UNIVERSITY OF PLYMOUTH

NSBM GREEN UNIVERSITY TOWN

PROJECT HELIOS

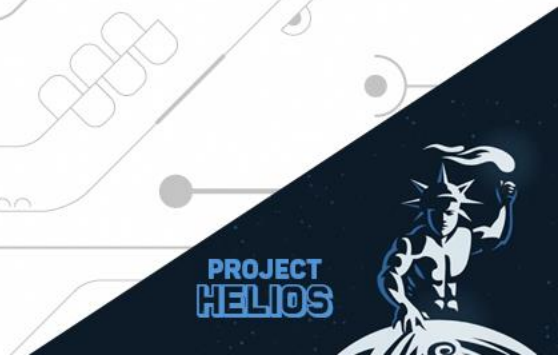
IOT FINAL PRESENTATION

IOT GROUP 77 X

Background

- Maximum efficiency of a solar panel is 15% to 20%
- Solar power is the least complicated and most reliable
- Lowest environmental pollution

- Aid in efficient decision making
- Provide accurate and Up-to-date information



Problem and Solution

- Problem

A panels maximum efficiency is between 15% to 20%.

Environmental factors reduces efficiency

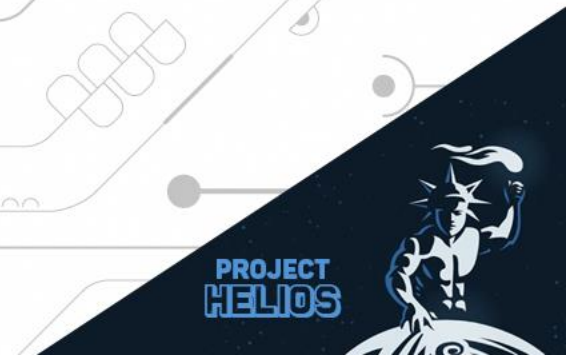
No specific method to identify the cause of inefficiency

- Solution

Optimize power output

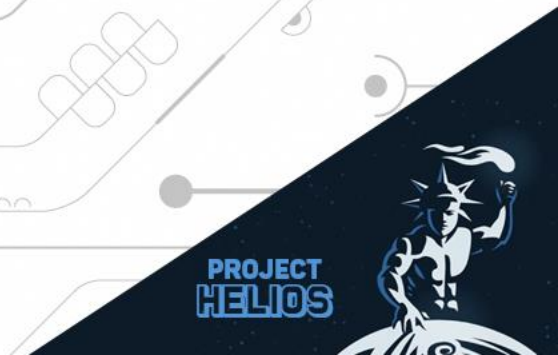
A System to inform the user

Possible action to take



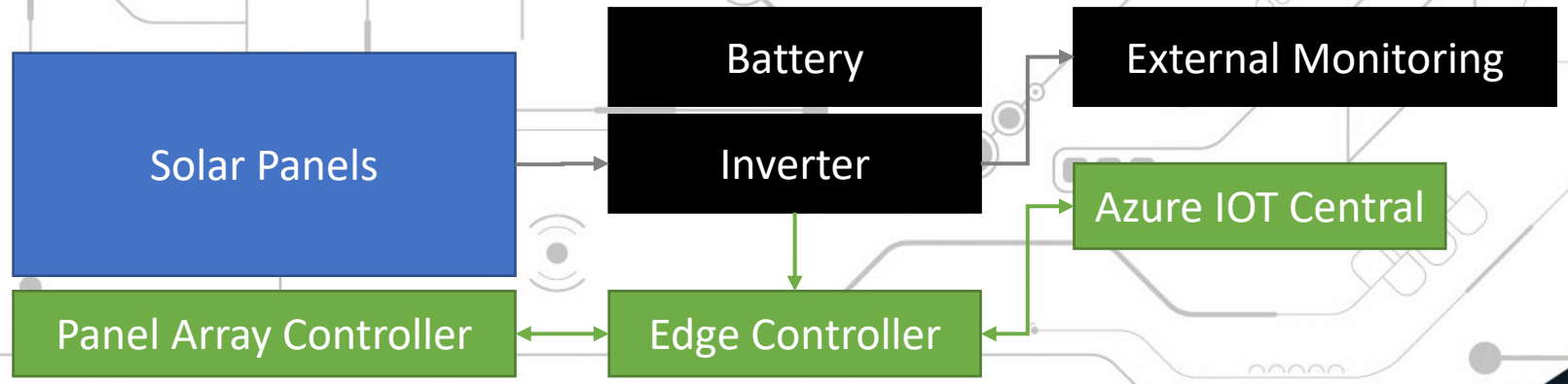
Objectives of Projects and Scope

- Optimum power out of the used solar panel
- Alert users of changes in efficiency
- Affordable to anyone
- Increase the usage and output of solar energy
- Create a GUI



Current Systems

- PV Module Monitoring based on low-cost solution: wireless raspberry application
- IOT enabled solar power monitoring system – Dust-particle
- Integrating A Cooling System For Solar PV Module To Maintain Energy Generation Efficiency



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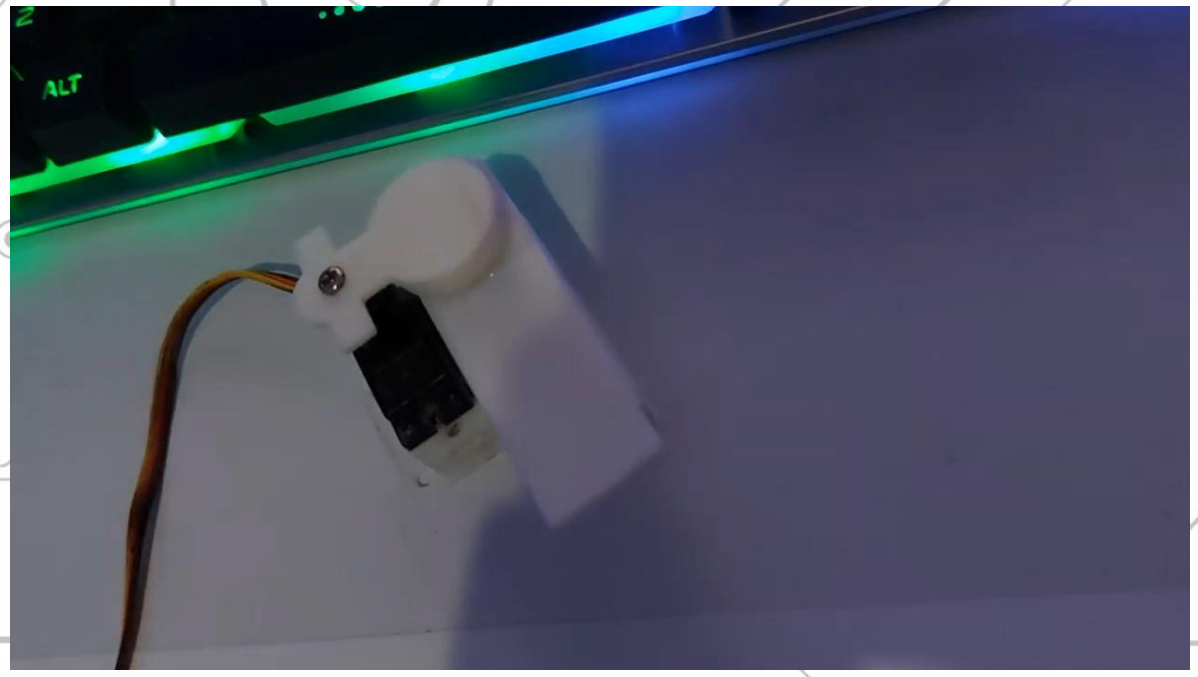
Applications

➢ Dust Detection Unit / Dispense clean solution

- Have two LDR Sensors in Place
- One is covered by a Plastic Plate (Controlled Environment)
- Motor can open and close the cover when needed.

