Indian Institute of Technology, Delhi

ELP305
Systems and Design Lab

Tribe B : BHARAT

Week 1
Requirements

(version 1.2.2)

Table of Contents

Authors/Involvements

1. Team

SNo	Name	Entry No	Email	Designation	Vertical	IF
1	Divyansh Mohan Bansal	2020MT10800	bansal.divyansh14@gmail.com	Co-ordinator	Logistics	1
2	Ravi Raj Kumawat	2020MT10835	ravirajkumawat2020@gmail.com	Sub Co-ordinator	Logistics	1
3	Aashish Kumar	2020MT10778	aksofpm001@gmail.com	Sub Co-ordinator	Design	1
4	Hanish Goyal	2020MT10805	hanishgoyal0708@gmail.com	Sub Co-ordinator	Design	1
5	Abhinav Sharma	2020MT10780	abhi24082014sharma@gmail.com	Team Member	Design	1
6	Arshia	2020EE11002	arshia.rashi13@gmail.com	Team Member	Design	1
7	Krishna Kumar Singh	2020MT10814	sskrishna1122@gmail.com	Team Member	Design	0.7
8	Muvva Srija	2020EE30605	muvvasrija@gmail.com	Team Member	Design	1
9	Sanya Mehadia	2020EE30623	sanyaamehadia@gmail.com	Team Member	Design	0.4
10	Shivam Jharwal	2020MT60892	jharwalshivam@gmail.com	Team Member	Design	1
11	Shrey Chandra	2020EE10553	cshrey2002@gmail.com	Team Member	Design	0.4
12	Shubham Raj	2020EE10555	shubhamraj.tfx@gmail.com	Team Member	Design	1
13	Smrati Tripathi	2020MT10855	smrati.iitdelhi@gmail.com	Team Member	Design	0.7
14	Valla Chaitanya Krishna	2020EE10564	chaitanyakrishnavalla007@gmail.com	Team Member	Design	1
15	Atharva Pratap Suryawanshi	2020MT10791	suryawanshiatharva2029@gmail.com	Sub Co-ordinator	Documentation	1
16	Pratik Behera	2020MT10831	pratikbehera247@gmail.com	Sub Co-ordinator	Documentation	1
17	Aakrity Pandey	2020MT60865	ritaakrity@gmail.com	Team Member	Documentation	1
18	Adarsh Roy	2020MT10782	adarshroy.formal@gmail.com	Team Member	Documentation	0.7
19	Basani Tharuni	2020MT10793	basanitharunireddy20@gmail.com	Team Member	Documentation	0.7
20	Brahamjot Singh	2020MT10794	brahamjot2511@gmail.com	Team Member	Documentation	1

SNo	Name	Entry No	Email	Designation	Vertical	IF
21	Deepak	2019MT10685	Deepakkhichar60@gmail.com	Team Member	Documentation	0.7
22	Kushagra	2020EE10603	kushagraiitdelhi2022@gmail.com	Team Member	Documentation	1
23	Maitree Shandilya	2020EE10510	shandilyamaitree31@gmail.com	Team Member	Documentation	0.7
24	Manya Aggarwal	2019EE30579	manyaaggarwal2001@gmail.com	Team Member	Documentation	1
25	Mundlapati Unnathi Suneel	2020MT60883	unnathisuneelm@gmail.com	Team Member	Documentation	0.7
26	Naman Agrawal	2020MT60884	namanagrawal6517@gmail.com	Team Member	Documentation	1
27	Rani Meena	2020EE10537	konghyunjae.1997@gmail.com	Team Member	Documentation	0.4
28	Rhythm Gupta	2020MT10836	rhythmgupta.082@gmail.com	Team Member	Documentation	0.4
29	Sai Kiran Gunnala	2020MT60889	saikirangunnala16@gmail.com	Team Member	Documentation	1
30	Shubh Harkawat	2020MT10853	shubhharkawat@gmail.com	Team Member	Documentation	1
31	Harshvardhan Patel	2020MT10808	harshvardhanpatel2212@gmail.com	Sub Co-ordinator	Research-Apparatus	1
32	Aditya Agrawal	2020MT10783	agrawaladitya270@gmail.com	Sub Co-ordinator	Research-Apparatus	1
33	Aarya Oganja	2020EE10453	aaryaoganja@gmail.com	Team Member	Research-Apparatus	0.4
34	Ajay Kumar	2020MT60867	ajstyle9373443@gmail.com	Team Member	Research-Apparatus	0.7
35	Ayan Jain	2019MT10678	ayaen5601@gmail.com	Team Member	Research-Apparatus	0.4
36	Ayush Mishra	2020MT60234	theayushmishra345@gmail.com	Team Member	Research-Apparatus	0.4
37	Bhavik Sankhla	2020MT60873	bhavik.jodhpur@gmail.com	Team Member	Research-Apparatus	1
38	Chandrakant Rajput	2020EE10485	ck9112002@gmail.com	Team Member	Research-Apparatus	1
39	Dev verma	2020MT60875	devv1450@gmail.com	Team Member	Research-Apparatus	1
40	Jatin Jangpangi	2020MT10811	jatinjangpangi30.5@gmail.com	Team Member	Research-Apparatus	0.7
41	Kanishk Singhal	2019MT10698	kanishksinghal2001@gmail.com	Team Member	Research-Apparatus	1

