VIVID

Visually Impared Visualization Device

ME-102B Project

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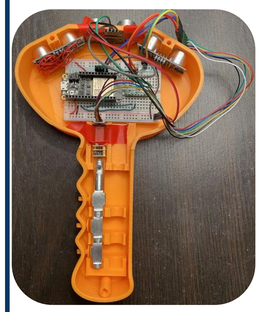
What is VIVID?

A device targeted towards visually impared people, VIVID allows the user to visualize how far away obstacles are

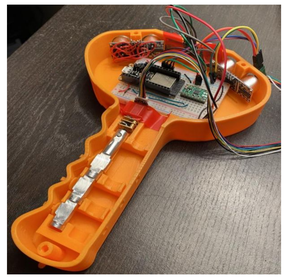
Our Product includes

- Ultrasonic Depth Sensors
- Spring assisted pin triggers
- Mechanical Triple Position System
- Rechargeable battery assisted

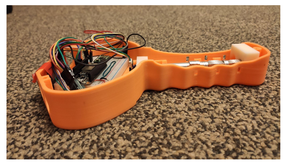
Hardware



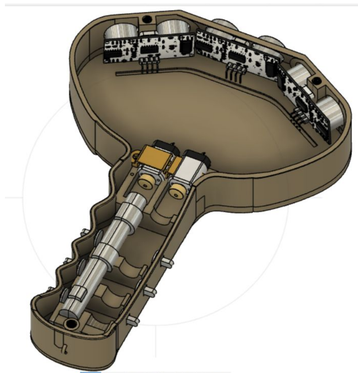
Top View



Isometric View

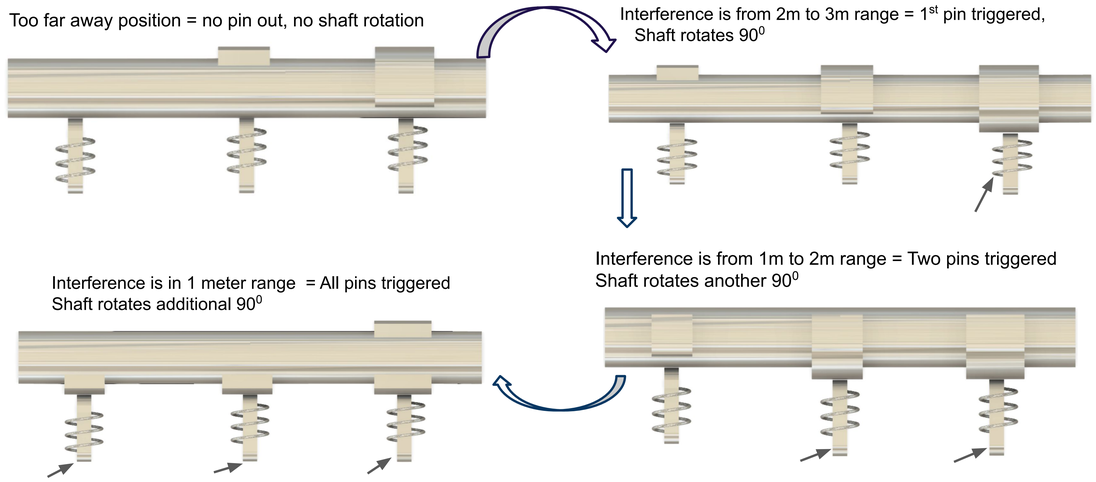


Side View



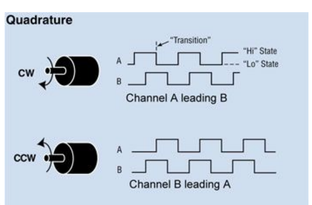
3-D Render

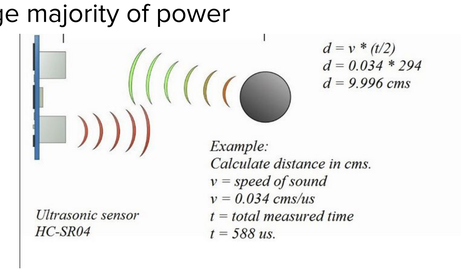
Drive shaft system:



Electrical Components:

- Ultrasonic Sensor
  - The Ultrasonic Sensor provides rapid updates
  - Ultrasonics are preferred over cameras due to their ability to detect clear objects like glass, mirrors, and acrylic
- Motor + Encoder + Driver
  - The brushed DC motor provides 1.3kg*cm of torque with a gear ratio of 76:1
  - Encoder provides information about motor's position, which can be integrated to find velocity and acceleration
  - Driver provides high power to motor and protects circuit
- ESP 32 Microcontroller
  - Controls and integrates all sensors and motors
  - Allows Wi-Fi connectivity for debugging and future IoT applications
- Entire system consumes 15.16 Watts peak power draw, with motors drawing the large majority of power





Code:

Sensor Integration

```
int Distance(){
  int post;
  digitalWrite(trigPin1, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin1, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin1, LOW);
  float d1 = pulseIn(echoPin1, HIGH);


  float r1 = (d1*.0343)/2;

 void readEncoder(){
   int b = digitalRead(ENCB);
   if(b > 0){
     posi++;
   }
   else{
     posi--;
   }
 }
 attachInterrupt(digitalPinToInterrupt(ENCA),readEncoder,RISING);
```

PID Control

$$CO(t) = P\left[e(t) + \frac{1}{T_I}\cdot\left(\int e(t)\,dt\right) + T_D\cdot\left(\frac{d}{dt}e(t)\right)\right]$$

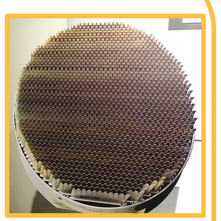
Proportional term | Integral term | Derivative term

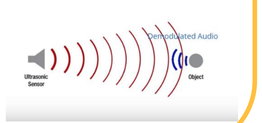
```
float u = kp*e + kd*dedt + ki*eintegral;
float pwr = fabs(u);

kp = 1.0;
kd = 0.1;
ki = 0.000;
```

Future Improvements:

We plan to continue development of this device. Future improvements could include the addition of a phased array ultrasonic system, which will allow for longer range and more precision when compared to our current system. Depending on future research, we may opt to develop a modulated transducer. This could allow us to use obstacles as speakers, playing audio from each obstacle.

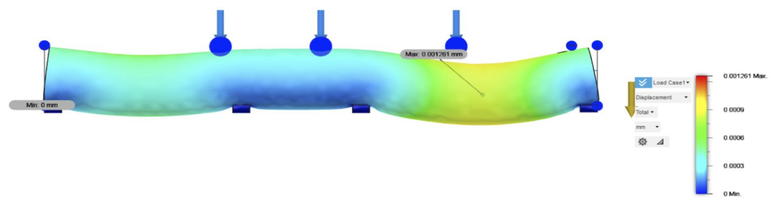




Mechanical Components:

Our prototype features a 3D-Printed main body, 3D-printed pins, and a **machined aluminum driveshaft**, which functions as a **short stroke, variable linear actuator** for three pins simultaneously linked to one motor. These pins then exert pressure on the hand, which facilitates **haptic feedback**.

By running **finite element analyses**, we determined that a 3D-printed driveshaft would not be able to withstand anticipated axial forces exerted by fingers on each pin.



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