Electric Formula SAE 2020-21

Easton, Pennsylvania 18042-1775

Lafayette College 2020-2021 FSAE Formula One Hybrid Team

ID001 Statement of Individual Goals

Introduction:

This document details the breakdown of tasks that each student member of the 2020-2021 Lafayette Motorsports FSAE team submitted as their individual goals within the project, meant to satisfy requirement ID001 from the Statement of Work (SOW). (SOW available on our website) With the goal of creating a team that understands their individual roles, the goals they share, and the milestones that the project needs to reach in a certain time, team members created their statements of individual goals while referencing the team's current Work Breakdown Structure (WBS), which is also available on our website, most recently updated on October 19, 2020. In general, these tasks follow a structure where sub-teams are creating their own products that correspond to the required or encouraged systems that exist within a functioning electric vehicle. Tasks numbered 3-13 are subsystem specific tasks, with the second number referring to what type of task they are. Lower second numbers generally mean that the task is related to design. For example, task 9.1 is a task detailing the creation and upkeep of Inventor models of the car's Chassis. Further breakdowns are not detailed it the top level of our work breakdown structure and are specified by the sub-teams rather than the entire project team.

These statements also include a variety of other goals beyond those rooted specifically in the delivery of an electric vehicle and its documentation. Usually these goals relate to the development of skills that will be completed throughout the project rather than tasks enumerated in our WBS. However, because these statements are presented here without editing or comment, the goals expressed by each team member may vary wildly. Some team members may focus on soft skills like leadership and communication, while others are more direct in their goals to learn about the operation of a new software or tool in the process of constructing and designing the 2020-2021 car.

Michael Anderson

Suspension: System designed to be able to hold the chassis off the ground under full load. The goal is to have a rolling chassis by February 26th, 2021. Within the suspension subsystem, I am responsible for the redesign of the rear coil-over damping system. This has involved adding triangular components to the top of the upper A-Arm mounts, and extending them outwards so that the coil-over shocks can be mounted to the top of the upper A-Arm plate in a more vertical position than the previous design. This also opens up space in the rear chassis and gives other subsystems more room for cooling components as well as wiring. With this redesign, I am also responsible for selecting new shocks that will adhere to the rules requirements regarding ride height. These parts will be selected and ordered by October 23rd, 2020. New shocks will also be critical for maintaining rules compliance during heave, roll, and pitch of the vehicle. I am also responsible for overseeing the entire suspension subsystem, and with this must produce full Inventor assemblies of each component that will eventually be implemented on the car. These assemblies will be completed by October 21st, 2020. My updated work breakdown schedule is also available in sections 13.1-13.11 of the WBS. Within suspension I am also in charge of utilizing Optimum Kinematics to test my new design for rules compliance. This performance software allows me to input pickup and mounting points for the A-Arms to the uprights and the chassis, and put the system through motion analysis. It is my responsibility to make sure that we have the proper pickup and mounting points for the parts we have designed in the front and rear of the car, hence allowing us to have a suspension system that complies to the rules. Overall, having a rolling chassis is the main goal for my subsystem and I, as it is vital for the mechanical team working on this project, and sets a basis for testing to begin.

Herbert Atwater

My role on the 2020-2021 Lafayette FSAE team is as a mechanical engineering team member on the chassis team, a helper for the braking subsystem, as well as having been introduced recently into the mechanical aspect of the battery pack team. Many of my current planned tasks are within Chassis, Body Panels and Pedals. My goals include but are not limited to the creation of Pedals and Hardware, which I will be the lead on starting in the next few weeks when we begin working on that aspect of Chassis. This will include everything from ensuring there is a proper bar in place on which to mount the pedals, as well as all the pedals and hardware to make the brakes and accelerator work. This is points 9.1.6 Pedals and Hardware, 9.2.3 Pedals and Hardware, 9.3.3 Pedals and Hardware, 9.4.3 Pedals and Hardware, and 9.5.3 Pedals and Hardware on the WBS.

In the past I have worked on tasks 9.1 Inventor Models, 9.1.1 Rear Frame in the WBS, which required numerous rebuilds of our new rear end design, as well as 4 or so design reviews. I also completed the seat and hardware inventor files and then implemented them into the Full Car Assembly, which is parts 9.1.2 Full Frame, 9.1.4 Seat and Hardware, 9.1.3 Full Car Assembly in the WBS.

I also plan to finish my work on the placement and construction of the seat, most of this work has been done in the past weeks, but some of it needs to be finalized and some parts for mounting need to be found in inventory, ordered or manufactured. This also includes the decision of whether or not we wish to cut off the seat rest on the seat and use the roll bar to hold the head cushion. The work needed to be done for this includes part numbers 9.2.1 Seat and Hardware, 9.3.1 Seat and Hardware, 9.4.1 Seat and Hardware, 9.5.1 Seat and Hardware on the WBS. Then comes my work Body Panels, we have not full divided up the work yet for body panels, but I plan on working at least a little bit in every aspect as I have a good interest in the creation of body panels for use in my personal and

professional life later on. This includes the creation of inventor models which show the curvature of the panels, as well as the processes which we use to physically create the panels using the inventor model. This includes part numbers 9.1.7 Body Panels and Hardware, 9.2.4 Body Panels and Hardware, 9.3.4 Body Panels and Hardware, 9.4.4 Body Panels and Hardware, and 9.5.4 Body Panels and Hardware in the WBS. Lastly I plan on helping on the overall completion/assembly of the chassis one all parts are received and ready to be put together, which is parts 9.6 Chassis Assembled, 9.6.1 Jigs Created, 9.6.2 Rules Non-Compliant Members Cut Out, 9.6.3 All Members Welded of the WBS.

My deliverables are a large amount of inventor drawings which are needed to have parts created either by our manufacturing team or an outside vendor. You could also count the specific parts of the cars I work on as deliverables, especially when it comes to the full car assembly and there is actual physical work to be done in the shop next semester. Being as we are off campus this semester, my main goals in personal growth are based in learning how to design, create an inventor of the drawing, and send said file out to get manufactured elsewhere. While I joined chassis to gain a hands on approach and learn trades such as welding so I could use this knowledge for my own use on vehicles I build, as well as professional knowledge, I can get just as much use from the ability to create the wanted object and send a working model of that object to a company with the proper tools to create it for me.

Andrew Bachman

In my view, my role in this project is as a manager for the whole team, who is also aiding in the design and construction of the dashboard and other external indicator systems as part of the External Panels And Lights (EPAL) sub-team. In service of this role, my goals include the completion and delivery of all required course deliverables and competition deliverables, as well as the completion of all tasks assigned to EPAL. Listed as items 21, 22 and 6 on the team's work breakdown structure (WBS), these items are due all throughout the project, so in some sense they are both short term and long-term goals. To specify, the EPAL tasks I aim to complete before the end of the first semester are WBS tasks numbered 6.1-6.7, which include documenting our designs for the external indicators of the car in all relevant ways. For the course deliverables and competition deliverables, I aim to complete WBS items 21.1-21.5 and items 22.2, 22.3, 22.7, and 22.8. (WBS item 22.1 has already been completed.) All other WBS tasks in sections 6, 21, and 22 are goals that I aim to complete next semester.

