Embedded Systems International

Project Statement of Work (PD3)

Team Identifier: Section 5-D

Team Name (optional): CyTheseus

Team Member Names: Varun Jain, Josh Holloway, Eli Ripperda, Tommy Youhn

Submit your document as a PDF file in Canvas under the corresponding project assignment.

One of your section's lab TAs must approve of this Statement of Work by adding a comment in the Canvas assignment. The team is responsible for requesting approval promptly after submission.

Refer to the Project Requirements document before completing this Statement of Work (SOW). A statement of work is a focused concise proposal and agreement that describes work to be done. Teams should complete and submit this SOW form, which represents several parts of a statement of work, including a plan for what you are doing and how. The SOW defines the scope of your project and the approach you are taking to deliver on the goals.

Problem Statement

First, has your team reached consensus on the autonomous vehicle (AV) application you will use as the context or story for your project? **YES** All projects, regardless of application, will need to meet the same basic requirements and will be recognized for innovative features.

To define your problem, think about one or more users and their needs. Write at least one Point of View (POV) statement for your application. Follow Steps 2 and 3 in the following guide (also in Canvas as a PDF document):
Define and Frame Your Design Challenge (links to IDF page) (URL: https://www.interaction-design.org/literature/article/define-and-frame-your-design-challenge-by-creating-your-point-of-view-and-ask-how-might-we)

Next, think about and write a few sentences that give a high-level summary of the broad mission goals for your AV application. For example:
The purpose of the AV is to provide ... .
The AV will be capable of doing ... .

The mission goals and user needs establish the purpose of the project and why you are working on it. Now you should translate these into a more detailed problem statement that provides a specific, concise, clear and thorough description of the context for the problem, an explanation of user needs that will be addressed, and an outline of your proposed technical approach to solving the problem.

Problem Statement

POV statement:

Theseus needs to explore Labyrinth to find Minotaur's lair.
Theseus needs to find Minotaur's liar to kill Minotaur.

High-level mission goals:

To find Minotaur's liar so that Theseus can hide and kill Minotaur.
To not fall Minotaur's traps.
To not run into a wall (tall object).
To find Minotaur's Liar quickly.
For Theseus to find Minotaur's Liar without Ariadne telling him where to go (autonomous mode)

Short description of the problem:

King Minos wants Theseus dead, so the king threw Theseus in the Labyrinth (a big maze) to die from the Minotaur. Theseus knows Minotaur isn't currently in his liar. Theseus wants to find Minotaur's liar to kill Minotaur after he falls asleep there. If Theseus kills the Minotaur, he will marry Ariadne. Ariadne is listening to Theseus as he explores Labrinth. She can tell him where to explore and she can tell him where to move as needed. Minotaur is deaf and cannot hear communication between Theseus and Ariadne.

In addition to writing a paragraph about the problem, you are to draw a **problem sketch: a one-page sketch illustrating your solution with a user context (big picture view)**. This should show the scope of your work in relation to one or more user needs. Refer to the sample project sketches.

Design Approach

Next, consider your AV application in relation to the project requirements and the five categories by which it will be evaluated.

1) Functionality in relation to the AV application mission goals and user needs
2) Mapping of functional requirements to platform components and capabilities
3) Elements of the test field
4) Serious incident penalties
5) Feature bonuses

In this section, you will identify and describe how you will design your application for each of these categories.

To complete the tables below, your team may want to use ideation tools, such as Lotus Blossom. Refer to the project ideas guidelines and Lotus Blossom worksheet as needed.

In addition to completing the tables below, you are to draw a **technical system sketch: a one-page sketch depicting a high-level technical system diagram of your proposed solution, such as a block diagram or dataflow diagram**. This should show both hardware and software modules.

The tables below are your initial proposal, and you may update these before your demonstration.

Functionality

Describe each of the basic functionalities required for the project in terms of your AV application. The functionality should be specific to the problem and user(s). Several functional statements are given in the example functional description for the Mars rover application in the Project Requirements document.

