

Obstacle Detection and Avoidance Robot

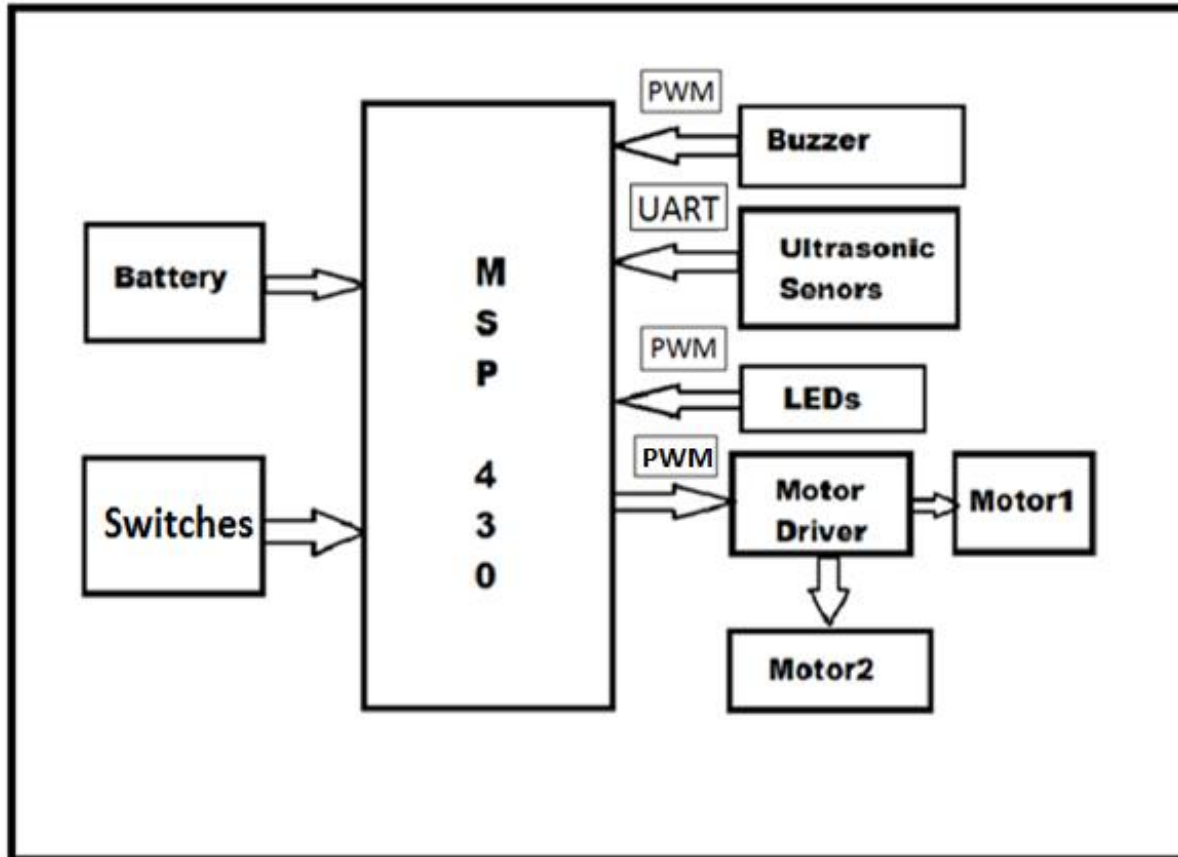
Project Presentation
Group 05
ECE 511, Fall 2014
George Mason University

