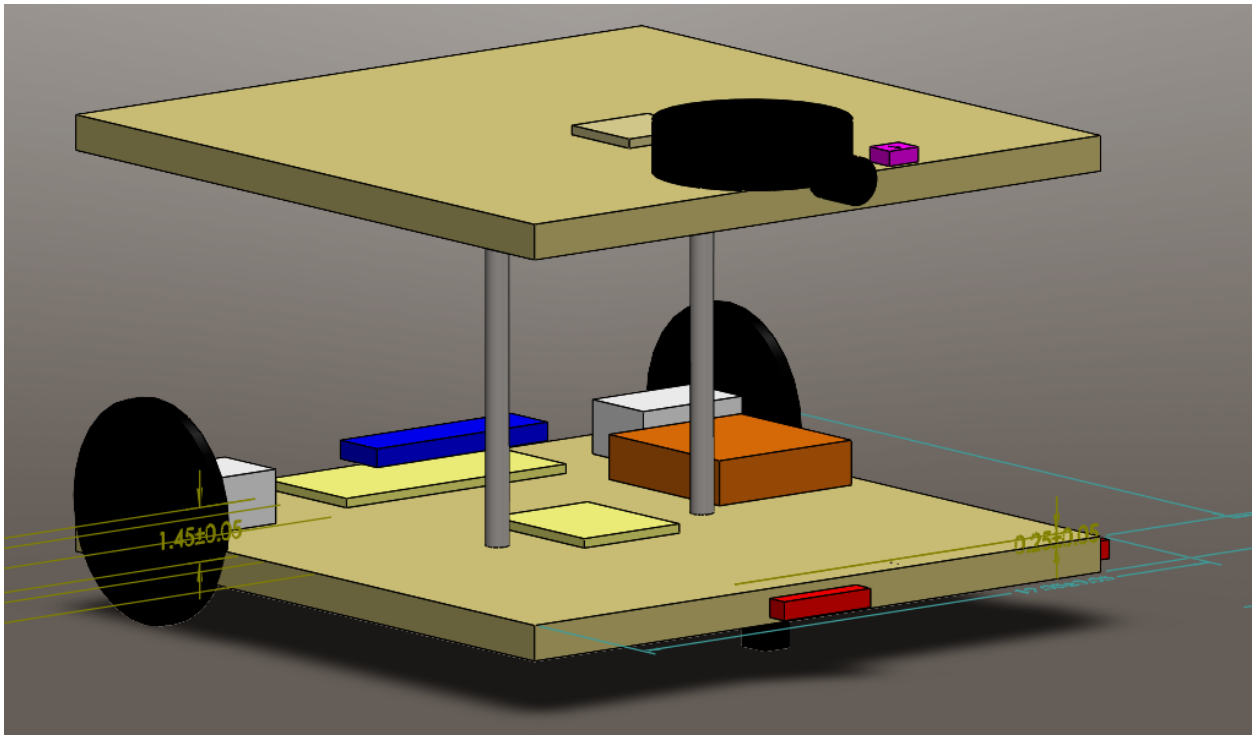
Firefighter Bot Proposal



By Neel Patel

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TEJ4MI

Mr.Webb

Description

Objective:

The objective of the firefighter bot is to be able to navigate a maze in which there is a lit candle. The bot will be programmed to extinguish the candle autonomously without any aid from external forces. This task may seem simple but in reality is difficult to achieve. It will take precise planning, continuous effort, and determination. This document outlines the plans for building and programming the bot.

Wall Detection:

Starting off with one of the most integral parts of this bot is its wall detection. This is achieved by using two wall sensors, one that is attached to the front of the bot and one that is on the left side of the bot. The sensors used in this bot are Sharp GP2D12 distance-measuring sensors. These sensors will allow the bot to know how far it is away from an object and will allow it to follow the left wall at an appropriate distance. This will allow the bot to navigate the maze for the first three rooms. Since the fourth is floating the bot will not be able to follow the left wall to find it. However, the distance sensor can still help to locate the fourth room. This strategy will be discussed further below.

