Project Execution Plan

Due: February 12, 2024

ENEL 400: Electrical Engineering Design and Technical Communications

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Group 2

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Introduction

This project execution plan will serve as a roadmap designed to guide us through the successful implementation of our Finger Tracking Smart Glove project. In this document, we outline the scope of work, responsibilities, timelines, deliverables, and reporting requirements needed to accomplish our goals effectively. We aim to deliver high quality results while managing the risks to ensure our users satisfaction.

Scope of Work

Objective Statement

Our objective is to design and implement a finger tracking wearable smart glove with the aim of creating a user-friendly product for interfacing with diverse software and hardware devices. Our project aims to deliver fast, accurate, and consistent flex values, ensuring a seamless user experience.

Project Scope

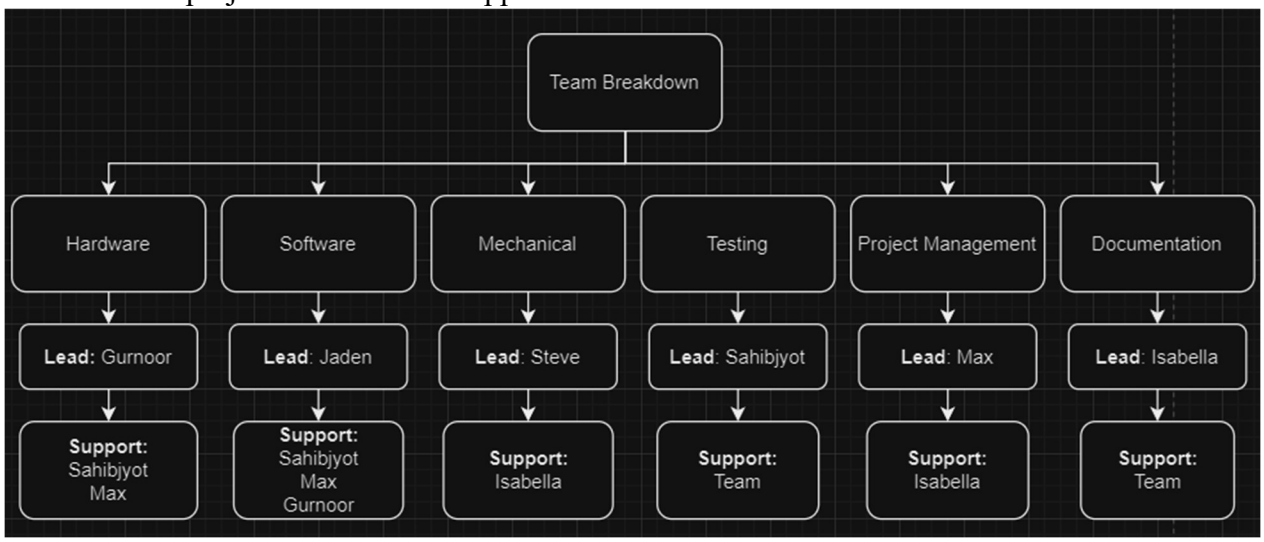
The scope of this project primarily involves interfacing with an analog sensor to determine finger flex positions, managing power to ensure extended battery life, establishing seamless wireless communication, developing software for device pairing and diverse computer applications, and integrating with an RC car to demonstrate hardware device interfacing. There are many other areas we could focus on to improve this project and make it commercially viable but for this course we will only be documenting these ideas as we go along.

Final Deliverable

At project completion, our aim is to deliver a fast and accurate smart glove capable of reliably tracking finger positions. The minimum viable product will entail a glove capable of determining the degree of finger flexion. While discrete small movements may not be tracked, the glove will provide general open-to-close percentages that will allow for software and hardware interfacing.

