

STRIDE

Mobility Aid for the Visually Impaired



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Motivation

- Started with Camera Centering Tripod Mount (CCTM)
- Wanted to create a product with a wider impact
- Chose to create a mobility aid for the visually impaired

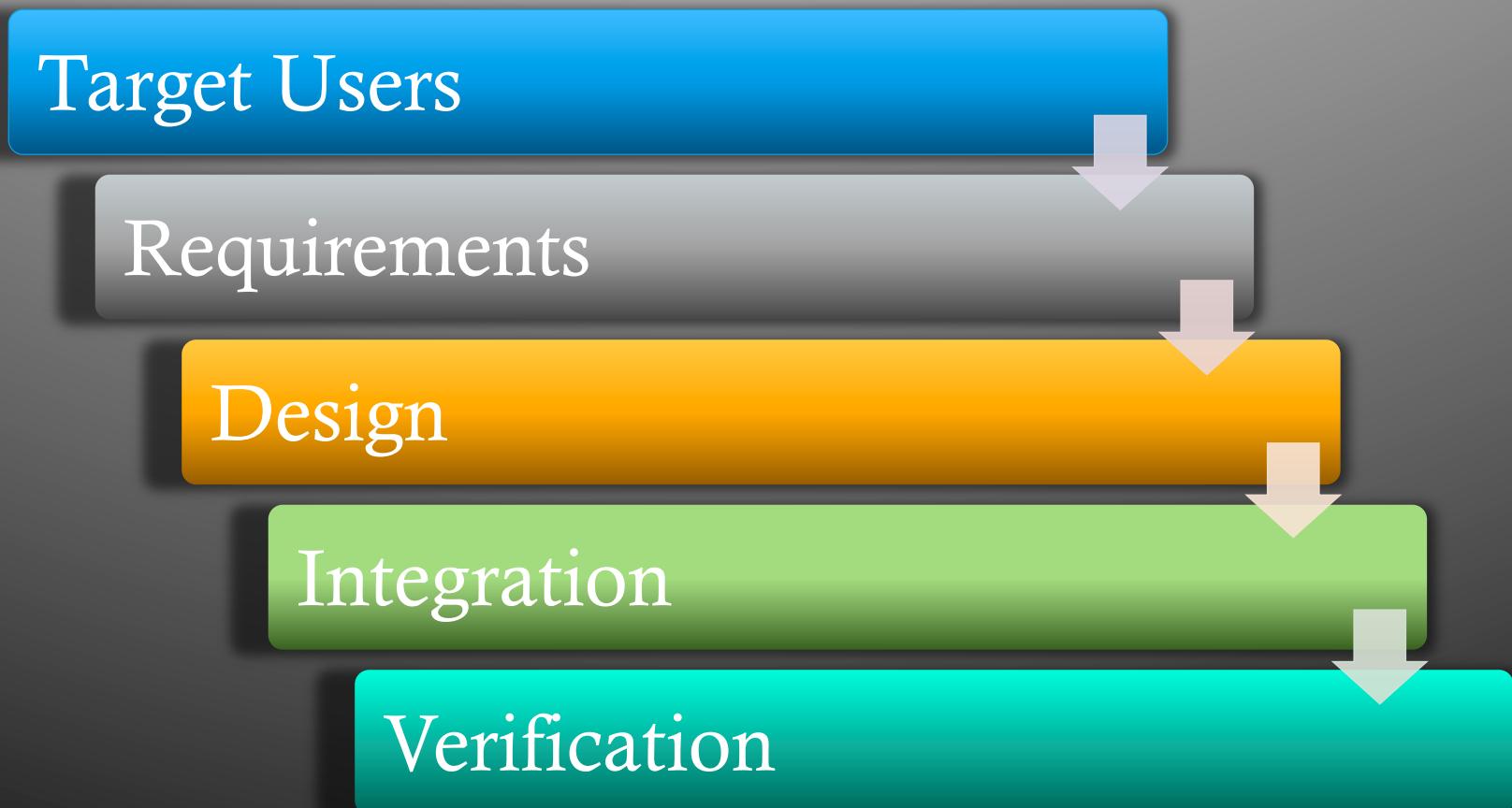


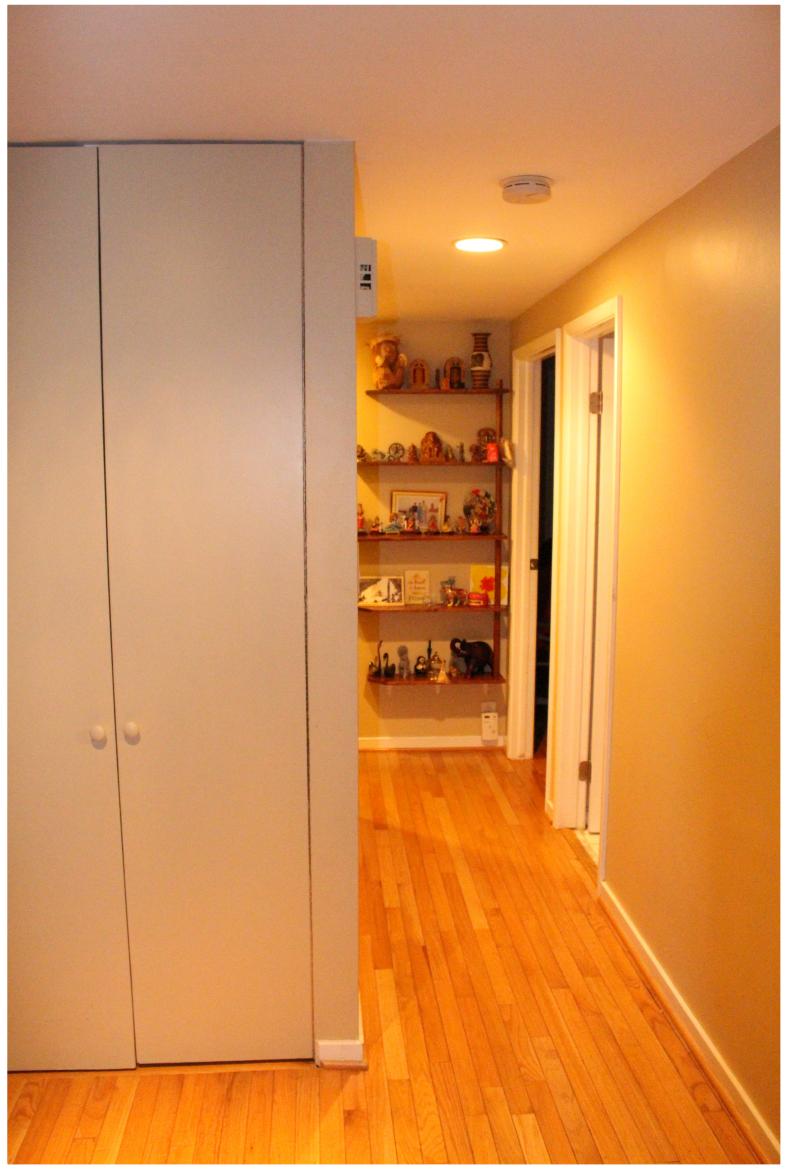
Adapted CCTM Technology into STRIDE

What does STRIDE stand for?

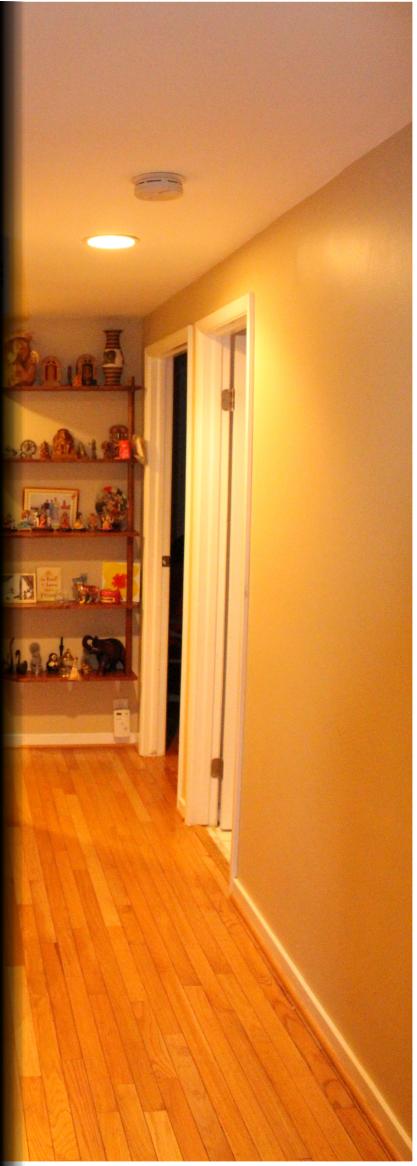
- Simple
- Technological