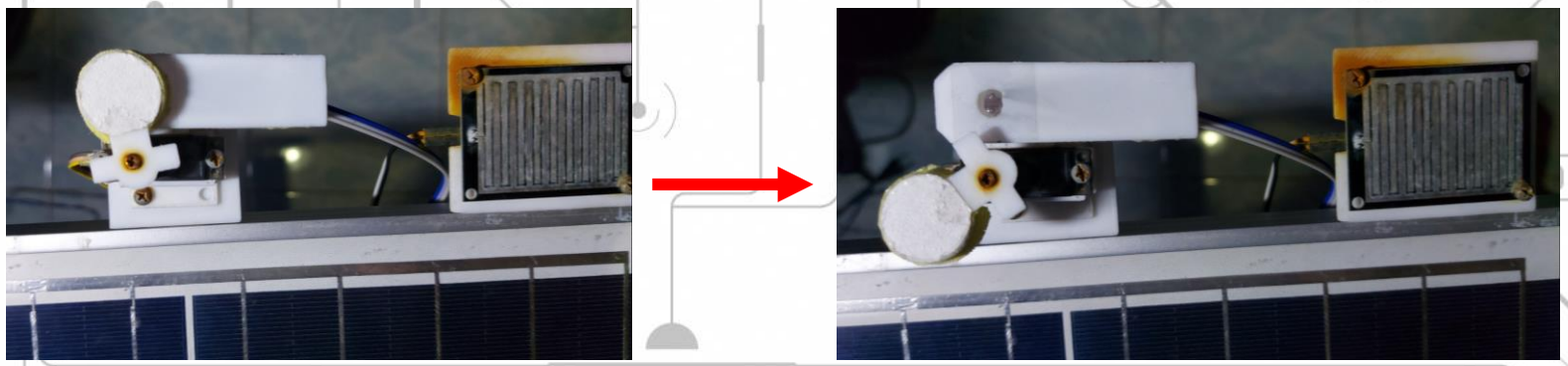


PROJECT HELIOS

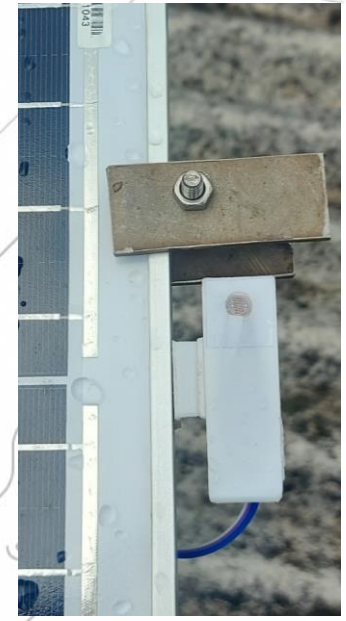
Applications

➢ Dust Detection Unit / Dispense clean solution

- Uncovered sensor will face the same environment faced by the panels (Dust, Light etc.)
- Difference between the two sensors show the dust coverage on the panel.
- Panel and Uncovered sensor can be cleaned at the same time.



Covered LDR Sensor with Servo Motor (Dust Detection Unit)

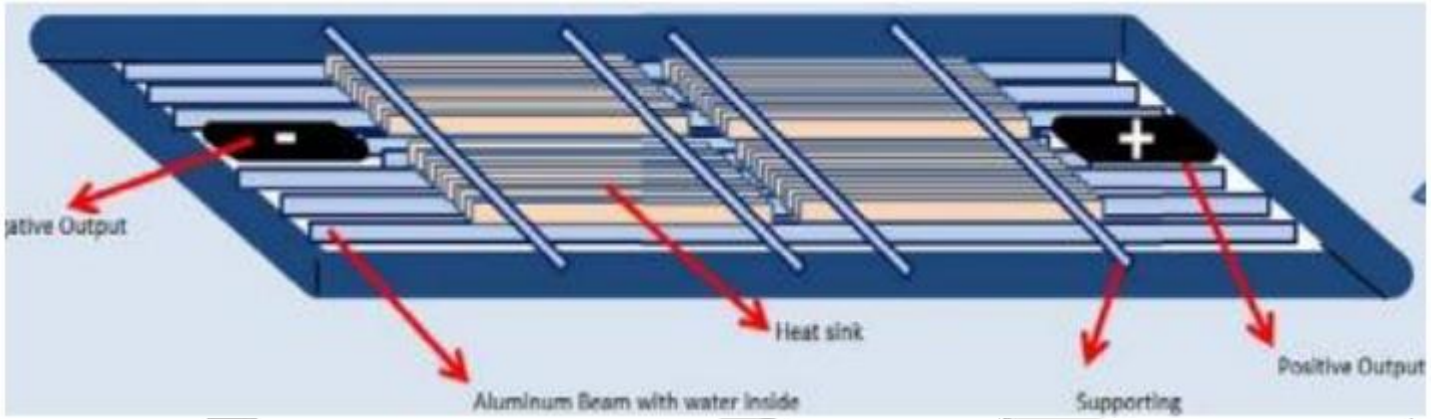


Uncovered LDR Sensor

Applications

➢ Temperature Controlling

- Keeping the Panels (relatively) cool is the key to efficiency.
- Incorporate Passive Cooling methods, monitor the temperature levels.
- Using water cooling, diagram below;



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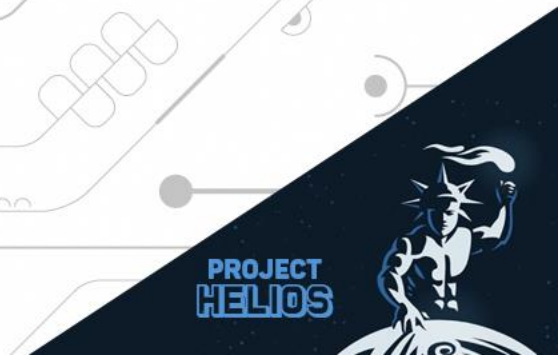
Applications

➢ Per Panel Statistics

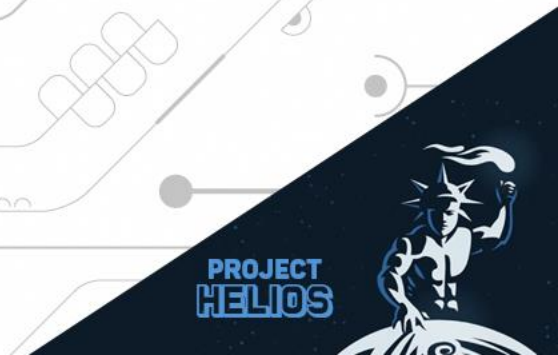
- Data that has been collected by an Individual panel.
- Implementation of a dedicated monitoring system.
- Makes troubleshoots easier for users.



