Marmara University Graduation Project Presentation

Transferring the Sunlight With Fiber Optical Cables

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According to the statistics coming from the UK %74 of the people has levels below the optimum level for wellbeing and %27 of have insufficient or deficient levels of Vitamin D. This shows us a very big and increasing problem. We cannot access the sunlight enough.

https://www.forthwithlife.co.uk/blog/why-we-all-need-to-take-vitamin-d-supplements/

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Concept of operation

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Mechanical Subsystem

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Electrical Power Subsystem

Lower-Level Software Subsystem

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Presentation Outline

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1.Motivation

ANSWERING THE WHY?

1.1 Introduction

1.2 Research Objective

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1.1 Introduction

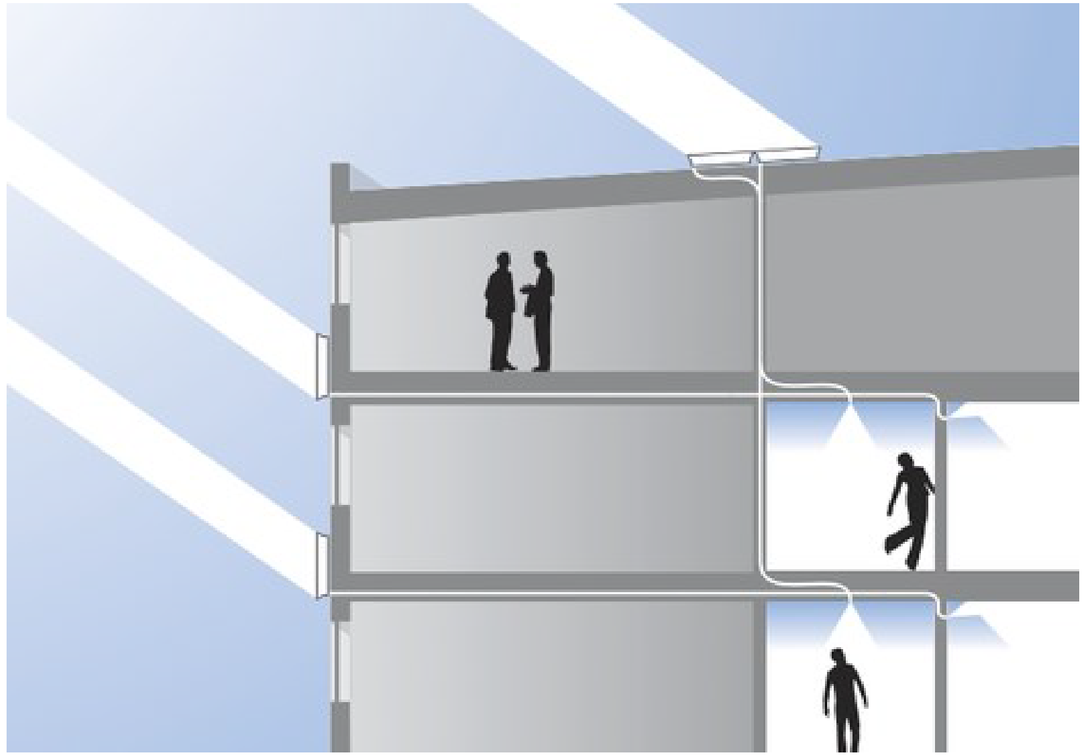
With the increased population in mega cities architects had to design denser bigger and taller buildings to supply this increased population accessing the healthy sunlight is getting harder and harder. The working hours, the traffic puts a heavy burden to our health by limiting accessibility to sun.

We cannot change how we work. We cannot decrease the population, or we can't make the buildings so that every room and every floor take enough light. So, what can we do so that people get enough sunlight? To fix this problem and increase our health and decrease the energy use we should find a solution to transfer the sunlight and our research focuses that problem.

1.1 Introduction

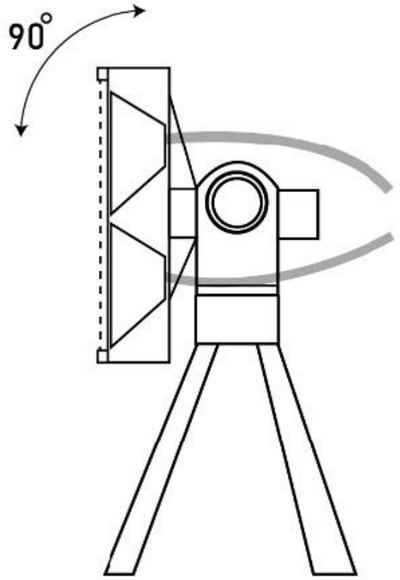
1.2 Research Objective

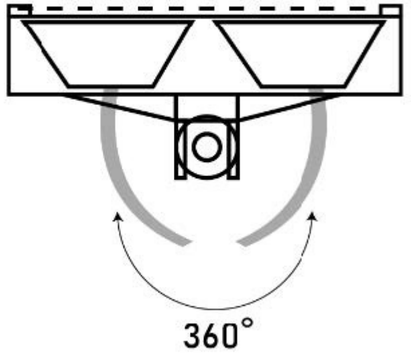
Our main research objective is that answer these questions to be able to transfer the sunlight what system should we use? How to design it? What are the ways of sunlight transfer. What are the subsystems. What is the feasiblity of such a system and what problems should be solve.



1.2.1 Scientific Value

We will be able the harness the power of the sun more efficiently and directly without the need of converting it to some other energy type. With the dual-axis sun tracker and specially designed lens and fiber optic cable combination we will be able to transfer the sun into the dark places to eliminate the need of unnecessary light usage and help people to get the natural and healthy daylight.





1.2.1 Scientific Value

Also people will be able to monitor their systems every day from anywhere using the platform we will develop. They will be able to check if their sun-collector is working correctly and how much they are profiting on daily basis by using this system. Also, the producer and the seller of this product will be able the determine if the sun-collector is need maintenance or not, this monitoring systems also applicable for not only for this product it is also suitable for other types of sun energy collector systems like solar panels.

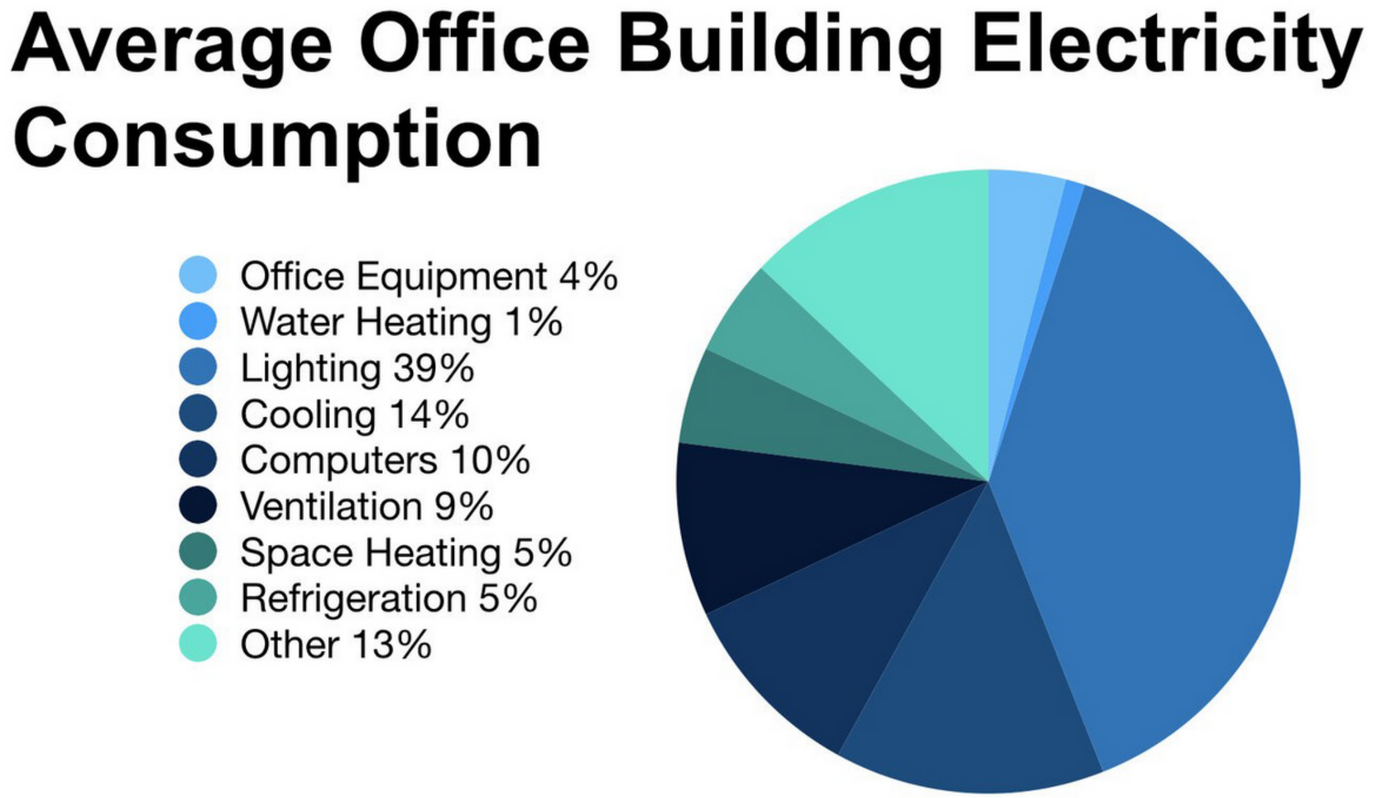
1.2.2 Statement of the Problem

Sunlight is irreplaceable part of our daily life, with the sunlight we can feel better, restore our health faster and become more productive and become more successful in the long term. But unfortunately, our schedule is not suitable for enough sunlight access, many people spend their life working under the artificial flickering lights which are open day and night and they are not accessing the healthy natural light of the sun. Offices, hospitals, underground spaces are using artificial lights all day because the buildings are not and cannot be designed so that every place on the building can access the sunlight.

1.2.2 Statement of the Problem

With the Industrialization and increasing need for more buildings with the increased population, accessing the sunlight is getting harder and harder because of the urban and crowded structuring. To solve this and save the future we need to deliver the sunlight to the people using efficient and specially designed lenses and fiberoptics. And with this research we could achieve this. In the next figure the average office building electricity consumption can be easily seen and as we can see from the graph the top one consumption comes from the lighting.

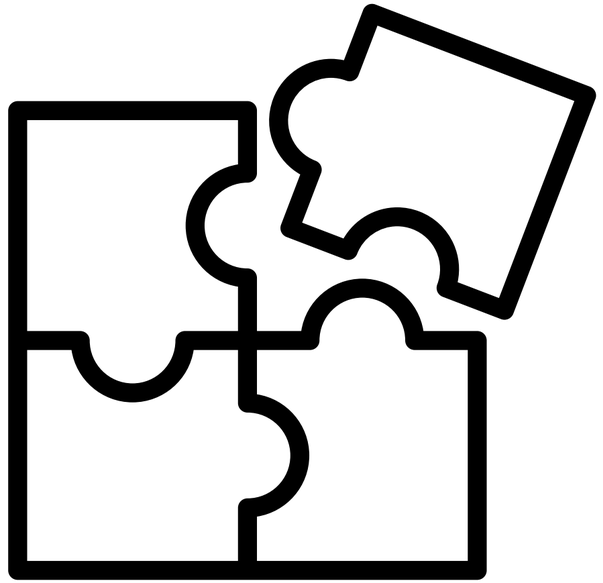
1.2.2 Statement of the Problem



U.S Energy Information Administration , "Madison Gas and Electric Company's Managing Energy Costs in Office Buildings research report," 2018.

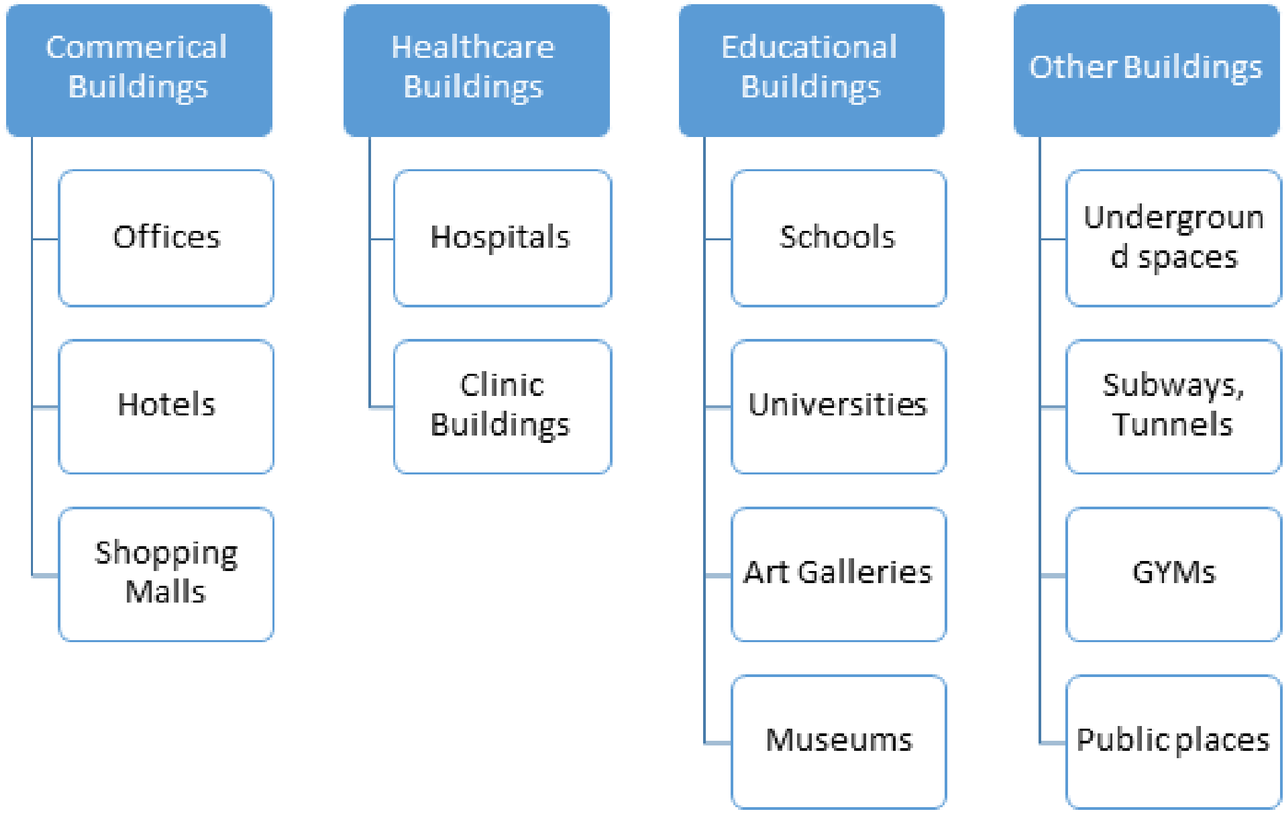
1.2.3 Aim of This Project

Aim of this project is to be able to use the energy of sun and bring light to the unilluminated places of buildings like offices, underground places, hospitals etc. to decrease the need for using artificial flickering lights and become more healthy, productive, and happier in long term. With this research and project, we will be able to find that what is the optimum choice of lenses and fiber optic cables should be use from a vast of selections and combine them with the most efficient dual-axis sun tracker with monitoring system made from sensors.



1.2.3 Usage of this project

People can use this product in every building where comfort and health of the occupants are important.



1.2.5 Needs and Benefits

Natural Light and Increased Health

Increased Learning

Required Need for Daylight in Urban Cities

Decreasing the Need for Electricity

Increased Value of Property

Better Light Quality

Meeting the Daylight Requirements

1.2.6 Sub Problems

Choosing the Lenses

Choosing the Fiber Optic Cables

Design, Algorithm of the the sun tracker

Choosing and getting the right measurements from different sensors

Transferring the data from microcontrollerto web server and storing them.

2.Literature Review and Contribution of the project

2.1 Similar Projects

2.1.1 Solar Daylight Tubes - Sun Tubes

2.1.2 Optical Fiber Daylighting System Combined with LED Lighting

2.1.3 Research 3 - Optical Fiber-based Daylighting System with Uniform Illumination

2.2 The Difference

2.3 Originality

2.1 Similar Projects

2.1.1 Solar Daylight Tubes - Sun Tubes

The solar daylight tubes or the commercial name for them VELUX Sun Tubes is a product manufactured by the roof window company by VELUX. Their tubes are a way of bringing the sunlight into the home with the most cost-efficient solutions. In the figure the tube and how it is used can be clearly seen.

Velux, "Velux Sun Tunnel Skylights," 2021. [Online]. Available: https://www.veluxusa.com/products/sun-tunnels. [Accessed 14 February 2021].

