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# ENEL 351 PROJECT REPORT

## State Machine obstruction rover

# INTRODUCTION

In the functional specification for this project, a state machine obstruction detection rover was proposed. Initially my proposed rover was to have 2 LEDS, 2 pushbutton,4 motors , 2 motor drivers and 6 ultrasonic sensors. In the final result of this project, most of the proposed parts and functionalities were successfully implemented. The final rover had 4 tyres, 3 LEDS ,2 push buttons, 2 motors, one motor driver and one ultrasonic sensor.

| **DEVICE** | **Pins on STM** |
|---|---|
| 3 LEDS | PA8,PA9,PA10 |
| 2 PUSHBUTTONS | PB7,PB9 |
| L298N MOTOR DRIVER | PA0,PA6,PA1,PA4,PA5 |
| HC SR04 SENSOR | PC6,PC7 |

## LEDs

For my LEDs I connected to a 270 ohm resistor, and the other pin on the resistor was connected to a GPIO port. The resistors mostly worked on the first attempt of the trial. To test their functionality, I just coded them to be on once the STM was reset using BSRR. I ended up adding an extra LED for reasons that would be covered later in this report.

## PUSHBUTTONs

For my two start and stop pushbuttons, I had to make sure I pick the right sides of pins that are parallelly connected to each other using a multimeter. I connected one side of the pins to ground and the other side of pins to a 1k ohm resistor, then from the same line of connections to the STM . Initially my push buttons were not working as I tried testing their functionality by turning on LEDs when high. I

connected the pushbuttons to wrong pins on the STM so initially it was not working. I then found the right pins that were safe to use from the pin function map.

## L298N MOTOR DRIVER/ MOTORS

For my l298N driver, I decided to make the rover easier to implement by making it a 2 wheel drive. This made it easier as I only needed one motor driver, this was a very smart deviation from my original plan. This left a lot more available ports on the STM. I connected the two side pins to ground and power on each motor. Then I connected the ENA and ENB pins to the same port on the STM, the IN1,IN2,IN3 and IN4 on GPIO ports on the STM. Using pulse width modulation on the EN ports, I was able to control the speed of the motors. The IN ports was to control the direction of the motors.

## HC SR04 ULTRASONIC SENSOR

This sensor was initially planned to be 6 and be all around my rover to detect obstacles all around and either stop or go the other direction of the obstacle. After realizing the number of connections required for all proposed sensors, I decided that two is better and more reasonable(one in front and the other behind). After consulting with the datasheet and finding the right way to use this sensor, by counting the time the sound travels before it is echoed back to the sensor. After figuring out this method of manipulating the trig and echo pins, the sensor was still not fully functioning. Using an ADALM200, I tried to debug the issues and didn't come up with anything definite as the reason for the issue. To test if the sensor was working I connected it to an external LED that comes on when an obstacle was within a range and goes off if it's outside the range. This was only successful sometimes as I wanted the LED to come on every time an obstacle is within or closer than the range, however the LED only usually came on if you're very close to the exact range and goes off if you're farther or closer than the range. I manipulated the calculations and played around with the code to test different instances and nothing changed. Due to time as a constraint, I just decided to have the sensor only talk to the LED and it worked mostly but the LED was very shaky and was only solid when an obstacle was close. This still falls within the general scope of a state machine rover, the third LED just shows that there is an obstacle nearby.

POSSIBLE COMBINATIONS OF STATES

| **LED 1(standby )** | **LED 2 (motion)** | **LED 3(obstruction)** | **Movement/ meaning** |
|---|---|---|---|
| ON | OFF | OFF | No movement and no obstruction |
| ON | OFF | ON | No movement and an obstruction |
| OFF | ON | OFF | Moving forward and no obstruction |
| OFF | ON | ON | Moving forward and an obstruction |

PICTURES OF ROVER