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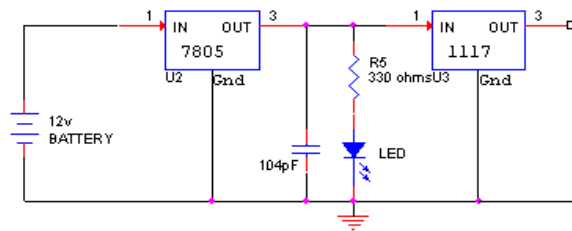
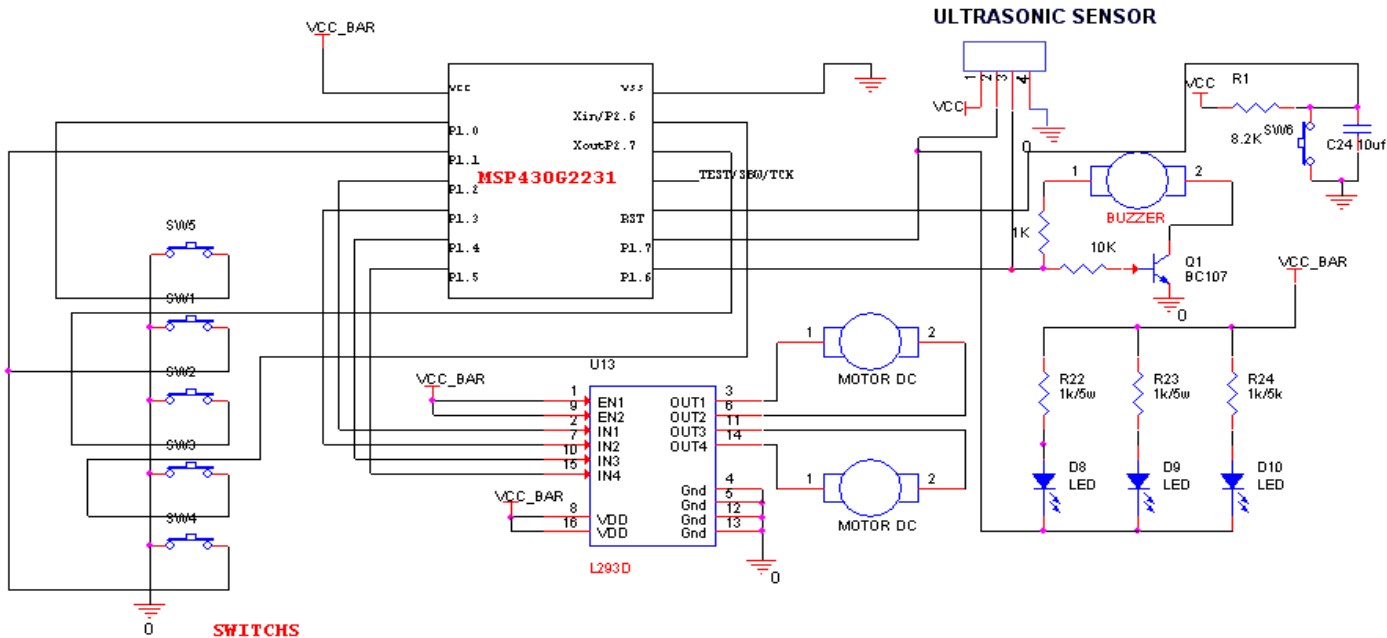
Motivation

- ▶ Utilizing all the resources of the MSP430, we wanted to create a robot which was both challenging as well as entertaining.
- ▶ It was challenging to build such a robot because it has interfacing and integration of many components.
- ▶ The concept behind this was a simple remote control car, where the car detects an obstacle and changes its direction.

Block Diagram



Schematic Diagram



Title		
MSP430 Based Robot		
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Hardware Description

1. Microcontroller MSP430.
2. Ultrasonic sensor(HC-SR04).
3. DC motors and L293D (Dual H-Bridge Motor Driver).
4. Light Emitting Diode (RGB).
5. Piezo Electric Buzzer.
6. Switches (Remote Control).

