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ENEL 351: Functional Specification – Delivery E-Commerce Robot

Project Description:

A general overview of what the project is supposed to do is to follow a line sensor inside a pre-designed course by the user. I will also be creating a makeshift course for the robot to follow using cardboard with lines inside the course to guide it with the line sensor. This is to operate as simulation for a real-world situation of what the robot could be potentially capable of doing. The robot also has a proximity sensor that is responsible for detecting anything that is within a certain range of the robot which will then stop the robot from proceeding and hitting the obstruction. There will be a couple doors with LEDs on them that will have an LED light this is to signify to the light sensor whether this door requires a package to be delivered. The higher the intensity will mean a package will be delivered and a lower intensity will mean the package does not need to be delivered. The robot will then stop a certain distance from the desired "door" and signify a successful package delivery with and two green LED flashes on the breadboard. If the package is not required or after reading the LED on the door the robot will simply respond with two red LED flashes.

Main project functions:

1. PWM for motors
    a. This involves using the STM32 Microcontroller to implement PWM. Involving configuring our clock source for a timer and changing our clock frequency correctly to determine our desired PWM frequency.
    b. Then I will configure the timer where I select the PWM output and the timer pre-scaler/period.
    c. Next, I will be configuring our PWM channel involving selecting our I/O pin, setting the duty cycle, and then enabling the PWM channel.
    d. The motors will be driving off a motor driver module itself the L298N.
    e. Lastly, setting off our timer to generate the PWM signal and get our motors moving at our desired speed and frequency.
2. Line Sensor (Analog)
    a. Since we already have ADCs in our microcontroller, we can use this to read analog outputs of our line sensor. We first connect our line sensors to V_{cc} to our 5V power source, GND and the OUT. The OUT pin will be connected to an ADC channel.
    b. Once this is connected. I will be configuring the ADC which involves setting the ADC clock, resolution, and the sampling rate.
    c. Next involves reading the ADC value to read the analog output of the line sensor. Involves a conversion and then reading the value.
    d. Lastly, is to read the ADC value to determine the position of the line sensor. This will include using a comparison of the ADV converted value to a threshold of sorts to determine where the line is (L, R, Center)
3. Ultrasonic Distance Sensor (Digital)
    a. Again, we will begin with connections involving slightly more than the line sensor we had. V_{cc} to our 5V power source, GND, TRIG to a GPIO pin and ECHO to a timer input capture pin.
    b. We then configure our pin to generate an ultrasonic pulse. Involves setting the pin mode, output type, speed, and pullup/pulldown configuration
    c. Configuring our timer so it can measure the time between the ultrasonic pulse and echo signal. Involves setting timer clock source, pre-scaler, period, and input capture

   d. Now we generate our ultrasonic pulse, once this timer is configured, we can generate the pulse by setting the TRIG pin to logic level high.
   e. Next, we measure our echo signal for how long it takes for it to return. Involves starting the timer and waiting for it to trigger the input capture event.
   f. Lastly, we can measure and find our distance between the sensor and the obstruction based on the time it takes for the pulse to travel.

4. Motion Sensor (Digital)
   a. Make our connections: V_{cc} to 5V power source, GND and OUT to a GPIO pin.
   b. Configuring our GPIO pin to detect our signal from the IR sensor. Involves setting the GPIO mode to pull-up/pull-down configuration.
   c. Configuring our EXTI interrupt to ensure it can detect the rising edge of the IR sensor. Involves setting our EXTI line, mode, trigger, and its priority.
   d. Interrupt handling: When EXTI is triggered the ISR should be executed. In this routine, we can set a flag to indicate when motion is detected (red LED will be prompted to flash until obstruction removed)
5. Photoelectric Sensor (Analog)
   a. Make our connections: V_{cc} to 5V power source, GND and OUT to a GPIO pin.
   b. Configure our GPIO pin to an ADC input pin (i.e., PA0).
   c. Read the analog value from the ADC and display it using an LED.

Block Diagram:

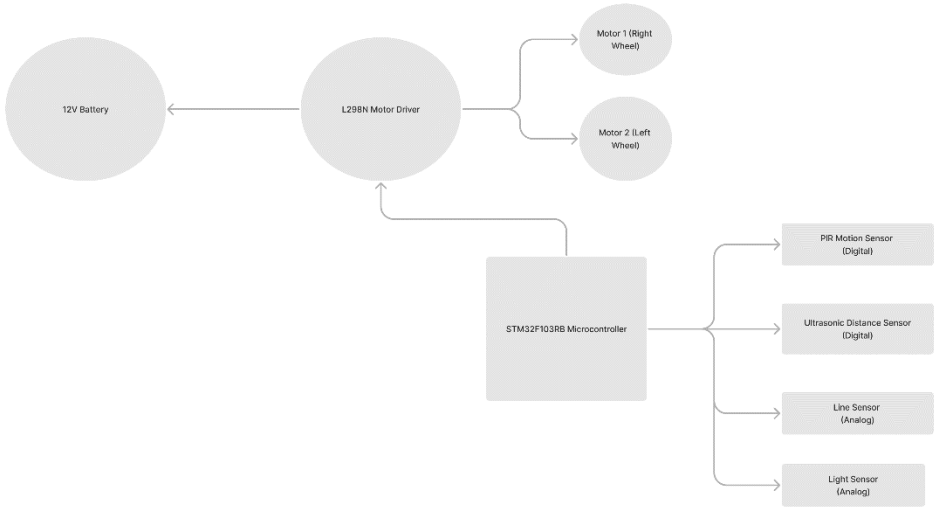

Figure 1. Block Diagram for E-Commerce Robot

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Rough Sketch: