Embedded Systems International

Project Statement of Work (PD3)

Team Identifier: G-4

Team Name (optional):

Team Member Names: Michael Berg, Michael Schmalz, Yash Wadhwa, Gavin Nienke

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? 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 webpage)
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
See the Lab Project page in Canvas for the PDF file for the webpage.

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: something like an emergency response team would benefit from a vehicle or bot that can navigate through constantly changing areas filled with debris in order to locate those who are in need of help, particularly in situations where humans would be less efficient.

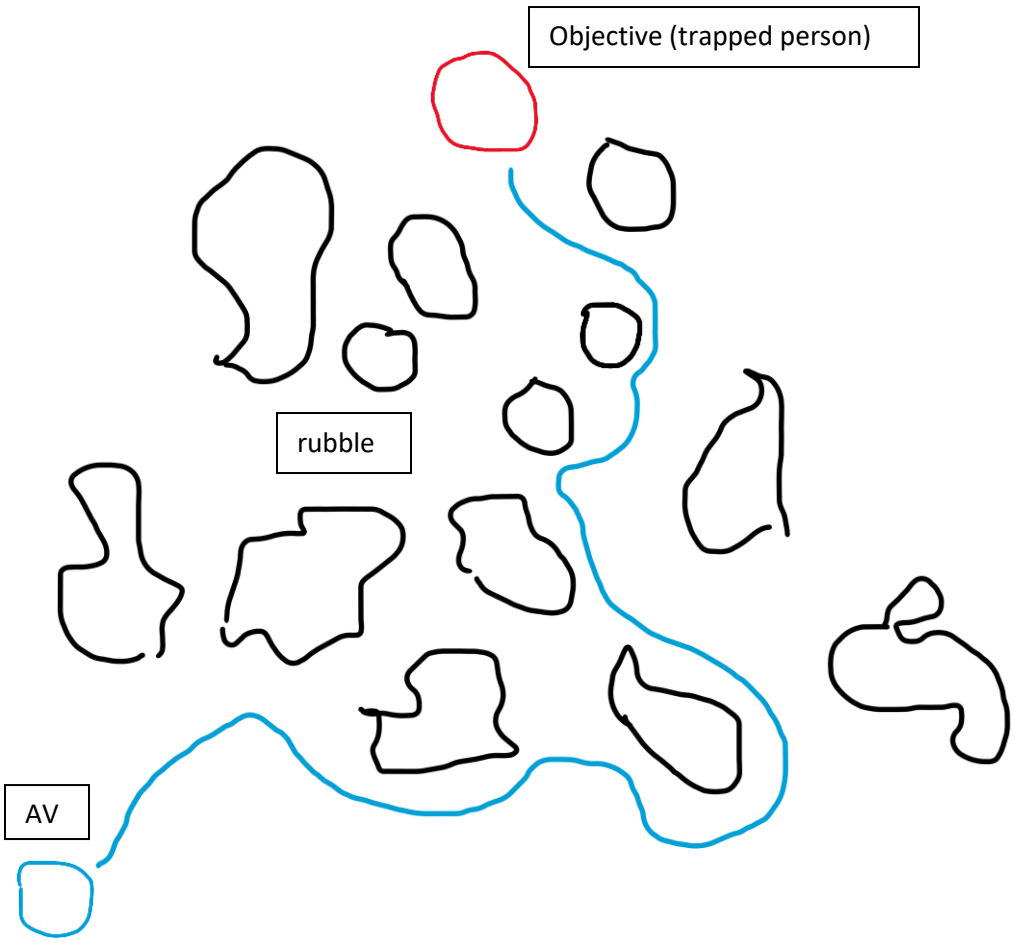
High-level mission goals:

- Autonomously explore and navigate through hazardous environments to its intended objective while maintaining the safety of the vehicle.
- Be able accurately scan the environment to minimize the possibility of getting the bot into dangerous situations.

Short description of the problem:

In many emergency cases, the environment could be impassible by humans. This project requires the implementation of a bot that can navigate the dynammically changing environment, avoiding collisions and making it to the objective.