Beyond the tasks listed on the WBS, there are several skills I plan to develop and secondary assignments to be completed in service of this project. As part of the EPAL team's software development I intend to learn and practice my Python skills, as well as my UI design skills. As a manager for the project I hope to further practice my leadership and communication skills that will help me motivate the project team and guide them towards a one hundred percent complete project. Project management, including communication with team members, customers, and project directors seems to be a very particular set of leadership skills that I look forward to learning more about. My last goal for the project is to engage with the ethics and safety materials presented in the Wednesday lectures for Electrical Engineers, and develop my person views of engineering and its place in the world through the timely completion of assigned readings and assignments.

Nathan Beal

My primary role for the rest of the duration of the EV design will relate to the design, testing and implementation of the new boards that will be fabricated for the CarMan subsystem. Over the course of the past three weeks the Tractive System Interface (TSI) subsystem team and Grounded Low Voltage (GLV) subsystem team have merged into a CarMan conglomerate. We have since worked towards a complete internal CarMan overhaul that started with a task partitioning until we settled on the design of three new boards and their roles respective to each other. I will be one of the few that will move forward with the TSI KiCAD schematic design (WBS 4.3.2), the TSI PCB layout (WBS 4.3.5), and subsequent TSI testing (WBS 4.10.1) and documentation (WBS 4.13.1). IO will additionally continue to tribute to the overall design, documentation and maintenance of the CarMan system as will the rest of my teammates. Our goal is to have each of the three boards designed and sent to the shop for production over winter break.

During the course of my position as a member of CarMan, I look forward to learning the intricacies of PCB design and fabrication. I also anticipate learning how to be mindful of the needs of other engineers and their subsystems while simultaneously maintaining and organizing the CarMan subsystem. Due to the sheer number of connections from TSI to the other subsystems I expect I will have to debug and work through many challenges during our design process. I believe this process to be indicative of what it would be like to work in the real world on a large engineering project with many other people. Lastly, I hope to continue to grow and continue to learn from the ethical discussions and lectures we have been having in class concerning engineering and about the difficult decisions we may sometimes have to make.

Sam Bluvol

My primary long term goal is to have a rules compliant rolling chassis that the entire team can test drive at least two weeks before competition. Within the chassis subsystem, I have set smaller goals that will allow me to stay accountable and on track. The first goal is that by the end of the semester we will have the redesigned back portion of the frame and merged with the front. This will either be done by VR3 or strictly done by the machine shop. My contributions heavily rely on planning and organization, and my deliverables will include outlining a bill of materials and creating drawings to be approved by the machine shop.

Another goal that aims to be finished by the end of this semester is to have the seat and harness functional and ready to be installed.. This means deciding whether or not to have the seat be able to move back and forth, depending on who is driving. It also includes finalizing the mounting point for both the seat and harness. The mounting points of the harness will depend on the rules for the firewall.

Another essential goal that contributes towards the overall rolling chassis is completing new body panels. This task requires the full chassis team to come together and redesign. My specific goals for this task are to research different materials that could be utilized for these panels, and see how they could be implemented. Throughout this redesign we as a chassis subsystem have to emphasize rules compliance.

Another long term goal that I take responsibility for is complete transparency with all other subsystems that are dependent on the chassis subsystem.This includes getting all the mounting locations of the other subsystems; Carman, suspension, GLV, motor controller, drivetrain and cooling. Completing these mounting positions requires a lot of communication between not only

chassis, but each other subsystems. It is a combined effort to stay up to date and make sure that all designs are rules compliant.

John Burk

My role in this project pertains to the hardware design, testing, and integration of the new CarMan board with a focus on the TSI board. CarMan has evolved to be a joint effort, given that we repartitioned the old GLV & TSI boards into GLV, TSI, & Logic in an effort to create a more understandable, logically-separated CarMan design. Tentatively speaking, I'm responsible for the following WBS tasks: 4.2.1, 4.3.2, 4.3.6, 4.10.4, 4.13.1, as well as any other tasks defined by "all" or "full team." Most of these tasks refer to designing board layouts, PCBs, and test plans for the TSI board. Our goal as a team is to have the new boards in the shop for production by Winter Break – consequently, my intent is to uphold my responsibility within the team and ensure completion of TSI and its appropriate documentation. Though these are individual goals, many of these WBS tasks are collaborative and will involve myself and at least one other member of the team.

Through fulfilling my responsibility to CarMan and our FSAE team at large, I hope to further my skills in hardware design and validation. Despite our efforts to simplify and reduce the pigeonholing of extraneous functions on TSI, the board is still the most scattered of the three in terms of focus and scope. As such, I hope to be able to not only complete this task but make an intelligent design that is as bug-free as possible. Beyond the narrow scope of hardware and design skills, I hope to also improve my ability to function in a large team of people working on differing tasks. I am perfectly comfortable collaborating on a team towards a common goal, but I have never really had to consider the work of other subsystems in the same manner as this project. Working together to make a board is one thing, but to accommodate a dozen other subsystem's needs is a new challenge. Finally, I hope to explore the ethical, moral, and social role of the engineer in modern society through our planned lectures with Professor Nadovich.

Da Cheng

Battery Pack Team: Battery packs are designed to be providing the car with proper and safe voltage. Firmwares including Packman (pack management) and Cellman (cell management) will be used for monitoring battery status and communicating with SCADA through CANbus.

For the Battery pack team, the currently finished task is drawing a battery pack wiring diagram (WBS_5.2). Due to remote class constraints, the team plans to build a prototype battery pack with power supply/Lithium battery for firmware debugging. The short term goal, also as the most important goal for the rest of this semester for me will be having Cellman firmware properly functioning on the built battery prototype (WBS_5.6.2). I will need to create test plans and implement them for Cellman (WBS_5.8.1). Having the Cellman successfully debugged, I will join my teammate in Packman debugging due to its heavy work. As a team, we decide to complete all firmware testing on the prototype battery by the end of this semester (Nov. 16/2020). The long term goals, considered as for the next semester (Spring 2021), will be actual battery construction (WBS_5.5.3) and testing on the actual battery. The testing will include all manufactured Packmans and Cellmans function tests (individually without being assembled with batteries) and behavior tests (after being assembled with batteries) (WBS_5.8.2&3).

Based on my role and tasks in this team, I mainly intend to learn about Cellman I2C interface and Packman CANbus data transmission. Since it is a two-man team for the electrical part of the battery pack, there will not be too much leadership involved. As a team member, the most important thing for me is to finish my assigned task on time and try my best to share the other member's task burden. In addition, communications with other subsystems, such as SCADA for CANbus transmission, would also be valued for the whole project. From tasks of the battery pack subsystem,

I see a great opportunity of improving my understanding of data address and transmission through C coding.

Above all, having working Packmans and Cellmans is the main goal for me and the team both this semester and next semester.

Lia Chrysanthopoulos

As a member of the System Control and Data Acquisition (SCADA) team, my long term goal is to create a configurable and maintainable system that relays data for all sensors on the car in a comprehensive and configurable manner. Specifically, my role on the SCADA subsystem has been to create the front end Graphical User Interface (GUI) to display real time data from the sensors (7.6.7). This includes the task of creating a configuration file that can be easily edited by users unfamiliar with code (7.6.8.1). This file will configure the GUI to display specific sensors from the car. I have been given the responsibility to create the layout and decide appropriate attributes that each sensor will be given in the configuration file.

I have also been tasked to create a log file which contains a log of errors that occur when the code is executed (7.7.1) . In order to make the system user friendly, and ensure the user knows what is going on with the system at all times, I have decided to add security features and error messages to the GUI when the code is executed, i.e the user will receive pop-up error messages. This makes the user more aware of errors that are occurring in the configuration file and within the code. This I believe will make error handling and bug catching much easier.

In addition to my duty to create and display data on a GUI, I have been given the responsibility to create a makefile for our code (7.6.8.3). A makefile is a file that would be run before executing our code. The makefile contains a list of rules essentially. These rules tell the system what commands to execute. These commands compile or recompile a series of files, ensuring that the user is running the system with the most up-to-date files. This make file is essential for our program in order to upkeep the maintainability of the system.

I along with Irwin, Mithil, Harrison, and Adam will be working on the manual & maintenance documentation (7.11) and the Build of Materials (7.9). I will also be working on the test plans for the system along with my teammates Irwin and Harrison (7.8). In Spring 2020, I will also be tasked to work on the post processing system and file explore system along with my teammates Irwin, Harrison, Mithil, and Adam (7.13). We have discussed adding some GUI components to post processing, so the user can easily access, read, and rely data on other team members.

Troy Coleman

My role in this project is as a member of the Carman subsystem, which deals with the design of the three PCB and the relay board as well as the Carman enclosure and the interconnections between all the subsystems and Carman. More specifically, my role in Carman will be focused around the design and testing of the Grounded Low Voltage (GLV) and Logic PCB's as well as assisting in the creation of Interconnection diagrams and the Safety Loop diagram. In terms of the Work Breakdown Structure (WBS), I will be working on Carman 4.2, 4.3.1, 4.3.4, 4.10.2, 4.10.3, 4.10.4, 4.10.7, 4.13.2, 4.13.3, 4.13.5, 4.13.7 and 4.13.8 as well as any other tasks that the team needs me to complete. These tasks involve wiring diagrams, board layouts in KiCAD and PCB layouts, creating test plans for the GLV and Logic boards, and uploading documents to the website. My main goal for the end of this semester is to have the GLV and Logic boards designed, ordered, and in the shop for assembly by the winter break. For next semester, my goal would be to get GLV and Logic as well as the other Carman parts integrated and working in the whole car. This goal would require some testing as described in the WBS and the success of the other parts of the Carman to work as a unit.

Over the course of this project I intend to develop skills in using KiCAD, designing PCB's, learning about board design, learning about ground isolation between systems, learning about communications protocols (I2C, SPI, CAN), analog design, using relays and isolators, safety in high voltage environments, effectively communicating with a large team, and keep accurate documentation on all the work I do. There are probably other skills that I will develop during this project that I either forgot to mention or that I don't even know about yet. That's the great thing about this project, it provides the opportunity to learn many useful skills that I didn't even think I needed.

Emily Cook

In this design project I am in the suspension subsystem as a mechanical engineer. My group works on suspension but we are also involved in decisions regarding design and implementation in the frame, steering, and braking systems as it pertains to the suspension of the automobile.

The redesign of the rear frame of the automobile was done in order to provide more room for electrical and cooling components, as well as make for a more efficient design. As a result, the rear suspension has been the primary focus for alterations so that more space can be provided for those components and so the ride height is in compliance with the rule's requirements with the new design.

The rear suspension is now being designed to have steel members in a triangular shape above the A-Arm mounts on the new frame design. These members extend the horizontal frame of the vehicle so that the coil-over shock absorbers can mount to the top of the upper A-Arm plates rather than the lower A-Arm plates as in the previous design. This also allows the shock absorbers to be mounted in a more vertical position than the previous design, rendering them more effective. The ride height will also benefit from this design for the shock absorbers.

The Inventor assemblies and design reviews for this new design are set to be complete by October 21st. I will be working primarily on the Inventor assemblies as way to conceptualize and document the design progress for the design reviews. This allows professors and other team members in other groups to better understand the goals of my team, and pictures of the Inventor models can be uploaded to the website to document our progress on that platform as well. These and other goals for the implementation and testing of these designs is included in the Suspension section of the WBS.

It is the long term goal of myself and the other members of the suspension team to have a rolling chassis that complies with the rule requirements for ride height, heave, roll, and pitch requirements, and provides the space necessary for other subsystems to work effectively on the automobile. The rolling chassis can hopefully be completed early in the spring semester in order to make time for testing and making other improvements to the design if problems should arise.

Matthew Eckhart

As the team leader for Drivetrain and Cooling, my broad objective in this project is to oversee and participate in the design, manufacturing, and construction of the Cooling and Drivetrain subsystems. I am handling all cooling-specific management work (WBS, schedule, purchasing , subsystem deliverables) and some for both Cooling and Drivetrain (website documentation, mid-week check-ins).

Within the cooling subteam specifically, I personally completed the wiring diagram (8.2) and cooling calculations among a number of lesser tasks. I had a limited role in creating our Inventor models (8.1). Instead, I did all of the hunting down of information for Jack so he could work uninterrupted. I have also been coordinating cooling with drivetrain, frame, interconnect, and TSI to ensure our system is effective, mounted, powered, and controlled. This mostly consisted of sending technical information to other subteams and voicing concerns in meetings.

My current focus on the project is the completion of a BOM (8.10) so we can begin ordering (8.3) and assembling (8.6) parts to construct the prototype cooling system (8.7.1).

In the future of this project, there are several tasks I would like to complete myself or be a part of. I plan to take the lead on assembling and testing the cooling system while also being an active participant in the drivetrain assembly process (presumably led by Lucas). I will also continue as team leader for Drivetrain & Cooling, completing deliverables and updating the website as appropriate.

Further in the future of the car, I am also willing to lend my hands to any mechanical subsystem in their assembly process. I have basic machining and fabrication experience including welding. I would value an opportunity to contribute to a rolling chassis while building my knowledge of metalworking.

Lucas Foulk

As a system engineer who will be overseeing the mechanical side of this project my overarching goal is to direct, participate in the design of, and deliver a mechanically sound, functional, and practical Formula SAE ready car. In this roll I will help to solve the technical problems that may arise in all of my subsystems which include steering, suspension, braking, drivetrain, cooling, frame/chassis, and the cockpit. While Matt Eckhart is the drivetrain team lead, I will also be handling the redesign of the entire drivetrain system. I am handling all drivetrain-specific management work including the WBS, schedule, purchasing , subsystem deliverables as well as all of the engineering work including redesign, inventor, ANSYS, drawing creation, and assembly. I will be working closely with the machine shop technicians and likely Matt Eckhart, as well as Professor Helm to ensure accurate and efficient manufacturing of all required parts such that the design requirements are met and a functioning drivetrain is completed at the target date.