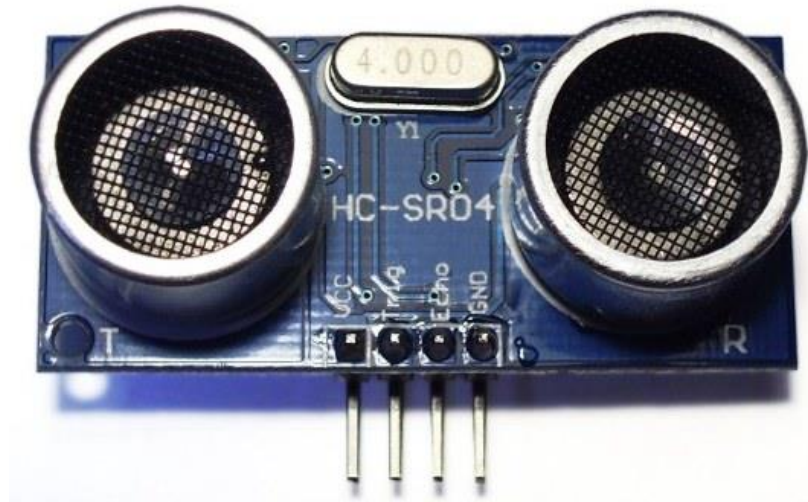
Ultrasonic Sensor(HC-SR04)

► Specifications:

- Supply voltage: 3.3V
- Current: 15 mA
- Range: 2cm-400cm

► **Interfacing:** First pin is connected to power supply, second pin (trigger pulse input) is connected to port1.7 of MSP 430, third pin (echo pulse output) is connected to port1.6 and the fourth pin is connected to ground.

► We are using UART serial communication



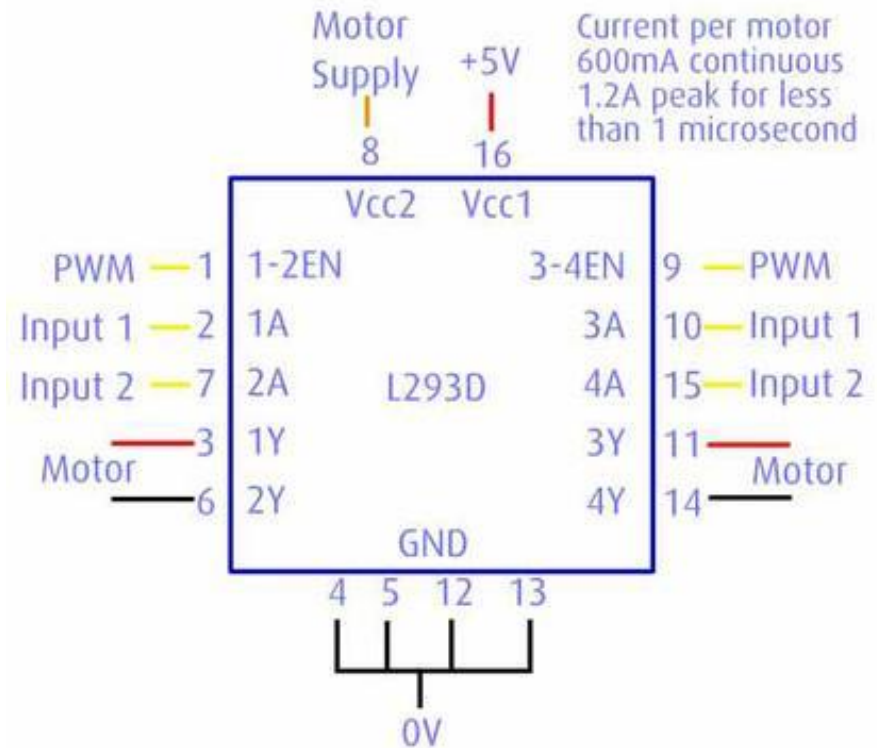
- ▶ There are several ways to measure distance without contact.
- ▶ Ultrasonic transducers measure the amount of time taken for a pulse of sound to travel to a particular surface and return as the reflected echo.
- ▶ The time delay of the transmitted and the received signal corresponds to the distance between the system and the obstacle
- ▶ The circuit calculates the distance based on the speed of sound
- ▶ Test distance = (high level time × velocity of sound (340M/S) / 2
- ▶ The received signal, which is very weak, is amplified several times in the receiver circuit.
- ▶ The positive going pulse is applied to one of the terminals of the ultrasonic sensor and the same pulse after 180-degree phase shift is applied to another terminal.