Applications

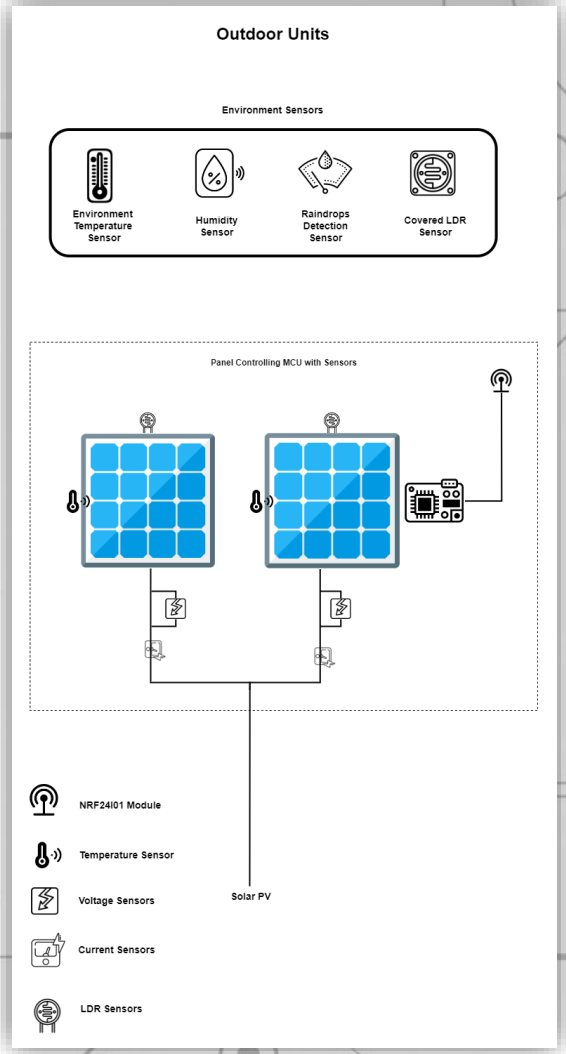
➢ Replacing Underperforming Panels

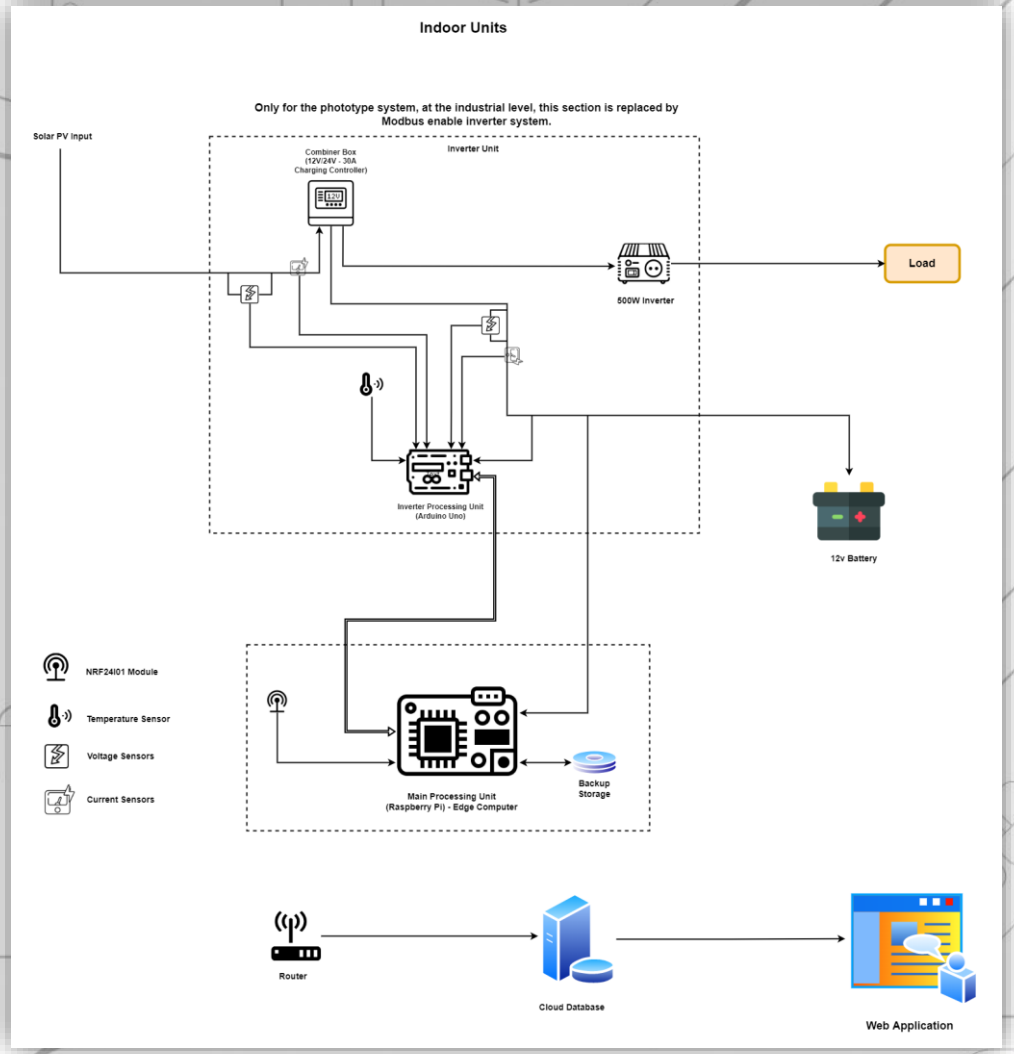
- Replacement of parts is inevitable.
- Using the system to identify the root of the problem.
- Users can ask for assistance or replace parts accordingly.



System Diagram

Power Consumption





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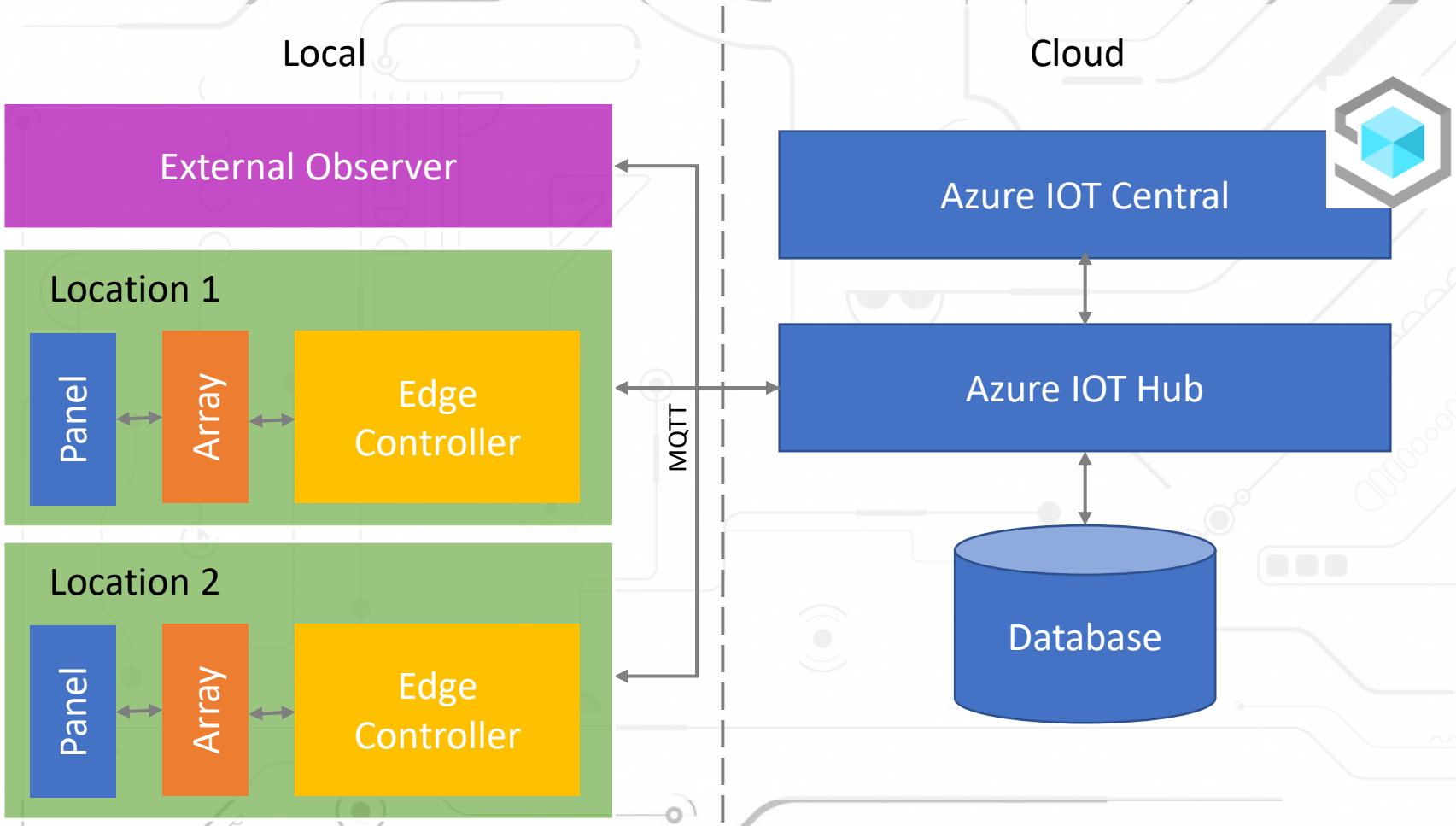
System Diagram

