UEH UNIVERSITY | INSTITUTE OF INNOVATION

Topic: Predictive maintenance system for renewable energy

Foreword: Special thanks to lecturer Nguyen Truong Thinh and our teaching assisstants

Project name:

Predictive Maintenance System For Photovoltaic System

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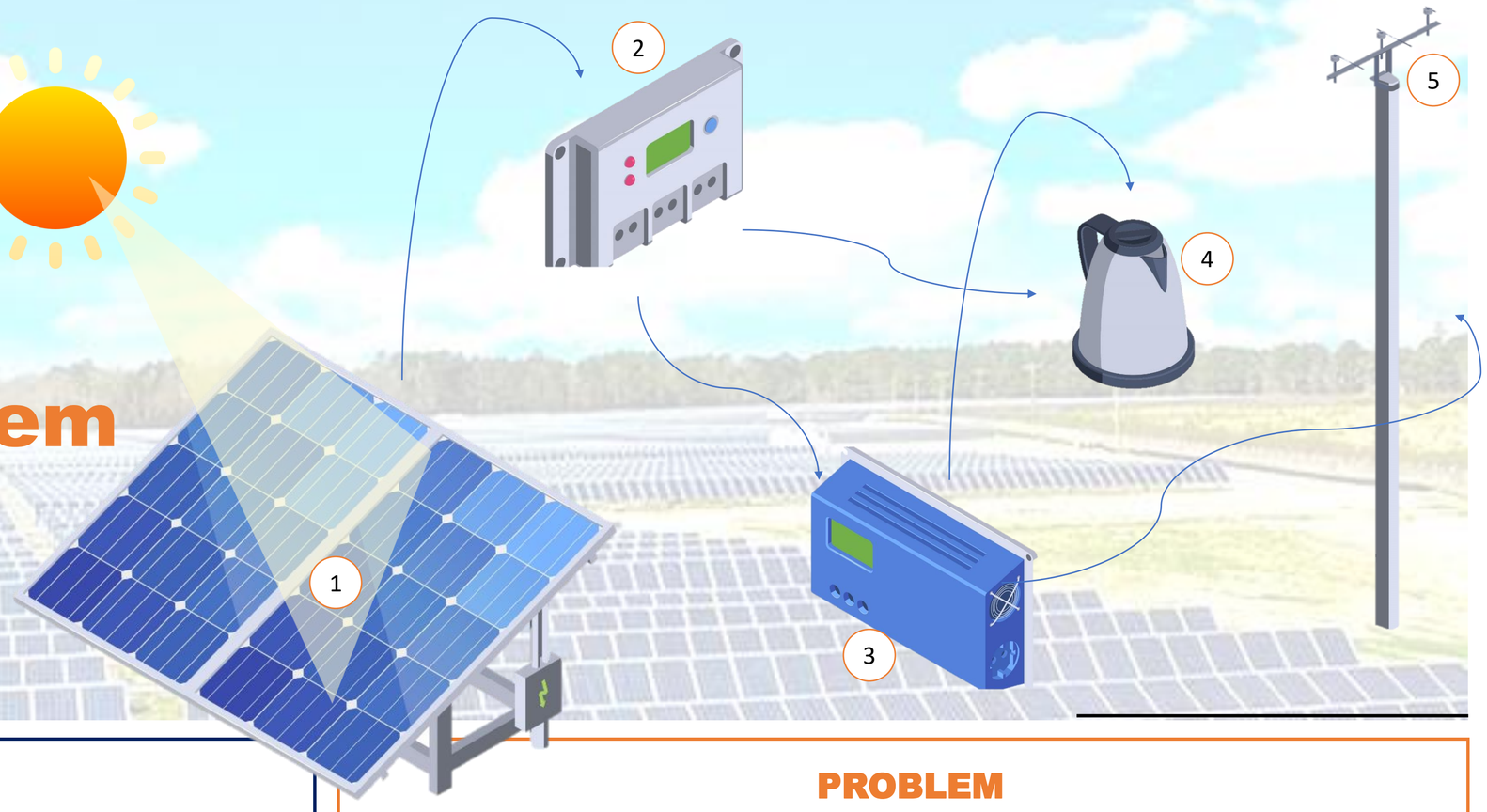
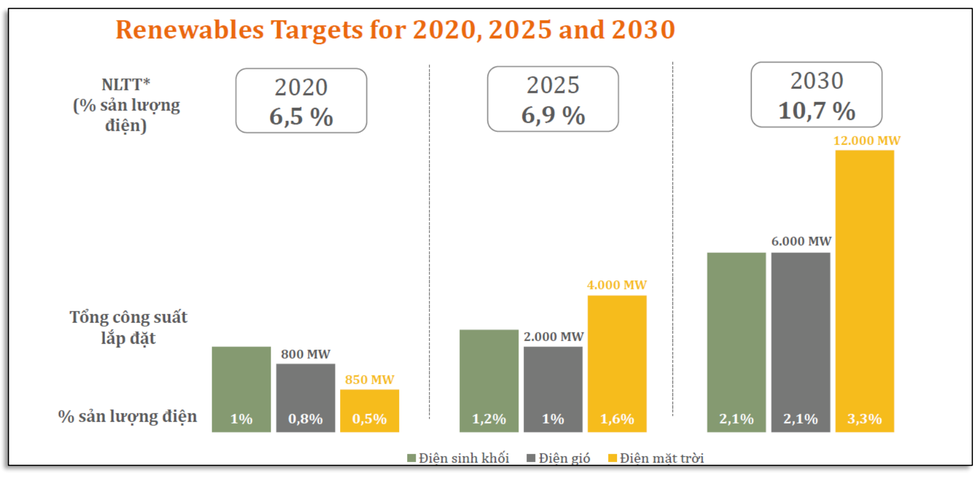


