The objective of creating a technology to detect obstacles was accomplished. The data from the actual vs recorded distances shows a high accuracy (insert stats data). From this it could be inferred that the obstacle detection methods planned would work. While the work was unable to produce a prototype for ground condition detection that would be able to give feedback, the device was able to detect noticeable and quantifiable differences between surfaces. This does not completely accomplish my objective, however, it is a very close step as I was able to prove the concepts being used. With further time, my original methods could be adapted so that the data would be collected numerically. This could allow for more in-depth analysis of each of the graphs and lead towards the development of feedback methods.

While in the process of creating my devices I experienced multiple difficulties. I originally attempted to set up my ground condition detection system using only one Arduino. This would allow for the timing of the output and input to be matched up and make the collection of numerical data much easier. While this system worked, it was not able to sample fast enough to obtain the whole curve and the signal was very weak. This prompted the attachment of an amplifier to my device. Due to a lack of time, an oscillator was used to see the signals instead of using a different kind of circuit to sample faster. However, using a raspberry pi or other similar board that would be able to sample fast enough could also be a potential solution to this issue.

Using the oscillator required the separation of the transmitting and receiving sensors into two different pieces. This made testing difficult as each of the sensors had to be in specific positions in order to receive a reliable signal. In order to be accurate with the testing and

measurements, clamps were used to hold the sensors at the set testing distances. Data was then able to be obtained for different surface/ground conditions.

My ground condition detection method is limited by its inability to create accurate specific distinctions between similar materials. While this method would be able to detect general hazardous surfaces, more precise sensors would be needed in order to create reliable distinction for specific classifications. In the field, there are very few articles that use the methods I have described to obtain ground condition. My research furthers the understanding of how the methods can be used and discusses a way that the technologies could be applied. Very few devices for the visually impaired include ground condition detection. There were no commercially available products to solve this issue. My research shows a method that could be easily applied to devices if converted into a form that allows for automatic detection/feedback.