

CSE 5342

Embedded -2

**Making of 40 KHz wave generator and using SONAR technology
to find coordinates of object and draw on terminal**

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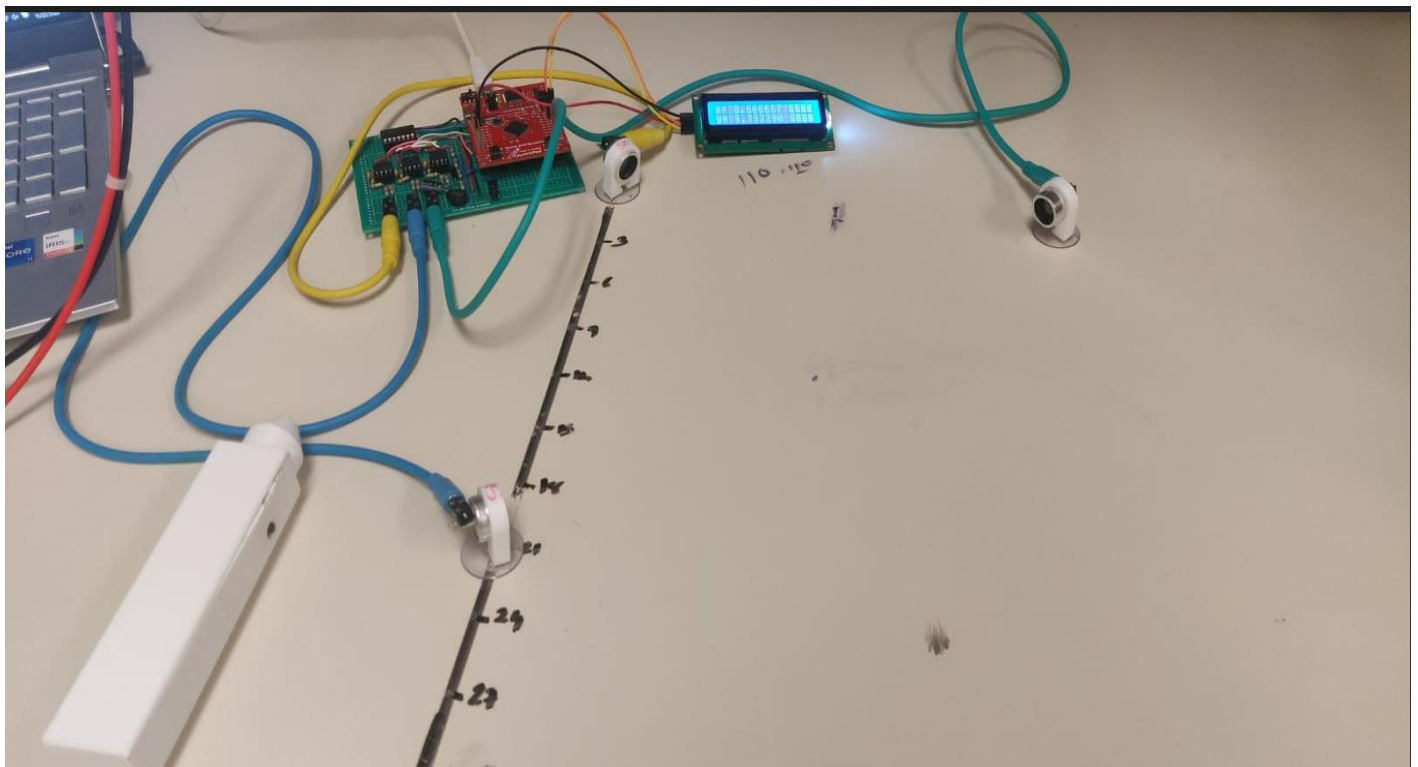
Overview

Making of 40 KHz wave generator and using difference between IR and Ultrasonic sound propagation speed phenomenon finding coordinates of an object in a plane using triangulation method and using those coordinates draw on Serial terminal by getting 5 mm error accuracy on each axis.

