Special Sensor Report

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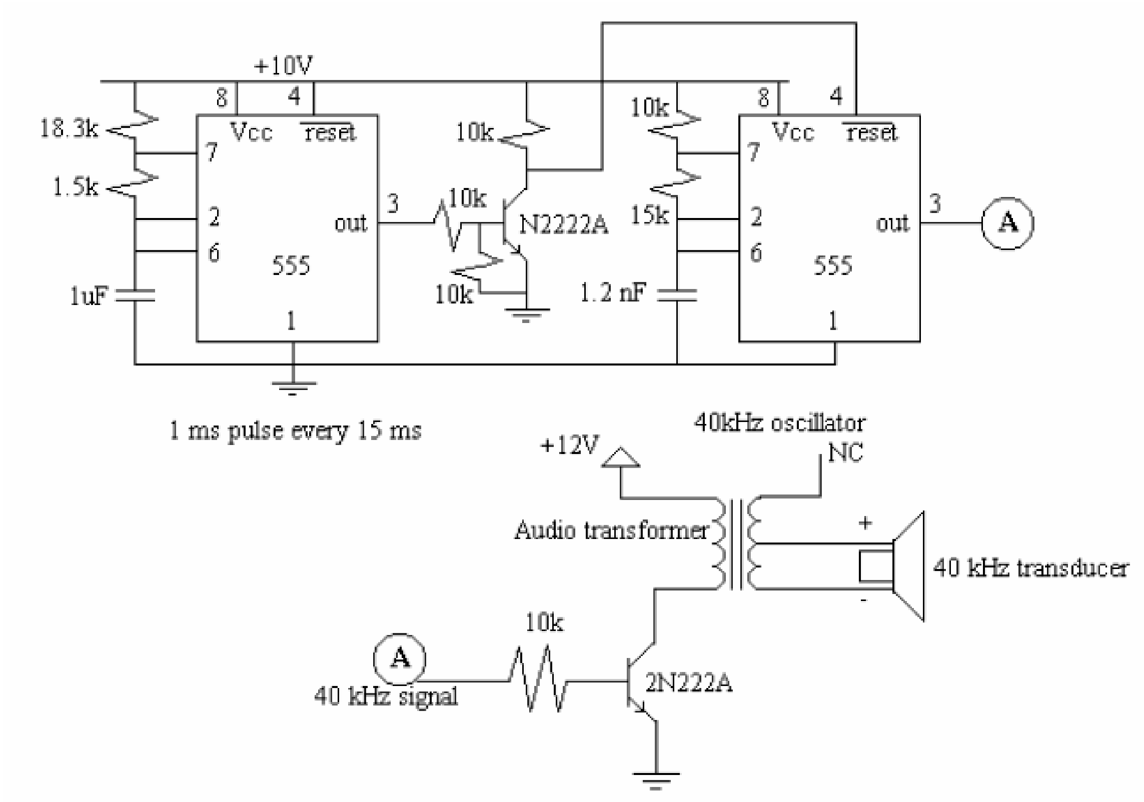
Special Sensors:

Sonar Transmitter – Built by hand, this sensor will be separate from the robot and will act as a beacon emanated a 40 kHz pulse every 1.5ms.

Sonar Receiver – Also built by hand, this sensor will receive the pulse given from the transmitter and will relay this to the microprocessor. These will be used to give my position depending on where the transmitter is located.

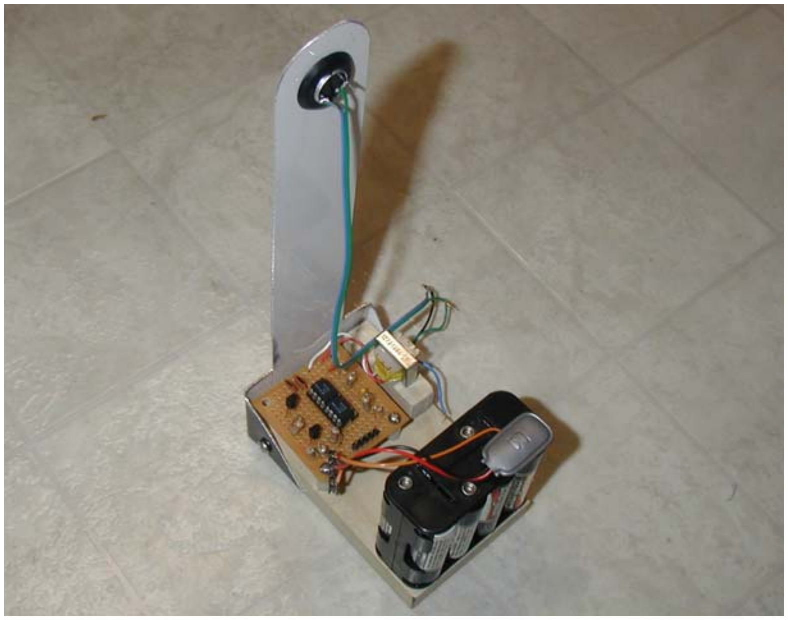
Sonar Transmitter:

