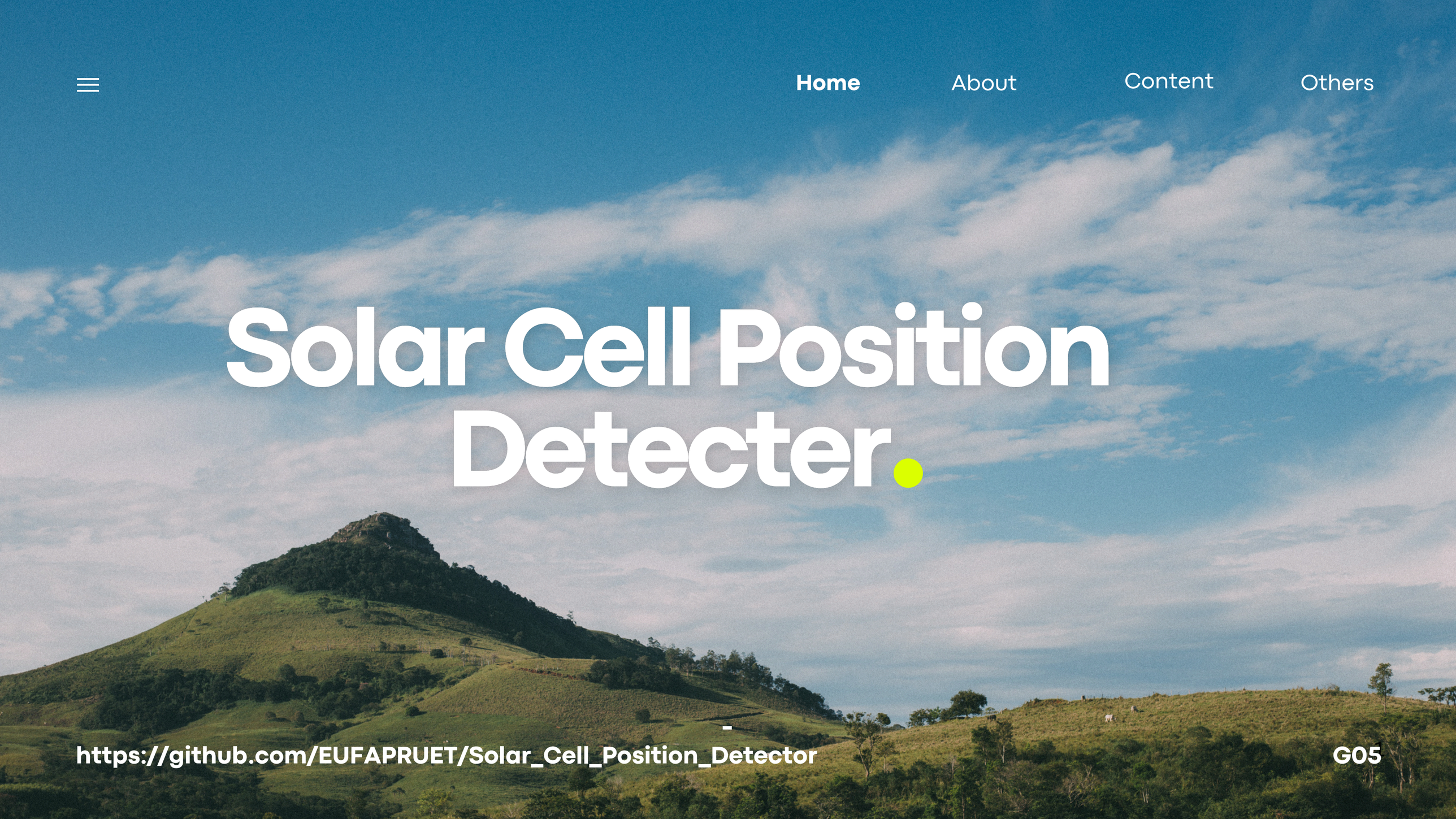
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Solar Cell Position Detecter.
https://github.com/EUFAPRUET/Solar_Cell_Position_Detector
G05

Project Member

Ukrit Suthanawat	2211310251
Chanaradee Prasansong	2211310582
Traipop Kitipichedson	2211311036
Thanakorn Techaphalangrak	2211311796
Pruet Phosri	2211312083

Project Detail

A sun-tracking system that uses YOLOv8 Nano on a Raspberry Pi 5 to detect the sun in real time and automatically adjust a solar panel via dual servos.

