Powering the Future of Travel: An Efficient and Safe Power System Architecture for Hyperloop

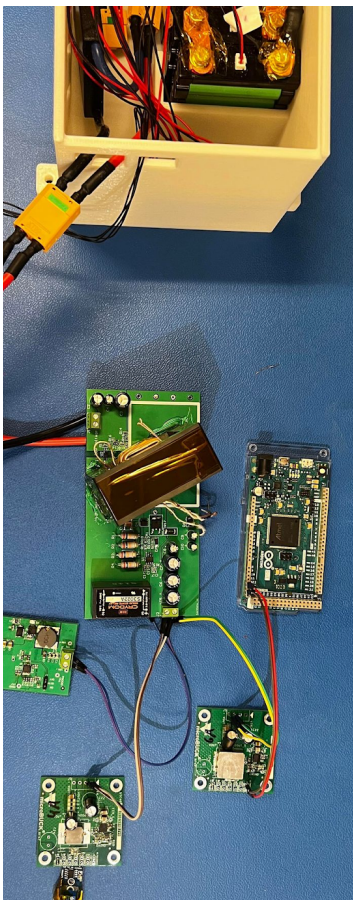
Team Members: Parsa Youssefpour, Chloe Bell-Beguin, Orest Cobani, Alexandre Singer, Andres Cervera Rozo, and Zenghao Wang
Supervisor: Professor Olivier Trescases
Client: University of Toronto Hyperloop Team (UTHT)

Objective

To design, build, and test a system that provides sufficient power to the Hyperloop Pod designed by UTHT. This includes powering both the High Voltage (HV) propulsion system and the Low Voltage (LV) electronics of the Pod. Since the design will be handled by students and, in the future, will transport humans, the first objective of the power system design is safety. The design must also be easy to use, to allow for easier operation of the power system, and modular to support future iterations of the Hyperloop Pod design.

Description of Engineering Design Process and Final Design

To design the most safe, easy to use, and modular system, while also being efficient, this capstone team built a **custom designed power distribution system for auxiliary loads**, specifically designed to convert HV battery power to LV. This reduces the capacity required for the LV batteries used in the system and allows for a more robust design. The LV system also includes electronics capable of **intelligent and seamless transition between LV and HV**; allowing the Pod to be powered off of the LV batteries when running diagnostics and transition to the HV batteries, without physical user interaction, when needed. The major components of the conversion system are shown in the image to the right.



Power Conversion System

Iterating on previous versions of the Hyperloop Pod design, the team built a **cutting-edge communication system** to transmit important sensor data about the state of the power system to the central computer of the Pod. The design uses a *CAN Bus* architecture similar to those found within modern Electric Vehicles. A **new HV and LV battery system architecture** was proposed by this capstone team, using **custom 3D printed battery encasings** to house the battery modules while they are in operation or being tested. To ensure functionality and safety, the capstone team performed **extensive testing and safety evaluations** on the design to ensure that all aspects would operate within the conditions present in the Hyperloop Pod. To aid testing, a **Graphical User Interface** was built to display the state of the power system to the user. This capstone team also tested and evaluated the safety of the batteries currently being used by UTHT.

Impact

The Hyperloop is planned to be a high speed train, with the goal of getting travellers from one place to another as fast and as sustainably as possible. The design for Hyperloop is still not complete, and each year a competition is held to compile the ideas from university students all over the world to improve the design. UTHT compete in this competition each year, and they have ambitious plans to use a magnetic levitation system to propel their Pod, requiring significantly more power. The power system, designed by this capstone team, will be used to power these new upgrades and further improve the Hyperloop mission.