ELP305

DESIGN AND SYSTEM LABORATORY

Tribe Bharat

Report
2023-04-04
Version 2.2.8

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1. Abstract

This report describes the implementation of a rotating solar panel. The main aim is to provide a solution that aims to enhance the efficiency of solar panels through sustainable energy development. The proposed model utilizes engineering techniques inspired by solar tracking, similar to a sunflower, that allows for converting a stationary unidirectional solar cell to a rotatable one. This model generates more power than a conventional system without external assistance. The installation is made more accessible, thus increasing the product's scalability. With this solution, it is possible to achieve a more efficient and sustainable energy source that can contribute to the global shift towards cleaner and renewable energy sources.

The product design cycle starts with requirements, which include apparatus, rotational mechanisms, and embedded systems. Then a set of specifications is developed with the help of the given requirements. These specifications have two sub-sections, namely structural and embedded specifications. Structural includes rod specifications, solar panel holding material specifications, disk-shaped base material specifications, and gears specifications. Embedded specifications include microprocessors, motors, and sensor specifications. There is a mention of material costs at wholesale prices.

2. Motivation

We had numerous inspirations for making this product. Some of them are:

- **Sustainability:** Our product enhances the power output of a solar panel, increasing India's green power capital.
- **Efficiency:** A rotatable solar panel is more efficient than a fixed one. An efficient design is one of the main motivations for our product design.
- **Convenience:** Our product is made so that it does not require expert interference. This increases the scalability of our product.
- **Cost-Effective:** A cleaner energy source should also be cost-effective, and we have chosen components accordingly.
- **Adaptability:** Our product is suitable for use on a global scale because it can be adapted to any geographical area with sufficient solar power generation potential.

3. Requirements

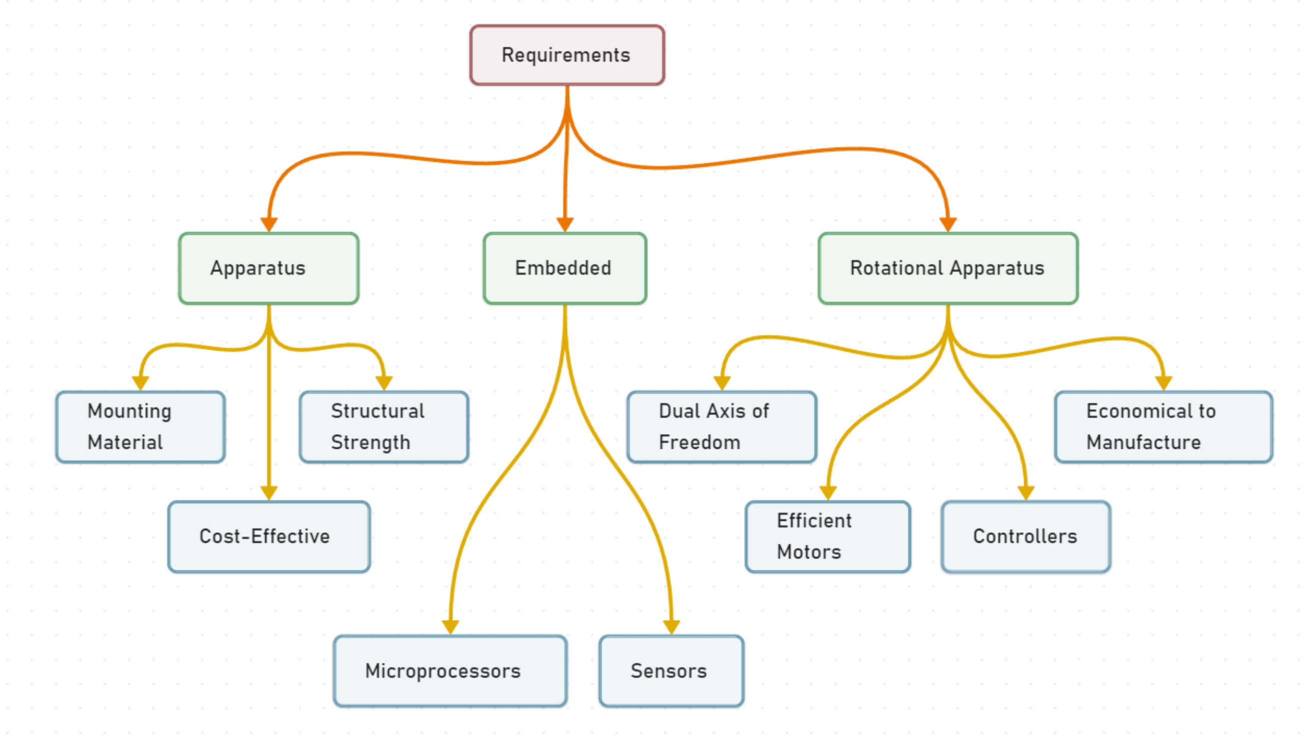


Figure 1. MindMap-requirements

Our product is based on a 60-cell solar panel. All calculations have been done likewise. The average dimensions of a 60-cell solar panel are about 65” x 40” x 1.5”. The weight of a 60-cell solar panel ranges from 18 to 23 kg, which again depends on the manufacturer.

