TEJ4UI
Computer Technology
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Firefighter Bot Proposal

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Description

Purpose

The purpose of the firefighter bot is to navigate around a maze, locate a flame, and extinguish the flame in as little time as possible. To achieve this goal, the three main challenges we face in the construction of the bot is the bot's mobility, its ability to sense where the fire is, and the choice of which tool to use to extinguish the fire. If the first challenge is successful, the bot will reach all four rooms in the maze and extinguish the flame if the flame is present. Once the bot has graduated from the first challenge, the bot will be invited to navigate a more challenging second maze, in which the goal is both speed and accuracy.

Features

In order to minimize the time spent in the maze before the flame is extinguished, the bot will include several design features. The features of the bot will include a fan, flame sensor, distance sensor, line detection, and LCD.

1. Body

   The body of the bot will be 6 inches by 8 inches, with three tiers of plywood held together by four support columns, and rounded corners to prevent the edges of the bot from catching on the corners of the maze. The rounded corners will also allow for lesser contact of the bot with the walls and reduce the frictional force resulting from when the bot slides against the wall. The rectangular shape will allow our bot to have greater holding capacity without a greater width, as opposed to if the bot base was square. This will allow for the bot to remain stable as the wheels can be set further apart. Thin pieces of wood will be used to construct the base in order to reduce the weight of the bot and increase the speed at which the bot is able to navigate throughout the maze.

2. Fan

   In order to put out the flame, a 33mm blower fan will be mounted on the second tier of plywood, at the front of the bot. This allows for the air to unrestrictedly flow to the flame and put it out.

3. Motors

The two wheels on the bot will be controlled by the left and right motor. The motors are implemented using an H-bridge, which allows the motors to spin in both directions. The bot is able to move forwards, backwards, and spin on the spot.

4. Sensors

The bot will have distance sensors on the front and the left side of the bot to detect walls. There will also be a flame sensor at the front of the bot. The bot will convert the data it receives from its sensors from digital to analog through programming the PIC18F887.

5. Line Detection

As the threshold of each room is marked by a white line, the bot will use line detection to monitor when it enters and exits a room. This allows the bot to change its procedure as required specific to the position in the maze. Different functions can be called to adapt the bot's behaviour in correspondence to the current step in its firefighting procedure.

6. LCD

The LCD will be placed on the uppermost tier of the bot so it can be easily accessed. This allows for easier troubleshooting, as the sensor readings are clearly displayed. Sensors readings will include whether flame detection is working properly, the distance that the bot is from the wall, and whether or not line detection is working properly.

7. Power Supply

Wires will be woven together to minimize the possibility of confusion and tangled wires. As the bot moves into the testing stage within the maze, a change will be enacted to switch to a constant, reliable power supply.

Strategies

The bot will use a variety of strategies to detect and navigate to the flame, starting with wall-hugging. The bot will detect the right wall of the maze and utilize the right-hand rule for solving mazes where the bot "hugs" the right wall, ensuring it has travelled through all parts of the maze. When the bot senses the presence of a flame, the bot will position itself at an allowable distance to the flame, orient the fan in a straight direction to the flame, and will be programmed to trigger the fan to start. If a flame is not detected, the bot will exit the room by detecting the walls and avoiding them. As the development of the bot continues, we will be developing and implementing new strategies to adapt to the requirements.