L293D H-Bridge Motor Driver

► Specifications:

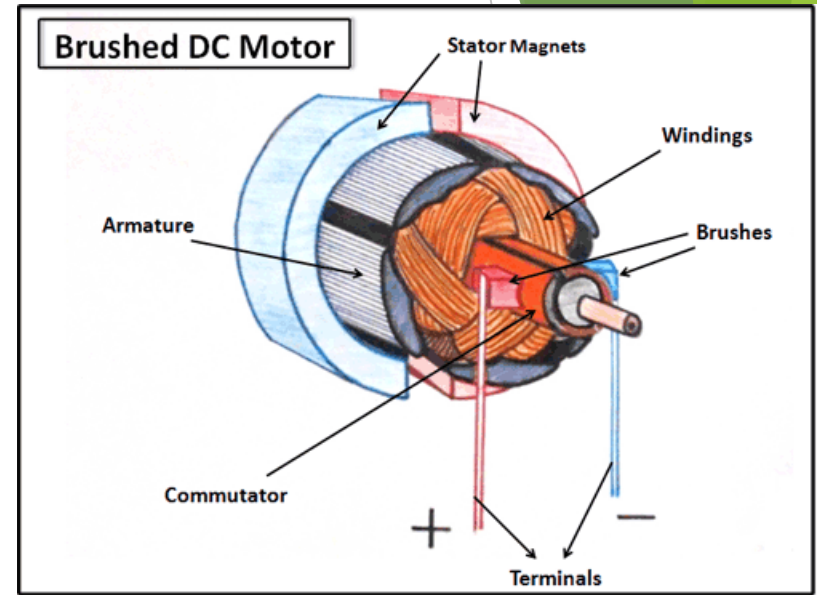
- Wide supply voltage: 5V to inputs (motors) and 12V is the driven voltage.
- High noise immunity inputs
- Output current 600 mA per channel
- Peak output current 1.2 A per channel

- **Interfacing:** Enables are connected to port 1.0 and 1.1 of MSP 430. Input ports of the driver are connected to ports 1.2,1.3,1.4,1.5 MSP 430. Four Output ports of the driver are connected to the DC motor.



DC Motor

- ▶ **Specifications:**
 - ▶ Speed: 60 rpm
 - ▶ Operating voltages: 5V
- ▶ **Interfacing:** Connected to H- Bridge L293D motor driver output ports (3,6,11,14).