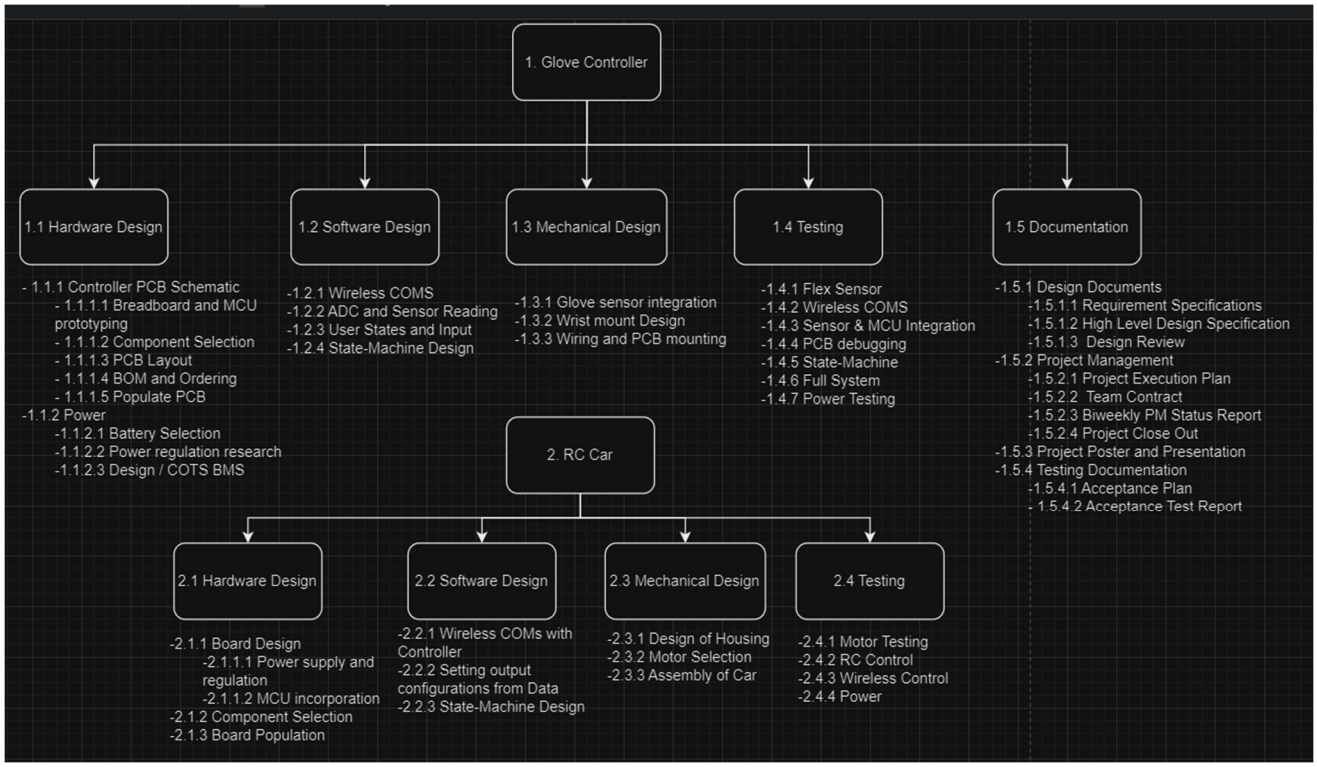
Organizational Chart

Below is a flow chart showing the breakdown of roles with-in the team, outlining leads of each section of the project and the main support for each section.



Work Breakdown Structure

4.1 Breakdown Flow-Chart



4.2 Glove Controller Breakdown

4.2.1 Hardware Design

Project	Glove Controller
Work Package ID	1.1.1.1
Work Package Name	Controller PCB Design -> Breadboard and MCU prototyping
Work Package Description	Design and prototyping of initial flex sensor systems using the flex strips and ESP32 development boards on breadboards and available MCUs with same peripherals as the ESP32.
Assigned To	Gurnoor, Max
Estimated Effort (hours)	20 (10 research + 4 hardware set up + 4 code + 2 testing)
Estimated Cost ($)	$50

Table 1: Task 1.1.1.1 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.1.1.2
Work Package Name	Controller PCB Design -> Component Selection
Work Package Description	Selection of components based of requirements of the hardware after testing and initial high-level design planning. Looking for component availability, ordering time, and component specifications.
Assigned To	Gurnoor
Estimated Effort (hours)	2 hours
Estimated Cost ($)	$0

Table 2: Task 1.1.1.2 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.1.1.3
Work Package Name	Controller PCB Design -> PCB Layout
Work Package Description	The board schematic and PCB layout in Altium Designer keeping it to a 2-layer board to minimize cost, following best design practices and size constraints of board.
Assigned To	Gurnoor, and Jaden for help/review
Estimated Effort (hours)	25 hours (5 for compiling library, 3 for schematic Layout, 10 PCB layout, 3 for review and revisions, 3 for trouble-shooting any issues)
Estimated Cost ($)	$0

Table 3: Task 1.1.1.3 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.1.1.4
Work Package Name	Controller PCB Design -> BOM and Ordering
Work Package Description	Compiling the BOM for all components needed for the board, as well as Gerber file preparation and board ordering through JLCPCB. To be done in **parallel** with the power system ordering
Assigned To	Gurnoor
Estimated Effort (hours)	2
Estimated Cost ($)	$150

Table 4: Task 1.1.1.4 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.1.1.5
Work Package Name	Controller PCB Design -> Populate PCB
Work Package Description	Placing and soldering of the components onto the PCB board, will most likely use a stencil and solder for ease of use due to surface mount components.
Assigned To	Gurnoor, Jaden, Sahibjyot or anyone interested
Estimated Effort (hours)	3
Estimated Cost ($)	$0

Table 5: Task 1.1.1.5 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.1.2.1
Work Package Name	Power -> Battery Selection
Work Package Description	Battery selection between LiPi and Lithium cell, as well as the size and capacity of the battery based off power requirements of the system.
Assigned To	Steven, Isabella, Gurnoor
Estimated Effort (hours)	6 (3 for research, 2 for requirement selection, 1 for meeting and decision)
Estimated Cost ($)	$0-$20 (Possibility of recycling old portable charger for LiPo Battery)

Table 6: Task 1.1.2.1 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.1.2.2
Work Package Name	Power -> Power regulation research
Work Package Description	Look into power regulation requirements of the board and battery systems, and if a BMS or other components are required.
Assigned To	Gurnoor, Jaden
Estimated Effort (hours)	10
Estimated Cost ($)	$0

