Project Team Charter

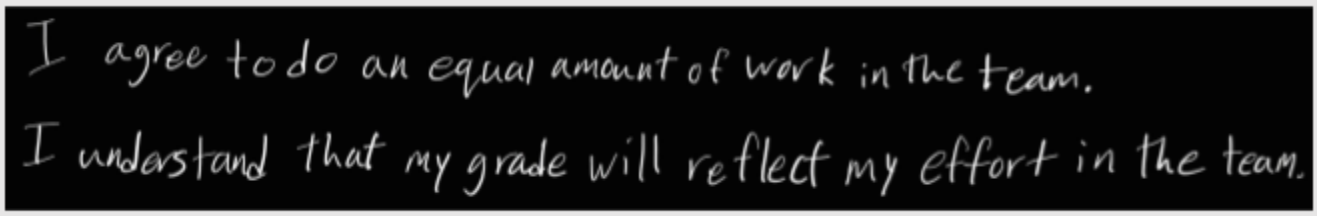
ME476C: Capstone I

Signature Cover Page

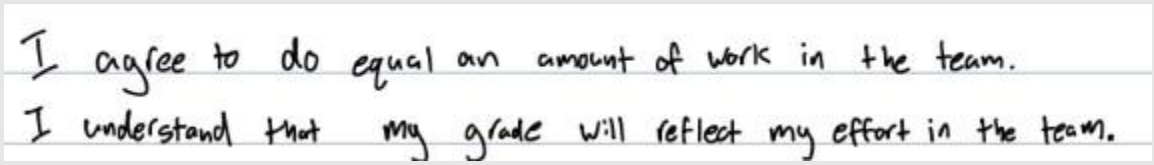
Each team member will copy the following statement in their own handwriting (LEGIBLY) in one of the designated areas below:

I agree to do an equal amount of work in the team. I understand that my grade will reflect my effort in the team.

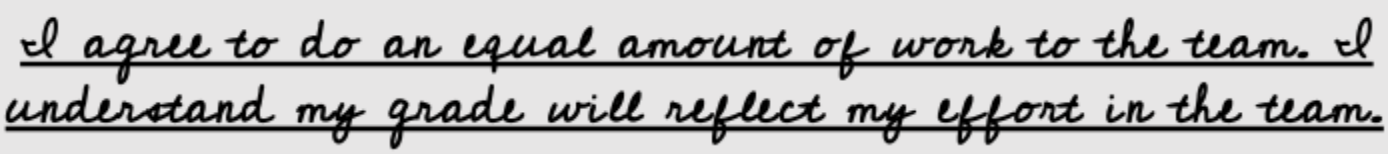
Print Name: Joseph Mathews **Signature:** Joseph Mathews



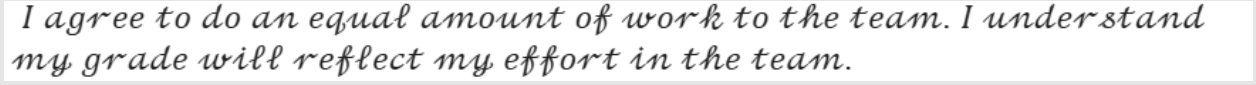
Print Name: Ryan Donnellan **Signature:** Ryan Donnellan



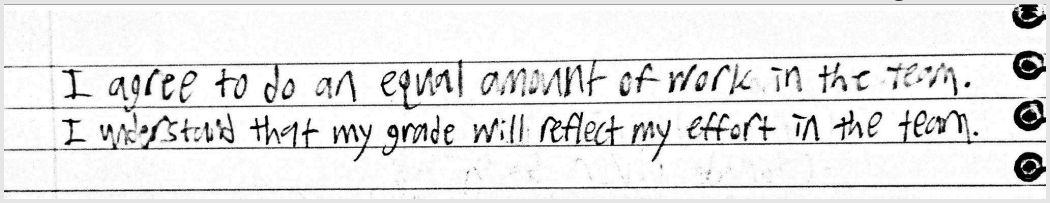
Print Name: Justin Joy **Signature:** Justin Joy



Print Name: Jonathan Avila-Copado **Signature:** Jonathan Avila-Copado



Print Name: Owen Kehl **Signature:** Owen Kehl



NORTHERN ARIZONA UNIVERSITY

Department of Mechanical Engineering
Justin Joy
Ryan Donnellan
Joseph Mathews
Jonathan Avila
Owen Kehl
ME 476C Section 001

To: Carson Pete

CC: Connor Gaudette

From: *Flying Squirrel Team*

Date: *1/26/2025*

Re: *Team Charter*

Team Purpose

The aim of this project is to build upon and upgrade the preexisting "Hamster" physical rehabilitation robot. This original design was conceived to train arm motion in patients who have suffered a debilitating accident, such as a stroke. Patients are supposed to grasp the device like a computer mouse, which in turn assists or resists their arm movements. While the Hamster functions as intended, it can only provide motion in the horizontal plane. Many simple actions require vertical arm movement from the patient. The upgraded robot, or "Flying Squirrel", will add vertical motion to the planar capabilities of its predecessor, allowing patients to exercise three dimensional movement during rehabilitation.