2.1 Similar Projects

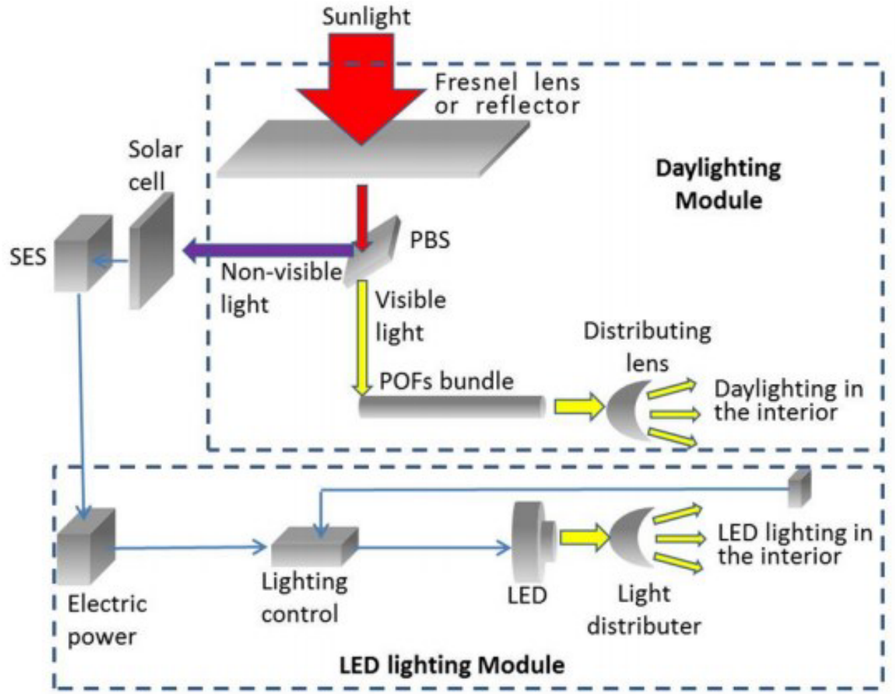
2.1.1 Solar Daylight Tubes - Sun Tubes

+ Cost Effective
+ Easy to install
- Sunlight can only be carried to roof to the floor below.
- Endless cycle of low temperature of outside and high temperature of inside changing between them thus decreasing the energy efficiency.
- Fixed, angle of the placement is highly decrease the efficiency of the product according to the time of the year.

Velux, "Velux Sun Tunnel Skylights," 2021. [Online]. Available: https://www.veluxusa.com/products/sun-tunnels. [Accessed 14 February 2021].

2.1 Similar Projects

2.1.2 Optical Fiber Daylighting System Combined with LED Lighting

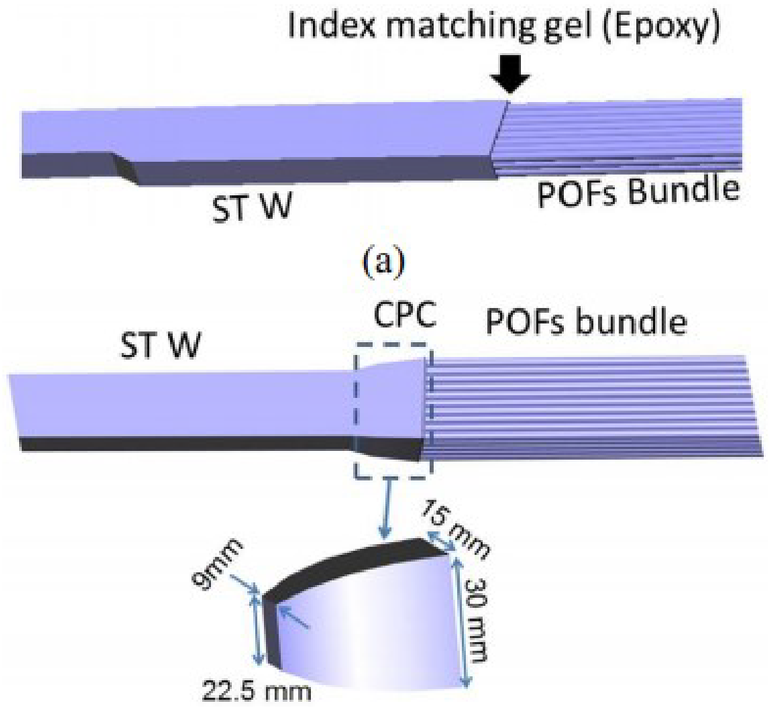


A research named “Optical Fiber Daylighting System Combined with LED Lighting and CPV based on Stepped Thickness Waveguide for Indoor Lighting” made in Myongji University shows the great potential of the optical fiber daylight and delivers the methods and design specifications for transferring the light using fiber optic cables. The most innovative part of this design is even tough we have the LED lighting in this research the energy required for the light is made by dividing the sunlight into non-visible and visible light and using the energy of the non-visible light.

V. &. S. S. Ngoc-Hai, "Optical Fiber Daylighting System Combined with LED Lighting and CPV based on Stepped Thickness Waveguide for Indoor Lighting," Journal of the Optical Society of Korea, 2016.

2.1 Similar Projects

2.1.2 Optical Fiber Daylighting System Combined with LED Lighting

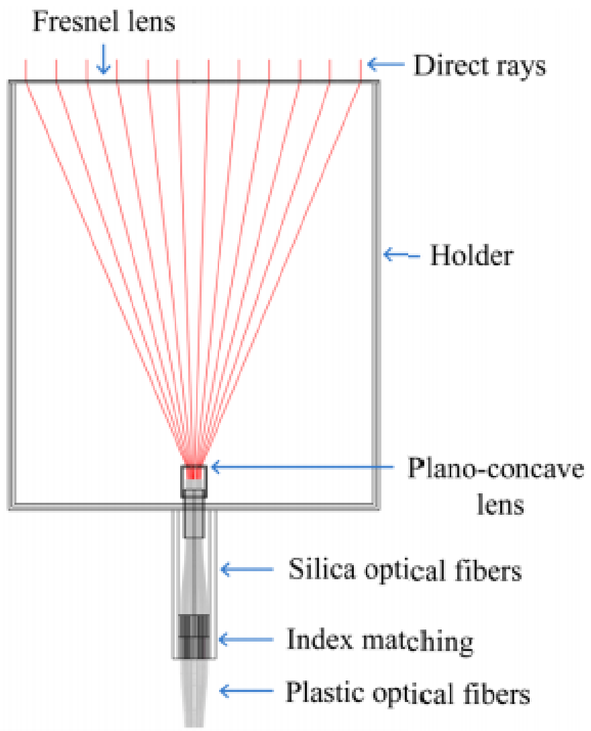


+ LED's are directly powered by sunlight.
+ Shows a great potential of using this product as a commercial product.
- Cost is too hight
- Too complicated and require very hard to find materials.
- Fixed fresnel lenses, has efficieny problems.

V. &. S. S. Ngoc-Hai, "Optical Fiber Daylighting System Combined with LED Lighting and CPV based on Stepped Thickness Waveguide for Indoor Lighting," Journal of the Optical Society of Korea, 2016.

2.1 Similar Projects

2.1.3 Optical Fiber-based Daylighting System with Uniform Illumination

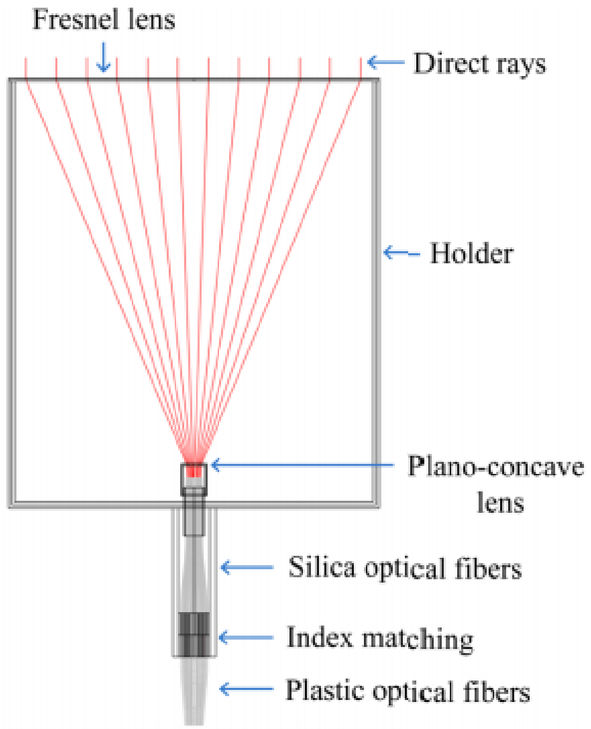


A research named “Development of Optical Fiber-based Daylighting System with Uniform Illumination” made in Myongji University by Irfan Ullah and Seoyong Shin [15] tries a different approach and combines a 300mm diameter of very large Fresnel lens combined with small plano-concave lenses to focus the light into the 2mm bundle of plastic optical fibers again combined with silica optical fibers.

A. j.-w. W. Irfan Ullah, "Development of Optical Fiber-Based Daylighting System and Its Comparison," energies , 2015.

2.1 Similar Projects

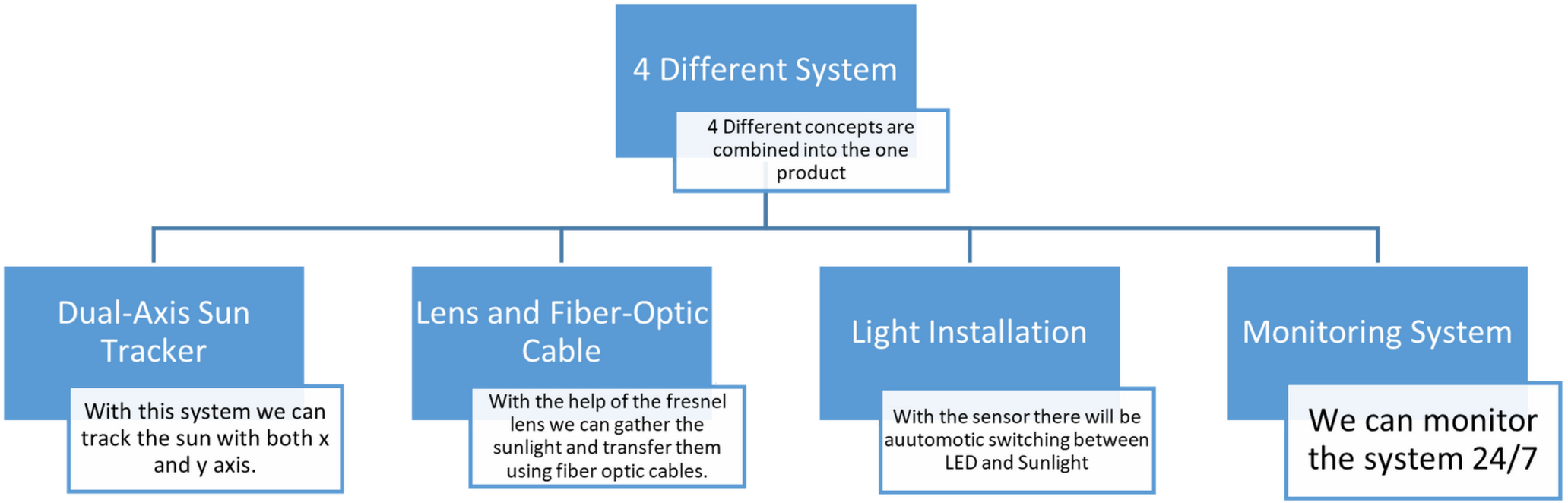
2.1.3 Optical Fiber-based Daylighting System with Uniform Illumination



+ No heat problem.

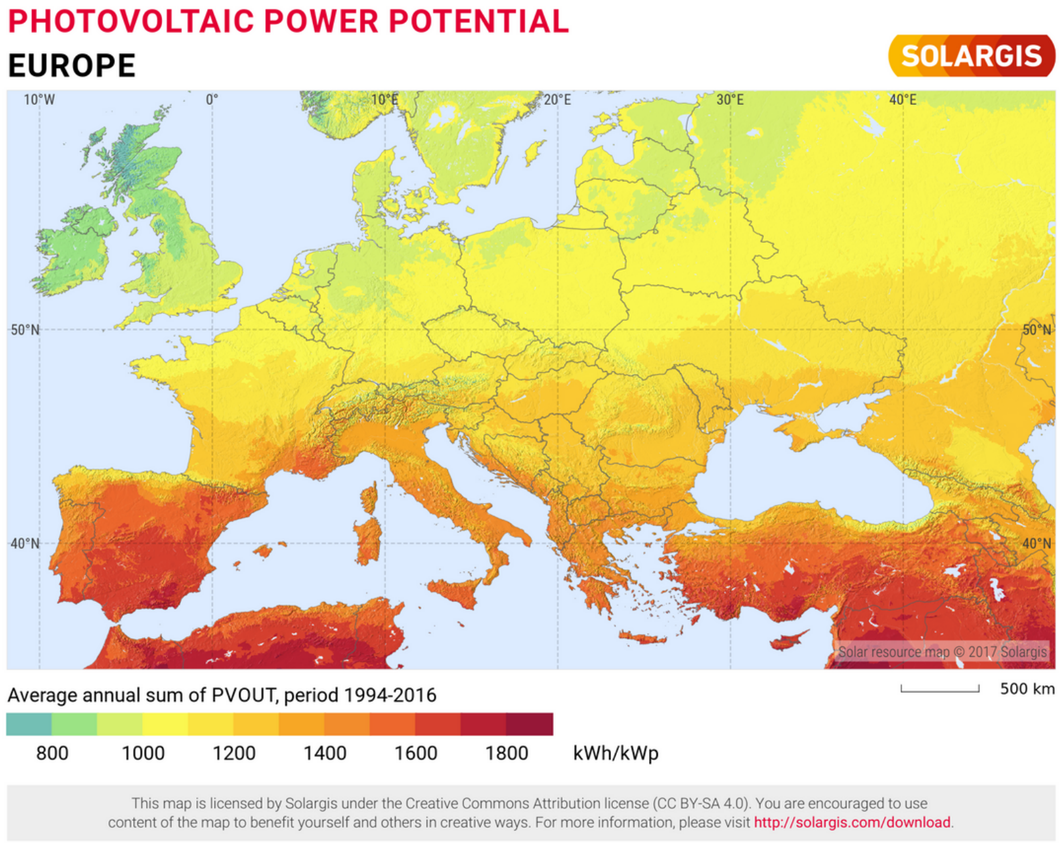
- Complex manufacture in fiber connection point.

2.2 The Difference



2.3 Originality

According to our research there is no other company or research are trying to combine these four different systems into the one system and investigate the effects of compatibility of these systems. Also, this research becomes more important in our country Turkey, because Turkey is one of the countries which has high Global Horizontal Irradiance value by compared to other countries in Europa [1] ,and currently we are not efficiently using the power of sun and green energy [2].



[1] Global Solar Atlas, "globalsolaratlas.info," 2020. [Online]. Available: https://globalsolaratlas.info/global-pv-potential-study. [Accessed 13 December 2020].

[2] E. Özgür, «Solar Power in Turkey,» TTMOB , 2020.

2.3 Originality

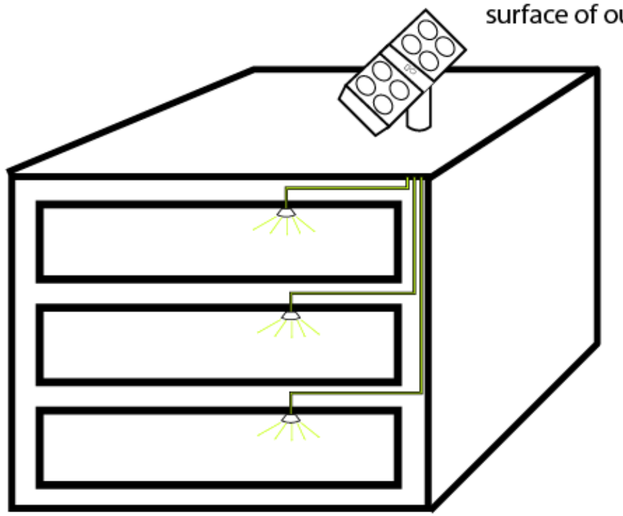
Key differences are,

- Using five LDR and one lux sensor to track to sun instead of using four LDRs only.
- Using sun tracker with dual-axis mechanism instead of a fixed system.
- Dimming LED and create a balance between artificial light and daylight using lux sensor.
- Monitoring system for a sun-collector system.
- Combining four different system into one system and see their effects as a whole.

3.System Model

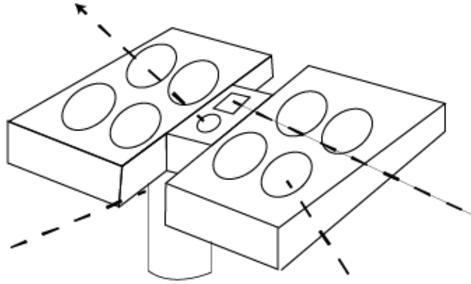
ANSWERING THE HOW?

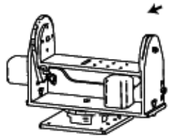
3.2 Concept of operation



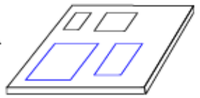
1) Sunlight shines on the surface of our system.

2) With the sun tracker sensor we can sense the position of the sun, data sent to the dual-axis tilt mechanism.



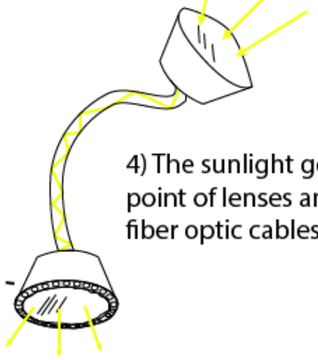


3)The mechanism is localted underneath the system and it allows for x and y axis turns for 90 degree.

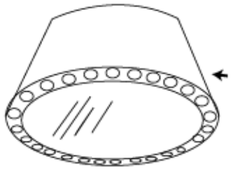


5) The lux, temperature, air pressure and humidity sensors sends the data to the ESP32s.

7) ESP32s sends data to the monitoring system.



4) The sunlight get focused into the focal point of lenses and transfered with the fiber optic cables.

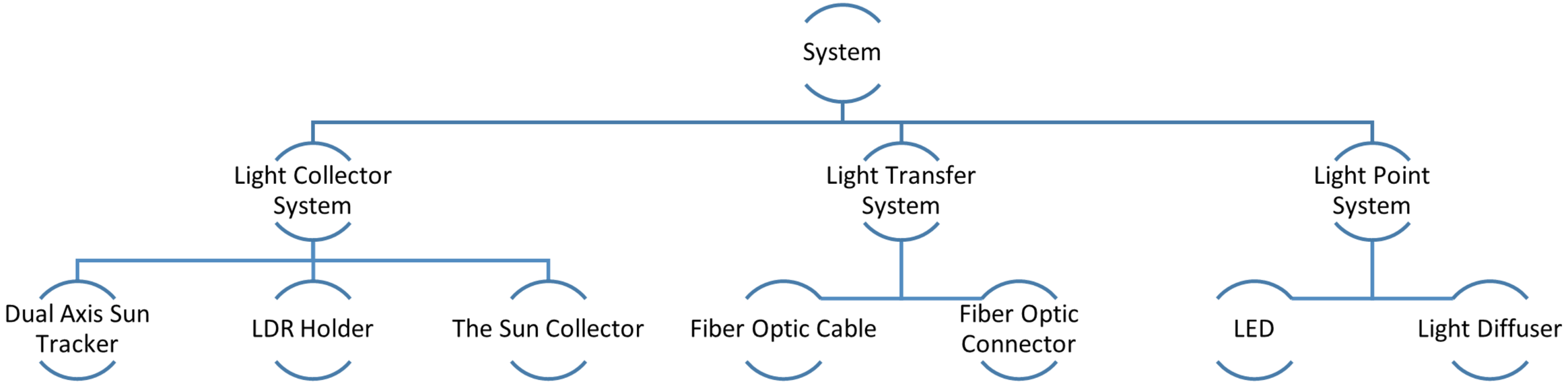


6) According to the data coming from Lux sensor LED dims. If it is a sunny day no external light required so LED becomes off.

3.3 Sensor Subsystem

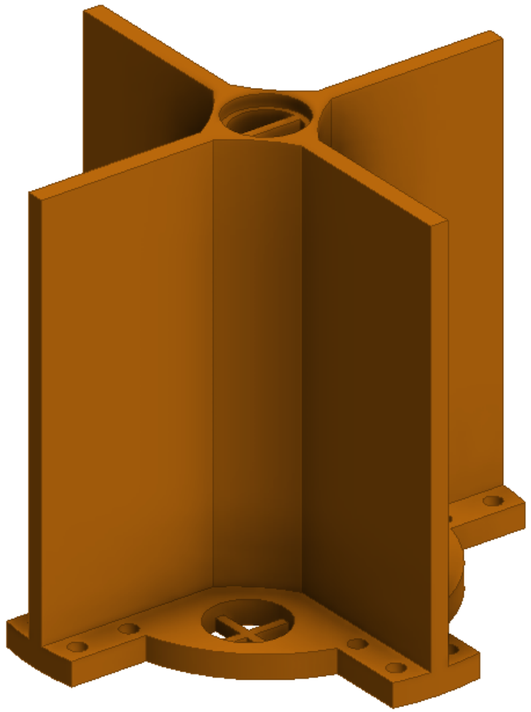
Sensor Type	Model	Purpose	Place of use
Light Dependent Resistor	LDR	To track the sun	Sun tracker tube in the main system.
Lux Sensor	TS2561 Lux Sensor	To dim the LED	Sensor chamber in the main system.
Temperature and Humidity Sensor	DHT11	To measure temp and humidity to check if maintenance is required	Sensor chamber in the main system.
Temperature and Pressure Sensor	MS5611	To measure temp and pressure to check and locate where our system is.	Sensor chamber in the main system.
Rain Sensor	FC-37	To be able use it as a weather station.	Outside of the main system.

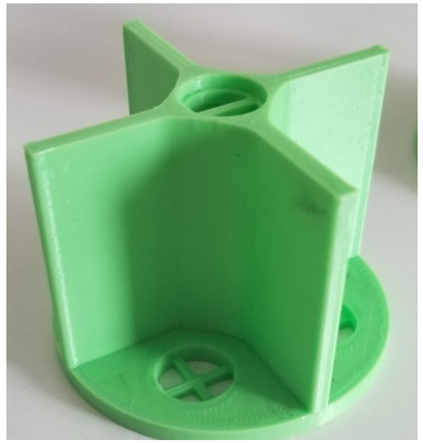
3.4 Mechanical Subsystem

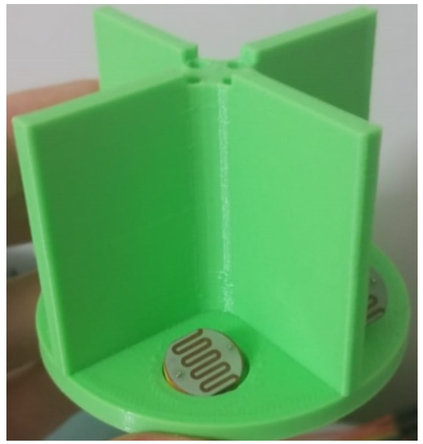


3.4.1 Light Collector System

3.4.1.1 LDR Holder





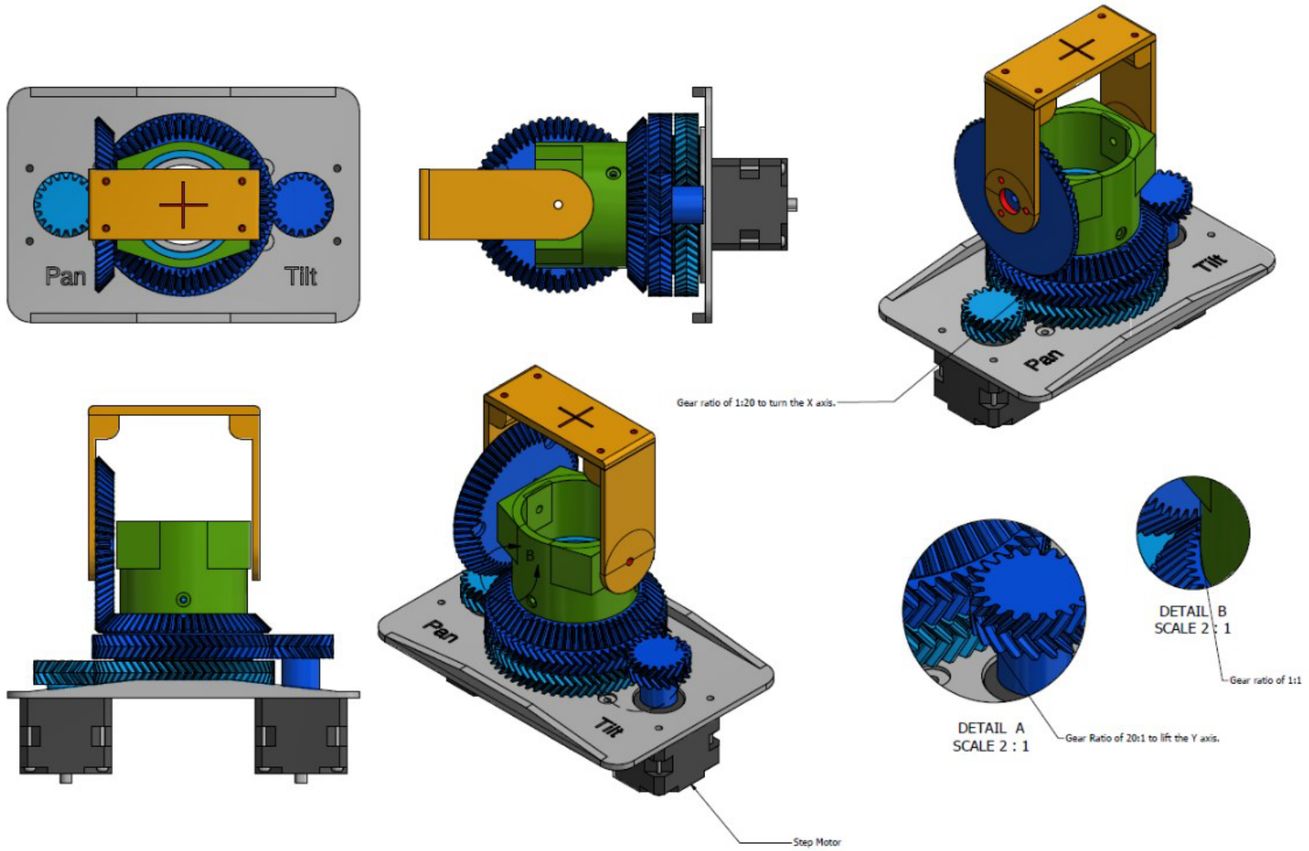


This is the part where LDRs are located. The aim of this holder is to keep the LDRs in place so that LDRs resistance value can increase or decrease according to the where the sun is located. If the holder is not perpendicular to the sunlight, the shadow will fall on the LDRs and will create difference in terms of light intensity.

3.4.1 Light Collector System

3.4.1.2 Dual Axis Sun Tracker

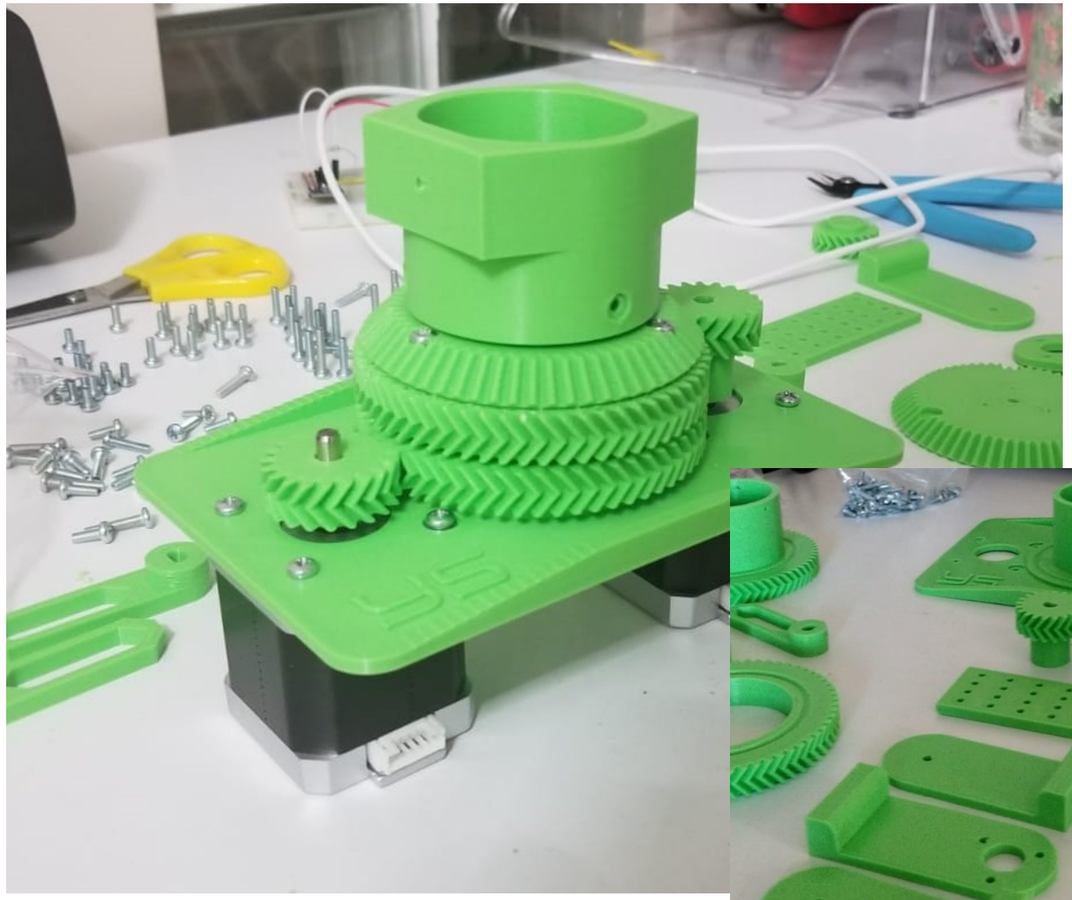
This is the mechanism which will be used to move the system in X and Y axis. With this mechanism lens will be always perpendicular to the sun so that efficiency will be increased.

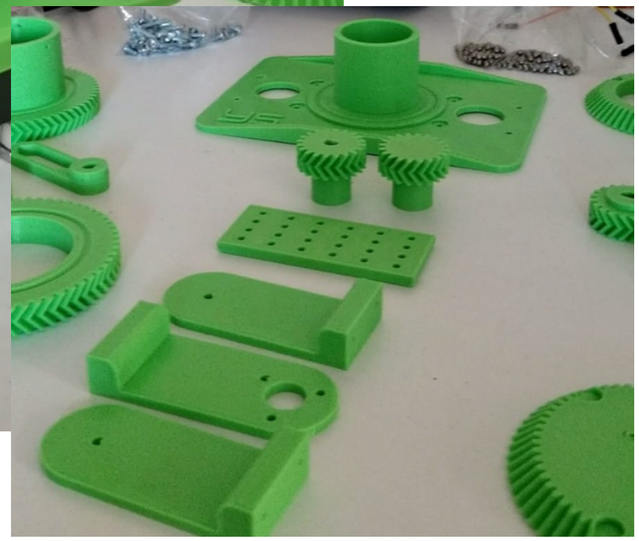


3.4.1 Light Collector System

3.4.1.2 Dual Axis Sun Tracker

For the mechanism all connections, bolts and nuts are selected as the 3M bolts with different height according to the place. For the bearing part 3MM bearing balls are used. For the shaft, a 100mm 3mm bolt is used. In the next figure all individual parts for the dual-tracker mechanism can be seen.

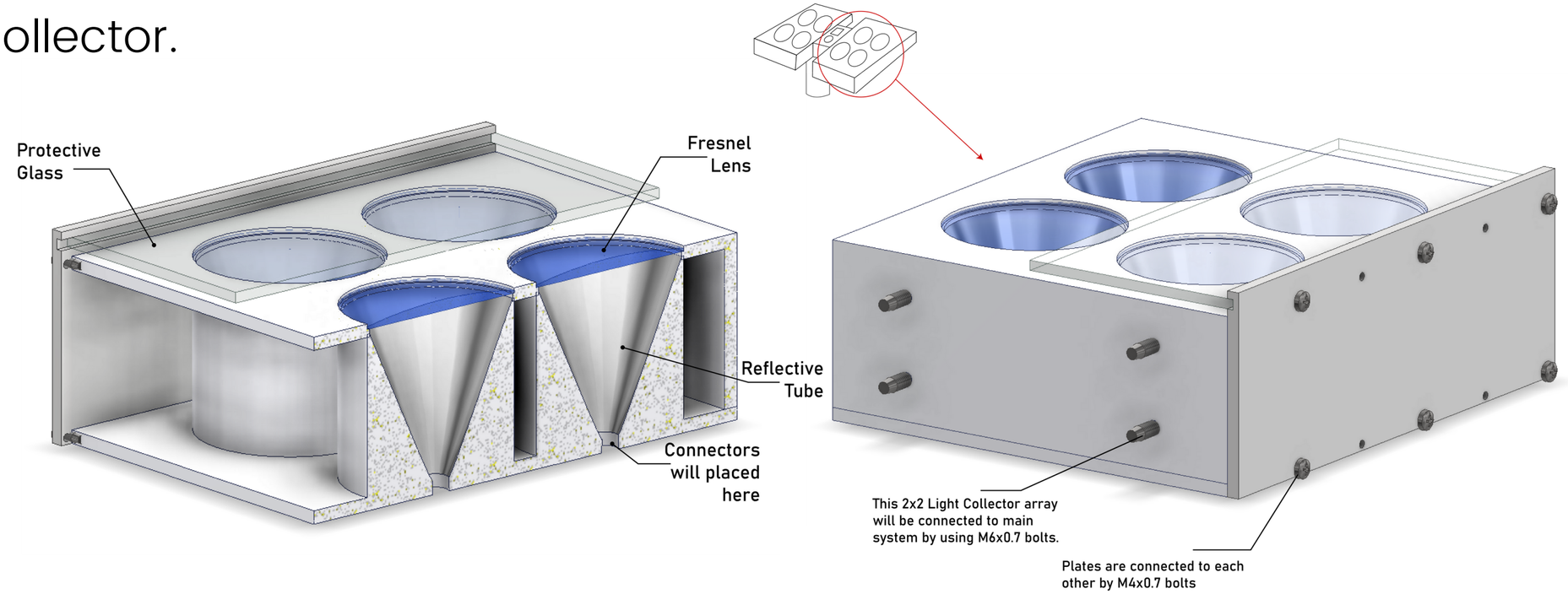




3.4.1 Light Collector System

3.4.1.3 The Sun Collector -End Product

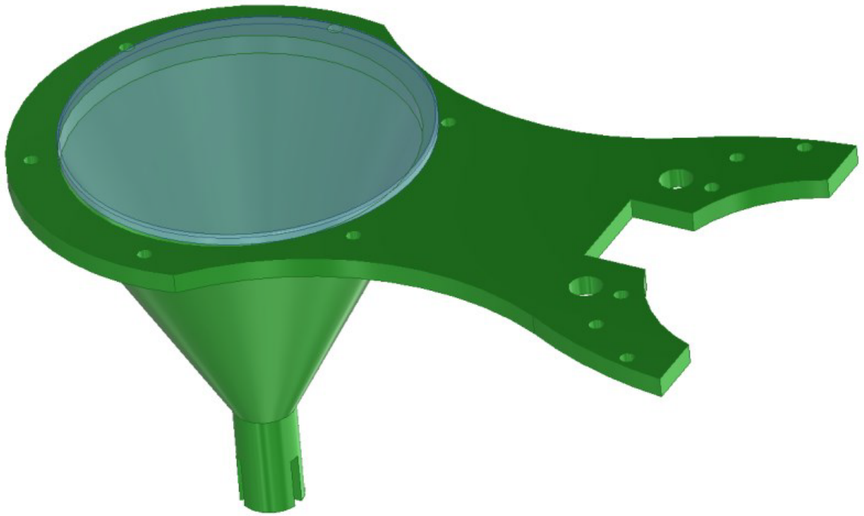
This is the part we are focusing the sunlight into the fiber optic cables using Fresnel lenses or Convex lenses. In the end product Lenses will be placed in 2x2 array in right and left part of the system. Total number of lenses will be 8 in the sun collector.