Table 7: Task 1.1.2.2 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.1.2.3
Work Package Name	Power -> Design / COTS BMS
Work Package Description	Design of a BMS and power regulation board to be done coinciding with the controller board design, and/or purchase of a pre-made BMS and power regulation system.
Assigned To	Gurnoor, Jaden for review/help
Estimated Effort (hours)	10 (6 for PCB schematic and Layout and/or COTS board research, 4 for review and revisions)
Estimated Cost ($)	Shared cost with task 1.1.1.4

Table 8: Task 1.1.2.3 WBS Dictionary Entry

4.2.2 Software Design

Project	Glove Controller
Work Package ID	1.2.1
Work Package Name	Wireless COMS
Work Package Description	Research and design of the wireless communication protocol between the glove controller and peripheral devices (RC car). One way communication to be implemented in the design with data packages containing 5 to 7 variables
Assigned To	Jaden
Estimated Effort (hours)	25 (5 initial research, 15 for code and 1-way communication set-up, 5 for debugging and refining)
Estimated Cost ($)	$0

Table 9: Task 1.2.1 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.2.2
Work Package Name	ADC and Sensor Reading
Work Package Description	System integration of flex sensors and IMU with the ESP32 board. Multiple approaches to be researched and made to ensure best data results, and speed of communication and sampling to be selected.
Assigned To	Jaden, Max, Gurnoor
Estimated Effort (hours)	20 (5 for research, 10 for design, 5 for debugging and refining)
Estimated Cost ($)	$0

Table 10: Task 1.2.2 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.2.3
Work Package Name	User States and Inputs
Work Package Description	Reading sensor data and providing different states, such as bent, straight, half bent, etc based of flex sensor data. Also giving variables/actions to be performed by the peripheral device given the state of each finger/ flex sensor.
Assigned To	Jaden, Team for input of actions
Estimated Effort (hours)	15 (5 data reading methods, 5 faulty data fail safe design, 5 action implementation)
Estimated Cost ($)	$0

Table 11: Task 1.2.3 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.2.4
Work Package Name	State-Machine Design
Work Package Description	State-machine design for the system following the high-level overview given in the design review. Defining all states needed for system and criteria needed to advance from each state.
Assigned To	Jaden
Estimated Effort (hours)	14 (4 initial state-machine design, 4 code implementation of design, 4 code compilation from previous tasks, 2 for debugging)
Estimated Cost ($)	$0

Table 12: Task 1.2.4 WBS Dictionary Entry

4.2.3 Mechanical Design

Project	Glove Controller
Work Package ID	1.3.1
Work Package Name	Glove Sensor Integration
Work Package Description	Design of the glove the user will wear and the integration of the sensor and boards onto it, making sure it stays unrestrictive, low-profile, and does not hamper sensor readings.
Assigned To	Isabella, Steven
Estimated Effort (hours)	15 (2 initial design, 8 sewing and manufacturing, 5 review and revisions)
Estimated Cost ($)	$15

Table 13: Task 1.3.1 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.3.2
Work Package Name	Wrist Mount Design
Work Package Description	CAD modelling of the wrist mount that will be used to house the power for the system and controller board. Designing for comfort, size, ventilation, and weight for 3D printing.
Assigned To	Steven
Estimated Effort (hours)	20 (2 compilation/ design of assets, 3 for design of casing, 15 for revisions and prototyping design)
Estimated Cost ($)	$0

Table 14: Task 1.3.2 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.3.3
Work Package Name	Wiring and PCB Mounting
Work Package Description	Sourcing of flexible and durable wires for the connection of the glove sensors to the main controller and power unit in the wrist mount. Wiring the devices in an organized and unobtrusive way for the user.
Assigned To	Isabella, Steven
Estimated Effort (hours)	2 (1 sourcing wire, 1 running wiring)
Estimated Cost ($)	$10

Table 15: Task 1.3.3 WBS Dictionary Entry

4.2.4 Testing

Project	Glove Controller
Work Package ID	1.4.1
Work Package Name	Flex Sensor
Work Package Description	Testing of the flex sensors range and accuracy, ensuring it meets the requirements of the system and is consistence over different sensors, time, and charge of device.
Assigned To	Max, Gurnoor, Jaden
Estimated Effort (hours)	20 (10 Testing of flex sensor readings two different ways, 10 characterizing the sensors)
Estimated Cost ($)	$0

Table 16: Task 1.4.1 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.4.2
Work Package Name	Wireless COMS
Work Package Description	Testing the wireless communication protocol being used (ESP-NOW) the transmit speed, max data size, delay, max range of communication, and expandability such as multiple devices, or 2-way COMS
Assigned To	Jaden
Estimated Effort (hours)	5
Estimated Cost ($)	$0

Table 17: Task 1.4.2 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.4.3
Work Package Name	Sensor and MCU Integration
Work Package Description	Flex sensor and IMU integration with the ESP32 board, ensuring sampling and data transmit speed requirements are met, proper reading of data, and parsing of data to be transmitted
Assigned To	Jaden, Max
Estimated Effort (hours)	5 (2 connection with the sensors, 2 debugging, 1 various test cases)
Estimated Cost ($)	$0

Table 18: Task 1.4.3 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.4.4
Work Package Name	PCB Debugging
Work Package Description	After board population testing of connections, and placement of components before powering ensuring no shorts on the board. Testing of board powered and proper functionality including MCU booting, power, and sensor readings
Assigned To	Gurnoor, Jaden
Estimated Effort (hours)	15 (5 unpowered testing, 5 powered testing, 5 debugging)
Estimated Cost ($)	$0

