Autonomous Way Finding Vehicle

Group: B02
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Submitted by:

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1.0 <u>Abstract</u>

Our aim is to design a robot that can move on its own and navigates its path avoiding obstacles in between. Ultrasonic receiver receives the voltage whose peak value depends upon its distance with the obstacle. We determine this peak value, amplify it, compare it with a certain value and then imply the logic through microcontroller accordingly.

2.0 <u>Design approach</u>

2.1 <u>Hardware</u>

2.1.1 <u>**Ultrasonic sensors**</u>: The ultrasonic sensor determines the distance to a reflective surface by emitting high-frequency sound waves and measuring the voltage received by the receiver. The peak value of the voltage received depends on the distance of object and reflection from that surface. The ultrasonic sensor can determine the distance to an object between 3cm and 3m away; closer than 3cm will result in the sound waves echoing back to the sensor before the detector is ready to receive.

   The ultrasonic sensor actually consists of two parts: an emitter, which produces a 40kHz sound wave; and a detector, which detects 40kHz sound waves and sends an electrical signal back to the microcontroller. In order to determine the distance to an object, it is necessary to implement a timing loop in your microcontroller code to measure the length of time required for the sound wave generated by the emitter to traverse the distance to the object

2.1.2 <u>**High frequency wave generation**</u>: We are generating a triangular wave of 40 KHz using Schmitt trigger in Astable multivibrator mode. We have used R to be variable so that we can set frequency. Yet ultrasonic sensors work at 40k but sometimes during the time of testing it showed its best at a frequency higher than 40K
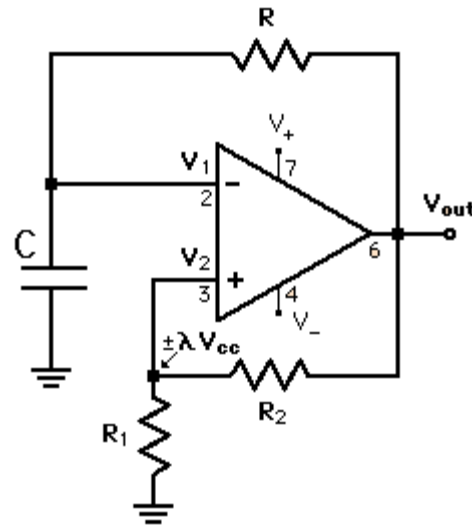
SCHMITT TRIGGER

2.1.3 Peak detector: The DC voltage produced tracks the positive peak of the input signal received by the receiver. It works from about ten millivolts to about 1 volts peak to peak. The maximum frequency is about 150 KHz which is sufficient for our purpose.
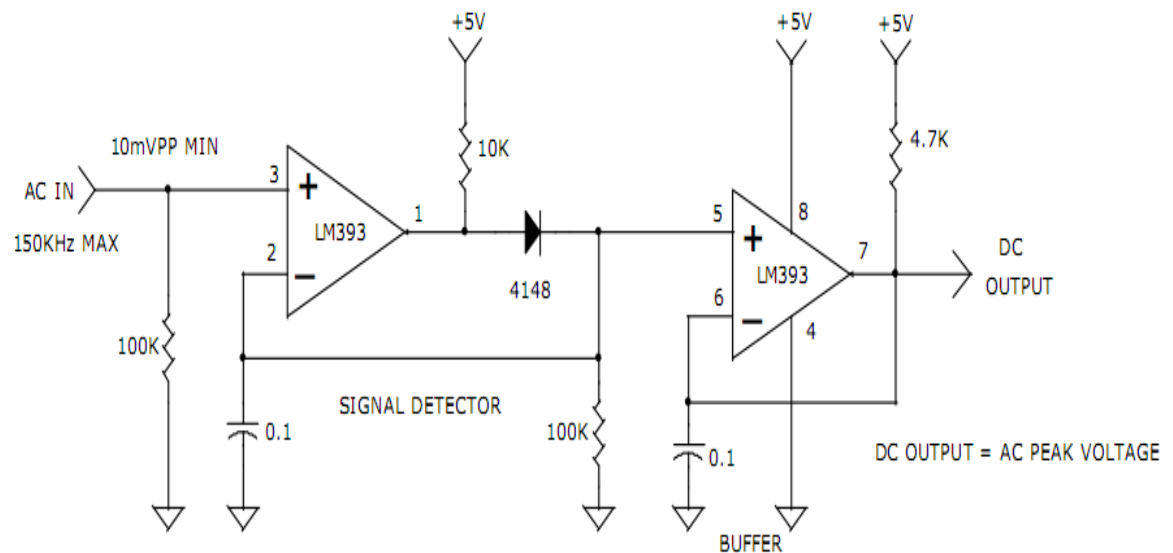
2.1.4 Amplifier and comparator: the peak voltage determined by peak detector is further amplified by Opamp LM741. The output of this opamp (gain=10) is compared with 4V to determine whether the distance of obstacle is less than critical distance which is 10 cm in our case. The output of the comparator is then feed to microcontroller.