CONTEXT

Vietnam has the largest offshore wind power potential among ASEAN countries, with over **470 GW** technical potential within 200 km of the coast.



PROBLEM

Degrafation: the degradation of PV system components, such as solar panels, inverters, or cables can lead to premature equipment failure and shorter lifespan

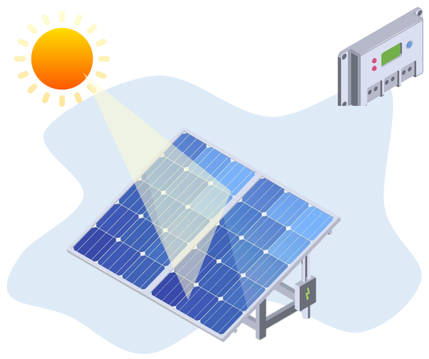
Environment factors: the impact of factors like rain, dust or dirt on the PV system may reduce its efficiency and the electricity production.

Downtime and productivity loss: inadequate maintenance increases the risk of unexpected system failures, resulting in downtime.

SOLUTION

A photovoltaic system maintenance system that uses AI algorithms (**fuzzy logic** and **conventional neural networks**) to predict whether the system needs repair or not by analyzing **data** and **images** from the PV system.

Fuzzy logic – Data-driven

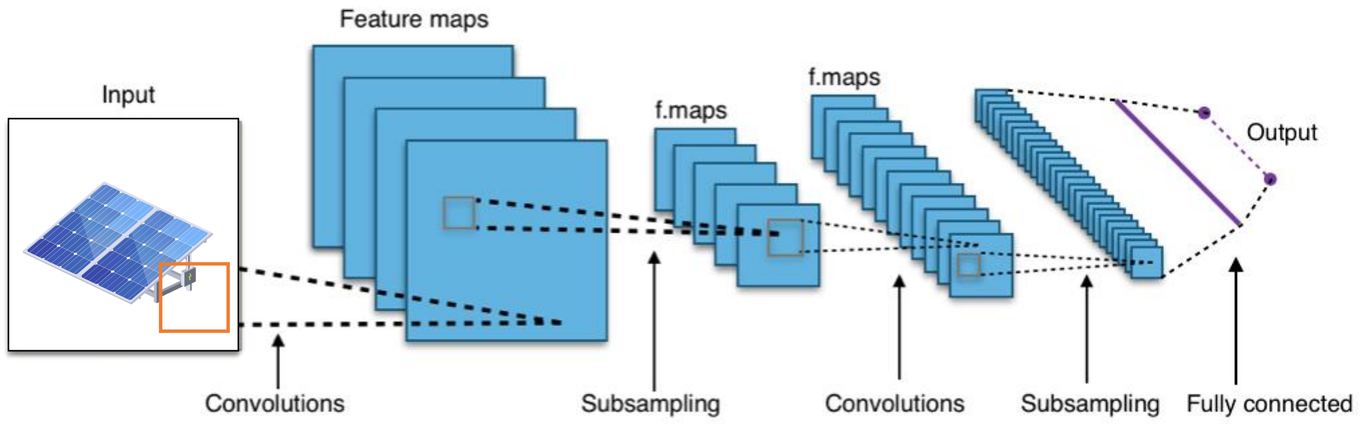


Input data:
1. Solar irradiance
2. Panel temperature
3. DC Voltage output
4. Humidity

