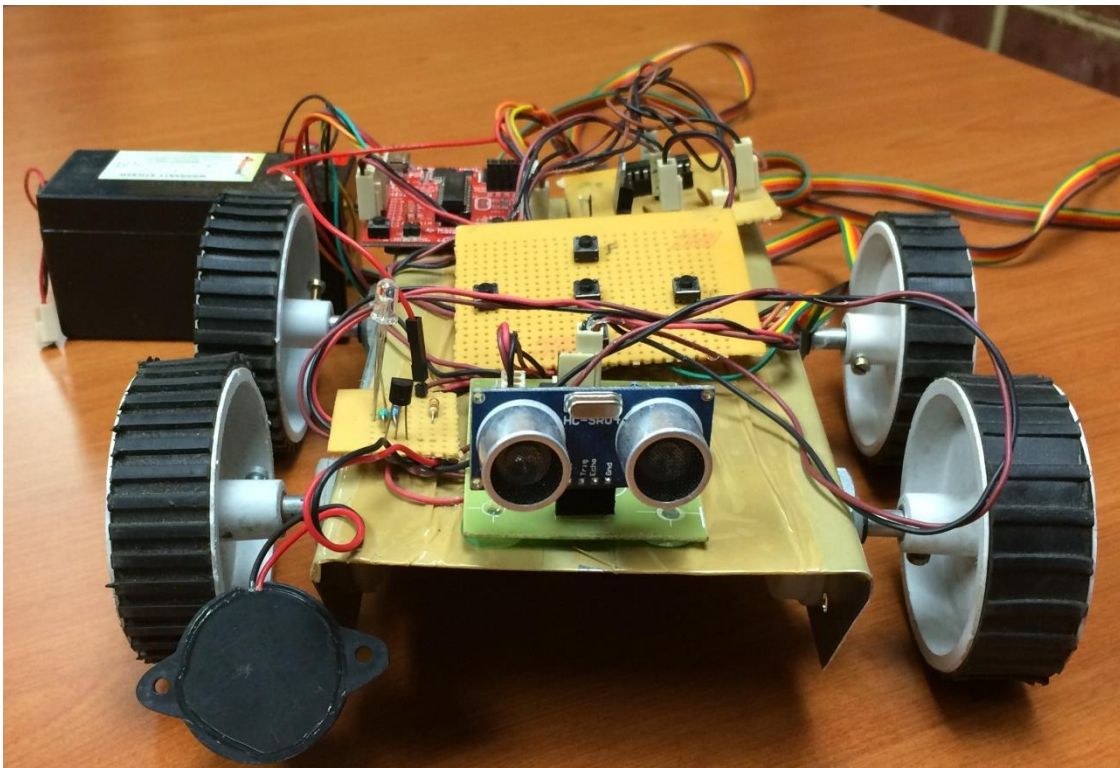




A project report on
OBSTACLE DETECTION AND AVOIDANCE ROBOT
Under the guidance of Prof. Jens Peter Kaps



ECE 511 PROJECT GROUP 5

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ABSTRACT

The motivation for this project was to design a robot toy which would entertain the user of all the age groups. The goal was to detect an obstacle and if found, then change its direction automatically which involves the utilization of MSP430 along with other components like ultrasonic sensors, motors, buzzers and LEDs.

In the end, the robot was a success. The robot was a successfully demonstrated during the presentation on 12/05/2014.