1. Design

Hardware

- Using LM555 IC which has 2 555IC timer using this 1 timer IC gives 50% duty cycle and another IC gives 99.98% duty cycle of on time of 1st Timer IC hence we get 50% duty cycle of 40 KHz wave generator by changing duty cycle of 99.98% I can connect multiple wave generators in a single object though in this project I used 40Khz wave generator at 50% duty cycle which you can see on picture as a white pen.
- On the receiver side using TLC 0721 which has 2 Opamp which set as 1 as amplifier with gain of 100 times which gives amplified signals as an Output from Ultrasonic receiver and second opamp made as a full wave rectifier which gives signal between 0 to 5V.
- MCP 5544 has 4 opamps those opamps used as comparator and receives signal on Tiva TM4CGH6PM micro controller which compares, where according to acoustic wave travel time calculated distance with using appropriate beeps at receiving signal and using Triangulation method to calculate coordinate of an object in a 2-D plane.
- Using LCD which works on I2C communication with Tiva to display those coordinates or a wave generator



Software

- Writing and Reading from EEPROM also we are using UART to load values like frequency and duration of beep or enable or disable the beeps, Receivers (Detectors) Location (Coordinates), Current calibration values of each Receiver, Averaging, Acceptable variance value all these values stored in EEPROM hence when System collects all these configuration data from EEPROM.
- set configuration of beep command for all ir/beep2/beep3 frequency and duration, those values stored in EEPROM. PWM module 1 with generator 2 works to create 50%duty cycle of that frequency which we stored in EEPROM that frequency runs with 50% On time with Duration we store in EEPROM. For this we used Circular buffer to prevent Overflow of buffer.
- Also, created shell interface using different command to see or modify configuration which we used like sensor, beep, distance, average, variance, correct have written.
- Using Triangulation method finding coordinates of the object and getting 5mm error accuracy in the results.
- LCD which communicates through I2C communication shows coordinate of an object

2. Shell Interface

Commands	Arguments
beep	02
beep	04
correct	03
reset	00
average	01
distance	00
Sensor	03

Commands

beep ir/beep2/beep3/freq Duration

beep command has 4 arguments

1st Argument selects frequency and Duration for which receiver or condition you want to put For an Example beep ir 40494 80000000 means when ir receiver detects ir signal and If ir is ON then whenever ir signal receives then 40Mhz/2/1024/40494 frequency will run around 2 second.

beep ir/beep2/beep3/fix ON/OFF

if beep command has 2 arguments

1st Argument selects frequency and Duration for which receiver or condition you want to put
For an Example beep ir ON/OFF means when ir receiver detects ir signal and If ir is ON then whenever ir signal receives then frequency and duration at which stored in EEPROM will run.

correct sensor offsetvalue slopevalue

correct command has 3 arguments

if correct 0 17 957 have written then for sensor 0 whatever value we stored in that 17 offset we can add or subtract with slope value 0.957

reset

reset has 0 argument so whenever reset command has entered it reset microcontroller

average Noofaveragevalue

average command has one argument

if average 15 then when we have 15 number of samples we received by each receiver then only we calculate coordinate of an object.

variance variancevalue

variance has 1 value in argument

if variance 500 means if 15 is an average then in all 15 values total variance should be below 500 if not then it discards received values and coordinates we cannot get because we cannot rely on those reading.

Distance

distance command has 0 argument

if distance command typed then it will give raw distance value of each sensor until we press pushbutton from microcontroller.

sensor sensornumber xcoordinate ycoordinate

sensor command has 3 arguments

if sensor 0 10 15 entered

then for sensor 0 positioned at x coordinate 10 and y coordinate 15 we can modify all 3 receiver coordinates.

3. SpeakerBuffer(Circulerbuffer)

Whenever beep ir/beep2/beep3/fix ON and receiver detected first it prime speaker buffer in reset isr where using to reset all timer interrupt after 40ms after staring pwm_isr everything related to speaker happens in pwm_isr which is Wtimer4_isr() so according to ir/beep2/beep3/fix happens that value stores in buffer and write Index increments read index is always increments until readindex==writeindex.

In this way speaker runs independently to program and prevents overflow condition.