→ Define membership function → Fuzzification → Fuzzy reasoning ← Fuzzy rules → Defuzzification →

Output:
1. Alert (green – yellow – red)
2. Performance (poor – balanced - excellent

CNN Model – Photo-driven

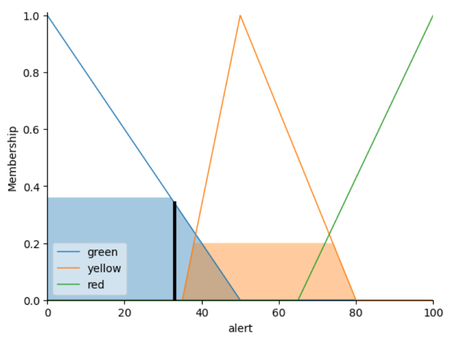


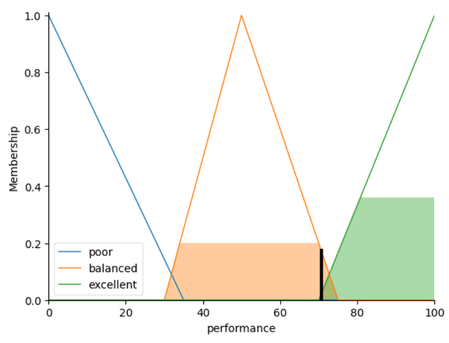
Output:
1. Good – array[0]
2. Defect – array[1]

FUZZY LOGIC RESULT

```
Enter solar irradiance level (0-100 W/m2): 60
Enter panel temperature (0-60 Celsius degree): 23
Enter DC voltage output (0-1000 V): 897
Enter humidity level (0-100 %): 34
```

Maintenance Alerts: 32.95400126023949 %
Performance Monitoring: 70.64142766093055 %



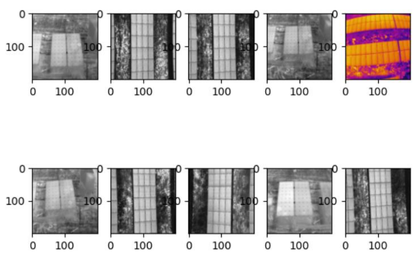


CNN RESULT

```
if file.startswith('good'):
  output = 0
elif file.startswith('defect'):
  output = 1
```

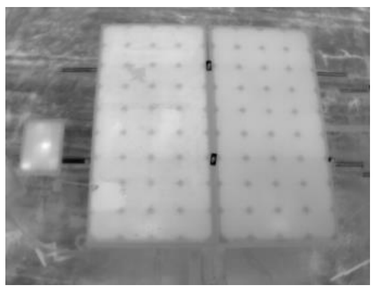
```
Expectation [0]
Answer 0
1/1 [==============================] - 0s 18ms/step
Expectation [0]
Answer 0
1/1 [==============================] - 0s 19ms/step
Expectation [1]
Answer 1
1/1 [==============================] - 0s 21ms/step
Expectation [1]
Answer 1
1/1 [==============================] - 0s 18ms/step
Expectation [1]
Answer 1
1/1 [==============================] - 0s 21ms/step
Expectation [0]
Answer 0
1/1 [==============================] - 0s 26ms/step
Expectation [0]
Answer 0
1/1 [==============================] - 0s 22ms/step
Expectation [1]
Answer 1
1/1 [==============================] - 0s 19ms/step
Expectation [0]
Answer 0
```

```
Loss rate: 0.0007795371930114925
Testing accuracy rate: 1.0
```



Test with testing image

Test with random image



```
1/1
[==============================]
- 0s 32ms/step
array([1])
```

IMPACT

BUSINESS

1. Cost Reduction
2. Operational Efficiency Enhancement
3. Data-driven decision making

PEOPLE

1. Safety Assurance
2. Reliable Energy Supply
3. Energy Affordability and Accessability

ENVIRONMENT

1. Carbon Footprint Reduction
2. Renewable Energy Adoption
3. Conservation of Natural Resources