1 Project Introduction

The current shutdown imposed by the COVID-19 pandemic prevents us from conducting our final project in the usual manner, which would require teams to actually build and demonstrate a working project. Therefore, we will proceed with the following alternative project specification.

2 Project Specification

Teams of two students each, will collaborate remotely to create a project proposal. Each team may choose one project from those listed in Section 3 below.

2.1 Scenario

Your employer is interested in producing the device/system that you are proposing, and you want to be the ones who take on this project.

• You must submit a proposal to your technical manager detailing how you propose to go about it. Assume that other teams in your company will do likewise; they are your competition.

• Your manager does not want his reputation sullied by a failed project, so he will be very careful in choosing which team he will endorse, and give the go-ahead.

• Therefore, your proposal must convince your manager that you understand the problem, have done your homework, and have the technical knowledge and a plan for successful completion.

2.2 Standards and Styles

All written proposals & reports must comply with the Written Document Style Guide [2]. All source code must comply with the Embedded Programming Style Guide [1] for this course. Failure to do so, will cause your manager to doubt your ability to manage details and follow directions.

• Proposals must not exceed 10 pages, including Title page, References, and Appendices (if any).

• References, must include at least the data sheets or manuals for all parts and components needed (except trivial generic parts like resistors, capacitors, etc).

2.3 Deliverables and Deadlines

By Noon, EDT on Friday, April 24: Email a .pdf file of the formal, written proposal to the instructor, who will play the role of your technical manager. Grading will depend on how likely it is that the manager would allow your team to proceed with the project. Grading criteria will include:

• Completeness of your analysis,

• Understanding of the problem and issues to be addressed, as demonstrated in your proposal,

• Quality of your solution and approach, and the likelihood of success,

• Clarity, readability, and style-guide compliance of your proposal,

• Adequate citations and references, showing that you have identified and familiarized yourself with all parts and components needed.
3 Project Choices

These projects are decidedly low-tech. They are achievable using eZ430 target cards, and other devices discussed in lectures. They emphasize reaching an engineering objective at minimal cost and complexity (i.e. doing the most with the least).

3.1 Line Mapper Bot

Given a contiguous curved line with up to 8 intersections (or cross points), a mobile robot will:

1. Traverse the taped line on the floor, from beginning to end.
2. Measure the linear distances between each of the cross points.
3. Wirelessly report these distances to a PC for human-friendly real-time display on a terminal.

Conditions of testing:

- The line and cross points will be laid out in black electrical tape on light colored (but not white) floor tiles.
- Each cross point will be a right angle cross that extends at least 2 inches in each direction.
- The minimum radius of curvature for the path is 6 inches.
- The line sensor suite will be designed by the team, using up-to 4 IR Reflection Detectors.

3.2 Light Seeker Bot

A lamp with a bare bulb (equivalent to 40-60 W incandescent) will be placed at an arbitrary location in a straight section of building hallway with no obstacles in the hall. A mobile robot shall:

1. Traverse the hallway and, using up-to 4 CdS photoresistor cells, detect & localize the light source.
2. Approach to within 6 inches of the lamp and stop, without moving or tipping the lamp.

Conditions of testing:

- No part of the robot chassis, wheels, or attachments may touch any wall or the lamp at any time.
- The base of the lamp will be located with at least 1 foot clearance from the nearest wall.
- The team may decide:
  - Which sensors & means to use to avoid hitting a wall and/or the lamp.
  - If and how to aim or steer the photoresistor sensors.

3.3 Hallway Shuttle Bot

Using only an accelerometer chip for input, a mobile robot shall traverse the distance between two lines across a straight hallway. Given lines that are exactly 12 meters apart, the robot shall:

1. Pause for a few seconds,
2. Start at a Start line, drive to a Finish line, and stop within ± 0.5 meter of the Finish line,
3. Pause for a few seconds,
4. Back up to the Start line and stop within ± 1 meter of the Start line.
3.4 Hallway Navi Bot

Given up-to 3 active ultrasonic sensors (pingers), a mobile robot shall autonomously:

1. Complete at least one circuit through a building hallway about 8 - 12 feet wide (such as the main rectangular loop of the EERC 6th or 7th floor)
2. Avoid bumping into the walls or any other static obstacles.
3. All obstacles will be 1 - 2 feet in diameter, and may be placed anywhere in a straight section of hallway (not at corners). Only one obstacle will be placed in any given location.

3.5 Ultrasonic Radar Line

Using two “radar towers”, each comprising an active ultrasonic sensor (pinger) mounted on a servo, and wired to an MSP430:

1. Detect and track a single target as it moves through the radar’s range of view.
2. Determine the target's (X,Y) position & velocity, and point the pingers toward the target.

Conditions of testing:
- The area to be covered shall be a 1 meter x 1 meter square.
- The pingers have a wide field of view, so azimuth is useless; you have only range to work with.
- You may not use any Floating Point values or operations (yes, it can be & has been done).
- The target to be tracked will be cylindrical or spherical, and at least 6 inches in diameter.
- The speed of the target will be limited to no more than 15 cm/sec. However, the target may wobble or vibrate, so those motions must be filtered out, esp. from velocity.

3.6 WSN and Guard Bot

Create an eZ430-based Wireless Sensor Network (WSN) to detect and locate an intruder in a straight section of building hallway about 8 - 12 feet wide, and forward the data wirelessly to a base station mounted on a mobile robot.

1. There must be 4 free-standing sensor nodes and 1 base node mounted on the robot.
2. The fixed sensors employed shall be simple Passive Infrared (PIR) motion detectors.
3. If the intruder comes “too close” to the robot's end of the hallway, then dispatch the robot to approach and challenge the intruder.

Conditions of testing:
- The robot shall approach to within 2 feet of the intruder and point at the intruder.
- No part of the robot chassis, wheels, or attachments may touch any wall or the intruder at any time.
- The robot should be able to tell the difference between the intruder and a wall.
- The designers may decide what robot-mounted sensors & methods to use for localizing the intruder.
4 References
