EG1000

Engineering Design and Innovation

Project MPRC

Design Proposal for Team 16

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Abstract

This document presents the design proposal for Team 16, focusing on the SunRay Speedway. The proposal outlines two design concepts and provides a detailed analysis of the advantages and disadvantages of each. The document concludes with a recommendation for the most promising design concept based on the evaluation criteria.

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1 Introduction

Transportation is a crucial part of modern society. However, current personal transportation is based on petrol, which is not sustainable. In Australia, road vehicles made up 84 percent of full fuel cycle greenhouse gas emissions from all domestic transport modes in 2022-23, compared to 9 percent from aviation [1].

Many people are concerned about the environmental impact of transportation. Some people will choose to use electric vehicles, but the electricity used to charge the batteries of these vehicles is still mostly generated from thermal power plants, which is also an unsustainable method. The needs for transportation are increasing, and the environmental impact of transportation is becoming more severe.

Hence, it is high time to develop a sustainable transportation system. Solar power is a promising renewable energy source that can be used to power vehicles. The SunRay Race Car is a proposed solar-powered transportation system that aims to provide a sustainable and efficient mode of transportation for the future.

The most constraints of the current SunRay car are the speed and the strict use conditions. For the speed, our team will focus on minimizing the inner friction and the weight of the car and maximizing the efficiency of the solar panels. For the use conditions, our team will use capacitors to store the energy from the solar panels and use the energy stored in the capacitors to power the car. This method can make the car run in the rainy and cloudy days.

This design aims to address the increasing transportation demand while minimizing environmental impacts. By utilizing solar energy, the SunRay Race Car provides a reliable, eco-friendly solution that meets both current and future transportation needs

2 Problem Formulation

3 Conceptual Design

4 Design Evaluation

5 Project Planning

5.1 Gantt Chart

Here is the Gantt Chart of our project planning to help you understand our project planing better.

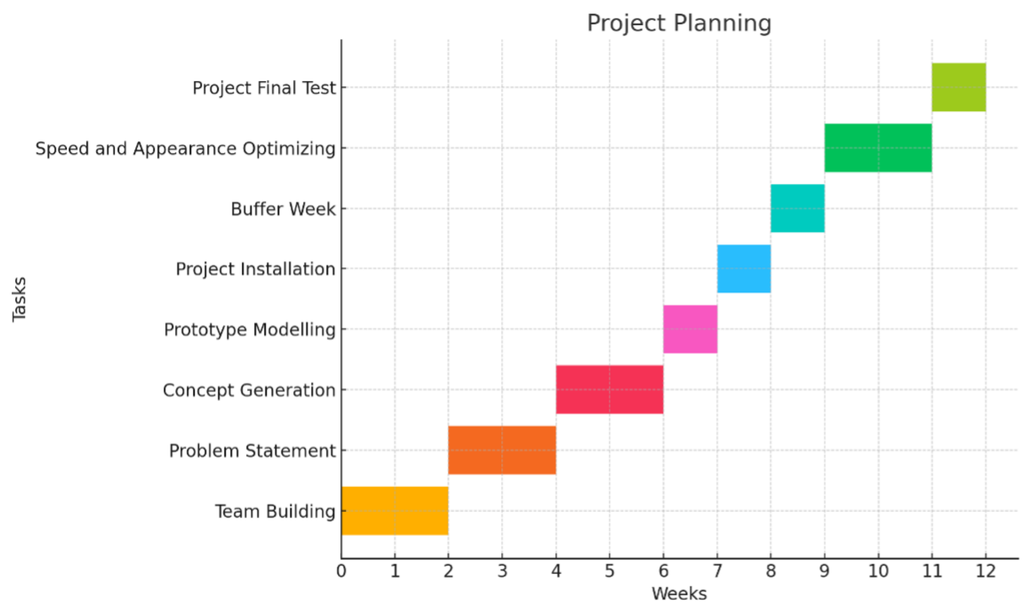

Figure 1: Gantt Chart

Responsibility	Assigned Members	Description
3D Printing Design Map	Chi-En Peng, Yung-Ching Liang	Accelerates project development and helps achieve precise design outcomes.
Gearbox	Yaran Zhang, Shenglin Wang	Contains gears, bearings, input shaft, output shaft, and housing. Provides torque amplification and load distribution.
Power System	Weijia Xiao	Ensures continuous power supply from solar panels to power the car efficiently.
Organizing & Laser Cutting	Cheong Zhang	Organize the team and assign tasks &Ensures accurate splicing of frames and reduces material waste.
Measurement	Yaran Zhang, Yixuan Wu, Chengrui Jiang	Ensures components fit together correctly and machines operate efficiently through precise measurements.

