

POLYTECH®
ORLÉANS

Solar tracker project :

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referent : Quentin Legros

26th April 2024

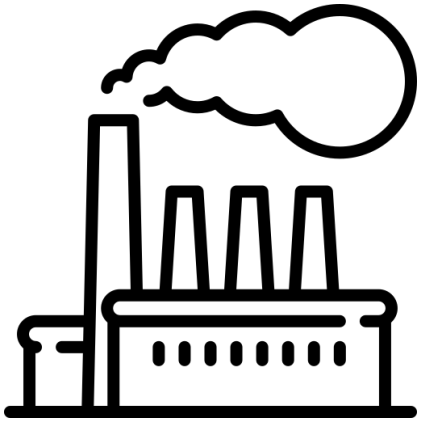
Contents

Context

renewable energy
source :freepik.fr

photovoltaic cells
source : greenmatch.fr

Contexts

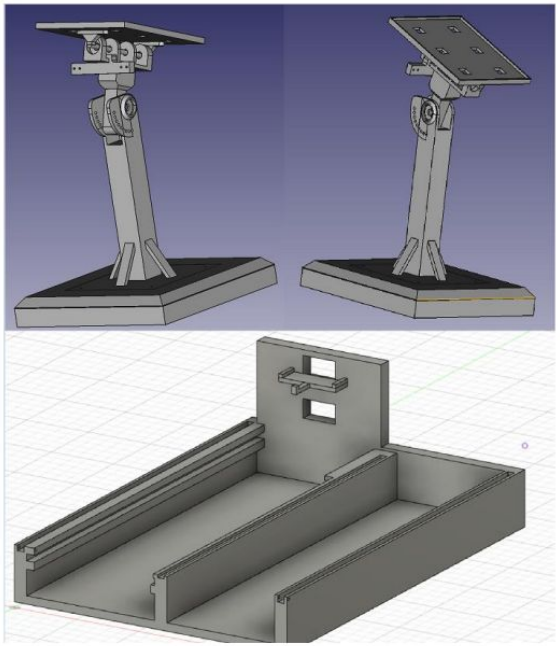


industry,
source france-industrie.pro

house with a garden, source :
maisonsclairlogis.fr

metropolitan France region, source :
francetvinfo.fr

Last year project



view of the 3D models of the 2022-2023 solar tracker project group

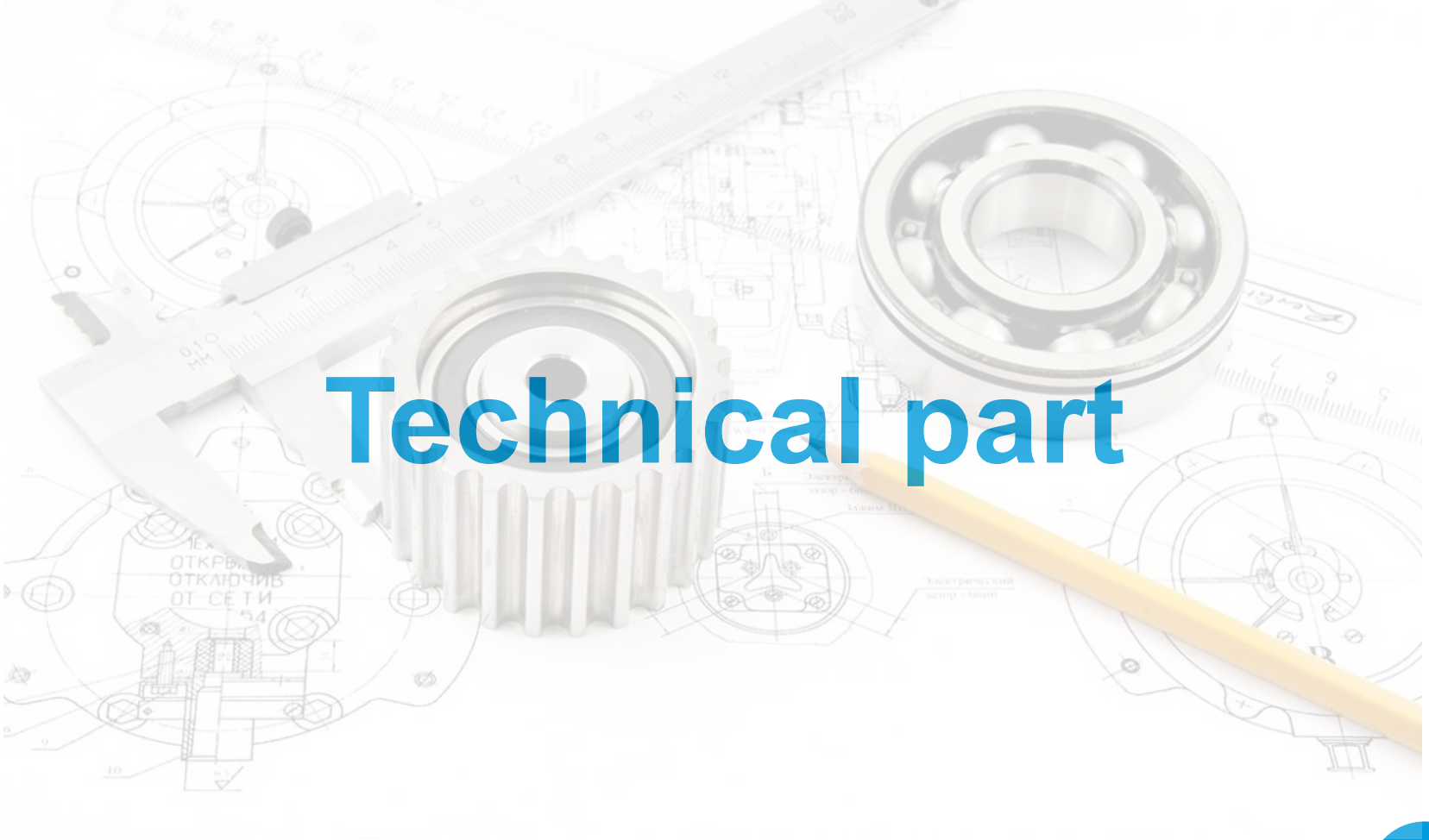
We were able to recover their :
-documents
- photovoltaic cells
- tracker.