- **IoT Architecture: Level 4**



PROJECT HELIOS

Hardware Components

Sensors
DS18B20 Sensor Module DS18B20 Sensor Module
Snow & Raindrops Detection Sensor Module
LDR Sensors
DHT11 Sensor Module (Temperature and Relative Humidity)
Voltage Detection Modules
ACS712 20A Current Sensor Modules

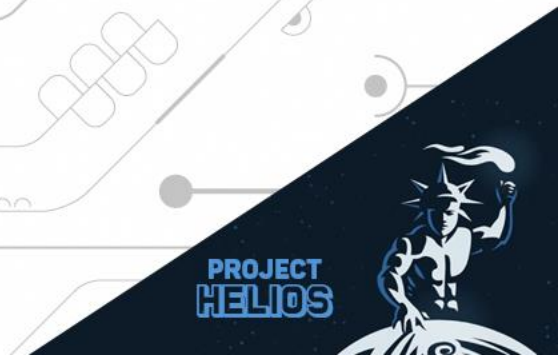
Actuator
Servo Motor Metal Wheel MG995

Communication
NRF24L01 2.4GHz Wireless Transceiver Modules

Inverter Unit
Arduino Uno
12V/24v 30A Auto Solar Panel Charge Controller
12V DC 500W Inverter
128×32 IIC I2C Blue OLED LCD Display Module

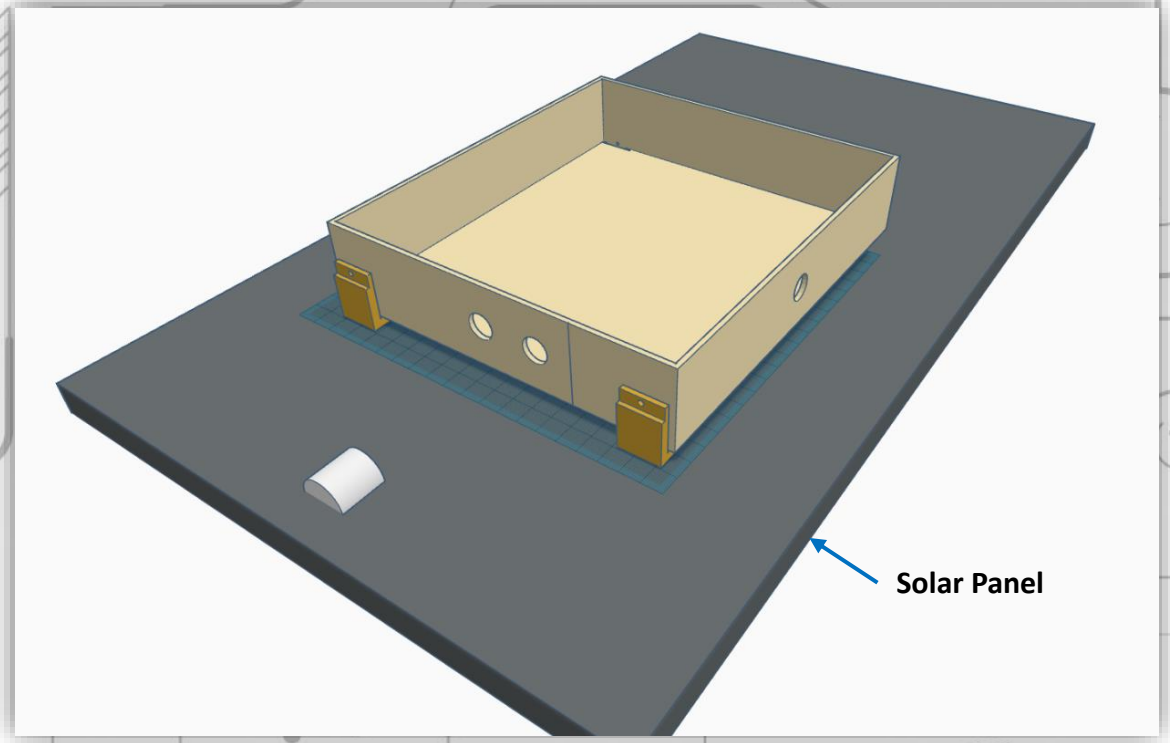
Edge Computer
Raspberry Pi 4 Model B 4GB RAM 1.5GHz 64bit CPU

Other
Arduino Mega
microSD UHS-I 32GB Memory Card
LM2596 DC-DC Buck Converter Step-Down Power Modules
DS3231 RTC Module