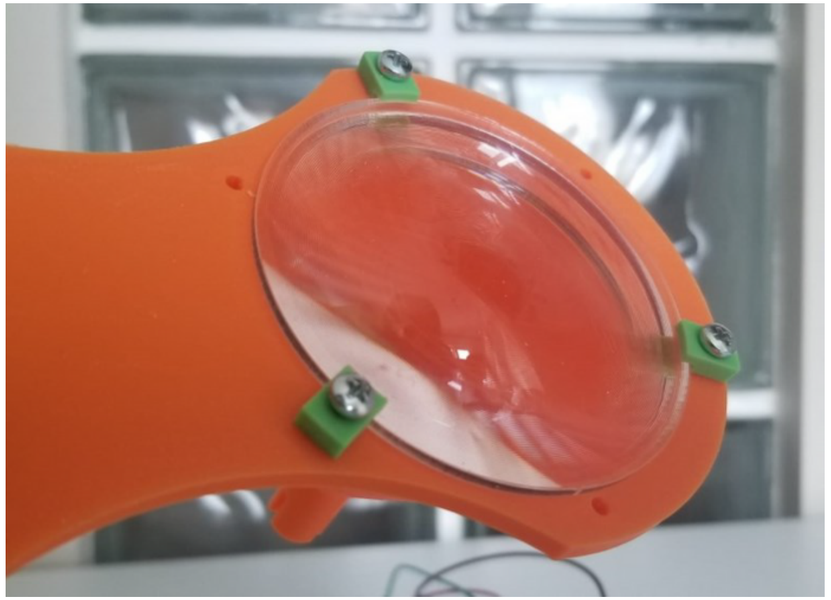


3.4.1 Light Collector System

3.4.1.3 The Sun Collector - Test Version

After our research, trial, and error we have decided to use Fresnel lenses with the specifications of 70mm in diameter, 80mm in focal length and 2mm in thickness. Below the figure you can see our lens holder design for test version of our project.



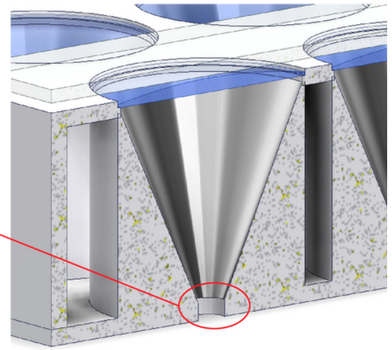


3.4.2 Light Transfer System

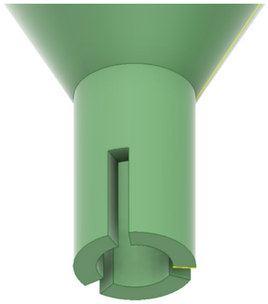
3.4.2.1 Fiber Optic Cable

7mm Outer 5mm Inner 0.45db/m 50mm bend radius PMMA Fiber Optic Cable

3.4.2.2 Fiber Optic Connectors - End Product

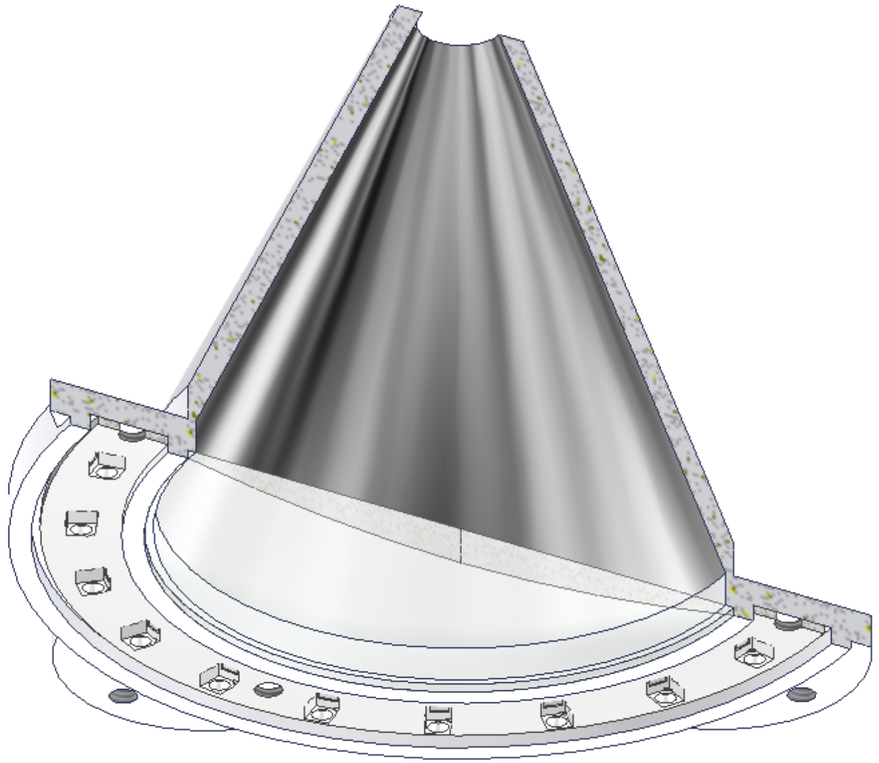


3.4.2.2 Fiber Optic Connectors Test Product - Clips are Used



3.4.3 Light Point System

This system will be placed in the ceiling or the walls to bring light from the outside to inside. It consists of two parts first is LED and second part is light diffuser. These are connected via 3D printed parts. Light point is like the reversed sun collector. Lens, collector, and reflective tube is the same the only difference is LED, and bolt holes are added.



3.5 Communication and Data Handling Subsystem

Using different algorithms for communication and HTTP

Sending the data from ESP32S to web server

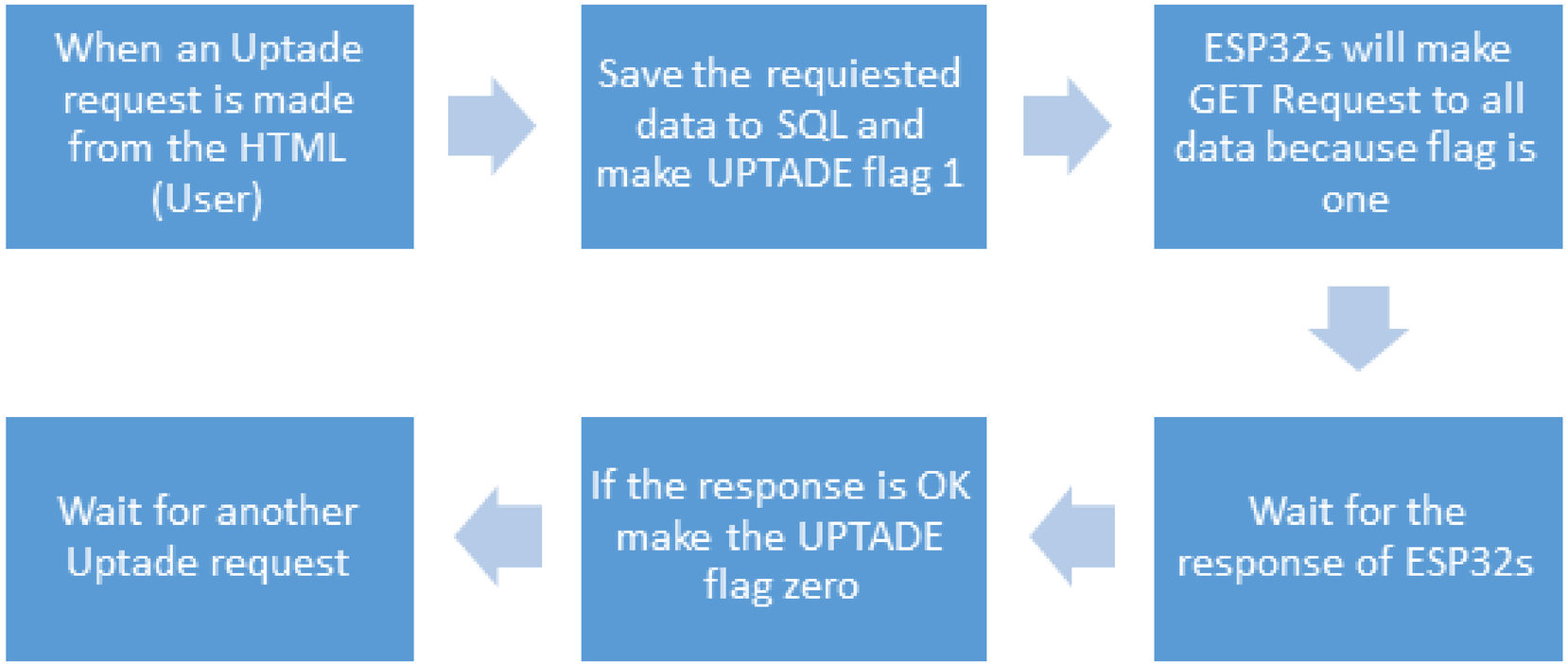
Getting the data to ESP32s from web server

Getting the data to web server coming from ESP32s

Sending the data from web server to ESP32s

3.5 Communication and Data Handling Subsystem

Sending the data from server to ESP32s Algorithm



3.5 Communication and Data Handling Subsystem

We are using Json formats to send and receive data.

Post Request to the Server	Get Response from the Server (1 is on)

{
"time":"09:28",
"date":"27.11.2020",
"apiKey":"AZD124",
"luxValue":35000,
"esp32Temp":"28.2",
"dht11Temp":"29.0",
"bmp180Temp":"31.2",
"humidity":35,
"airPressure":386,
“LDR1”: 80
“LDR2”: 80
“LDR3”: 50
“LDR4”: 40
“LDR5”: 32
"ledPercentage":20,
"rainPercentage":0,
"errorCode":"404",
}
	{
	"time":"09:28",
	"date":"27.11.2020",
	"apiKey":"AZD124",
	"isReset":1,
	"isManuelLedOn":0,
	"ledValue":30,
	"sendDebugData":1,
	"isSunTrackingOn":1,
	}

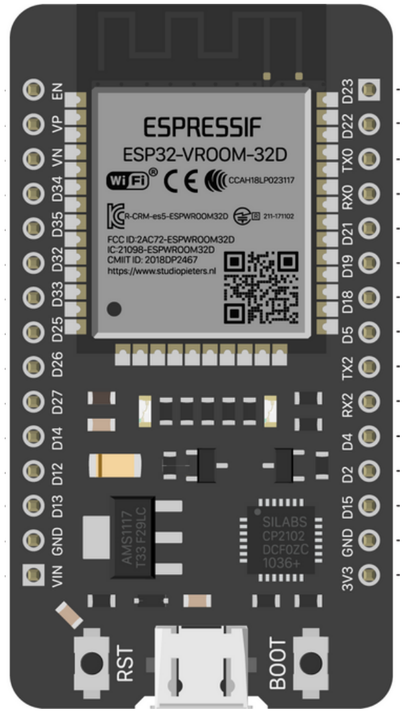
3.5 Communication and Data Handling Subsystem

We are using ESP32s as our main microcontroller.

We have selected the ESP32s because it has both fast and easy to impellent Wi-Fi and Bluetooth properties.

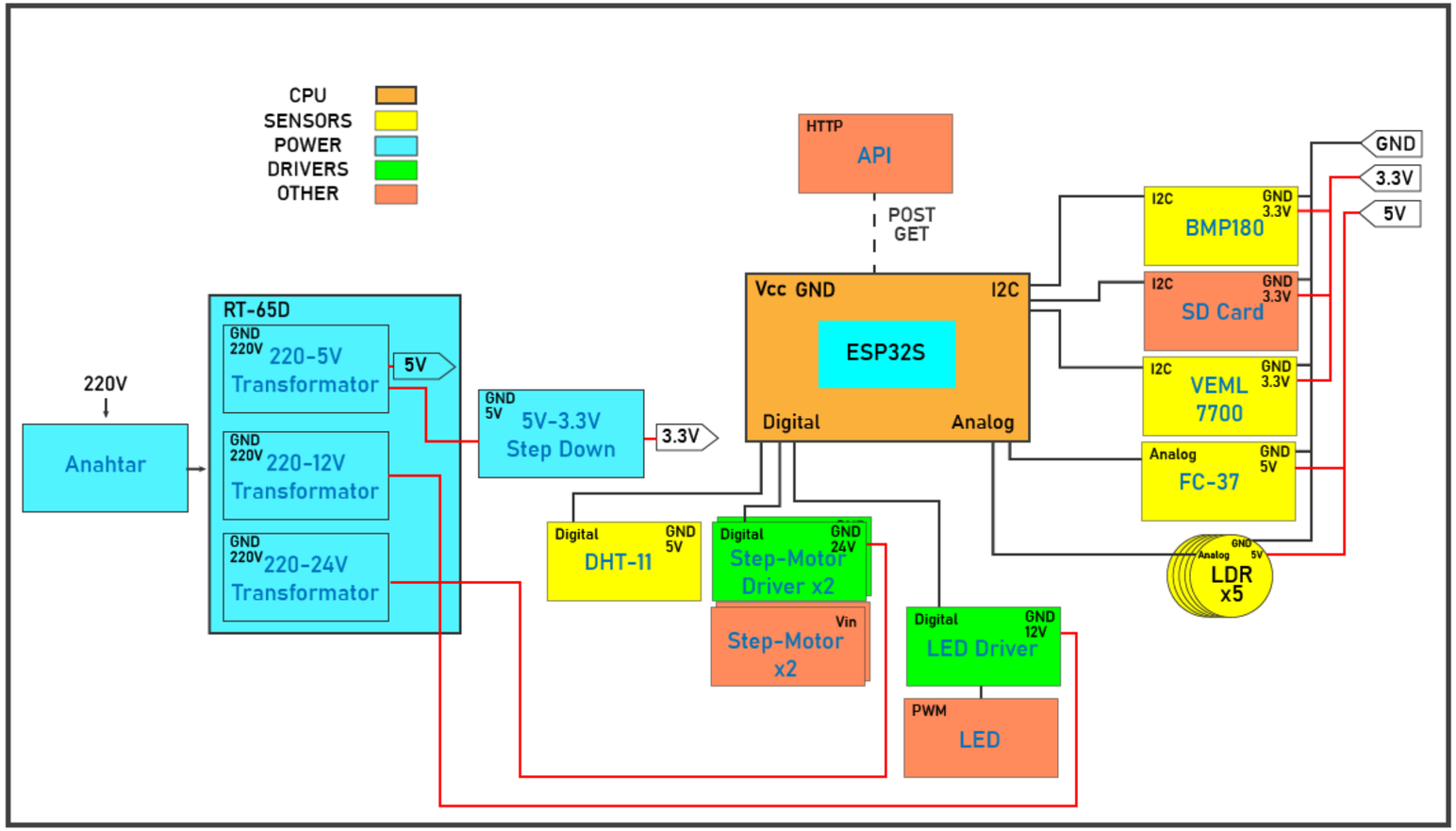
• ESP32 is capable of functioning reliably in industrial environments, with an operating temperature ranging from −40°C to +125°C. Which makes it very conventional for us to work because where it is located can be very cold or very hot according to the climate.