Objectives

Build a solar tracker able to follow the sun's path

Implement a HMI in order to show the performance to the users

Generate energy with the system

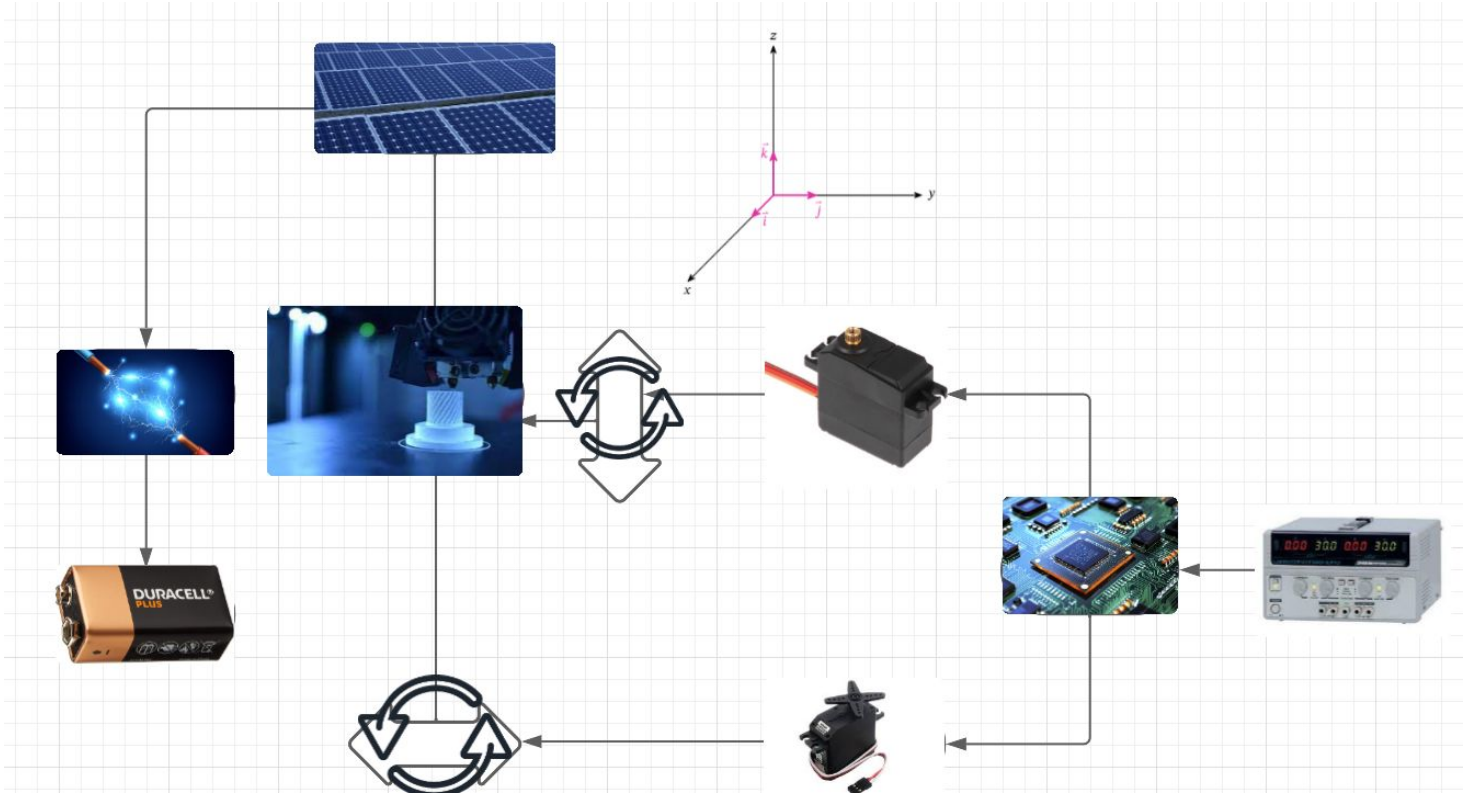


Technical part

Technical part : What is a solar tracker

mediascol.al

Technical part : What is a solar tracker



Features of our project

Features	Assessment criteria	Level of appreciation	Acceptation limit
Tracking Precision	- Angle of rotation	110 degrees around the West/East axis	± 5 degrees
Energy Production	- Performance of the cells	0,5W/panel	-0,15W/panel
Resists to challenging weather conditions	-snow, rain, wind -temperature -humidity	-5°C - 40°C 40% - 70%	
Ease of Installation and control	- Datasheet		
Carry/Protect the sensors and the microcontroller	- Structural stability - Durability	PLA 6 months -1year	

Technical Solutions : Measures

	Orientation optimale	Orienté à l'horizontal
heure	Courant Max en mA	Courant Min en mA
8h29	1,1	0,3
9h33	48,1	19,3
10h31	64,2	32,1
11h27	74,1	35,1
12h27	75,2	46,2
13h28	79,1	48,9
14h08	85,1	55,1
14h44	85,7	53,1
15h40	77,2	47,3
16h35	61,4	34
17h34	17,1	10,2
18h30	6,5	3,9