2.1.5 **Microcontroller**: microcontroller (AVR 16) is having three signals as input from sensors on three sides. The input port is port A. microcontroller uses the logic that if any obstacle is present in the path it drives the motors in such a way that they tend to change the direction of the robot. Output port is port B. We are using B0-B3 pins; two of them drive one motor while the other two drive the other.

This is a very simple logic and can be done by logic gates or other low level microcontroller. We used Atmega 16 because we were producing 40 KHz square wave from it but this couldn't work.

2.1.6 **Motor driver**: current provided by the microcontroller is not sufficient enough to drive a motor so we need a motor driver which basically amplifies the current that is sufficient enough to drive DC motors. We have used L298 for this purpose at Logic supply voltage is 5V and supply voltage is 15V. The output of driver is fed to Dc motors directly.

2.2 Software:

Software contains a very simple logic. Let's say if the inputs are F, L, R that depends upon if front, left, right sensors are detecting any object or not. If that so then the values are 1 if not then it is 0. By default we have made the R=1; we actually don't need this signal our work cane be done without it. Now what we want from microcontroller is to do.
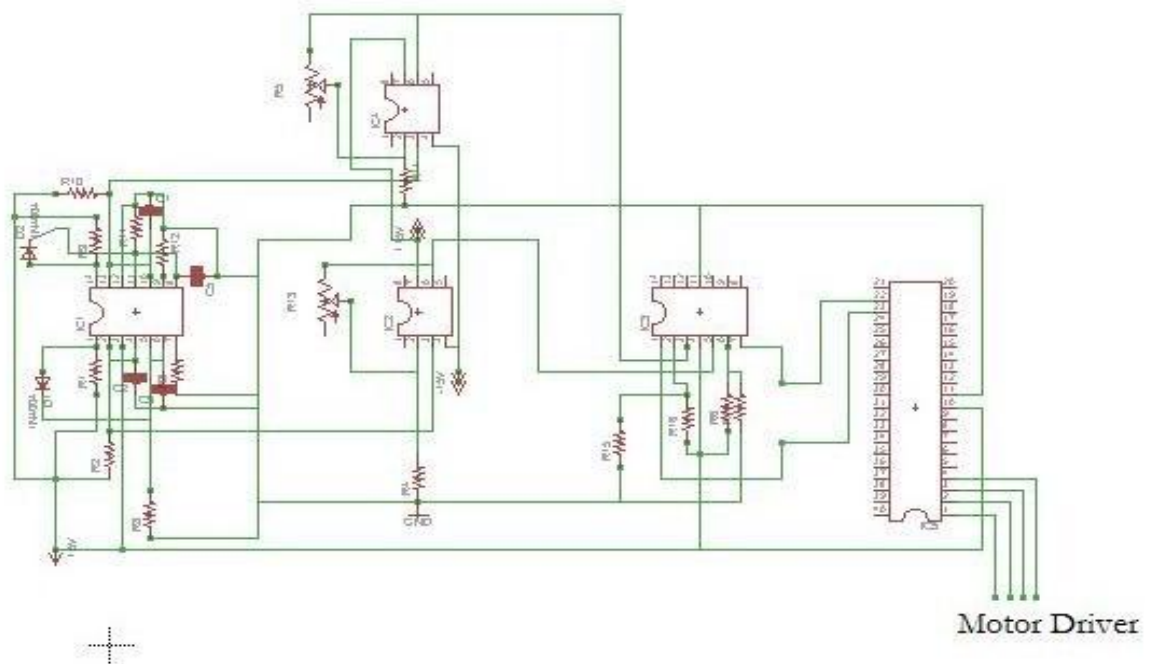
	B0	B1	B2	B3
F= 0 L=0	0	1	0	1
F=1 L=0	0	1	1	0
F=0 L=1	0	1	0	1
F=1 L=1	1	0	0	1

This can be done using if else loop.