Line Detection:

Line detection will be an important part of the bot as it can be used to determine how many rooms have been completed and if it is necessary to change algorithms to search for room 4. The line detection is obtained by using a phototransistor and a super-bright LED. Since all the rooms are divided by white lines when the bot crosses over the line the light is reflected and the phototransistor which will be placed next to the LED will change the voltage sent to the control chip. This change in voltage will tell the chip that a line has been detected and through the use of programming the number of times a line has been detected can be recorded. So after the bot has detected 6 lines it will know that it only has room 4 left and to find it it will have to change its approach.

Fire Detection/ Extinguish:

To detect the fire an infrared phototransistor will be used while a fan will be used to extinguish the flame. The placement of these two components is critical as the flame can be anywhere between 15 centimeters to 20 centimeters of the ground. This means the phototransistor and fan must be able to detect and extinguish flames between these two measurements. The phototransistor and fan must be near the front of the bot as well. The bot will be programmed to turn on the fan if the flame is less than a certain amount of centimeters to the bot. The exact measurement will be determined through testing.

Build Strategy:

The overall build of the bot will ideally include two square 7.5x7.5inch pieces that are ⅜ inch thick. The bot will have two layers that are attached by two long bolts or threaded rods. The first layer will consist of the motherboard, motorboard, motors, wheels, LCD screen and 6 volt battery pack. This will allow the whole drive system to be on just one level. The second level will contain the fan board, fan, wall sensors and the infrared transistor. The testing will be done in two stages the first being only using the first level. In this stage wall hugging will be tested by mounting wall sensors on the first layer temporarily and the line detection will be detected to make sure each component works. Once the first stage is complete the second layer will be added. This will be the second stage of testing where the bot will have to use the fan to extinguish the flame. Using this plan makes sure all components will work together and doing this step by step will make troubleshooting easier than building the entire bot at one time. The motors and wheels used in this bot will be the standard ones given in class as they are adequate for the bot to complete its objective. The wheels will be placed near the back of the sides as that will be the most effective way to make sure the bot drives properly. In addition there may be a third wheel or block to stabilize the bot if it can not balance on two wheels. This third wheel will only be for stability so no motor will be attached to it. The left wall sensor will be placed near the front of the left side of the bot on the first level so turns and wall following stays accurate. The phototransistor and super-bright LED will be facing toward the ground from the bottom wood board so the light from the LED will reflect off the white and the phototransistor will detect there is a line. This is the basic plan for the construction of the bot but if problems arise adjustments will be made to fix the issues.

Programming Strategy:

As stated previously the strategy for the first three rooms will be to follow the left wall. This will be done by turning off the left wheel if the bot is too far from the left wall and turning off the right wheel if the left wall is too close or if the front wall is too close. This simple programming will be able to take the bot through the first three rooms but will not work for room 4 so room 4 needs a different strategy. The easiest thing to do for room 4 might be as soon as the bot exits room 3 it changes algorithms and turns right instead of following the left wall and goes straight until it is a certain distance from the opposing wall then tell the bot to turn into the room 4 hallway. Using the left wall sensor it will then turn into room 4 when distance to the wall increases substantially. Although this strategy may work I feel there may be a more effective way to achieve room 4 but it would take some testing. Now that strategies to get into rooms have been discussed it is time to strategize how extinguishing is going to work.The basic concept will be if the infrared transistor detects any flame within a certain distance then the bot will stop and turn on the fan while turning to each side a bit to spread out the air. What I hope to accomplish is to find a way to exit the room quicker than just following the left wall out but that will take time and testing so it may not be possible under these time restraints.

