

Deep Pujara¹, Andreas Spanias¹, Cihan Tepedelenliolu¹, Devarajan Srinivasan²

¹SenSIP Center, School of ECEE, Arizona State University, Tempe, Arizona, USA

²Poundra LLC., Tempe, Arizona, USA

SOLAR TESTBED FACILITY AT ASU MTW



Solar Monitoring Facility at the ASU Research Park

- 18 kW PV array consists of 104 PV panels.
- Each panel has a smart monitoring device.
- SMDs monitor current and voltage.

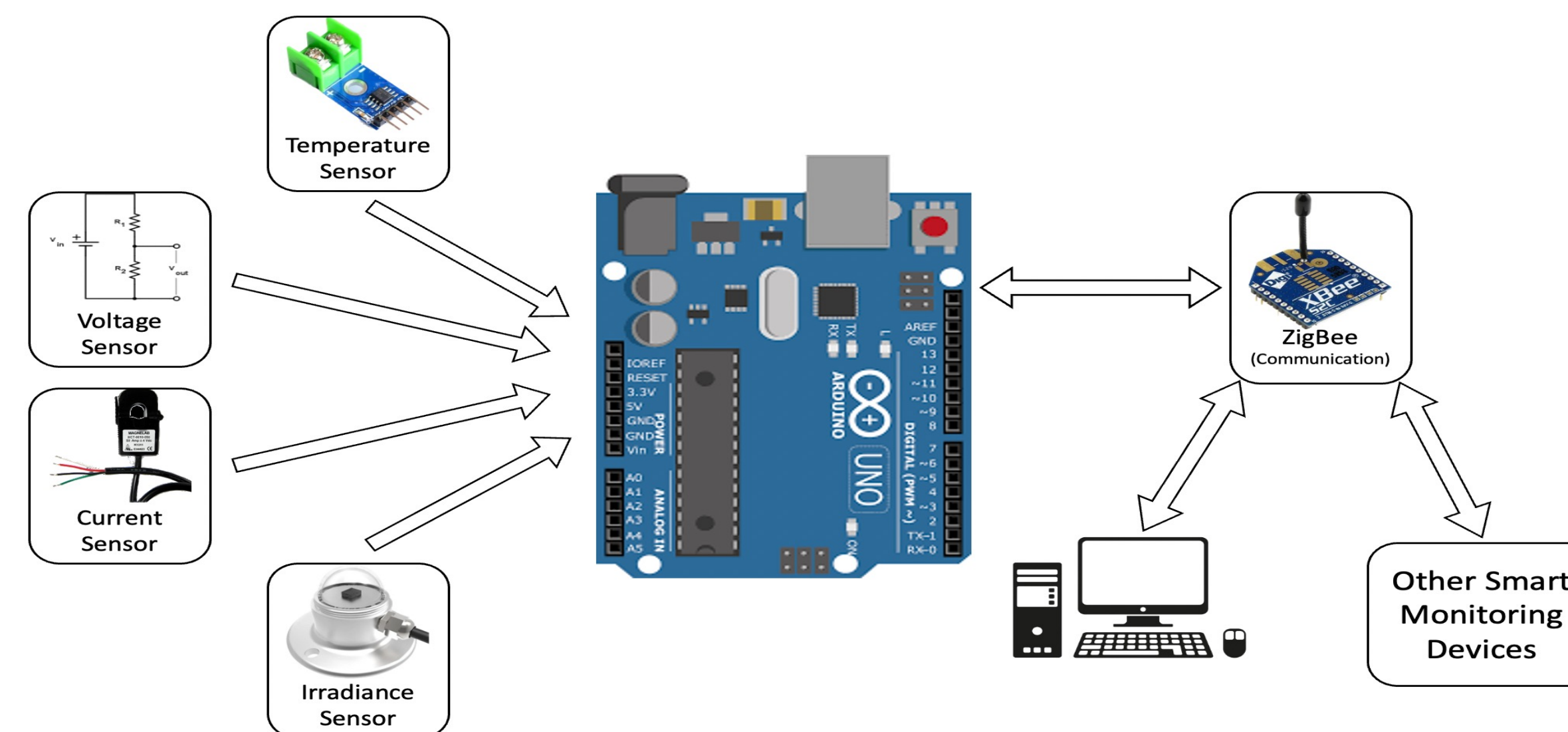
DISADVANTAGES OF THE EXISTING SMD

