3d Map modelling using ultrasonic sensor

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OBJECTIVE

The objective of this project is to find a cheaper system to build a map for an object in 2d or 3d, that can replace the existing system using . If not exploring the limitations.

REQUIREMENTS

We require the following items to build the proposed system:

- Arduino (Uno/Mega)
- Ultrasonic Sensors
- Servo Motors
- Jumper Wires and connecting wires
- 5v Power Supply
- Arduino IDE

MODEL

➔ Our project can be decomposed into two parts since it was an experimental project where we were trying to develop a new method to challenge.

- 3-D map generation
- 2-D boundry estimation

3-D Map Generation

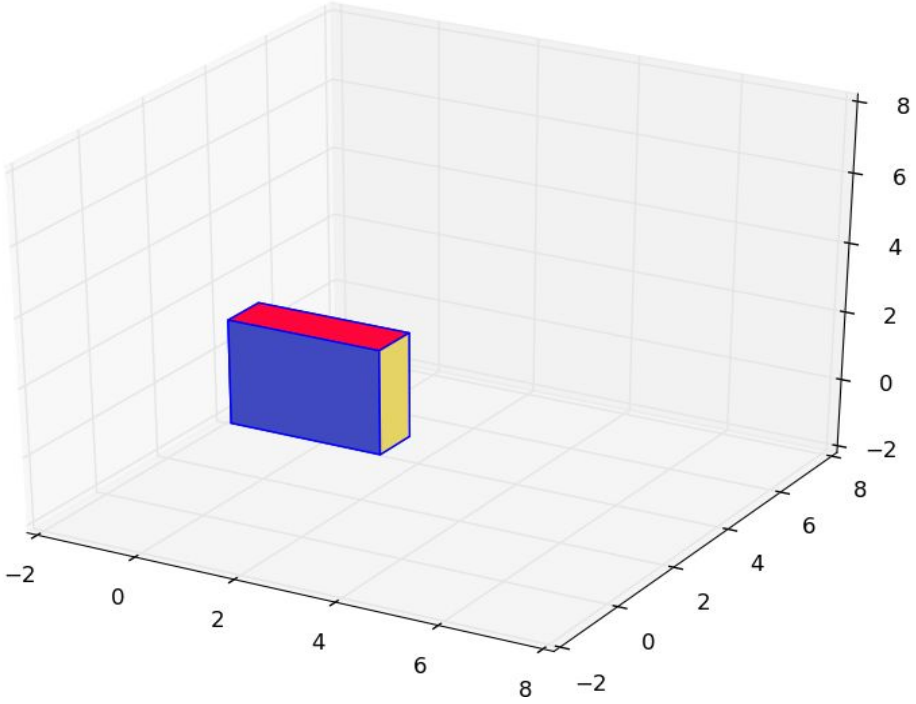
Model Description (Software)

- ➔ First we made a basic 3d map generation model in python that can generate a 3-d map of the object but with some limitations (as shown during mid semester).
- ➔ We were able to obtain a 3d map with estimated boundaries, but the actual boundaries were varying much, so our next goal is to further optimize the boundary detection of the object.

Model Description (Hardware)

- ➔ Here we needed multiple ultrasonic sensors:
    - 5 x ultrasonic sensors
    - 1 x dc servo motor
- ➔ The module made to measure the height of the object is made by mounting ultrasonic sensor on the axle of servo motor.

3-D Map Generation (Result)



2-D Boundary Estimation

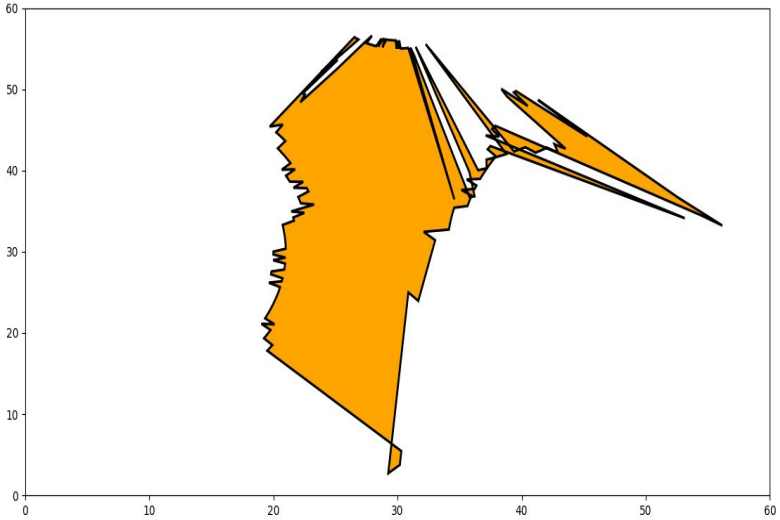
Model Description (Algorithm)

