Indian Institute of Technology, Delhi

ELP305
Systems and Design Lab

Tribe B : BHARAT

Week 1
Requirements

(version 1.2.2)

Table of Contents

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Documentation Statistics

2.a Text Statistics

Word Count	**# Lexical Diversity**	**# Lexical Density**	**# Sentences**	**# Character Length**
811	47%	77%	115	4993
# Syllables	**Avg # of words per sentence**	**Avg # of characters per sentence**	**Letters**	**Avg # of syllables per word**
3145	5.2	40	3761	1.7

2.b Readability Statistics

Readability Index	**Score**	**Can be easily understood by**
Flesch Reading Ease score	52.4	fairly difficult to read
Gunning Fog Score	9	fairly easy to read
Flesch-Kincaid Grade level	7.8	Eighth grade students
The Coleman-Liau Index	11	Eleventh Grade students
Automated Readability Index	4.9	Fourth and fifth graders students
SMOG Formula score	6.9	seventh grade students
Linear Write Formula Score	4.1	Fourth grade

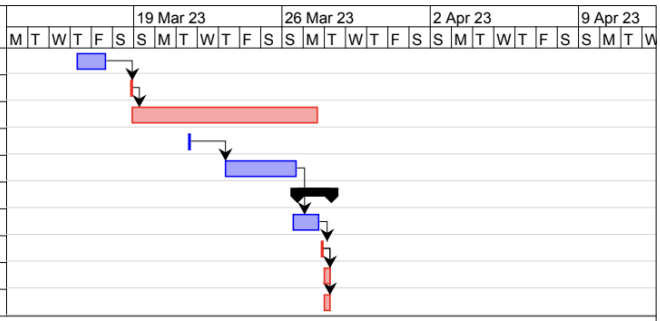
The above results were obtained using https://readabilityformulas.com/freetests/six-readability-formulas.php.

2.c List of Abbreviations

- **PWM** : Pulse Width Modulation
- **GPS** : Global Positioning System
- **ASCE** : American Society of Civil Engineers

2.d 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



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

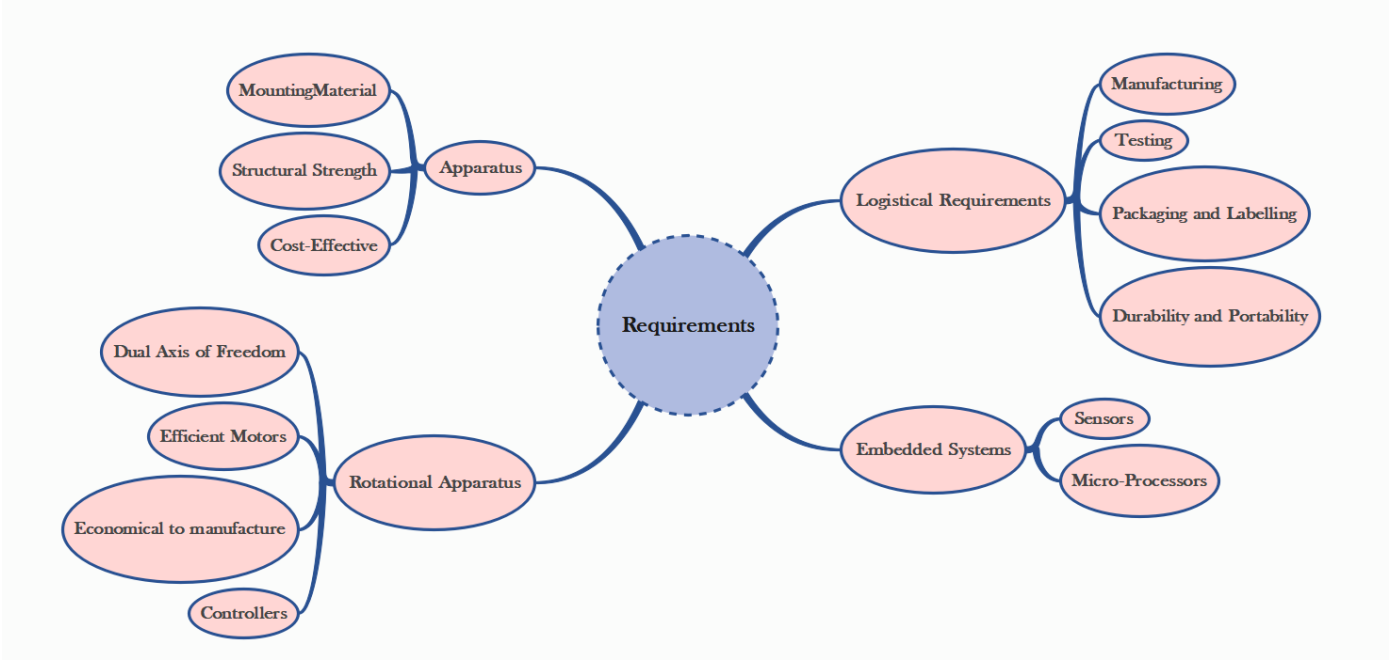


Figure 1.1

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

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