- No direct temperature and irradiance measurement
- Slow transmission rate
- Only performs series, parallel, or series-parallel topology reconfiguration
- No provisions for secure access
- No encryption

FEATURES OF PROPOSED SMD

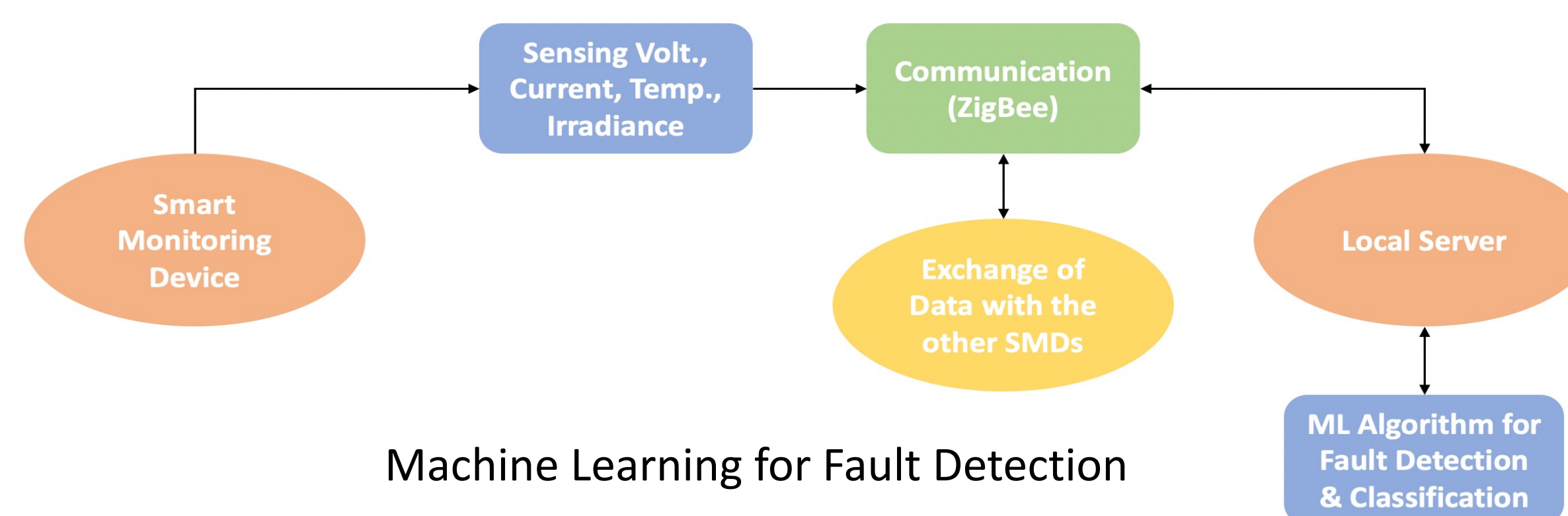
- Temperature, voltage, current, and irradiance data collection
- Better data transmission rate (1 Packet/sec)
- PV array control using Zigbee mesh network
- Fault detection using neural nets
- Provision for topology optimization
- Secure access and encryption