19h30	1,2	0,5

Monday 9th Octobre 2023

Dawn:	07:31:09
Sunrise:	08:01:46
Culmination:	13:39:37
Sunset:	19:16:41
Dusk:	19:47:14
Daylight duration:	11h14m55s
Distance [km]:	149,445,438
Altitude:	34.36°
Azimuth:	161.96°
Shadow length [m]:	1.46
at an object level [m]:	1

Technical solutions

Components

Figure : esp32 (gotronic.fr)

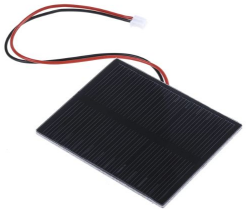


Figure : Photovoltaic plates (Seeedstudio.com)

Figure : Battery LI-ION (Go-tronic.fr)

Figure : Servo-Motor (Robot-maker.com)

Servo-Motor, source : go-tronic.com

Esp32	
Power supply	5V-3,3 V
Consumption	Max 50mA
Programming language	C/C++
Price	12€
Weight	7g

Photovoltaic plates	
Power rating	0.5W
Current	100 mA
Dimensions	70x55x3mm
Price	3,3€
Weight	20g

Battery Li-Ion	
Tension	3,7V
Capacity	3400 mAh
Type	Lithium-Ion
Rechargeable	Yes
Weight	46g

Servomoteur		
Tension	4,8 - 6,6V	
Torque	15kg.cm	10kg.cm
Rotation angle	180°	280°
Price	17€	14,65€
Weight	50g	65

Technical solutions

Components

Figure : Voltage regulator (Aliexpress.com)

Voltage regulator DC-DC	
Input Voltage	3,2V - 42V
Output Voltage	1,25V -35V
Output current	3A (Max)
Rendement	92%
Price	0,6€