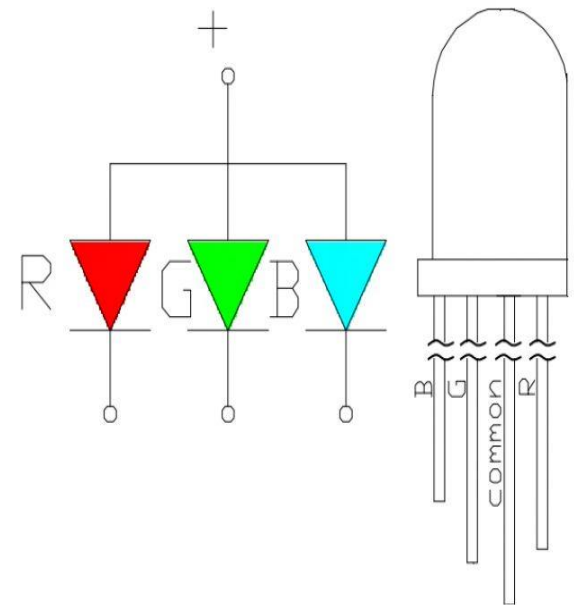


Motor Functioning

- ▶ A DC motor consist basically of two parts, the stationary body of the motor called the “Stator” and the inner part which rotates producing the movement called the “Rotor”.
- ▶ A motor needs a lot more power at startup that it does when running. The speed of the motor can be controlled by the duty cycle of the square wave.
- ▶ To vary their speed with PWM increases the efficiency of the total system.
- ▶ Pulse width modulation speed control works by driving the motor with a series of “ON-OFF” pulses and varying the duty cycle(the percentage of time the wave is high across one period).
- ▶ The power applied to the motor can be controlled by varying the width of these applied pulses and thereby varying the average DC voltage applied to the motors terminals. By changing or modulating the timing of these pulses the speed of the motor can be controlled, ie, the longer the pulse is “ON”, the faster the motor will rotate and likewise, the shorter the pulse is “ON” the slower the motor will rotate.

LED

- ▶ **Name:** RGB LED
- ▶ **Specifications:**
 - ▶ Input voltage: 3.3V, 3.3V and 5V
 - ▶ Emits 3 colors (Blue, Green and Red)
- ▶ **Interfacing:** One pin is connected to input supply and the other pin (including the colors) is connected to Port1.7 of MSP 430 and is also connected to the ultrasonic sensor.
- ▶ Common cathode.



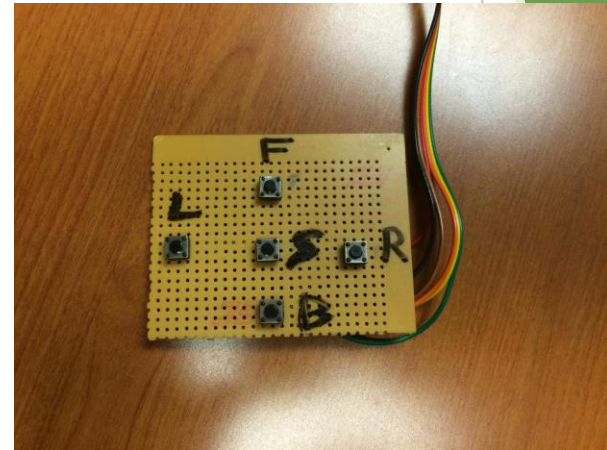
Buzzer

- ▶ **Name:** Piezoelectric Buzzer
- ▶ **Specifications:**
 - ▶ Voltage: 3.3V
 - ▶ Input current required: 10mA
- ▶ **Interfacing:** Connected to port 1.6 of MSP 430.