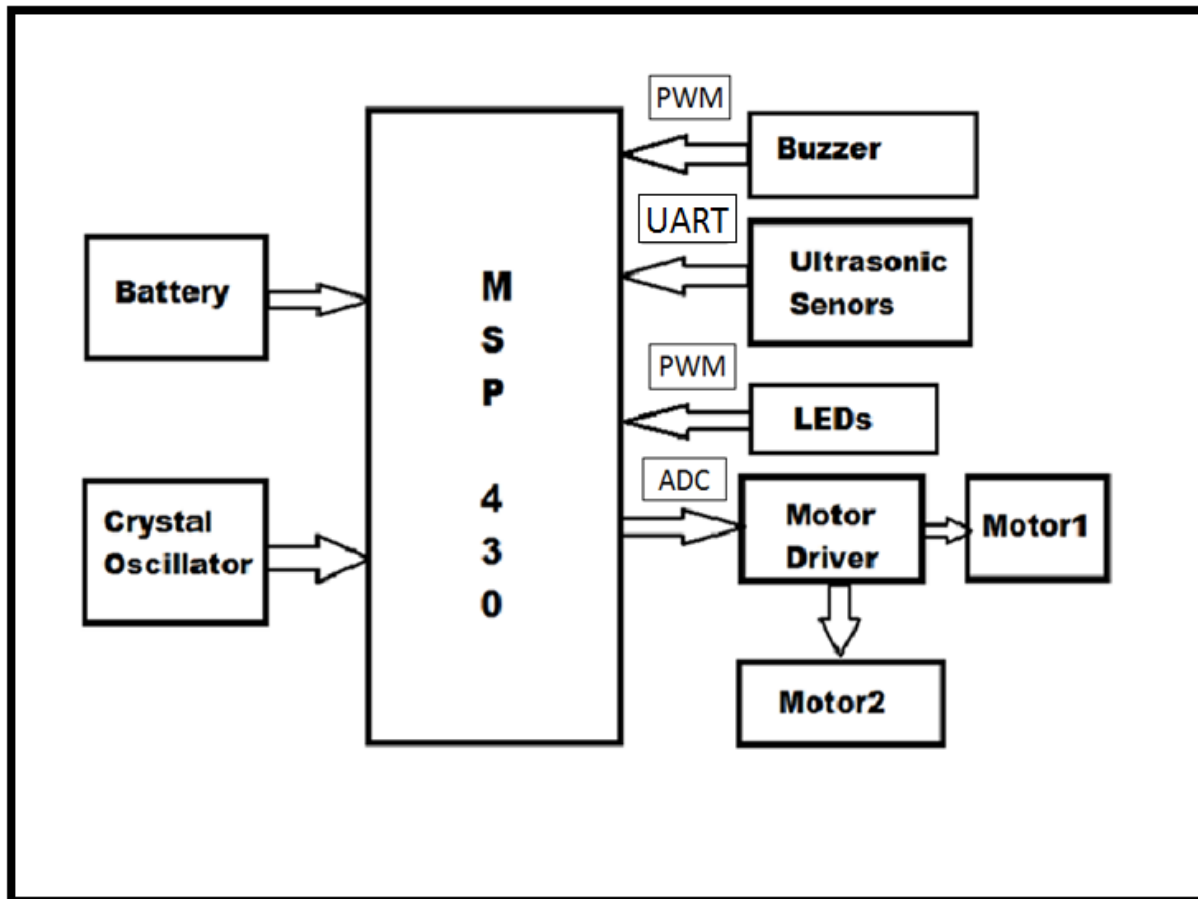
MOTIVATION

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.

SOLUTION

The main goal of this project was to interface all the components to MSP430 by connecting all of them together and make them function accordingly. This project features Ultrasonic sensor, DC motor, RGB LED'S and buzzer. All these are interfaced as shown in the block diagram below

BLOCK DIAGRAM



In this MSP430 is the main component and all other components functioning is controlled by the controller input. The ports are shared by the components and the code of individual component is written and later dumped into msp430.

COMPONENTS

ULTRASONIC SENSORS

Ultrasonic sensor HC-SR04 is integrated with MSP430. This sensor can be treated as one of the major components in the robot. This is used for sensing the obstacle, measuring the distance, giving input to the controller so that the controller can act accordingly and make other components integrated to it function accordingly.