Schematic:



The 555 timer on the left produces a 1 ms pulse every 15 ms. The 1 ms pulse is a 40 kHz signal being transmitted out a transducer. This 40 kHz oscillation is being produced from the 555 timer on the right.

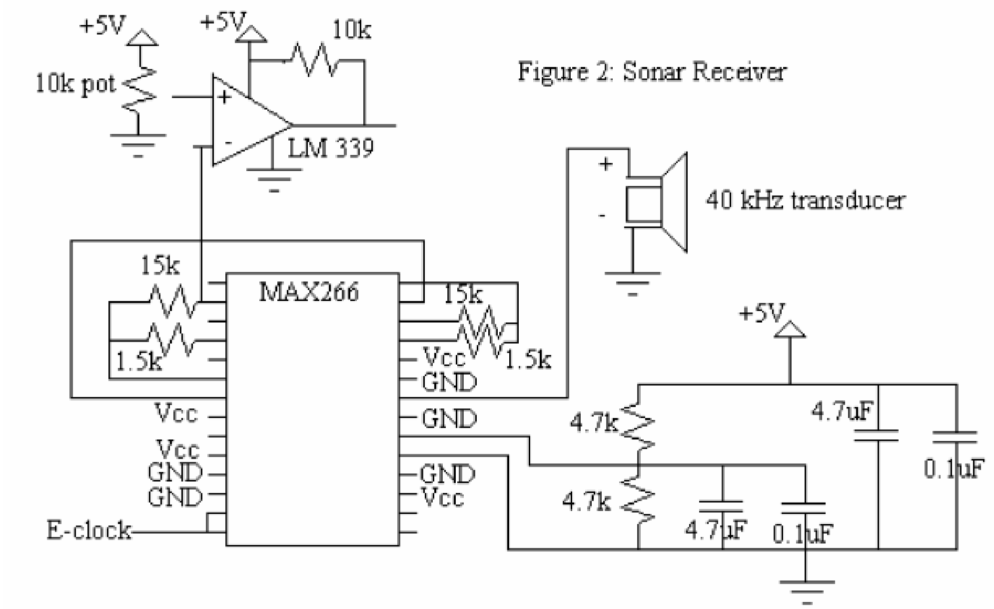
Platform:



To build the schematic shown on the previous page, I bought small PC mount board from RadioShack for mounting purposes. The audio transformer also came from RadioShack. Four boards come to a pack so I could use them for the receivers too. I obtained the 555 timers from the IMDL lab and capacitors, resistors and transistors came from the same lab and RadioShack. Once I built the schematic by hand, I soldered and wire wrapped with solder to connect wires and to keep the parts in place. This was a good system but time consuming. The transducer is attached through a grommet rough 7.5 inches from the ground to maintain the same height that the receivers would be at and also be high enough to overpass obstacles that would be in the way.

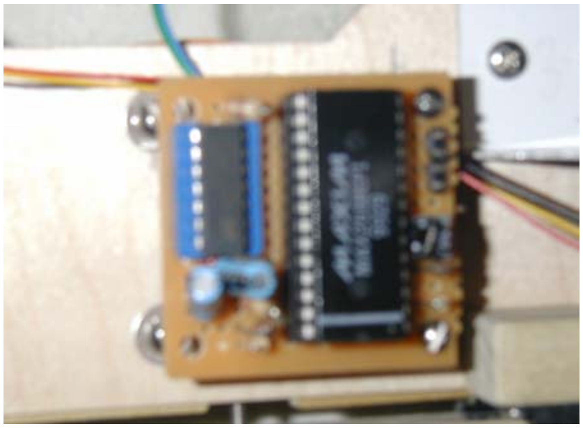
Sonar Receiver:

Schematic:



The MAX266 chip acts as a high order filter. With the correct resistor values, one can create a filter for a 40 kHz signal. Once the signal has passed through the filter, the analog comparator then converts the signal into a digital signal. Basically, if there is no 40 kHz signal being passed through the filter, then a 0V is given through to the output. If the comparator receives the 40 kHz signal, then an output of ~5V is given depending on the gain given by the potentiometer. In theory, this is what is supposed to happen.