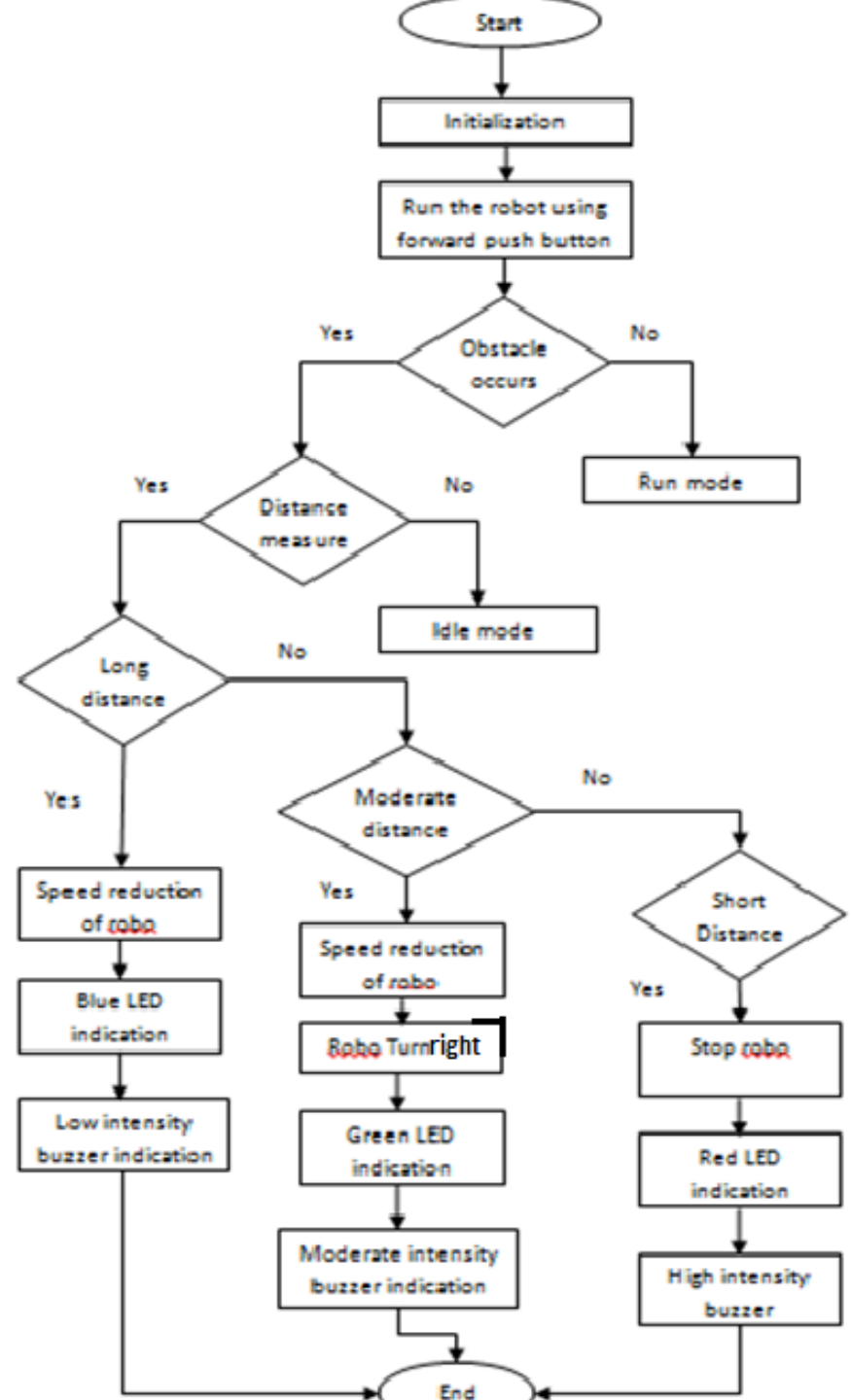


Switches

- ▶ Total 5 Switches are used:
 - ▶ Switch F: Move forward
 - ▶ Switch B: Move backward
 - ▶ Switch L: Move left
 - ▶ Switch R: Move right
 - ▶ Switch S: Stop
- ▶ All these switches are connected to the Digital input-output ports of MSP 430.
 - ▶ Switch F: Port 2.3
 - ▶ Switch B: Port 2.4
 - ▶ Switch L: Port 2.5
 - ▶ Switch R: Port 1.6
 - ▶ Switch S: Port 1.7



Flowchart



Task Division

- ▶ Pravalika Reddy Podduturi: Dealt with DC motor interfacing, hardware interfacing of all components.
- ▶ Yasaswi Garimella: Dealt with the buzzer, RGB LED's and the final testing.
- ▶ Sirisha Kurakula: Dealt with ultrasonic sensor, software interfacing of all components and final dumping of all code into msp430.

Results

- ▶ This Robot successfully detects the obstacle and then turns right to avoid the obstacle, even though if it comes across an obstacle then it would completely come to a halt.
- ▶ This robot was completed as it was proposed in the class earlier along with few simple modifications like using RGB LEDs instead of simple LEDs and also adding a buzzer and adjusting the volume depending on the distance of the obstacle.

Further developments

- ▶ Obstacle detection using Ultrasonic sensor can be designed even more sophisticated by using touch pads, where the robot can start with a touch or voice detector where voice commands can be set and make them function according to the command. Or may be an android application can be developed in order to control the functioning of the robot using our phone.

Demonstration

Thank you!!

Questions??