SWIMMING GOGGLES WITH PROXIMITY SENSORS

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ENGINEERING PROBLEM/PURPOSE

- Many swimmers don't pay attention in a pool and end up crashing into the wall at the ends of the pool. This collision can cause injuries to the swimmer ranging from small abrasions to fractures and sprains.

ENGINEERING GOAL

- The goal of this project is to engineer a waterproof, wearable device that utilizes a proximity sensor and a display to warn swimmers of an upcoming wall.

BACKGROUND

- Radiofrequency identification (RFID) is used for many simple applications such as highway EZ-Pass systems.
  - RFID tags are small, waterproof objects that do not require batteries.
- Heads-up displays (HUDs) are a "holographic" projection within the user's field of vision
  - HUDs are expensive, though, and very complex.
- Light emitting diodes (LEDs) are very small lights that are easily hooked up to an LED.

PROCEDURE

I. First, an RFID system will be engineered. An LED display will be attached to assist in testing.
   I. The distance from the RFID tag to the sensor will be measured when the LED light up to indicate that the RFID has sensed the tag. The accuracy will be to the nearest half of a millimeter.
   II. The system will then be tested for functionality underwater. The number of times the device functions accurately (as described above) in a tub of water will be counted.

II. Then, the RFID/LED system will be attached to a pair of swimming goggles. This final device will be thoroughly tested to ensure that the attachment does not interfere with the sensor.
   I. The system will be tested in a tub of water to see if the modifications interfere with the RFID and if the final product functions as expected.
   II. In addition, this test will determine whether or not the device will be safe to use in a pool.

DECISIONS

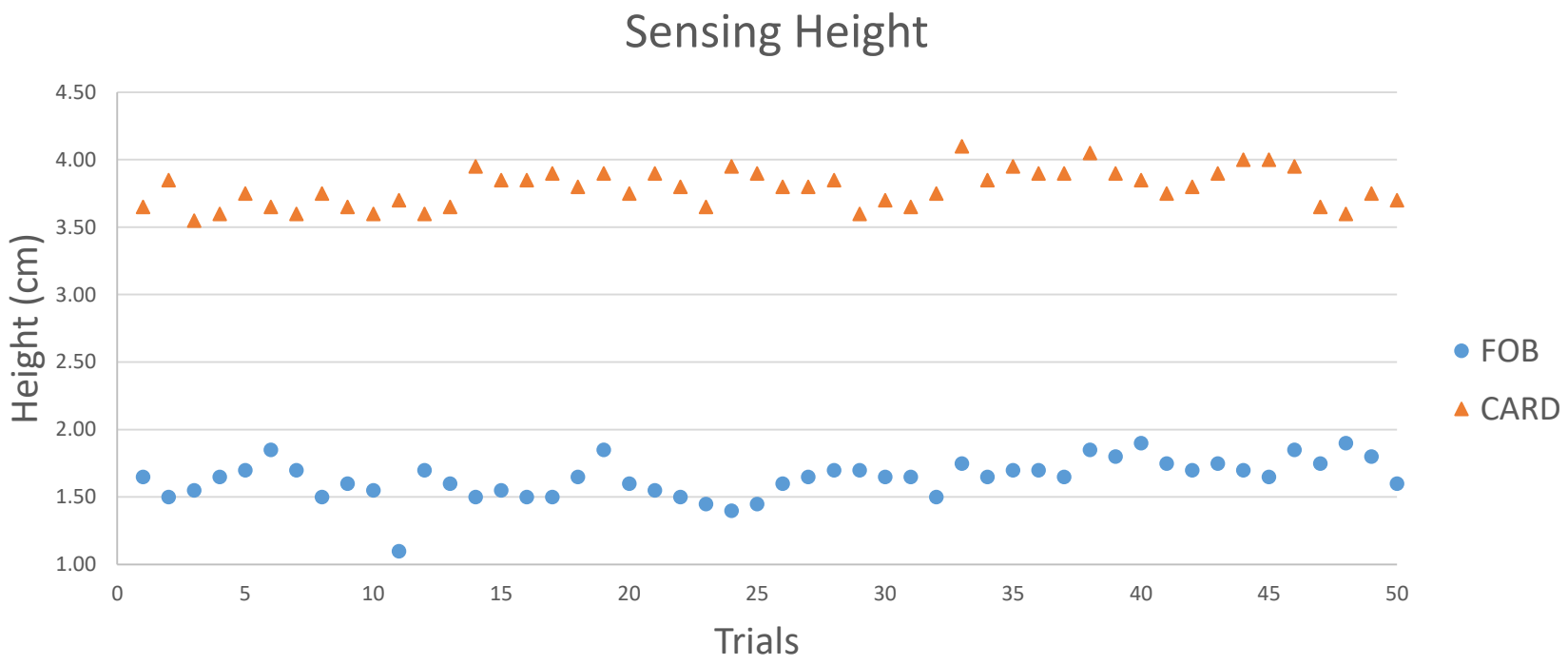
Sensors		Potential Designs		
Criteria	**Weight (max 10)**	Capacitive Sensor	RFID	Laser Beam
Low Cost	7	8	9	4
High Safety	10	7	8	6
High Accuracy	9	9	9	8
High Precision	8	9	8	7
High Simplicity	6	4	9	6
Waterproof	5	2	10	4
Total	450	313	392	272
	Percentage (x/450):	69.6	87.1	60.4