• The clock frequency can go up to 240MHz and it has a 512 kB RAM, so it is fast enough to make GET and POST request when immediate results are required



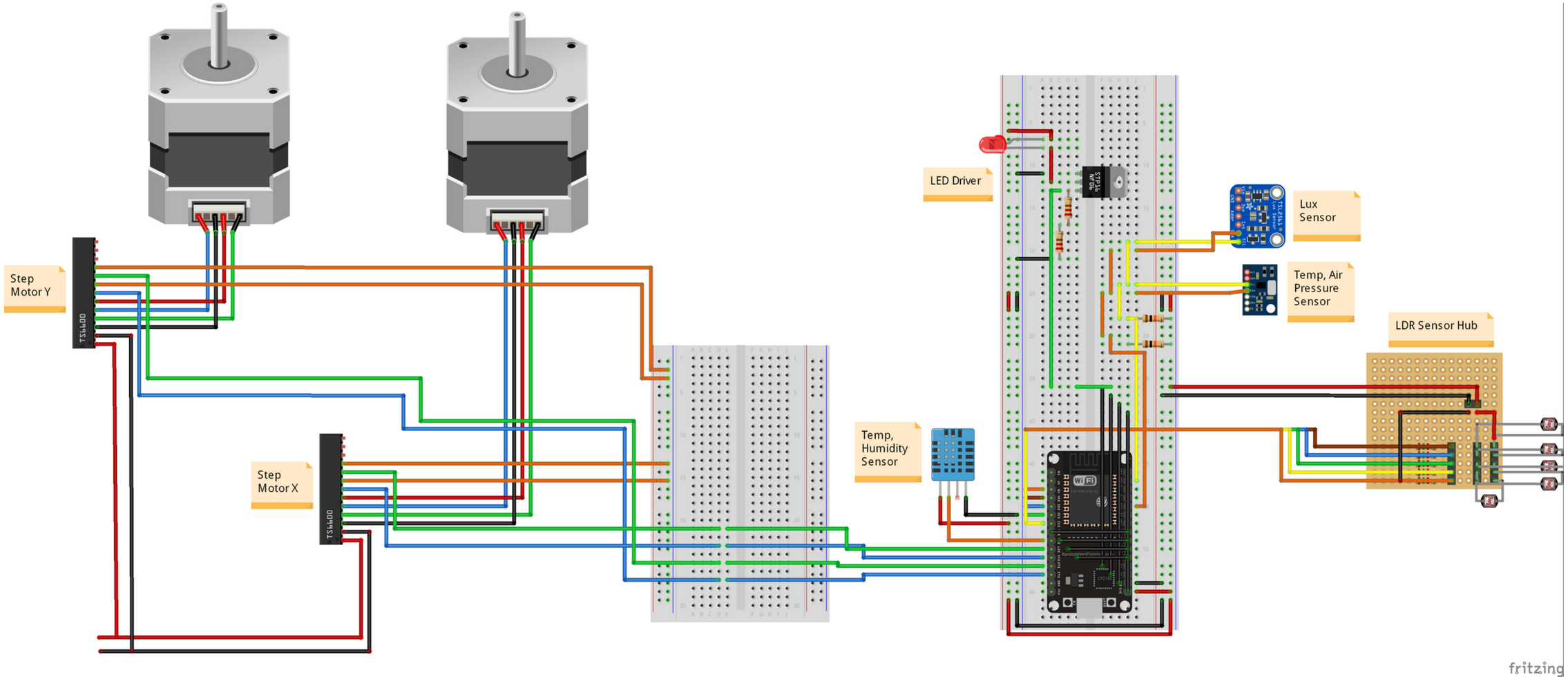
3.6 Electrical Power Subsystem

Power connections and regulators can be easily seen in the diagram.

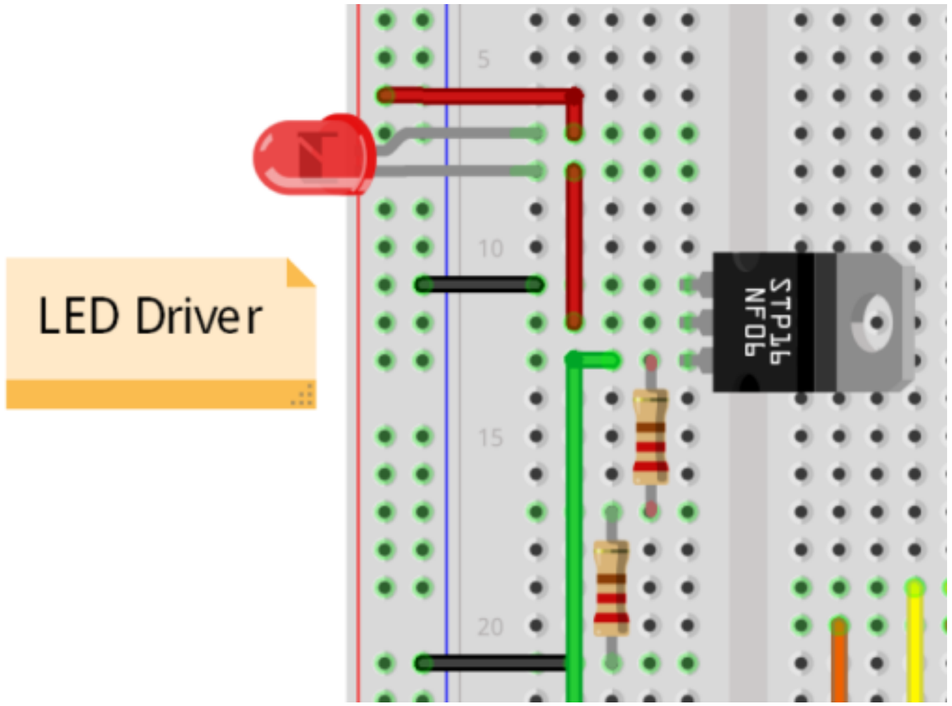


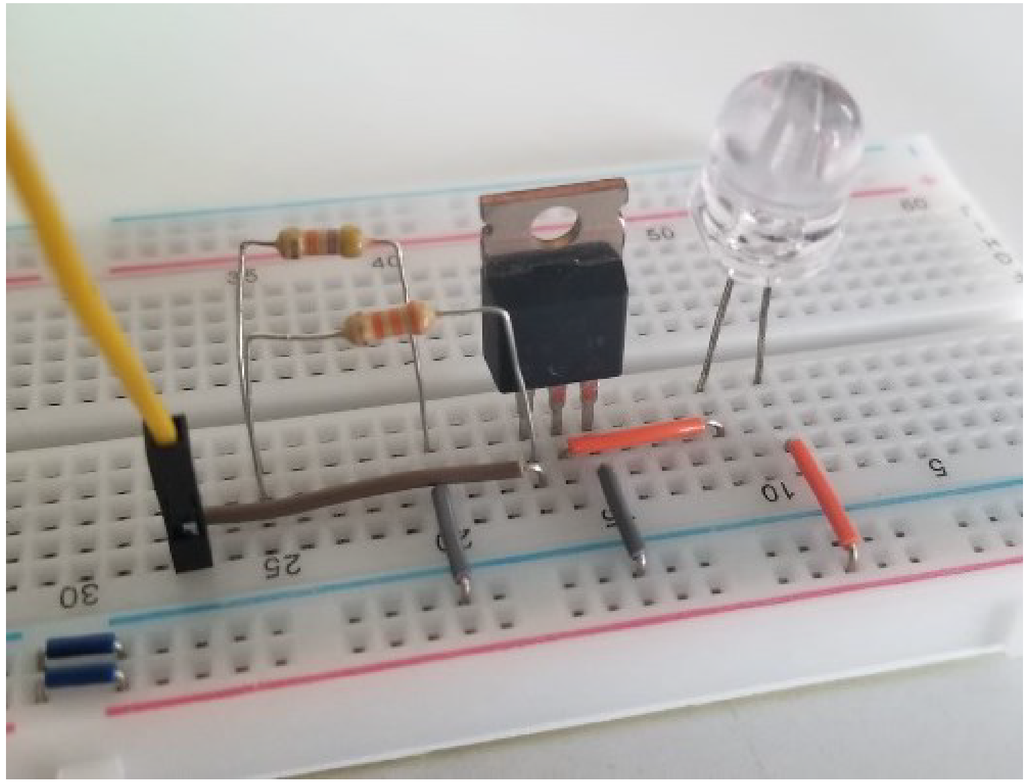
3.6 Electrical Power Subsystem

Detailed schematics for the Step motors, step motor drivers, ESP32s, MS5611, TS2565 DHT11 and LDRs.



3.6 Electrical Power Subsystem



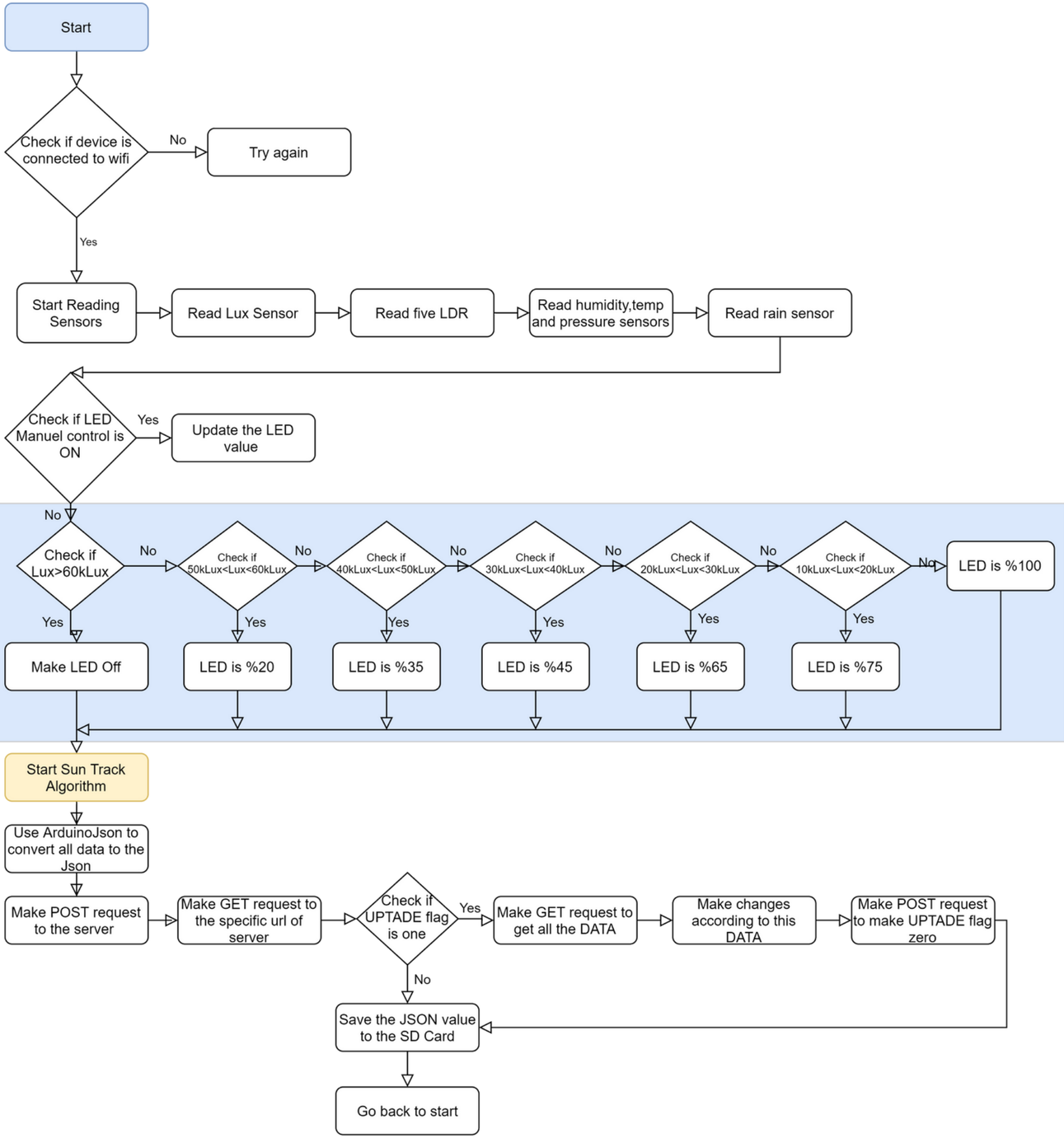


3.7 Lower-Level Software Subsystem

Aim of the Lower- Level Software

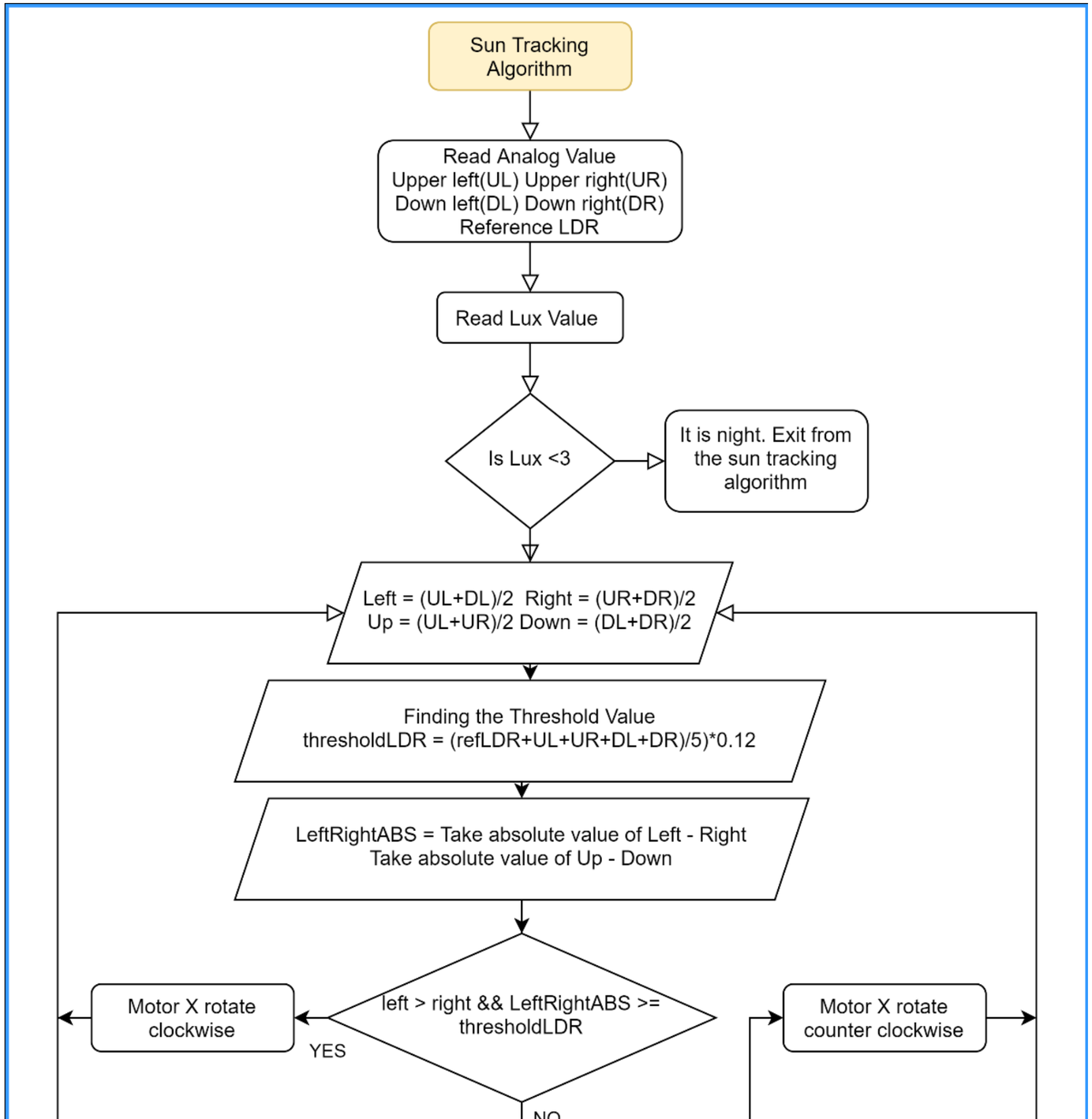
- Connect to the server via Wi-Fi
- Read the measurement results from the sensors
- Save these measurement values in the SD Card and send them to server via HTTP
- Send necessary information to the step motor drivers so that system can track the sun.
- Get information from the server and update itself according to what user wants.
- By using the measurement values coming from Lux sensor dim the LEDs it is connected.