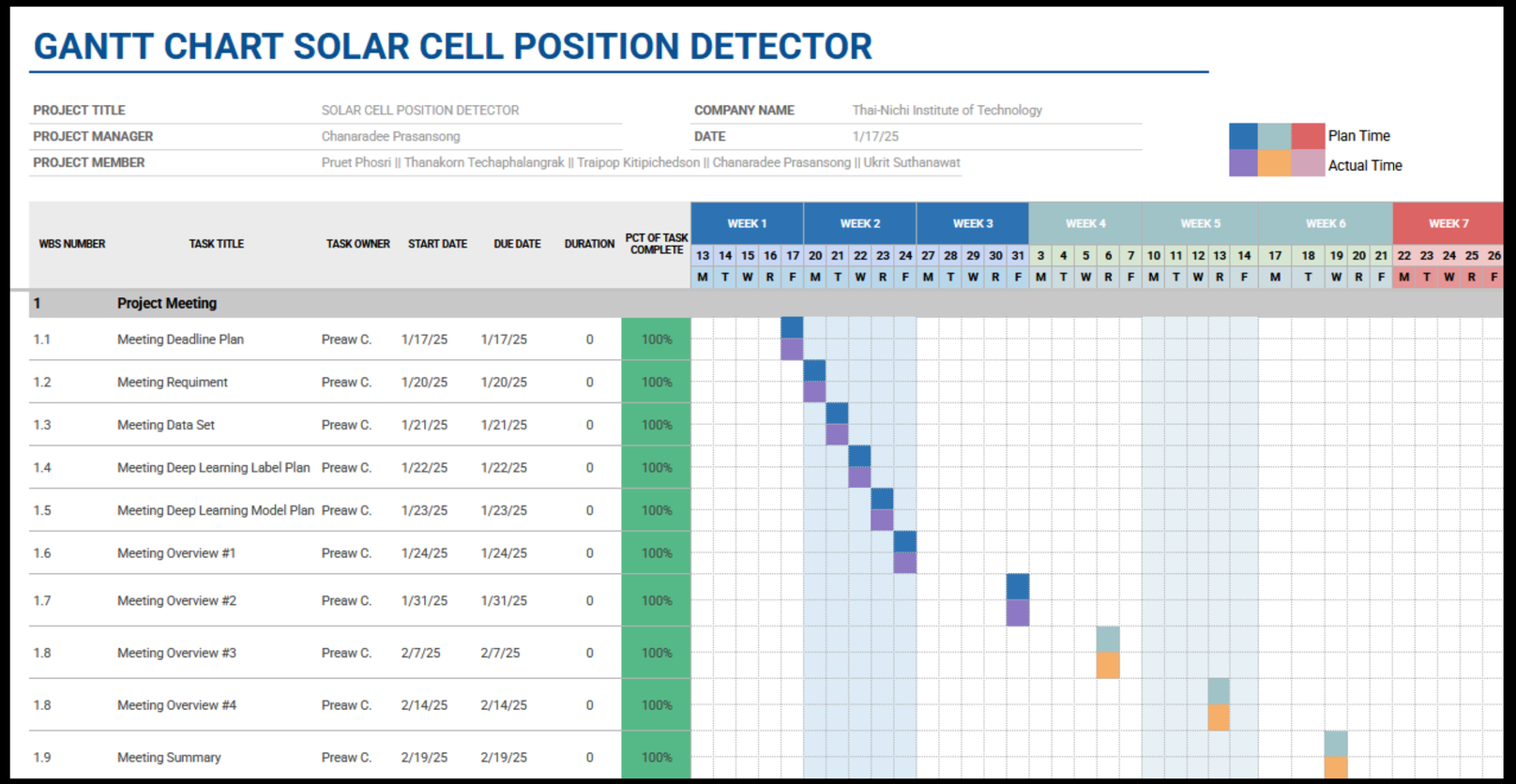
Plan

GANTT CHART SOLAR CELL POSITION DETECTOR

PROJECT TITLE	SOLAR CELL POSITION DETECTOR	COMPANY NAME	Thai-Nichi Institute of Technology
PROJECT MANAGER	Chanaradee Prasansong	DATE	1/17/25
PROJECT MEMBER	Pruet Phosri || Thanakorn Techaphalangrak || Traipop Kitipichedson || Chanaradee Prasansong || Ukrit Suthanawat		