Unique aspects:
While it will be hard to achieve just the basic bot I plan on trying to implement some unique aspects on my bot. I do not think these aspects will be hardware related but more in the way of programming the bot. I want to make an effective program that can get to each room and extinguish the fire and head straight back out. This seems a little bit complicated at this time but I hope that seeing how the robot moves through the maze will give me some ideas on how to optimize its programming.

Material List

Material	Type	Quantity	Source	Code	Unit Price	Total Price
Capacitors	0.1uF	2	Abra Electronics	0.1R16	$0.29	$0.58
	1000uF	2	Abra Electronics	1000R16	$0.29	$0.58
Diodes	Diode	1	Mouser	1N4148	$0.14	$0.14
	Super-Bright LED	1	Digikey	SSL-LX5093 SI C/G	$1.52	$1.52
Resistors	220 Ω	1	Abra Electronics	R1/4-220	$0.01	$0.01
	1K Ω	1	Abra Electronics	R1/4-1K	$0.01	$0.01
	4.7K Ω	1	Abra Electronics	R1/4-4K7	$0.01	$0.01
	10K Ω	2	Abra Electronics	R1/4-10K	$0.01	$0.02
	47K Ω	1	Abra Electronics	R1/4-47K	$0.01	$0.01
	150K Ω	1	Abra Electronics	R1/4-150K	$0.01	$0.01
	Variable	1	Abra Electronics	63P10k	$0.69	$0.69
Voltage regulators	LM7805	1	Digikey	LM7805CT	$1.22	$1.22
Transistors	Phototransistor	1	Solarbotics	17700	$0.59	$0.59

	IR Phototransistor	1	Digikey	QSD123-ND	$0.75	$0.75
	Transistor	1	Digikey	TIP120-ND	$1.48	$1.48
Wall sensors	IR Wall sensor	2	Amazon	B07FDLM8YF	$15.09	$30.18
Motors	GM2 Motors	2	Solarbotics	GM2	$7.49	$14.98
	GM Bracket	2	Solarbotics	GMB28	$1.95	$3.90
Wheels	GM Wheels	2	Solarbotics	GMPW	$4.33	$8.66
PIC Chips	PIC16F887	1	Digikey	PIC16F887-I/P	$4.18	$4.18
	L293D	1	Digikey	L293D	$6.13	$6.13
	40-pin Chip holder	1	Digikey	243-40-1-06	$0.94	$0.94
	16-pin Chip holder	1	Digikey	4816-3000-CP	$0.55	$0.55
	40-pin IC Socket	1	Abra Electronics	ICC40	$4.60	$4.60
	16-pin IC Socket	1	Abra Electronics	ICC16	$2.76	$2.76
Blower Fan	Blower Fan	1	Robotshop	COM-11270	$8.67	$8.67
LCD Screen	16x2 LCD screen	1	Abra Electronics	LCD-MOD-11	$11.34	$11.34
Terminal blocks	2 Slot terminal block	2	Digikey	277-5986-ND	$3.02	$6.04
Other	Battery clips	2	Abra Electronics	29-130	$0.35	$0.70
	Threaded rod/12 in	2	Lowe's	44597	$1.99	$3.98
	Wood 7.5x7.5x3/8	2	Mr.Webb	N/A	$0.00	$0.00
	Circuit boards	3	Mr.Webb	N/A	$0.00	$0.00

TOTAL COST						$112.39

Timeline:

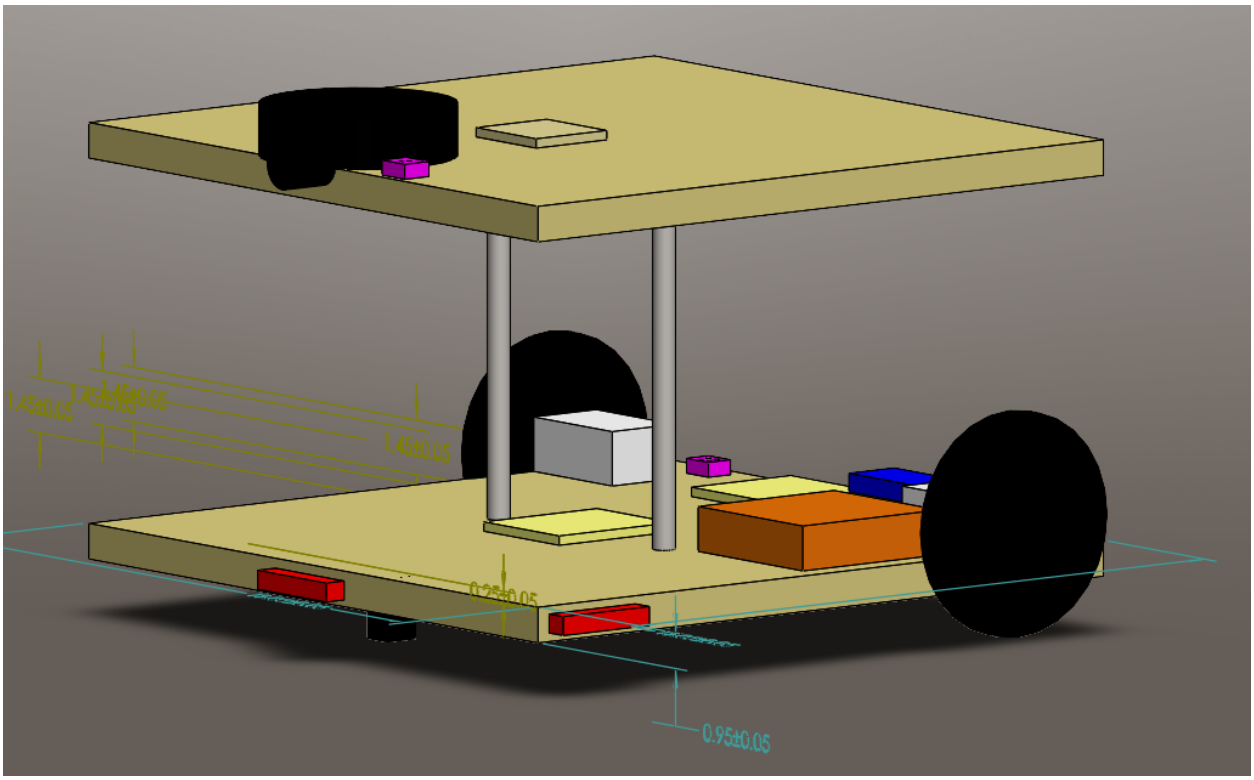
Date	Tech Class	In Person	Objective
February 18	Yes	Yes	- Complete Safety Test - Read Firefighter notes - Read Sumo bot Notes - Start Breadboarding Blinking LED
February 19	Yes	Yes	- Finish Breadboarding Blinking LED - Program blinking LED - Read through Firefighter Notes again
February 20	Weekend	No	- Clean up breadboard - Wire for motors - Read Firefighter Notes for programming motors
February 21	Weekend	No	- Program Motors - Read Ahead to Line detection and LCD programming
February 22	Yes	Yes	SNOW DAY - Make motherboard on Traxmakr - Make motorboard on Traxmakr - Make fan board on Traxmakr
February 23	Yes	Yes	- Prepare motors - Attach motors to Breadboard - Test Motors - Breadboard Line Detection - Program Line detection - Write program for LCD, wall sensors, flame detection and extinguish at home
February 24	Yes	Yes	- Breadboard and test LCD - Breadboard and test Wall sensors - Breadboard and test Flame detection and Extinguish
February 25	Yes	No	- Work on proposal - Finish Description part of Proposal

