Related Works

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As cell phones get more powerful, they become usable for more and more applications. Cell phones these days have many different sensors and components built in, such as GPS, accelerometer, camera, internet, etc. Cell phones can be used for almost everything these days, and are starting to become recognized as tools for aiding people who are disabled.

1 Zebra Crosswalk Detection

Figure 1: Zebra Crosswalk

Zebra crosswalks are very common these days, and as such any crosswalk detection program should be able to detect and handle them. These crosswalks are identified by the zebra-like pattern seen in Figure 1. In order to navigate these crosswalks, the pedestrian must remain within the lines at all times. A method for detecting these crosswalks was tested in "Detecting and locating crosswalks using a camera phone[1]." The authors proposed a method based on four steps:

1. Extract straight line segments from the image
2. Apply segmentation algorithm to group the detected segments
3. Score the detected segments
4. Use a pre-determined threshold to determine if enough horizontal line segments were in the image

By doing so, they were able to achieve a high percentage accuracy on the recognition of zebra crosswalks with blind users operating the cell phone.

2 Two Stripe Crosswalk Detection

The most common type of crosswalk is the "two stripe crosswalk." These are denoted by two parallel lines marking the boundaries of the crosswalk, as seen in Figure 2. In order to navigate this crosswalk, the pedestrian must stay within the two white lines as they make their way across the street. A method for detecting these is as follows:

1. Read accelerometer in phone to determine orientation of the phone in relation to gravity
2. Determine horizon line
3. Discard data above the horizon line

Figure 2: Two Stripe Crosswalk

4. Use brightness of points to estimate if they are in the crosswalk stripes
5. Draw the crosswalk lines on the image

As with their Zebra results, they were able to obtain steady and consistent and correct predictions through their work[2].

3 Walk Light Detection

Figure 3: Walk Symbol

Detecting the "Walk" light is another feature that would be helpful for the visually impaired pedestrian. If they are unable to see the walk symbol (as seen in Figure 3, there is not an efficient way to know when its safe to walk across the street other than listening to traffic. One such method involves using the phone's accelerometer to find the horizon line, and discardinmg data below that line. They also use other factors to narrow down the search, such as looking for a green traffic light, and looking right below it for the walk light[3].

4 Simple Lane Following Algorithm

As autonomous cars start to become a reality, there are needs for algorithms that can assist them in navigating and staying inside the lines. These algorithms work by detecting the lines that are drawn on the pavement, and instructing the car to stay in the center of these two lines. This is similar to the crosswalk problem, in that you want the user to stay in between the two lines, but different because you don't necessarily want the user to stay in the precise center at all times, the main goal is to keep them inside the crosswalk. One algorithm for lane following is as follows:

1. Convert the image to grayscale

2. Crop to the center portion of the image
3. Identify the edges using an edge detection algorithm, and then draw the edges onto a new image
4. Apply Hough line detection to find shapes in the edges
5. Delete extraneous lines that were detected
6. Reapply the lines that have been found to the main image and draw them on

By following these steps, the image is processed and the lanes are returned, which can then be used to direct the car. We should be able to adapt this successfully to the two stripe crosswalks, and this should assist us in guiding the user through the street[4].

References

[1] V. Ivanchenko, J. Coughlan, and Huiying Shen. Detecting and locating crosswalks using a camera phone. In *Computer Vision and Pattern Recognition Workshops, 2008. CVPRW '08. IEEE Computer Society Conference on*, pages 1 –8, june 2008.

[2] Volodymyr Ivanchenko, James Coughlan, and Huiying Shen. Crosswatch: A camera phone system for orienting visually impaired pedestrians at traffic intersections. In *Proceedings of the 11th international conference on Computers Helping People with Special Needs*, ICCHP '08, pages 1122–1128, Berlin, Heidelberg, 2008. Springer-Verlag.

[3] Volodymyr Ivanchenko, James Coughlan, and Huiying Shen. Real-time walk light detection with a mobile phone. In *Proceedings of the 12th international conference on Computers helping people with special needs*, ICCHP'10, pages 229–234, Berlin, Heidelberg, 2010. Springer-Verlag.

[4] Marco Conti. Vision system - lane detection assignment, June 2009.