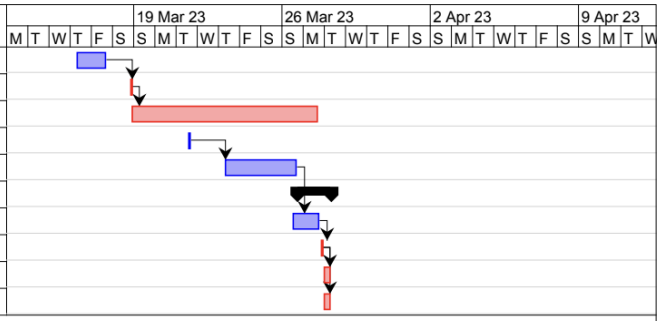
SNo	Name	Entry No	Email	Designation	Vertical	IF
42	Kanishka Singh	2020MT60880	singhkanishka147@gmail.com	Team Member	Research-Apparatus	0
43	Mayunish Agarwal	2020MT10819	myunish@gmail.com	Team Member	Research-Apparatus	1
44	Nikhil Agarwal	2020MT10825	nikhil.agar147@gmail.com	Team Member	Research-Apparatus	1
45	Ojas Bhamare	2019MT10682	bhamareojas@gmail.com	Team Member	Research-Apparatus	0.4
46	Srishti Sachan	2020EE30628	srishtisachan18@gmail.com	Team Member	Research-Apparatus	1
47	Mohammad Areeb	2020MT10656	mohd.areeb02@gmail.com	Sub Co-ordinator	Research-Embedded Systems	1
48	Shreyansh Jain	2020MT01852	shreyanshj292@gmail.com	Sub Co-ordinator	Research-Embedded Systems	1
49	Kunal	2020EE10507	shahikunal436@gmail.com	Team Member	Research-Embedded Systems	0.4
50	Madhav Goel	2020MT10817	madhav1234vasu@gmail.com	Team Member	Research-Embedded Systems	0.7
51	Priyanshu Yadav	2020MT60618	priyanshu999yadav@gmail.com	Team Member	Research-Embedded Systems	0.4
52	Rahul kumar	2020MT10833	www.5234rahul@gmail.com	Team Member	Research-Embedded Systems	1
53	Rishabh Singh	2020EE30122	notrishabhsingh@gmail.com	Team Member	Research-Embedded Systems	1
54	Sachin Kumar	2020EE10543	sachinmewal12345@gmail.com	Team Member	Research-Embedded Systems	1
55	Suhani Agrawal	2020EE30629	suhaniagrawal35@gmail.com	Team Member	Research-Embedded Systems	1

SNo	Name	Entry No	Email	Designation	Vertical	IF
56	Upasak Sharma	2020EE10310	upasak19dhotra@gmail.com	Team Member	Research-Embedded Systems	0
57	V Sai Niketh	2020MT60895	sainiketh2002@gmail.com	Team Member	Research-Embedded Systems	0.7
58	Vanchanagiri Alekhya	2020EE10565	alekhya.vanchanagiri@gmail.com	Team Member	Research-Embedded Systems	1
59	Vineet Kumar	2020MT10862	vkraj0383@gmail.com	Team Member	Research-Embedded Systems	1
60	Mohit Kumar Gond	2020MT10823	mohitgond170@gmail.com	Sub Co-ordinator	Research-Rotational Mechanics	1
61	Abhay Saini	2020EE10455	optimusprime94135@gmail.com	Team Member	Research-Rotational Mechanics	0.7
62	Ankit Kumar	2020MT10788	akmeena26012003@gmail.com	Team Member	Research-Rotational Mechanics	1
63	Arpit Goyal	2020MT60870	goyalarpit015@gmail.com	Team Member	Research-Rotational Mechanics	1
64	Bolledhu Sree Divya	2020EE10483	sreedivyab03@gmail.com	Team Member	Research-Rotational Mechanics	1
65	Dhruvendra	2020EE10487	endradhruv@gmail.com	Team Member	Research-Rotational Mechanics	1
66	Harsh Sharma	2019MT60628	harsh2001apcr@gmail.com	Team Member	Research-Rotational Mechanics	1
67	Kanta Meena	2020EE30601	Kantameenaiitd2000@gmail.com	Team Member	Research-Rotational Mechanics	0

