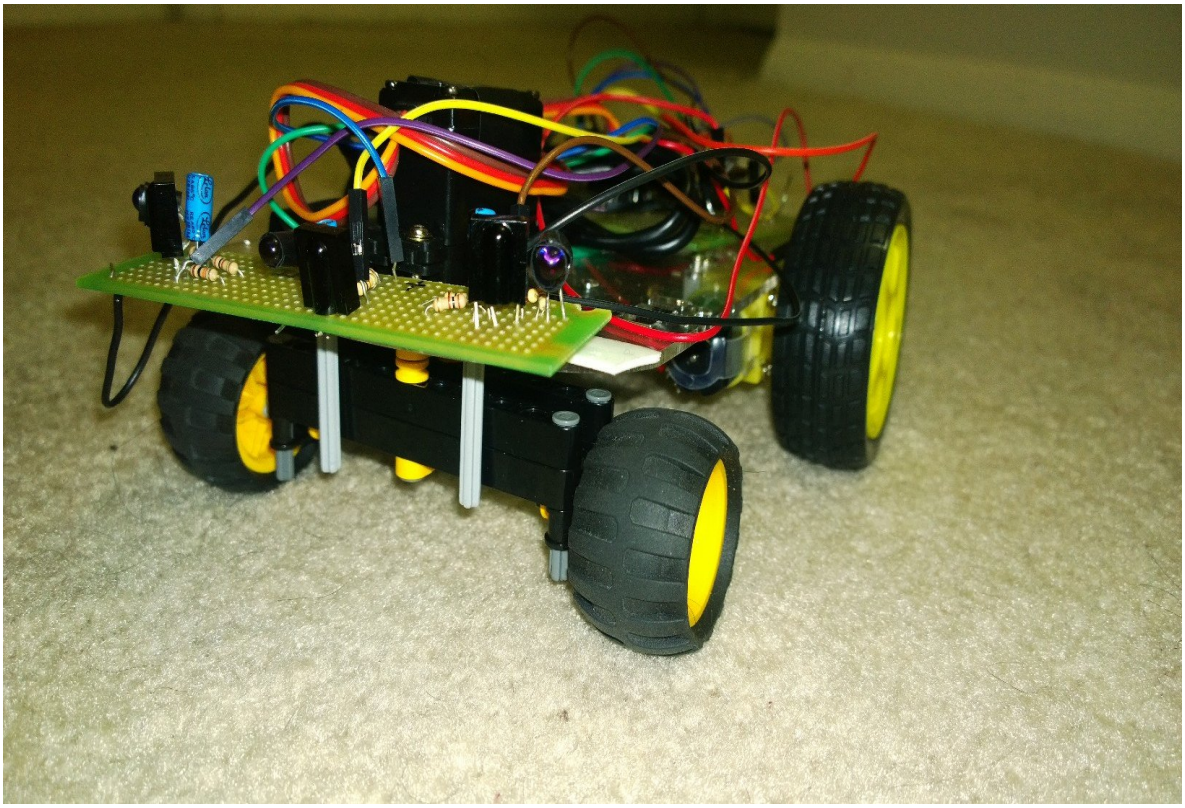
ECE 511 PROJECT REPORT

OBSTACLE AVOIDANCE CAR



Submitted by GROUP 1

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ABSTRACT :

The purpose of the project was to implement simple sensors and motors and develop an autonomous robot. The aim was to build a self-navigating decision making robot using a servo motors and couple of DC motors and IR transceiver.

The robot was fully functional and was successfully demonstrated during the presentation on 12/03/2013.

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1. Motivation :

The motivation of the project was to make a robot car that would be both fun and challenging to build and the end product would prove to be a cool toy using the MSP430 Microcontroller. Although the toy looks simple, the interfacing and integration of all components was complex.