Within the drivetrain subteam specifically, I personally have completed the redesigned inventor models. (12.1.2) This redesign was fairly significant and addressed some major concerns related to the functionality of the drivetrain. I will complete the entirety of WBS (12.1) in the near future. This includes completing a final independent assembly of the drivetrain, ANSYS analysis of the newly designed parts, and a full integration of the drivetrain assembly on the full car model (12.1.3-12.1.5). I also look to complete WBS (12.2) in the very near future. This will allow a swift transition into manufacturing because upon completion of this work breakdown item all parts and material required for completion of the drivetrain will be ordered and received.

My long term goals for this car include not only completion of WBS (12), the fulfillment

of the revamped drivetrain but also a systematic and systematized Formula SAE car structure (from a mechanical standpoint) that will be able to be reworked and built upon comfortably by future SAE teams at Lafayette. I personally feel that regardless of the circumstances this year, if we are physically unable to assemble the completed car, my goal is to help facilitate the collective learning of the engineering design process. I am also looking to expand and utilize the engineering analysis tools that I have been taught over the last three years in order to create useful physics based models of the dynamics of the car. My hope is that these models will provide the foundation for years going forward and will be easily built upon in order to foster the creation of a more well tuned car.

Finally, I look to add tools to my finite element analysis (FEA) toolbox, increase my knowledge of 3D modeling and drawing creation, build upon my interpersonal and communicative and leadership skills. I also look to increase my knowledge of electrical components and processes by listening to and asking questions about the interconnected pieces of this project where mechanical meets electrical in a ubiquitous manner.

Irwin Frimpong

The overarching goal for the entirety of the Supervisory Control and Data Acquisition (SCADA) is to develop a configurable and maintainable system that acts both as passive data acquisition interfaced with the protocols including CANOPEN and I2C but also an active system that is able to send signals to subsystem ie: Dashboard and Carman.

For the SCADA team, as of now I've been able to obtain a Raspberry Pi and experiment with the integration of the Real Time Clock (RTC) and Inertial Measurement Unit (IMU) with the GPIO I2C pins on the raspberry pi. Since both devices were a few of the many other sensors using the I2C protocol for communication on I2C bus, my teammates (Adam & Mithil) and I developed an I2C Driver (WBS 7.6.1). To address maintainability and configurability, the I2C driver was made with the intention of it being adapted for other sensor data to be received from Carman and the RTC and IMU interface with Scada. We have debugged and tested the driver with the RTC and IMU separately. Moreover, due to addressing issues, specifically the IMU sharing the same base address as the IMU, it warranted a new P.O (WBS 7.3) to put in for a new IMU with a modified address to avoid this conflict.

As of now my focus has now shifted to building the Calibrator class (WBS 7.6.9.1) which integrates Redis Test Server with our database used for calibrating raw sensor data according to their calibration formulas entered in the Configuration File.Once this is complete my goal,is to edit the Configuration YAML file (WBS 7.6.8) to reflect I2C sensors especially from the IMU along with their respective calibration formulas. Furthermore, to finish off the passive acquisition system, I intend on enhancing the Logger class with Mithil (WBS 7.6.9.2) to reflect the changes made with

our Redis implementation with calibration and into integrate it with Postgres to store relevant sensor information which would be key for post processing; Since Postgres is fairly new to me one of the goals from working on logger to gain an understanding of the framework and also the Structured Query Language (SQL) used to talk to the database. Logger also communicates with the GUI Display that Leah is working on, so it entails establishing the framework for that communication.For maintainability I also plan on working on creating a bash install script (WBS 7.6.8.2) to house all the dependencies needed for our software to run all its required services for our DynoRoom Dev Environment. Ultimately, with the passive data acquisition complete, the next goal will be developing a Post Processor framework (WBS 7.13) with the team with the addition of a USB Driver (WBS 7.6.3) for the completion during the second half of the year.

Lastly, I also serve as Team Lead of the SCADA Subsystem and the overarching goal is that my subsystem is on track for the completion of our deliverables before the end of the semester. This includes planning weekly check-in meeting with team members to gauge progress and relaying these updates to management in Monday check ins as well working on documentation with the team, required for our overall success ie (WBS 7.11.1 , WBS 7.9, WBS 7.1,7.2) Ultimately, I not only intended on enhancing my technical skills (ie. Python, Redis, i2c) with this project but also my soft skills as it pertains to communication , leadership, and teamwork.

Chris Mackey

My primary roles within the Formula Electric Team are to create a frame, dashboard, body, and seat for the 2021 car.

The frame subsystem determined at the beginning of the semester that the car used last year did not have a high enough ride height and that while the rear envelope had enough space to fit all of the subsystems it could not accommodate the wires and tubes attached to those subsystems. Our solution was to completely redesign the rear of the car. I have worked with the frame subsystem to create an inventor model of the new rear frame(9.1.1). More recently, I worked with Jack Mueller to dissect the inventor model of the current frame in order to integrate our new rear frame design(9.1.2). We now have a FullCar model. I will be working with the frame subsystem group to make sure that the frame design is sent to VR3 Engineering before the end of the semester. Ideally VR3 will assemble the frame and ship it to Lafayette College by the end of the winter interim(9.2.1).

For the dashboard, I am creating two housings, an instrument cluster that will hold the warning lights and driver display, and an enclosure that will hold button controls such as the Big Red Button. The dashboard subsystem considered a variety of ways to arrange the warning lights and we considered a variety of screens to use to display the speed of the vehicle. The instrument cluster is in its 4th iteration and I am planning on having a complete inventor model(6.1.1) of it by October 26th. I plan on having the dashboard 3D printed by the start of the spring semester. The button enclosure(6.1.2) will also be manufactured by the start of the spring semester. I will acquire fasteners before the start of the spring semester as well. I will learn how to use 3D printers in order

to make the instrument cluster. Through this process, I will learn how to use a 3D printer and how to format drawings for 3D printing. Further, I will expand my understanding of fasteners and engineering fits as these concepts pretain to assembling the dashboard.

For the body, I will be working with the frame subsystem to assemble a body for the car. The frame subsystem is planning on building a fiberglass body. I will assist the frame subsystem with acquiring the materials necessary to set up a fiberglass mold and acquire the raw materials. I will design the car body(9.3.5) in Autodesk Inventor by the end of the semester. In the spring I will assist in assembling the fiberglass. I will learn how to assemble fiberglass and I will further advance my Inventor skills because an aerodynamic car body is one that has few right angles.

Lastly, I will be assisting the frame subsystem to choose a seat, design the hardware required to mount that seat, and design hardware to secure the seatbelts to the car frame. A seat that already belonged to the college was tentatively chosen. I made an Inventor model of that particular seat myself(9.1.4). My teammates worked to add the seat to the model of the whole car in Inventor. If the seat doesn’t provide ample space for the driver as required by the rules, then I will order a new seat before the start of the spring semester.

Zachary Martin

For this project, I intend to work on the CarMan system of the vehicle, focusing on the hardware and testing of the system, such as for the grounded low voltage system(GLV) and microcontroller(LOGIC) boards. I am acting as a team lead so that I act as a point of contact between CarMan and other subsystems while ensuring team members complete their assigned WBS tasks. For short-term goals (end of this semester), I intend to complete tasks 4.2.2, 4.3.1, 4.3.4, 4.10.2, 4.10.3, 4.13.2, and 4.13.3. Completing these tasks will provide CarMan with proper documentation on the GLV and LOGIC boards, an up-to-date and accurate interconnect diagram of the CarMan components, fully designed GLV and Logic boards, and acceptance test plans for the GLV and Logic boards. It is my hope to have the two boards tested over break, as it is my goal to see the boards ordered and ready to be manufactured in the shop by winter break. If that is not possible, I will complete testing tasks 4.11.2 and 4.11.3 next semester.

For long-term goals, I intend to complete the integration between GLV, LOGIC, and the tractive-system interface (TSI) boards. This will be done in the second semester. It is my goal to have the three boards properly connected and able to communicate with each other via I2C.

During this project, I intend to learn about pcb manufacturing, communication protocols, and analog design. Previous classes focused on small signal and low voltage environments, and so I am excited to branch out and learn about high voltage systems, relays, and isolators. I also intend to learn about Can and I2C communication. Lastly, I will learn how to design pcbs and how to lay them out and get them manufactured. As a team lead, I also intend to hone my communication skills, part of an essential skillset for any engineer.

Ethan Miller

As team lead for TSI, and now Carman as a whole, my role has evolved from responsibility for one specific piece of the car to an integral part of TSV, GLV, Safety Loop, SCADA, and everything in between. My goals have also evolved with this change to encompass both completing every individual task and also ensuring completion of Carman as a whole. My overarching goal is to complete Carman (task 4 in the WBS) by the end of this project next semester. As team lead, all sub tasks within Carman fall under my responsibility, however there are some sub tasks that specifically fall under me to complete. These are the Kicad and PCB layouts of the Logic Board and the TSI Board (WBS Task 4.3.2/4/6/7), the Carman interconnect diagram and maintenance (WBS Task 4.2.2), and firmware refactoring and deployment to the logic board (WBS Task 4.8). I will also create and maintain documentation of the Logic board and the firmware (WBS Task 4.13.2) as well as relevant sections in Carman as a whole (4.13.6).

As far as long term goals are concerned, I am responsible for developing the test plan for the Logic Board and working with the rest of the Carman team to integrate Carman into the car as a whole. My main goal is to ensure that the firmware aboard the Logic Board properly communicates with every sensor and other processor in the car.

In addition to the tasks laid out above, there are several skills I want to develop as a part of this project. First and foremost are technical skills that can be refined by working on Carman: the process of designing and laying out PCBs, writing embedded firmware and working with the associated toolchains, and communication methods between different processors such as I2C and CANBUS. In addition, this is the first project I've worked on that requires strict separation of a high and low voltage systems, and I look forward to learning more about ways of separating those via relays and other devices, and managing electrical return paths.

Jack Mills

My main responsibility in working with the drivetrain and cooling team is to design and integrate a cooling system for the car that will allow both the motor and motor controller to operate without needing to throttle down to prevent overheating. The major goal of this subsystem is to produce a complete Inventor model (8.1) as well as a working prototype of the cooling system (8.7.1) by the end of the semester.

While last year's team was able to produce a working prototype of the cooling system, both I and my teammate Matthew Eckhart concluded that it was insufficient due to the size of the radiator used which would have caused the system to become oversaturated under load. As a result, the new cooling system will implement a larger radiator to increase the rate of heat dissipation as well as include a reservoir to increase the heat capacity of the system such that the system can run for a longer period of time under heavy load.

The main tasks I have worked on in order to keep with the end of the semester deadline is designing and modeling how this new system will be positioned and mounted within the chassis (8.1). This means I must keep in communication with the chassis team to ensure that placement of the system's components do not interfere with other team's components. I am also in communication with the interconnect team to notify them of coolant tubes that will be used and how they interface with other systems in the car. I am also currently working on the BOM (8.10) and construction of the cooling system prototype (8.7.1) with my teammate.

In the future, I hope to assist in the construction and integration of the cooling system into the car as well as assist in the assembly and integration of the drivetrain. Following the completion of this, I would turn my attention to assisting other teams such as interconnect or the chassis team in machining and manufacturing of their system components.

Jack Mueller

Chassis:

My overarching personal goal for this year is to deliver a rules-compliant frame that provides logical and ergonomic mounting solutions for every subsystem. To accomplish this, by the end of the Fall 2020 semester, I will have made arrangements for the all-new frame to be manufactured and assembled. Having a ready-to-go frame in the lab next semester will set the team up for success, as the chassis will be in a state that will allow other subsystems to physically mount their components onto the frame.

To ensure my goal is met, it is my personal responsibility to finalize the design of the all-new rear frame. By the end of the Fall 2020 semester, the rear frame technical data package will be finalized and distributed via the Lafayette Motorsports website (Chassis 9.1.2 and 9.10). The rear frame needs to be concrete, such that the design will not change and disturb the progress of their subsystems. Having the rear frame locked down affords the team confidence in going ahead with creating the car's other components.

In order to assure my goal of rules compliance for the overall frame, it is my responsibility for the Structural Equivalency Spreadsheet (SES) to be approved by the Formula Hybrid Rules Committee. By the end of this semester, it is my goal to have submitted the document twice. Once on October 14th, 2020, and another submission in later November (Competition Deliverables 21.1). Allowing for multiple revisions to be done before next semester will afford the team more time and more feedback from judges to ensure the frame is rules compliant from a construction perspective.

To accomplish the entire frame being assembled over the Winter 2020 interim, my goal is to have determined whether VR3 Engineering or the Lafayette College Machine Shop will be responsible for welding together the individual members that comprise the new rear frame. This

decision will have been made using a price estimate provided by VR3 Engineering. My goal is to have submitted a price evaluation to VR3 before November 2020, as that will afford the team and the Professors time to make an informed decision regarding how the frame will be constructed. Within the VR3 price request, it is also my goal to create a bill of materials (BOM) for inventory and organization purposes (Chassis 9.9).

In order to have all steel tubes be ready for welding and assembly, it is my personal responsibility to have all Inventor drawing files approved by Professor Helm before Winter break and all steel tubes purchased and sent to VR3 Engineering or the Lafayette College Machine Shop for manufacture (Chassis 9.3.1). It is my goal to lock down both the manufacturer and the assembler of the frame, such that the frame can be assembled throughout the Winter Interim and ready for individual subsystem work come the first week of next semester.

Battery Packs:

As a member of the Battery Pack team, I am responsible for the construction of two rules-compliant accumulators for the 2021 Spring semester. From a Mechanical Engineering perspective, I define rules-compliance as relating to the adherence of all rules of construction for high-voltage accumulators in assembly and layout of all of the individual components that comprise each accumulator.

It is my responsibility to ensure that the accumulators that the team intends to race with will be constructed in a manner that violates no rule as defined in the 2021 FSAE-EV regulations. As it is my goal to have the car compete on track next semester, it is my responsibility to allow for the car to pass technical inspection.

I will work with the Lafayette College Machine Shop and independent vendors to gather all components necessary to assemble two rules-compliant accumulators. I will represent the work performed by Battery Packs in all formal reports, Inventor models, and on the automobile. For any component intended to be manufactured by the Lafayette College Machine Shop, it is my responsibility to have the part drawing of such component approved by Professor Helm before being submitted.

After all parts have been created or ordered (Battery Packs 5.4.4), I will assemble the two accumulators and then mount them to the car (Battery Packs 5.5.3). If any faults or errors are discovered with the current design, I will bring the battery packs into rules-compliance through design reviews and interaction of design.

If any changes are to be made as suggested from the Electrical Engineering side of battery packs, I will ensure that those changes are reflected in the overall 3D CAD models of the accumulators, as it is my goal to have the Inventor model match the physical body of the accumulator (Battery Packs 5.1).

It is my goal to have created a bill of materials (BOM) for the Mechanical side of battery packs, such that construction and inventory of components are easily done and transparent (Battery Packs 5.9.1).

With all of these goals and responsibilities, I will have laid out the groundwork in order to assure the Lafayette Motorsports team with rules-compliant accumulators that will reliably send electrical power to the motor controller.

Devin Murphy

My goals for the project are easily separated into two sections, fulfilling my role as a member of the management team and working as a part of the interconnected subsystem. My goal of working in management in this project is to create a positive work environment and sense of "team" whilst keeping the team on track and accountable. In the interconnect team I plan to complete the testing module to help speed up the fabrication of connectors. In order to complete the testing module, I will create its inventor models, translate them into drawings with the help of the mechanical engineers inside the interconnect subsystem, create electrical diagrams for the internals of the tester, and assemble the test module. (3.1, 3.2, 3.3, 3.4, 3.5, 3.6 of the WBS). I hope to streamline the connector types in the car (3.2 of the WBS) to further simplify the fabrication process and make the testing module more effective and remove clutter and confusion from the interconnectivity of the car.

Beyond the technical skills and quantifiable goals laid out above I want to utilize the unique remote working environment to learn how to work within and lead a team without in-person interaction. We don't know for how long the global pandemic will impact the world's working environment but, we can adjust to what remote work means with the FSAE car project.

Zach Pitner

My role on the 2020-2021 FSAE EV team is to work as a member of the Project Management Team. The role of management in this project is to provide structure and assistance to the engineers working on the project in order to ensure that the team's goals are met, as well as working to complete team deliverables for both the course and the competition.

I am contributing to the team primarily by working to complete and submit key deliverables such as TD001 - Conceptual Design Study (WBS 22.1) and TD002 – Design Proposal (WBS 22.2), as well as other future deliverables. I have already worked to deliver the first two 5-minute updates (WBS 22.5), and actively facilitate the weekly team status updates (TD004) (WBS 22.4) on behalf of management. I am also managing the purchasing for the project and will take the lead on TD018 – Purchasing Report (WBS 22.15). I will provide weekly purchasing updates to keep the team up to date. I plan on continuing to work to communicate effectively with team members by holding weekly work plan meetings with the System Engineers, and by scheduling meetings with teams who have concerns about the various issues that may arise.

Personally, I see this project as an opportunity to expand my experience within project management. I will hone my presentation and effective communication skills, while continuing to practice best organization and management practices. Above all, my goal is to see this project to its completion and do anything that could possibly help the team reach its goals.

Jackson Pogue

Suspension:

The suspension subsystem is designed to hold a fully loaded chassis off the ground. A rolling chassis is planned to be ready by February 26th, 2021. The rear part of the suspension subsystem is currently being redesigned to a triangular group of steel members above the A-Arm mounts on the new frame. This triangular structure is used to extend the horizontal frame so that the shock absorbers will be mounted to the upper A-Arm plates instead of the lower A-Arm plates, allowing the shock absorbers to be more vertical than the previous design, making them more effective.

Within this subsystem my job at the moment is to compile inventor files and assemble them for the wheels and uprights for the suspension as a means to document design progress and conceptualize it as there will not be a physical model for some time. Doing this also gives our advisors, other team members, and anyone who would like to track and critique our design a means to understand what we are doing and how we are progressing.

Steering:

The steering subsystem is designed to allow the car to turn and control the rate at which the car turns. Within this subsystem I am also going to be responsible for determining whether the planned steering subsystem from last year is functional and able to comply with FSAE rules and to redesign it if necessary as well as assemble the steering subsystem regardless of whether a redesign is necessary.

Braking:

The braking subsystem is designed to be able to stop a car that is moving at full speed in a safe and controlled manner.

While my group's primary foci are steering and suspension, we will be involved in the decision making for the braking system as it is closely related to and affects the steering and suspension subsystems.

Jonathan Rosenblum

My role in this team is to work as a mechanical engineer for the interconnect subsystem, and as a result of this, also for the Carman subsystem. My current main role is designing panels and enclosures in Autodesk inventor. During the later portion of the semester I will assist with mounting and assembly of the Carman, as well as other “Interconnectivity” wires.

My planned tasks are to design the side panels of the car 6.1.3, as well as redesign the carman enclosure in inventor (4.1.1-3, 4.1.7). The top, side, and bottom and back panels as well as connection panels must be redesigned, and I must ensure this enclosure extends to the Motor controller. I will then be in charge of the manufacture (4.6, 4.5.1) and assembly (4.7.5) of these parts, as well as their documentation (4.12.4, 4.13.6). Another task is to design a physical model of the cable test bench (3.1) for later assembly (3.7). as well as for documentation. Later I will have the task of designing and choosing mounts and brackets to secure various cables and hoses safely to the car (3.1).

My long-term goal is to be one of the individuals who assists in mounting and securing the wires and electronics to the car (3.7).

My current role in the team is less a leadership role and more of a role as “assistant” to Ben Surman, the Systems engineer. I am content with a support role here, as it allows me to lighten his heavy workload, which I know is a contribution to the team. As a result of working with the systems engineer on the Interconnect team, I am also “on call” for fixing physical enclosures and mounts that may not work or may have errors, though being “on call” is not something that can be displayed in the WBS it is shown in my sudden assignment to the Carman system, and the Car side panels when it was decided that modifications needed to be made to those systems.

Working interconnect has already been a learning experience and it will continue to be so. I thus far learned of the flexibility and especially inter-subsystem communication required to ensure that various electronics work with each other, as well as with their physical enclosures. Currently I have been gaining much needed experience in Autodesk inventor by designing unique parts and using its more unfamiliar features such as sheet metal. I have also been gaining familiarity with electronic components by learning about wiring diagrams as well as what physical and electrical traits to note when purchasing electronics from sites such as McMaster and Digikey.

Mithil Shah

As part of the SCADA subsystem, my role in the Formula Hybrid 2020-21Team is to ensure we have a working supervisory Control and Data Acquisition System. My personal responsibilities include overviewing a variety of SCADA documentation, as well as writing code for the SCADA system, which is a shared responsibility of mine with various team members.