Basic Functionality	Mapping to AV Application
Cybot Communication	Theseus communicating to Adriane.
Cybot Movement	Theseus moving around Labyrinth.
Object Detection	Tall objects: Theseus seeing an object (or a wall) in Labyrinth. Short objects: Theseus stubbing his toe on debris.
Object Avoidance	If Theseus runs into an object in Labyrinth, he might get injured. If he gets injured, Minotaur will find him and kill him.
Boundary Adherence	Theseus can't climb the tall walls of Labyrinth.
Arrival at Destination	Theseus getting to Minotaur's liar. (So that he can hide and kill Minotaur when Minotaur returns).
User Interface	The user interface is Ariadne as she listens to Theseus describe his surroundings. She can shout to tell him where to explore (scan) and where to move to.
Base Station Control	Ariadne listening to Theseus and telling him where to go
Other Application Specific Functionality (may be novel features for bonus points) As Ariadne listens, she will be making a map of Theseus's surroundings and where he has been.	

Mapping to Platform

Briefly describe how each of the basic platform components required for the project will be used in your AV application.

Basic Platform Components	Usage in AV Application
Open Interface and iRobot Sensors	Open Interface is the following: Theseus's ability to see a trap (hole) in front of him, his ability to see the walls of Labyrinth, and the feeling in his toes when he stubs his toe on debris on the ground. All of his human senses correlate to the cliff, line and bump sensors respectively.
Interrupts	Interrupts are Theseus prioritizing different processes for the preservation of his life. For example: As he is walking, he will prioritize not falling into a trap over continuing to walk.
ADC	The ADC is Theseus's depth perception. His brain processes the raw image data from his vision to get an idea of how far objects are from him.
Input Capture (PING sensor)	This is Theseus looking at an object to send that image to his brain.
PWM (Servo)	The Servo is Theseus turning his neck so that he can see his surroundings.
UART/WiFi	UART+Wifi on CyBot will connect to MatLab for GUI Our application: This is Theseus telling Ariadne about his surroundings. UART will connect to open interface This is a process in Theseus's brain to understand his senses (sight and feeling).
Other Platform Components or Modes (may be novel features for bonus points) Matlab is used as a GUI to represent the environment around the Cybot. Our application is that Ariadne has knowledge of where Theseus has been based off of the map that she drew. Ariadne can inform Theseus where not to go – and tell him where to go – based off of his past and current surroundings.	

Elements of the Test Field

Briefly describe a test field in the context of the real application (e.g., Martian terrain, city streets, etc.). Then state what each of the basic objects and other elements required for the test field represent in terms of the AV application. Draw and attach a **sketch of a possible simple test field for the lab**.

Test Field Description
The setting of this test-field is the maze that Minotaur lives in, which is called Labytinth. The CyBot, from modern day, time traveled back to Minotaur's time and was exploring Labyrinth when it realized Minotaur is alive and is likely to damage/destroy the bot if it gets ahold of it. The rush is on for CyBot to get out before Minotaur destroys the bot.
The test field has a key with it that clearly describes the map. It includes the destination zone (DZ) in the center of the field, surrounded with 6 pillars. Around the DZ are a maze-like environment (Labyrinth) consisting of tall objects.

Basic Objects and Other Elements	Mapping to AV Application Test Field
Tall objects (wide or composite)	Parts of a wall in Minotaur's maze
Short objects	The short objects are debris in Minotaur's maze.
Holes	The holes in the test field are holes in the ground. Minotaur made holes to trap people (and robots) who are in its maze.
Pillars (thin tall object)	The pillars mark the corners of Minotaur's liar, which is a confirmed landing zone for our helicopter to pick up the Cybot
Out of bounds	The white tape is walls of the maze – the confines of Minotaur's home
Destination zone	The destination zone is a confirmed landing spot for out helicopter to pick up the CyBot, reliving it from the risk of Minotaur destroying it.
Other Application Specific Elements (may be novel features for bonus points or incidents to avoid) The pressure is on – if the bot doesn't escape before Minotaur gets to it, Minotaur will destroy the bot.	