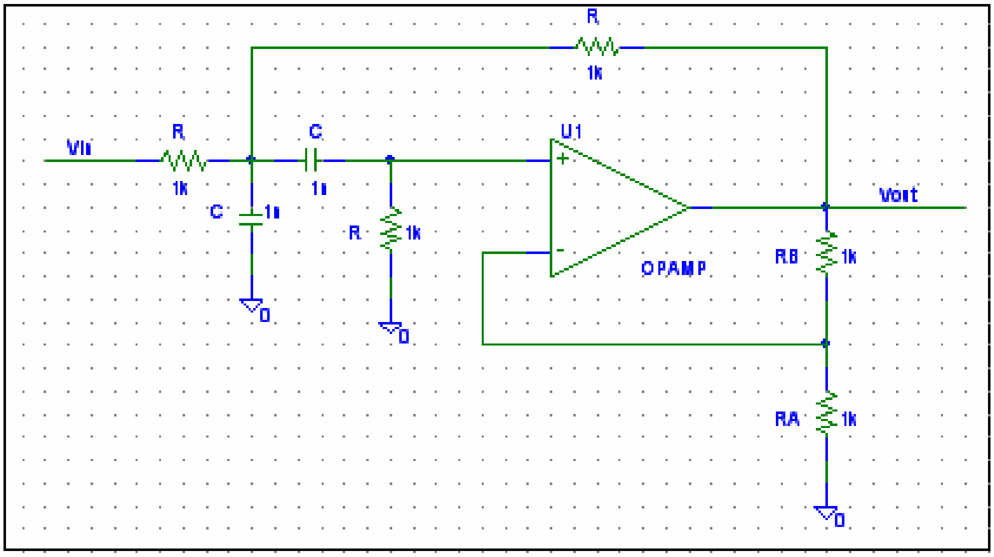
Platform:



The schematic above was built on one of the PC mount boards that I previously mentioned. I used wire wrap sockets going into the board because they are easy to work with when wiring and soldering. Once again, this is very time consuming especially when you must build three of them. As you can see in the picture, I mounted the board on my platform right next to the stand that holds the sonar transducer.

Experimental Setup:

I used an oscilloscope to measure the filter pulse that this receiver would obtain. The values obtain were not correct. I don't think the schematic was setup properly. With numerous attempts at trying to get this to work, I did try an RCK filter to try and get a signal. This actually did work but both transducers had to be about an inch away from each other. Therefore the transmitter did work but the receivers were faulty.



This is a picture of the RCK filter. These are the design formulas:

$\omega o = 2^{1/2} / (RC)$ $4 - 2^{1/2} / Q = K$ $R_B = (1 - K)*R_A$

Using these equations: R = 5.6 kΩ, C = 1μF, R_B = 15 kΩ, and R_A = 5.6 kΩ.

Using an oscilloscope and function generator, this filter did work quite well. Now trying to use this filter with a small voltage from a transducer is hard became the voltage is so very small, therefore I tried to implement a gain afterwards using a inverted Opamp. I kept raising the gain in increments to see how things would work.

Gain	**Result**
1	Nothing happens, output is still very small
50	At 1" I notice a small 40 kHz signal being received. Everything past that is no output.
100	At 1" I notice a 1 V pk-pk. Everything past that is nothing.
500	At 1" I notice a 1.5 V pk-pk and up until 2" it declining and going to zero quickly.
1000	Opamp produced smoke. I think the system reached its tolerance.

So close to 1", the sonar system did work but better results couldn't be obtained due to the limitations of this particular filter and system. So at one point the sonar system did work but it definitely would not be practical for SPARtan because of outputting such small voltages and having to have the sonar transmitter transducer so close to the receiver transducer.

Conclusion:

The original sonar system did not work for me. I put together the receiver schematics three different times because of the three receivers and not one of them seemed to work. I worked with the MAX266 chip with different settings and I still couldn't produce a result.

The RCK filter system did work but only for very close distances so that does show some potential for future work. Because this circuit did work, this let's me know that the transmitter did perform its job.

Overall, I had a very tough time working with the receivers. I spent a lot of time trying to get them functional and the MAX266 filter to work properly. Next time I would also try to get a PCB board made via the T-Tech machine so that only soldering would be necessary. I attempted to get this done but none of us could figure out how to get the footprints and various other problems working properly. In conclusion, I would definitely not work with this sonar system again. I think the schematics were very sketchy and didn't have much information about why certain options were chosen and what not.