I am responsible for the Software Architecture Diagrams and Class Descriptions, and for ensuring that our ideas or features that we are implementing in our design are accurately communicated through the Software Diagrams and Class Descriptions. I am also responsible for the Wiring Diagrams and to ensure that both Wiring Diagrams and Architecture Diagrams are routinely updated. Furthermore, I am responsible for the website to make sure the design reviews, important changes, and any other relevant documentation finds its way to the website to be appropriately shared. I am responsible solely for the Tasks 7.1, 7.2, and 7.10 from WBS.

I am also responsible for coding and various other shared responsibilities including working on the I2C Drivers to have the ability for the SCADA system to communicate with CarMan and read as well as write using an I2C bus. I am responsible for the Calibrator class along with other members from SCADA to make sure that all the raw data from any bus type is calibrated appropriately to be displayed as human readable values. Some team members and I are working on a Logger class to store the acquired data in order to display it on the CarMan Display and to be used in the Post Processing Tool. I am also responsible for ensuring that the various classes and methods described above are all interconnected and that they all work together in a SCADA system that is assembled, which all members of the SCADA team are responsible for. I am also working with a comember on documentation and plans for testing to cover various cases to ensure SCADA is

extremely reliable. I also plan to help with and work on various tasks that come up, and help compile a User Guide/Manual and a Maintainability Documentation. I am responsible for the Tasks 7.5, 7.6, 7.6.1, 7.6.9.1, 7.6.9.2, 7.7, 7.8, 7.9, 7.10, 7.11, 7.11.1, and 7.11.2 from the WBS along with various other team members for this project.

In the future, I am responsible for ensuring that SCADA is able to take the data and process it through a post processing tool, which I plan to work on with other team members, as well as take responsibility for a working Parallel IO Driver to enable it to read from Parallel IO bus in the next semester. This includes continuing my responsibilities for the previous roles mentioned along with the WBS tasks of 7.6.4, and 7.13.

Through working on the SCADA system and the FSAE project I hope to acquire various technical and interpersonal skills that will help me succeed in a professional environment. I hope to learn technical skills such as writing code in Python, working with CANOpen and I2C busses, and the Redis Database interface. I also hope to develop interpersonal skills such as communication, conflict resolution, problem solving, and more largely due to the collaborative nature of the FSAE project. I also hope to learn relevant engineering skills during the lecture such as safety and ethics, and apply it to this project and my professional engineering career.

Thomas Stranick

Working as a team member of the 2020-2021 Lafayette Formula team my main goal is to support the team through management as well as my role in the External Panels and Lights sub team. Within management I aim to write professional documents for turn in for the class and competition deliverables as well as help keep the team on track through a well-defined work breakdown structure. On the EPAL sub team I aim to create and design electrical and software systems that provide meaningful notification of the car's status to the driver and other team members.

In my role in management thus far, I have helped formalize TD001 and TD002 to provide the information needed according to the Statement of Work. Making sure everything that is outlined on the requirements document is key to having a complete deliverable that can be presented or read. For the long term I look to continue this with reports such as TD007,009,010 as well as presentations like TD008 and 011. I also organize the creation of every Monday agenda and make an announcement such that people are not confused or curious as to what is being discussed in the meeting. I will continue to do this throughout the year. Something that I had not initially planned on doing however took the reins of was completing a WBS that allowed the team to see the high-level breakdown of the project as well as what dates need to be met. This will be an instrumental document to help the project move forward and hold people accountable in the future. Website management is also something that I have done and will continue to do moving forward to make it presentable and ensure all information is present.

At the beginning of the project I looked to accomplish an embedded engineering task, and thus joined the EPAL team. In this team I intend to focus on the electrical hardware as well as software that encompassed the front dash, button array, and now side panels. In the immediate,

WBS tasks 6.2 and 6.4 are the focus, wiring diagrams and PCB layouts. I intend to contribute to these and help complete them fully such that the development of the individual parts can proceed. After the hardware is designed and documented I intend to focus on 6.5 Software development for the duration of the semester. When we are back on campus the focus will be on 6.9 and 6.10, the actual construction of our subsystem. I also look to contribute to all documentation outlining what the systems do as well as update the website to reflect what we are working on.

Through this project I intend to learn more about how to use KiCAD to design PCBs as well as Inventor to view the full car. Working with the Raspberry Pi is also something that I have never done before and hope to learn how to code for it and allow it to work within the subsystem. As management, I will learn how to look at a project from a very high level perspective to then help format the schedule and tasks that need to be done. This role will allow me to experience what it is like to be a Project Manager for a large scale project and help the team succeed.

Benjamin Surman

For the 2020-2021 Lafayette College FSAE Senior Design team I am the Electro-Mechanical Systems engineer as well as Interconnect team lead. My goal is to make sure nothing falls through the cracks having a high-level view ensuring all aspects, mechanical and electrical, electrical subsystems are addressed. With the ultimate goal that all electrical subsystems can be successfully integrated.

As team lead for interconnect I am ultimately responsible for the successful completion of all the subsystem's task. Specifically, I am personally responsible for the LCFSAE Electrical System Wiring Diagram, and its accompanying wiring lists (WBS 3.2). As well as ensuring that all other interconnect diagrams are compatible and sufficiently similar with each other. I will use the completed system wiring diagram to select the electrical connectors and wire/cable needed for interconnecting the various subsystems in the car, per WBS 3.2. Trying to standardize the specifics connectors and cables used, as much as possible. Due to the large number of interconnections within the carman subsystem an additional goal of mine is the completion of the relay board. Specifically, in the short term to complete all the board's WBS tasks. I am also handling parts of the carman enclosure design working with Jonathan specifically focusing on the parts involving the relay board and motor controller (WBS 4.1.4-5,4.3.3,4.7.3).

Longer term goals of mine are to ensure successful dyno integration and full car integrations, working with the other subsystems to ensure that the car is fully integrated (WBS 1). As part of interconnect my longer-term goals are to keep the ESWD up to date (WBS 3.2). As well as the physical creation of all the cables of the car, along with the other members of the interconnect team (WBS 3.6). For my responsibilities within CarMan longer term goals are to ensure the successful integration of the relay board within the CarMan assembly (WBS 4.9).

Lastly, from participating in this project I am looking to increase my skill working within a team, specify in a leadership capacity as both a subsystem lead and system engineer. As well as developing my knowledge of electrical components and theories. Increasing my ability to preform and oversee electrical integration.

Adam Tunnell

My role in this project is both as Software & Firmware Systems engineer and member of the Supervisory Control and Data Acquisition (SCADA) team. As part of my Software & Firmware Systems engineer role, my goals consist of ensuring the subsystems I overlook are rules compliant, compatible with each other, and meet the specifications for making a one-hundred percent complete car. For my team-member role, my goals include tasks 7.6.1, 7.6.5, 7.6.5, and 7.6.9.1 on the SCADA team's work breakdown structure (WBS). For clarification, my goals for this semester are the tasks I have listed for SCADA. Goals for the next semester will be decided based on what is completed at that time as well as continuing with the responsibilities I have as Software & Firmware Systems engineer.

Outside of planned goals for this project, there are some skills I expect to need to develop to aid in completing the car. For my SCADA member role, I will learn Python, Redis, CAN and I2C as well as other interfaces if needed. As a Systems engineer, I will practice my leadership, communication, and system analysis skills. Lastly, I will participate in the ethics and safety discussions during the Wednesday Electrical Engineering lectures and incorporate what I learn there into the project.