Stakeholders for this project include its main client, Dr. Razavian, and his group (The Raz Lab). While we have not entered direct communication with the client, we can infer what the main expectations will be. Our team is expected to communicate regularly with the client during the course of the project, and inform him of our plans and progress. We are expected to work in a timely manner, such that our prototype designs are finished by the end of this semester and our final design is tested and ready for presentation by the end of next semester. Additionally, the final design is to adhere to the design requirements listed in the project description. This includes the unit production cost of less than $1000. In all, our project activities are not to exceed the development budget of $3750 with an additional $500 to be raised by the group.

Still other stakeholders include the users, or patients, themselves. Our product should effectively simulate the three dimensional movements necessary to perform simple tasks. This will be done by either guiding the arm movements of patients, or by providing small resistance to the motions of more capable patients. In accomplishing all these requirements, the Flying Squirrel must be a successful physical therapy device.

Finally, Professor Pete may be considered this project's last main stakeholder. It is important that the quality and efficacy of our work redounds well to the NAU engineering college, and that all interactions with clients and colleagues are conducted with civility and professionalism.

Team Goals

Our team was given a list of restraints to follow during this project. Our goal is to be able to achieve all of these requirements. The minimum goal would be to meet each requirement as specified, but we will aim to surpass each requirement, whether it be to lower the production cost, backlash, or size, or to have a longer run time or an increased accuracy with its sensors. Striving to exceed all of the requirements is our team's goal for quality, to ensure the best product we can deliver. The given requirements are listed below.

- **Operation:** The robot must be fully stand-alone and easy to operate (no extra hardware, monitor, etc.).
- **Set-up time:** The robot must be operable in less than 1 minute from a stowed condition.
- **Range of motion:** Moving the hand in 3D space up to 1ft above the surface of a table.
- **Size:** Fit within a box of 8"x8"x8".
- **Speed:** The device must be able to "catch up" with users at a hand speed of up to 1 m/s in any direction.
- **Force:** The device must be able to produce forces of up to 10 N to the hand in any direction.
- **Internal friction:** When motors are turned off, the device must be able to move with less than 5N force.
- **Backlash:** The device must move no more than 0.1 mm when motors are locked in place.
- **Total run time:** The device must run for at least 30 minutes (active time) on a single charge.
- **Sensing accuracy:** Position sensing accuracy: <0.1mm. Force sensing accuracy: <0.1N.
- **Control accuracy:** position control with <0.5mm error. Force control <1N error.
- **Interface:** The device must send (x,y,z) position to the computer and receive force commands from it.
- **Screen:** The device must have a touch screen of at least 6 inches for future developments.
- **Cost:** The total "production" cost (bill of materials + manufacturing/labor cost) must be <$1000.

Following this, our team is planning to commit at least 9 hours per week, however we will likely exceed this, and we strive to have a higher average of hours per week if possible. Each of us are also striving to earn an A in this class. Furthermore, we have set a goal for how our project will progress, beginning with reviewing the Hamster capstone project to gain an understanding of how we can design and create the Flying Squirrel. The team will need to identify necessary components, programs, and specific details and design elements we will need to use for the Flying Squirrel. After that, we will begin work on the calculations and preliminary designs, followed up by the CAD

models we will use to help virtually test our design. Once we are confident that our design will satisfy the requirements, we will begin the fabrication process and begin prototyping, both with the physical model and with coding, and work towards creating an optimal final product.

Team Member Roles/Duties/Personalities

Role Title	Role Description
Project Manager Owen Kehl ISTJ	• Manages tasks, develops overall schedule, runs meetings, reviews individual contributions, provides safe and welcoming team environment, does NOT make all decisions (rather facilitates discussion of the team to arrive at team decisions) • Some experience with Solidworks • Basic programming knowledge (Matlab) • Experience with ANSYS mechanical Technical Roles: Python, Microsoft Suite, Control Integration
Logistics Manager Jonathan Avila INTJ	• Manages internal and external communication (point of contact for client), documents meeting minutes, manages facility and resource usage • Has experience in health care from being a CNA • Matlab programming experience Technical Roles: Matlab, Microsoft Suite, Python
Financial Manager Jonathan Avila INTJ	• Oversees all purchases, main contact with Front office for budget management, monitors and records all purchases for budget tracking, updates Bill of Materials • minoring in mathematics • 2 years of CAD modeling in Solidworks. Technical Roles: Matlab, Microsoft Suite, Python