Table 1: Roles and Responsibilities in Solar-Powered Car Project

5.2 Previous Work

In the first six weeks, we completed three theoretical parts: Team Building, Problem Statement, and Concept Generation. In Week 1, team members got to know each other and held the first group meeting, where everyone presented their understanding of the problem statement. In Week 3, the problem statement facilitated more productive group discussions, as the outcomes were more comprehensive and feasible than individual solutions. By Week 5, the team delivered a presentation on concept generation, exploring various materials, power sources, and transmission methods to optimize performance by balancing efficiency, cost, and weight.

5.3 prototype modeling

Using a well-equipped car for simple tests was impractical, so we started with temporary substitutes. The body and bottom plate were made of cardboard, with a motor, solar panels, and wheels installed. While the car ran successfully, its speed was unsatisfactory. Additional materials were acquired, and further testing led to design optimizations to reduce weight and improve speed.

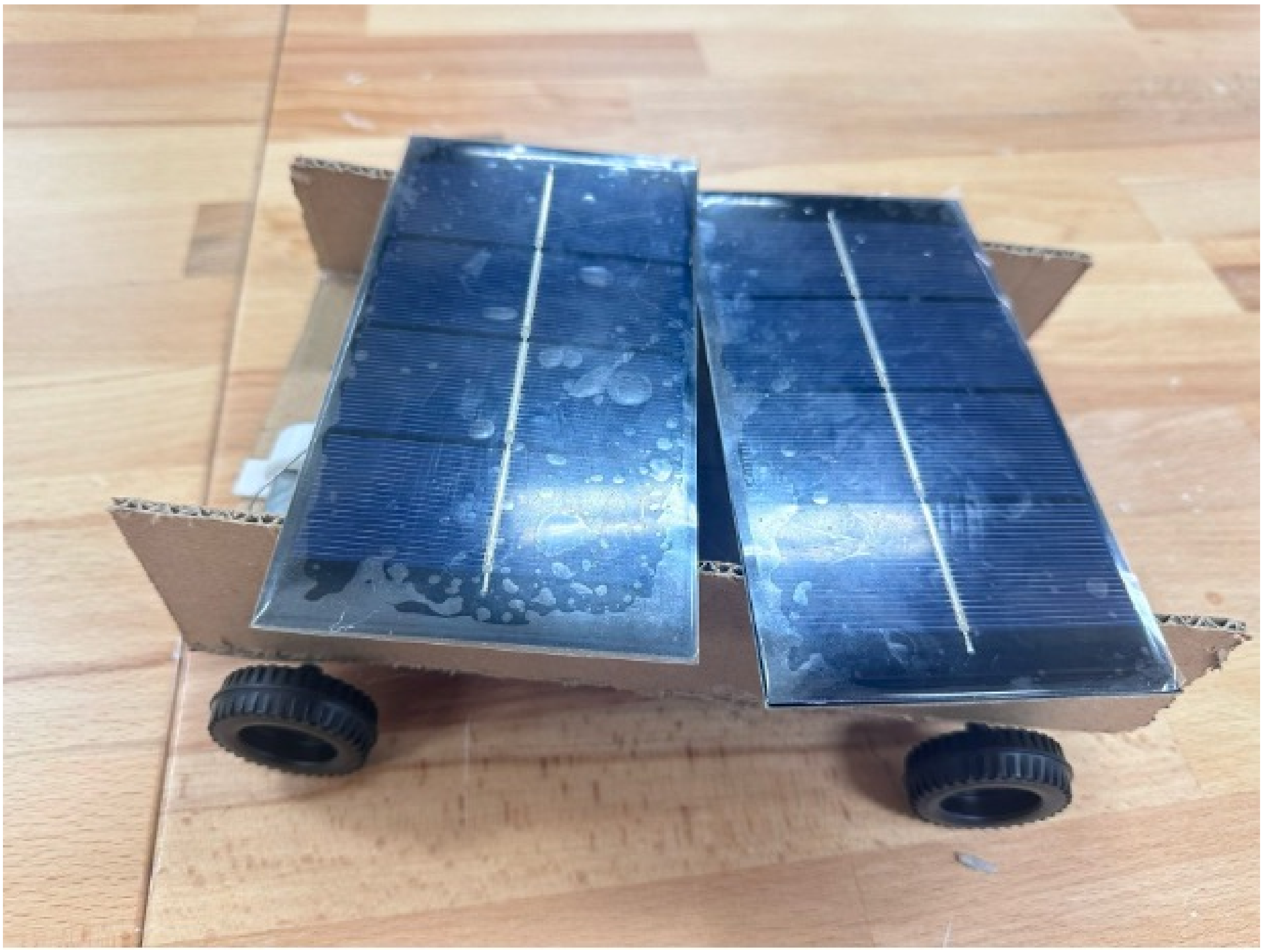

Figure 2: Tested Car prototype

5.4 Project installation

To install the car, we have decided the components that may be used in our solar panel car. Such as the solar panel, DC Motor, wheels, base, the shell, gears, transmission shaft and some wires to transfer electric energy. Careful selection and placement of components, such as the solar panel, motor, wheels, and transmission system, is important to ensure a balanced and smooth-running car[2].

5.5 Speed and Appearance optimization

To achieve high speed, we focused on reducing weight and minimizing components. After building the first version, we removed or replaced parts to make it lighter and faster. Friction within the power system, including the gearbox and transmission shaft, was minimized. On cloudy days, capacitors will power the car, requiring resistor optimization. We will also test and adjust the gear ratio to maximize speed. Additionally, the car's appearance will be refined to enhance market appeal.

