

Project #10

See course website for due date.

Overall Project Goal:

The plan is to create a car that can follow a black electrical tape line after navigating via a Wi-Fi connection. The creation of the car is broken into ten projects.

The first project is building the battery power system. Verification will be performed using Either Analog Discovery or other Lab test equipment.

The second project is the installation of the LCD onto the Control Board and the material to attach it to the FRAM board. Demo your working LCD with the Project 2 code.

The third project is the creation of the car with the Forward only part of the H-bridge control for the wheels. Successful verification will be movement of the car and appropriate car labeling.

The fourth project is the controlled movement of the car with the forward only part of the H-bridge control for the wheels. Successful verification will be of the car moving in predetermined shapes within a 36" x 36" square area.

The fifth project is adding full control of the H-Bridge allowing the vehicle to travel forward and reverse. Verification will be with timed travel forward followed by timed travel in reverse; ending with spinning motion.

The sixth project is the addition of the emitter / detector circuit that will detect the black line, and the code to resolve the Thumbwheel to a digital value to verify ADC configuration. Verification will be manual display of ADC values as your vehicle transitioning from white to black and back to white; independent tracking of the Thumbwheel.

The seventh project will be replacing the timed travel forward and reverse from Project 6 with intercepting a black line circle and motoring around following the black line.

The eight project is the serial communication. There will be homework assignments that will assist in building software routines that can be used in the project.

The ninth project is to communicate with a Wi-Fi device.

And the tenth project is steering via a web interface, auto intercepting and following a black line to the course end. The Wi-Fi course will be to navigate an area in the Atrium or EBII Hallway. A Bonus will be awarded to those demoing to full completion on the first day. Navigation of each Wi-Fi course segment will be considered successful by driving into the 1-foot square and stopping; if it is the last point, or passing over [at least two wheels] on the way to the next point. Once on the square, a command is to be given via IOT that causes the vehicle to navigate autonomously from the square to a black line, turn on the black line and follow it to the end circle, traveling around the circle twice.

When the vehicle gets to the end of the circle travel a last command must be given to cause the vehicle to exit the circle away from the 8th square, navigated further than 2 feet from the circle.

Project 10 Directions:

In this project you will write software and assemble hardware to make your car navigate a course using the IOT Module and then transition to intercept / following a black line to the end. The work on the project can be a collective effort between team members [not code sharing].

Project 10 is making all the pieces of code work together, providing an adequate power source and make your car navigate a course using the IOT Module transitioning to follow a black line to the end.

The black line part of the course will include no sharp turns with a radius less than 4 inches. Your car must traverse the black line part of course to the end. At the end is circle that your car will merge into. After traveling around the circle twice a TA will indicate to you to give your vehicle the exit command. Your vehicle should exit in a direction away from the 8th square and stop more than 2 feet away from the circle. A special message should be written to the LCD indicating it has ended the project.

Once at the 8th IOT course square, only two IOT commands can be given. The first is to go autonomous and locate / follow the black line and the second is to exit the circle when completed. No other Wi-Fi command can be given after the car has exited the black line circle and stopped. What ever method you use to give commands must be placed either on the ground or a table.

The IOT course will have 9 numbered 1-foot squares [0-8] placed around the atrium. You will start at 0 and navigate via IOT to each number in sequence. Successful arrival at a number will be 2 wheels traveling over the number with TA verification. The last number, 8 will have the two, white panel black line courses set one to the right and one to the left. The edge of the black line panels will be 2 feet away from the edge of the #8 1-foot square.

Starting will be a range of area **around** the 0 square and not limited to being **on** the 0 square.

Upon arriving within 2 feet of the number 8, a TA will start a timer. You will have 45 seconds to get 2 wheels on the #8 and issue the black intercept command. You will not be able to move or give commands to re-position your vehicle, you must only execute your command to intercept the black line. No additional commands can be given until the vehicle has traveled around the black circle at least twice. At that time, the TA will instruct you to issue a command to exit the circle. Your car must exit the circle and end more than 2 feet away from the black line circle and in a direction away from the #8 square. Each of the lower black line elements must be displayed on the top line of the display; BL Start. Intercept, BL Travel, BL Circle, BL Exit, BL Stop.