3.1 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° to maintain an optimal angle to the sun throughout the day and year, resulting in higher power output than fixed-tilt or single-axis solar panels.

Efficient Motors:

- A maximum of two motors would be required. One would rotate the panel on the horizontal axis and the other across the vertical axis.
- We can also create a manual apparatus for horizontal movement because two motors are costly and it will consume more power.
- 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.

- They should require low maintenance and must not wear out quickly.
- They should be easy to control with a simple digital signal for convenience.

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 are straightforward and inexpensive.

Controllers:

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

3.2 Apparatus

Mounting material:

- Stainless steel, aluminium, and galvalume are commonly used for solar mounting structures. Mounting racks can also be made from different materials.
- Many manufacturers use aluminium due to its low weight, corrosion resistance, strength, and compatibility with solar module frames made of aluminium. It’s important to know about the material of the mounting structures to avoid post-project issues.
- It’s important to consider factors such as the weight and size of the solar panel, the wind and snow loads at the installation location, and any local building codes or regulations that may apply.
- These factors will help determine the appropriate dimensions and materials for the mounting system to ensure it is strong, stable, and safe.

Structural Strength:

- The 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.
- We will require strong enough rods for them to support this structure. They should be corrosion-resistant and lightweight.

Cost-effective:

- The apparatus should be economical to manufacture. The material for mounting structures should be inexpensive to avoid high production costs.
- Plastic-made mounting racks can be a viable option for structure mounting.

3.3 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 ability to generate analog output based on the sun’s intensity.
- GPS technology can also be utilized to determine the exact latitude and longitude of the solar panel’s location. This can be used with RTC IC to estimate the sun’s relative position to the solar panel’s position.

4. Specifications

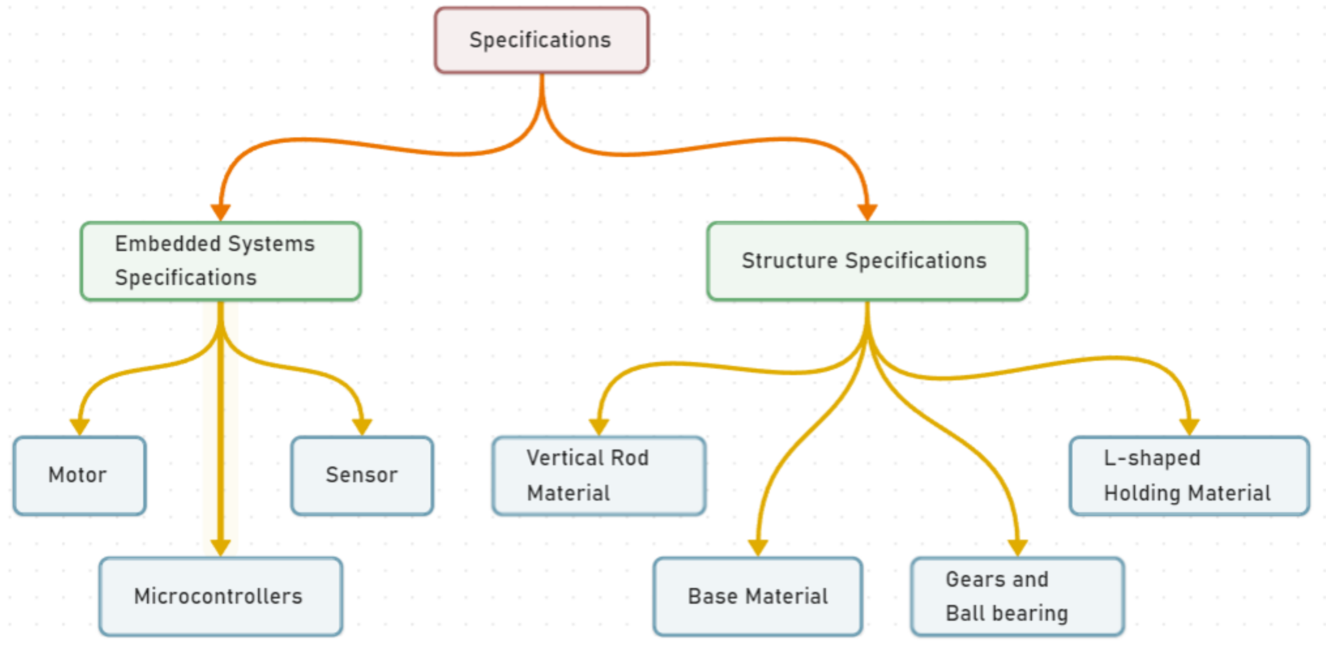


Figure 2. Mindmap-Specifications

4.1 Structural Specifications

4.1.1 Vertical Rod Material

The vertical rod has to withstand a weight of about 19 Kg of the solar panel, the weight of the L-shaped column (where the solar panel will rest) and the torque that the whole system will exert, as it will be at some distance from the neutral axis. The rod also should be able to withstand torque exerted by winds and the additional weight caused to surroundings and environment, like the weight of snow and dust.

Steel with protective coating and aluminium are the best options available for this. Steel, being strong and durable, require a protective coating, whereas aluminium, being lightweight and corrosion-resistant, needs to have more thickness than steel.

The rod will be cylindrical, with dimensions as follow.