Plan Time
Actual Time

WBS NUMBER	TASK TITLE	TASK OWNER	START DATE	DUE DATE	DURATION	PCT OF TASK COMPLETE
1	**Project Meeting**					
1.1	Meeting Deadline Plan	Preaw C.	1/17/25	1/17/25	0	100%
1.2	Meeting Requiment	Preaw C.	1/20/25	1/20/25	0	100%
1.3	Meeting Data Set	Preaw C.	1/21/25	1/21/25	0	100%
1.4	Meeting Deep Learning Label Plan	Preaw C.	1/22/25	1/22/25	0	100%
1.5	Meeting Deep Learning Model Plan	Preaw C.	1/23/25	1/23/25	0	100%
1.6	Meeting Overview #1	Preaw C.	1/24/25	1/24/25	0	100%
1.7	Meeting Overview #2	Preaw C.	1/31/25	1/31/25	0	100%
1.8	Meeting Overview #3	Preaw C.	2/7/25	2/7/25	0	100%
1.8	Meeting Overview #4	Preaw C.	2/14/25	2/14/25	0	100%
1.9	Meeting Summary	Preaw C.	2/19/25	2/19/25	0	100%



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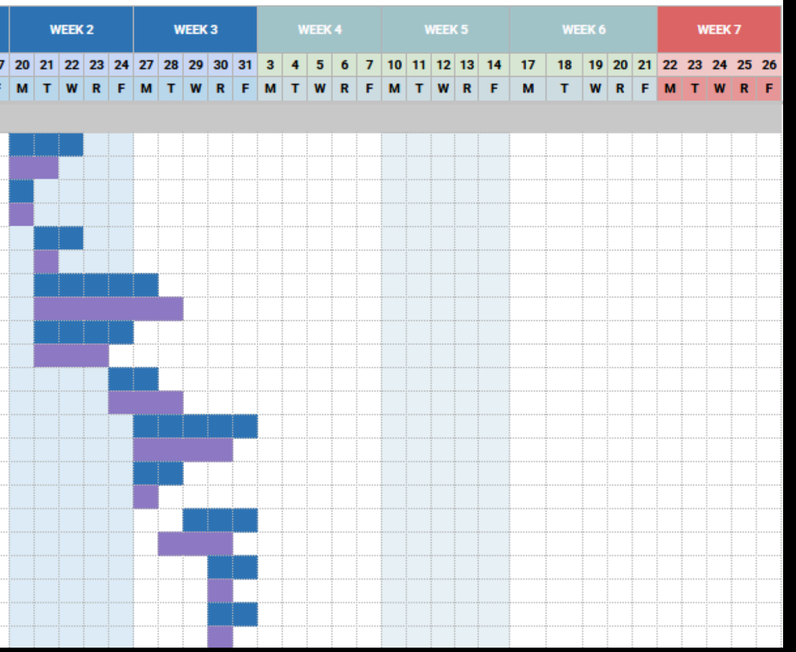
Plan Time
Actual Time

WBS NUMBER	TASK TITLE	TASK OWNER	START DATE	DUE DATE	DURATION	PCT OF TASK COMPLETE
2	**Deep Learning**					
2.1	Requiment	Palm U., Korn T.	1/20/25	1/22/25	2	100%
	2.1.1 Check Requiment	Palm U., Korn T.	1/20/25	1/20/25	0	100%
	2.1.2 Analys Requiment	Palm U., Korn T.	1/21/25	1/22/25	1	100%
2.2	Data	Ford T.	1/21/25	1/27/25	6	100%
	2.2.1 Find Data	Ford T.	1/21/25	1/24/25	3	100%
	2.2.2 Label Data	Ford T.	1/24/25	1/27/25	3	100%
2.3	Model	Plam U.	1/27/25	1/31/25	4	100%
	2.3.1 Design Model	Plam U.	1/27/25	1/28/25	1	100%
	2.3.2 Coding	Plam U.	1/29/25	1/31/25	2	100%
	2.3.3 Traning	Plam U.	1/30/25	1/31/25	0	100%
2.4	Validate Model	Korn T.	1/30/25	1/31/25	0	100%



