Project Team Charter
ENGR 416: Capstone II

Team Purpose

Our team's primary goal is to retrofit all functional components from the new metal chassis onto the existing wooden chassis while trying to improve overall system performance. Following the revision, we will verify all functions of the motors, drivetrain, steering, and movement systems to ensure reliable and safe operation. An important quality objective of the team is to confirm that the platform meets all load and carrying capacities necessary, as stated by our sponsor. Our key stakeholders are the school and its maintenance department, whose objective is to deploy an autonomous vehicle capable of navigating the campus to deliver heavy or bulky items efficiently and safely. Our performance targets include consistent mobility under load, structural integrity of the vehicle, and dependable, safe control of motion under real operating conditions.

After ensuring the basic functionality of the EV, we are tasked with creating and installing a self-navigating/self-driving system in the EV and installing an emergency brake system into the vehicle.

From a process standpoint, our team will follow a structured, test-driven development approach. After we finish revising the vehicle to its stock form and complete baseline functionality tests, we will research the necessary hardware and software needed to implement the autonomous operation. All the components will be double-checked against our sponsor-provided criteria before installation, and each subsystem will be tested individually before full integration. We will document any design or test results to maintain traceability and accountability through the project. Team members will be expected to meet aggressive milestones and contribute consistently to integration and testing to address issues collaboratively to avoid late-stage failure. Collectively we are aiming for an A-level outcome, achieving both autonomous and reliable operation.

Team Goals

For this project, our group has the opportunity to equip the car with advanced steering and autonomous sensor hardware. Our approach to the design will be to analyze the car from a systems perspective to coordinate seamless integration of every part. Because there are several electronic and mechanical parts to the car, one goal is to stay organized with the requirements, specs, and design notes of each component. To achieve this, one of the goals of our group is to evenly distribute tasks among our group and have each engineer be responsible for a number of components. Each engineer is responsible for documenting their work in a standardized way to make presenting our progress smooth. Additionally, a quality goal we have is to conduct robust tests to cover several use cases and scenarios to make sure the customer requirements are met. The end goal is to see the vehicle running on campus with the technology we helped implement.

To achieve this, we plan on implementing sensors to detect where the vehicle is in space and then navigate through it at low-speeds. Throughout our design process, we will thoroughly research the types of sensors in the current market, determining the best cost-effective solution and creating open-source code to maneuver the vehicle through space without collision. Team members will contribute equally to research based on their areas of interest and expertise. Past examples and asking faculty relevant questions will all be a part of this research process. We will document our findings in our shared Google Drive folder. Implementing the detection sensors will require close communication with the 4-wheel drive capstone group to work with their components to the sensors and motor controllers. Additionally, we have an underlying open-source philosophy, proving that anyone can create an autonomous electrical vehicle that is modular to adapt to many use cases and applications. For example, moving stock material through the iLabs here on campus.

We recognize that our project is in its second year, which underlines the need to understand the progress that has been made so far. This entails one goal early on, which is to communicate with our sponsor and be on the same page about the goals and achievements of the previous group in order to roadmap our next steps as the project's current engineers. Overall, we aim to do our best as a group and earn A grades on this project. We hope to gain valuable experience while working on an exciting project that synthesizes our undergraduate education.

Team Roles

High5 Strengths:

Eric Jensen: 1:Empathizer 2:Beliver 3:Self-Beliver 4:Deliverer 5:Peace Keeper

Nathan Nguyen: 1: Thinker 2: Philomath 3: Coach 4:Catalyst 5:Problem Solver

Bo Won Shin: 1: Focus Expert 2: Thinker 3: Time Keeper 4: Strategist 5: Coach

Camden Galen: 1: Philomath 2: Deliverer 3: Catalyst 4: Peace Keeper 5: Strategist

Zachary Azmus: 1: Coach 2: Peace Keeper 3: Catalyst 4:Empathizer 5: Focus Expert

Shion Britten: 1: Philomath 2: Focus Expert 3: Catalyst 4: Optimist 5: Empathizer

Team Member	Role Title	Role Description
Shion Britten	Line following and electrical lead	Responsible for prototyping the line-following program. I have coding experience and will connect the on-board computer with the motor/steering/brakes.
Camden Galen	Collision detection lead	Assisting in prototyping the collision detection system and manufacturing mounting components. Has experience with CAD, 3D printing, Arduino.
Zach Aszmus	Line following and software integration	Help with the line-following software and integration. I have experience with mechatronics and coding.
Eric Jensen	Emergency brake lead	Obstacle detection team and braking team. I oversee routing the brake fluid lines.
Nathan Nguyen	Object detection team member	Object detection team – using the LiDAR sensor and installing automatic braking.
Bo Won Shin	Braking team member	Braking team – installing the emergency brake. Also, responsible for CAD design of sensor housings/brackets.

Team Rules

Meeting time:

-Meet as a team with sponsor: Bi-weekly, Fri. 12:00 p.m. (Zoom)

-Weekly work on EV: Fridays 9 a.m. - 12:00 p.m.