Figure : Ball bearing (rs-online)

Ball bearing	
Inside diameter	60 mm
outside diameter	95 mm
Price	19.34€
Weight	200g

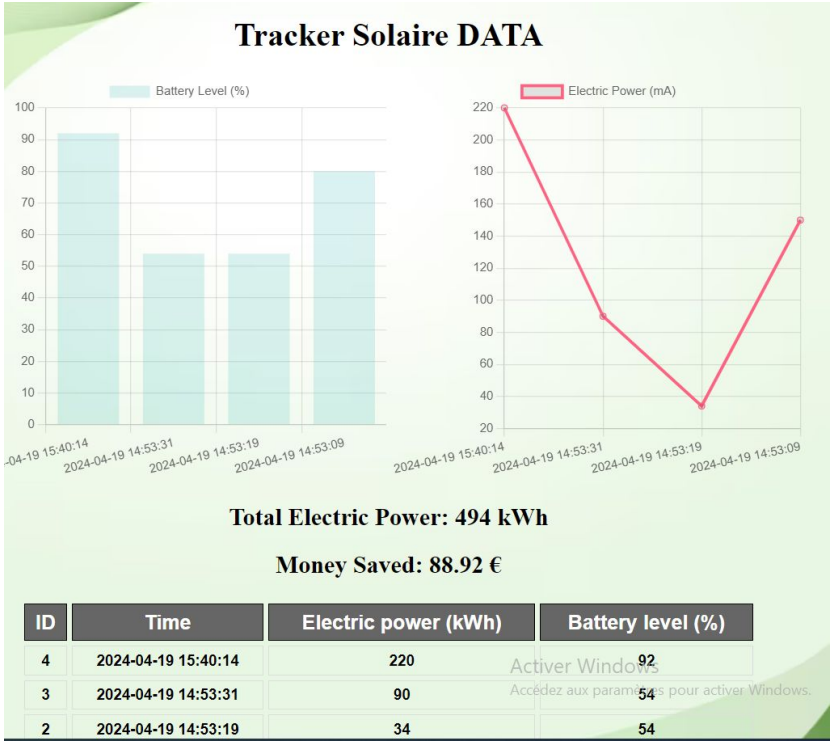
Figure : Ball bearing (SKF.com)

Ball bearing 2	
Inside diameter	12 mm
outside diameter	26 mm
Price	19 €
Weight	30g

Figure : light sensor (go-tronic.com)

light dependant resistor	
Weight	7g

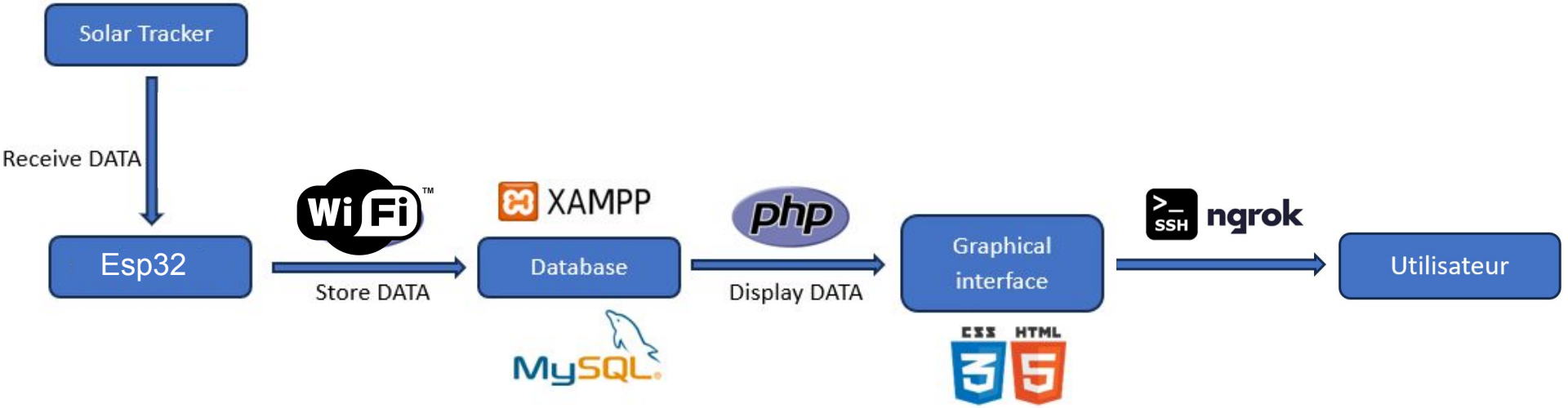
Technical solutions : Human Machine Interface