PROPOSED SMD DESIGN



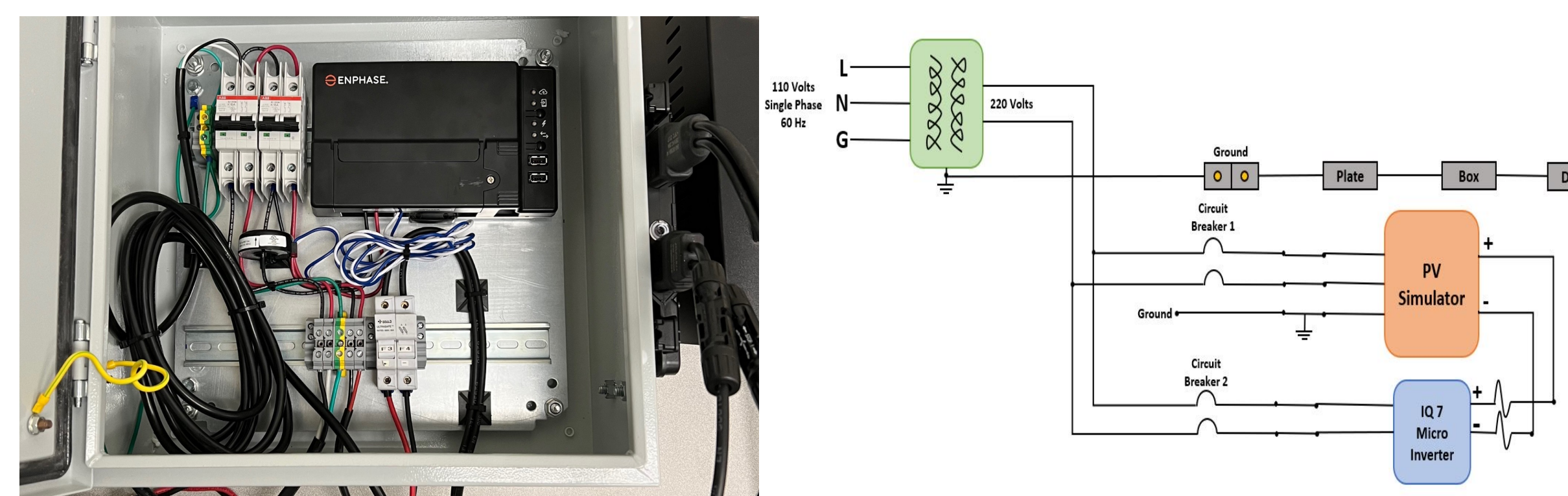
Circuit Diagram of a Smart Monitoring Device: a) Data Collection, b) Data Transmission, c) Real-Time Fault Detection