Serious Incidents to Avoid and/or Novel Features (Optional)

You may have identified novel features in the tables above. Enter them in the table below and propose possible bonus points if demonstrated successfully. In addition, describe any additional serious incidents that might happen in your test field for your AV application.

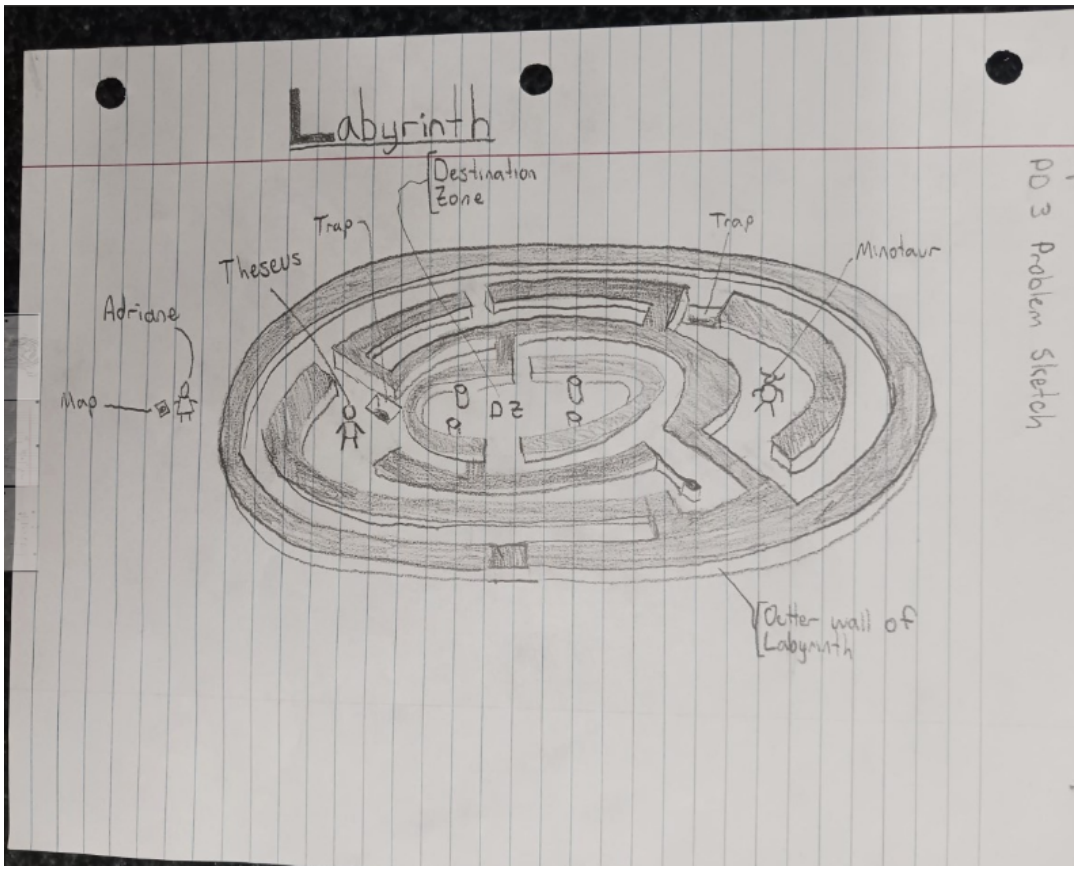
Novel Features	**Bonus Points**
If Theseus can find Minotaur's liar in 10 minutes or less, there is a 0% chance of Minotaur killing Theseus. This means there is a 100% chance of Theseus killing Minotaur when Minotaur falls asleep in his liar.	5
If Ariadne can accurately draw a map from Theseus's description, she will be able to guide him with good accuracy.	Up to 10 points
If Theseus can find Minotaur's liar without help from Ariadne (Autonomous program) he deserves a reward.	Up to 10 Points
Theseus will sing as he walks through Labyrinth.	2 Points
If Theseus tries to find Minotaur's Liar – and succeeds – before the week of the dead (dead week)	5 points