2. Solution :

The obstacle avoidance robot uses a robust algorithm combining the results of the TSOP1738 (IR Receiver) to detect obstacles. The avoidance of objects was achieved by interfacing the Servo motor to the MSP430. The steering mechanism was designed by coupling a steering system built using Lego parts. If an obstacle is detected on the right side, the steering system (Servo motor) turns towards the right and vice versa. The turning radius is improved by stopping the left DC motor when the car is turning towards the right and vice versa.

A special case when an obstacle large enough to produce output at all TSOPs is avoided by reversing the car for a short distance.

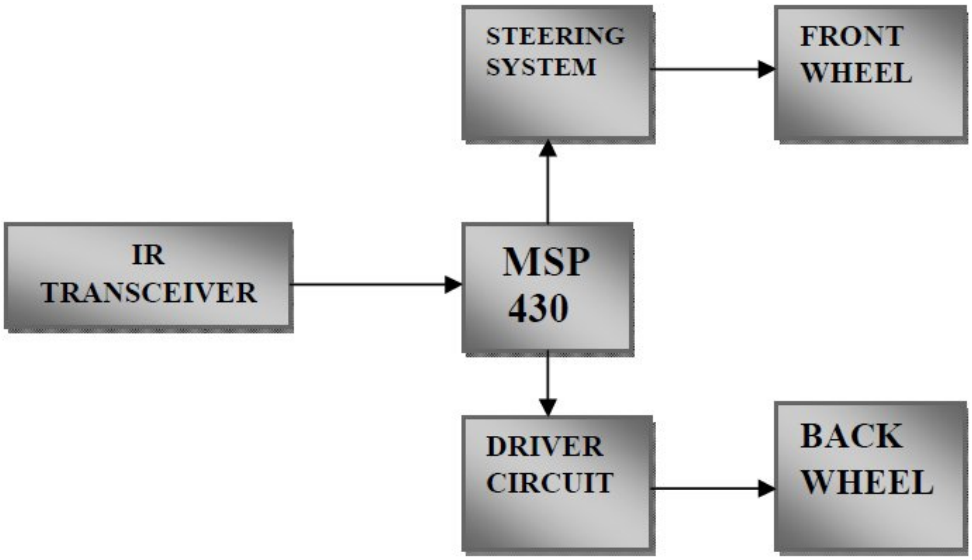

Figure 1 : Block Diagram

3. Description :

3.1 IR LED Interfacing :

IR LED is interfaced with MSP 430 through pin P1.0. IR LED transmits IR pulses with 38 KHz frequency using timer and interrupt. To generate pulse of 38 KHz frequency timer A is used to produce an interrupt 26 ms with 50% duty cycle. If an obstacle is present in front of the robot then IR pulses reflect back from an obstacle.

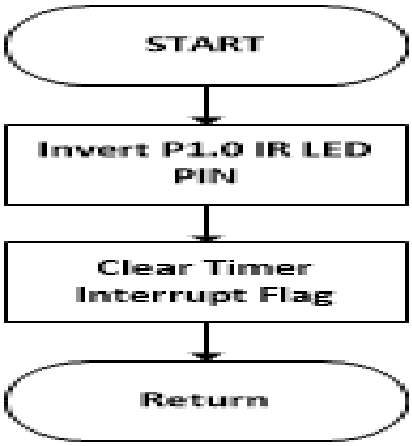

Figure 2: Timer Interrupt for IR LED

3.2 IR Receiver Interfacing :

The IR receiver TSOP 1738 is a photo-detector and a preamplifier in one package. It has high immunity against ambient light. TSOP 1738 detects on IR pulses with 38 KHz frequency. Three TSOP 1738 are interfaced with MSP 430 through pins P1.1, P1.2, and P 1.3. TSOP1738 detects the reflected pulses from obstacle and gives a low output to MSP 430.