Harrison Walker

As a member of the System Control and Data Acquisition (SCADA) subteam, my overall long-term objective is to develop a configurable and maintainable system that acts both as a passive data acquisition interface for all sensors on the vehicle and an active system that is able to send signals to control subsystem components. More specifically, my role within SCADA is to implement functionality for the Controller Area Network (CAN) protocol, both for data acquisition (WBS 7.6.2) and for active control (7.6.5). Within CAN, I will be focusing my efforts on sending/receiving data and control messages using the open-source CANopen sub-protocol. I am also responsible for integration of the SCADA system with Dyno Room hardware (7.12) in the short-term and final vehicle hardware in the long-term.

In addition to the tasks taken on myself, I am collaborating with other members of the SCADA team in the short-term to create an install script for easy setup of the system on a new device (7.6.8.2), create a test plan for the entire system (7.8), and update our manual and maintenance documentation to reflect new user-side functionality (7.11). In the long-term, I will collaboratively implement a driver for USB protocol (7.6.3) and complete development of a post-processing and file exploring tool for organized review of test data recorded to our PostgreSQL database (7.13) during the spring semester.

In the process of completing the aforementioned goals in service of producing a fully-functional electric vehicle for the 2021 Formula Hybrid competition, I also intend to develop my engineering skill set. By developing software with Python and Tkinter, I will deepen my understanding and prowess in the Python programming language. In addition, I will become intimately familiar with all data protocols handled by the SCADA system: CAN, I2C, USB, and Parallel I/O. By taking the lead in integrating our system with working hardware, I will gain

experience in software deployment, specifically on Linux-based systems such as Raspberry Pi. By creating a system that takes action to minimize danger on-board the vehicle, I will also gain a deeper understanding and appreciation of the safety standards in my field of expertise. In addition to hard engineering skills, I hope to further develop my teamwork, communication, organizational, and collaborative problem-solving skills.

Tony Xiao

Battery pack: System designed to provide sufficient power to the tractive system voltage(TSV) for the vehicle to drive. It also takes various measurements of lithium cells. Including temperature, voltage and current. Lastly, it needs to provide safe means to contain and operate the battery.

I'm mainly in charge of developing the battery pack management board (Pacman). This involves analyzing current Pacman schematic and PCB layout to determine whether it can perform a few crucial tasks: Firstly Pacman need to be able to collect information from each cell management board (Cellman), then it need to be able to correctly display those information on the side display on the pack, as well as sending those information to Supervisory Control And Data Acquisition system (SCADA) though Canbus. Lastly it needs to be able to control the charging of the battery. This validation of the old Pacman board is documented in work breakdown structure(WBS) as 5.6.1. If the current version 1.2 Pacman board turned out to be unsuitable for the task, I will be in charge of either fixing the existing board or modify the schematic and manufacture a new board.

After the circuit board of Pacman is determined to be suitable, I will move on to the programming of the Pacman firmware. This involves locating and analysing the current version of the Pacman firmware, and making the necessary changes. The goal is for the firmware to aid the circuit and perform the three tasks required from the Pacman. The difficulty of this task, at time of writing the deliverable, is still largely uncertain. Should it get too tricky, I will need to seek help from Da to solve the unforeseen problems. The coding of the firmware and its debug is tasked in work breakdown structure as 5.6.3.

To assess the working of Pacman, I will produce a test plan as described in the work breakdown structure 5.7.1. To develop and confirm the passing of the tests, I will take part in the development of a prototype battery pack. The prototype will be using the actural Pacman and Cellman, but will use power supply or 18650 Lithium cells instead to ensure the safety during testing. The test plan will be devised through the development of this prototype system and be used to test the Pacman before and after the final assembly of the battery pack.

Lastly, I'm the team leader of the battery pack. I will be in charge of planning and documenting the work of the battery pack sub-team, provide brief overview of the progress of the team on Monday meetings, and meet with the management team during midweek meetings to discuss details of the requirements and needs of the sub-team.

Overall, during the development of the battery pack, I will be incharge of the circuit, firmware and testing of the Pacman, while helping the rest of the team should the need arise.

Han Xu

The primary goal of the EPAL subsystem is to deliver a user-friendly and rules-compliant front dashboard and buttons display that can inform the driver of the car's running status while driving. Also, the EPAL team will undertake the delivery of all other external panels, lights, and buttons. Thus, my role in this project is to deliver the above primary goal with my teammates successfully. In short, my role is the design and implementation of the dashboard and other signal systems. To accomplish this, I aim to finish WBS 6.1-6.7 by the end of the Fall semester, which includes inventor models, wiring diagrams, software diagrams, board layouts, software written, parts ordered, and drawings sent to manufacturing. Other WBS tasks, including WBS 6.8-6.14, are goals that I aim to achieve in the Spring semester. Through the WBS tasks, I can develop my design, technical, and writing skills. Designing wiring diagrams, software diagrams, and board layout will enhance my skills in planning and designing. The software planning and development will build up my software development skills using Python and expose me to Raspberry Pi development, Linux, and understanding of computer networks. Preparing for the website documentation will enhance my writing skills.

Other than the WBS tasks, I serve as the Team Lead of the EPAL subsystem. The role as the EPAL Team Lead includes communicating with other subsystems closely especially Carman and SCADA, speaking to the management and professors on behalf of the whole team, planning weekly meetings to keep track of the progress, making sure each individual is assigned his role and work weekly, and ensuring the whole team is on the right track. Eventually, this helps me to strengthen my leadership, communication, and cooperative skills. The team project also features the collaboration between interdisciplinary fields, including mechanical engineering and electrical engineering. This is a miniature of real-life where the interplays of different areas matter. I plan to

utilize this experience to learn to work and communicate efficiently and effectively with people from various fields to better prepare myself for my future career.

Jeremy Yu

For the senior design project, my role is to work on the carman system, which is mainly about parts list and bill of materials. Specifically my role will focus on estimating the budget, list and order parts, communicating with manufacturers, and tracking the packages. In addition to that, I am also taking charge of drawing the PCB layout of GLV and logic board, board inter connection, carman integration, creating a test plan of GLV board, and updating the website documentation of GLV board. I will complete task 4.2, 4.3.5, 4.3.7, 4.4 (4.4.1-4.4.5), 4.10.3, 4.10.4, 4.10.7, 4.12.1-4.12.3, 4.13.3, 4.13.7, 4.13.8. My main goal for this semester is to get every part needed in carman on time, design, assemble, and make the test plan for the GLV board. Next semester, I will mainly focus on the performance of the GLV board in physical tests and the communication of the GLV board with other boards. The integration of carman will be done next semester also.

Over the course, I further my skill in KiCad and PCB layouts. Also, I learned the procedures of doing a project: learning from the past, reading rules and understanding design goals, and realizing the team idea. In addition, I learned more about the communication protocols of I2C, SPI and CAN. I further my understanding about analog design, knowledge of mosfet, safety loop, relay stuff, and some other elements like AIRS, IMD.