February 26	Yes	No	- Work on proposal - Finish Material's part of Proposal Work on proposal
February 27	Weekend	N/A	- Work on proposal - Finish Drawings part of Proposal
February 28	Weekend	N/A	- Work on proposal - Finish Timeline part of Proposal
March 1	Yes	No	- Work on fixing circuits in Traxmakr - Look through proposal and make improvements
March 2	Yes	No	- Finalize Traxmakr circuits
March 3	Yes	No	- Get friend from other cohort to prepare circuits
March 4	Other Course	N/A	- Retrieve circuits and necessary equipment from friend
March 5	Other Course	N/A	- Solder Motherboard and Motorboard - Program wall hugging
March 6	Other Course	N/A	- Build bottom layer of bot - Attach Motherboard, motorboard, motors, wall sensors, and wheels
March 7	Other Course	N/A	- Program wall hugging and line detection
March 8	Other Course	N/A	- Test Wall hugging and line detection (Simple) - Fix any errors
March 9	Other Course	N/A	- Test Wall hugging with more turns - Fix any errors
March 10	Other Course	N/A	- Get Second layer ready - Attach Flame Sensor and Fan - Attach Fan board
March 11	Other Course	N/A	- Program and test the flame extinguish
March 12	Other Course	N/A	- Test Flame extinguish with candle
March 13	Other Course	N/A	- Fix any errors that occured
March 14	Other Course	N/A	- Start programming for Maze
March 15	Other Course	N/A	- Think of strategies for room 4
March 16	Other Course	N/A	- Program strategies for room 4
March 17	Other Course	N/A	- Test all parts of the bot to make sure they are

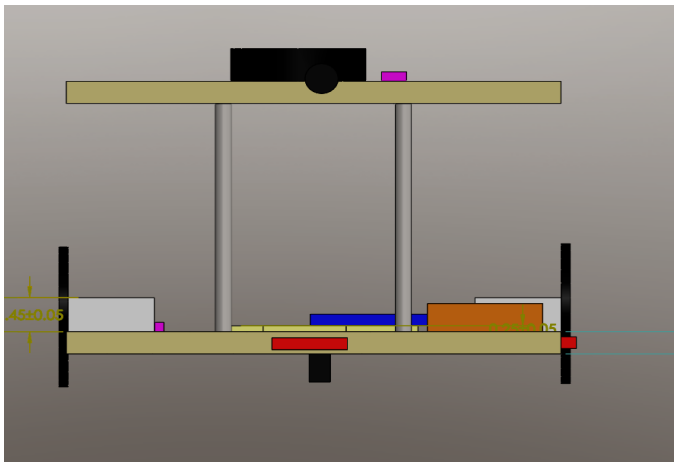
			working
March 18	Yes	Yes	- Make any final improvements to the bot that could not have been done at home
March 19	Yes	Yes	- Hopefully have a try at the maze - Objective is to get through three rooms with wall hugging - Make plans to optimize code after testing bot in the maze
March 20	Weekend	N/A	- Rethink Strategies for maze
March 21	Weekend	N/A	- Program improvements/strategies
March 22	Yes	Yes	- Test bot in maze - Look for potential improvements - Fix errors that occured
March 23	Yes	Yes	- Test bot in maze - Look for potential improvements - Fix errors that occured
March 24	Yes	Yes	- Test bot in maze - Look for potential improvements - Fix errors that occured
March 25	Yes	No	- Look for ways to improve bot/program
March 26	Yes	No	- Look for ways to improve bot/program
March 27	Weekend	N/A	- Look for ways to improve bot/program
March 28	Weekend	N/A	- Look for ways to improve bot/program
March 29	Yes	No	- Look for ways to improve bot/program
March 30	Yes	No	- Look for ways to improve bot/program
March 31	Yes	No	- Look for ways to improve bot/program
April 1	Other Course	N/A	- Work on Final Report
April 2	Good Friday	N/A	- Work on Final Report
April 3	Weekend	N/A	- Work on Final Report
April 4	Weekend	N/A	- Work on Final Report
April 5	Easter Monday	N/A	- Finalize Final Report