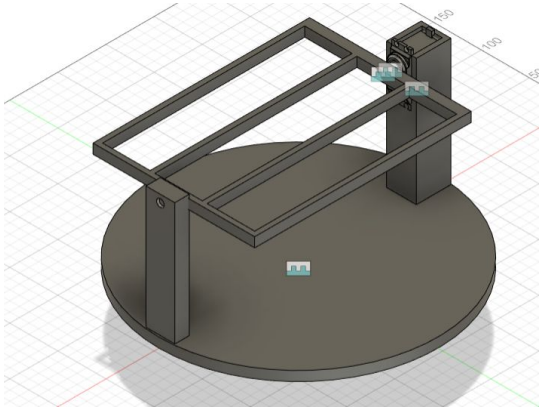
ID	Time	Electric power (kWh)	Battery level (%)
4	2024-04-19 15:40:14	220	92
3	2024-04-19 14:53:31	90	54
2	2024-04-19 14:53:19	34	54

graphical interface on a PC

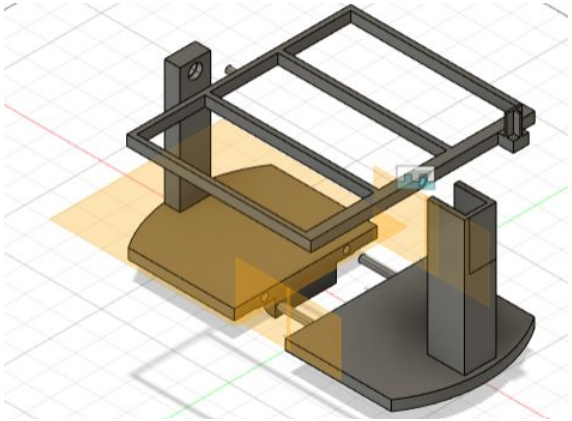
Human Machine Interface (HMI)