- The length must be at least 6 feet.
- The diameter of the rod must be at least 2 inches.

The weight of such a rod of aluminium is about 9.85 kg, and that of steel is about 28 kg.

We choose aluminium as our rod material.

4.1.2 Base Material

The base would be a hollow cylinder with gears in its inner circle on the lower base, which is placed near ground, and the circular disk above it helps stabilize the rod against torque.

Design Considerations:

- Strength and Stability: The mounting system must be solid and stable enough to support the solar panel's weight and withstand external forces, such as wind and snow.
- Ease of Installation: The design should be simple and easy to install, requiring minimal tools and expertise.
- Flexibility: The design should be flexible enough to accommodate different sizes and types of solar panels and other installation locations and environments.

Maintenance: The design should allow for easy maintenance and repair, if necessary.

Material Considerations:

- Durability: The base material should be solid and durable enough to withstand harsh weather conditions and prevent corrosion over time.
- Weight: The base material should be lightweight enough to make the mounting system easy to transport and install.
- Cost: The base material should be affordable and within budget while providing strength and durability.
- Availability: The base material should be readily available and accessible for sourcing and manufacturing.

Based on these considerations, some potential base materials for a cylindrical solar panel mounting system include aluminium or stainless steel. Both materials are strong, lightweight, and corrosion-resistant, making them ideal for outdoor applications. Additionally, they are widely available and can be sourced at a reasonable cost.

In terms of design, a simple and effective approach could be to use a series of aluminium or steel poles arranged in a circular pattern, with brackets or clamps at the top to hold the solar panel in place. This design would provide stability and flexibility while being easy to install and maintain.

The torque exerted by the solar panel and L-shaped column is more than 150 Nm. Considering torque exerted by winds and environmental factors, the radius of the base must be at least 0.5 m.

- Base radius : 60 cm
- Width of base material : 0.5 cm
- Height : 30 cm

The material we choose for this will be steel as we need a material with high strength.

4.1.3 L-shaped Holding Material

Our product is based for Solar panel of dimensions 1.65 m x 1.0 m .

Taking into account the different latitudes, this panel can be placed in India,

- For the vertical plate of the L-shaped structure,
  Height : 1.75 m
  Width : 1.2 m

Thickness : 1 cm

- For the horizontal plate of the L-shaped structure,
  Height : 1.4 m
  Width : 1.2 m
  Thickness : 1 cm

We need a material with the following factors:

- Durability: This should be solid and durable to withstand windy weather conditions and prevent corrosion over time.
- Weight: It should be lightweight.
- Cost: It should be affordable without compromising other factors.
- Availability: Depending on the above factors, aluminium and stainless steel can be used. Due to its lightweight and corrosive resistance, aluminium is a good choice for this.

4.1.4 Gear and Ball Bearings

Material of Ball Bearing: SAE 52100 steel is the industry standard for bearing courses. Chromium steel (SAE 52100) contains 1% carbon and 1.5% chromium. Plastic, porcelain, and even stainless steel can all be used to create bearings. In addition to its high strength, SAE 52100 also has high elasticity, high machinability, and high consistency. AISI 440C stainless steel, prized for its resistance to corrosion, is another frequently employed substance. AISI 440C has higher machining costs and lower weight capacities than 52100. 440C's strength is equal to 85 percent of 52100's at 70 degrees Fahrenheit. To lessen bearing disturbance or lengthen fatigue life, other martensitic stainless steels are also employed.

Dimensions: Given the inputs from the rod sub-vertical, taking the rod diameter as 2 inches, the ball bearings could have an internal diameter bigger than 2 inches considering the friction.

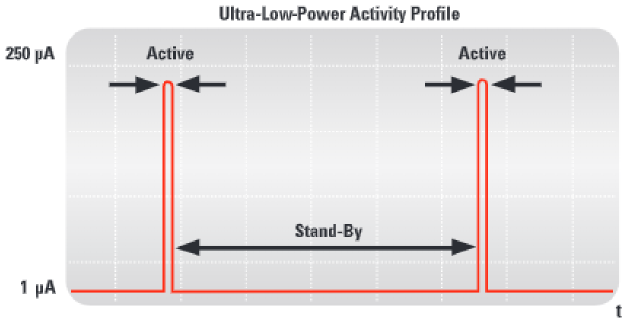
Material for Gears: We have worked with all of these materials over the years, though steel is by far the most prevalent. For our purposes, steel is ideal because of its low cost, high strength-to-weight ratio, high resilience to wear, and potential for further improvement via heat treatment.

Product link: https://amzn.eu/d/85ed5WN

4.2 Embedded Systems Specifications

4.2.1 Microcontrollers

Texas Instruments (TI) MCUs are 16-bit RISC-based mixed-signal processors made with minimal power consumption in mind. Our product requirements state that the microcontroller must be capable of handling thousands of different tasks while remaining inexpensive, simple to program, and light on power usage. MSP430 meets all of the requirements, so it's a good fit for our offering.



Ultra-fast 1-µs DCO start-up allows MSP430-based systems to remain in low-power modes for the longest possible interval – extending battery life. The DCO is fully user programmable.