Plan

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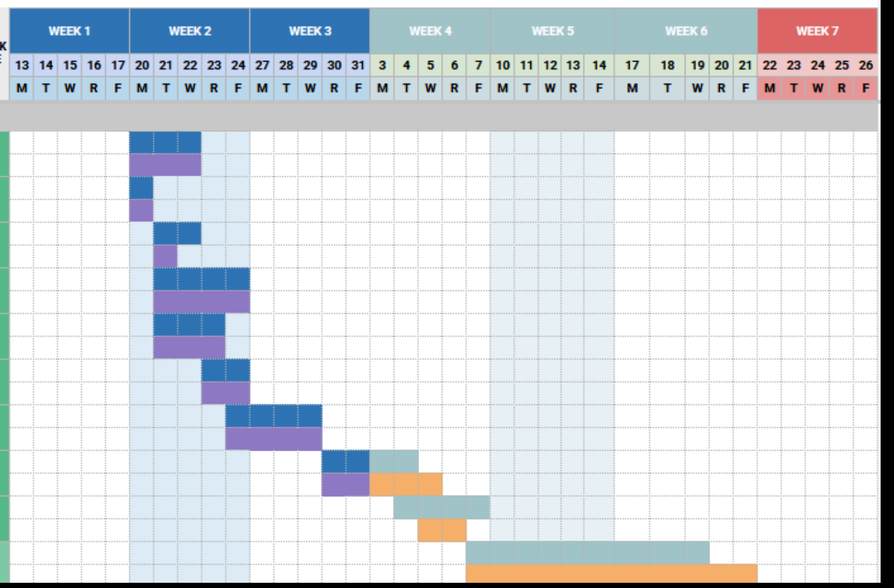
Plan Time
Actual Time

WBS NUMBER	TASK TITLE	TASK OWNER	START DATE	DUE DATE	DURATION	PCT OF TASK COMPLETE
3	**Hard Ware**					
3.1	Requiment	EUFA P.	1/20/25	1/22/25	2	100%
	3.1.1 Check Requiment	EUFA P.	1/20/25	1/20/25	0	100%
	3.1.2 Analys Requiment	EUFA P.	1/21/25	1/22/25	1	100%
3.2	Equipment	EUFA P.	1/21/25	1/24/25	3	100%
	3.2.1 Find Equipment	EUFA P.	1/21/25	1/23/25	2	100%
	3.2.2 Prepare Equipment	EUFA P.	1/23/25	1/24/25	1	100%
3.3	Receive Model And Deploy Model	EUFA P.	1/24/25	1/29/25	5	100%
3.4	Servo Motor Control	EUFA P.	1/30/25	2/4/25	4	100%
3.5	Coding RTOS	EUFA P.	2/4/25	2/7/25	3	100%
3.6	Validate Project	EUFA P.	2/7/25	2/19/25	12	75%



Requirment

Image Processing & Sun Detection

- The system captures real-time images of the sky using a camera module.
- The system detects the sun's position in the image using a trained Deep Learning model (YOLO/SSD) or image processing techniques (OpenCV-based filtering, Hough Transform, etc.).
- The system calculates the offset of the sun from the center of the frame.
- The system continuously updates detection in real-time to track the sun's movement.