- Reconnaissance
- Interface for
- Distance
- Estimation

STRIDE Development Lifecycle (SDLC)





Target Users



Target Users

- Homonymous hemianopsia patients
 - 63,000 Patients every year in USA
 - 9% of stroke survivors



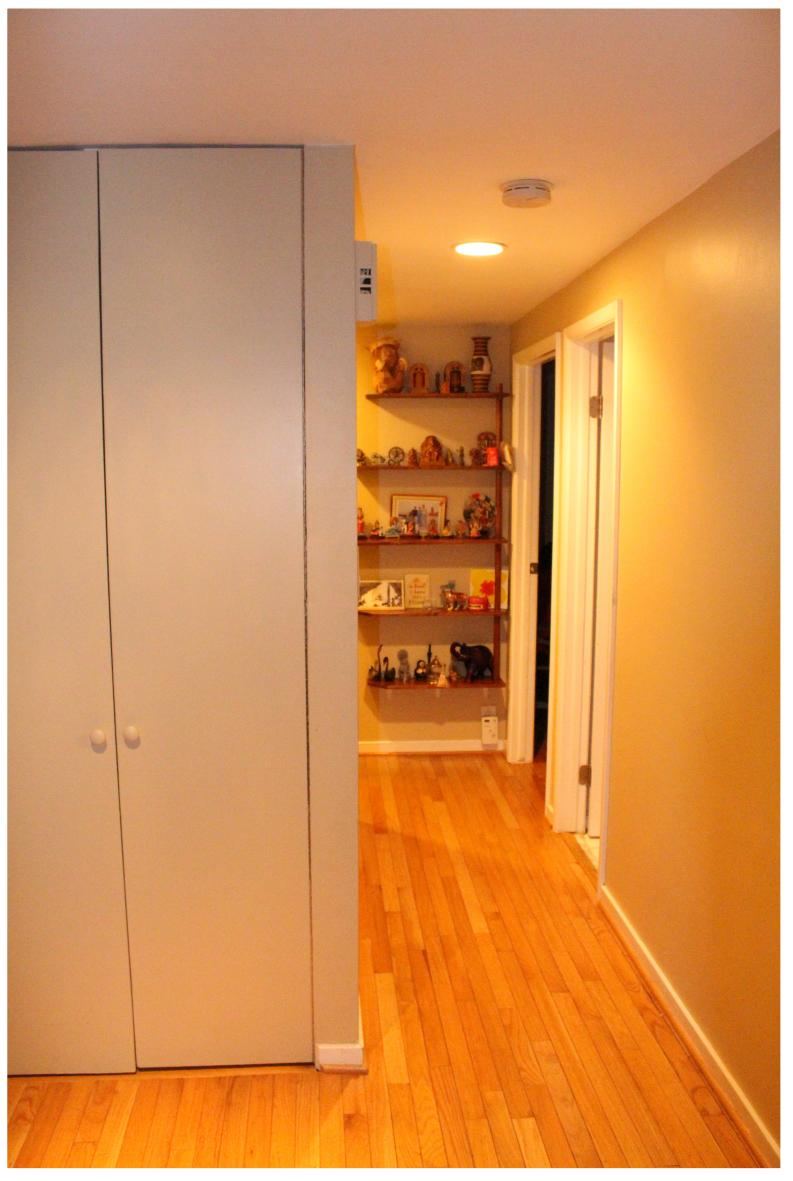
Target Users

- Glaucoma patients
 - In the US, 2.7 million people impaired, above age 40
 - 22% increase since 2000



Target Users

- Retinitis pigmentosa patients
 - 1 in 4,000 people per year
 - 627,800 new patients per year