Power specifications [MSP430]

- RAM retention : 0.1 µA
- Real-time clock mode : 2.5 µA
- Power efficiency: 165 µA / MIPS active
- Features fast wake-up from standby mode : less than 5µs

Device parameter [MSP430]

- Flash options: up to 512 KB
- RAM options: up to 66KB
- ADC options: 12-bit SAR
- GPIO options: 74 pins
- Other integrated peripherals: USB, LCD, DAC, Comparator_B, DMA, 32x32 multiplier, power management module (BOR, SVS, SVM, LDO), watchdog timer, RTC, Temp sensor

Special features

- **Instant Wakeup:** The MSP430 MCU supports fast resumption from low power modes. The MSP430 microcontroller unit (MCU) has an internal digitally controlled oscillator (DCO) that can source up to 25 MHz and be active and steady in 1µs, allowing for this ultra-fast wake-up.
- **Flexible Clocking System:** The MSP430 MCU clock system allows the device to enter a number of low-power modes (LPMs) by enabling and disabling different clocks and oscillators. By selectively enabling clocks as needed, the flexible clocking system reduces unnecessary power usage.

Product Link: https://www.indiamart.com/proddetail/msp430-microcontroller-19798018991.html

Image shown is a representation only. Exact specifications should be obtained from the product data sheet.

4.2.2 Motor

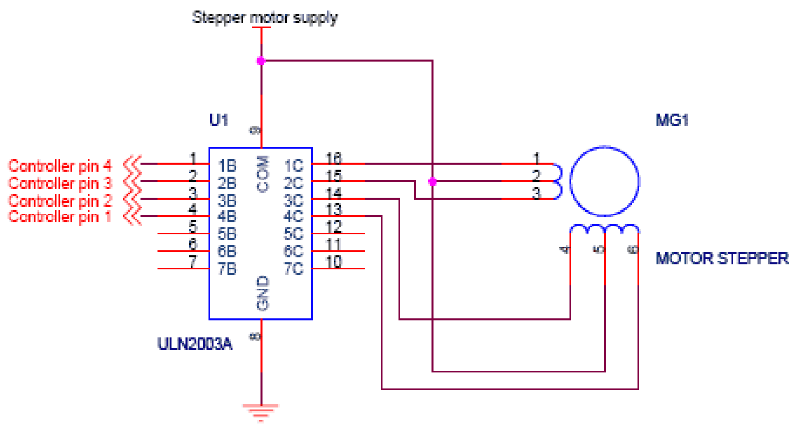
Stepper motors offer precise control over position and speed. They require low maintenance and do not wear out quickly. Stepper motors provide high torque at low speeds. They are easy to control with a simple digital signal. They are cost-effective compared to other types of motors.

Properties:

- Speed Range: Stepper motors have typical speeds ranging from 26 to 30 RPM.
- Torque: Stepper motors typically have higher starting torque and are used in applications that require high torque at low speeds. These are extensively used where smaller power ratings are required.
- Power Output: Torque x Angular Speed (Depends on the chosen values and on the operating conditions)
- Efficiency: The efficiency range for a Stepper motor can vary depending on the motor design and operating conditions but typically falls within the range of 70% to 80%.
- Power Density: Generally, Stepper motors have a high power density compared to other types of DC motors. (Range: 400 W/kg - 2000 W/kg)
- Approximate Cost of Maintenance: Stepper motors typically have 10,000 operating hours due to the limited life of carbon brushes.
- Chances of Damage: Depend on various factors such as overheating, overloading, voltage surges, and mechanical wear and tear. However, these factors can be minimized by proper maintenance, such as regular cleaning and lubrication, and by using protective measures such as thermal overload protection and surge suppression devices.
- Control: Stepper motors require electronic commutation, which makes them highly

controllable. They can be precisely controlled for speed, torque, and direction.

- Best selected Manufacturers: GENERIC or PANASONIC
- We will be using the manufacturer GENERIC (the link is mentioned below for the product chosen).
- The cost is about Rs 150.



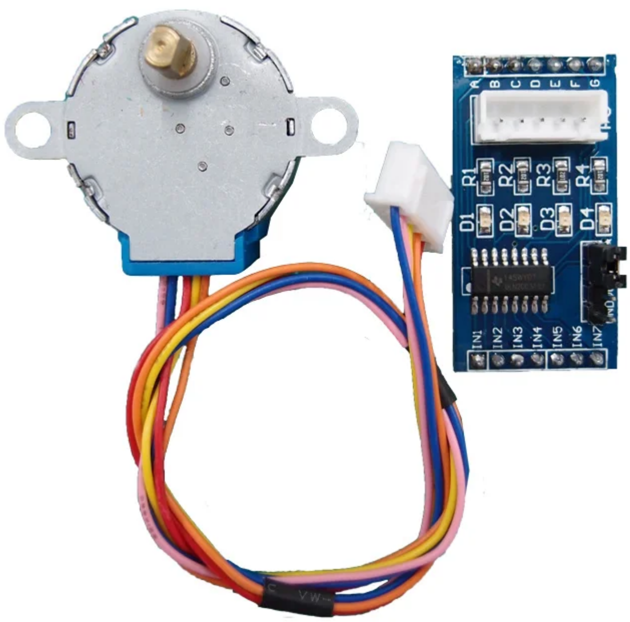


Figure 3. Stepper-motor

Here are the specifications for the ULN2003:

- Input voltage: 5V to 15V
- Output current: 500mA per channel
- Maximum voltage: 50V
- Maximum power dissipation: 1.25W
- Number of channels: 7
- Darlington transistor configuration: NPN

- Maximum on-state voltage: 1.2V
- Maximum collector-emitter voltage: 50V
- Maximum collector current: 500mA
- Maximum operating temperature range: -20°C to +85°C

Product Link: https://robu.in/product/28byj-48-stepper-motor-and-uln2003-stepper-motor-driver-good-quality/

4.2.3 Sensor

Light Dependent Resistors (LDRs), also known as photoresistors, are passive components that change their resistance in response to changes in the amount of light falling on them. LDRs are commonly used in solar trackers to detect the position of the sun and adjust the orientation of solar panels accordingly.

The specific LDR chosen for a given application will depend on factors such as the required resistance range, peak sensitivity, and maximum voltage, as well as the availability and cost of the component. Some commonly used LDRs in solar trackers include the GL55xx series, SFH 5711 and SFH 5712 series, RP-L7014 and RP-L7024 series, and VTD series.

The GL55xx series LDRs have the following properties:

- Max and min resistance: The GL5528 has a resistance range of 1kΩ to 10kΩ, while the GL5537 has a range of 10kΩ to 500kΩ.
- The dark resistance of the GL55xx series LDRs decreases over time when exposed to light. This can be compensated for with circuitry or software.
- Max power dissipation: The GL55xx series LDRs can handle a maximum power dissipation of 100mW.
- Max voltage: The maximum voltage that can be applied to the GL55xx series LDRs is 150V DC.
- Peak wavelength: The peak sensitivity of the GL5528 is around 540nm, while the GL5537 is around 700nm.
- The GL55xx series LDRs are rated for operation up to a maximum temperature of 85°C. Exceeding this temperature can cause damage to the device.
- Temperature coefficient of resistance (TCR): This is a measure of how much the resistance of the LDR changes with temperature. The GL55xx series LDRs have a TCR of about -0.5%/°C.
- Rise and fall times: These are measures of how quickly the LDR can respond to changes in light levels. The rise time is the time it takes for the LDR to go from 10% to 90% of its final resistance when the light level changes from dark to light, and the fall time is the time it takes for the LDR to go from 90% to 10% of its final resistance when the light level changes from light to dark. The rise and fall times of the GL55xx series LDRs depend on the specific model and range from a few milliseconds to several hundred milliseconds.
- Spectral response: This is a measure of how sensitive the LDR is to the light of different wavelengths. The GL55xx series LDRs have a peak spectral response in the visible range (around 550 nm) and are less sensitive to light outside of this range.

- Operating temperature range: The GL55xx series LDRs can typically operate over a wide temperature range, from -40°C to 85°C.
- Package type: The GL55xx series LDRs come in a variety of package types, including through-hole, surface mount, and radial leaded packages.

Product Link: https://robu.in/product/5mm-ldr-pack-of-10/

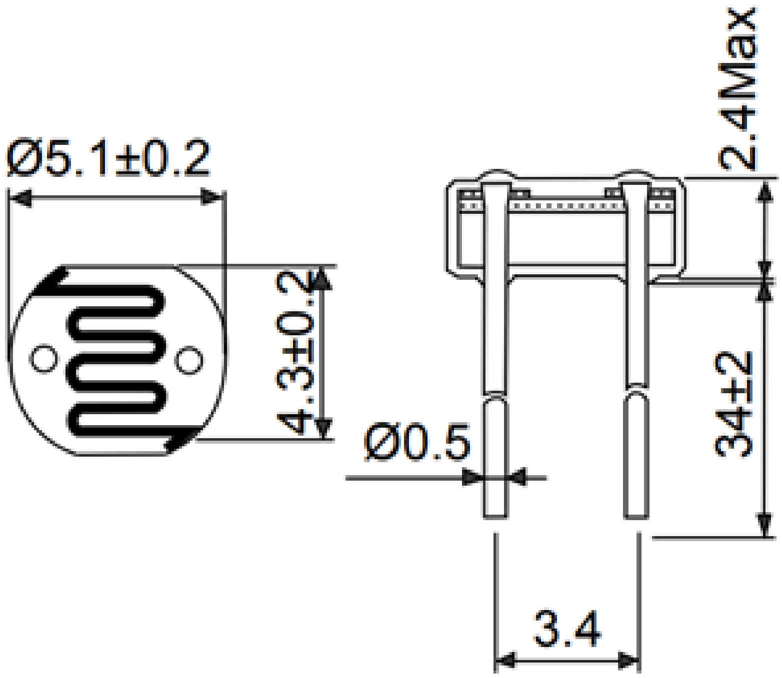


Figure 4. GL5228 Cross sectional diagram

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6. Document Statistics

6.1 Text Statistics

Word Count	# Lexical Diversity	# Lexical Density	# Sentences	# Character Length
3723	47%	77%	369	24220
# Syllables	**Avg # of words per sentence**	**Avg # of characters per sentence**	**# Letters**	**Avg # of syllables per word**
6459	10.1	65.6	19261	1.7