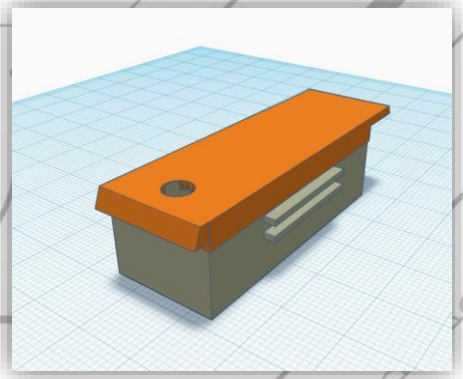


Hardware Components

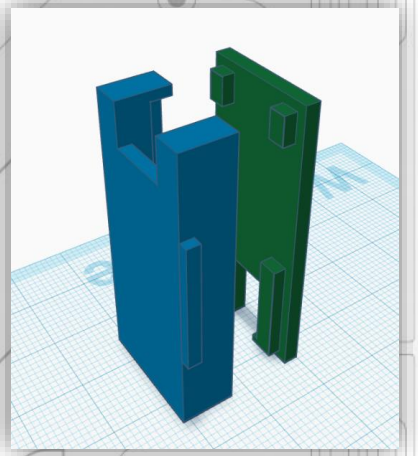
➢ 3D Designs



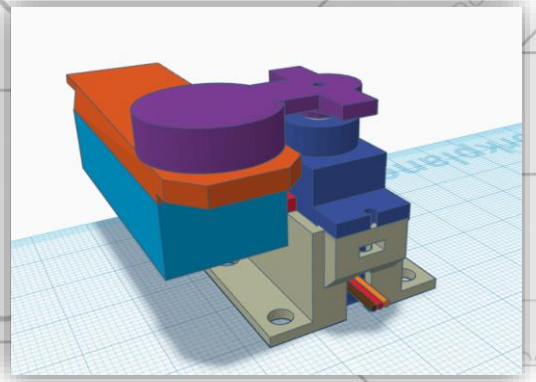
Solar Panel Monitoring Unit Box



Waterproof LDR Sensor Cover



NRF24L01 Module Cover



Dust Detection Unit

PROJECT HELIOS

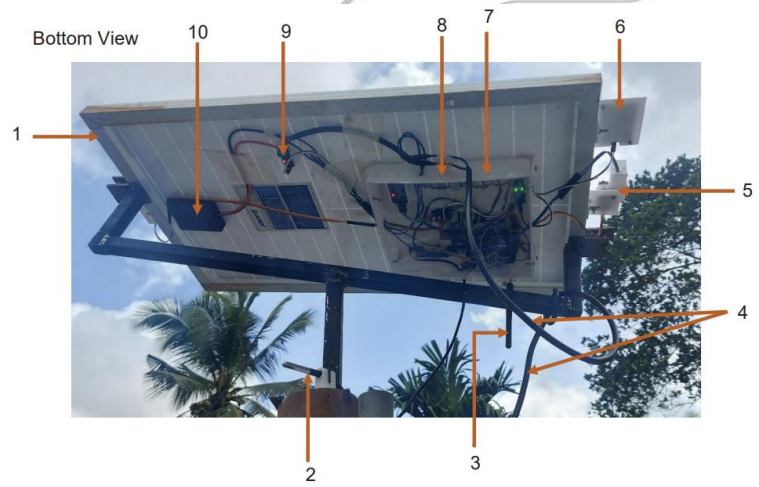
Working Product

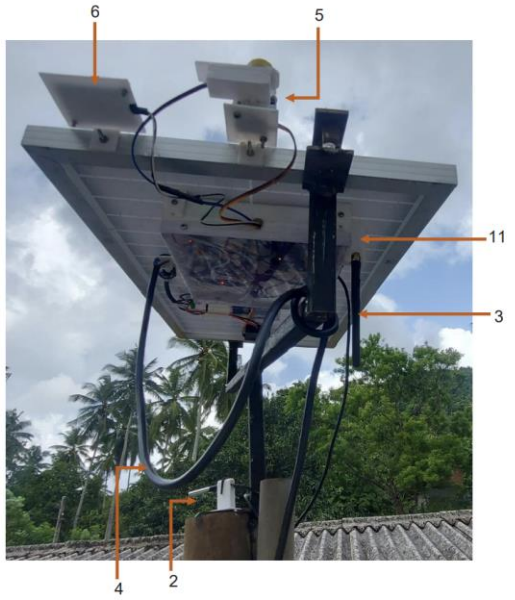
- **Outdoor Unit**

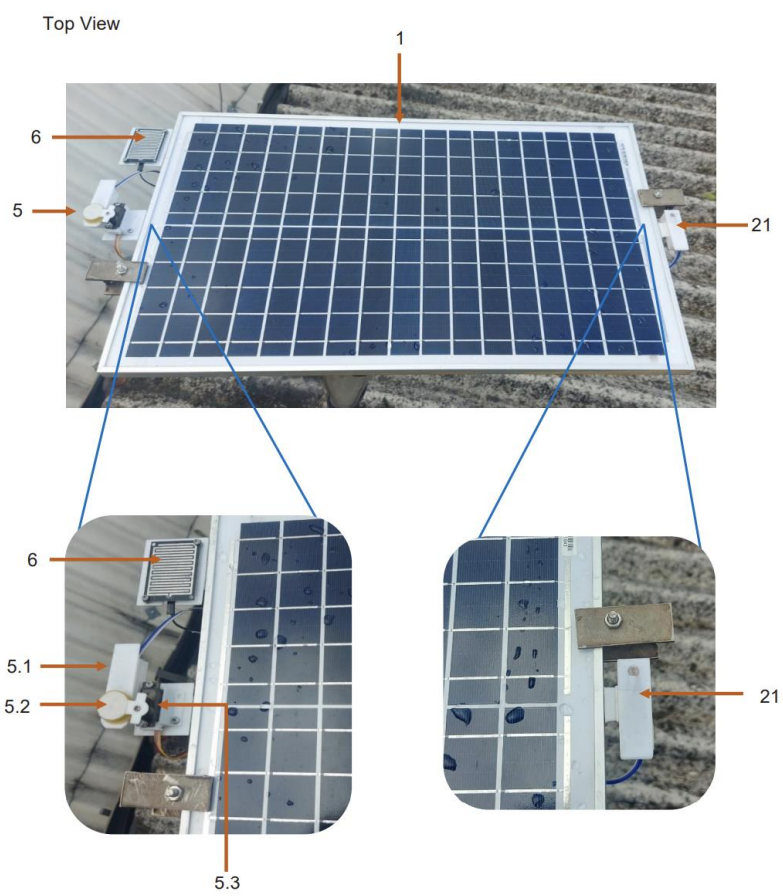
PROJECT HELIOS

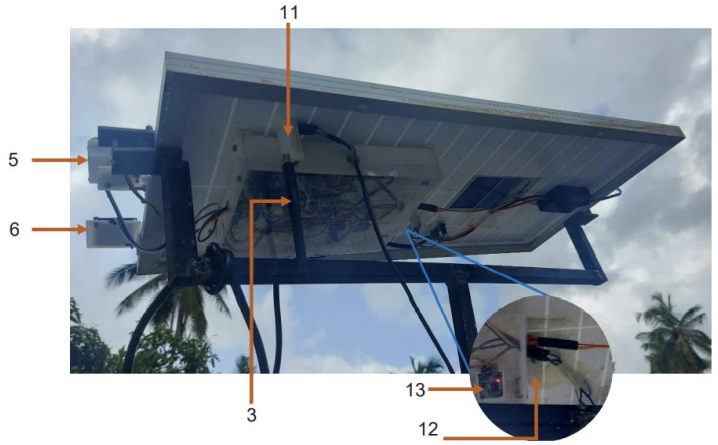
Working Product

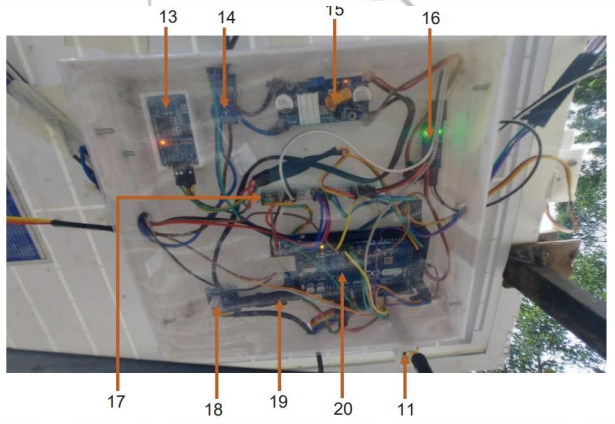
➢ Outdoor Unit







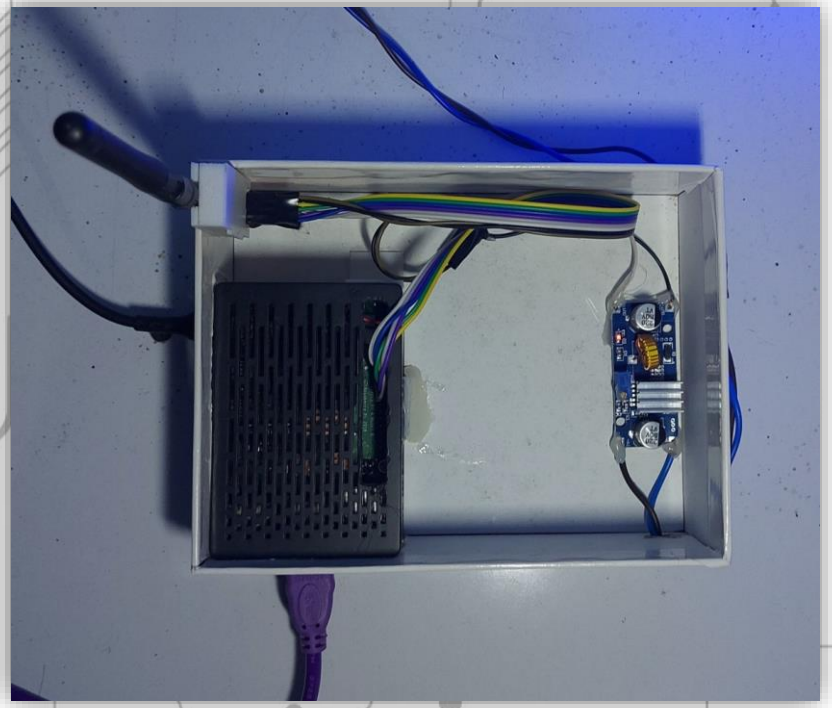


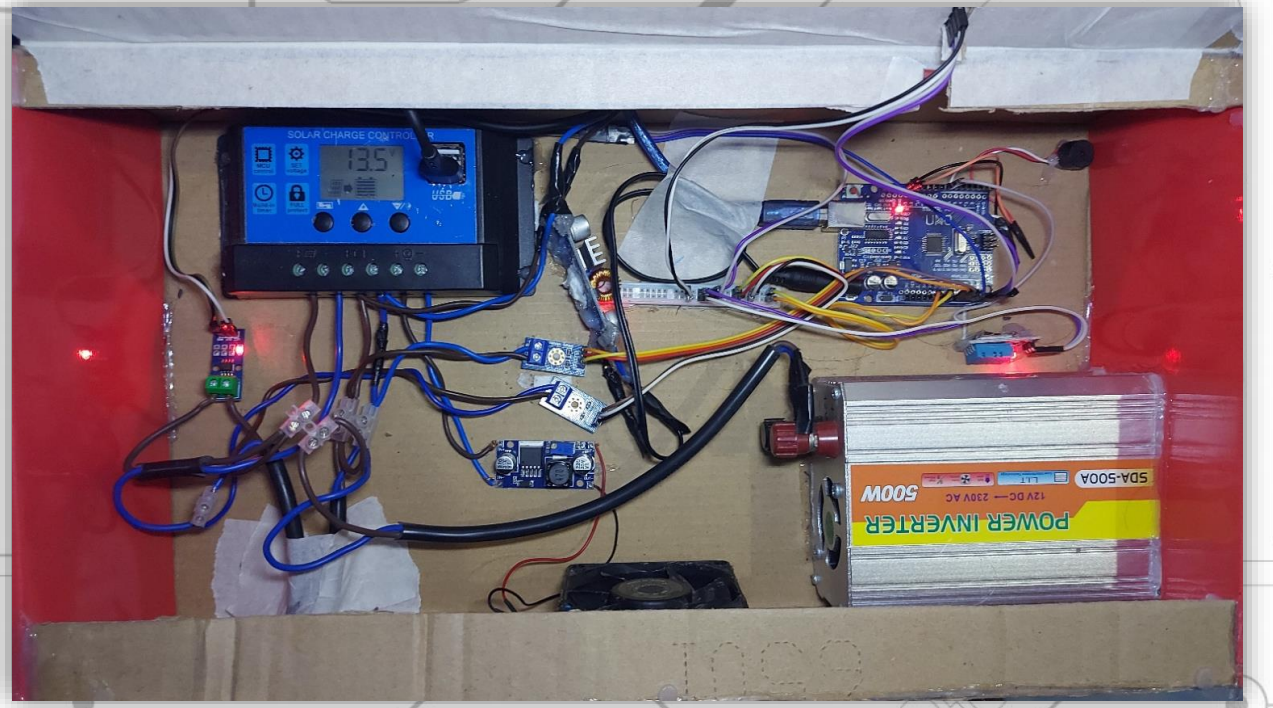


PROJECT HELIOS

Working Product