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

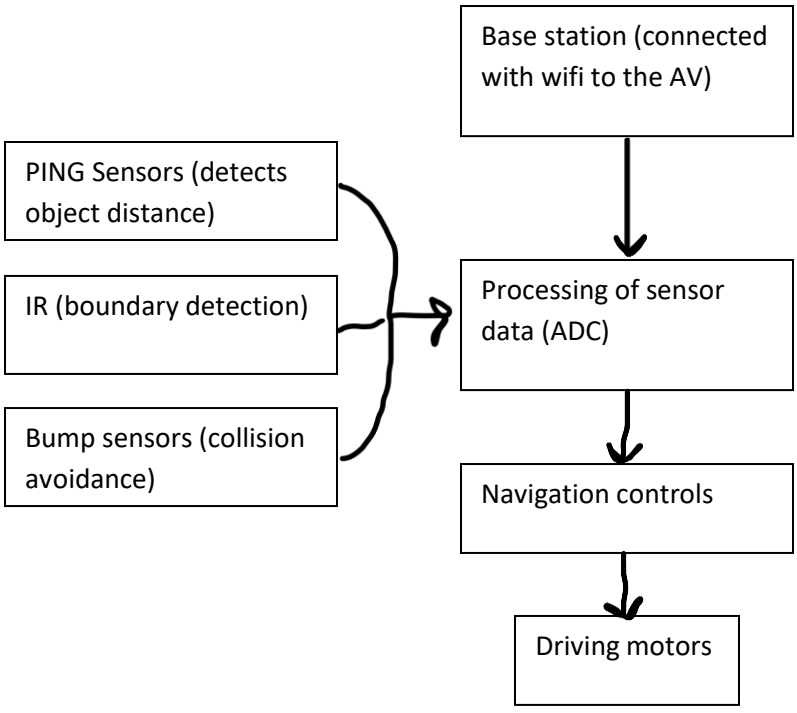
Next, consider your AV application in relation to the project requirements and the five categories by which it will be evaluated.

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 Lab Project page in Canvas and see 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 must 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	Sends object info to the computer
Cybot Movement	Manuevers through an environment full of obstacles
Object Detection	Utilizes the sensors to locate obstacles to navigate around and eventually find the objective
Object Avoidance	Utilize distance measurement/bump detection (PING, IR, bump sensors)
Boundary Adherence	Constantly ping with sensors to ensure that it is within bounds
Arrival at Destination	When the scanner picks up the desired object, the bot completes its demo and stops
User Interface	Displays scanner data, obstacle detection, and other general bot status
Base Station Control	Sends commands to initiate search, set destination, or stop.
Other Application Specific Functionality (may be novel features for bonus points) **Flash LEDS at destination, log certain obstacle types (send to the computer and actively display)**	

Mapping to Platform

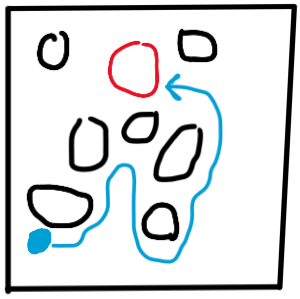
Briefly describe how each of the basic platform components required for the project will be used in your AV application.

Basic Platform Components	Usage in AV Application
Open Interface and iRobot Sensors	Detects obstacles, walls, objective, platform edge.
Interrupts	For responsive object detection and collision handling.
ADC	Read analog values from ping and IR sensors.
Input Capture	Measure distance between object and bot using sensors
PWM	Controls motors for movement and steering
UART/WiFi	Communicates with base for further commands and updates.
Other Platform Components or Modes (may be novel features for bonus points) **Play noise when the objective is reached**	

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 : an environment with fallen rubble and a survivor who needs rescue. PVC is the obstacles, and the objective block we are given is the survivor.



Basic Objects and Other Elements	Mapping to AV Application Test Field
Tall objects (wide or composite)	Big rubble
Short objects	Small rubble
Holes	Pits in the environment
Pillars (thin tall object)	Structural beams brom buildings
Out of bounds	Unsafe or insignificant area
Destination zone	Safe area where the survivor is locaated
Other Application Specific Elements (may be novel features for bonus points or incidents to avoid)	

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**
Logs and timestamps obstacle findings	+2
LED flash + sound emission when survivor found	+1
Real-time mapping to web UI	+2

Serious Incidents	**Deductions**
Exits test field	-2
Collision with survivor object	-1
Failure to send status updates	-1

Sketches

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

- **Problem sketch**
- **Technical system sketch**
- **Test field sketch**

Visual communication is helpful for sharing information. There are many ways to represent your information. The problem sketch could be anything from a cartoon (informal) to a UML use case

diagram (more formal). The technical system sketch is similar to what has been used/shown in class and lab. The test field sketch probably needs no explanation.