Table 19: Task 1.4.4 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.4.5
Work Package Name	State-Machine
Work Package Description	Testing of all states of the state-machine ensuring proper functionality of all states, and all transition between states.
Assigned To	Jaden
Estimated Effort (hours)	2
Estimated Cost ($)	$0

Table 20: Task 1.4.5 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.4.6
Work Package Name	Full System
Work Package Description	Full table-top testing of the system integration with sensors, power, controller board, and peripheral device control (RC car). Ensuring that all components work when combined into the system, for extended periods of time.
Assigned To	Team
Estimated Effort (hours)	15 (1 set-up of system, 3 sensor reading testing, 3 wireless COMS, 3 peripheral devices, 5 power)
Estimated Cost ($)	$0

Table 21: Task 1.4.6 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.4.7
Work Package Name	Power Testing
Work Package Description	Testing the power requirements of the system, ensuring we are staying under power consumption requirements, system does not heat-up excessively, and can stay powered for up to 5 hours.
Assigned To	Team
Estimated Effort (hours)	8 (3 requirements testing, 5 power duration testing)
Estimated Cost ($)	$0

Table 22: Task 1.4.7 WBS Dictionary Entry

4.2.5 Documentation

Project	Glove Controller
Work Package ID	1.5.1.1
Work Package Name	Design Requirements -> Requirements Specifications
Work Package Description	Outline the problem statement of the project and project, break down the requirements the minimum viable product has to meet, and the constraint the project has (e.g. time, money, etc). Will be updated throughout term.
Assigned To	Gurnoor, Sahibjyot
Estimated Effort (hours)	6
Estimated Cost ($)	$0

Table 23: Task 1.5.1.1 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.5.1.2
Work Package Name	Design Requirements -> High Level Design Specifications
Work Package Description	Gives a general high-level overview of the design outlining each component of the system briefly and how they integrate with one another to meet the requirements outlines in task 1.5.1.1
Assigned To	Isabella
Estimated Effort (hours)	3
Estimated Cost ($)	$0

Table 23: Task 1.5.1.2 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.5.1.3
Work Package Name	Design Requirements ->Design Review
Work Package Description	High level presentation giving the projects problem statement, requirements, and key components to be presented to other groups.
Assigned To	Team
Estimated Effort (hours)	5
Estimated Cost ($)	$0

Table 24: Task 1.5.1.3 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.5.2.1
Work Package Name	Project Management -> Project Execution Plan
Work Package Description	Gives a breakdown of the scope of the project, team roles, ll breakdown of all tasks needed to be completed for the project, budget, and scheduling. Also included is a team contract outlining expectations of members contributions and behaviour within the group.
Assigned To	Jaden, Isabella, Steve
Estimated Effort (hours)	10
Estimated Cost ($)	$0

Table 25: Task 1.5.2.1 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.5.2.2
Work Package Name	Project Management -> Meeting Minutes
Work Package Description	Summary of the weekly meeting outlining what everyone has completed during the last week, what each member will work towards completing for the next meeting time, and overall expenditure of the week.
Assigned To	Max
Estimated Effort (hours)	2 hours weekly
Estimated Cost ($)	$0

Table 26: Task 1.5.2.2 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.5.2.3
Work Package Name	Project Management -> Project Close Out
Work Package Description	This will be the final report of the project compiling all information surrounding each component of the project and its workings including, hardware, software, mechanical, testing, documentation, and appendixes where needed.
Assigned To	Team
Estimated Effort (hours)	10
Estimated Cost ($)	$0

Table 27: Task 1.5.2.3 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.5.3
Work Package Name	Project Poster and Presentation
Work Package Description	This is the final presentation and poster giving a high-level overview and description of the project for when showcasing to other teams at the end of the term.
Assigned To	Team
Estimated Effort (hours)	5
Estimated Cost ($)	$10

Table 28: Task 1.5.3 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.5.4.1
Work Package Name	Testing Documentation -> Acceptance Plan
Work Package Description	This document overviews the testing that needs to be completed through the duration of the project and outlining the required results and benchmarks of the various tests.
Assigned To	Max
Estimated Effort (hours)	5
Estimated Cost ($)	$0

Table 29: Task 1.5.4.1 WBS Dictionary Entry

Project	Glove Controller
Work Package ID	1.5.4.2
Work Package Name	Testing Documentation -> Acceptance Test Report
Work Package Description	This document coincides with task 1.5.4.1 being updated throughout the term describing test being completed, the results of the test, and if it met the benchmarks outlined.
Assigned To	Team
Estimated Effort (hours)	5
Estimated Cost ($)	$0

Table 30: Task 1.5.4.2 WBS Dictionary Entry

4.3 RC Car Design

4.3.1 Hardware Design

Project	RC Car
Work Package ID	2.1.1.1
Work Package Name	Board Design -> Power Supply and Regulation
Work Package Description	Research and design of the power system that will be used to power the RC car systems including the motors, ESP32 board, and other subsystems. Including the design onto a single board that will be used for the car.
Assigned To	Sahibjyot
Estimated Effort (hours)	5
Estimated Cost ($)	$0