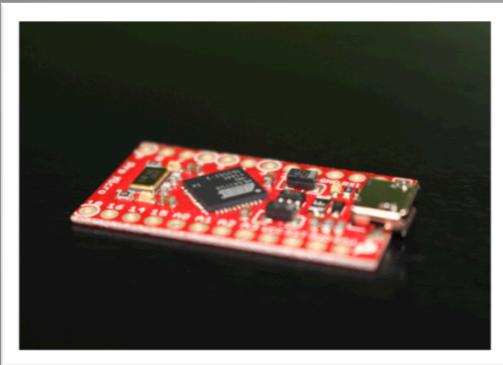
Target Users

- Other Visually Impaired Users
 - Parkinson's Disease patients
 - In the US, 1 million people impaired
 - 60,000 new patients per year
 - Advanced Diabetic patients
 - In the US, 7.7 million people impaired, above age 40
 - 89% increase since 2000

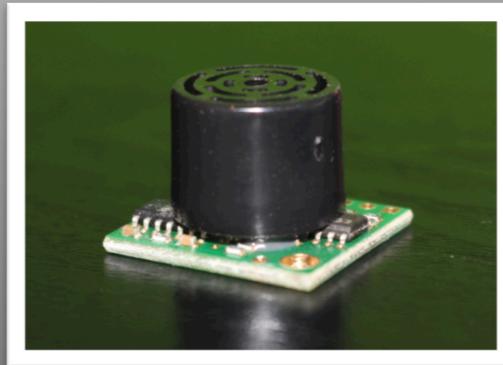
Requirements

- Signal within a stride (2 seconds)
- Complement remaining vision
- Be unobtrusive
- Work in rain or shine
- Fit onto any shoe
- Must be cost effective