MACHINE LEARNING FOR FAULT DETECTION

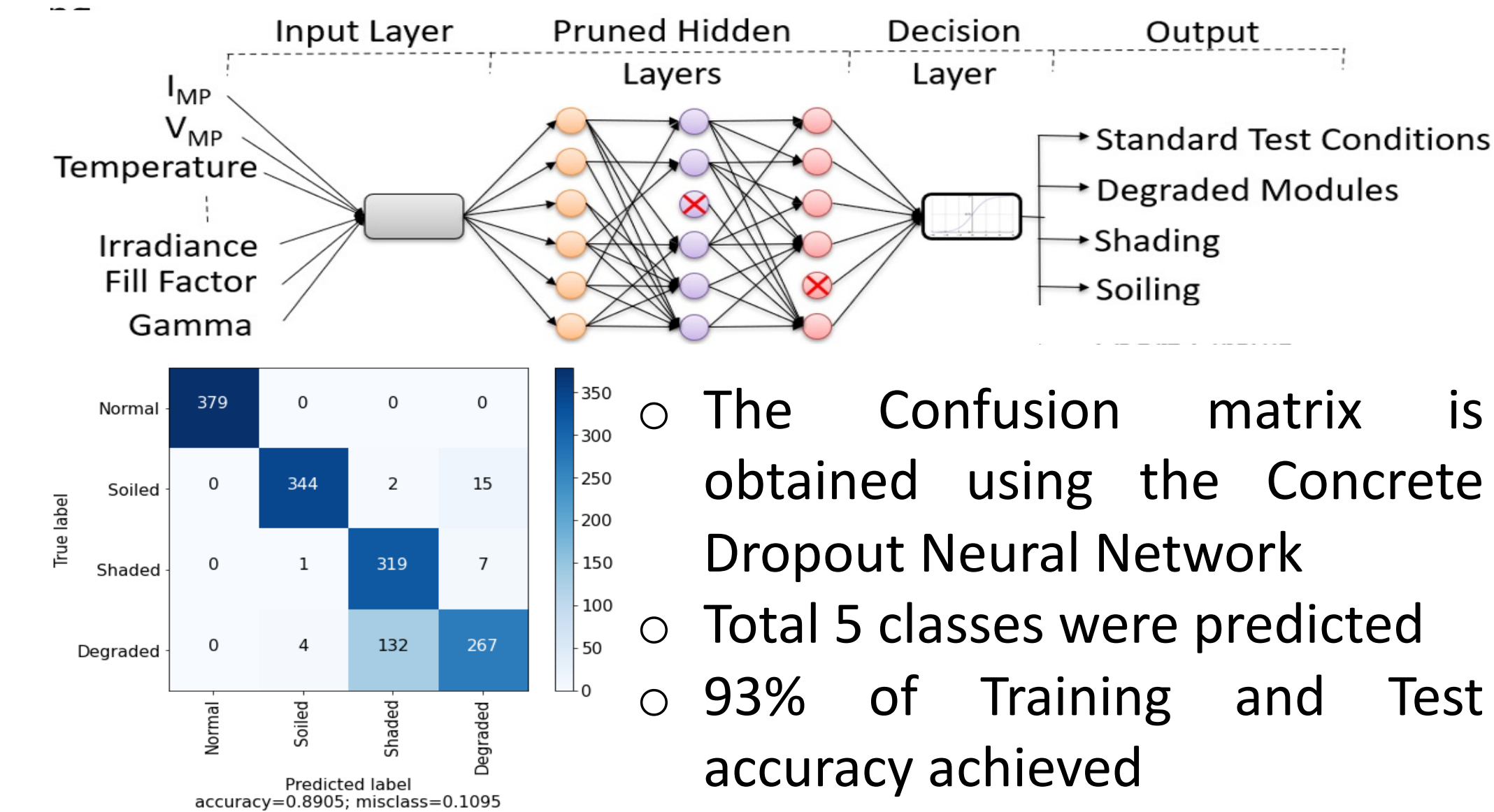


Machine Learning for Fault Detection

BLOCK DIAGRAM AND CIRCUIT OF SOLAR TESTBED



NEURAL NETWORK AND CONFUSION MATRIX



CONCLUSION & FUTURE WORK

- Preliminary design accomplished
- Initial machine learning simulations promising
- Relays for topology reconfiguration
- Secure access and encryption
- Packaging, testing, and validation of the hardware

REFERENCES AND PATENT

1. Rao, S., Katoch, S., Narayanaswamy, V., Muniraju, G., Tepedelenlioglu, C., Spanias, A., Turaga, P., Ayyanar, R., and Srinivasan, D., "Machine learning for solar array monitoring, optimization, and control." *Synthesis Lectures on Power Electronics* 7, no. 1 (2020): 1-91.(Book).
2. Narayanaswamy, V., Spanias, A., Ayyanar, R., Tepedelenlioglu, C., M19-149P Systems and Methods For Connection Topology Optimization In Photovoltaic Arrays Using Neural Networks, US 11,616,471, March 2023.
3. Rao, S., Spanias, A., Tepedelenlioglu, C., (M19-102P), Solar Array Fault Detection, Classification and Localization Using Deep Neural Nets, US 11,621,668, April 2023.

ACKNOWLEDGMENTS

This work is supported in part by the NSF CPS Award 1646542, the NSF MRI Award 2019068, Poundra, LLC, and the NSF SENSIP I/UCRC.