**Abstract**

In this work we are presenting a two-part ultrasonic based distance sensor which overcomes the limitation of the bouncing based standard commercially available ultrasonic distance sensors. We are extending the measuring angle from 15 to 80 degrees.

**1 Introduction**

Our initial intention was to use ultrasonic distance sensors in order to create an indoor navigation system by measuring the distance between shoes. After some initial investigation of sensors, namely the hc-sr04 according to its datasheet [1] has a measuring angle of just 15 degrees. The reason for this are not limitations of the hardware, as can be seen from the datasheets of the ultrasound transducers used [FIND DATASHEETS]. They are very well capable of operating at wider angles, but the limitation comes from the operating principle. These sensors work based on bouncing of a sent signal at an object in front of it. After a distance value is requested, the transmitter sends an 8 burst 40kHz pulse and starts a timer at the same time. That pulse bounces of the object to which we want to measure the distance, and is caught by the receiver. Then the timer is stopped, and the distance calculated from the time it took the sound to go and come back. Beside the fact that the object has to be in the 15-degree angle in front of the sensor, there are other limitations like bouncing from other objects and signal strength loss which are a side effect of the bouncing operating principle. After validating our assumptions that the hardware can do better, by using two sensors, and covering the transmitter on one, and the receiver on the other, then testing at wider angles, we started working on the design of our own sensor.

**2 Methodology**

Our sensor is consisting of two parts. One which we call the “initiator”, the smarter of the two, and the other named the “repeater”. Hardware wise they are consisting of almost the same parts except a difference in the microcontroller. The initiator is run by an ATMega328p, while the repeater is operated by an ATTiny24. The reason for this is the fact that we needed to use uart on the initiator, and the ATTiny24 does not have a hardware uart module. Implementing it in software would introduce delays, which due to the nature of the project are not allowable. Before going into more details about the hardware here is the operation principle:

1. The initiator sends a 6-8(check this in code) burst at 40kHz, and starts a timer.
2. The repeater, which is listening all the time, receives the burst, and sends it back after a 5ms delay. The delay is introduced so that eventual bounces fade away.
3. The initiator gets the reply, stops the timer, and sends its value to a pc via uart. There the distance is calculated.
4. This process is repeated every 30ms (check as well and if we are not doing the shoes we don’t have to repeat this process, we can just do the measurement once or a few times when it is requested)

We are aware that the period of 30ms and the delay which we introduce against bouncing are effectively limiting our maximum distance to 413cm (might want to check this), but since we had our shoe distance application in mind while designing, this limitation is not a problem. The sensors based on bouncing are also limited to 300cm.

**2.1 Hardware**

Since we implemented the initiator on a perfboard, and its construction is similar to the repeaters, except the microcontroller, we will explain the circuit on the schematic diagram of the repeater. In the figure below (@Imran can you add the latest screenshot of the schematic) is its schematic diagram. It is consisting of a four stage amplifier integrated circuit, namely the \_\_\_\_\_\_\_ , the microcontroller and a rs232 converter which generates differential voltage for driving the transmitter, and a linear voltage regulator. @Luis if you want to go into more detail about the amplifiers here is the place ☺

**2.2 Software**

**3 Results and Analysis**

**4 Discussion**

**5 Conclusion**

**Refferences (need to be formatted somehow)**

[1] <http://www.micropik.com/PDF/HCSR04.pdf>

[2] <https://www.elfa.se/Web/Downloads/_t/ds/senscomp_40lt12_40lr12_eng_tds.pdf?mime=application%2Fpdf>