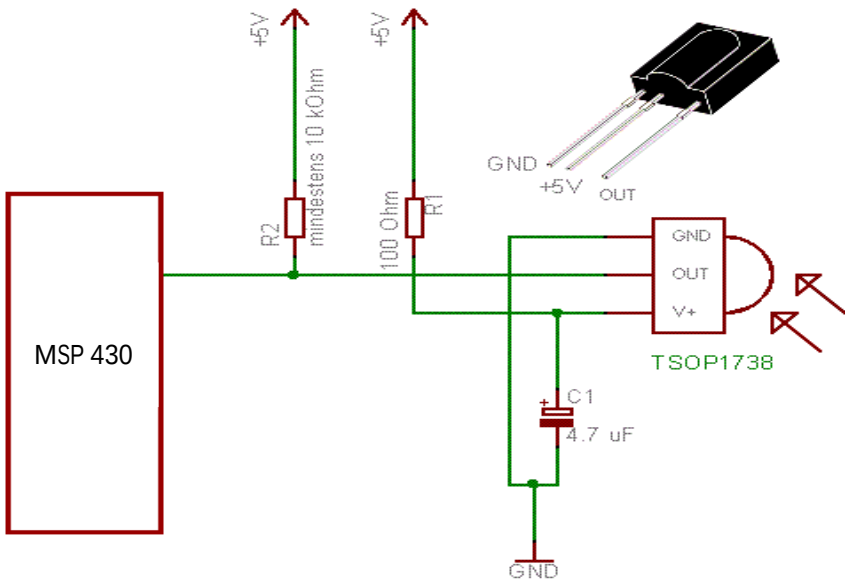

Figure 3: TSOP 1738 interface with MSP 430

3.3 H- Bridge :

The IC L293D provides H-Bridge functionality. It boosts current to drive the DC motors. It is also used for clockwise & counter-clockwise rotation of DC motor. Basically used for driving DC Motors coupled with rear wheels. The inputs for L293D are connected to MSP 430 port pin P1.4, P1.5, P1.6, and P2.1.

3.4 Geared DC Motor:

Geared DC motors were coupled with rear wheels of car. It was used to drive car. Interfacing of DC motor with MSP 430 was done through H-Bridge IC (L293D).

Specification:

1. 6V DC.
2. 160 mA.
3. 100 RPM.

3.4 Servomotor(Tower-pro MG-995):

It was used for steering front wheels of car. Servomotor shaft was coupled with steering mechanism made up of Lego parts.

Specifications:

- Operating voltage: 4.5 to 6 V.
- Gear Type: Metal.
- Rotational Range:180°.
- Pulse Cycle: 20 ms.
- Pulse Width: 1000-2000 µs.
- Pulse Width of 1500 us for neutral position.

Interfacing: Servomotor was interfaced with MSP430 through General Purpose Input Output. Port 2.1 was to used to provide pulses of 50 HZ frequency continuously. For steering straight Pulse Width of 1.5 ms was given. Pulse Width of 1.1ms and 1.9ms was given to steer car in right and left direction respectively.

