View results

Respondent
8 Derrick Ho

04:02
Time to complete

Final Project Report

1. Date of this final project report submission *

03/01/2025

2. Name of project exactly as it was listed in your award letter *

G6 Max

3. Date (or semester/year) of original award letter *

2023

4. Expiration date of award as listed on original award letter or approved scope change letter - whichever is more recent *

09/27/2023

5. Enter the amount of the award, including any budget increases as a result of a previous scope change. *

10000

6. How much (in dollars) of your award (including previous approved budget increases) is remaining? *

0

7. Briefly describe the goals of your project. *

G6 Max was Eco Illini's supermileage vehicle project for the Fall 2023 - Spring 2024 semester. It was an electrically-powered vehicle, translating battery power into mechanical power. G6 taught students key values of sustainability and energy efficiency, showing how battery-electric vehicles can be viable alternatives to internal combustion vehicles. Split into Mechanical, Body, and Electrical Subteams, students received unique hands-on experiences maximizing G6's efficiency capabilities by optimizing transmission and motor systems, reducing weight and drag on the body, and revamping electrical components and microcontroller units.

8. Did you complete your project as it was outlined in the original award letter or in a subsequent approved scope change? *

- (●) Yes, the project was completed as originally outlined.
- ( ) No, the project was not completed as originally outlined.

9. On what date did you consider the project finished or that you stopped working on it? *

4/2/2024

10. Describe, in detail, the challenges / obstacles your project faced. *

On the mechanical team, we completed reliability improvements on a number of mechanical systems, including iteration on the installed phases of various subsystems and designed parts. Specifically, frontal steering geometry was remachined and mechanically tuned with custom spacer inserts in order to reduce steering backlash and improve overall accuracy. Likewise, rearwheels systems were remachined and installed for improved maintainability and overall robustness. Many of these improvements reflected the last wave of integration with the steel frame that became the centerpoint of the chassis, a distinct difference from previous years. Continued mechanical testing gains were made in developing a rolling resistance apparatus, track and load simulator, and diagnosing problems relating to an engine dyno used to characterize the load-response of the engine and support tuning measures. Other engine and powertrain systems were tested and installed including a new clutch system and updated modifications to the two-speed transmission; this included significant and iterative testing including the printing a 3D scale model, the custom machining of a full production model and load testing.
On the electrical team, we faced some issues with operating legacy parts with our newer electronics, specifically those parts that we had used for a long time but have little to no formal documentation. We had to trial and error a number of solutions to problems such as inconsistent ignition sparks, relay power consumption, and ESD discharge on development ECU boards. We also ran into practical concerns with switching to Altium last semester for PCB design, as a lack of formal training with the software caused inconsistency when developing and exporting for fabrication. With updates to KiCAD addressing some of our previous issues, we decided to switch to a hybrid approach - use whichever members are more comfortable with.

11. Describe, in detail, the successes your project experienced. *

In total significant mechanical progress has been enjoyed through this spring semester. After structural performance issues in past years, a steel frame was introduced to increase rigidity, but this was not fully compatible with the mechanical architecture at the time of its inclusion. In this semester, all mechanical systems have been converted to be compatible with the frame enabling modular testing and dramatically enhancing the robustness of the overall mechanical systems. It also has the benefit of reducing inter subteam dependance. Additionally, significant strides were made in developing test apparatus and models used to simulate our engine as well as the track and loading conditions during races. This is especially useful for testing during the difficult winter months or during machining periods. Smaller subsystems were improved as well including the resolution of brake pressure issues and engine timing concerns. Finally, large stroke preparation was completed for the fabrication of an entirely new body and aerodynamic package, aided by CFD analysis and significant input from competition experts in carbon fiber composite work.
On the electrical team, our G6 Max electrical architecture progressed very well, and prototyping proved easier and less buggy than we had expected. Communication between ECUs has been facilitated and works reasonably reliably, comparable to our previous tests using CAN bus. Some of our new parts we have been testing like high side drivers and motor drivers have not been as cooperative, but they are mounted on test boards. Another success has been that members have found more initiative than before, developing and taking agency over their own boards to be implemented on the vehicle.

12. Describe, in detail, how your implemented project addressed sustainability. *

The G6 Max emphasized sustainability by integrating sustainable practices and principles across all aspects of its engineering. Environmentally, we addressed sustainability through the design of an electric-powered vehicle, supporting the transition to alternative energy sources by demonstrating their effectiveness. We also participated in various outreach events, such as Green Quad Day and Robot Day, to promote sustainability awareness. Additionally, we highlighted the reduced maintenance costs for our project compared to more traditional combustion engine vehicles, thanks to the G6 Max's simpler design and fewer mechanical components.

13. Describe, in detail, how your project integrated student involvement and community outreach. *

We intended for this project to serve as an entry point into sustainable engineering for many of our members, especially considering that freshmen comprised nearly 55% of our club. All the students working on the project gained real-world engineering experience working on this project, as we built a vehicle from scratch. That being said, project ownership is one of the core beliefs of Eco, and I can confidently claim that every student learnt how to take charge of challenging problems by applying the engineering fundamentals and knowledge they've obtained in class to actual applications. This includes training in and applying industry-relevant fabrication processes, R&D, CAD, and design for assembly. We hope that the students were inspired by this project's efforts in green energy and efficiency and take the knowledge learned onto other phases of their lives, maintaining mindsets of sustainability when engineering in their later careers.

14. Describe how the project engaged individuals from underrepresented groups and/or how it promoted diversity, equity, and inclusion. *

Our project actively engaged individuals from underrepresented groups and promoted diversity, equity, and inclusion by fostering an open and inclusive environment within the team. During recruitment, the team targeted a broad range of students across various disciplines, genders, and cultural backgrounds, ensuring that individuals from underrepresented groups had equal access to projects and technical roles. By offering mentorship, workshops, and collaborative activities, the G6 project provided opportunities for skill development and leadership, ensuring that every member, regardless of background, could contribute meaningfully to the project's success while gaining hands-on engineering experience.

15. What key takeaways should the campus community know about your project? *

The G6 Max was an ambitious project entailing the design, manufacturing, prototyping, and assembly of a vehicle built to maximize fuel and energy efficiency. The G6 Max competed in the Shell Eco-marathon, an annual competition where similar renditions of prototype vehicles race to determine the most efficient design. The project and competition serve as great experience for those interested in automotive design, or those looking to learn skills not covered in coursework, such as machining, design for assembly, or FEA.

16. Describe the marketing material developed for promotion of your project, including but not limited to advertising (including digital) and/or signage related to this project. All marketing must include SSC's logo and/or a statement of which fee funded the project. Projects must coordinate with SSC to ensure the promotion appropriately highlights the SSC's contributions to the project. *

Marketing material for the project included placing the SSC logo at the top of the G6 Max's body, which was seen by all of our competitors and competition sponsors.

17. Upload project marketing and/or media not previously submitted in semester progress reports. *

SSC Logo 2_Derrick Ho.jpg

SSC Logo_Derrick Ho.jpg

18. Complete and upload the final financial documentation for your project. You should reflect all expenditures since your last semester project report. We strongly suggest that you also upload supporting financial documentation from Banner for your award's CFOP. Any remaining funds will be transferred back to the SSC. It is the sponsoring department's responsibility to close the CFOP after the account is at a zero balance.

https://studentengagement.illinois.edu/sites/default/files/2024-09/SSC-Budget-Timeline-FINAL-PROJECT-REPORT-template.xlsx *

G6 Max Final Project Financial Report_Derrick Ho.xlsx