Annotated Bibliography: Smart Cane

Matthew Giuffrida

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1 Summary of Sources

1.1 Accelerometer-based Activity Recognition on Smartphone [8]

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 [5]

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 function in a environment without them, reducing much of the potential utility of the system.

1.3 Accurate Map-based Indoor Navigation Using Smartphones [7]

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.

1.5 Positioning using Combined Bluetooth and WiFi[3]

In this article, methods are discussed to perform positioning, specifically positioning in an indoor environment. This is a very difficult problem, as the degree of difficulty is greatly increased in an indoor environment due to the need for a much greater amount of accuracy. This reduced tolerance for error means that traditional positioning using GPS tends to be too inaccurate to be an effective solution to the problem. In the paper, the authors discuss methods of combining both WiFi and Bluetooth connections to increase the accuracy of their positioning estimates. This could be useful in regards to our project, as if we needed to implement indoor navigation inside specific buildings, we could potentially use this method as as well, though it likely not be feasible to extend it out to the general case.

1.6 Measuring Rotation and acceleration with the Raspberry Pi[2]

This article is a tutorial about utilizing a gyroscope and accelerometer to measure rotation and acceleration, respectively, on the Raspberry Pi. It goes into detail on how to do so, including a large amount of sample code to demonstrate how to accomplish this task. It also has code that allows for a 3d visualization of the movement of the sensor, which could be very useful as we begin testing on the indoor navigation section of the project, which relies heavily on readings from the gyroscope and the accelerometer.

1.7 Interfacing with and using the Ultrasonic Sensor[4]

This article is a tutorial that describes the process of setting up an ultrasonic sensor with a Raspberry Pi, and obtaining a reading of distance using that sensor. There is some extraneous information, as the first part of the tutorial describes setting up a voltage divider to convert a 5 volt output to a 3.3 volt output, which is unnecessary with the setup we are using, but overall it is a useful resource to deal with this component, and the sample code it provides is useful to cross-check against.

1.8 Setting up a Bluetooth Connection with a Raspberry Pi[6]

This article is a fairly straightforward tutorial about setting up a Bluetooth connection between a Raspberry Pi and a Bluetooth enabled device. This is useful to us as we intend to set up a Bluetooth connection between a smartphone and our device in order to communicate, specifically to utilize the resources available on a smartphone that are much more difficult to replace utilizing solely a Raspberry Pi or similar microcomputer. This tutorial in particular is useful because it provides several possible methods of establishing that Bluetooth connection, which allows us more options as we begin to do so.

References

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