Design – Hardware Used



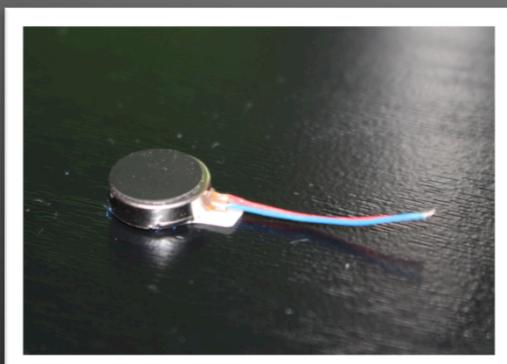
Microcontroller



Proximity Sensor



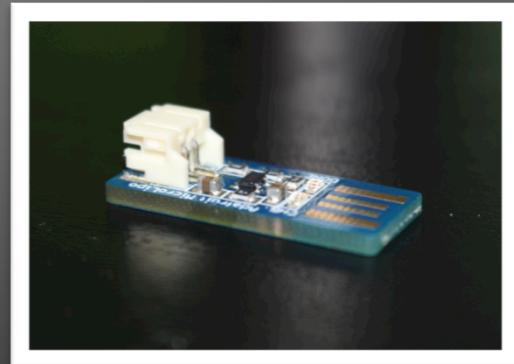
Accelerometer



Vibrator



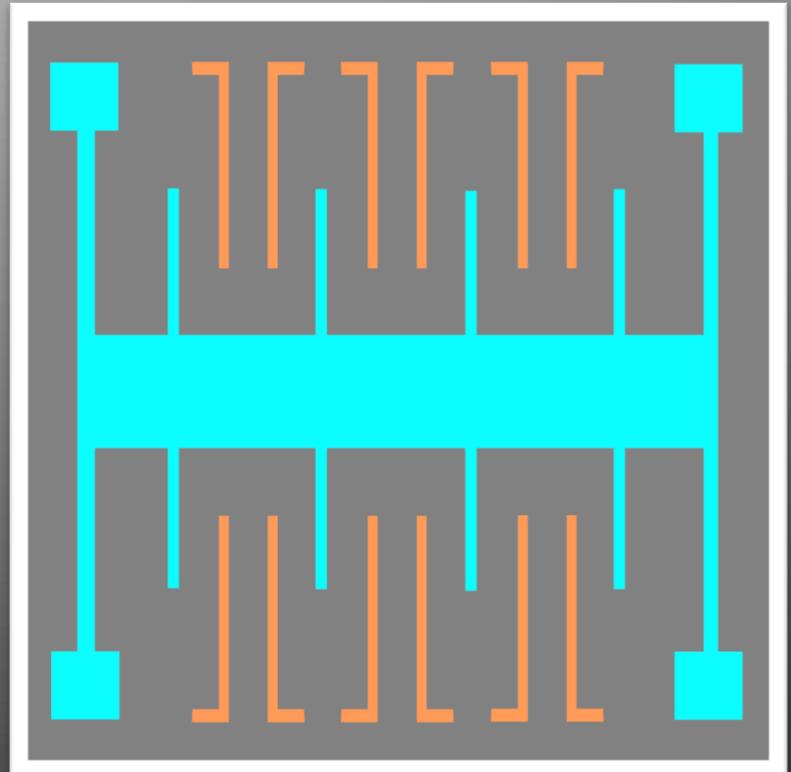
Lithium Polymer
Battery



Battery Charger

Design – Accelerometer

- Cost effective
- Low power consumption
- Simple to use



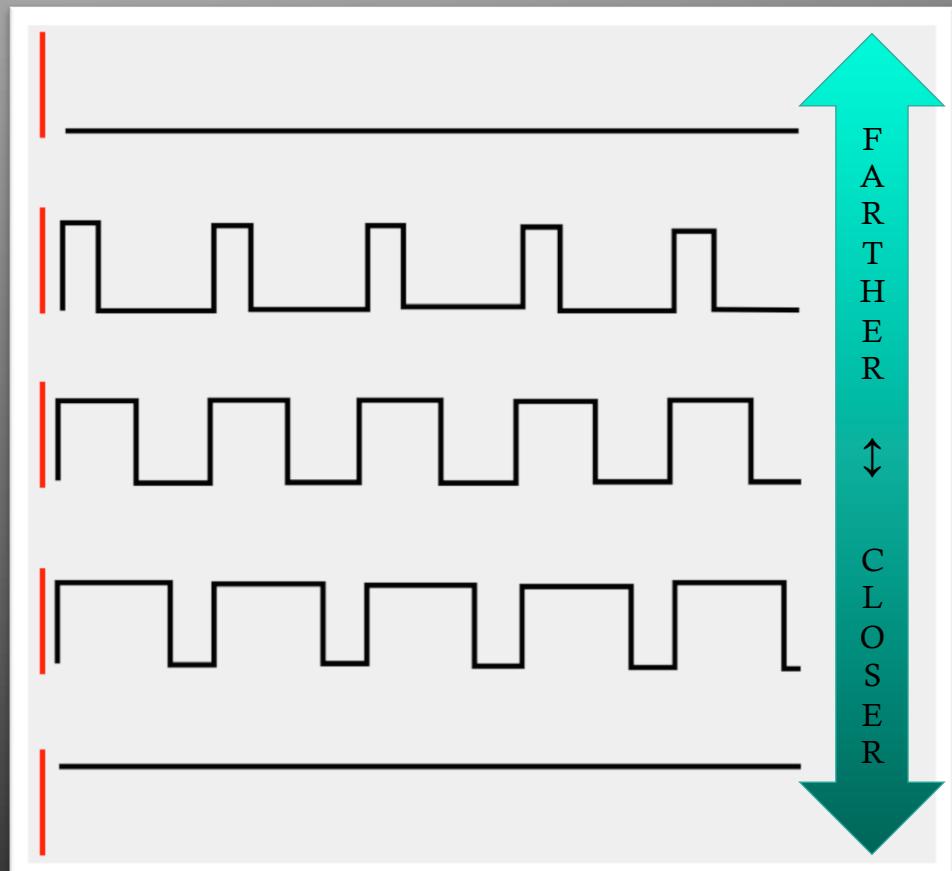
Design – Proximity Sensor

- Uses ultrasonic pulse
- Range is 6" to 512" with a large beam width
- Easy to mount – single unit sender and receiver
- Simple programming interface



Design – Vibrator

- Pulse Width Modulation to control intensity
- Not as intense if object is far, more intense if object is close
- After a certain distance, doesn't notify



Design – Software Used



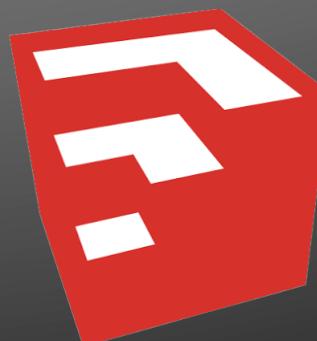
Integrated Software
Development Environment
(Arduino IDE)



Printed Circuit Board
Development Environment
(KiCAD)

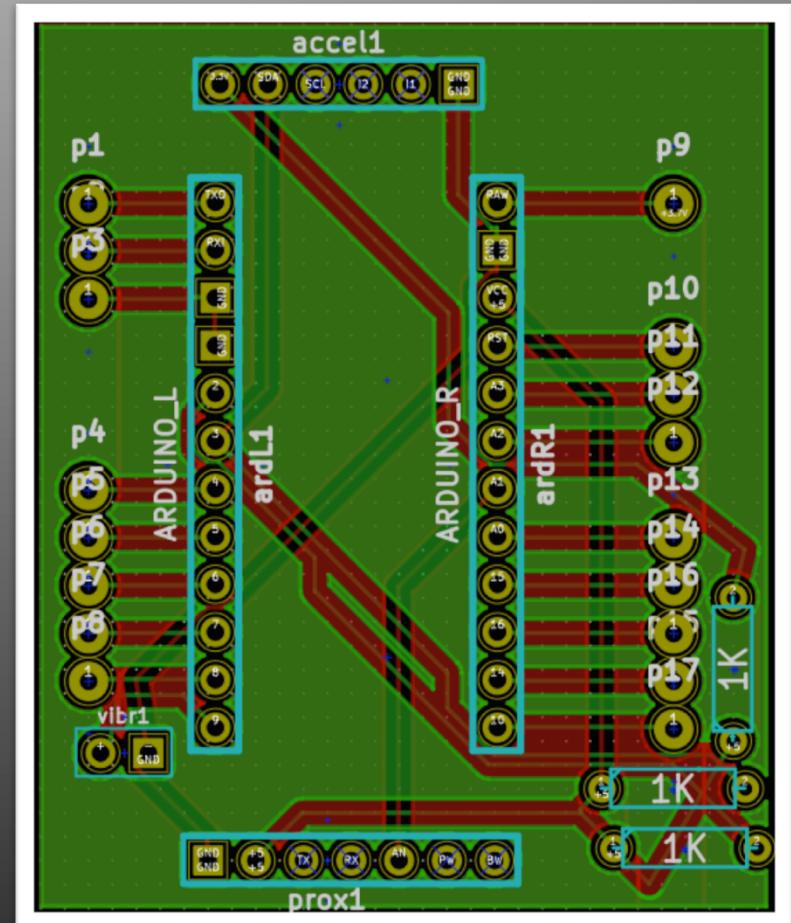
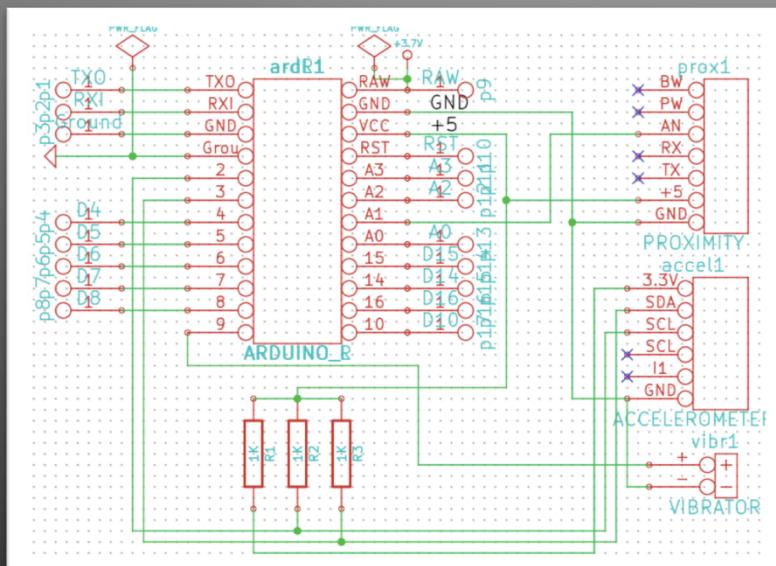


