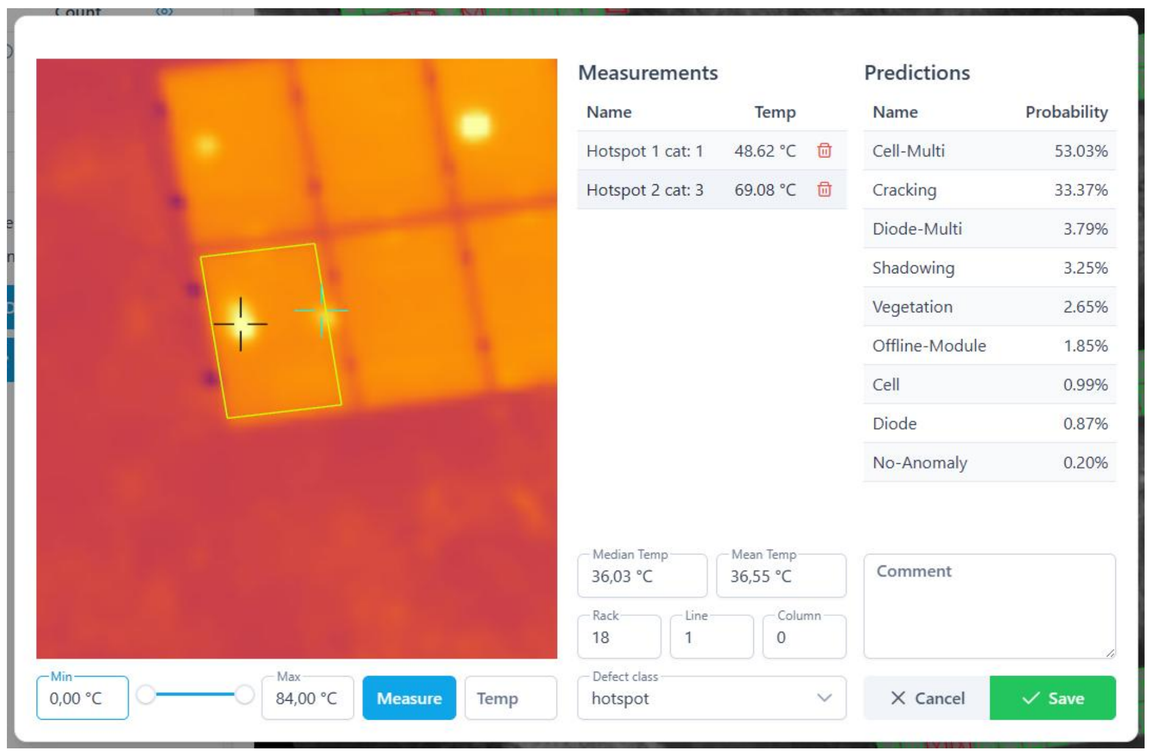

Figure 7: Panel detail view

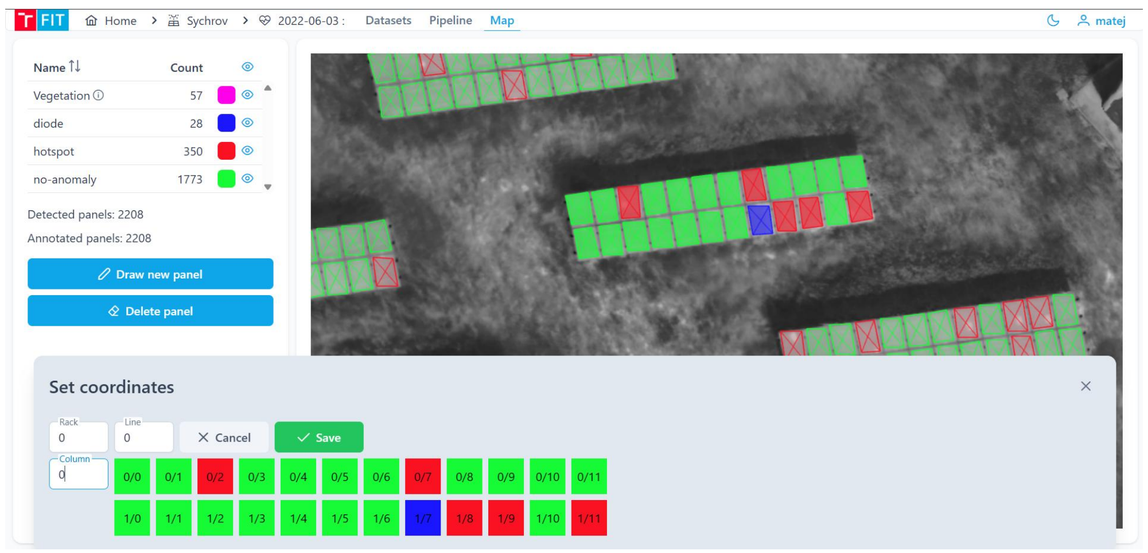

Figure 8: Panel labeling view

Evaluation and Results

- Tested on a dataset annotated by a domain expert.

Class	Vision Transformer Precision	Vision Transformer Recall	Convolutional Precision	Convolutional Recall
diode	0,26	0,75	0,38	0,64
hotspot	0,59	0,92	0,74	0,99
no-anomaly	0,98	0,83	1	0,91

Table 3: Tests results

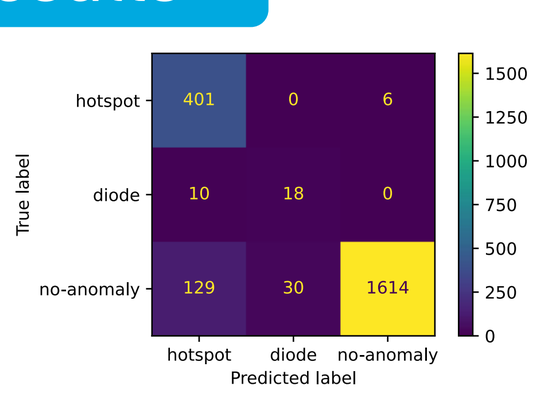

Figure 9: Confusion matrix of the convolutional model

BRNO UNIVERSITY OF TECHNOLOGY
FACULTY OF INFORMATION TECHNOLOGY

Excel@FIT 2025

Bc. Matěj Gotzman
Supervisor: Ing. Daniel Bambušek