All the numbered squares are not affixed to the floor and may move from their initial location due to student vehicle operation. Re-placement will not happen unless the number is moved more than a few feet away from its original location. Re-position can only be done by Instructor / TA.

The IOT Module course will consist of 1-foot square numbered markers. The task is to cross over each marker in sequence with at least two wheels touching the square to count. The cars starting position will be around the 0 square. When your car is placed at the starting location, the LCD should display “**Waiting for Input**”. When your car starts moving start a counter to count seconds. Use Line 4 to display the number of seconds your car is on the course. When you stop at the end display the total number of seconds.

As you navigate, when you have arrived at a number, you must identify on the top line of the display, Arrived 0?, where ? is 1,2,3,4,5,6,7,8.

Once navigating, each command sent to the car must be displayed on the LCD display. Use Line 2 and Line 3 to display the IP address.

Recognize that the course will have several cars going at the same time. Accidents and obstructions may happen. Insure your car and or your car control has commands to stop to avoid damaging yours or others cars.

Software

You may use any part of the previous code that you have developed. No magic numbers allowed. Headers for functions and files are required. Software submission to Moodle is required.

Write the code; update the project document; maintain a revision list on the first page identifying the changes made. This may encompass more than one page. Identify the problems encountered and the solutions made.

Project Write-up:

Complete the project write-up. Flow charts and all code need not be included. **Include all code and create flow charts for Main and 10 other functions. Describe main and the same other functions. Make sure the code is well documented.**

Your conclusion should be your team’s impression of the overall projects / class.

You must also complete section 5 identifying how long your car will last from a fresh set of batteries.

Demonstration Procedure:

Demos will be in class during the last week of class.

You will place the car on the first square with the display showing the correct information. Once the starter has acknowledged you are ready to go, start navigating the course.

The Rules:

- a. There is no overall time limit.
- b. Multiple students can start the course at the same time. There will be a starting area that will support multiple simultaneous cars starting.
- c. Multiple cars will be going on the course simultaneously.
- d. Faster cars can pass slower cars.
- e. You cannot touch your car after it leaves the Starting square.
- f. If you need to touch your car you must return to the waiting line to start again.
- g. When you are arriving at Marker #8, a timer will be started. The autonomous command must be given before the timer expires.
- h. Each arrival at a number must contain the number on your display and the TA record acceptance.
- i. Each of the lower black line elements must be displayed on the top line of the display; BL Start, Intercept, BL Travel, BL Circle, BL Exit, BL Stop.
- j. At each Black line segment is completed, a 2 second stop must occur before continuing.
- k. Re-tries at arrival and go autonomous will be allowed; pending first timers on the course take precedence.
- l. Once you give the command to intercept the black line only the ending stop command can be given.
- m. Once the stop command is given, you have either made it to the end, or will have to start again.]
- n. Your car MUST stop on its own after exiting the circle.

Grading Scale for Project 10:

Demo 80%

<u>Item</u>	<u>Description</u>	<u>Points</u>
1	It completes the wi-fi course	40
2	It displays the numbers identifying progression	5
3	It navigates to the black line	5
4	It stops at the black line	10
5	It turns and intercepts the black line	10
6	It travels the black line course	10
7	It navigates around the circle twice	5
8	It displays the progression	5
9	It exits the circle and stops	5
10	It stops	5
11	It waits 2 seconds between BL events	5
		<hr/> 105

[note the 5 point bonus for completing all]

Demo 20%

<u>Item</u>	<u>Description</u>	<u>Points</u>
1	Project Write-up Notebook	<u>100</u> 100

Software Project and the Team write-up both need to be submitted to Moodle. Make sure to delete the contents of the DEBUG\LST and the DEBUG\OBJ files. The Team Write-up can be submitted as either a PDF or as a Microsoft Word docx file.