Distributed Revision Control
Management System
(Git)

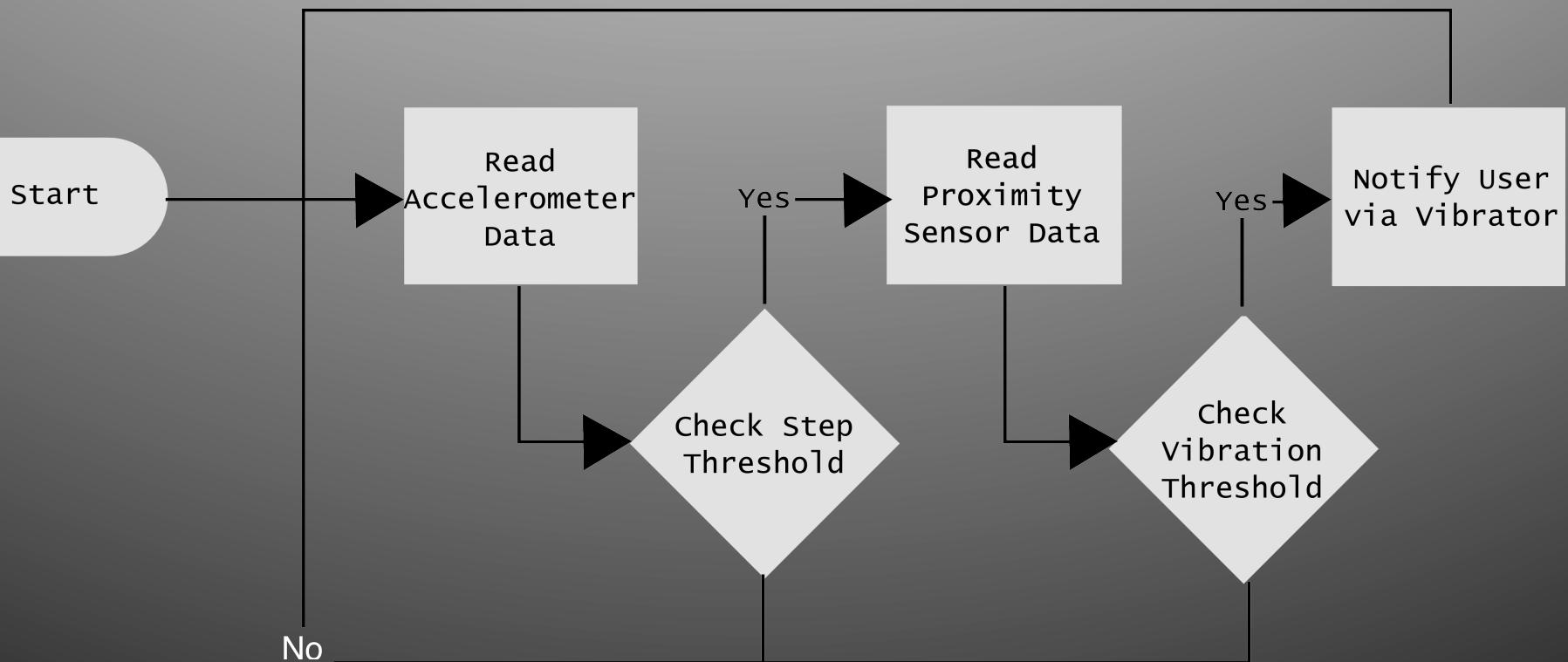


3D Computer Aided
Design Software
(SketchUp)

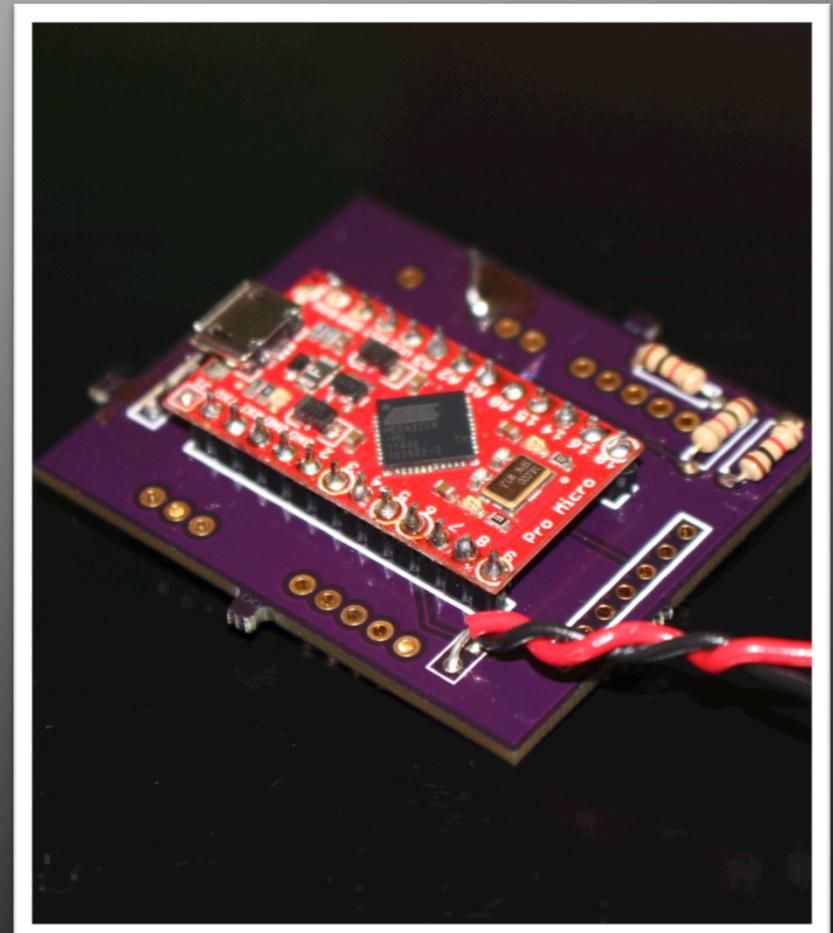
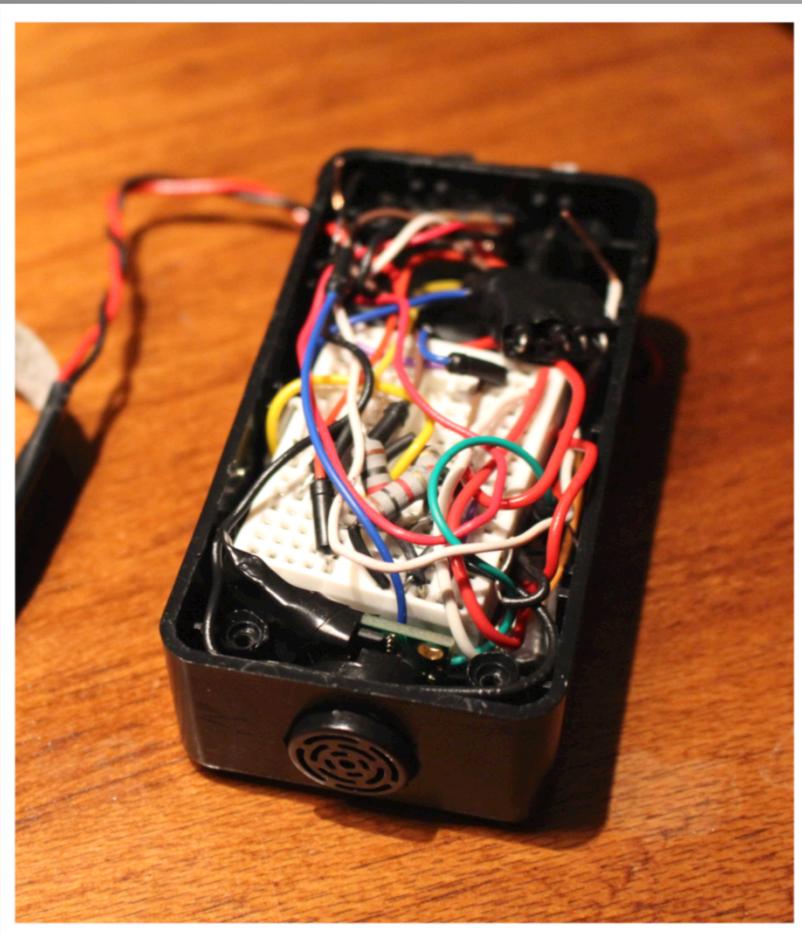
Design – Printed Circuit Board