Materials List

Item	Source	Quantity	Unit Cost	Total Cost	Link
Motor Driver Board					
Wheel Motor	Solarbotics	2	$6.24	$12.48	https://solarbotics.com/product/gm2/
Wheels	Solarbotics	2	$3.89	$7.78	https://solarbotics.com/product/sw/
Small Wheel	Make in tech shop	1	--	--	
L293D Motor Driver Chip	Digi-key	2	$3.12	$6.24	https://www.digikey.ca/product-detail/en/stmicroelectronics/L293D/497-2936-5-ND/634700
1000uF Capacitor	Abra Electronics	1	$0.49	$0.49	https://abra-electronics.com/capacitors/electrolytic-capacitors-radial/1000r16-electrolytic-radial-capacitor-1000uf-16v-1000r16.html
Sensor Board					
Sharp Analog Distance Sensor 10-80 cm	Solarbotics	2	$12.94	$25.88	https://solarbotics.com/product/35238/
Super-bright LED	Digi-key	1	$0.50	$0.50	https://www.digikey.ca/product-detail/en/lumex-opto-components-inc/SLX-LX5093UWC%2FC/67-1691-ND/754532?utm_adgroup=&mkwid=sG8iWLVvv&pcrid=311470541424&pkw=&pmt=&pdv=c&productid=754532&slid=&gclid=EAIaIQobChMIn9uFp8fF4AIVBR-tBh0XHg0vEAQYASABEgLEVPD_BwE
QSD123 IR Phototransistor	Digi-key	1	$0.42	$0.42	https://www.digikey.ca/product-detail/en/on-semiconductor/QSD123/QSD123-ND/187443
4.7K Resistor	Digi-key	2	$0.02	$0.04	https://www.digikey.ca/product-detail/en/yageo/CFR-25JB-52-4K7/4.7KQBK-ND/1846
220 Ω Resistor	Digi-key	1	$0.02	$0.02	https://www.digikey.ca/product-detail/en/yageo/CFR-25JB-52-220R/220QBK-ND/1295

10K Resistor	Digi-key	1	$0.05	$0.05	https://www.digikey.ca/product-detail/en/yageo/CFR-25JB-52-10K/10KQBK-ND/338
150K Resistor	Digi-key	1	$0.05	$0.05	https://www.digikey.ca/product-detail/en/yageo/CFR-25JB-52-150K/150KQBK-ND/468
1000uF Capacitor	Abra Electronics	2	$0.39	$0.78	https://abra-electronics.com/capacitors/electrolytic-capacitors-radial/1000r16-electrolytic-radial-capacitor-1000uf-16v-1000r16.html
Other Circuit Board Parts					
Reset Switch	Abra Electronics	1	$0.41	$0.41	https://abra-electronics.com/electromechanical/switches/tactile-switches/pbs-smd-100-smd-tactile-push-button.html
PIC16F887 Chip	Digi-key	1	$3.23	$3.23	https://www.digikey.ca/product-detail/en/microchip-technology/PIC16F887-I-P/PIC16F887-I-P-ND/1015608
1K Resistor	Digi-key	1	$0.02	$0.02	https://www.digikey.ca/product-detail/en/yageo/CFR-25JB-52-1K/1.0KQBK-ND/96
1N4148 Diode	Digi-key	1	$0.02	$0.02	https://www.digikey.ca/product-detail/en/on-semiconductor/1N4148TR/1N4148FSCT-ND/9356376
TIP120 Transistor	Digi-key	1	$1.00	$1.00	https://www.digikey.ca/product-detail/en/on-semiconductor/TIP120/TIP120-ND/1052441
10K Variable Resistor	Digi-key	1	$3.06	$3.06	https://solarbotics.com/product/rt10k_t/
1000uF Capacitor	Abra Electronics	1	$0.49	$0.49	https://abra-electronics.com/capacitors/electrolytic-capacitors-radial/1000r16-electrolytic-radial-capacitor-1000uf-16v-1000r16.html
LCD Output	Digi-key	1	$10.65	$10.65	https://www.digikey.com/product-detail/en/newhaven-display-intl/NHD-12232KZ-NSW-BBW-P/NHD-12232KZ-NSW-BBW-P-ND/1701265
LM7805 Voltage Regulator	Digi-key	1	$1.18	$1.18	https://www.digikey.ca/product-detail/en/on-semiconductor/LM7805CT/LM7

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Bot Body					
Scrap Wood	Wood shop	--	--	--	
Screws	Digi-key	16	$0.44	$7.04	https://www.digikey.ca/product-detail/en/3m-aearo-technologies-llc/SB-4102/EAR1236-ND/6226886
Threaded Rod	Angela	4	--	--	
Nuts	Angela	16	--	--	
Misc					
PICit 3 Microchip	Mouser	1	$70.14	$70.14	https://www.mouser.ca/ProductDetail/Microchip-Technology/PG164130?qs=dQMF8gqycOUCaciWtY5TuA%3d%3d
Blower Fan	Robotshop	1	$6.35	$6.35	https://www.robotshop.com/en/12v-16cfm-33mm-blower-fan.html
9V Battery	Jessica	1	--	--	
Total				$158.32	

Drawings