State diagram of the lower level software



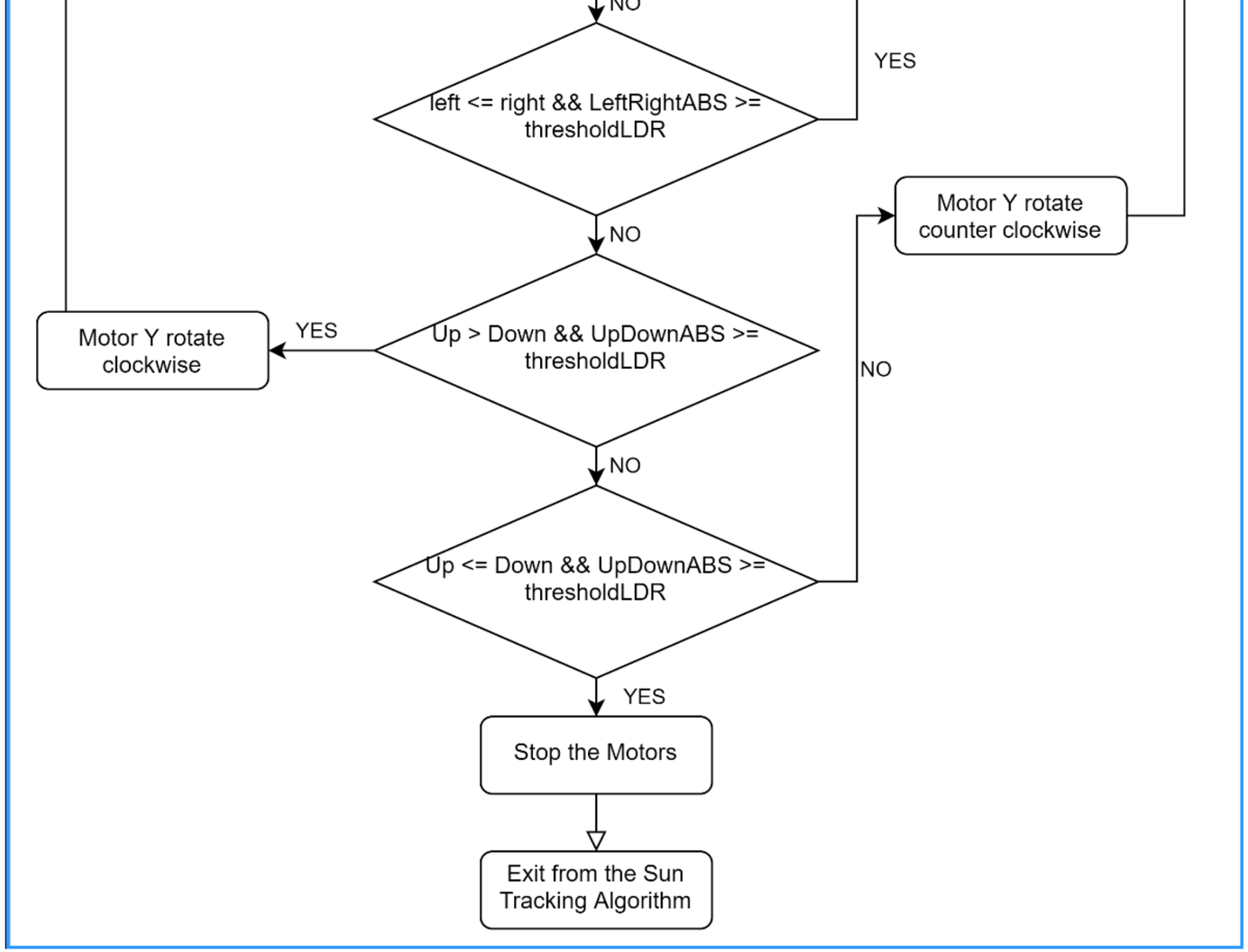
Sun Tracking Algorithm

- Using reference LDR
- Threshold Error
- 12%



Sun Tracking Algorithm

- Using reference LDR
- Threshold Error
- 12%



3.8 Higher Level Software

The purpose of higher-level software

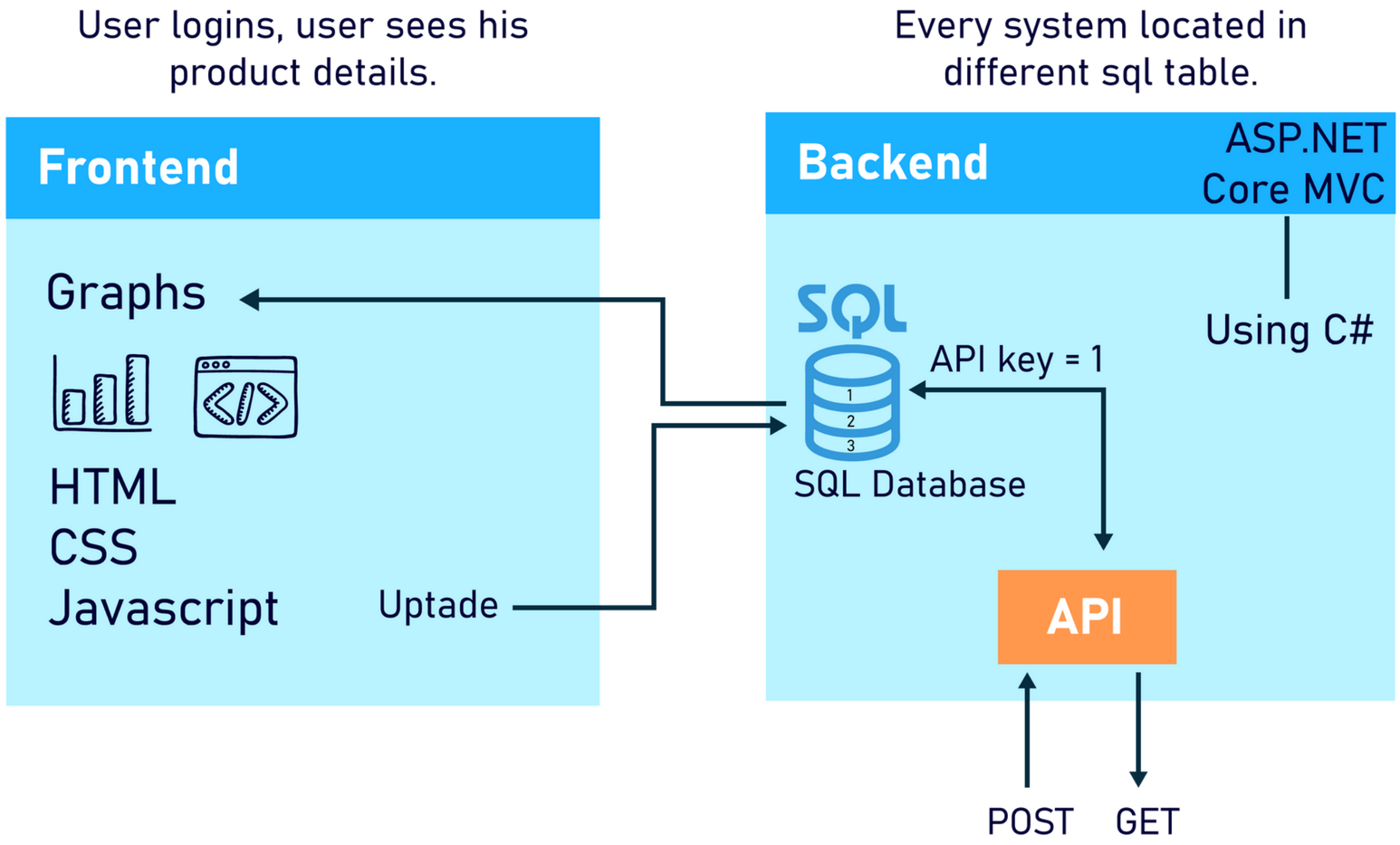
- In our monitoring system user can be able to check their products, check if their product requires maintenance and how much does he save by using this system.
- User will be able to manually control his or her products, can manually change the value of LED or deactivate the tracking system.
- User will be able see the temperature, air pressure, humidity, rain sensor and lux value in graphical way.
- User will be able to see the system as a weather situation.
- User will be able to see if there is a problem with his or her products.
- Company will be able see all the products that they sold.
- Company will be able see if a product needs maintenance or not.
- Company will be able see if their products are working correctly or not.

3.8 Higher Level Software

The architecture of higher-level software

To access to data - EF Core

To render graphs - CanvaJS and Ajax



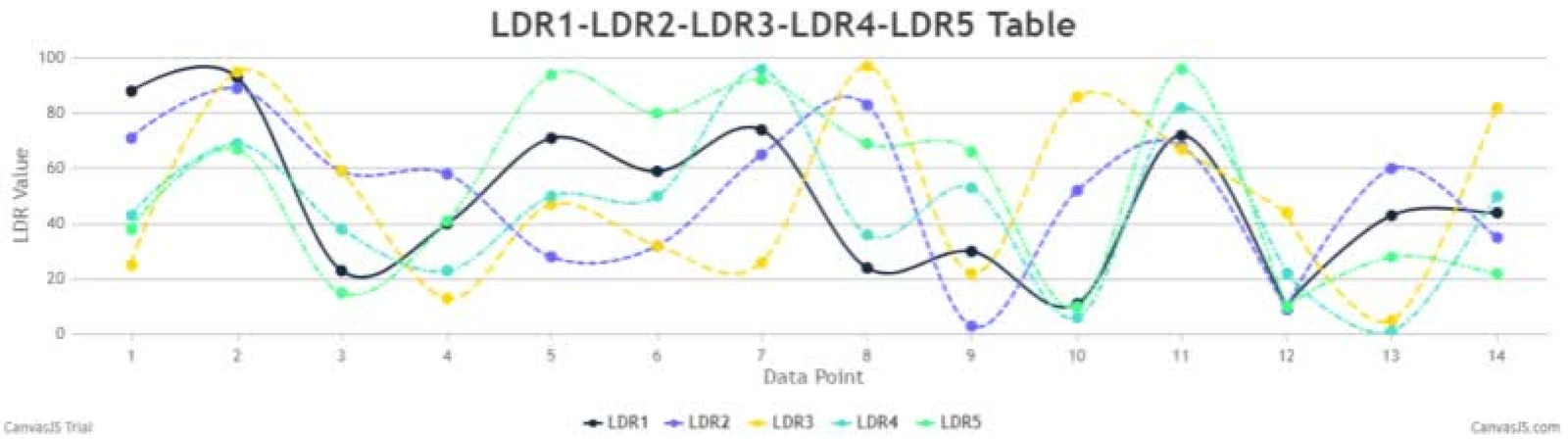
Real Time Statistics - Contoso Ur

localhost:44335/StudentsNew

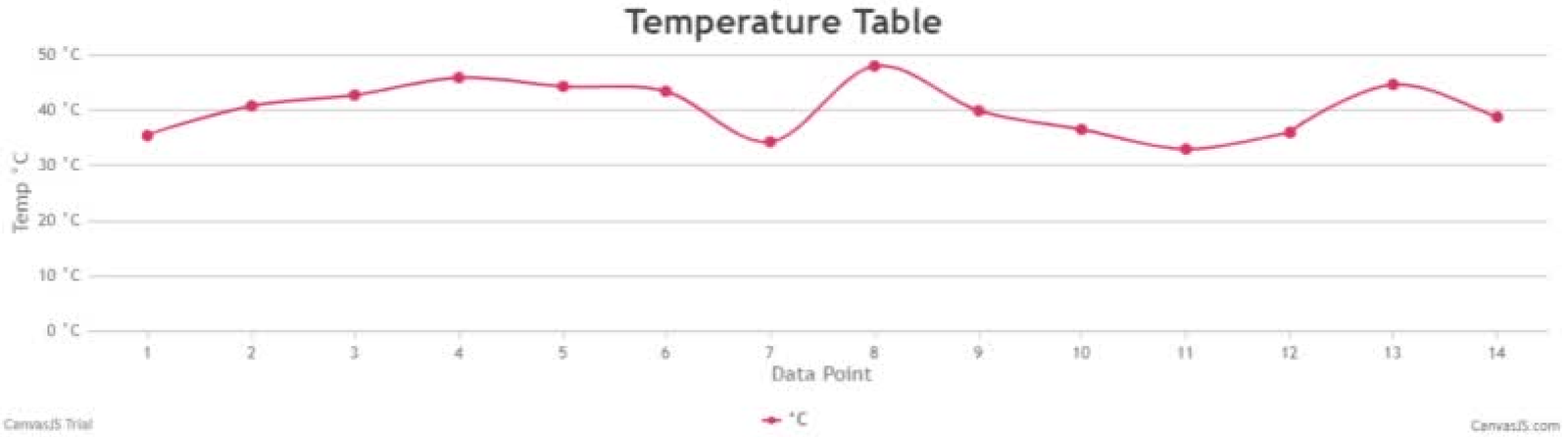
SunLight Technologies

Real Time Stats | Check and Update | Stats | Other Products | About

LDR



Temperature



Lux

01:28
2.07.2021

4.Realistic Constraints and Engineering Standards

FINDING THE LIMITS

4.1. Constraints
- 4.1.1 Economic constraints
- 4.1.2 Environmental constraints
- 4.1.3 Health and Safety constraints
- 4.1.4 Manufacturability constraints
- 4.1.5 Sustainability constraints
- 4.1.6 Political constraints

4.2 Cost of the design

4.3 Engineering Standarts

4.1. Constraints

4.1.1. Economic constraints

We have calculated and found that for a 55mm^2 room there is a 10 year payback time.

4.1.2 Environmental constraints

Product must be placed in flat surface.

4.1.3 Health and Safety constraints

Lenses and step motors are generating too much heat.

4.1.4 Manufacturability constraints

Focal points are not exactly same.

4.1. Constraints

4.1.6 Political constraints

The EU Workplace (Health, Safety and Welfare) Regulations (1992) requires that “Every workplace shall have suitable and sufficient lighting”. Both European Committee for Standardization, CEN and The International Organization for Standardization, ISO puts a daylight requirement and regulations for the buildings saying that “The design illuminance levels needed to enable people to perform visual tasks efficiently and accurately shall be obtained by means of daylight, electric light or a combination of both.” [1] That is why our product should provide enough lighting to meet the required criteria for these regulations.

[1] Velux, "Velux Sun Tunnel Skylights," 2021. [Online]. Available: https://www.veluxusa.com/products/sun-tunnels. [Accessed 14 February 2021].

4.2 Cost of the design

Electronic System					
Component	Model	Piece	Price (₺)	Total Price (₺)	Exact/Estimated Price
Light Dependent Resistor	LDR	4	5	20	Exact
Lux Sensor	VEML7700 Lux Sensor	1	30	30	Exact
Temperature and Humidity Sensor	DHT11	1	9	9	Exact
Temperature and Pressure Sensor	BMP180	1	8	8	Exact
Rain Sensor	FC-37	1	6	6	Exact
Step Motor Driver	TB6600	2	121	242	Exact
Step Motor	Bipolar NEMA 17 200	2	196	392	Exact
LED	5050 Double PCB 3 Chip LED	4	18	72	Exact
LED Driver	Led Strip Driver	4	55	220	Exact
Microcontroller	ESP32s	2	75	150	Exact
Voltage Regulator	RT-65D	1	185	185	Exact
Cables and connectors	-	-	-	50	Estimated

Mechanical System					
Component	Model	Piece	Price (₺)	Total Price (₺)	Exact/Estimated Price
Fresnel Lenses	70mm 60mm 2mm Fresnel Lens	10	40	400	Exact
Convex Lenses	63mm 70mm 2mm Convex Lens	10	25	250	Exact
Light Point Mechanism	Spotlight Mechanism	6	40	240	Estimated
Fiber Optic Cable 5mm	5mm 30 meter	1	350	350	Exact
Fiber Optic Cable 2mm	2mm 30 meter	1	300	300	Estimated
Fiber Optic Cable Connectors	7mm Connector	8	20	160	Estimated
Bolts and Nuts	-	-	50	50	Estimated
Filaments	1.75mm 1kg Esun Filament	3	200	400	Estimated

Tools					
Component	Model	Piece	Price (₺)	Total Price (₺)	Exact/Estimated Price
Lux Meter	UNI - UT383	1	180	180	Exact
Multimeter	UNI – UT139C	1	325	325	Exact

Total Budget			
Electronic System	Mechanic System	Tools	Total Budget
1386₺	2150₺	505₺	4041₺

4.3 Engineering Standarts

4.3.1. Network Standards

Wi-Fi Standards

Conventional Name	Name	Release Year	Maximum Data Rate	Frequency	Notes
Wi-Fi 2	802.11a	1999	54Mbps	5Ghz	One of the oldest standards, not compatible with b or g networks.
Wi-Fi 1	802.11b	1999	11Mbps	2.4Ghz	Compatible with g networks
Wi-Fi 3	802.11g	2003	54Mbps	2.4Ghz	Most popular network type.
Wi-Fi 4	802.11n	2009	600Mbps	2.4Ghz & 5Ghz	The first standard to achieve dual-band.
Wi-Fi 5	802.11ac	2014	3.6Gbps	2.4Ghz & 5Ghz	Used by current home routers and has MIMO.
Wifi6	802.11ax	2019	10-12Gbps	2.4Ghz & 5Ghz	The latest technology and has four times throughput of Wi-Fi 5

4.3 Engineering Standarts

4.3.1. Network Standards

TCP Standard

Transmission Control Protocol made by DARPA Internet Program named RFC-793. Used in libraries named "WiFi.h" and "HTTPClient.h" in ESP32s.