5.6 Project Final Test

In the final test, we aim to have a high speed within competitors. Under the full support of previous test and optimization, we believe our car will have a high speed.

5.7 Risk Management

The main risk are shortage of makerspace resource(equipment and material) and installation detail, which could delay the project. Both risks are mainly affect to the "Project installation" part. To mitigate this risk, we will have a buffer week between the "Project installation" and "Speed and Appearance optimization". This week will be used to address the problems and unexpected detail that may occur in the "Project installation" part.

5.8 Budget

Item	**Quantity**	**Unit Price ($)**	**Total Price ($)**
Wheels (40mm)	4	1.40	1.40
Motor F 18	1	2.20	2.20
Toggle switch (two-way, blue)	1	3.00	3.00
Pinion Gear (10 Tooth)	1	0.30	0.30
Pinion Gear (12 Tooth)	1	0.30	0.30
Super Gear (36 Tooth)	3	1.65	1.65
Super Gear (48 Tooth)	2	1.10	1.10
Super Gear (54 Tooth)	2	1.10	1.10
Super Gear (60 Tooth)	1	0.55	0.55
Spur Gear (48/12 Tooth)	1	0.60	0.60
Motor Mount (3D printed - Basic)	1	1.00	1.00
Solar Panel (2V)	1	8.50	8.50
Ply Wood (for Laser cutter)	1	5.00	5.00
Capacitor	1	3.65	3.65
Axle Collar/Bush	1	0.14	0.14
F/Glass Axle (3mm x 167mm)	1	0.45	0.45
F/Glass Axle (3mm x 177mm)	1	0.50	0.50
Other (Double-sided tape, glue, bolts, washers, wire, etc.)	-	4.00	4.00
Sum			**35.44**

Table 2: Bill of Materials for Solar-Powered Car

6 Summary and Conclusion

References

[1] BITRE. *Australian Infrastructure and Transport Statistics Yearbook 2023: Transport Energy Environment*. https://www.bitre.gov.au/publications/2023/australian-infrastructure-and-transport-statistics-yearbook-2023/transport-energy-environment. Viewed 6 October 2024. 2023.

[2] B. M. Hapuwatte, F. Badurdeen, and I. S. Jawahir. "Metrics-based Integrated Predictive Performance Models for Optimized Sustainable Product Design". In: *Sustainable Design and Manufacturing 2017*. Ed. by G. Campana et al. Vol. 68. Smart Innovation, Systems and Technologies. Springer, Cham, 2017, pp. 801–811. DOI: 10.1007/978-3-319-57078-5_79. URL: https://doi.org/10.1007/978-3-319-57078-5_79.