Documentation Statistics

2.f] Gantt Chart

	Name	Duration	Start	Finish
1	Tribe Formation	2 days	3/16/23 8:00 AM	3/17/23 5:00 PM
2	First Online Meet	0.062 days	3/18/23 10:00 PM	3/18/23 10:30 PM
3	Ideation Started	8.312 days	3/18/23 10:30 PM	3/27/23 5:00 PM
4	First Lab Meet	0.375 days	3/21/23 2:00 PM	3/21/23 5:00 PM
5	Minor-2	3.5 days	3/23/23 8:00 AM	3/26/23 5:00 PM
6	**Requirements**	**2.5 days**	**3/26/23 5:00 PM**	**3/28/23 8:00 AM**
7	Idea Brainstorming Session	1 day	3/26/23 5:00 PM	3/27/23 7:00 PM
8	Second Online Meet	0.125 days	3/27/23 10:00 PM	3/27/23 11:00 PM
9	Research and Development	1 day	3/28/23 12:00 AM	3/28/23 8:00 AM
10	Documentation	1 day	3/28/23 12:00 AM	3/28/23 8:00 AM



P2- Tribe B ELP-305 - page1

3. Abstract

In this requirement report, you will find the implementation of a solution which increases the efficiency of the Solar Panel. This idea focuses on sustainable energy development through utilisation of various engineering techniques. The model is inspired by the idea of solar tracking, like a sunflower. The model allows the user to convert it from a stationary unidirectional solar cell to a rotatable solar cell, generating more power than a conventional system, without the need of external assistance, which ease the installation process, increasing the scalability of product.