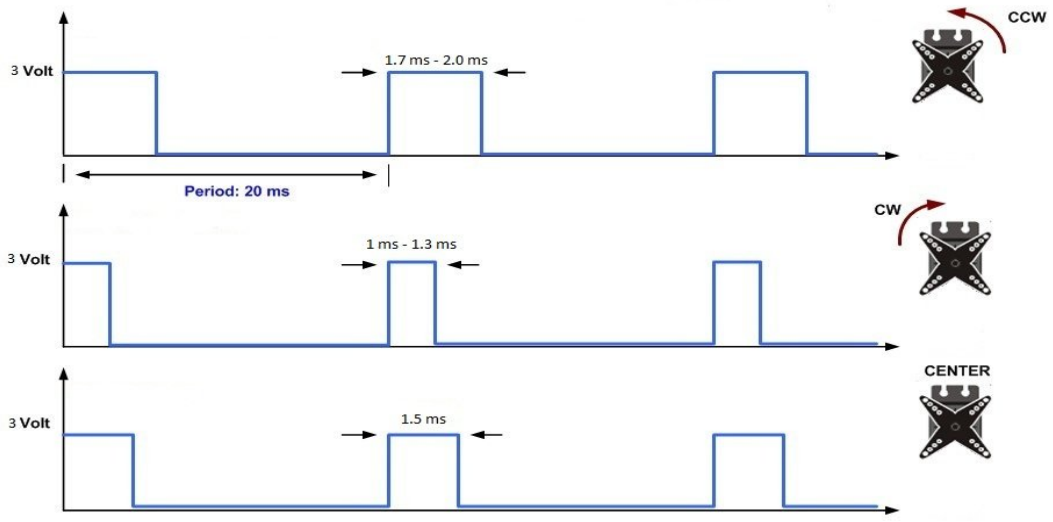

Figure 4: Servo Timing Diagram

4. Flow Chart :

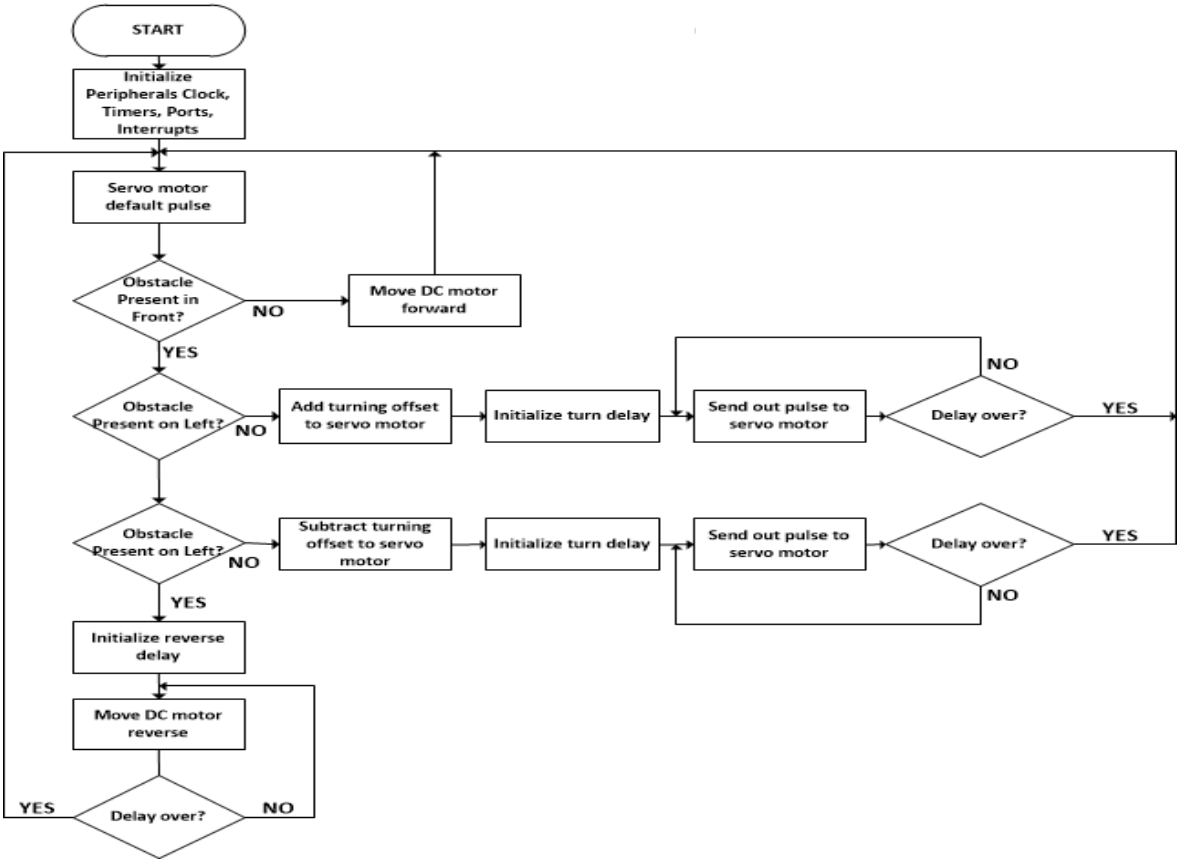

Figure 5: Flow Chart

5. Results and Conclusion :

The Obstacle Avoidance Car successfully detects and avoids obstacles. Simple algorithms used to steer and reducing the turning radius, successfully navigated the vehicle.
In conclusion, the group successfully interfaced every component that was originally planned.
Lessons learned from this project:

- Timer interrupt for IR pulse generation.
- Obstacle detection using IR transceiver.
- Servo mechanism using PWM.
- Steering system using Lego and Servo.

