ENEL 387: Microcomputer System Design
Robotics Lab Project
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1.0 System Information

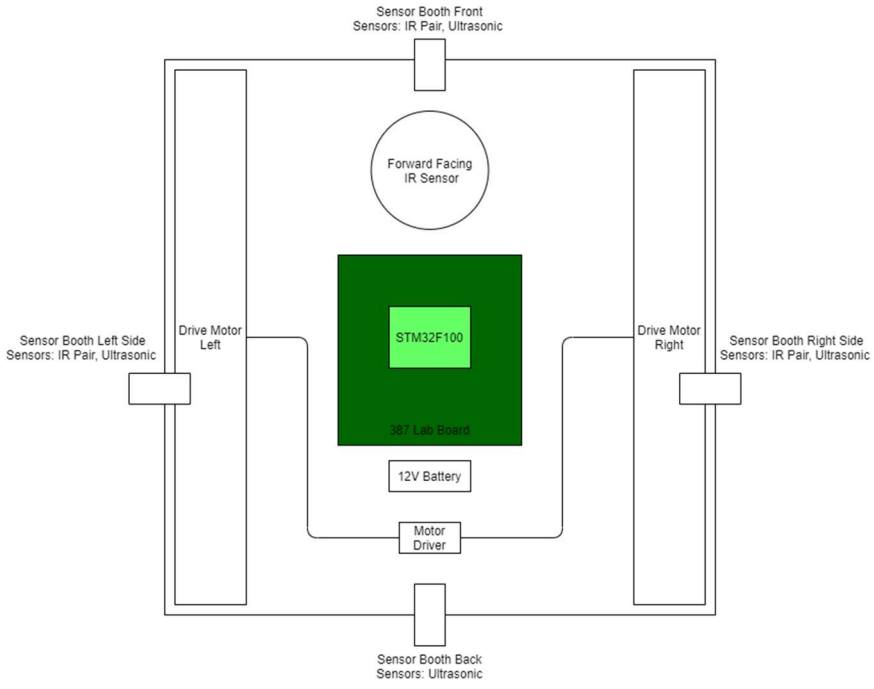
1.1 Description

Robots are machines which makes our life a lot easier by reducing the amount of human effort required in order to finish a task. An example can be a motor vehicle automobile industry such as “Tesla”, which has brought fully automatic cars in the market making the controller (robot) do all the work whereas the human has to put no efforts to get from one point to another.

The main scope of this project is for a robot to be able to navigate through a course avoiding all the obstructions in its path, detect incandescent source of light and notify the viewers what room number and the block target number the robot has found while navigating through each of the rooms.

1.2 System Diagrams

The functional system block diagram is shown below. This diagram shows the basic system components that make up the robot.



1.3 Parts and User Interface

1.3.1 Parts Table

Part Name	Part Number	Functionality
Car Chassis	-----	The use of the chassis is to hold all the parts in place and act as the main system of support(Robot).
Ultrasonic Sensor	HC-SR04	The ultrasonic sensor is used for analyzing the course and localization of the walls from the car.
IR Pair	TSOP382	The IR pair will be used for multiple functionality to: 1. Assist in course navigation where the sensor will be mounted on the bottom side of the vehicle. 2. Detection of the block. 3. Detection of the incandescent light bulb.
Battery Pack 12V	-----	This will energize the entire system.
Motor Driver	SN754410	The motor driver will control the amount of power to each wheel using Pulse Wave Modulation (PWM) to make forward/reverse/left/right to navigate through the course.

1.3.2 User interface

The robot starts to navigate once the blue (USER) button is pressed which indicates the system to begin. The green led on the STM32 will remain on indicating the robot is functioning the way it should without encountering any errors. In case of any error, the green light will blink indicating it has an error which needs to be fixed. The 16x2 display on the board will indicate every action the robot performs. For example, if the robot turns right, the LCD will display right.

1.4 Electrical Ratings

Parameter	Rating	Units
Voltage (Max.)	5	VDC
Power Supply	12	VDC
Max current(STM32F100RB)	25	mA

2.0 Operation

2.1 System Start-Up

1. To start the robot in order for it to navigate through the course, hit the blue button (USER) so it knows that it has to start and perform the task.
2. After pressing the USER button, the LEDs (blue and green) on STM32 will turn on/off alternatively.
3. The system will then go into the initialization process where all sensors will test and localize the robot.

2.2 General Operation

2.2.1 LCD Screen Configuration

The LCD screen output has two data lines that will represent the state of the robot vehicle. The LCD screen has two lines that contain 16-bits of information. This first line will be used to show the intention that the vehicle is currently going to perform. This will allow for visual identification of the current action vehicle is trying to make. In addition, the second line will be used to show two different blocks of information. The first 5-bits will be used to represent the current Room that the car is in followed by two underscores that provide padding before the next information is shown. Following the padding, there is another 6-bits that will be used to represent the block data. For Example:

L1: [Direction - RIGHT]

L2: [Room1_ _ Block1]

2.2.2 LED Sequence

On the ENEL 387 carrier board there is a series of four LED lights. The lights will be mapped in a specific order to visually represent the rooms that the vehicle has visited.

Room	LED
Room 1 - One Stripe	LED 1
Room 2 - Two Stripes	LED 2
Room 3 - Three Stripes	LED 3
Room 4 - Incandescent Room	LED 4

2.2.3 Direction Control

To navigate through the course, there are a couple of sensors that will help navigating through keeping the robot in the center of the course without hitting any obstacles encountered in its way such as the walls, block target.

1. The front InfraRed sensor will keep the robot centered by detecting the navigation white lane.
2. The side InfraRed sensors will be used to detect the lanes while exiting a room and telling the STM32 to make a 90 degree turn to align with the center of the room.
3. The ultrasonic sensors mounted in all the four directions will prevent the robot from colliding with anything it encounters in its path.

2.2.4 Emergency Routine

In the case of a robot malfunction, and there is no change in position after a set period of time, the robot will go into an emergency routine.

2.3 Factory Reset

The system will reset and it will begin in the Initialization/ Startup procedure. This will be connected to Reset Button (Black) on the STM32. Once the Reset button is pressed, the system will restart and will do nothing unless the Blue button (USER) is pressed as it is the start button.

3.0 Service Notes

3.1 Software Updates

Software Version	Date
Version 1.0	06/03/2020

3.2 Notes

4.0 Warning and Labels

4.1 Warnings

Do not supply more than 5V

4.2 Labels

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