April 6	Yes	Yes	- Test Bot in maze and see what improvements can be made for the next day - Hopefully attempt maze 2
April 7	LAST DAY	Yes	- Hopefully finished maze 1 and attempt to do maze 2

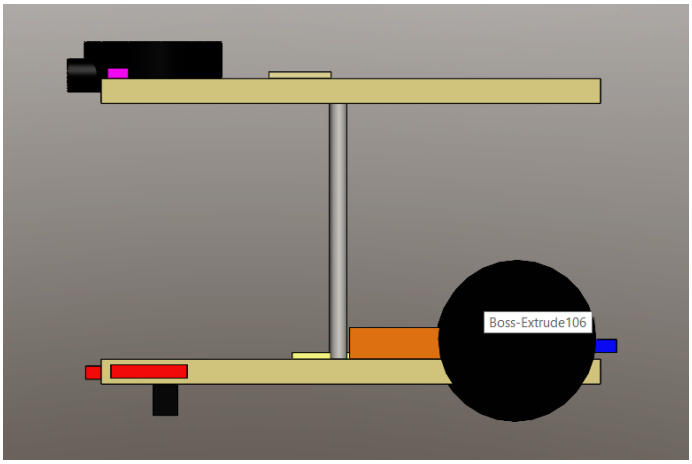
Drawings:



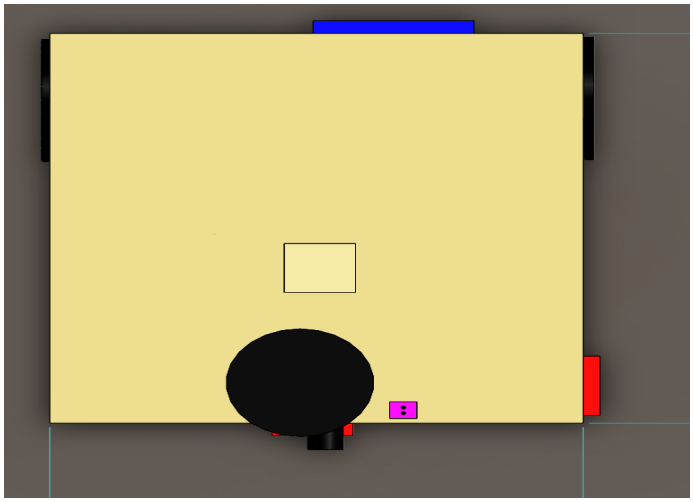
Black- Fan/Wheels
White- Motors
Yellow- Circuit boards
Blue- LCD Screen
Orange- Battery Pack
Red- Wall sensors
Pink- Phototransistors/Superbright



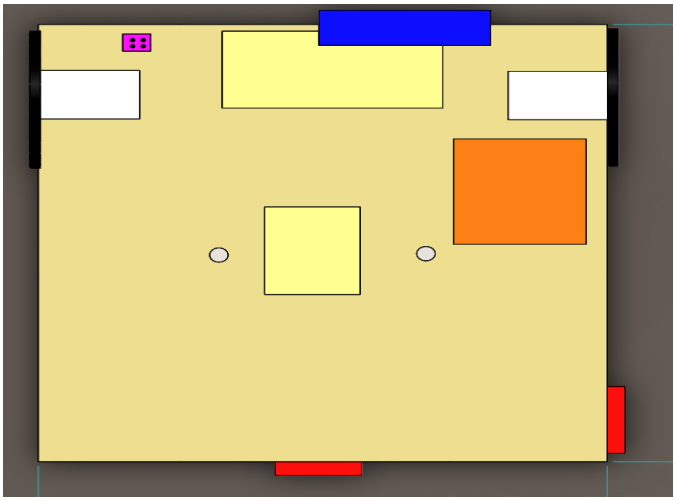
Front View



Side View



Top View Second Layer



Top View First Layer