Table 31: Task 2.1.1.1 WBS Dictionary Entry

Project	RC Car
Work Package ID	2.1.1.2
Work Package Name	Board Design -> MCU Incorporation
Work Package Description	Design of the board to include the ESP32 in the layout that will be used for the wireless communications, and interfacing of the board with other systems such as power.
Assigned To	Sahibjyot + Gurnoor, Jaden review/help
Estimated Effort (hours)	10 (3 Research, 6 Layout, 1 review)
Estimated Cost ($)	$0

Table 32: Task 2.1.1.2 WBS Dictionary Entry

Project	RC Car
Work Package ID	2.1.2
Work Package Name	Component Selection
Work Package Description	The component selection and research for the board components, ensuring the availability, delivery time, constraints, and requirements when selecting. To be done in **parallel** with task 1.1.1.2
Assigned To	Sahibjyot
Estimated Effort (hours)	3
Estimated Cost ($)	Shared Cost with task 1.1.1.4

Table 33: Task 2.1.2 WBS Dictionary Entry

Project	RC Car
Work Package ID	2.1.3
Work Package Name	Board Population
Work Package Description	Placing and soldering of the components onto the PCB board, will most likely use a stencil and solder for ease of use due to surface mount components.
Assigned To	Sahibjyot, anyone interested
Estimated Effort (hours)	5
Estimated Cost ($)	$0

Table 34: Task 2.1.3 WBS Dictionary Entry

4.3.2 Software Design

Project	RC Car
Work Package ID	2.2.1
Work Package Name	Wireless COMS with Controller
Work Package Description	Setting up the wireless communication protocol with the glove controller, setting up proper variable type, communication speed, and connection with the glove controller.
Assigned To	Jaden, Sahibjyot
Estimated Effort (hours)	5 (3 setting up receiver code, 2 debugging)
Estimated Cost ($)	$0

Table 35: Task 2.2.1 WBS Dictionary Entry

Project	RC Car
Work Package ID	2.2.2
Work Package Name	Setting Output Configuration from Data
Work Package Description	Setup of code for variables and actions to be set by the received data creating the functions for reading the data, manipulating it, and converting it into outputs for the system
Assigned To	Jaden, Sahibjyot
Estimated Effort (hours)	10 (4 revived data
Estimated Cost ($)	

Table 36: Task 2.2.2 WBS Dictionary Entry

Project	RC Car
Work Package ID	2.2.3
Work Package Name	State-Machine Design
Work Package Description	Creation of the finite state-machine that will be used on the RC car, defining the states, and all the actions needed to advance to the next state. Will be like task 1.2.4.
Assigned To	Jaden, Sahibjyot
Estimated Effort (hours)	6
Estimated Cost ($)	$0

Table 37: Task 2.2.1 WBS Dictionary Entry

4.3.3 Mechanical Design

Project	RC Car
Work Package ID	2.3.1
Work Package Name	Design of Housing
Work Package Description	CAD design of the housing/casing of the RC car that will cover and protect the electronics of the car. Designing for weight, aesthetics, and ventilation.
Assigned To	Sahibjyot
Estimated Effort (hours)	4
Estimated Cost ($)	$0

Table 38: Task 2.3.1 WBS Dictionary Entry

Project	RC Car
Work Package ID	2.3.2
Work Package Name	Motor Selection
Work Package Description	The selection of the motors that will be used to drive the RC car. Choice will be based of power requirements and restrictions of system, as well as size.
Assigned To	Sahibjyot
Estimated Effort (hours)	2
Estimated Cost ($)	$30

Table 39: Task 2.3.2 WBS Dictionary Entry

Project	RC Car
Work Package ID	2.3.3
Work Package Name	Assembly of Car
Work Package Description	The assembly of the car housing and subsystems, connecting the motors, wheels, ESP32 board, and other subsystems to one another.
Assigned To	Sahibjyot
Estimated Effort (hours)	2
Estimated Cost ($)	$0

Table 40: Task 2.3.3 WBS Dictionary Entry

4.3.4 Testing

Project	RC Car
Work Package ID	2.4.1
Work Package Name	Motor Testing
Work Package Description	Testing of the motors once assembled to ensure they can handle the load of the RC car and stay within the limits of power consumption to allow for extended use.
Assigned To	Sahibjyot
Estimated Effort (hours)	2
Estimated Cost ($)	$0

Table 41: Task 2.4.1 WBS Dictionary Entry

Project	RC Car
Work Package ID	2.4.2
Work Package Name	RC Control
Work Package Description	Testing the control of the RC using an IR controller for initial testing of RC car to insure functionality. Moving to the glove controller to test the commands through the ESP32 board.
Assigned To	Team
Estimated Effort (hours)	3
Estimated Cost ($)	$0

Table 42: Task 2.4.2 WBS Dictionary Entry

Project	RC Car
Work Package ID	2.4.3
Work Package Name	Wireless Control
Work Package Description	This coincides with the second part of task 2.4.2 testing to ensure proper data transmission and connection to the glove controller. Testing all functionality and actions outlined in the code from task 2.2.2
Assigned To	Jaden, Sahibjyot
Estimated Effort (hours)	3
Estimated Cost ($)	$0