HTTP Standard

With the help of the HttpClient library and Http standardization we can easily add header and payload to the packet and sent it

Document Name	HTTP Version	Purpose
RFC 7230	HTTP/1.1	Message Syntax and Routing
RFC 7231	HTTP/1.1	Semantics and Content
RFC 7232	HTTP/1.1	Conditional Requests
RFC 7233	HTTP/1.1	Range Requests

4.3 Engineering Standarts

4.3.1. Software Standards

JSON Data Interchange Format Standards

JavaScript Object Notation（JSON）is a lightweight, text-based, language-independent data interchange format and standardized in the document named RFC7159. We are sending the data to the web server it is in the json format

ASP.NET Core Coding Naming Standards

The naming standards for the .Net framework and C# are provided by the Microsoft itself

Vocabulary standards for software

The vocabulary standards are determined in the ISO/IEC/IEEE 24765:2017 [28] document and it provides a common vocabulary applicable to all systems and software engineering work.

4.3 Engineering Standarts

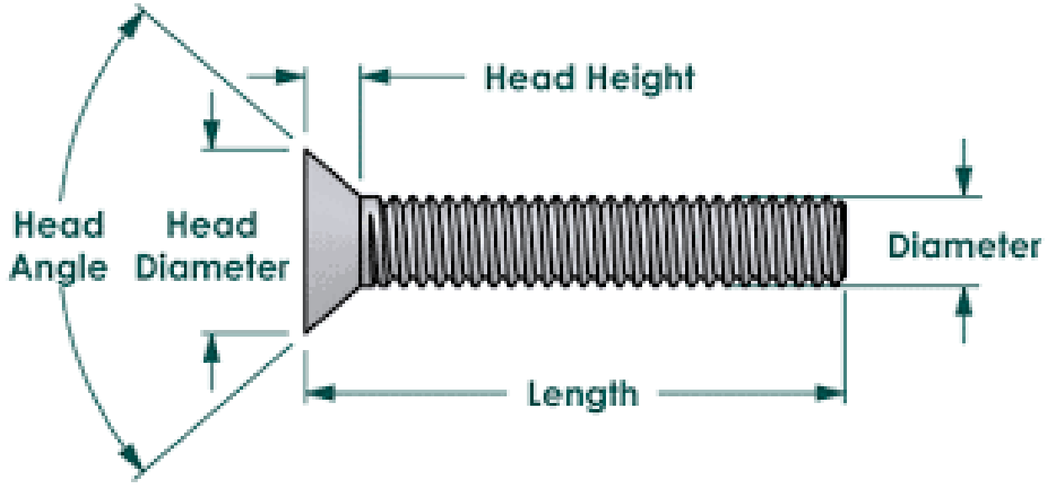
4.3.1. Mechanical Standards

Lens Standards

The standards of the Ophthalmic optics and Spectacle lenses are made by the ISO in the document named ISO 13666:2019. Parameters defined here helped us to choose lenses.

Fasteners Standards

The standardization for these bolts is in the document named ISO 898-1:2013. We have used M3,M6 and M4 bolts and nuts.



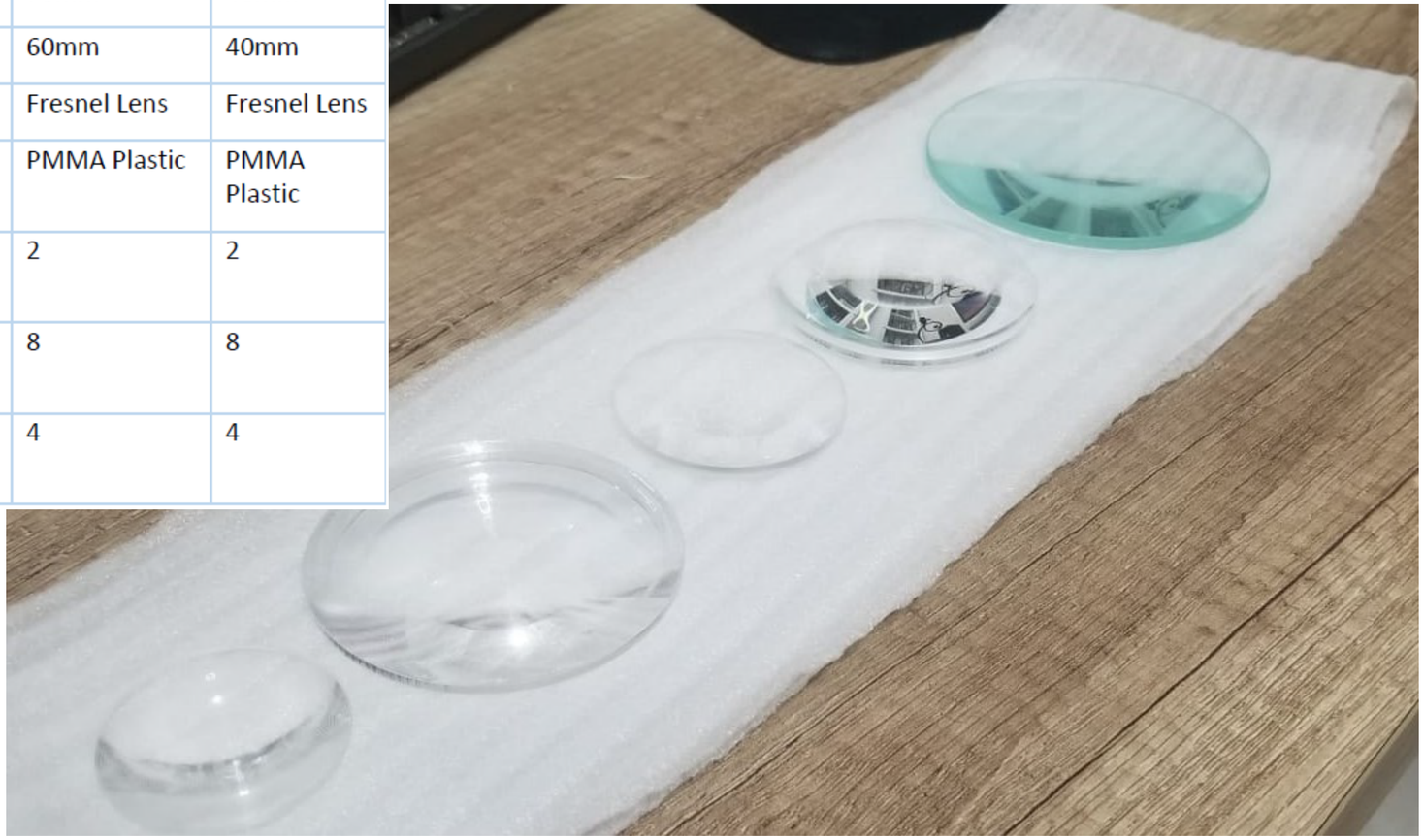
5.Numerical Results and Discussion

SOLUTIONS FOR PROBLEMS

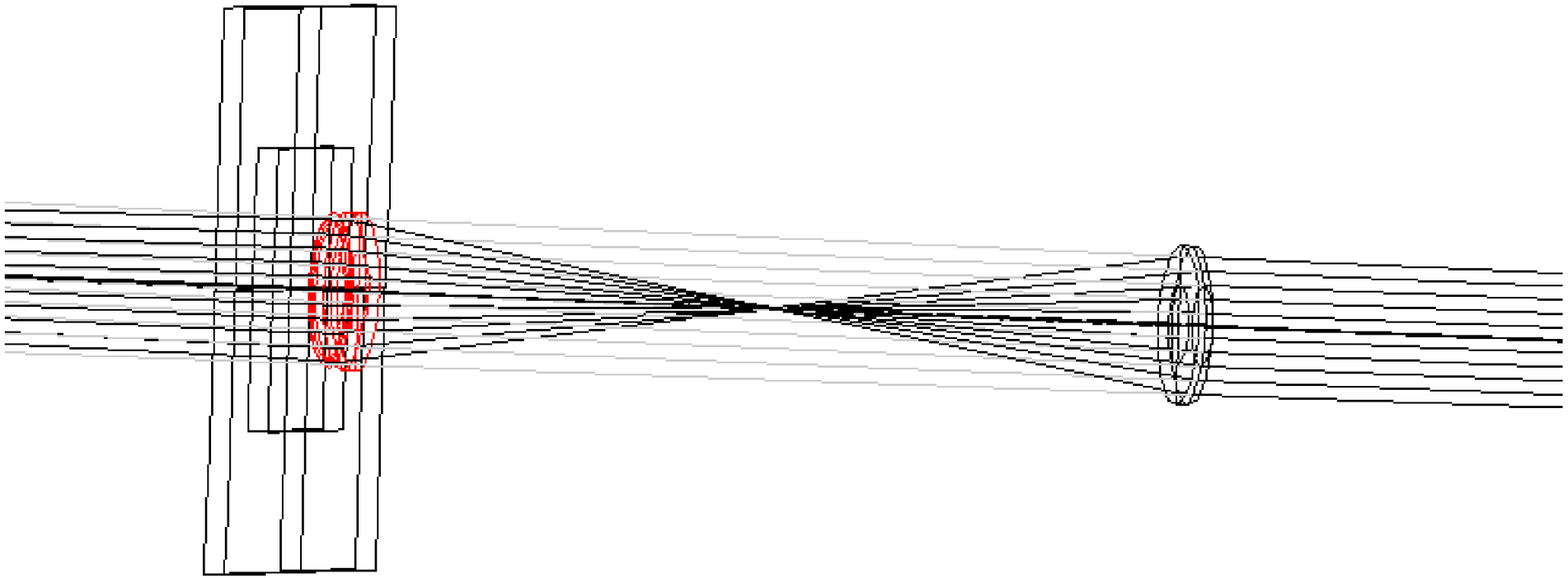
5.1 Choosing the Lenses
5.2 Choosing the Fiber Optic Cables
5.3 Design
5.4 Data Transfer

5.1 Choosing the Lenses

	Lens Option 1	Lens Option 2	Lens Option 3	Lens Option 4	Lens Option 5
Diameter	100mm	40mm	63mm	70mm	40mm
Focal Length	90mm	50mm	100mm	60mm	40mm
Type	Convex	Convex	Plano Convex	Fresnel Lens	Fresnel Lens
Material	Glass	Glass	Glass	PMMA Plastic	PMMA Plastic
Number for one light	1	2	2	2	2
Total number on system	4	8	8	8	8
Light output number	2	4	4	4	4



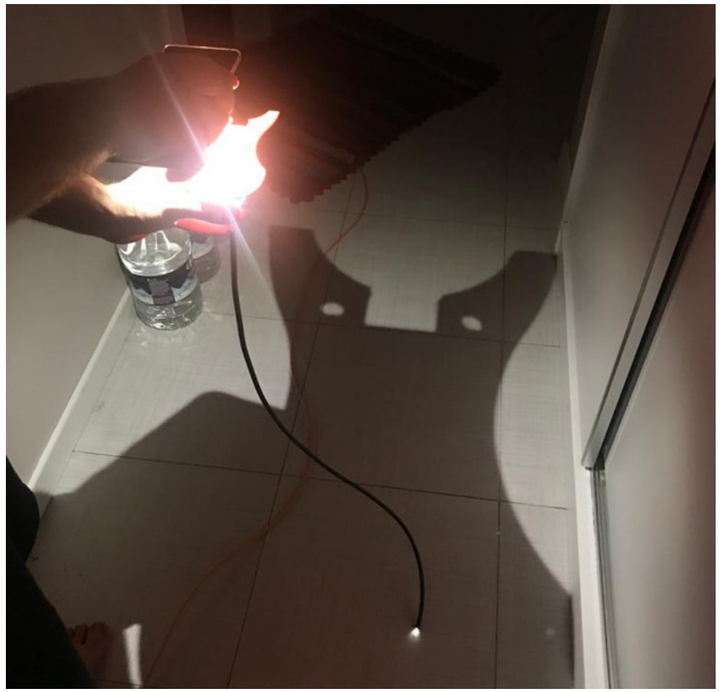
5.1 Choosing the Lenses

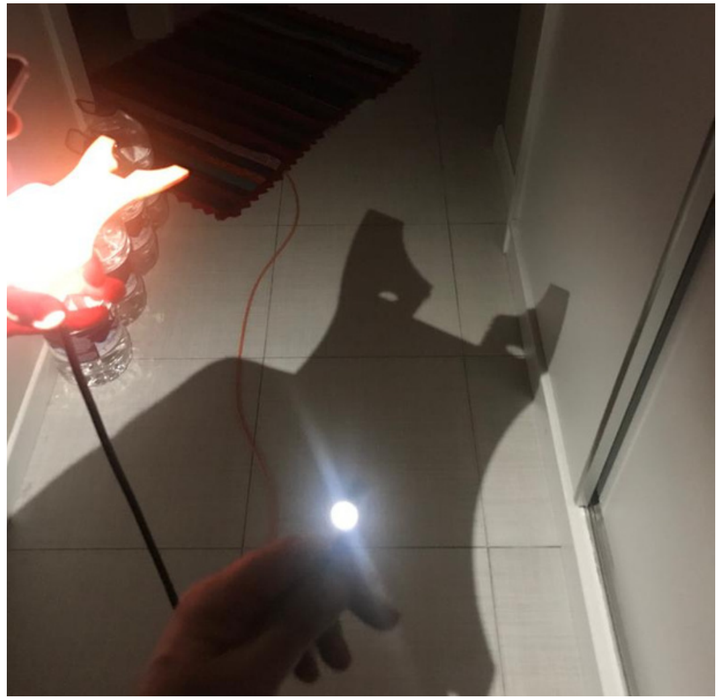


5.2 Choosing the Fiber Optic Cables

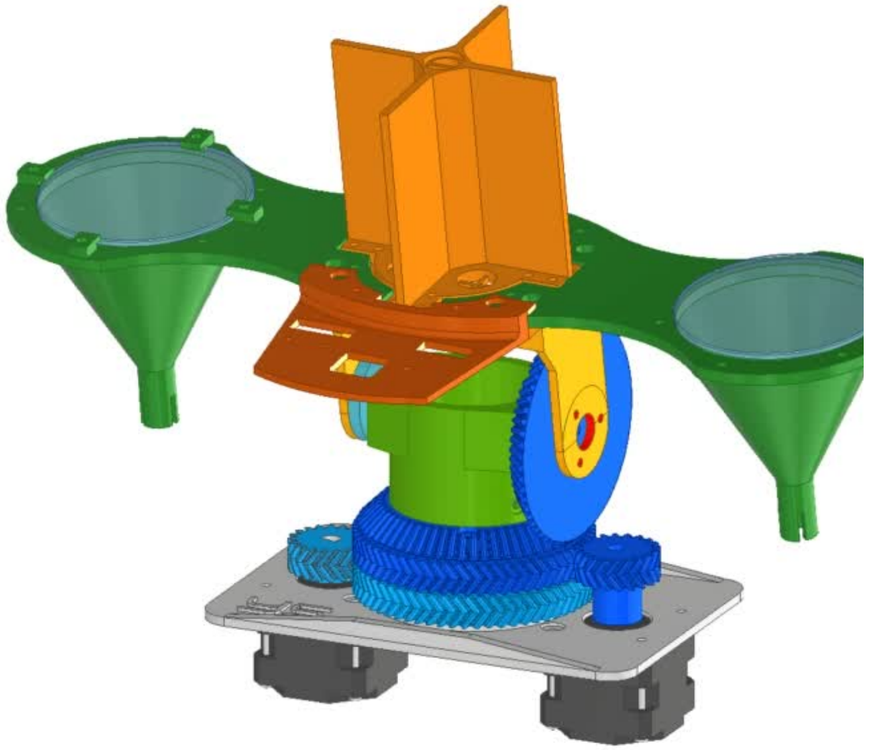
	Option 1	Option 2	Option 3	Option 4
Inner Diameter	1mm	0.75mm	2.0mm	5.0mm
Outer Diameter	1mm	0.75mm	3.8mm	7.0mm
Type	PMMA Fiber Optic Cable	PMMA Fiber Optic Cable	PMMA Fiber Optic Cable	PMMA Fiber Optic Cable
Material	Plastic (No Coating)	Plastic (No Coating)	Plastic (Black Coating)	Plastic (Black Coating)