Specifications

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function. The modules includes ultrasonic transmitters, receiver and control circuit. The basic principle of work:

- Using IO trigger for at least 10us high level signal,
- The module automatically sends eight 40 kHz and detect whether there is a pulse signal back.
- IF the signal back, through high level , time of high output IO duration is the time from sending ultrasonic to returning.
- Test distance = (high level time × velocity of sound (340M/S) / 2

When the sensor detects any obstacle then the echo pulse is reflected back.

Hardware Interfacing

1. 5V input power supply
2. Trigger Pulse Input
3. Echo Pulse Output
4. Ground(0v)

Here power supply is given to Vcc, trigger pulse input is given to port p1.7 of msp430, echo pulse output is connected to port p1.6 of msp430 and ground pin is connected to 0v ground.

DC MOTOR

DC motor was used in this project for the movement of the robot. The rear wheels were driven by a motor. Depending upon the input of ultrasonic sensor and MSP430, the speed of the motor varies. When the obstacle is at certain distance from the robot, it slows down at first and when it approaches the obstacle it slows down more, and after getting close to the obstacle, it stops.

Specifications

- Speed: 1000rpm
- Operating voltages: 12V

Hardware Interfacing

DC motor is connected to the output ports 3, 6, 11, 14 of H-Bridge L293D. And further H-Bridge is connected to msp430.

DC BATTERY

Battery is the main power supply for the circuit. The input power supply is 12V.

BUZZER

In this project buzzer used to make sounds when the robot is approaching the obstacle. When the robot is a bit far from the obstacle then it makes a less pitch sound, as it approaches the obstacle further, the sound of the buzzer increases drastically.

Specifications:

- Voltage: 5V
- Input current required: 10mA

Hardware Interfacing

Buzzer is connected to the output port of MSP430 p1.6 and the other pin is connected to ground.

RGB LED

RGB LED's used in this project to just indicate the position of the obstacle. When the robot is on, the blue light glows and it starts to move and as soon as it detects an obstacle a green light glows after that when the object is very near a red light glows.

Specifications

- Input voltage: 3.3V, 3.3V and 5V
- Emits 3 colors (Blue, Green and Red)

Hardware Interfacing

One pin of LED is connected to input supply and the second pin is connected to p1.7 of MSP 430 and also to ultrasonic sensor.

L293D H-BRIDGE

H Bridge is an electronic circuit where voltage can be applied in both the directions.

We use IC L293D for moving front and back. We firstly connect L293D to msp430 and then connect Dc motor to it. The purpose of using H bridge motor driver is the motor requires more current than the microcontroller pin provides it, so we need a circuit(transistors) which takes less current amplifies it and generates more current and give it to the motor. This process is done by the motor driver which is a current amplifier.