Integration – Flow



Integration – Hardware

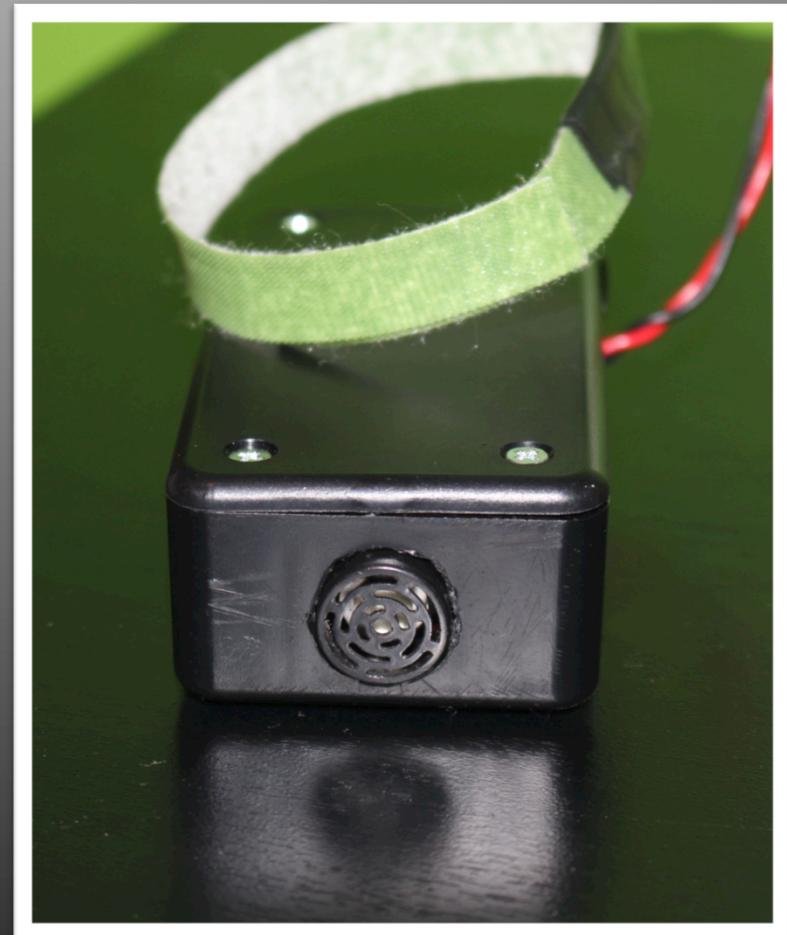
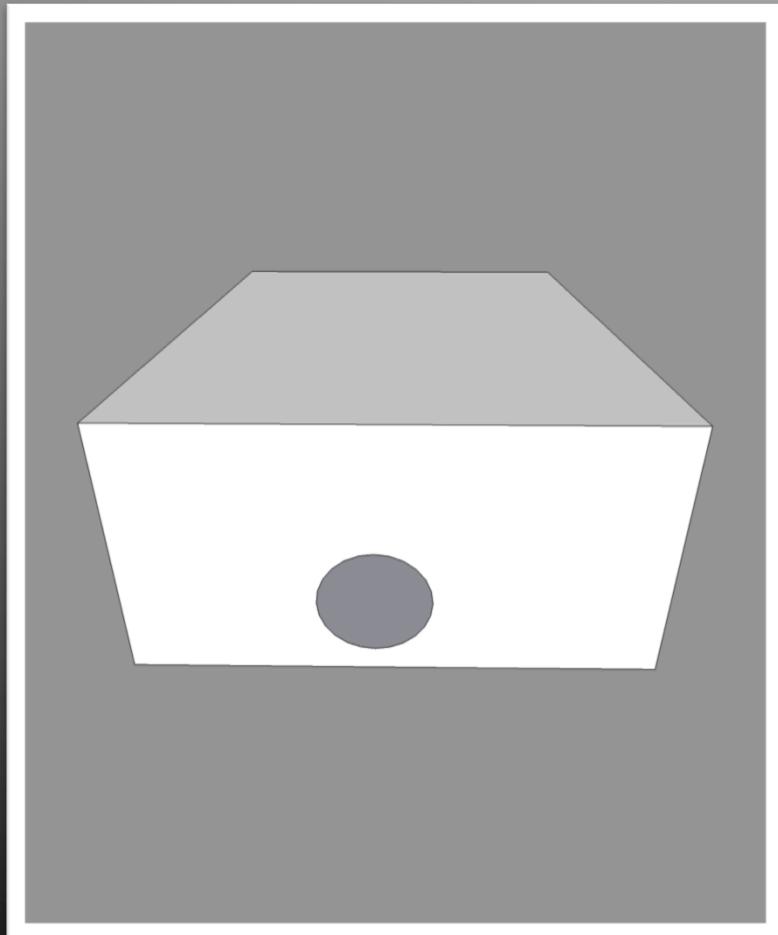