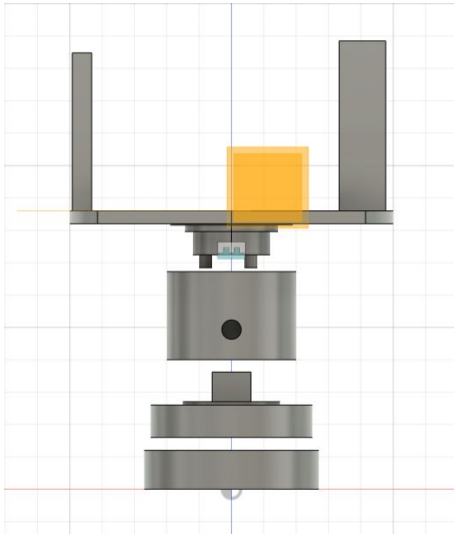
Technical solutions : The support



First modelisation

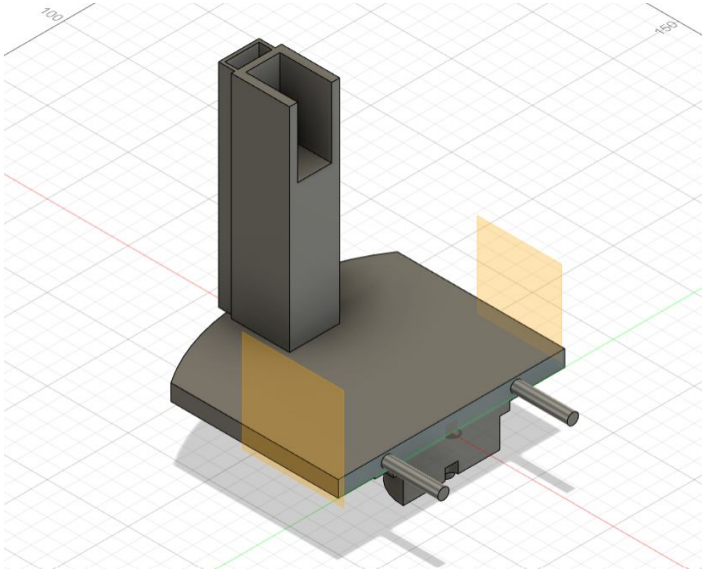


Second modelisation

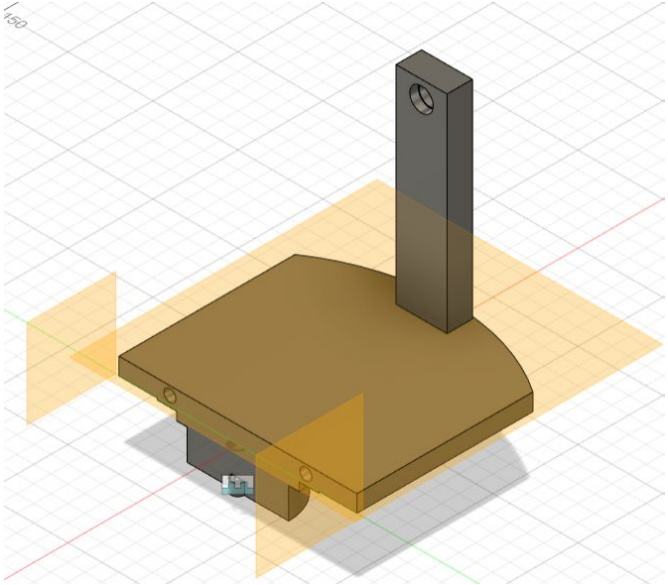


Final modelisation

Technical solutions: The support

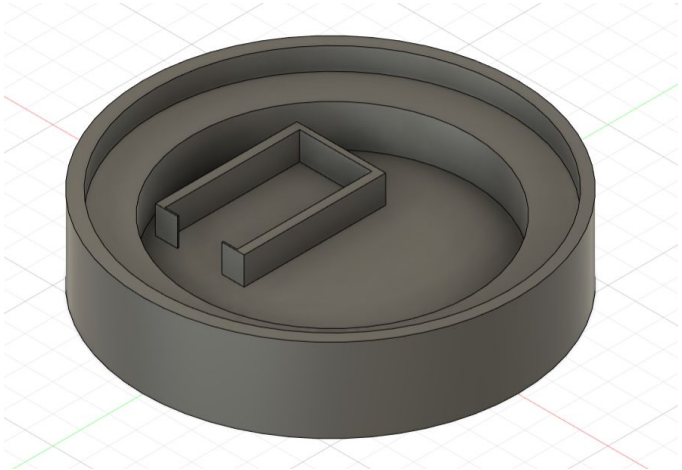


left side of the body

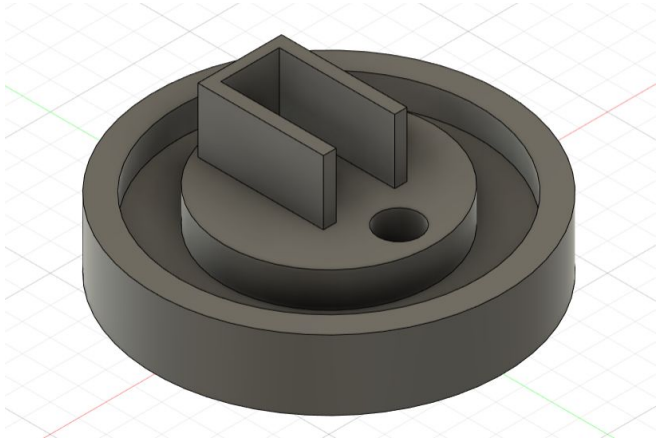


right side of the body

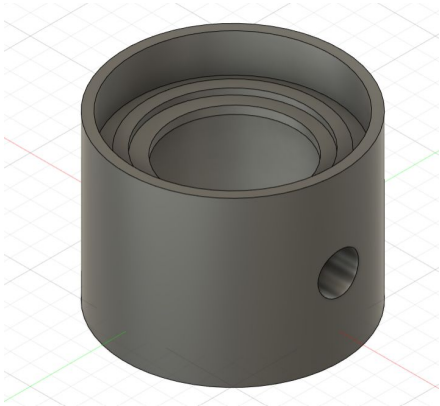
Technical solutions: The support



base for card



second motor base

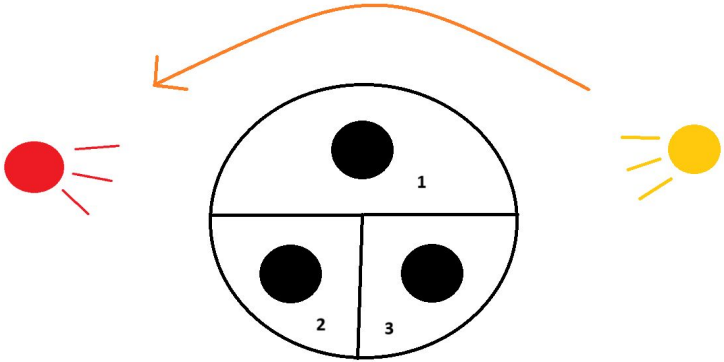


ball-bearing base

Technical solutions : coding

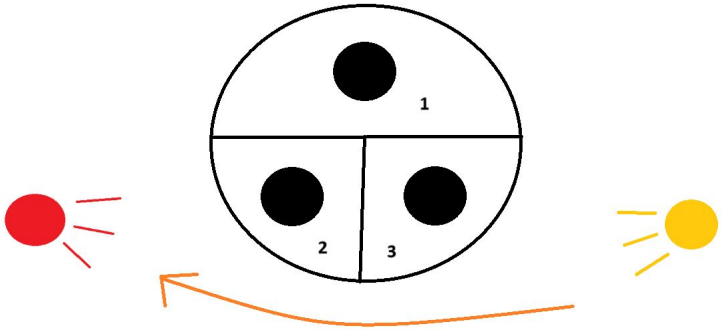
-Define the movement limits

-Finite state machine approach

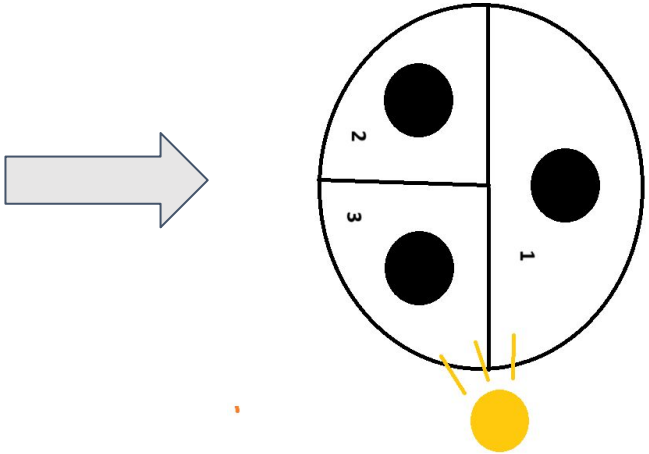


Representation of the sensors

Technical solutions : coding



sun’s inclinaison in winter

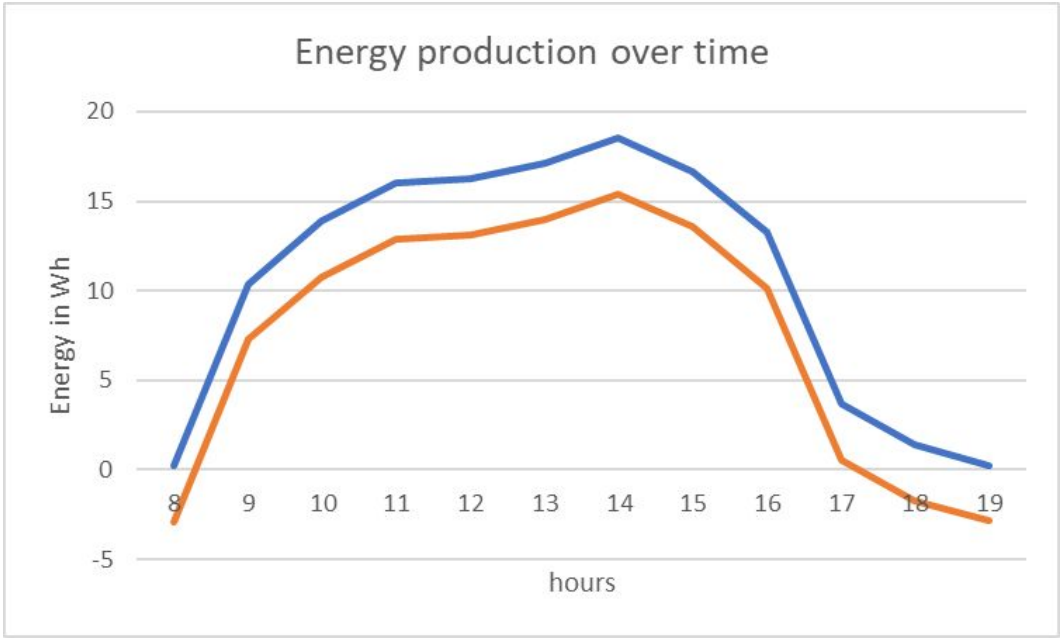


The rotation in order to be align

The cost of our project excluding labor

Designation	Quantity	Unit price (euros)	Total
Photovoltaic cells	12	1,95	23,4
Raspberry pico	1	9,5	9,5
Servo-motor 1	1	17	17
Servo-motor 2	1	14,65	14,65
Voltage regulator	1	0,65	0,65
Ball Bearing 1	1	19.34	19,34