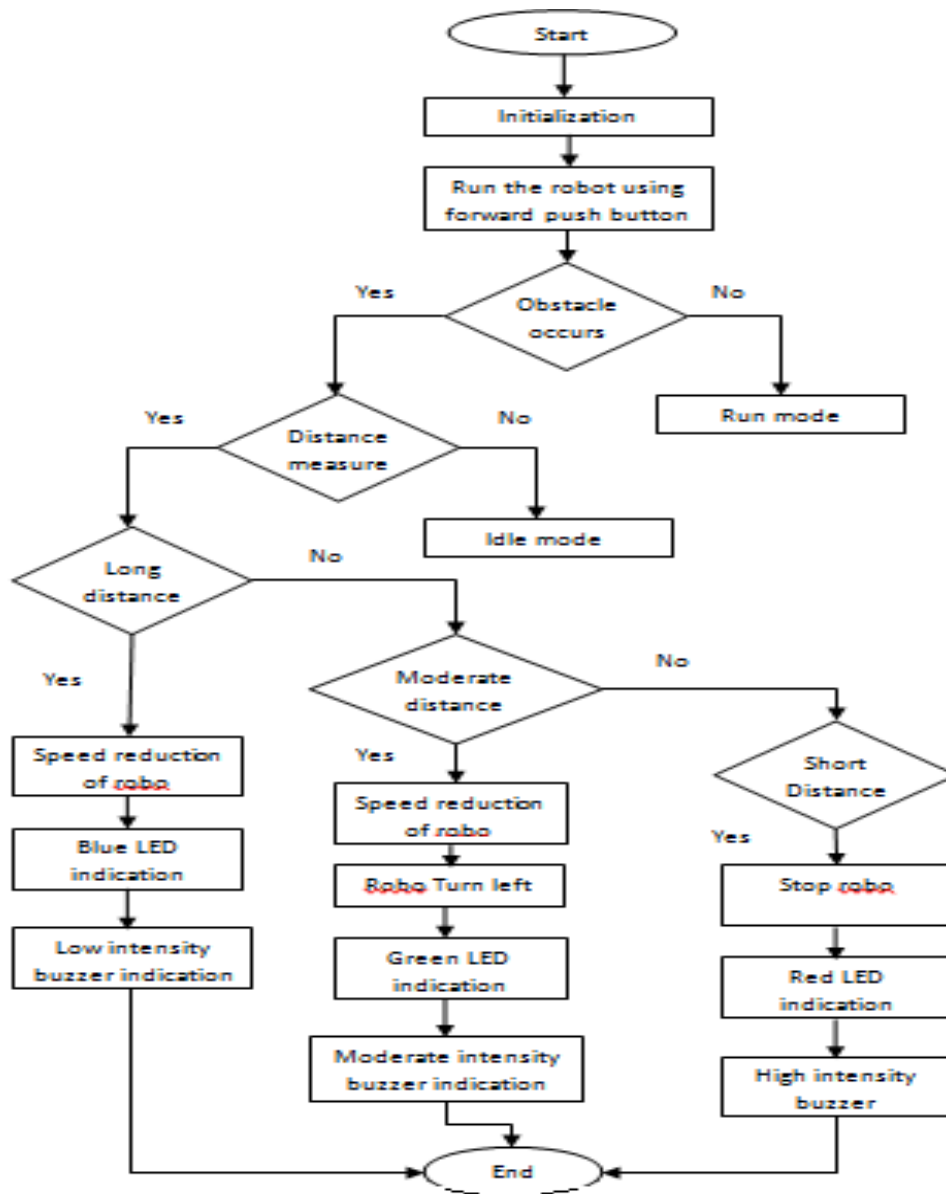
Specifications:

1. Wide supply voltage: 5V-12V
2. High noise immunity inputs
3. Output current 600 mA per channel
4. Peak output current 1.2 A per channel

Hardware Interfacing

Input ports of the driver are connected to ports 1.2, 1.3, 1.4, 1.5 of MSP 430. Four Output ports of the driver are connected to the DC motor.

FLOW CHART



RESULTS

Lessons Learned

The working with msp430 and interfacing all the components, using the resources to the maximum extent was a bit challenging. Interfacing UART and PWM and ADC was something very helpful. Soldering and wiring was the other thing learned, it was fun working with all those instruments. Developing code where all the other components following the inputs of the controller was difficult at first, took more time, but finally accomplished the task.

Achievements

The obstacle detection and avoidance robot now successfully detects and obstacle and then turns right to avoid the obstacle, enough though 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 IR LEDs and also adding a buzzer and adjusting the volume depending on the distance of the obstacle and its interfacing with MSP430 was one of the challenges faced by the team along with the integration of Ultrasonic sensors.

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.

CONCLUSIONS

The robot was developed as expected. The resource utilization was the main motto. The other important thing was using ultrasonic sensor, buzzer and dc motor to the fuller extent where they can follow the input of the controller and work accordingly instead of just on/off. The project result is worth the team effort. By doing this project we came across many challenges, fixed them and now we are confident enough to work in any component in embedded field.

