Project Overview

Mission
Aid people with limited mobility to navigate around easily and safely

Goal
Create a kit to allow the conversion of normal wheelchairs into smart self-driving ones.

Scope
Create a sensor suite that can detect environmental context cues and calculate trajectory traveled. Be able to relay information from sensors to allow users better understanding of environment they are in.

System Overview

Sensor Devices
- Adafruit BME280
- Adafruit CCS811
- Adafruit Si4145
- Adafruit ADA746
- Adafruit ADA476
- SparkFun Sound Detector
- Adafruit BNO055
- GPS

Part A. Sensor System and Enclosure

Temperature and Humidity
- Aerofit BME280
- Weather Determination

Air Quality
- Adafruit CCS811
- User Info

Lighting
- Adafruit Si4145
- User Info & Weather Determination

GPS
- Adafruit ADA476
- Location tracking & Pathing Reconstruction

Sound
- SparkFun Sound Detector
- User Information

IMU
- Adafruit BNO055
- Pathing Reconstruction

Development

Part B. Data Processing for Contextual Awareness

(1) Weather Classifier

(a) Collected data of 5 weather conditions
(b) Neural network model
(c) Weather classification

Figure 1. Weather Classifier Process

(2) Path Reconstruction

Figure 2. Kalman filter for path reconstruction using GPS + IMU

Results

Part A. Sample Sensor Data

Part B. Weather Classification

<table>
<thead>
<tr>
<th></th>
<th>Neural Network (2 hidden layer)</th>
<th>Logistic Regression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>94.4%</td>
<td>77%</td>
</tr>
</tbody>
</table>

Part C. Reconstructed Path

Figure 3. (a) Trajectory using GPS sensor data (b) Trajectory based on Kalman filter using IMU data and few GPS sensor data

Conclusions

In this project, we were able to get accurate weather classification and path reconstruction. Future work will involve automating some of the data processing into a single pipeline that will process everything from start to finish.