6. Appendix :

6.1 Task Division :

- Anish : Hardware assembly and integration, final testing, and report writing.
- Pushkar: Hardware selection, PCB designing, final testing, and report writing.
- Omkar: Firmware coding, debugging, final testing, and report writing.
- Hannan: Sensor & motor testing, interfacing, final testing, and report writing.

6.2 List of Components :

Component	Quantity	Manufacturer	Cost($)
MSP 430 Launch pad	1	Texas Instruments	7.50
Servo Motor	1	Tower-pro	13.18
TSOP 1738	3	Vishay	5.96
Lego for steering mechanism	1	Lego	39.78
L 293D	1	STMicroelectronics	2.58
IR LED	3	Vishay	5.94
Batteries	4	Duracell	14.90
Chassis	1	N/A	12.08
R _REG(100Ohm)	3	N/A	1.96
R_Pullup(10KOhm)	3	N/A	1.96
Resistor for IR LED(100Ohm)	3	N/A	1.96
Capacitor 4.7 microfarad	3	N/A	4.98
PCB	2	N/A	10.17
Bread Board	2	N/A	8.50
Connecting Wires	N/A	N/A	7.50
Total Cost			138.95

6.3 Schematic:

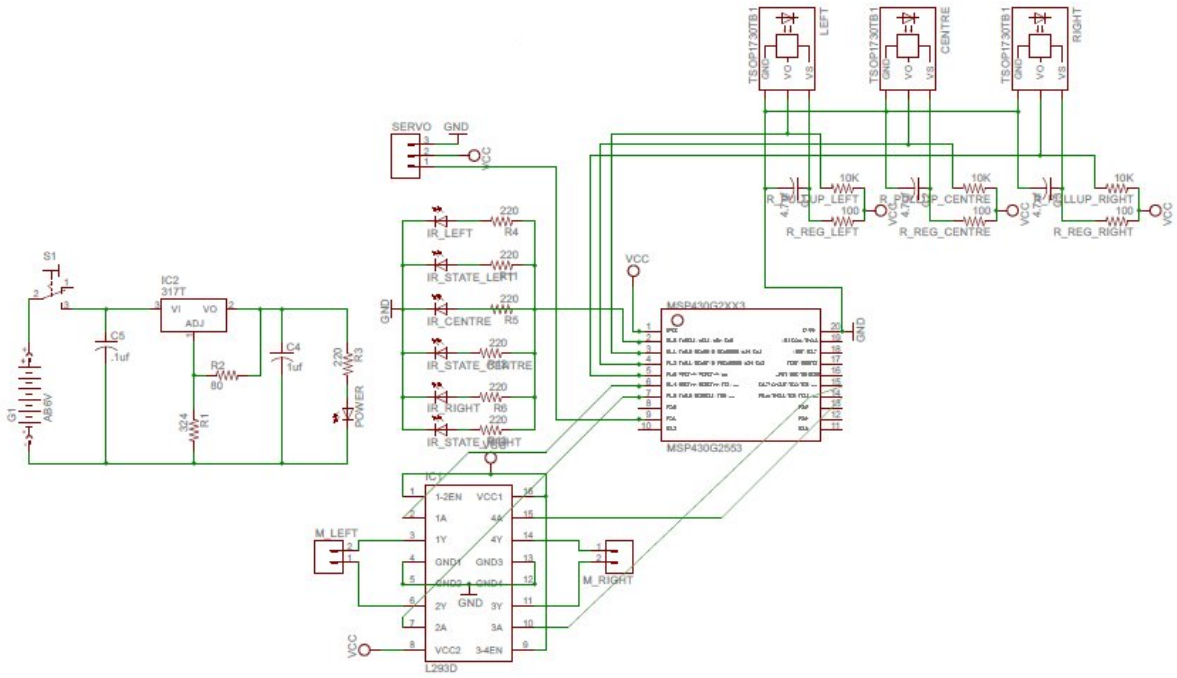

Figure 5: Schematic Diagram

6.4 PCB Layout :

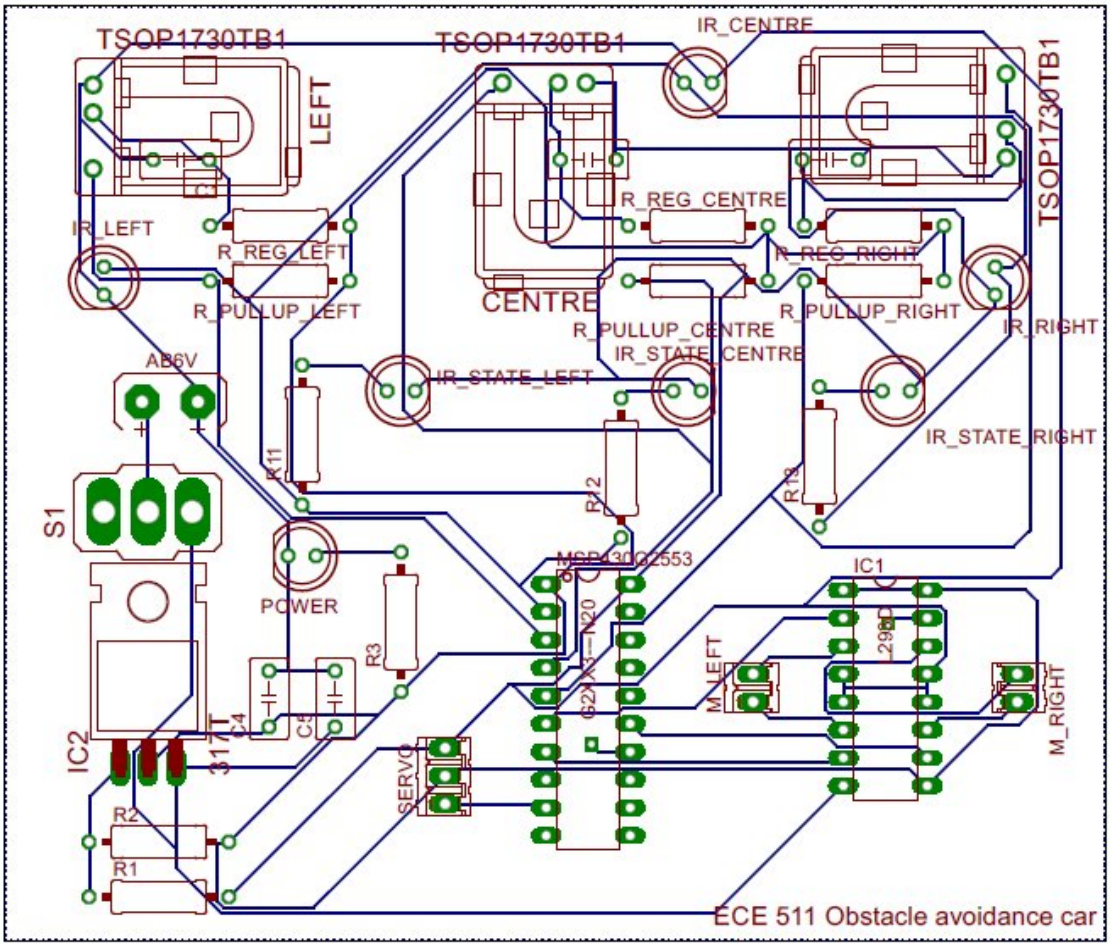

Figure 7: PCB Layout