Ball Bearing 2	1	5.24	5.24
3D printing	40	2	80
Total			**169.78 euros**

Expected results

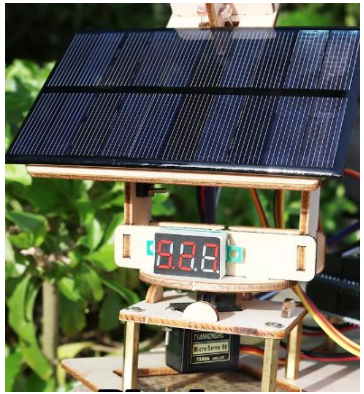


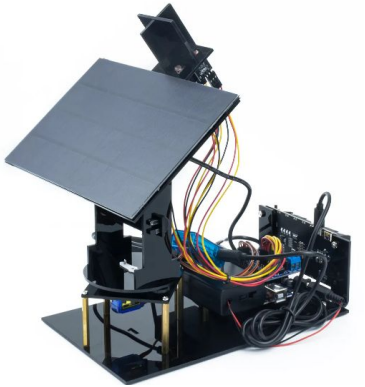
Over the course of a day : 24,961 W

Cost of the tracker : 169.78 euros
Fixed price of a kWh in France : 0.2561 euros

Profitable after 74 years …

Comparison with others trackers





Solar tracker	Aliexpress	Alibaba
Price	40 euros	35,7 euros

What if we build the same tracker at a bigger scale?

Comparison with others trackers

Characteristics	lumio	TOPREGAL	ILIOS
Price	12000 €	1321 €	2000 €
Area of the photovoltaic cells	7,2 m2	7 m2	7,48 m2
Tracking	Yes (2 axis)	No	Yes (2 axis)
HMI	Yes	No	Yes
Installation	Yes	No	No

Our tracker at a bigger scale

	quantity	unit price	mass (kg)	total (euros)
photovoltaic cells	4	65	24	260
motor 1	1	9.58	0.110	9.58
motor 2	1	27.34	0.60	27.34
aluminium	80	0,3	80	24
tracking	1	10	2	10
Manufacturing	1	120		120
transport	1	150		150
ball bearings	1	14.74	0.116	16.56
microcontroller	1	20	0.020	20
regulator	1	5	0.146	5
total				605.56

Taxes	
Amazon	15%
social contributions	12,80%

Quantity	Cost
10	6055,6
50	30278
100	60556

