Building Custom Sonar for Wall Cracks Detection

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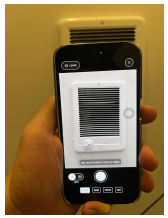
Motivation

➢ Visual Images DOES NOT Detect Wall Cracks Depth

➢ Drone equipped with Sonar Stay Within 40cm To the Wall to make a Scan

➢ Inspired by LiDar Scanning from iPhone And Robotics



Hardware Design and Thoughts

➢ Ultrasonic Distance Sensor has better Accuracy than LiDar (2mm vs 1cm)

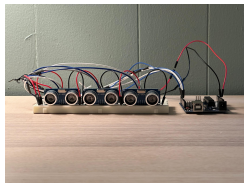
– Sound Speed in air is about 350 m/s while Light Speed is about 3E8 m/s

➢ Ultrasonic Distance Sensor costs far less than LiDar ($7 for 3 vs $120)

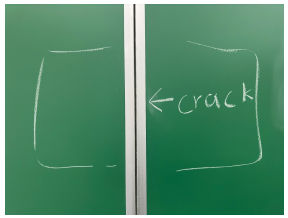
➢ Having 3 Sensors can Average results and Handle Measurements Errors

➢ Using Arduino as microcontroller is cheaper than Raspberry Pi ($30 vs $90)

– Arduino has more accurate pulse in and PWM readings than Raspberry Pi



Results




```
Distance Left: 51.17 mm
Distance Middle: 60.52 mm
Distance Right: 51.85 mm
Distance Left: 52.19 mm
Distance Middle: 61.71 mm
Distance Right: 51.85 mm
```

➢ Acceptable Measurement Results against Flat Wall within +-20 degrees and 50 cm range.

➢ Able to detect Wall Cracks more than 4mm wide and 1 cm deep

➢ Implemented Workable Scanner Mode which Allows User to Move the Broad Slowly for Scanning.

➢ Unacceptable Measurement Results against Complicated Objects such as a Grill or Filter.

– Sound will echo back and forth in those structures.

```
Distance Left: 167.79 mm
Distance Middle: 165.75 mm
Distance Right: 178.33 mm
Distance Left: 155.04 mm
Distance Middle: 156.23 mm
Distance Right: 104.55 mm
```

Further Steps

➢ Integration with Team 10 Mates for Camera Part

➢ Using Raspberry Pi (for Real Time Images) with Arduino (For Sonar)

Lessons Learned

➢ DO NOT Prefer a Sensor because it Sounds Advanced and Cool (LiDar vs Sonar)

➢ Doing Systematic Experiments and Adjustments for Complicated Environments Matters

➢ Accuracy of Sensors saves much efforts for Results Processing

➢ **Conclusion**:

○ Sonar is Acceptable for Wall Cracks Detection. Better Sonar Sensors will have Confidence for Smaller Crask less than 5 mm deep.

○ Sonar only works within 50 cm range and relative angle of +- 20. For more complicated Object Dedicated 3D LiDar scanning is required.

○ Sonar need to be combined with Camera to distinguish between Normal Gaps and Wall Cracks

Video

SCAN ME