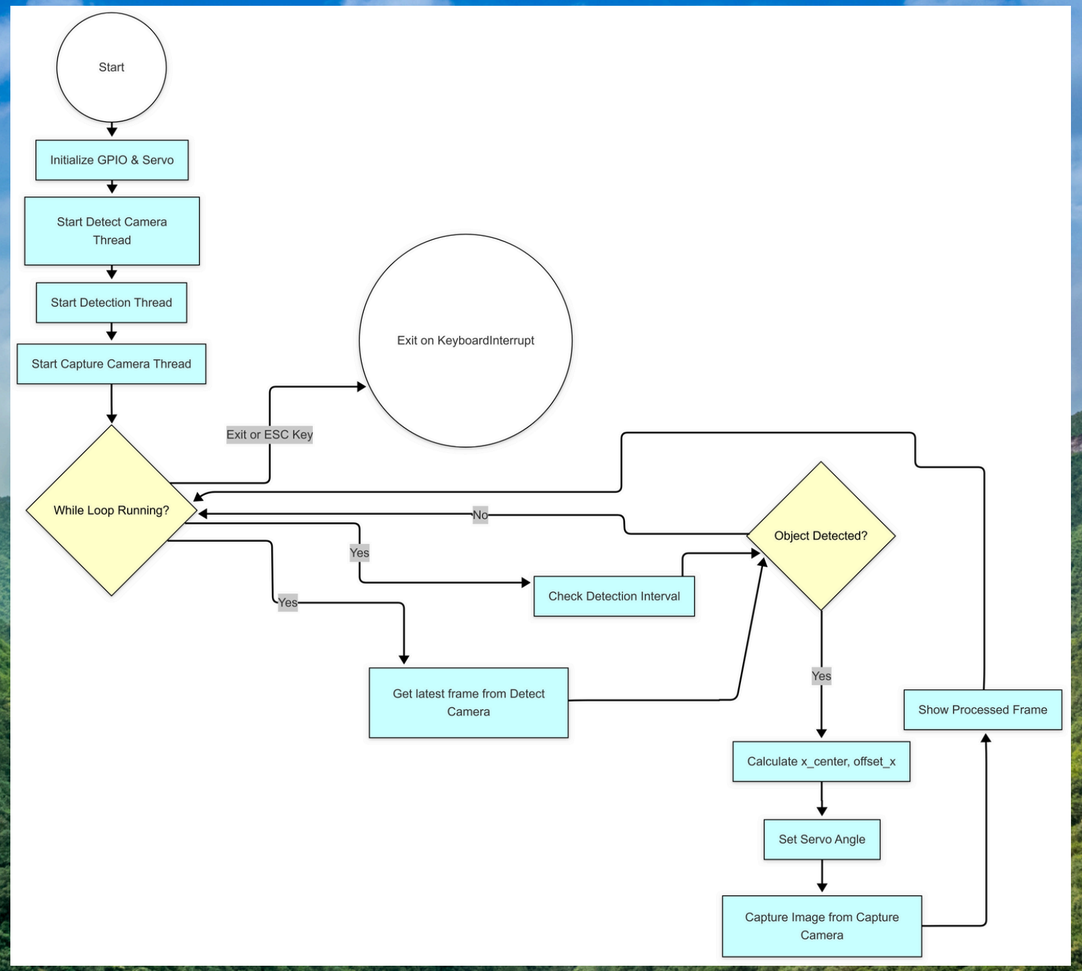
Hardware & Servo Motor Control

- The system sends servo control signals based on the detected sun position.
- The camera module can capture effectively.

- The system calculates the optimal angle for the solar panel based on the camera's orientation.
- The solar panel automatically rotates and tilts to match the detected sun's position.

Video

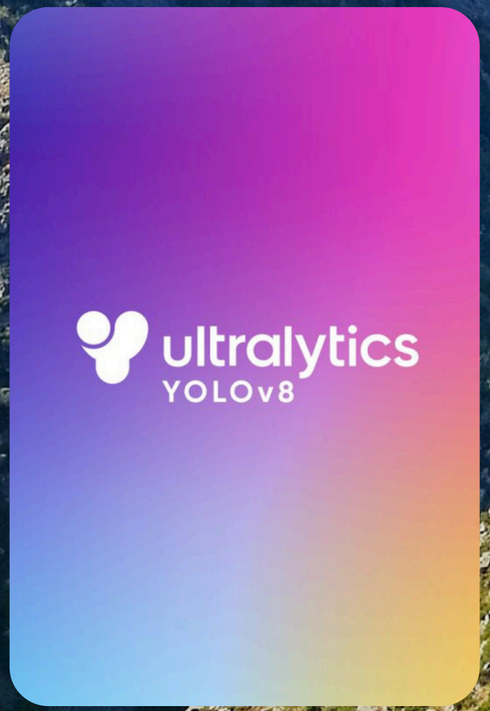
Flowchart


Start
Initialize GPIO & Servo
Start Detect Camera Thread
Start Detection Thread
Start Capture Camera Thread
Exit on KeyboardInterrupt
Exit or ESC Key
While Loop Running?
No
Yes
Yes
Object Detected?
Check Detection Interval
Get latest frame from Detect Camera
Yes
Show Processed Frame
Calculate x_center, offset_x
Set Servo Angle
Capture Image from Capture Camera

Technologies Used

- Hardware
  - Raspberry Pi 5 – Main processing unit
  - Camera Module – Captures real-time images
  - Servo Motors – Adjust the camera and solar panel's position
  - Solar Panel – Mounted on an adjustable tracking system
  - ND/Solar Filter – Prevents excessive sunlight damage
- Software & AI
  - Deep Learning (YOLOv5, YOLOv8, SSD-MobileNet) – Sun detection
  - OpenCV – Image processing & tracking
  - Python (RPi.GPIO, pigpio) – Servo motor control