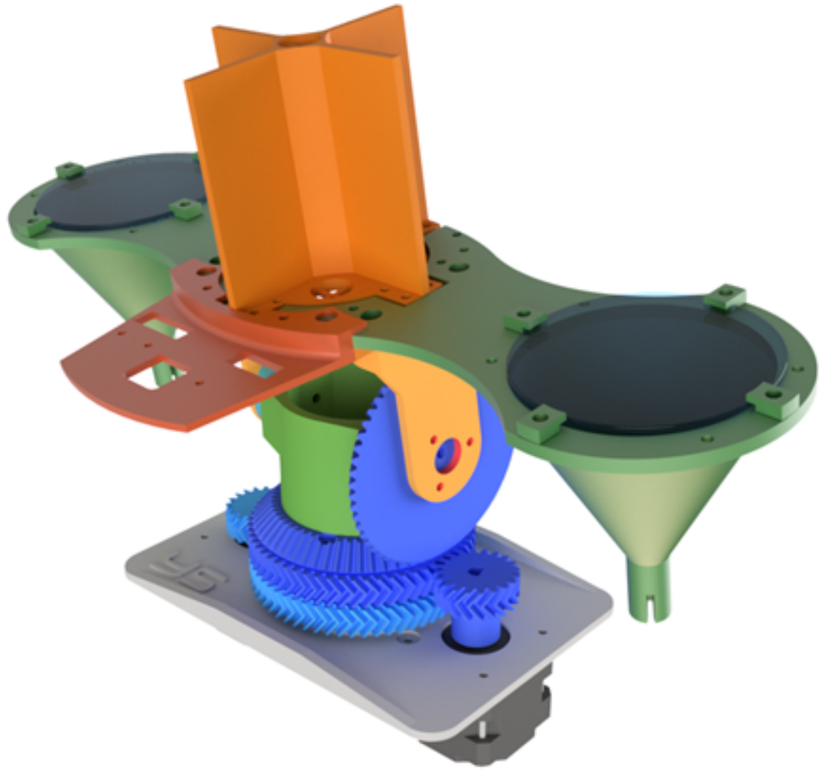
5.2 Choosing the Fiber Optic Cables





5.3 Design of the Sun Tracker Mechanism





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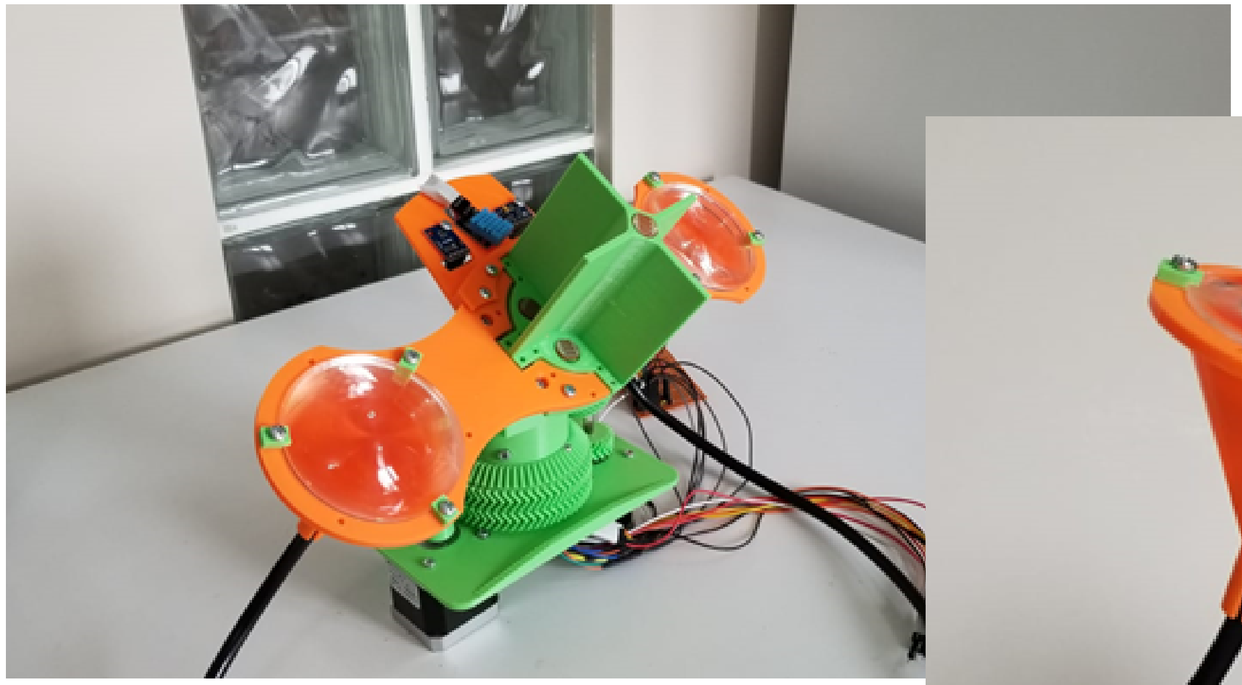
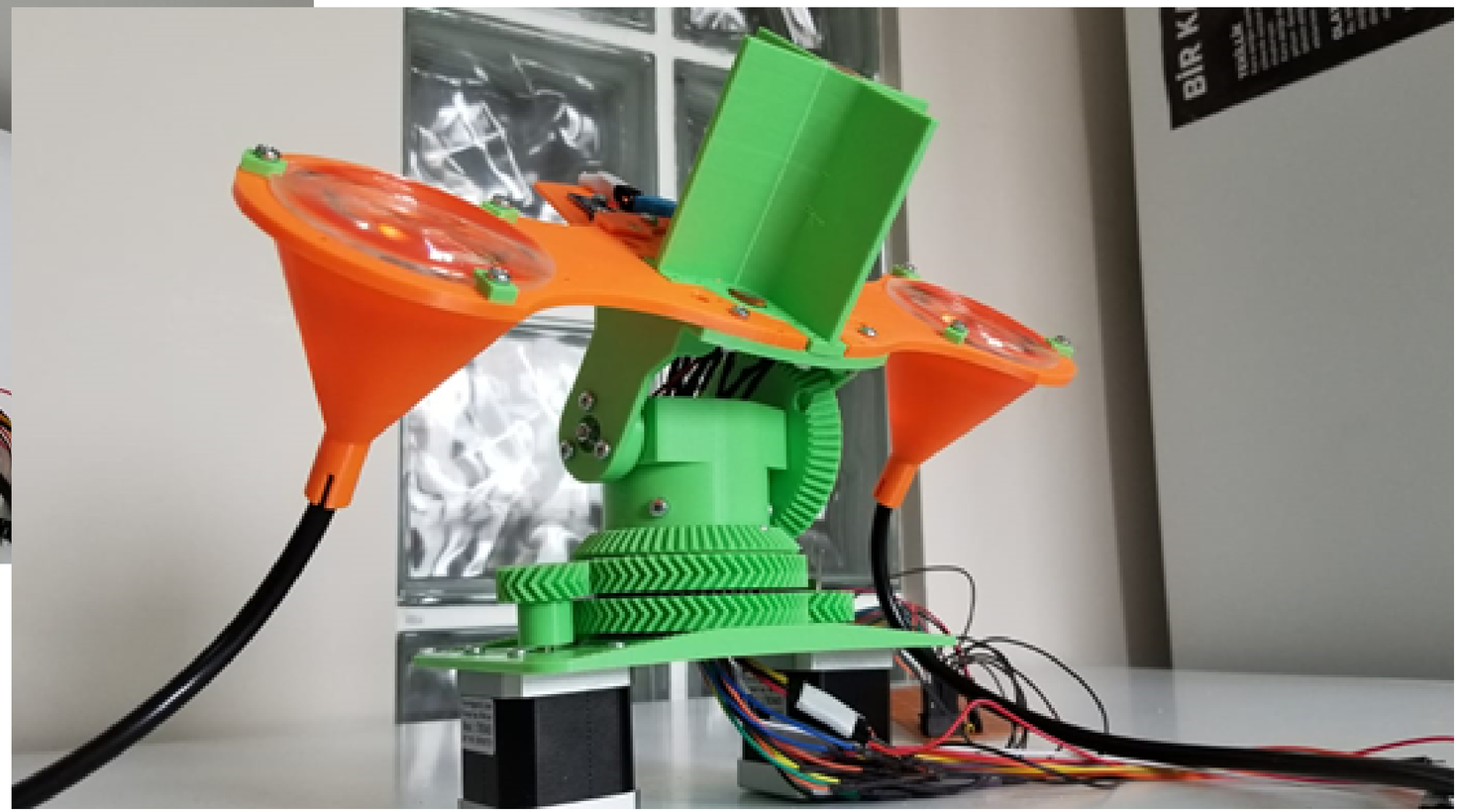


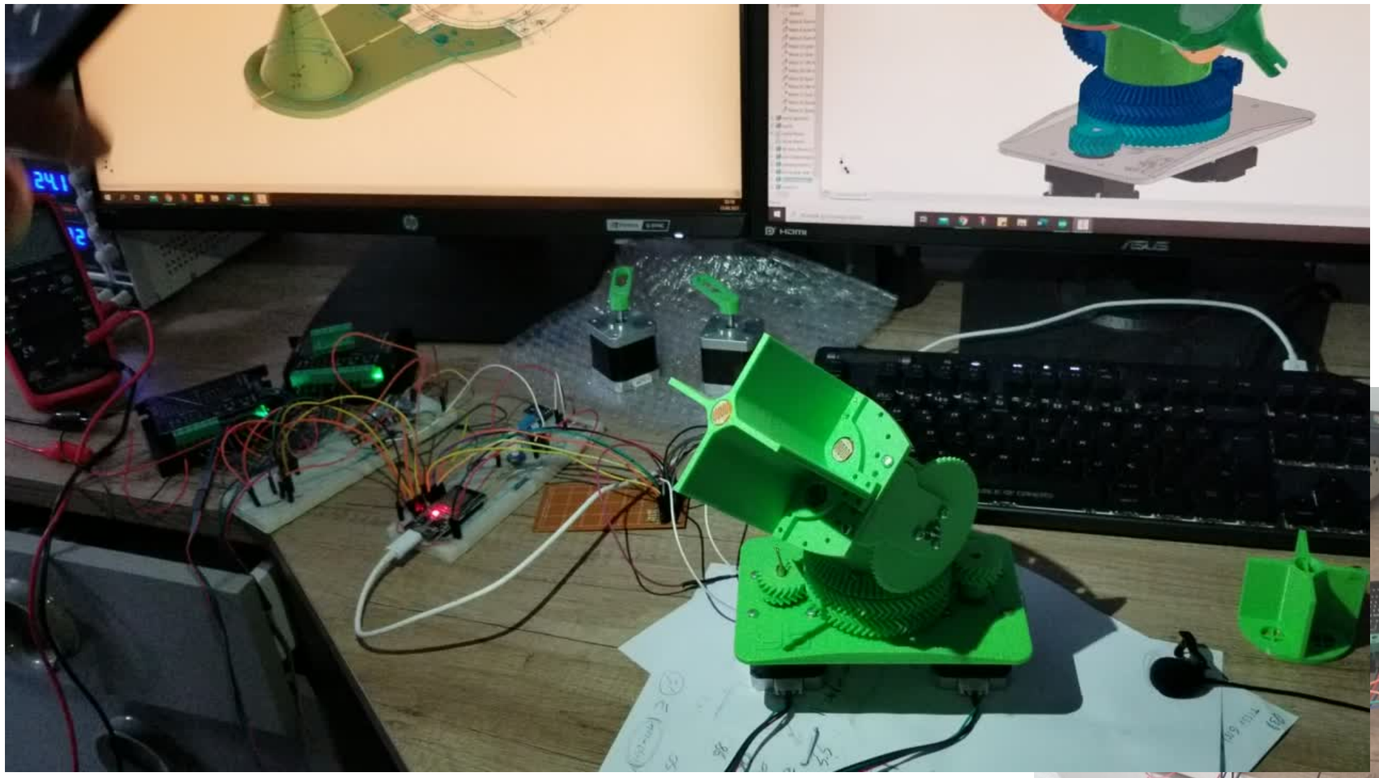


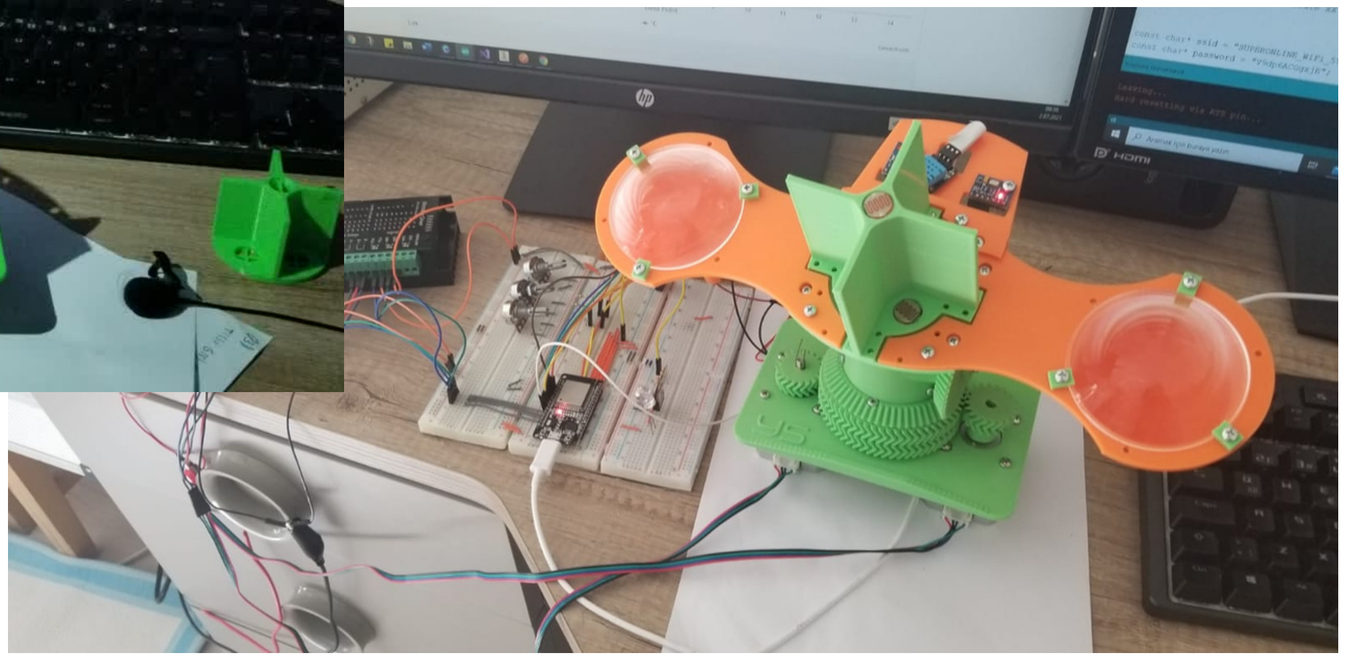
6.Conclusions and Future Work

THE END

6.1 Conclusions
6.2 Future Work

6.1 Conclusions



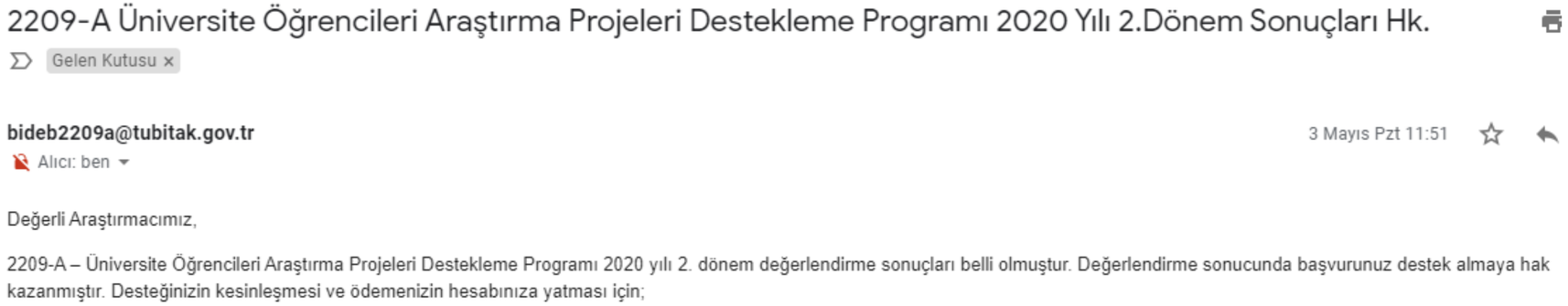


6.1 Conclusions

Our searches showed to us that fiber optic lightning and decreasing the energy usage is possible with the use of right materials and right components.

- Using the LDRs for the sun tracker with the algorithm we have developed is capable of tracking sun easily and efficiently.
- The sensors for the measurements are correct choices of sensors and can be implanted with the monitoring system to make the system easy to use and easy to examine.
- The mechanism can be further improved by changing the material to ABS and making it more resistant to cold and hot weather.
- Unfortunely the lens we have selected is not enough for collecting sunlight and needs to combined. There should be 3 or 4 lens for each fiber optical cable.

6.2 Future Work



2209-A Üniversite Öğrencileri Araştırma Projeleri Destekleme Programı 2020 Yılı 2.Dönem Sonuçları Hk.

Gelen Kutusu ×

bideb2209a@tubitak.gov.tr 3 Mayıs Pzt 11:51

Alıcı: ben

Değerli Araştırmacımız,

2209-A – Üniversite Öğrencileri Araştırma Projeleri Destekleme Programı 2020 yılı 2. dönem değerlendirme sonuçları belli olmuştur. Değerlendirme sonucunda başvurunuz destek almaya hak kazanmıştır. Desteğinizin kesinleşmesi ve ödemenizin hesabınıza yatması için;

In the next version of our design the more lenses can be added, the size lenses can be bigger and multiple lenses can be collected to the one fiber optical cable to increase the illuminance because in this version of our testing unfortunately using only one lens for the one cable is not capable of illuminating the room. Also new features can be added to the website, currently light point system is implemented with MOSFET it will be changed with real light bulb.

Light is Life.

SUNLIGHT TECHNOLOGIES