Group Contract & Memorandum of Understanding

Contract	**Group Name:** Team 2	**Project Name:** Robot Laser Tag

Participants (list group members):

- Aaron Feinberg | ajf5972@psu.edu
- Joseph Porrino | jhp5207@psu.edu
- Katherine Banis | kbb5551@psu.edu
- Mansib Ahmed (Syed) | sma6629@psu.edu
- Clay Blockinger | crb6023@psu.edu

Communication Rules:
(Main) Discord – Team 2 Channel
(Secondary) - Personal Cell Phones
(Formal Submission Posts/Progress Reports) - Microsoft Teams (Team 2 Channel)

Team GitHub: https://github.com/joeoakes/CMPSC488FA24Sec2Team2

Attendance Policy:
The team should meet at least once a week to discuss objectives and voice any issues encountered. Meetings should be goal oriented and end with clearly defined objectives for the next sprint. Additionally, a meeting should be held before every submission deadline to make sure the submission is done correctly and at a high level.

Rules for Quality of Work and Conduct
As a group, all team members should feel free to contribute ideas and suggestions. We should discuss these ideas as a team to arrive at the optimum way to approach a given task.

Division of Labor:
During weekly meetings, the established goals for the sprint (user stories) will be converted to concrete implementable tasks. Each task will be up for selection by a team member. If team members take an interest in specific sub-roles of the project (navigation, movement, comms, etc.), they may be delegated tasks in their respective domains.

Our goal is to make sure we are getting the sprints done and are nearing our objectives. It's important that team members are flexible to assist each other especially when nearing deadlines.

Rules for Removal from the Group
(replace with your own)
1. If a Team member is consistently late to meetings and fails to produce work on time, the team manager will contact them to try and get them back on track.
2. If a team member is consistently not contributing to the project, they may be voted out by majority vote (super unlikely).

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Project Goal/Objectives:
To design and build an autonomous robot that is able to navigate through a course and accurately target and fire a laser at the opposing team's target and robot.

Project Description:
We will be designing a robot that will be able to autonomously navigate and traverse in 2 dimensions. The robot will go through an obstacle course and be able to correctly identify the following:

- Laser Targets
- Other Robots
- Obstacles
- Map Boundaries

The robot will use this information to construct an internal representation of the battleground and generate a series of instructions to traverse the course and find the opposing team's target. After finding the target, the robot should be able to correctly target it and fire its laser. The robot should be able to update its approach based on new information (such as disruptor or enemy robot in path).

Scope of Work:
The tasks that the robot is expected to perform can be broken up into the following subtasks (may be revised as necessary).

Signal Processing & Recognition: The robot will receive data from a wide variety of sensors, namely:

- LiDAR
- Camera
- Bumper Switches
- Ultrasonic (possible)
- Bluetooth (for ranging)

This role will involve converting the raw data into a meaningful model of the battle ground for use by other subsystems to direct the robot to its goal. This will involve recognizing and categorizing objects in the robot's environment, monitoring the robot's position as it traverses the course, and giving priority to different sensors based on conditions

Navigation & Path Planning: After a working model of the environment has been generated, the robot must select a path to traverse. This role relies on accurate data provided by the signal processing subsystem and is flexible enough to adjust as conditions change. This role involves tasks such as:

- Creating path planning algorithms
- Generating/selecting strategies
- Generating movement instructions and correcting deviations on the fly

Hardware Design & Construction: The robot's physical design, assembly, and configuration. This involves:

- Designing CAD models of the robot and its components/frame
- Printing and testing physical performance of the robot
- Assembling and configuring the various components of the robot

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Major Deliverables:

- Discovery and Orientation Module
- Development Module Deliverable
- Design Module Deliverable
- Deployment Module Documentation and Testing
- Final Project Presentation
- Course Project Poster

Project Timeline:

- Discovery and Orientation (08/26 - 09/15)
- Design (09/15 - 09/15)
- Development (09/15 - 10/06)
- Documentation and Testing (10/06 - 10/17)
- Deployment (10/17 - 11/24)
- Final Project Presentation (12/02 - 12/13)
- Course Project Poster (12/02 - 12/13)

Project Group (Including Roles and Responsibilities for each member):

Aaron Feinberg (Team 2 Leader)

- Oversee all project phases and ensure milestones are met
- Manage all team communications including coordinating meetings through Discord and formal submissions on Microsoft Teams
- Develop algorithms for environment mapping, object recognition, path planning, and target identification
- Participate in assembling the robot
- Contribute to coding for navigation and sensor integration
- Assist with sensor setup and calibration
- Optimize the processing of sensor data from LiDAR, cameras, and other inputs