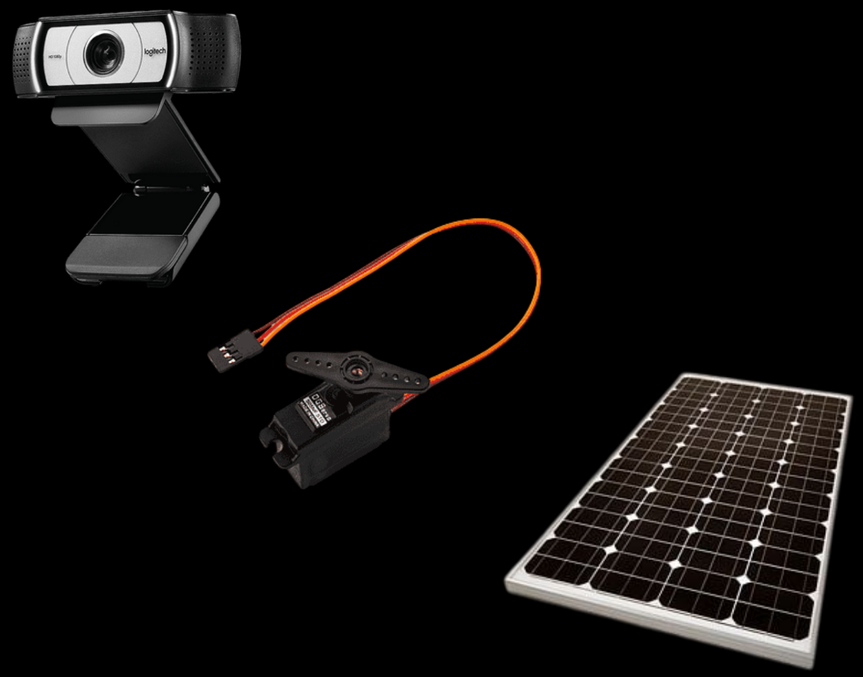
Model Selection



For sun detection, we utilized YOLOv8 Nano, a lightweight yet powerful model optimized for real-time object detection on edge devices like the Raspberry Pi 5. This model was selected due to its:

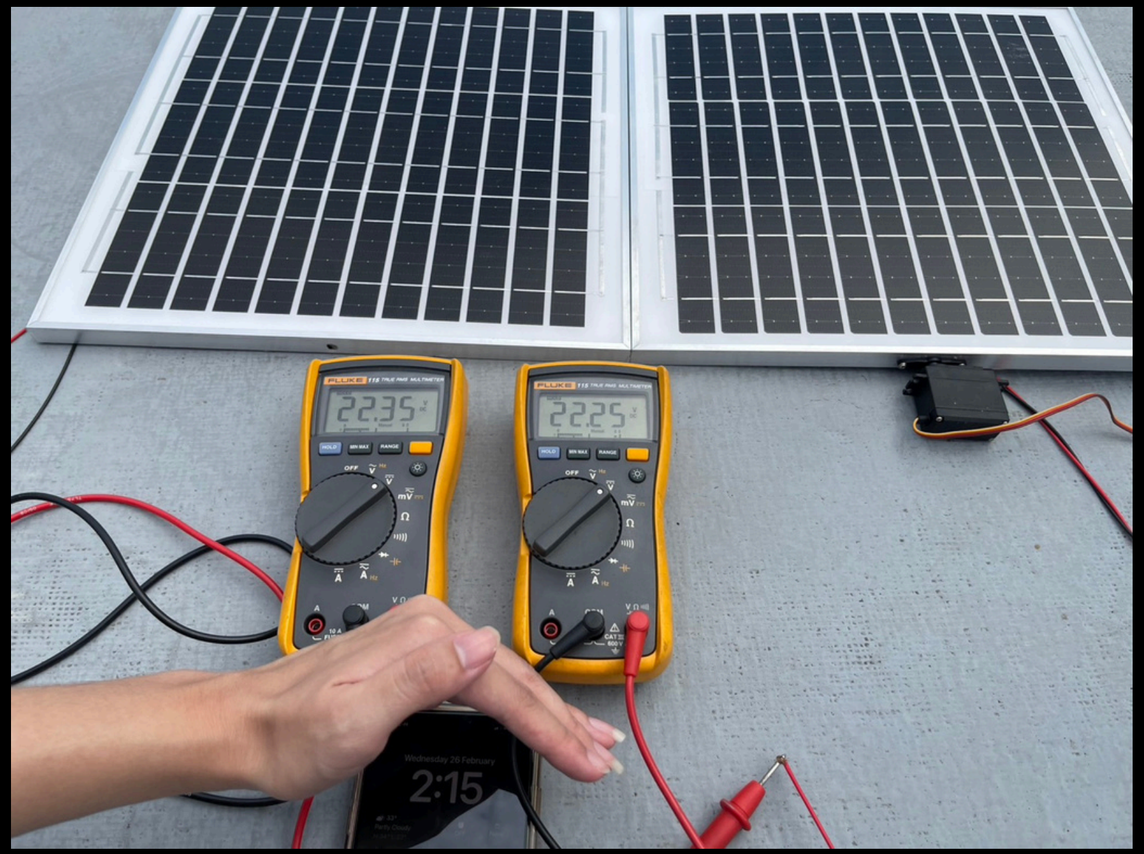
- High detection accuracy even in varied lighting conditions.
- Fast inference time suitable for real-time applications.
- Compatibility with resource-constrained hardware.