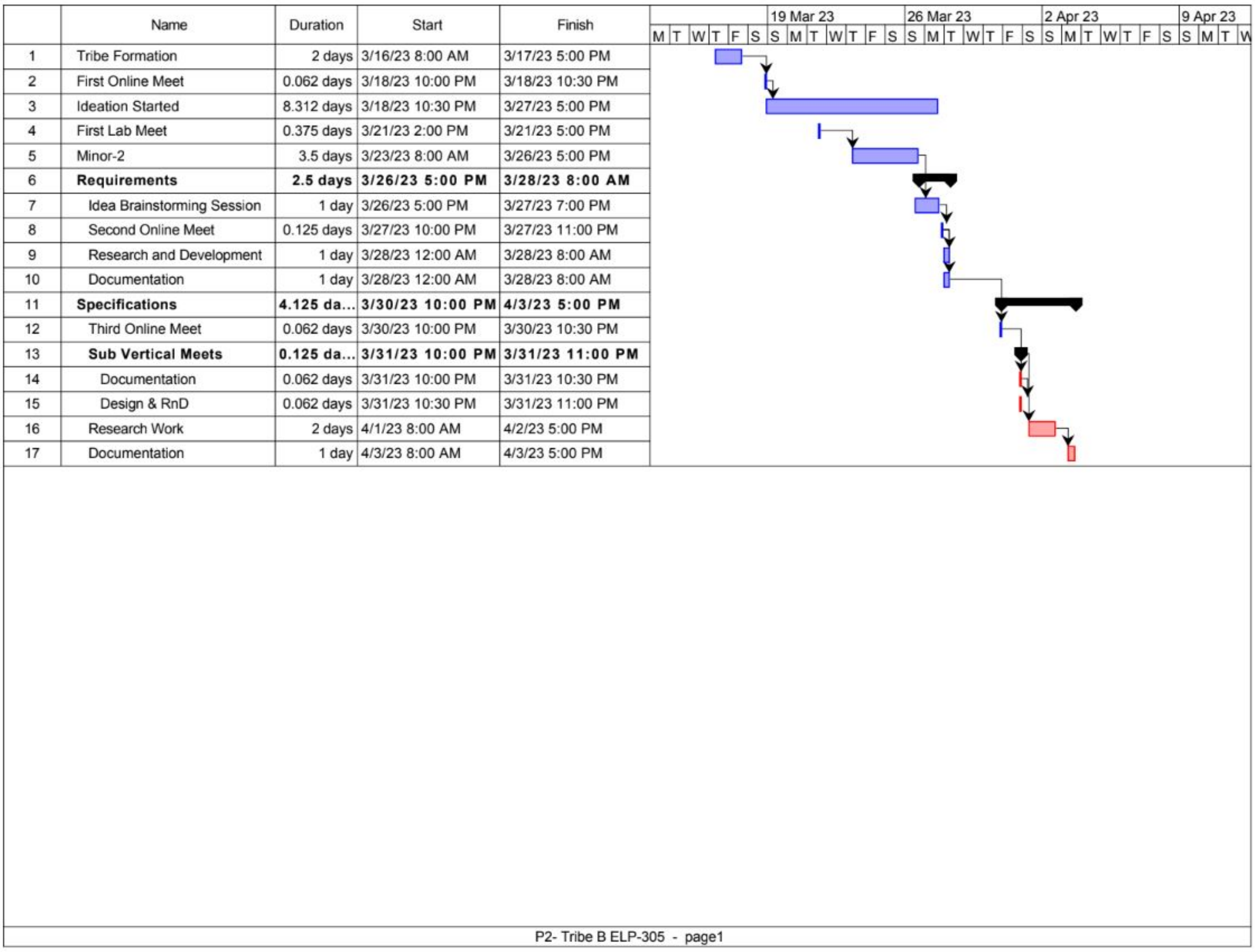
6.2 Readability Statistics

Readability Index	Score	Difficulty Status
Flesch Reading Ease score	52.6	fairly difficult to read
Gunning Fog Score	11.4	Hard to read
Flesch-Kincaid Grade level	9.3	Ninth grade students
The Coleman-Liau Index	10	Tenth Grade students
Automated Readability Index	7.5	Seventh and Eighth graders students
SMOG Formula score	8.9	Ninth grade students
Linsear Write Formula Score	8.2	Eighth grade

6.3 List of Abbreviations

- **IF** : Involvement Factor
- **PWM** : Pulse Width Modulation
- **GPS** : Global Positioning System
- **ASCE** : American Society of Civil Engineers
- **RTC** : Real-Time Clock
- **SAE** : Society of Automotive Engineers
- **AISI** : American Iron and Steel Institute
- **MCU** : Micro-Controller Unit
- **MSP** : Mixed Signal Processing
- **MIPS** : Million Instructions Per Second
- **SAR** : Successive Approximation Register

6.4 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
11	**Specifications**	**4.125 da...**	**3/30/23 10:00 PM**	**4/3/23 5:00 PM**
12	Third Online Meet	0.062 days	3/30/23 10:00 PM	3/30/23 10:30 PM
13	**Sub Vertical Meets**	**0.125 da...**	**3/31/23 10:00 PM**	**3/31/23 11:00 PM**
14	Documentation	0.062 days	3/31/23 10:00 PM	3/31/23 10:30 PM
15	Design & RnD	0.062 days	3/31/23 10:30 PM	3/31/23 11:00 PM
16	Research Work	2 days	4/1/23 8:00 AM	4/2/23 5:00 PM
17	Documentation	1 day	4/3/23 8:00 AM	4/3/23 5:00 PM