Joseph Porrino

- Handle project documentation including progress reports and final submission materials
- Develop algorithms for environment mapping, object recognition, path planning, and target identification
- Participate in assembling the robot
- Contribute to coding for navigation and sensor integration
- Assist with sensor setup and calibration
- Optimize the processing of sensor data from LiDAR, cameras, and other inputs

Katherine Banis

- Develop algorithms for environment mapping, object recognition, path planning, and target identification
- Participate in assembling the robot
- Contribute to coding for navigation and sensor integration
- Assist with sensor setup and calibration
- Optimize the processing of sensor data from LiDAR, cameras, and other inputs

Mansib Ahmed (Syed)

- Develop algorithms for environment mapping, object recognition, path planning, and target identification
- Participate in assembling the robot
- Contribute to coding for navigation and sensor integration
- Assist with sensor setup and calibration
- Optimize the processing of sensor data from LiDAR, cameras, and other inputs

Clay Blockinger

- Design and 3D print the robot’s structural components

- Develop algorithms for environment mapping, object recognition, path planning, and target identification
- Participate in assembling the robot
- Contribute to coding for navigation and sensor integration
- Assist with sensor setup and calibration
- Optimize the processing of sensor data from LiDAR, cameras, and other inputs

Fernanda Martins

- Develop algorithms for environment mapping, object recognition, path planning, and target identification
- Participate in assembling the robot
- Contribute to coding for navigation and sensor integration
- Assist with sensor setup and calibration
- Optimize the processing of sensor data from LiDAR, cameras, and other inputs

Open Issues, Assumptions, Risks, or Obstacles:

Open Issues:
- **Sensor Accuracy**: Ensuring that laser sensors are precise enough to detect hits consistently at varying distances and angles.
- **Obstacle Detection**: Verifying the robot's ability to detect and navigate around obstacles on the field during a fast-paced game.
- **Battery Life**: The power consumption of motors, sensors, and laser systems may need optimization for extended game sessions.
- **Latency in Communication**: Establishing fast and reliable communication between robots and central control to avoid delays in receiving and executing commands.
- **Collision Avoidance**: Ensuring the robots avoid crashing into each other or the environment during the game.
- **Hit Registration**: Developing a system to accurately register hits on robots using lasers without interference from environmental light or reflections.

Assumptions:
- **Standardized Playing Field**: The playing environment will have predefined obstacles and boundaries that do not change mid-game.
- **Controlled Lighting**: The game will take place in an environment with controlled lighting to ensure that laser hits are detected accurately.
- **Pre-Set Rules and Game Dynamics**: All robots will follow the same rule set and game mechanics, with no rogue behavior.
- **Wireless Connectivity**: Stable wireless connectivity will be available throughout the play area for real-time communication between robots and the central system.
- **Durability of Robots**: Robots will be designed to withstand minor impacts and rough play without damage.

Risks:
- **Technical Failures**: There's a risk of motor, sensor, or laser failure mid-game, affecting gameplay and robot performance.
- **Interference**: Signal interference could disrupt communication between robots or with central control, affecting command and control.
- **Sensor Overload**: Multiple lasers being fired simultaneously could overwhelm sensor systems, leading to missed detections or incorrect hit registration.
- **Player Safety**: Misuse of lasers or mechanical malfunctions could pose a safety risk to nearby players or spectators.
- **Complexity in AI/Autonomy**: Robots have autonomous decision-making capabilities, there is a risk of unpredictable or faulty behavior.

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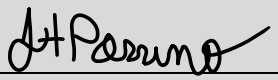
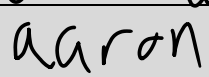
- **Power Constraints**: Battery failure or limitations could prevent robots from completing a match, leading to potential game delays, and might need backups.

Obstacles:
- **Precision Engineering**: Developing a laser system that is safe but also accurate enough to handle fast-moving, small targets such as another robot.
- **Physical Limitations**: Designing robots that are agile yet durable enough to survive collisions and rough play without losing functionality.
- **Software Integration**: Successfully integrating multiple systems (e.g., navigation, targeting, hit registration) into a single, reliable platform.
- **Regulatory and Safety Compliance**: Ensuring that the laser systems meet regulatory requirements for safety to prevent eye injuries or other hazards.

Project Start Date: 08/26/24	**Project End Date**
Document Prepared By	**Date Prepared**

Group Signatures

Name	Signature	Date Signed
Mansib Ahmed (Syed)		**09/04/24**
Joseph Porrino		**09/04/24**
Aaron Feinberg		**09/04/24**
Katherine Banis		**09/05/24**
Clay Blockinger		**09/07/24**
Fernanda Martins		**09/15/24**