Display		Potential Designs		
Criteria	**Weight (max 10)**	LEDs	Sound	Vibration
Low Cost	7	9	4	9
High Safety	10	9	4	8
High Accuracy	9	8	7	8
High Precision	8	9	7	7
High Simplicity	6	9	5	7
Waterproof	5	10	3	4
Total	45	401	232	333
	Percentage (x/45):	89.1	51.6	74.0

MATERIALS

- RFID-RC522
  - An RFID module that is meant to be used with an Arduino
- Arduino Uno
  - A microcontroller
- LED
- Wires

RESULTS


Sensing Height
Height (cm)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0
5
10
15
20
25
30
35
40
45
50
Trials
FOB
CARD

DATA ANALYSIS

Tag 1: FOB	
Avg Height (cm)	1.64
STDEV	0.15
MIN	1.10
MAX	1.90
RANGE	0.80

Tag 2: CARD	
Avg Height (cm)	3.79
STDEV	0.14
MIN	3.55
MAX	4.10
RANGE	0.55

The information to the left was based off of 50 trials for each tag.

The data collected was precise, as shown by the low standard deviations of 0.15 and 0.14.

The range of each set of data shows the degree of precision the sensor has. For instance, when using the fob, the RFID can sense the tag from anywhere within the 0.80 cm range. When using the card, the RFID can sense the tag from anywhere in the 0.55 cm range. The minimum and maximum of each range can be seen in the tables to the left.

DESIGN CRITERIA

Design Criteria	
Criteria	**Weight (max 10)**
Low Cost	7
High Safety	10
High Accuracy	9
High Precision	8
High Simplicity	6
Waterproof	5
Total	**45**

For my project, my main goals and criteria were to make the device safe, precise, and accurate. The precision and accuracy of the device weigh into the safety, because if a swimmer, receives wrong information about where the wall could be, he or she could crash into the wall and get injured.

My other aims were to make a device that was not too expensive, so that anyone who wanted to buy one could afford it, should the device ever make it to the shelves.

In addition, I was striving for a waterproof design, but this goal was not as important, because there are still plenty of uses for this device that do not require it to be waterproof.

FUTURE WORK

For February fair, I plan to have a device that is not dependent on being connected to a computer: it will have a battery. In addition, the device will be attached to a pair of swimming goggles. If possible, I aim to extend the range of the device to more than four cm and make the entire contraption waterproof, or at least water resistant.

TIMELINE UNTIL FEBRUARY FAIR

December Break: I will collect more data and design the RFID-to-goggles connection.

Early January: I will make the RFID-to-goggles connection and refine the design until it fits without interfering with the sensor.

Late January: I will begin waterproofing tests and attempt to extend the range of the sensor.

Early February: I aim to have all data collection completed and to begin data analysis.

February Fair: A completed project!