Figure 5. Gantt-chart

7. Tribe Members

Sr. No.	Entry Number	Name	Email ID	Vertical	IF
1	2020MT10800	Divyansh Mohan Bansal	mt1200800@iitd.ac.in	Logistics	1
2	2020MT10835	Ravi Raj Kumawat	mt1200835@iitd.ac.in	Logistics	1
3	2020MT10656	Mohammad Areeb	mt1200656@iitd.ac.in	Technical Head	1
4	2020MT10852	Shreyansh Jain	mt1200852@iitd.ac.in	Technical Head	1
5	2020MT10778	Aashish Kumar	mt1200778@iitd.ac.in	Design	1
6	2020MT10805	Hanish Goyal	mt1200805@iitd.ac.in	Design	1
7	2020EE11002	Arshia	ee1201002@iitd.ac.in	Design	1
8	2020EE30605	Muvva Srija	ee3200605@iitd.ac.in	Design	1
9	2020MT10793	Basani Tharuni	mt1200793@iitd.ac.in	Design	1
10	2020MT10780	Abhinav Sharma	mt1200780@iitd.ac.in	Design	0.8
11	2020EE10564	Valla Chaitanya Krishna	ee1200564@iitd.ac.in	Design	1
12	2020MT10782	Adarsh Roy	mt1200782@iitd.ac.in	Design	0.6
13	2020MT60883	M. Unnathi Suneel	mt6200883@iitd.ac.in	Design	0.4
14	2020MT60889	Sai Kiran Gunnala	mt6200889@iitd.ac.in	Design	0.8
15	2020MT60234	Ayush Mishra	mt6200234@iitd.ac.in	Design	0.1
16	2020MT10811	Jatin Jangpangi	mt1200811@iitd.ac.in	Design	0.3
17	2019MT10698	Kanishk Singhal	mt1190698@iitd.ac.in	Design	0.7
18	2020EE10507	Kunal	ee1200507@iitd.ac.in	Design	0.2
19	2020EE30122	Rishabh Singh	ee3200122@iitd.ac.in	Design	0.4
20	2019MT60628	Harsh Sharma	mt6190628@iitd.ac.in	Design	0.5
21	2020EE30601	Kanta Meena	ee3200601@iitd.ac.in	Design	0
22	2020MT10783	Aditya Agrawal	mt1200783@iitd.ac.in	Research I	1
23	2020MT60875	Dev Verma	mt6200875@iitd.ac.in	Research I	1
24	2020MT10817	Madhav Goel	mt1200817@iitd.ac.in	Research I	1
25	2020MT60870	Arpit Goyal	mt6200870@iitd.ac.in	Research I	1
26	2020MT60867	Ajay Kumar	mt6200867@iitd.ac.in	Research II	0.8
27	2020MT60873	Bhavik Sankhla	mt6200873@iitd.ac.in	Research II	0.8
28	2020MT10819	Mayunish Agarwal	mt1200819@iitd.ac.in	Research II	0.8
29	2020MT10825	Nikhil Agarwal	mt1200825@iitd.ac.in	Research II	0.8
30	2020MT60618	Priyanshu Yadav	mt6200618@iitd.ac.in	Research II	0.8
31	2020MT10794	Brahamjot Singh	mt1200794@iitd.ac.in	Research III	0.1

