Midterm Report

By: Andrew Tran (012394096), Hiromi Saito (014065129), Jonathan Austin (012148162)

**1. Social Justice Issue: Lower-class affected by environmental justice and access to EVs**

The amount of impact that Electric Vehicles have had on the environment, the automotive industry, and the world as a whole, with only being affordable to the middle to high class, has been impressive. Companies like Tesla have been working to drive down battery costs and ultimately the cost of the car which would make it more affordable to the general public. Another solution to this issue is better battery usage and efficiency, which is one of the primary goals of this project, given its modular configuration (George & Badawy, 2018). If Electric Vehicles were more prominent due to lower costs, especially in denser cities, this could improve the quality of life and health of those that reside in them. Lower-class residents may not have adequate healthcare access and living situations to deal with the negative effects of pollution like breathing problems. “According to Zhenhong Lin, a researcher at Oak Ridge National Laboratory in Tennessee… Pollutants from cars that use gas ‘directly or indirectly harm human health and the environment’” (Hineman, 2020).

**2. Responsibilities (i) and Plans (ii)**

1. **Hiromi:**
   1. Working on redesigning the circuits in order to account for previous errors found during lab testings. Specifically redesigning tasks include selecting components with the right characteristics and calculating total errors on components with real values. Common designing constraints include adequate common grounds between components, EMI, thermal capabilities, and prioritizing low-costs.
   2. The plan for this semester is to have a working PCB that can handle loads under testing. Steps, in order to ensure this plan comes to fruition, is to finish designing a complete circuit in OrCad, simulating with and without loads in OrCad, ordering the PCB of a working final design, and bringing the PCB into the lab for testing before May.
2. **Jonathan:**
   1. Working on researching and understanding the current system and code modules, including Maryam’s optimized control algorithm, Xavier’s ADC for frequency control, and Tristan’s main Multi-Level Converter PWM program. I just started testing each of the code modules to better my understanding in order to start debugging.
   2. The plan for the remainder of the semester is to finish testing and debugging the current code modules and then maybe start to think about the design and implementation of the FPGA arms.
3. **Andrew:** 
   1. Research on selecting components with parameters that would fit with the redesigned circuits. Testing the new components on OrCAD for the current sense module and h-bridge inverter. Learning to use ANSYS to test for thermal capabilities of each module.
   2. The plan for the remaining semester is to complete schematics for the redesigned circuits, agree on what type of connectors are going to be used for each board, and transfer the new schematics onto a PCB that would be used for testing later.

**3. Required Resources**

For the embedded systems team, the only resources we have needed so far have been the C2000 DSP microcontroller development kits as well as the testing inverter boards for testing at home. For the future, we might need FPGA boards for the plans of implementing FPGA arms in between the DSP microcontroller and the converter modules. As far as research goes, a lot of the literary resources are available from prior students who have worked on the project.

For the power module team, which includes Andrew and Hiromi, the resources can be found in component datasheets, a folder in the Energy Management of HESS in EVs Google Drive called “Modular Multilevel Converters”, and Youtube tutorials on how to use OrCAD provided by SJSU Center of Power Electronics.

References

[1] S. S. George and M. O. Badawy, *A Modular Multi-Level Converter for Energy Management of Hybrid Storage System in Electric Vehicles*, 2018 IEEE Transportation Electrification Conference and Expo (ITEC), Long Beach, CA, USA, 2018, pp. 336-341, doi: 10.1109/ITEC.2018.8450237. Available at: <<https://ieeexplore.ieee.org/abstract/document/8450237>> [Accessed 14 March 2021].

[2] Hineman, B., 2021. *Fact check: Electric vehicles emit fewer emissions and are better for the environment*. [online] Usatoday.com. Available at: <<https://www.usatoday.com/story/news/factcheck/2020/10/17/fact-check-electric-cars-emit-less-better-environment/3671468001/>> [Accessed 14 March 2021].