Serious Incidents	**Deductions**
If Theseus falls into one of Minotaur's trap, Minotaur will surely kill Theseus and we will all die.	Zero on the project -That's a joke. -10 points per time
If Theseus continues to run into walls (tall objects), he will hurt himself, increasing the chances of his death.	-5 for each collision, maximum of 15 points
If Theseus moves the small pillars (surrounding Minotaur's liar) by running into them, Minotaur will know someone is watching him.	-2 for each time a pillar is moved
If Theseus continues to stub his toe on debris (runs into short objects) he will hurt his toe.	-2 Per excessive amount of collision

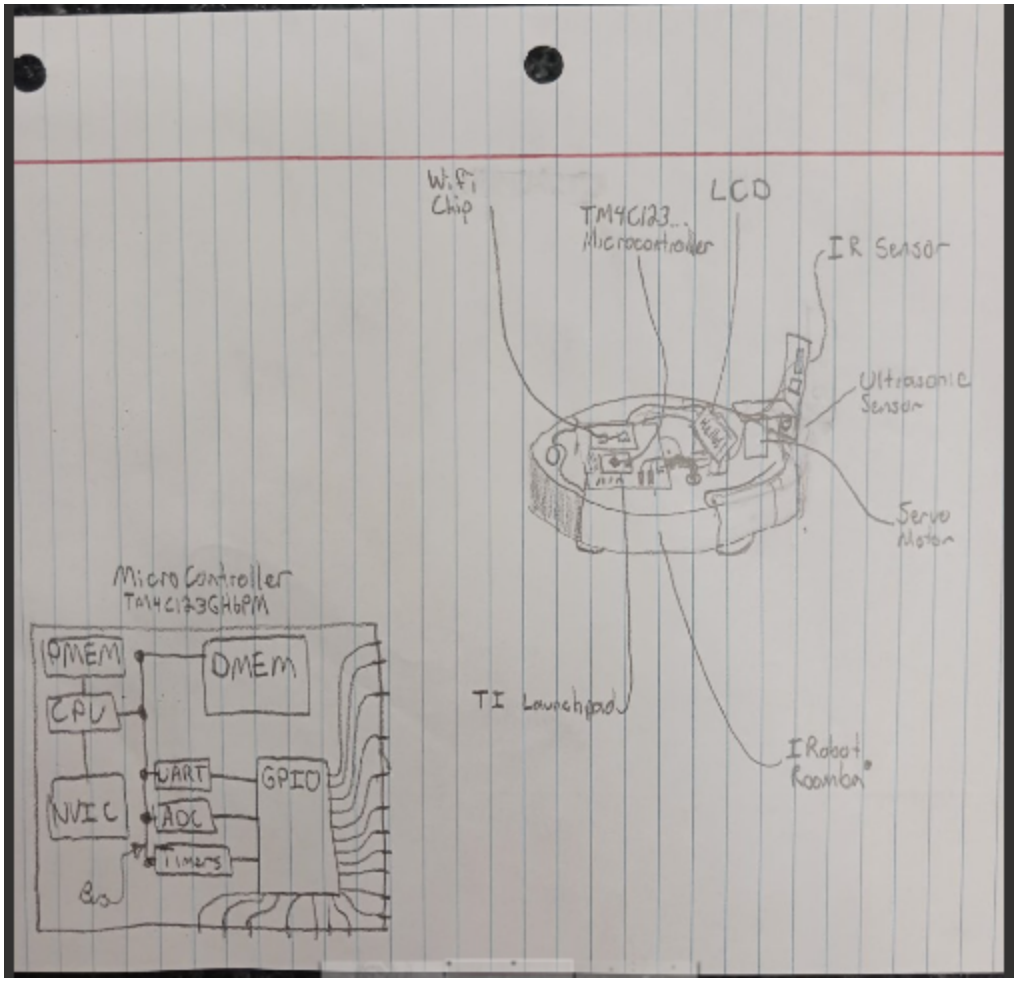
Sketches

Attach the following sketches to your submission. These were noted above in red.