- **Indoor Unit**



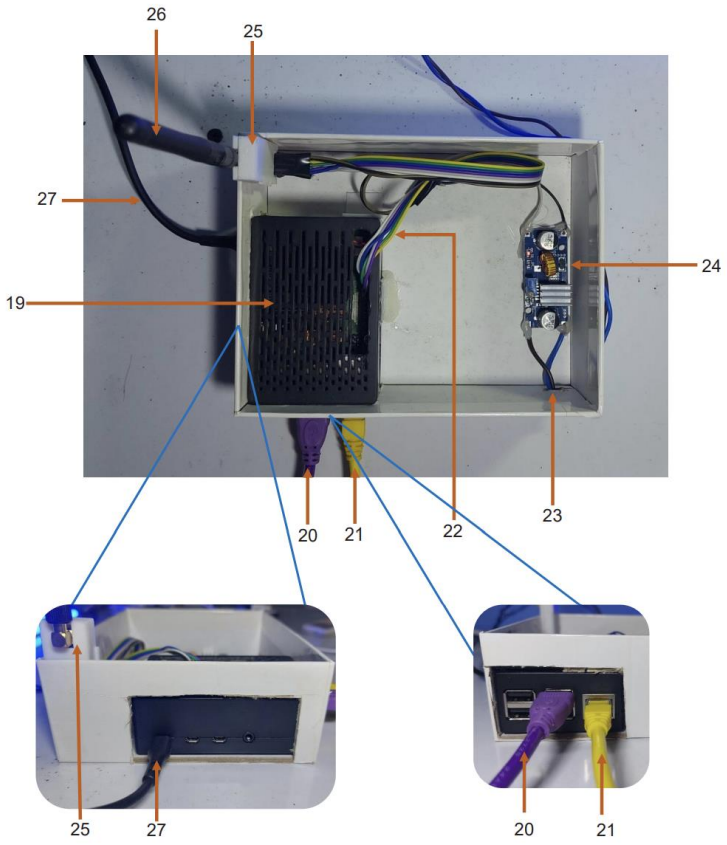


PROJECT HELIOS

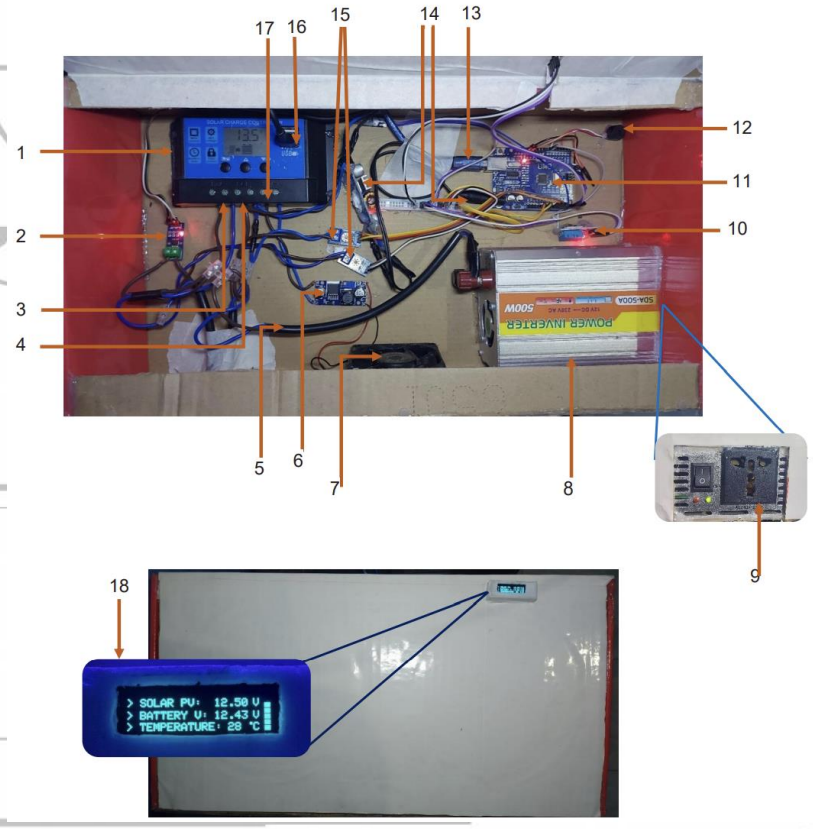
Working Product

➢ Indoor Unit

Edge Controller Unit



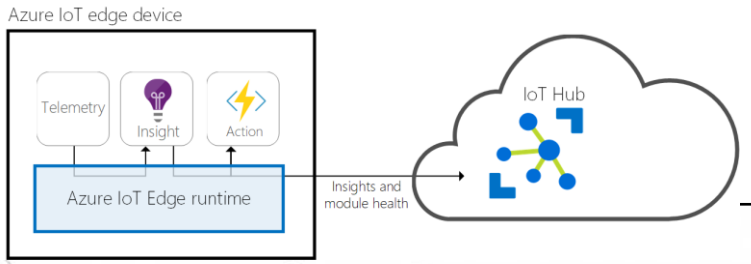
Inverter Unit

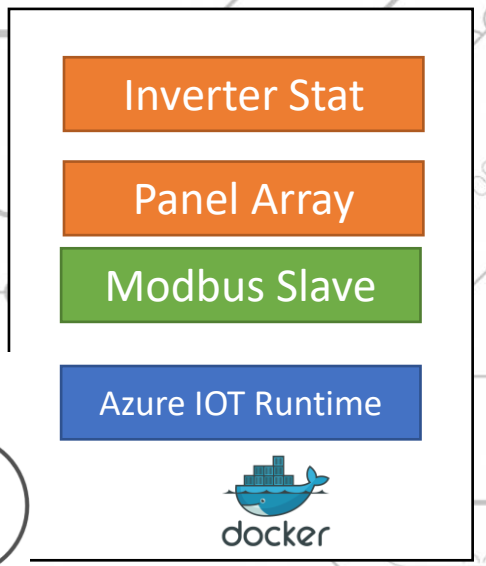


PROJECT HELIOS

Software

- **Modbus**
  - why/what
- **Arduino**
  - why/what
- **Python**
  - why/what
- **Software Update**
  - Why use raspberry pi
  - Azure Functional Module
  - How ->



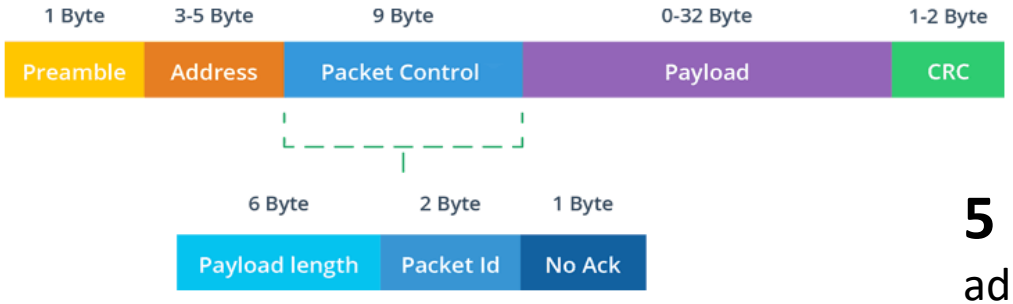


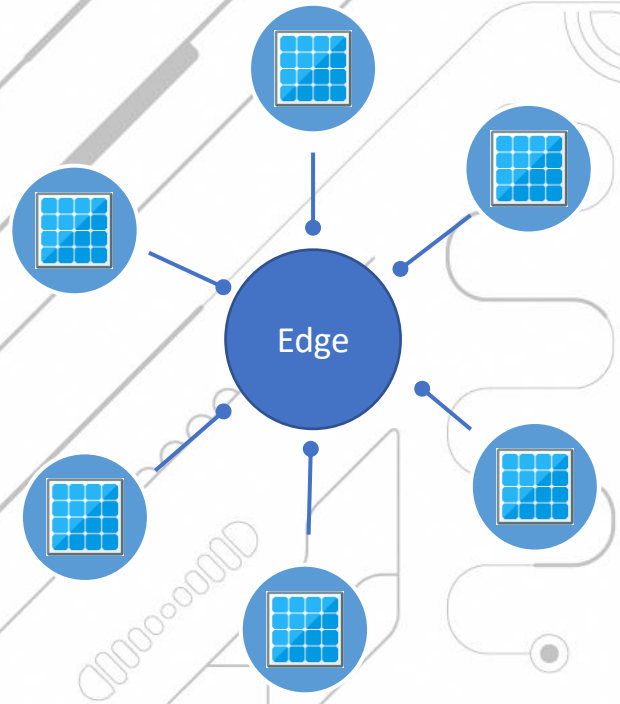
PROJECT HELIOS

Network

➢ Panel Controller to the Edge

- Wireless communication
- Why NRF24L01+ (Range, Bandwidth, Power)
- Enhanced ShockBurst Protocol