Test Engineer Joseph Mathews INTJ	Oversees experimental design and testing, plans testing procedures, acquires necessary equipment for testing, runs all tests for team ● About 5 years experience with SolidWorks ● 3 years experience with VEX Robotics ● Built a solar powered go-kart ● Basic knowledge with MATLab ● Proficient with manual mills and lathes ● 2 years as Quartermaster for Northwind Sabers (The lightsaber club)- Leadership role and electrical component repair Technical Roles: SolidWorks designing, Microsoft Suite, Python, Electrical sub-system/motor sub-system
Manufacturing Engineer Ryan Donnellan ISTJ	● 2 years experience with Stingers Robotics ● 3 years experience as treasurer with RoboBears Robotics ● 7 months experience at TIMET ● Experience with animation software ● Proficient with lathe and mill and experience with CNC Technical Roles: Solidworks designing, Microsoft Suite, Python, Electrical components
CAD Engineer Justin Joy ENTJ	● Coordinates and oversees CAD development throughout project, creates protocol for revision management, manages CAD files, ensures CAD model matches physical design, does NOT do entire CAD package themselves ● 20 years experience in automotive/mechanic field ● 3 years of CAD experience ● Military background ● Roles in leadership/team projects Technical Roles: Solidworks designing, Microsoft Suite, Python, Electrical components

Ground Rules

For the group's ground rules, we decided to meet at least once a week either virtually or preferably in person, where we will record meeting minutes for those meetings. These meetings outside of the given class times will be scheduled for Tuesday after two p.m. keeping Thursdays and weekends available for extra meetings if necessary. Prior to any meetings we will give ourselves 24 hours notice to ensure availability. If any members are unable to attend due to personal reasons or schedule conflicts, we will either pick another time or update them with relevant information pertaining to the project. The group will meet during lecture time scheduled on Monday from 5:30 p.m. to 8:00 p.m. even if class is cancelled.

Decisions for the project will be made by the group. If conflict in decisions arise between individuals, the group will decide on the best option by majority. For smaller decisions between two roles, the individuals participating can make changes or decisions without the group meeting as long as it does not negatively affect the team or project as a whole. The decision between the individuals will still be communicated with group members. If the group feels more discussion is required, a meeting will be held.

For assignments, we agree to share equal and fair contributions to each assignment even if it falls outside of our roles within the team. The team will attempt to complete and turn in assignments 24 hours prior to the due date or within a timely manner. The team will designate an individual to proofread the assignment prior to submission to ensure proper formatting and to communicate any assignment needs. If any issues arise with an individual that interferes with their contribution to an assignment, it is their responsibility to communicate with the team as soon as possible, preferably a minimum of 24 hours prior to assignment due date. Individuals are responsible for timely responses to the group's communication needs. If an individual is addressed, they are expected to respond within an hour during reasonable times of day.

The ground rules discussed are to help ensure success for the team. All rules listed are subject to modification as the semester progresses. The team will meet to discuss any benefits or challenges of the ground rules as appear. Rules may be added throughout the semester if the team feels they will benefit the project.

Potential Barriers and Coping Strategies

The first set of potential barriers identified by the team are time constraints due to other classes and projects having deadlines coming up sooner than ME 476C and having to put off the group work to finish those assignments. Having personal matters arise such as a death in the family, kids, emergency medical care, etc. A possible coping strategy that the team could use to deal with these situations when they arise is to communicate with the rest of the team well in advance that the individual will be unable to complete the assignment by the deadline. Thereby giving the team time to plan a strategy on how to complete the assignment. Another possible barrier with time constraints is waiting for parts to be made/printed and it taking up too much time causing the team to fall behind schedule. A coping strategy in this case would be to allot extra long manufacturing time in the gantt chart and ensuring all assignments are completed by the deadline if not before.

The next potential barriers identified by the team are breakdowns in communications. Specifically differences in opinion resulting in arguments amongst teammates, as well as poor communication resulting in missed deadlines. A potential coping strategy that the team could employ in these situations is to use the ladder method, talking to the team member directly about problems and if that does not work escalating the situation to the professor and so on. This way the team ensures no deadlines will be missed.

Another potential barrier identified by the team is class cancellation due to weather or other outside circumstances. A potential coping strategy for this situation was discussed in ground rules, that is to meet during designated class time whether it is online or in person to discuss project needs. Ensuring proper lines of communication stay open is vital to project progression and staying on track to meet project goals.

The final project barrier identified by the team is issues due to technology. An example of this would be internet outages on campus resulting in a breakdown in communication between team members. Another example would be laptops crashing resulting in loss of data. Possible solutions to these barriers would be to increase the habit of manually saving, having autosave on, as well as sharing important data to the cloud. To overcome the obstacle of loss of communication the team has set additional time to meet.