Table 43: Task 2.4.3 WBS Dictionary Entry

Project	RC Car
Work Package ID	2.4.4
Work Package Name	Power
Work Package Description	Testing of the power consumption and battery life of the RC car so that it will be able to power all subsystems onboard for at least a 2 hour time frame.
Assigned To	Team
Estimated Effort (hours)	3 hours (1 for power requirement testing, 2 for battery life)
Estimated Cost ($)	$0

Table 44: Task 2.4.1 WBS Dictionary Entry

List of Deliverables

List of deliverables for this project:

5.1. Reports

5.1.1. Weekly Meeting Minutes
5.1.2. Design Review Q&A Sheet
5.1.3. Requirements Specification
5.1.4. Project Execution Plan
5.1.5. Acceptance Test Plan
5.1.6. Design Specification
5.1.7. Test Record
5.1.8. Reflection Report

5.2. Documentation

5.2.1. Circuit Schematic and PCB Layout
5.2.2. Finalized Device Software

5.3. Prototype

5.3.1. Populated PCB
5.3.2. RC Car
5.3.3. Glove

5.4. Demonstration

5.4.1. Design Review Presentation
5.4.2. Minimum Viable Product
5.4.3. Final Presentation and Demo
5.4.4. Demo Day for Prototype

Schedule

To develop our schedule, we have used Microsoft List's integrated into SharePoint Gantt View. Each of our tasks is assigned a Start and Due date, with our estimated required hours. We also assign a % complete value which the Gantt chart shows to monitor our progress. This schedule allows us to adjust our tasks evenly between group members. This view also helps us make reasonable decisions on our designs to meet our milestones.

Budget

As per APEGS's Salary Survey, we have determined the following cost for our project. This includes an hourly wage breakdown per team member as well as our material costs.
For our Hourly wage's calculation, an P1 Entry Professional Engineer has a Median base salary of $78, 614.00 [1]. Based on working 40 hrs per week, this equates to an Hourly wage of $37.80. The following table depicts the salary cost of our project.

APEGA Salary Estimates:			$78,614	
Based of 52 weeks of 40 hour work week:			$37.80	/h
General estimate based off hourly wage:				
(6 hours a week) x (10 weeks) x ($37.8/h) =			$2,267.71	per person
Break-down with WBS time estimates:				
	Hours	Wage Estimate		
Hardware	101	$3,817.31		
Software	95	$3,590.54		
Mechanical	45	$1,700.78		
Testing	81	$3,061.41		
Documentation	51	$1,927.55		
	Total:	$14,097.61		

For material costs of the project a total maximum budget of $300 equating to $50 per person has been agreed upon. With the current cost estimates being seen in the table below:

Material Budget:	
	Cost
PCB Compoents	$ 75.00
PCB Fabrication	$ 75.00
Case Materials	$ 15.00
Sensor/ Testing	$ 30.00
Total	$195.00

The current estimate sits at about two thirds of the maximum budget giving a large safety net if extra components, microcontrollers, or other unexpected costs arise during the duration of the project.

Reporting

For reporting we will be utilizing Microsoft SharePoint, where tasks will be assigned to each team member to track their progress and time spent. Bi-weekly meetings will be held to discuss overall project advancement and any encountered challenges. We will maintain flexibility in milestone adjustments, adapting to the evolving project dynamics and the busy schedule of team members that may have to divert focus to other classes. This approach ensures transparency and allows for efficient management of the project due to varying schedules and priorities.

Risk Management

Our primary concern relating to risk management is the tight timeline of the semester and the potential for team members to fall short of expectations due to competing academic commitments. These risks could result in delays in deliverables and compromised project quality.

To reduce these risks, we have put into place several strategies. Firstly, we will be using a thorough project schedule with built-in buffers to accommodate unexpected delays. We will also engage in open communication within the team, encouraging members to flag any potential challenges early on. If a team member faces sudden academic demands, we will redistribute the workload fairly. We will continuously monitor progress and reassess timelines, allowing for necessary adjustments to ensure project success despite these challenges.

References

[1] APEGA, “APEGA Salary Survey Member Report 2023”, Calgary, AB, Canada, 2024. Available: https://www.apega.ca/docs/default-source/pdfs/apega-salary-survey-member-report-2023.pdf?sfvrsn=f81af9de_7 [Accessed February 7, 2024]

Appendix

Appendix A: Team Contract (see next page)

Team Contract

Group 2 -Finger Tracking Smart Glove

Team Member Names:

Gurnoor Gill	Maxwell McEvoy
Isabella Huang	Sahibjyot Deol
Jaden Savoia	Steven Greep

1. Document Purpose

The purpose of this team contract is to outline the standard operating practices and team norms of the above-named team and individually listed members for the remaining duration of the team lifespan. The guidelines outlined in this document are agreed to by all team members as indicated by their signature at the end of the contract. Any amendments to the contract must be discussed and agreed to by all signing members. Failure to abide by the outlined standard operating practices of this contract could harm the team's overall functioning and result in penalizing action as detailed in the contract.

2. Rules and Regulations

The team agrees to the following guidelines regarding general procedures, practices, and behaviors that are deemed acceptable.