4. Requirements

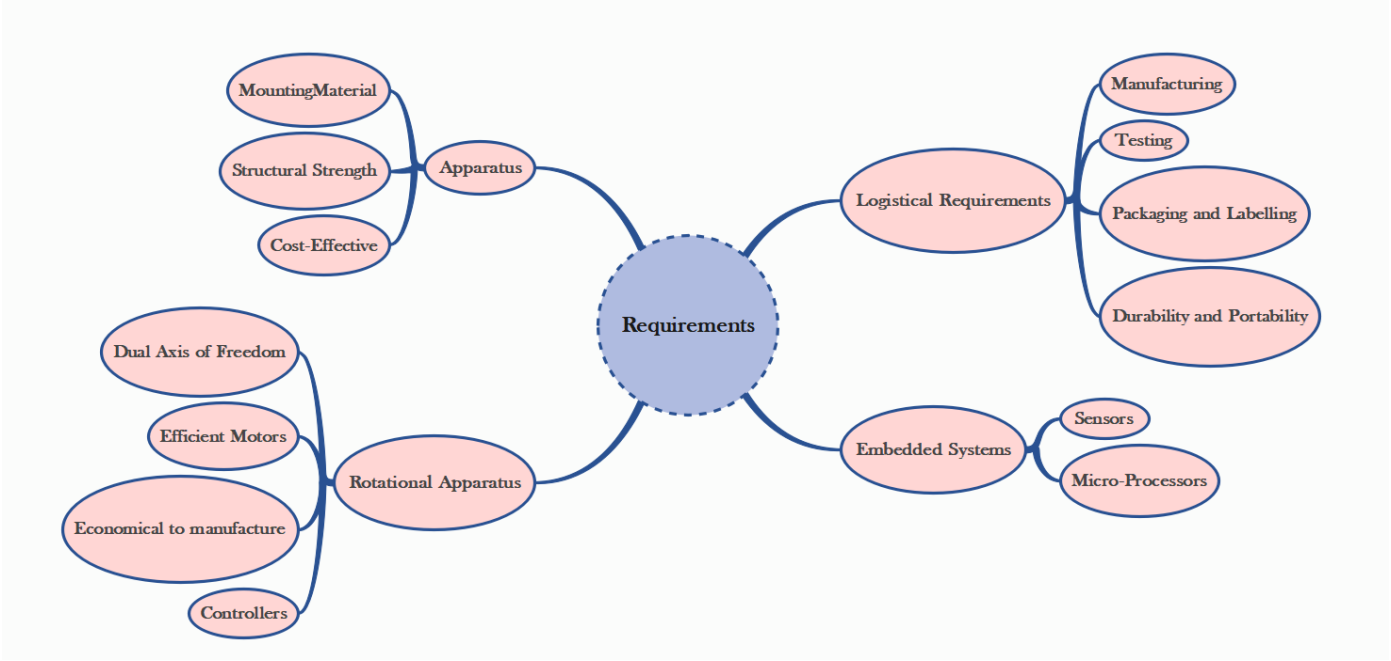


Figure 1.1

4.a Rotational Apparatus

Dual axis of Freedom: Dual-axis solar trackers adjust the angle of solar panels in two dimensions, resulting in higher efficiency than single-axis trackers. They produce 45-50% more power annually compared to stationary panels. The solar trackers must rotate from -180 to 180 degrees so that they can maintain an optimal angle to the sun throughout the day and year, which can result in higher power output compared to fixed-tilt or single-axis solar panels.

Efficient Motors: At least two motors would be required. One would rotate the panel on the horizontal axis and the other across the vertical axis. The power requirements for the motors should be low. RPH(rotations per hour) required for each horizontal and vertical axis motor would be a minimum of 0.088. The motor should produce a minimum torque of 0.1N-m.

Economical to manufacture: The parts for the rotational apparatus should be economical to manufacture. Various parts, such as the motor and gears, should be inexpensive to avoid heavy production costs. Spur gears may deliver excellent efficiency at low speeds, and they are straightforward and inexpensive.

Controllers: Arduino can be used to control the motor and its rotation speed and direction. By using light sensors or GPS modules, an Arduino can determine the position of the sun and adjust the angle and orientation of the solar panel to ensure that it is always facing the sun.

4.b Apparatus

Mounting material: Stainless steel, aluminum, and galvalume are commonly used for solar mounting structures. Mounting racks can also be made from different materials, with many manufacturers using aluminum due to its low weight, corrosion resistance, strength, and compatibility with solar module frames made of aluminum. It’s important to know about the material of mounting structures to avoid post-project issues.

Structural Strength: Structure should at least satisfy a minimum ASCE-7 10 safety standards threshold. It should be able to handle a wind load of about 200 N and a torque of 0.1 N-m. *Strong enough rods for them to support this structure.

Cost-Effective: The apparatus should be economical to manufacture. The material of mounting structures should be inexpensive to avoid heavy production costs. Plastics-made mounting racks can be a viable option for structure mounting.

4.c Embedded Systems

Micro-processors: We intend to use a microcontroller like Atmega328, capable of running at low power, and simultaneously able to control and analyse incoming analog data from multiple sensors, hence computing solar direction. It should be able to give instructions to the motor driver for precise movements hence able to output PWM signals to the motor controller.

Sensors: Photoresistors / Light dependent resistors are generally used to detect light. Analysing their analog output gives us the direction of direct sunlight. We require sensors consuming low voltage and power, and able to generate analog output based on intensity of sun. GPS chip can also be utlized to determine the precise longitude and latitude of the location.

5. References

1. S. Liu, Y. Liu, J. Li, Y. Li, and X. Chen, "A low-cost dual-axis solar tracking system based on digital logic design: Design and implementation," Journal of Renewable and Sustainable Energy, vol. 12, no. 1, p. 015005, 2020.
2. P. Dunne, "What Is The Best Angle For Solar Panels: Tips For A Good Solar Panel Angle," Forbes, Nov. 2020.
3. M. A. Rahman, M. R. Karim, and M. H. Ali, "Design and Analysis of a Low-Cost Solar Tracker," Energies, vol. 9, no. 9, p. 717, Aug. 2016. doi: 10.3390/en9090717.
4. F. M. Hadi, A. H. A. Bakar, and M. A. Othman, "Material Selection for Solar Tracking System," in 2018 4th International Conference on Science and Technology (ICST), 2018, pp. 1-4. doi:10.1109/ICSTC.2018.8536349
5. Renewable Watch, "Materials Analysis," [Online]. Available: https://renewablewatch.in/2019/06/28/materials-analysis/. [Accessed: Mar. 28, 2023].
6. S. Schöberl and S. Völker, "A Guide to Mounting Structures for Solar Panels PV," [Online]. Available: https://sinovoltaics.com/solar-basics/a-guide-to-mountingstructures-for-solar-panels-pv/
7. Solar Feeds, "Solar Trackers: Types and Its Advantages and Disadvantages," Solar Feeds Magazine, May 10, 2021, https://www.solarfeeds.com/mag/solar-trackers-types-and-its-advantages-and-disadvantages/.
8. SolarSquare, "What is a Solar Tracker and How Does it Work?" SolarSquare Blog, Aug. 16, 2021, https://www.solarsquare.in/blog/solar-tracker/.