Sr. No.	Entry Number	Name	Email ID	Vertical	IF
32	2020EE10453	Aarya Oganja	ee1200453@iitd.ac.in	Research III	1
33	2020EE10485	Chandrakant Rajput	ee1200485@iitd.ac.in	Research III	1
34	2020MT60880	Kanishka Singh	mt6200880@iitd.ac.in	Research III	0
35	2020EE30628	Srishti Sachan	ee3200628@iitd.ac.in	Research III	1
36	2020MT10814	Krishna Kumar Singh	mt1200814@iitd.ac.in	Research IV	1
37	2020EE10555	Shubham Raj	ee1200555@iitd.ac.in	Research IV	1
38	2020EE10543	Sachin Kumar	ee1200543@iitd.ac.in	Research IV	1
39	2020MT10833	Rahul Kumar	mt1200833@iitd.ac.in	Research V	1
40	2020MT60892	Shivam Jharwal	mt6200892@iitd.ac.in	Research V	1
41	2019MT10678	Ayan Jain	mt1190678@iitd.ac.in	Research V	1
42	2020MT10788	Ankit Kumar	mt1200788@iitd.ac.in	Research V	1
43	2020MT10855	Smrati Tripathi	mt1200855@iitd.ac.in	Research VI	1
44	2020EE10565	Vanchanagiri Alekhya	ee1200565@iitd.ac.in	Research VI	1
45	2020MT10862	Vineet Kumar	mt1200862@iitd.ac.in	Research VI	1
46	2020EE10483	Bolledhu Sree Divya	ee1200483@iitd.ac.in	Research VI	1
47	2020EE10487	Dhruvendra	ee1200487@iitd.ac.in	Research VI	0.5
48	2020EE10553	Shrey Chandra	ee1200553@iitd.ac.in	Research VII	0.1
49	2020EE10310	Upasak Sharma	ee1200310@iitd.ac.in	Research VII	1
50	2020EE10455	Abhay Saini	ee1200455@iitd.ac.in	Research VII	0.8
51	2020EE10510	Maitree Shandilya	ee1200510@iitd.ac.in	Research VII	1
52	2020MT10791	Atharva Suryawanshi	mt1200791@iitd.ac.in	Documentation	1
53	2020MT10853	Shubh Harkawat	mt1200853@iitd.ac.in	Documentation	1
54	2020EE30623	Sanya Mehadia	ee3200623@iitd.ac.in	Documentation	0.2
55	2020MT10831	Pratik Behera	mt1200831@iitd.ac.in	Documentation	1
56	2020MT60865	Aakrity Pandey	mt6200865@iitd.ac.in	Documentation	1
57	2019MT10685	Deepak	mt1190685@iitd.ac.in	Documentation	1
58	2020EE10603	Kushagra	ee1200603@iitd.ac.in	Documentation	0.5
59	2019EE30579	Manya Aggarwal	ee3190579@iitd.ac.in	Documentation	0.7
60	2020MT60884	Naman Agrawal	mt6200884@iitd.ac.in	Documentation	1
61	2020EE10537	Rani Meena	ee1200537@iitd.ac.in	Documentation	0.2
62	2020MT10836	Rhythm Gupta	mt1200836@iitd.ac.in	Documentation	0.1
63	2020MT10808	Harshvardhan Patel	mt1200808@iitd.ac.in	Documentation	1
64	2019MT10682	Ojas Bhamare	mt1190682@iitd.ac.in	Documentation	0.7

Sr. No.	Entry Number	Name	Email ID	Vertical	IF
65	2020EE30629	Suhani Agrawal	ee3200629@iitd.ac.in	Documentation	0.5
66	2020MT60895	V. Sai Niketh	mt6200895@iitd.ac.in	Documentation	1
67	2020MT10823	Mohit Kumar Gond	mt1200823@iitd.ac.in	Documentation	1

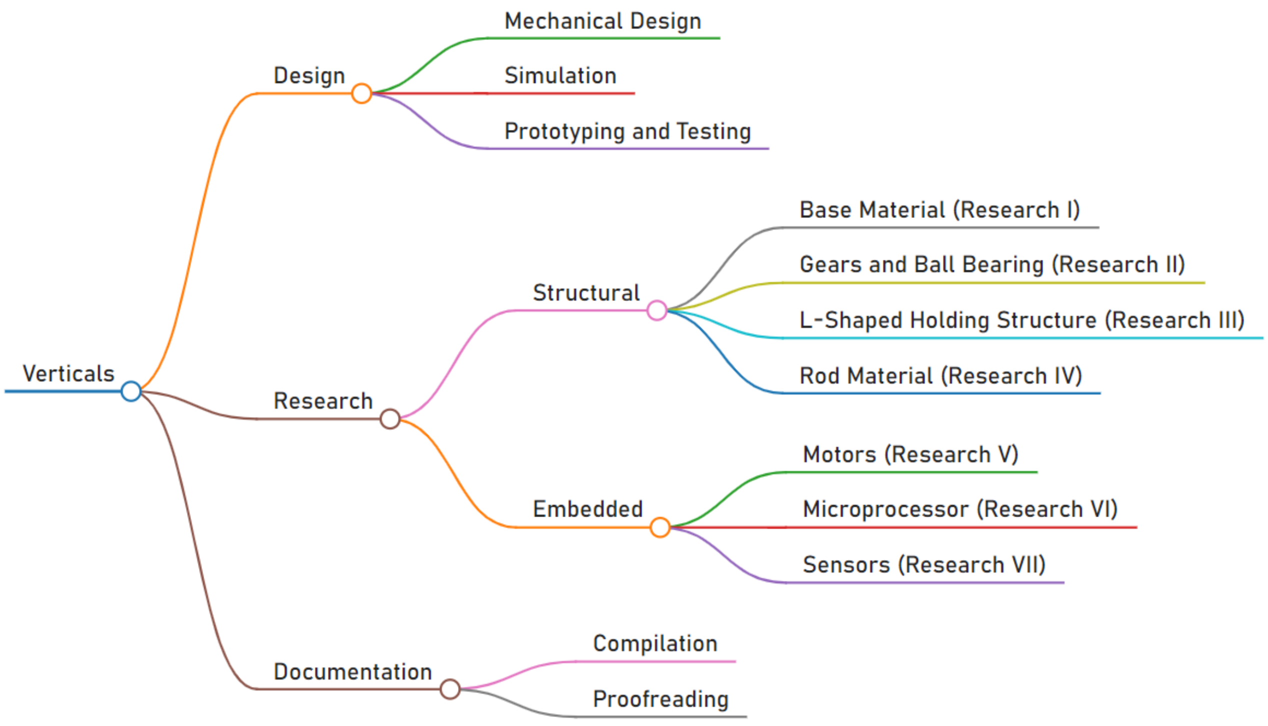


Figure 6. Tribe-Framework