A. Expectations

i. ***Project Expectations***

- *Detail the goals, level of quality, and acceptable outcome(s) for the project.*
    - Members will strive to create an excellent, functional prototype that exceeds expectations.
- *Outline the expected procedure of overall project deadlines set as a team and self-imposed deadlines or milestones set by individual members.*
    - In addition to the scheduled lab period every Tuesday, our team has agreed to have weekly meetings in ENG 305 on Wednesdays from 11:00 - 11:50 am. During these meetings, we will present the progress we have made individually and assign new action items to be completed for the next meeting.
- *Describe how the team will distribute contribution to the project equally among members and how to address inequality of member contribution throughout the project.*
    - Members are expected to contribute to the project equally. Workload is assigned during the meeting times outlined in section A.i. If the team feels that a member does not have an equal workload, they are permitted to assign another task to that respective member. To ensure that each member is contributing

equally, there should be constant communication amongst the group.

ii. Member Expectation

- *Detail the expected level of effort and the standard of work that is expected from each member.*
    - Members are expected to be diligent in their work and establish good communication with the rest of the team. This will ensure that there is a good source of feedback for everyone's work in order to create a great prototype.
- *Outline the expected weekly time commitment for each member.*
    - In addition to attending the weekly meetings, members are expected to finish their respective action item outside of meetings. Time commitments may vary, but an estimate of 5 hours a week must be contributed.
- *Describe the academic integrity and honesty policies team members are expected to adopt and adhere to (e.g., plagiarism, pirating, false reports, citations, etc.).*
    - All members are expected to uphold the policies in the University of Calgary Academic Integrity Website.
- *Define in the number of dollars the maximum financial contribution expected from each member and agreed upon by mutual consensus. This number may only be raised by unanimous consent of all team members and any such changes must be disclosed to the instructor immediately.*
    - The maximum financial contribution expected from each member is $50. Therefore, in total we have a budget of $300.

iii. Role Expectations

- *Outline the role titles and role descriptions within the team. Include the tasks and responsibilities that each role is accountable for.*
    - Gurnoor Gill: Hardware Lead and Software Support
        - Design block diagrams
        - Design system components
        - Documentation of hardware components
        - Assembly of components
        - Collaborate with Software Lead on the design and creation of the program
    - Jaden Savoia: Software Lead
        - Design and create a working program that follows the design specifications of the prototype
    - Steven Greep: Mechanical Lead
        - Design and make casing for the prototype
        - Ensure the casing meets requirements
    - Sahibjyot Deol: Testing Lead
        - Ensure the reliability and effectiveness of all components
        -

- Maxwell McEvoy: Project Management, Software and Hardware Support
    - Ensure all members are collaborating and the creation of the prototype is progressing
    - Delegate action items during meetings
    - Ensure delivery of all deliverables
    - Collaborate with Software and Hardware Leads to create the program and the system
- Isabella Huang: Documentation Lead, Project Management and Mechanical Support
    - Delegate tasks for project documentation
    - Ensure delivery of all deliverables
    - Collaborate with Mechanical Lead to ensure the casing meets requirements

- *Detail the agreed upon role assignment within the team. In instances where there are multiple individuals assigned to a role, assign a lead member to be responsible for accountability.*
    - Each team member will be assigned as a lead of one of Hardware, Software, Testing, Project Management, Documentation, and Mechanical. Responsibilities have been detailed for support roles. All team members will contribute to any support roles that are not assigned.

B. Communication

i. Communication Medium

- *Describe the preferred medium for communication regarding the project.*
    - All documents, notes, and trackers will be managed on Microsoft SharePoint. Technical files will be uploaded on a shared GitHub. General communication will be held through a Discord server.

ii. Communication Timelines

- *Outline the agreed upon acceptable hours of communication delivery (e.g., weekdays only, 9-5, etc.).*
    - Members are able to communicate through Discord at any time. However, communication should be limited to 8 - 12am as outside of this time may be disruptive to other members.
- *Detail the expected timeliness of responding (e.g., within 24-hours except on weekends) and if this expectation changes across the group project (e.g., quicker response times closer to project deadline).*
    - Members are expected to respond within 24-hours of receiving a message. However, as the project nears its deadline in the months of March and April, this will be reduced to a 12-hour response time.

iii. Communication Code of Conduct

- *Outline the expected standard of respectful and professional communications both internal (i.e., between members) and external (e.g., mentors) to the team.*
    - Members will ensure that any communication, whether internal or external, remains appropriate and respectful. This means that any aggressive, offensive, inappropriate, or derogatory language is not permitted.

C. Team Meetings

i. Scheduling

- *Outline the agreed upon meeting schedule and how this schedule is changed if unanticipated time conflicts arise.*
    - The scheduled lab time and the agreed meeting on Wednesdays at 11-11:50am are the required meeting times weekly. If unanticipated time conflicts arise for a group member, they are expected to communicate this to the rest of the group. The respective group member is still responsible for reporting their action item and reviewing what needs to be done for the next meeting.

ii. Involvement

- *Detail how the team will ensure all team members are involved in team meeting discussions and decisions.*
    - When involved in discussions and decisions, all group members are expected to participate and are encouraged to share their opinions. When coming to a decision, it is expected that the group thoroughly discusses and comes to a unanimous agreement.
- *Outline the expectation of team members in regards to preparation for team meetings.*
    - Team members are expected to complete their action item in preparation to present for team meetings. This is to ensure that the project progresses at a consistent pace.

iii. Attendance & Notice

- *Detail expectations regarding meeting attendance, tardiness, absences, and make-up sessions regarding team meetings.*
    - Members are expected to communicate with team members if they are unable to attend a meeting or will be late. This member is still expected to complete and present their action item and review their action item for the next meeting.
- *Outline procedures (e.g., amount of notice, contact medium, make-up meetings, etc.) team members are expected to follow if they anticipate being late or absent from a scheduled team meeting.*
    - If a team member anticipates being late or absent to a scheduled team meeting, they are required to give notice 24 hours before.