Team meetings will be held in-person in Merryfield Annex on Fridays from 9 a.m. to 2 p.m. We allow flexibility for team members to come join any time between then. Bi-weekly on Fridays, the autonomy team will meet with our sponsor to discuss progress and goals going forward. When a consensus can't be reached, we will let all parties make their cases and take a vote. Everyone will be allowed and encouraged to speak, and all opinions will be respected and taken with serious consideration.

The team will use text primarily and Microsoft Teams as a secondary form of communication. Team updates will be given to the sponsor as regularly as they wish. Communication should always be respectful and done earlier rather than later.

Information will be held and stored in a Microsoft Teams shared folder. The folder should remain organized. Documents should be appropriately named, and subfolders should be created to help with organization. CAD/CAM files should also be stored here will all sub-design files also attached.

Necessary work and tasks will be discussed and decided, after which individuals will be able to volunteer for assignments that interest them/suit their strengths. If the delegation of work seems uneven, we'll discuss it. Class loads and other responsibilities will be considered when distributing tasks. If problems arise and group responsibilities can't be met, individuals should try to voice this earlier rather than later so other group members can try to assist in helping. Respectful and early communication is key.

Potential Barriers and Coping Strategies

Potential team barriers include scheduling issues, work from other classes/other responsibilities preventing us from completing team tasks, and general communication problems. These issues are to be expected as we are all full-time students dealing with personal life issues as well. We can also expect disagreement on certain approaches/decisions made in the project.

To solve and prevent these team barriers, we can employ a few strategies and rules. The most important being constant, respectful, and early communication, if problems arise in scheduling and tasks may not be able to be completed in time, early communication can help the team divert resources to help. Respectful communication will also help when a consensus can't be reached. To deal with scheduling issues, we will plan ahead when to meet so that everyone can be sure to set aside the needed time and also find times when best to meet for them.

As for potential sponsor barriers, we could see strict timelines, slow component ordering, and unclear expectations to come into play. As in the nature of Capstone, we only have 20-weeks to complete this project, so we will have strict timelines and expectations from our sponsor to get the project done. To mitigate this barrier, we will have consistent communication and checkup meetings to ensure the project is staying on track. As well, once we get rolling on this project, we suspect that ordering parts could become an issue if they take, let's say, months to deliver. To prevent this, we will ensure we order the key components early that will require the most design, i.e., the lidar sensors, Arduino/Raspberry Pi, and the motor controllers. Finally, unclear expectations could lead us down rabbit holes that could potentially waste our time in this fast-paced project. To ensure this does not happen, we will formulate an overview of project scope early and ask any clarifying questions while still in the design phase.

Prototyping Strategies - Design-Based

Our team will begin prototyping once the design has reached sufficient maturity in both functionality and feasibility. Design maturity will be determined by the completion of detailed CAD models, confirmation that all core functions are addressed, and verification that key customer requirements identified in the House of Quality are being met. At this stage, the design should be manufacturable using available resources and materials.

Once a prototype is built, we will test its performance through structured and repeatable test procedures. Performance metrics such as functionality, durability, usability, and efficiency will be measured and compared directly to the engineering specifications defined in the House of Quality. Quantitative data will be collected whenever possible, and qualitative observations will be documented to capture user experience and unexpected behavior.

To prepare for potential component availability or shipping delays, our team will identify alternative components and suppliers early in the design process. Critical components will be ordered as early as possible, and the Bill of Materials will include backup options when feasible. This approach will help minimize schedule risks during prototyping.

If a prototype underperforms or fails, the team will evaluate whether the issue can be resolved through design iteration or if it indicates a fundamental flaw in the concept. Issues related to tolerances, materials, or assembly will be addressed through incremental improvements, while failures tied to unmet core requirements may require revisiting the overall design approach.

To enable rapid response to prototype issues, we will prioritize modular design, parallel task assignments, and early testing of high-risk components. All design changes, test results, and lessons learned will be documented in shared design logs and version-controlled files. This documentation will include not only test data, but also reasoning behind design decisions and insights gained during testing.

Our sponsor will be involved throughout the prototyping process through regular design reviews and feedback sessions. Prototype performance data and testing results will be shared with the sponsor to ensure alignment with project goals and expectations before moving to subsequent iterations

Solution Strategies - Process-Based

Once the design is implemented and the team has agreed that it has been produce in the intended manner, we will begin real world testing of the system as outlined by our testing plan which involves a series of tests to evaluate individual HOQ requirements for the EV.

Should any design fail to meet HOQ requirements we'll evaluate if the problem is inherent to the design/solution approach or if it was just a poor execution of the design. If the solution approach can be re configured using the parts we have on hand then we will try to re design/re implement the solution. Should the solution be inherently flawed or we do not have the available parts to re-design the solution then we will create documentation of our new idea so the next team my try to implement it.

To try and set ourselves up for success and the ability to adapt and change our ideas we will try to implement our ideas as soon as possible so that we have time to order parts and execute re-designs should we need to.

Documentation is an important part of our process. We will be sure to leave a detailed breakdown of parts used, how they were installed, documentation that came with said parts, a breakdown of the process, how we believe the system can be improved in the future, etc. This will be held in the MS Teams Database and is very essential for both our teams sake and for future teams working on the EV.

Sponsors will be regularly updated with emails and informed in our bi-weekly meetings on Friday. If any problems or triumphs arise we will be sure to update the sponsors immediately for feedback and help.