- Limitations & Solutions
- Security





5 bytes ≈ 1 million million unique addresses

https://lastminuteengineers.com/nrf24l01-arduino-wireless-communication/

PROJECT HELIOS

Network

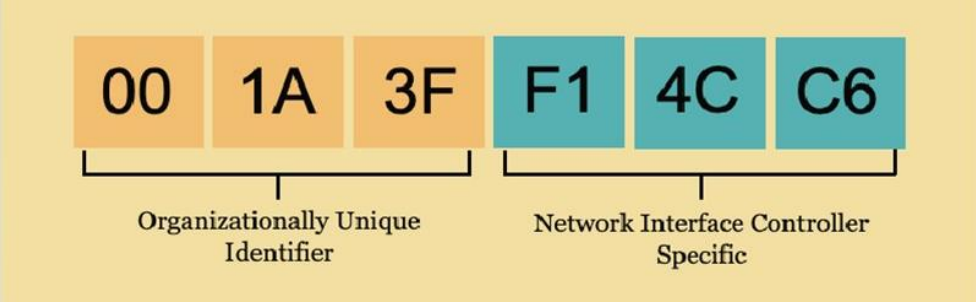
➢ Edge Controller to Cloud

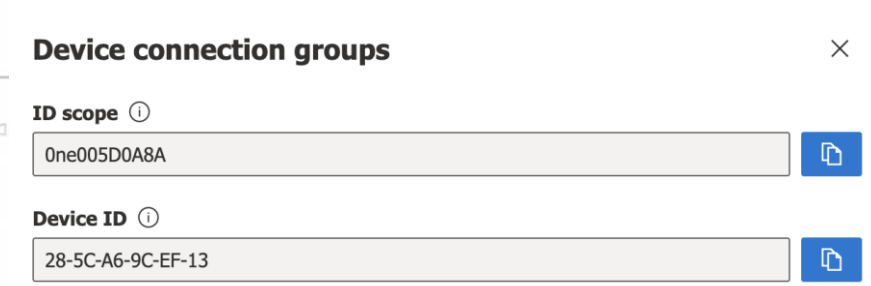
- Ethernet / WiFi
- Azure IOT SDK (MQTT Protocol)
- Symmetric key message encryption

```
provisioning:
  source: "dps"
  global_endpoint: "https://global.azure-devices-provisioning.net"
  scope_id: "0ne005D0A8A"
  attestation:
    method: "symmetric_key"
    registration_id: "64-7E-2F-71-42-1D"
    symmetric_key: "sbuO6pG5nafjgVvz61QS/Nmxsc5qjprXGX4EV+lMslc="
  always_reprovision_on_startup: true
```