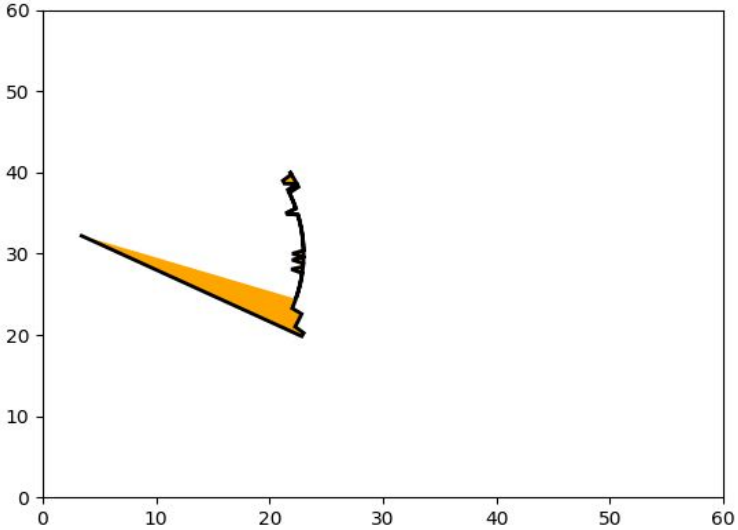
- ➔ First take from sensors the distance of object as well as the angle at which the reading was taken.
- ➔ Calculate the actual reading to distance.
- ➔ Calculate the position of the point in a 2d Cartesian plane using distance and angle.
- ➔ Now the points from all the 4 modules are arranged in a polygon sequence in any order (clockwise or anti clockwise).
- ➔ Due to sensory errors the polygon can be irregular in shape.

Model (Hardware and Error correction)

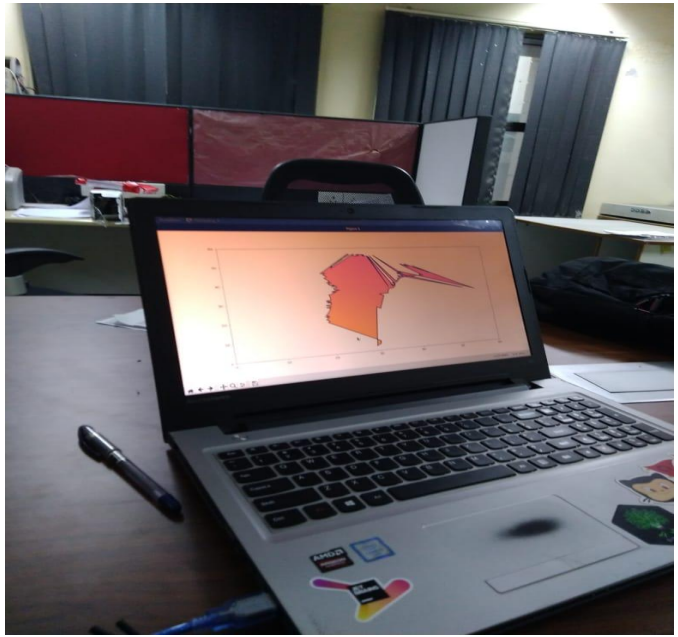
- ➔ To counter the irregularity of the polygon boundary, we deployed some techniques:
  - 4 x ultrasonic sensors
  - 1 x dc servo motor
- ➔ To counter the irregularity of the polygon boundary, we deployed some techniques:
  - Convex hull
  - Averaging

Result and Conclusion





Result and Conclusion



Result and Conclusion

The final output contains output of the boundary as an image which we brought to as close to actual parameter as possible.

We can conclude from our experiment that it is not feasible to create precise 3d map of an object using HC-SR04 due to following reasons :

- High Sensory Errors in the sensor.
- Inter module interference

This project can be made accurate by using some other high precision sensors.