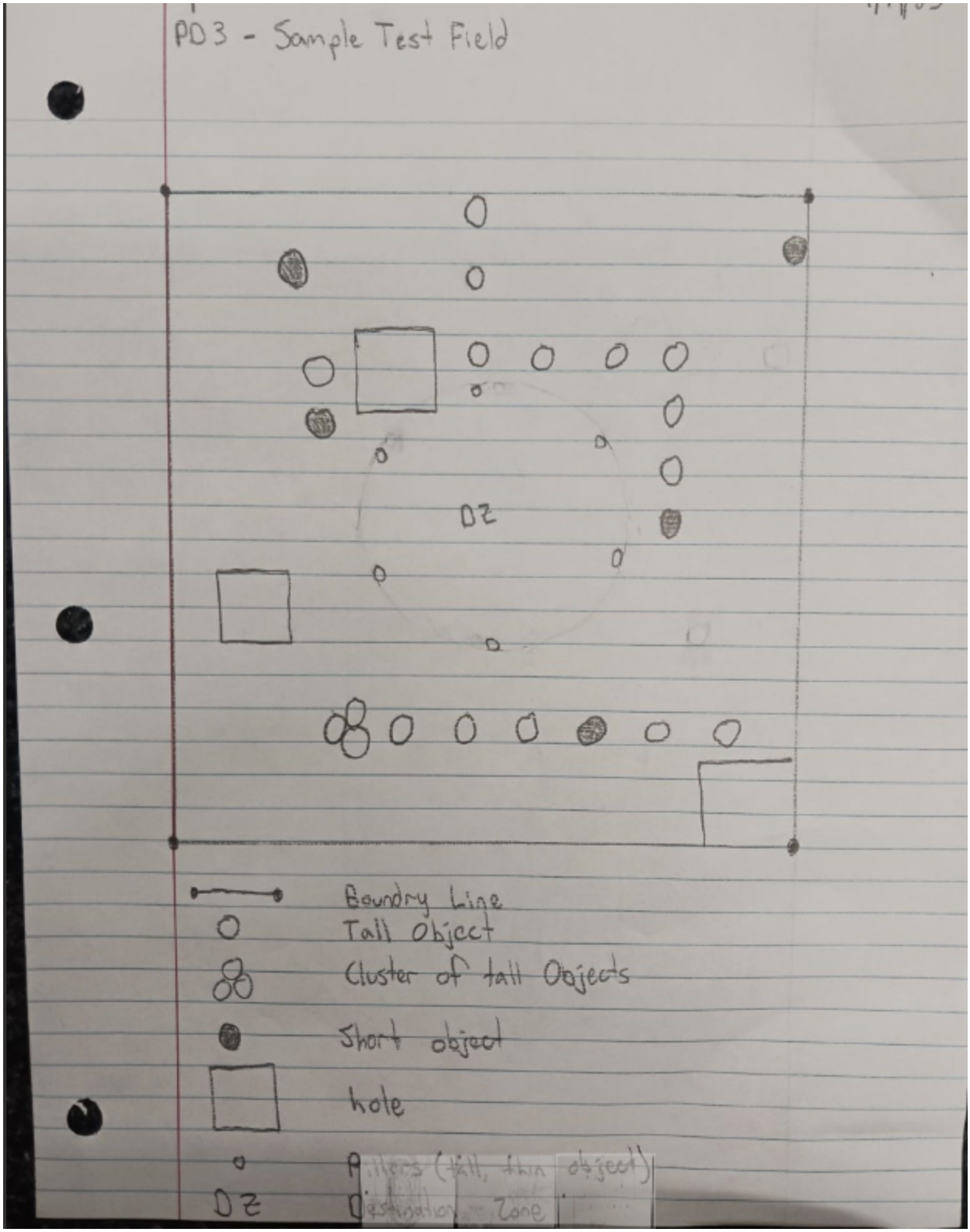
- **Problem sketch**



- **Technical system sketch**



- **Test field sketch**


PD3 - Sample Test Field
DZ
Boundry Line
Tall Object
Cluster of tall Objects
Short object
hole
Pillars (Tall, thin object)
Destination Zone
DZ