3.0 Block diagram:

Circuit Diagram:-

Motor Driver
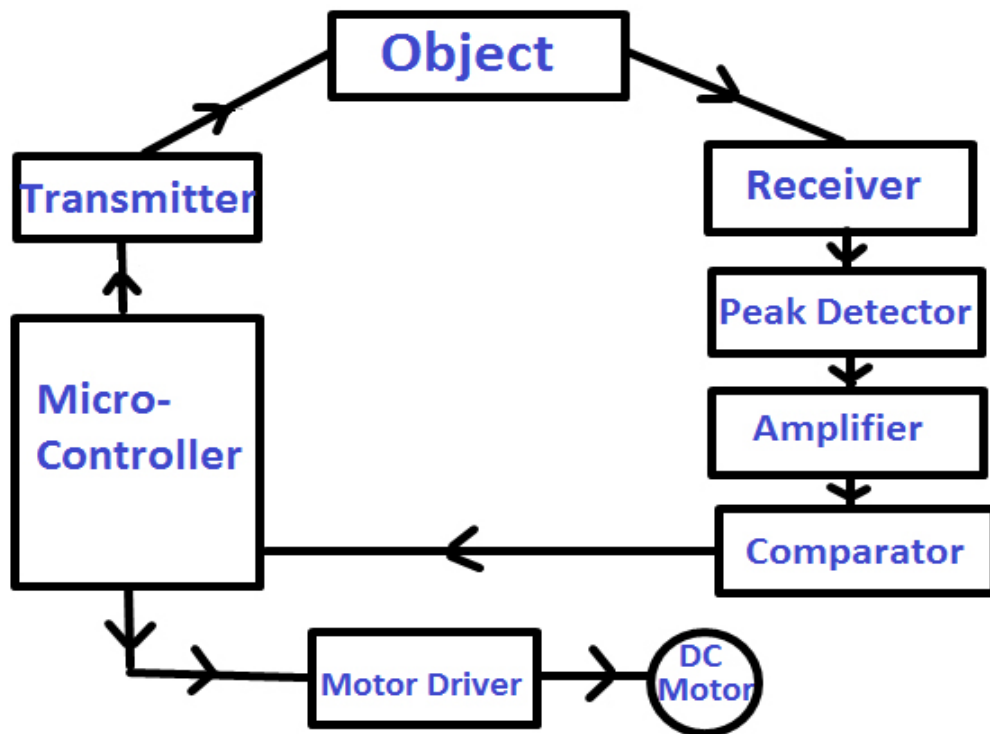
4.0 <u>Testing:</u> we are testing the whole circuit in 3 subparts

4.1 <u>Wave generation and ultrasonic sensor's testing:</u> we check if the
triangular wave generated have the frequency near to 40 khz or not. If not we convert
it into 40 KHZ using variable resistor. After checking the frequency we check if the
sensors are working their best on that frequency or not. If not then we vary the
frequency slightly to make them work at their best.

4.2 <u>Testing of PCB 2</u> – the main work of PCB 2 is to process the output of
receiver and convert it into a signal for microcontroller. If the voltage of receiver is
more than a critical value or the obstacle is present at some distance less than or equal
to a critical distance then or PCB-2 gives the output 5V. If not then the output is 0V.
The critical value of the voltage depends upon the surface of the obstacle.

To check the PCB-2 we check each part one by one. First of all we check
peak detector which simply determines the peak of input voltage. Hence in this step
we determine the peak of the voltage provided by the receiver. To check this
individually we can give it some signal from function generator and find out if it is
determining the peak or not. We then amplify this peak value using an Opamp whose
gain is variable because of variable resistance in its circuit. The gain is set in such a
way that if output of receiver is more than critical value then output of Opamp is less
than 4V, if less than critical value then output is more than 4V. this output is
compared with 4V in a comparator circuit hence the output of comparator is 5V if the
voltage of receiver is greater than critical value.

4.3 <u>Testing of microcontroller and motor driver:</u> microcontroller can
easily be test by checking the output pins at different inputs if microcontroller is
giving desired output to drive the motor in right direction then we are done.
For motor driver we need to find out if it is giving sufficient current or not. That
generally happens because of supply voltage or interchange between supply and
logic supply voltage. Motor driver doesn't create that much problem actually.

5.0 <u>Results and Problems faced:</u> while designing the above we found a
few points where the results were satisfactory while sometimes failed to implement
the things. With the help of our TA and Guide we were able to sort out the problems
and the problems had been good for learning. The few problems are as follows:

1. The orientations of sensors are very important as the peak of the received signal
    depends upon the orientation as well.

2. Amplifier is working on 15V so sometimes it somehow fluctuate the 15V signal,
    so we have to use two large capacitor on it supply pins.

3. Peak detector can work only with peak voltage less than 1V, so we have to make sure that signal received by receiver is less than 1V amplitude

4 We are able to generate square wave through microcontroller but our code for driving motor is not working along with it. Also it is impossible to generate exact 40kHz through microcontroller's timer. We can generate either 38k or 41.66k using it in CTC mode

5. For 40 KHz wave generation we simple cannot make something which generate 40 KHz but we need a variable frequency, this make the transmitter receiver pair to work at their best and we can have the best output.

6.0 <u>Conclusion and suggestion for further design</u>: our design can work only at a particular arena whose reflection coefficient and orientation meet with its requirement. Yet there are many possible things which can be suggested to make it better. Few of them are:-

1) Transmitter receiver pair can be used as pulse echo method which works on time between transmitted and receiving signal. This method need not require any kind of arena and will work with any kind of obstacle.
2) Microcontroller used is too much for our project. We don't need Atmega 16 but because of wave generation requirement we somehow used it. This is definitely increasing the cost of our product.
3) Our robot is withdrawing a large current from the source, so it is impossible to use disposable batteries for a long time. Also we have used some opamp which require source voltage of ± 15V. Hence creating such supplies through 9V or 12V is also a task.

<u>References</u>

1) www.atmel.com
2) www.Wikipedia.org
3) www.datasheetcatalogue.com
4) http://sharada.ee.iitb.ac.in/~wel12/resources.html