➢ Device Identification

- Media Access Control (MAC) Address

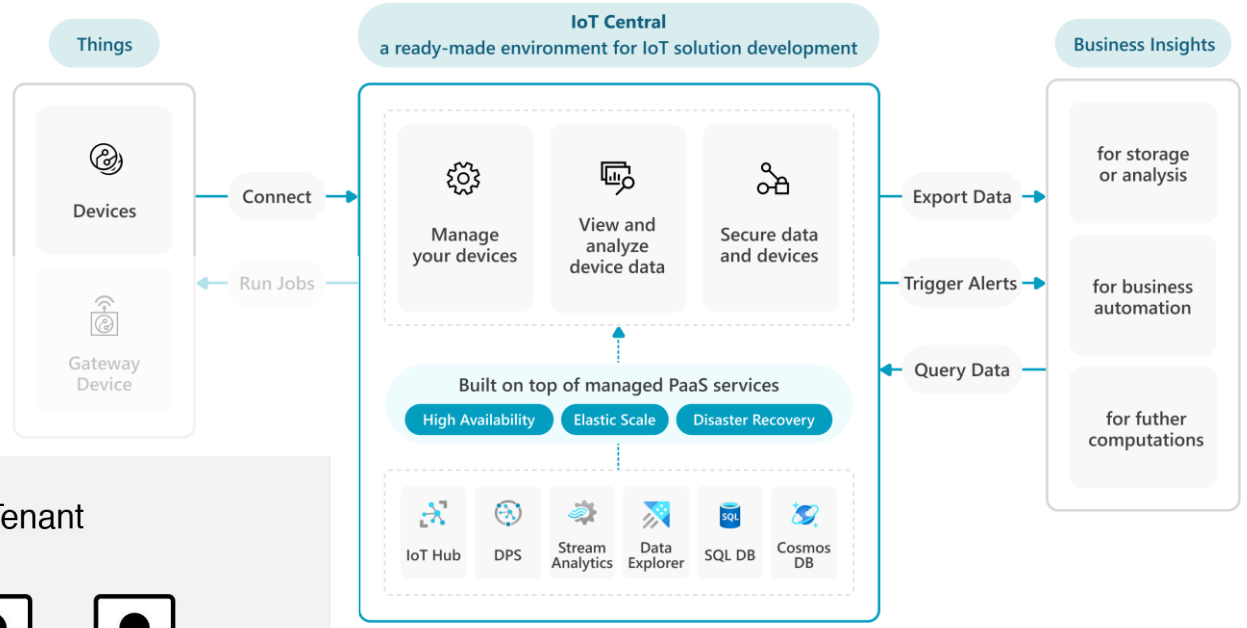


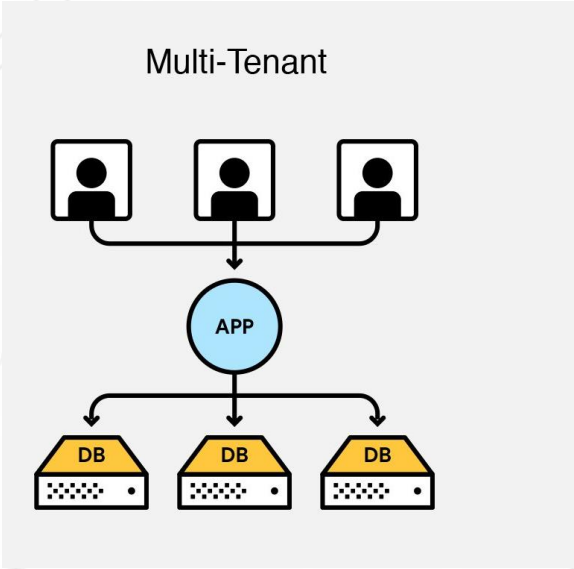


Helios Cloud

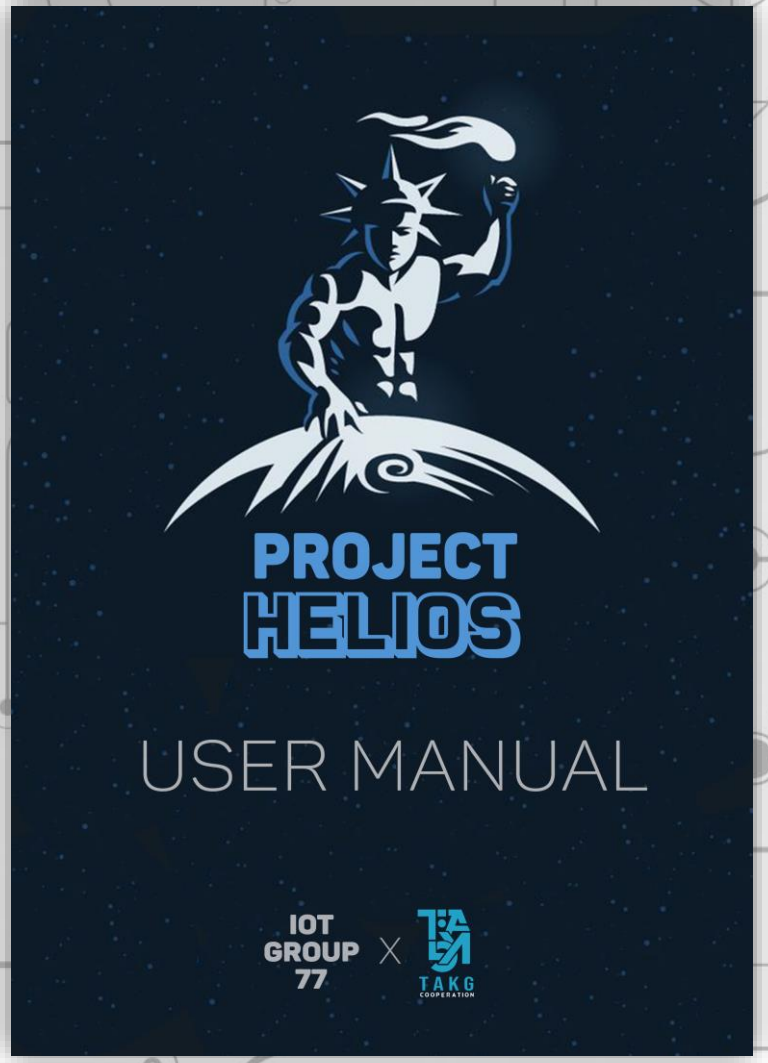
➢ Azure IOT Central

- Software-as-a-service
- Azure IOT Hub
  - Device Templates
  - Firmware Update
- White-label solution
- Multi-tenancy support
- Mobile Responsive
- Data visualization
- Jobs / Commands





User Manual


PROJECT
HELIOS
USER MANUAL
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GROUP
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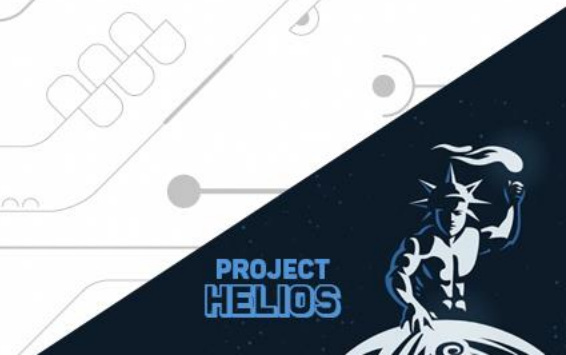
TAKG
COOPERATION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THANK YOU!

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