Integration – Step Check Code

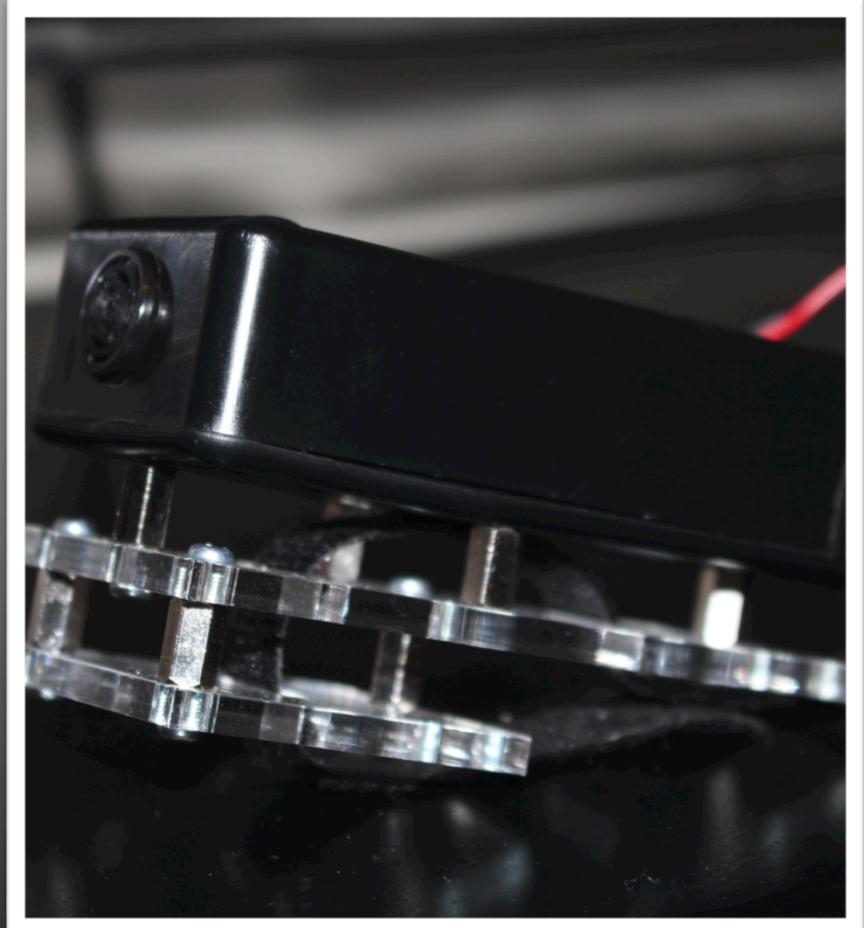
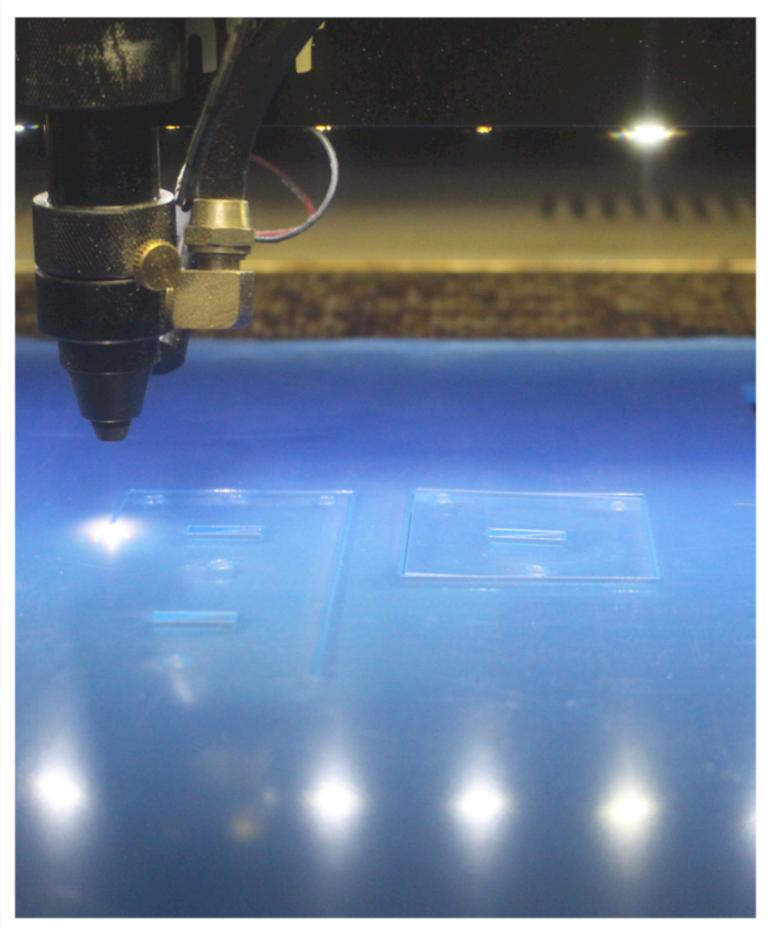
```
void tap(float xNewGVal, float yNewGVal, float zNewGVal)
{
    zOldGChange = zNewGChange;      //z axis being vertical axis
    zNewGChange = zOldGVal - zNewGVal;
    zOldGVal = zNewGVal;
    float zComp = zOldGChange - zNewGChange;
    float zOldThresh = zOldGChange * 1.5;
    float zNewThresh = zNewGChange * 1.5;
    zComp = abs(zComp);
    zOldThresh = abs(zOldThresh);
    zNewThresh = abs(zNewThresh);
    if (zNewThresh >= .5) {           //.5 being adjustable threshold
        tapAmt++;
        zNewThresh = zOldThresh;
        distance();
    }
    else { tapDone = false; }
    rounds++
}
```

