ECE4011/ECE 4012 Project Summary

Project Title	Converting Gas-Powered Go-Kart to Electric Power with a Brushed DC Motor
Team Members (names and majors)	Daniel Bruce - EE Hong Yee Cheah - EE Christopher Hooper - EE Moongyu Kang - EE
Advisor / Section	Dr. Thomas Habetler / L1C
Semester	Semester/Year: Spring 2020 - Final ECE 4012
Project Abstract (250-300 words)	(10 point font, single spaced) At this point, it is common knowledge that the world is running out of gasoline to fuel our cars. Not only that, but the cars themselves are getting bigger and heavier each year. There is no reason one person should be commuting to work every day in a vehicle that is nearly twenty times their mass and powered with non-renewable resources. The vehicle market is showing a shift towards electric vehicles but the ones currently on the market have the issue of still being as large as a typical car. Vehicles of this size are not necessary for the average commuter and waste power to move all of that unneeded additional mass. A solution to this problem is to design a smaller, two-person, electric vehicle that can be used for the public's daily commute. This project was designed to take a pre-existing gas-powered two-person 'go-kart' and replace it with an electric drivetrain powered by a brushed DC motor and Tesla Model S battery module. The design consisted of choosing a proper motor, motor controller, battery, battery charger and battery management system that are all compatible and fit within the budget of the project while meeting the speed and range goals the group decided on. The Go-Kart's goals were to reach a top speed of 25 MPH while having a range of at least 1 kilometer (0.621 miles). The prototype had to be simulated due to the COVID-19 crisis, leaving us with some idealized results of reaching a max speed of 23.056 MPH and an electrical only calculated range of 49.16 kilometers (30.547 miles). The range however has to be taken with a grain of salt as it only accounts for the battery electrically powering the motor, not including any mechanical losses like friction and drag.

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List **codes** and **standards** that significantly affect your project. Briefly describe how they influenced your design.	(10 point font, single spaced) According to the Georgia Department of Public Safety, all Low Speed Vehicles must be a four-wheel electric vehicle with a top speed obtainable in one mile is greater than 20 MPH, but no greater than 25 MPH. Additionally the vehicle needs to be manufactured in compliance of Federal Motor Vehicle Safety Standards for Low-Speed Vehicles. The Federal Motor Vehicle Safety Standards for Low-Speed Vehicles state they must include the following: Headlamps, Front and rear turn signal lamps, Taillamps, Stop lamps, Reflex reflectors: one red on each side as far to the rear as practicable, and one red on the rear, An exterior mirror mounted on the driver's side of the vehicle and either an exterior mirror mounted on the passenger's side of the vehicle or an interior mirror, A parking brake, A windshield that conforms to the Federal motor vehicle safety standard on glazing materials, a Vehicle Identification Number, a Type 1 or Type 2 seat belt assembly conforming to standards, and an alert sound. As well as conforming to rear visibility requirements. Influence: We can either buy all the parts aftermarket (which is expensive) or design them ourselves (which takes time and resources). We settled on buying a kart with most parts already on-board to reach most of these requirements as realistically possible. This project focuses on the electrical powertrain and thus could be adapted and applied to any vehicle that conforms to all of these standards.
List at least two significant **realistic design constraints** that applied to your project. Briefly describe how they affected your design.	(10 point font, single spaced) Weight: A heavier vehicle requires more power to move, thus draining the battery faster, which decreases range. A heavier vehicle has more momentum that the mechanical brakes must overcome. Cost: We have a budget limit of $1,000 to spend on the Tesla Model S Battery Module, Battery Management System, Battery Charger, Go-Kart frame, DC Motor Controller, and DC Motor. The battery module alone is $1,580, the motor will be another $250, and motor controller at nearly $600. For this project to work it is essential to get donation, loaned parts and sponsorship.
Briefly explain two **significant trade-offs** considered in your design, including options considered and the solution chosen.	(10 point font, single spaced) AC vs. DC motor: AC motors are more reliable, and safer, but harder to control. DC motors are more energy efficient but wear out faster (brush commutator). An AC motor needs extra inverting circuits to convert our DC battery to AC power Designing frame or buying pre-built kart: On one hand, designing the frame gives us more control over size and weight, but takes more time to design, simulate, and build. On the other hand, buying a pre-built kart is more expensive, but comes with most of the equipment needed to satisfy the codes and standards listed above. Also, we are not experienced with mechanical design and fabrication.

Briefly describe the **computing aspects** of your projects, specifically identifying **hardware-software** tradeoffs, interfaces, and/or interactions. *Complete if applicable; required if team includes CmpE majors.*	(10 point font, single spaced) N/A. No Computer Engineering Majors in this Project.

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Leadership Roles (ECE4011 & Forecasted for ECE4012) (NOTE: ECE4012 requires definition of additional leadership roles including: 1.Webmaster 2. Expo coordinator 3. Documentation	**Team Leadership:** Christopher Hooper **Expo Coordinator:** Christopher Hooper **Documentation Coordinator:** Daniel Bruce **Analog Design:** Daniel Bruce **Webmaster:** Hong Yee Cheah **Real-Time Coding:** Hong Yee Cheah **Project Management Expo:** Moongyu Kang **Mechanical Design and Assembly:** Moongyu Kang
International Program: Global Issues (Less than one page) (Only teams with one or more International Program participants need to complete this section)	(10 point font, single spaced) N/A