D. Team Conflict & Decision Making

i. Conflict Code of Conduct

- *Outline the expected code of conduct when team members experience disagreements about the project, processes, or interpersonal differences.*
    - If members encounter disagreement about the project and processes, it is expected that they will be discussed in a respectful way. If there are interpersonal differences, the respective members should resolve it individually and ensure discussions among the group remain on topic.

ii. Initial Conflict & Conflict Escalation

- *Detail the steps that team members are expected to follow in order to work through an initial conflict.*
    - When an initial conflict has arisen, the team should remember to remain civil and courteous. There should be open communication and an opportunity for all parties to voice their opinions. After listening to the involved parties, all members should come to an agreement on how to resolve the conflict.
- *Outline escalation procedures for team members to follow if initial conflicts cannot be resolved, including individuals who will have ruling and authoritative decisions in the conflict (e.g., team leader, mentor, etc.).*
    - If initial conflicts cannot be resolved, even with the involvement of the entire group, then a neutral party should be brought in to make the final decision. This neutral party will most likely be a professor or teaching assistant. However, it's important to note that this is a last resort.

iii. Decision-Making

- *Outline how the team plans to come to an agreed upon decision.*
    - Members should all be involved when a decision is being made. All members should be given an opportunity to voice their opinion. Once everyone has been given this opportunity, the group should have an overall discussion to agree on a final decision.
- *Outline procedures to follow when sub-groups (i.e., not including all team members) make project decisions.*
    - All decisions made will be brought up in meetings and can be discussed amongst the group. Sub-groups can make project decisions if it has already been discussed before hand or if the decision does not affect the other members. If there is a concern about the decision, it will be discussed amongst the group during a meeting.
- *Detail what the team will do when one or two team members have a different view of a decision.*
    - If two members disagree on a decision, there should be an equal opportunity for both parties to present their side. The group should then have open communication and reach a decision while ensuring

that the conversations remain civil and respectful. In the case that a decision still has not been made, then the group will vote based on majority rule.

- *Detail the steps the team will take if a decision cannot be reached including individuals who will have ruling authority in a final decision (e.g., team leader, mentor, etc.).*
    - If a decision cannot be reached, then a neutral party will be brought in for advice and to decide. This neutral party will most likely be a professor or teaching assistant.

E. Stress Management

i. Monitoring & Assistance

- *Outline how team members will reduce stress, manage their workload, and prevent burnout. Include how members will monitor one another and provide assistance when needed to help a fellow team member who is struggling.*
    - In order to reduce stress, manage their workload, and prevent burnout, members should ensure that they complete their tasks in a timely manner throughout the given time period. If a team member is struggling, they should inform the rest of the team for assistance.

ii. Resources

- *Outline at least three resources available for team members to reduce stress, manage their workload, and prevent burnout.*
    - In order to reduce stress, manage their workload, and prevent burnout, members should be aware of the following resources:
        - Personal support systems like friends, family, and loved ones.
        - Mental health services like the UofC Student Wellness Services
        - Inform other team members to offload some work

F. Contract Code of Conduct

i. Contract Breaches

- *Outline the agreed upon procedure for handling individuals who are in breach of the team contract. Specifically, outline how the team will identify and track breaches, discuss the breach, and inform the member in question (e.g., verbal warning, written warning, three strikes, etc.).*
    - Upon a first breach of the contract, a verbal warning will be given. Upon a second breach, a written warning will be given. Upon a third breach, this will be considered a major breach and the penalty described in F.ii. will be issued. Any minor breaches will follow the penalty described in F.ii.

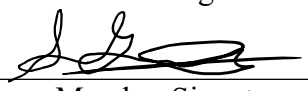
ii. Penalties

- *Detail the agreed upon procedure for deciding any penalization for members in breach of this contract (e.g., allocation of marks). Consider how you would want the situation handled if you were the one in breach of the contract.*
    - If a member breaks or loses equipment, they are responsible for the costs of replacement.
    - For minor breaches, the respective member needs to buy everyone hot chocolate. A minor breach, for example, would be failure to inform the group of lateness or an absence.
    - For major breaches, the course coordinator, Dr. Denis Onen, will be contacted for a deduction in allocation of marks for the respective group member.

3. Declaration

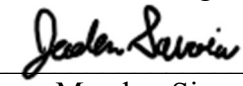
By signing below, team members acknowledge and agree to be bound by the guidelines outlined above.

Team Member Signature — February 7, 2024 — Date



Team Member Signature — February 11, 2024 — Date

Team Member Signature — February 12, 2024 — Date



Team Member Signature — February 12, 2024 — Date

Team Member Signature — February 12, 2024 — Date

Team Member Signature — February 12, 2024 — Date