4. Challenges phased and Overcome

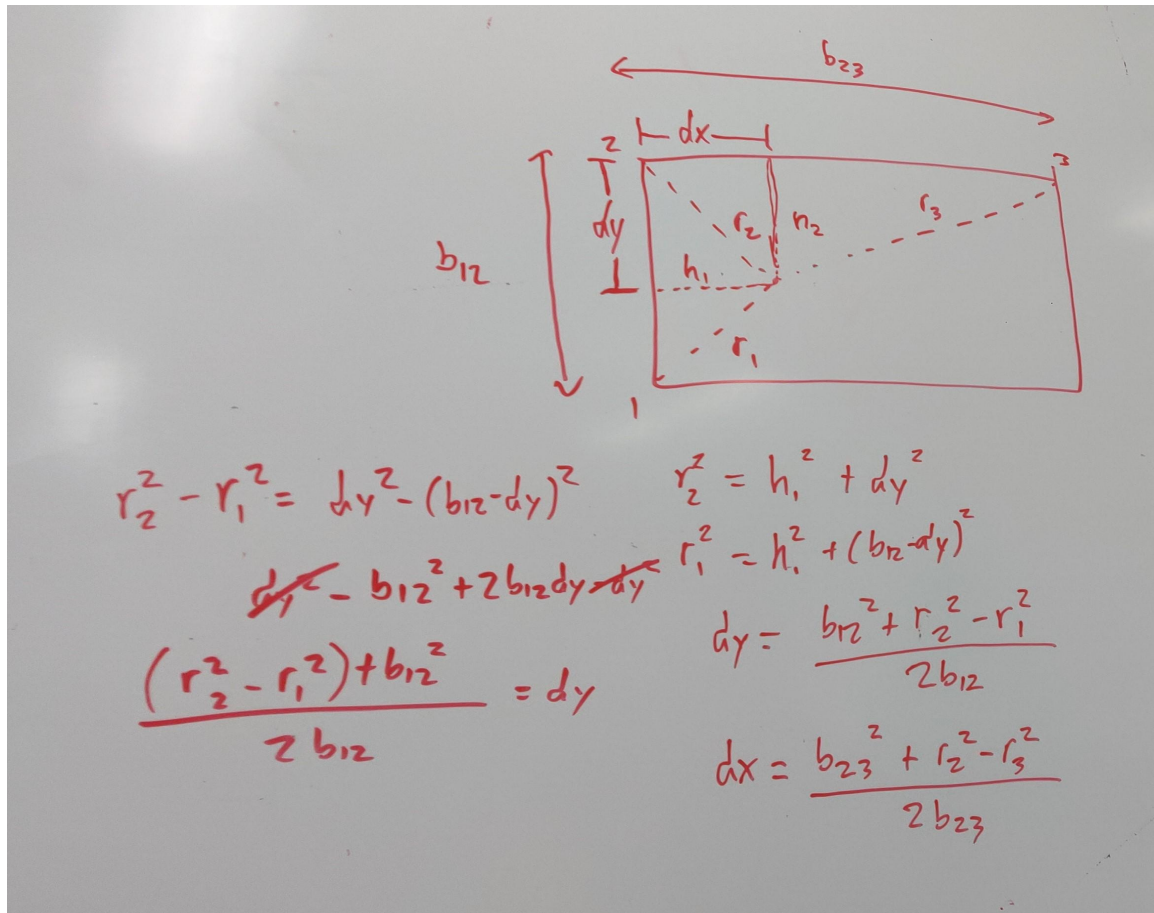
1. Higher distance found then usual and fluctuating- By removing calculations in individual isr, and made alignment of Hardware proper
2. Sometimes 1stValue is Slight lower- By taking 15 samples so 1st value which is sometime 20 mm lower doesn't affrect much in overall reading.

5. What can be done to make this project better

1. Use another 3 or 4 duty cycle not only of 99.98% duty cycle and calculating time delays we can identify more objects as well so simultaneously we can detect more than 1 object distance at a time.

6. Coordinate of an object

After finding distance of an object from receiver using triangulation and circular method finding coordinates of an object.



7. Draw from finding coordinates



8. Conclusion

In conclusion, I am getting 1 mm accuracy on sensor 0 and sensor1 and 5 mm accuracy on sensor 2

Sensor	Offset	Slope
S0	17	0.900
S1	22	0.857
S2	14	0.924

From coordinates it stores in array and if 4second if we are not getting coordinates then it draws in serial interface.