2021 NSF CYBER-PHYSICAL SYSTEMS PRINCIPAL INVESTIGATORS' MEETING

CPS: Synergy: Image Modeling and Machine Learning Algorithms for Utility-Scale Solar Panel Monitoring

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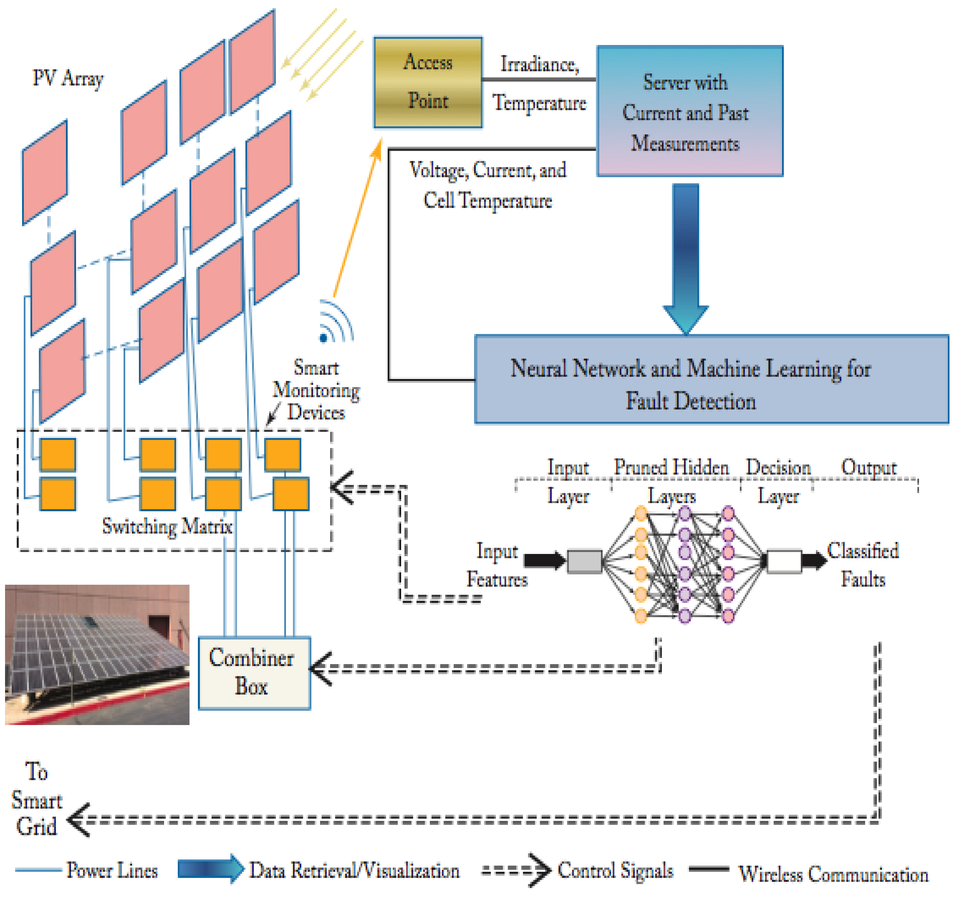
Challenge:

- Detect and classify solar array faults at the panel level.
- Optimize power using topology connection adaptation.
- Track cloud movement and predict shading using advanced vision methods.
- Design and implement hardware and algorithms for real time operation.
- Design IoT Secure Energy Monitoring system.

Solution:

- Use pruned neural networks to detect and classify faults.
- Use deep neural nets to select among four PV topologies and optimize power using shading conditions.
- Implement shading prediction and interface with topology adaptation.
- Topology Optimization yielded 16% (max) improvement in power output.
- Five different faults detected with greater than 90% accuracy.



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Scientific Impact:

- Developed IoT Solar Energy Monitoring.
- 16% Solar Power Output Improvement. Under shading).
- PV Array Robustness with Fault Detection.
- Novel ML methods can apply to other CPS.
- Vision and tracking algorithms developed.
- Net Security & Authentication established.

Broader Impact:

- Contributes to Green Energy Efficiency and robustness.
- Contributes to environmental sustainability.
- Application part of Workforce Development (REU, IRES, RET).
- ML for Solar Energy Education user-friendly software developed for use in UG and high school science classes.
- *Four provisional patents established.*
- *One startup company launched.*