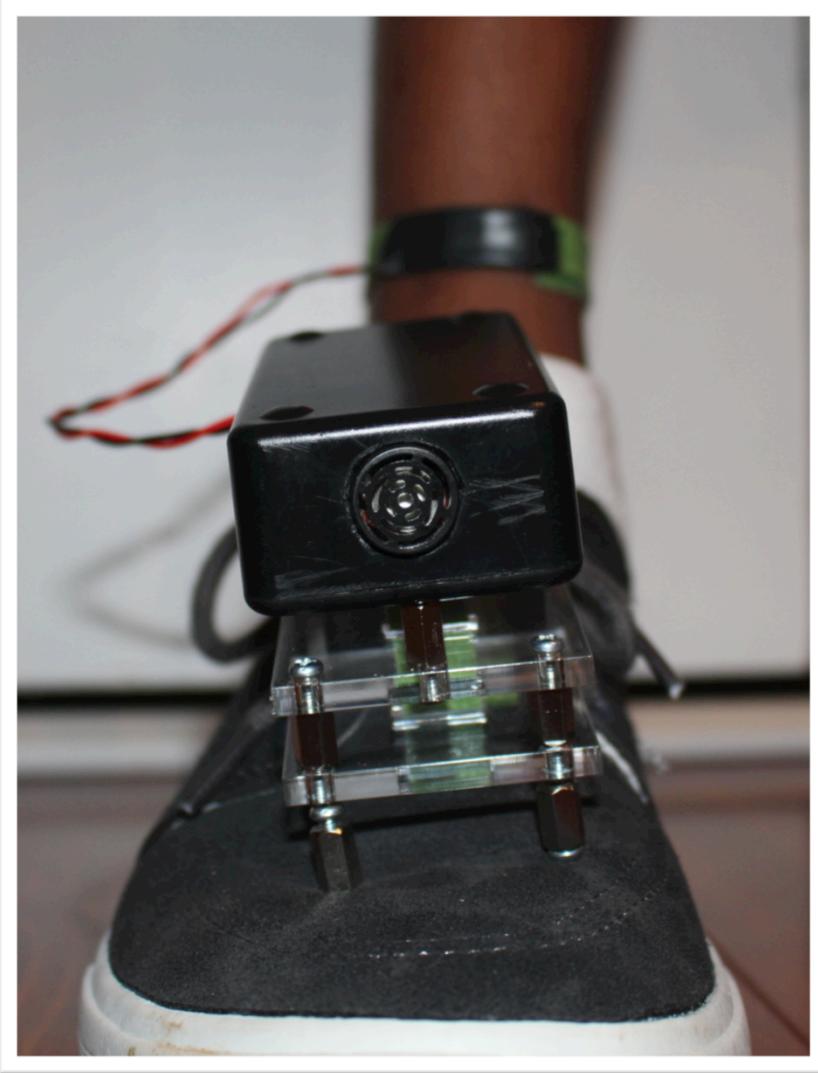
```
#include <avr.h>
#include <math.h>
#include <avr/pgmspace.h>
#define OUT_X_0x00000000
#define OUT_Y_0x00000000
#define OUT_Z_0x00000000
#define OUT_XY_0x00000000
#define OUT_XZ_0x00000000
#define OUT_YZ_0x00000000
#define OUT_XYZ_0x00000000
float zOldVal = -0.5;
float zNewVal = -0.5;
float zOldChange = -0.5;
float zNewChange = -0.5;
float zOldThresh = -0.5;
float zNewThresh = -0.5;
bool tapDone = false;
bool tapAmt = 0;
bool rounds = 0;
bool distance = false;
int target = 0;
int tapCount = 0;
void loop() { ... }
void configAngle(float yaw, float pitch) { ... }
void radioCalibrate(int destination) { ... }
void turnLeftAt200() { ... }
void turnRightAt200() { ... }
void readRegister(int address, int byteLength, byte data[byteLength]) { ... }
void writeRegister(int address, byte data[byteLength]) { ... }
void vibrate(int length) { ... }
void distekedDistance(vibr) { ... }
void debugPrintString(string varname, int varValue, boolean name) { ... }
void debugSetString(string varname, boolean varValue, boolean name) { ... }
```

Integration – 3D Casing



Integration – Shoe Mount





Demonstration

Verification

- Individual components tested
 - Unit testing code developed
- Integrated components tested
 - Main firmware written
- Field testing
 - 12 hour use
 - Daily maintenance
 - Durability

Looking to the Future...

- Potential new users
 - The Blind
 - Miners
 - Rescue personnel
- Interface with smart-watch or smart-phone
 - History tracking
 - Other reconnaissance intelligent processing



Thanks To

- Mentors
 - Dr. James Jonza – 3M Mentor
 - Ted Markson – Co-Founder, Nova Labs
 - Srini Kasturi – Dad
- Advisors
 - Dr. Fredric Schroeder – Vice President, World Blind Union
 - Dr. Joanne Crenshaw – Ophthalmologist
 - Mark Riccobono – Executive Director of Jernigan Institute
 - Dr. Ron Jesme – 3M Electrical Engineer
 - Dr. Anurag Gupta – Endocrinologist, Diabetic Specialist
 - Dr. Sandeep Gupta – Helios Engineering
 - Vidita Subbarao – Presentation Specialist
 - Sudhita Kasturi – Mom
- Organizations
 - 3M
 - Discovery Education
 - National Federation of the Blind
 - Wyolum
 - Sparkfun
 - Nova Labs
 - Jennyfer Peterson
 - Justin Shaw
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 - April Goff
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