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APPENDIX A:

Team members and their tasks

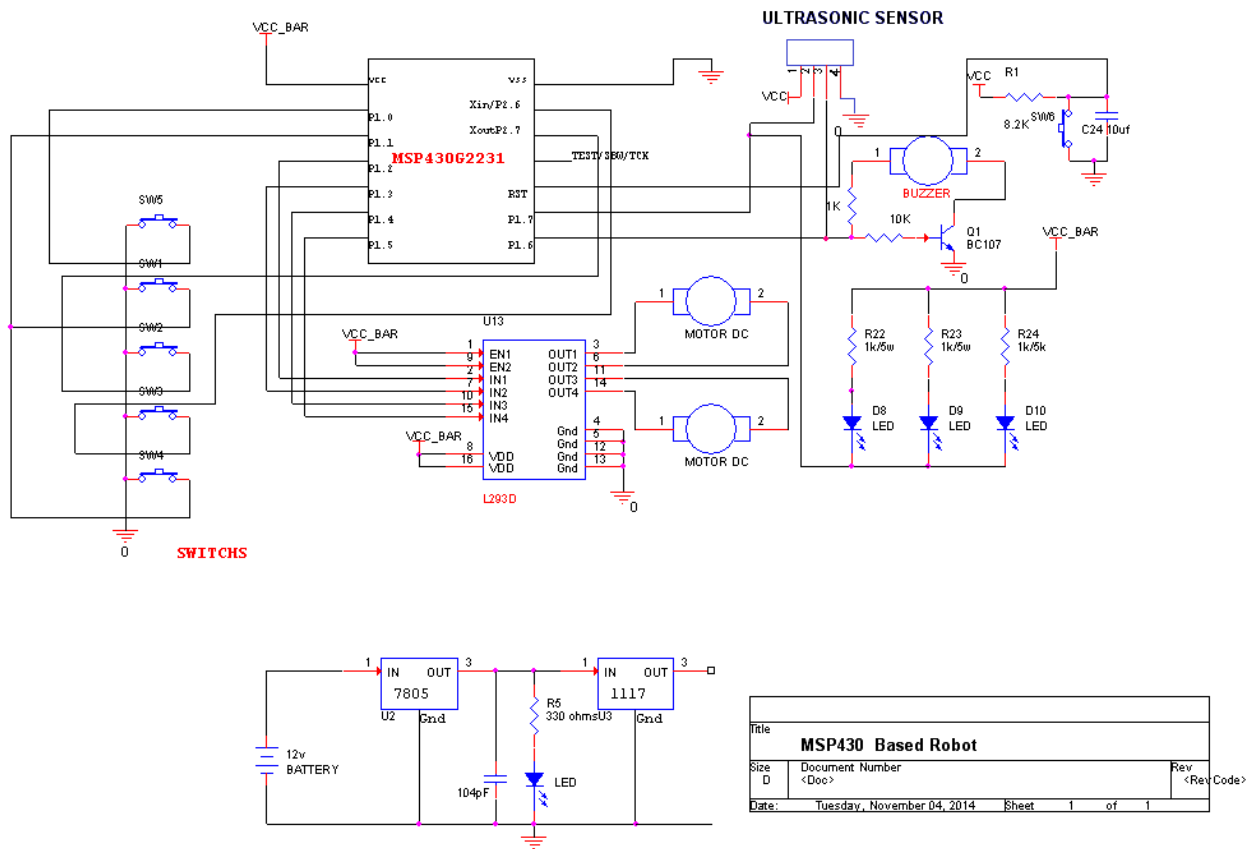
YasawiGarimella: Dealt with the buzzer, RGB LED's helped in preparing final presentation slides and report writing.

Pravalika Reddy Podduturi: Dealt with DC motor interfacing, hardware interfacing of all components, final testing and also helped in preparing final presentation and report writing

SirishaKurakula: Dealt with ultrasonic sensor, software interfacing of all components and final dumping of all code into msp430, helped in preparing the final presentation and report writing.

APPENDIX B:

Schematic



APPENDIX C:

Components List

Component Name	Quantity
MSP430	1
Ultrasonic Sensor	1
L293D H-Bridge	1
DC Motors	2
Buzzer	1
DC Battery	1
LED	1
Switches	5