Hardware Connections

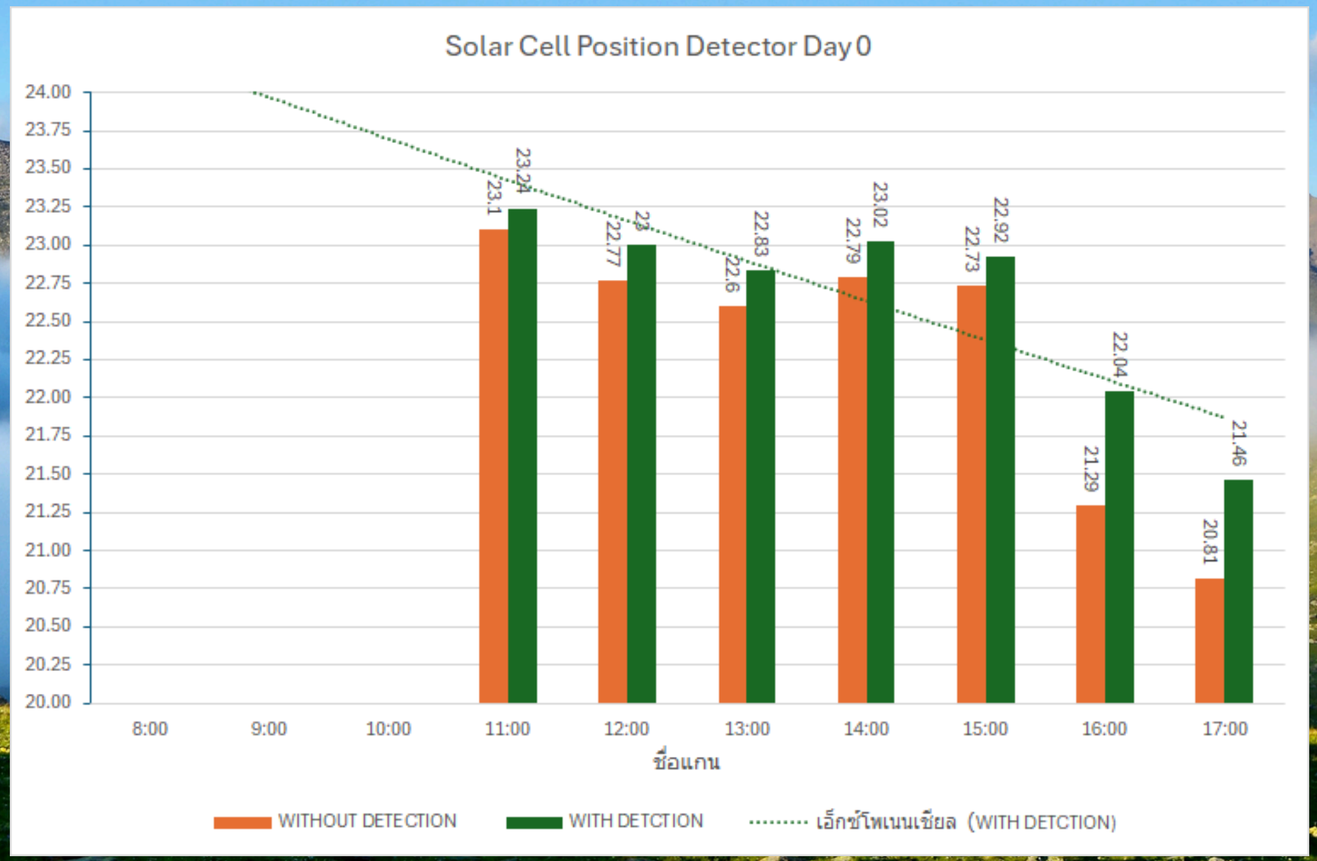


1. Connecting the Camera:
   - Attach the camera module to the CSI port on the Raspberry Pi or connect a USB camera
2. Servo Motor Connections:
   - Signal Wire (Orange/White): Connect to GPIO12, 13 (PWM) on Raspberry Pi.
   - Power Wire (Red): Connect to a 5V power source.
   - Ground Wire (Brown/Black): Connect to the GND pin on Raspberry Pi.
3. Solar Panel Mounting:
   - Mount the solar panel onto the servo-controlled frame.
   - Ensure the servo motors are calibrated for full 180° rotation.