Quantity	unit price	sells
10	2000	20000
50	2000	100000
100	2000	200000

Profit and taxes		
Quantity	Profit (euros)	taxes (euros)
10	13944,4	10067,85
50	69722	50339,28
100	139444	100678,56

Expected results

	Little Solar Tracker	Big Solar Tracker
hours	**Energy produced (Wh)**	
8 am	5,5	20,79
9 am	240,5	909,24
10 am	321	1213,58
11 am	370,5	1400,72
12 am	376	1421,51
1 pm	395,5	1495,23
2 pm	428,5	1620
3 pm	386	1459,32
4 pm	307	1160,65
5 pm	85,5	323,24
6 pm	32,5	122,87
7 pm	6	22,68

Production over the course of a day of the big tracker : 11,1kW

Return of investment over : 1.9 years

Involvement of each member

Objectives	Jérémie	Az-eddine
Schedule the development of the project	100%	
Command the pieces	50%	50%
Choose and start the construction of the Modelisation	100%	
Establishment of the human machine interface		100%
Testing and Soldering Electronic Components		100%
writing the technical file	100%	

Demonstration

Conclusion : skills acquired

- 3D modelisation on Vision 360
- Project management (Gantt project)
- Mechanical forces calcultation
- Computing in database
- Capella
- 3D impression with two printers



Thank you for your attention