Technical Survey: Smart Cane

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1 Summary of Sources

1.1 Accelerometer-based Activity Recognition on Smartphone [4]

In this paper, the authors developed a smartphone app for iOS that used the built in accelerometer to detect, measure, classify, and track the activities of the user. The specific portion of this activity tracking that would be useful for the Smart Cane project is the turn detection. Navigation, particularly indoors, would likely require some form of turn detection in order to be fully effective. In this paper, the method used for classifying the accelerometer data to detect a turn was a modified decision tree. This is something we may look into as we attempt to detect turns. An additional point of strength for the application in the paper is its ability to learn the habits of the user. The app prompts the user for feedback, which is fed back into the model to improve future accuracy. This may be a tool that would be useful to us as well.

1.2 RFID in Robot-Assisted Indoor Navigation for the Visually Impaired [2]

This is an article in which RFID tags are used to guide a robot within an environment. The authors tested a robot that used these sensors to navigate as a potential alternative or supplement to guide dogs or canes. This is useful for the Smart Cane project as it offers a potential alternative to the GPS or accelerometer-based systems we've been primarily considering. The advantage of the RFID system is that it is able to be customized to a particular environment, and can be tailed exactly to that environment. The downside, of course, is that the tags must be deployed ahead of time, and the system would not funtion in a environment without them, reducing much of the potential utility of the system.

1.3 Accurate Map-based Indoor Navigation Using Smartphones [3]

The authors in this article created an application designed to aid in indoor navigation. It used preset routes that were created ahead of time. Then, through the usage of step detection and direction tracking, the app attempted to match the user to the path they had selected. This is useful for the Smart Cane project as it matches closely with the intended functionality for indoor navigation. While the technology in the article has limitations - particularly the need to have the paths mapped out ahead of time - this could still be useful, as one of the desired functions of the Smart Cane is to allow the user to retrace their steps within a building, which seems to fit the type of system described in the article.

1.4 Crosswalk and Traffic Light Detection via Integral Framework[1]

In this article, the authors detail a crosswalk and traffic light detection system designed for usage on vehicles. It has potential applications for the Smart Cane project as well however, as the crosswalk detection functionality would be a valuable addition to the obstacle detection requirement of the cane. In particular, the system described in the article is designed to be lightweight enough to run on a device mounted to a car, which is obviously also a major concern for a handheld device as the cane is intended to be. The fact that such a system can be feasibly made lightweight is thus very positive news.

References

[1] J. Choi, B. Ahn, and I. Kweon. Crosswalk and traffic light detection via integral framework. *The 19th Korea -Japan Joint Workshop on Frontiers of Computer Vision*, 2013.

[2] V. Kulyukin, C. Gharpure, J Nicholson, and S. Pavithran. Rfid in robot-assisted indoor navigation for the visually impaired. *2004 IEEE/RSJ International Conference on Intelligent Robots and Systems*, 2004.

[3] P. Smith, J. Bitsch, and K. Wehrle. Accurate map-based indoor navigation using smartphones. *2011 INTERNATIONAL CONFERENCE ON INDOOR POSITIONING AND INDOOR NAVIGATION*, 2011.

[4] X. Su, H. Tong, and P. Ji. Accelerometer-based activity recognition on smartphone. *Proceedings of the 23rd ACM International Conference on Conference on Information and Knowledge Management*, 2014.