How to Validate



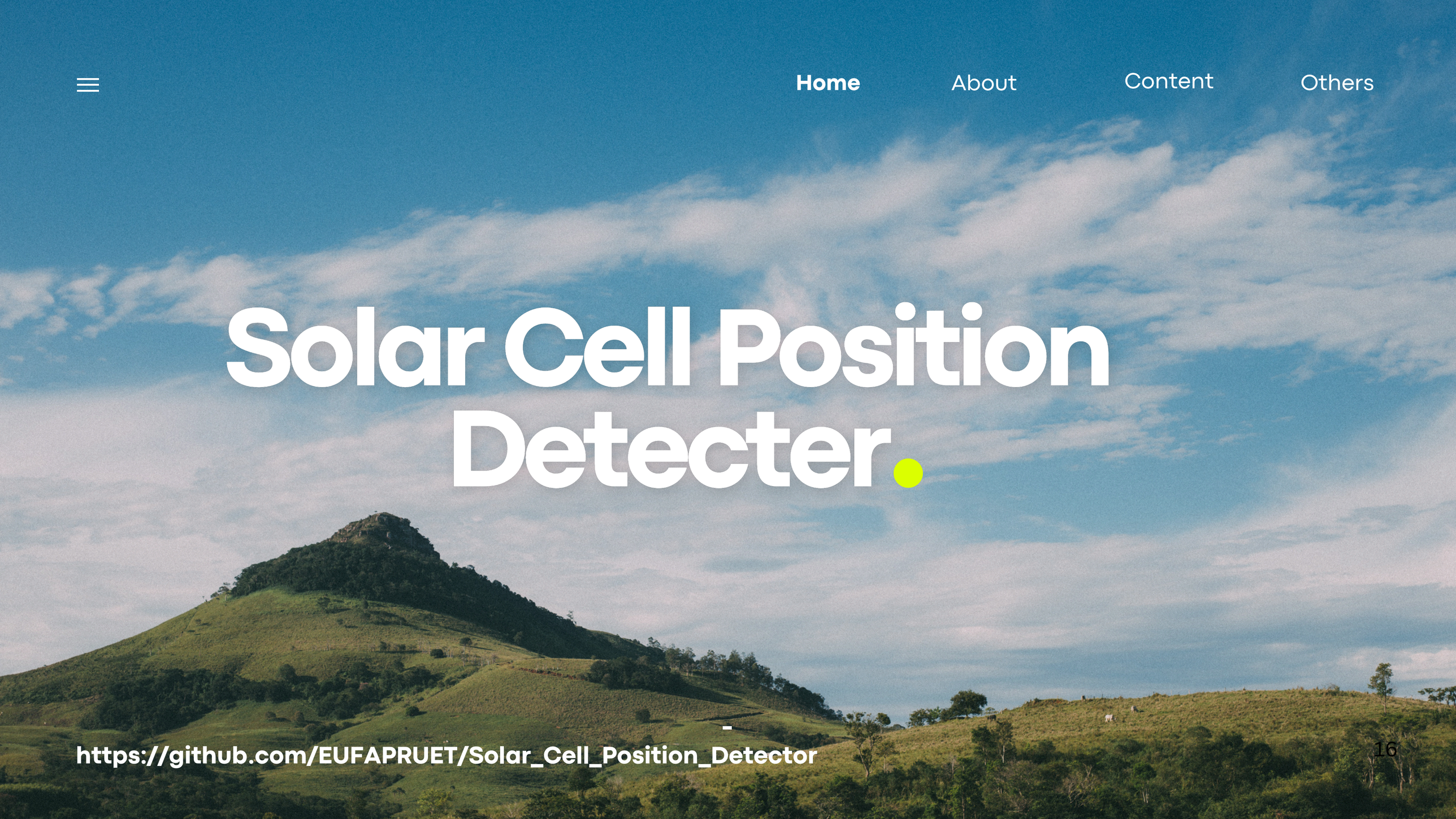
Validate Project



DAY 0		
TIME HOURS	WITH DETCTION (V)	WITHOUT DETECTION (V)
8:00	-	-
9:00	-	-
10:00	-	-
11:00	23.24	23.1
12:00	23	22.77
13:00	22.83	22.6
14:00	23.02	22.79
15:00	22.92	22.73
16:00	22.04	21.29
17:00	21.46	20.81

Summarize

- Overall energy harvested is higher, proving that active sun tracking is more effective than a fixed solar panel.
- Power output declines slower with detection, especially in the afternoon when sunlight angles change more significantly.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