SNOW -CANE

Assistive cane for path detection for blind people

VEENA J. KRISHNAN AND SHWETA M. VAVIYA

ADVISOR: PROFESSOR VIKRAM KAPILA

ROBOTS FOR DISABILITIES

Abstract

The mobility aid like assistive white canes specifically designed for assisting visually impaired people. Due to the primitive design, it is unable to make blind and visually impaired a level of independence. Different types of smart canes are available in the market which could help blind people in navigation, path find and obstacle avoidance. But none of them did not focus particularly on one difficult scenario for example path detection in a snow-covered road. In this project, we are trying to achieve a smart cane that can help the blind people to navigate through the snow-covered path. The smart cane called snow-can can help the blind person to detect the snow and path and can guide the person to move on the road. If the road is fully covered with snow, snow-cane can instruct the person to stop and move back.

1. Introduction

Visual impairment is a major global health issue. The World Health Organization (WHO) projected worldwide, the number of people of all ages visually impaired is estimated to be 285 million, of whom 39 million are blind. People 50 years and older are 82% of all blind. The preventable causes are as high as 80% of the total global burden which means around 45 million people depended on other humans for navigation, information dispensation and ecological analysis due to blindness. More than 3.4 million (3%) Americans aged 40 years and older are legally blind. New York itself has 387900 blind and low vision people. Now a day's the society depends upon the social independence, the visually impaired likes to earn independence.

Among the many challenges faced by the visually challenged persons are the constraints of independent mobility. These stem from hazards while walking in an unfamiliar environment, in outdoor navigation. Especially if the weather conditions are bad, the chance of hazards and fall is more. Advances in technology and better awareness in human observation permit the design and enlargement of new influential and high-speed interface assisting human with disabilities. It is observably disabled people also rely on walking canes to navigate in the known and unknown environment. A white cane is often carried by the blind and visually impaired to give more freedom to the individual. The two main functions of the cane are identification and safety; it should alert the user to obstructions and changes in their path and notify the seeing pedestrians and drivers that the user has some degree of vision loss. There are three types of white canes: identification canes, support canes, and long canes. Identification canes are short (reaching only to the user's waist), provide little to no protection, and are more popular with the visually impaired who only want to alert others of their impairment. Support canes have the same purpose as identification canes, except that they provide more support and balance for the legs and body of the user. Long canes, the type of cane chosen to modified into a smart cane, reach the user's sternum and provide the most safety for the user, alerting them of terrain and height changes, walls, doors, and obstacles. They are also the most visible to others.

The white cane, due to its primitive design, is unable to offer the blind and visually impaired a level of independence that is achievable with modern technology. Problem-related to mobility assistance are challenging. We have attempted to address this problem in this project by harnessing recent advancements in embedded system technologies. As the part of our course project, we prototyped a smart assistive cane called snow-cane which can help the visually impaired people to navigate bad weather condition, especially

snowy environment. The snow cane can detect the path in the snow-covered road and instruct the blind person which direction he/she must move.

2.Challenges of visually impaired travel in snow.

Traveling in snow is challenging for everyone, but it can present additional obstacles for those of us who are blind or visually impaired. Most people are not aware, but snow muffles the sounds of things. Someone who is blind or has significant low vision relies on echoes and other sounds to orient themselves to their surroundings, so naturally, snow will make this difficult. Crossing streets can also become challenging, as it can be harder to hear the sound of cars. Dog guide users have other challenges when dealing with ice and snow. While the salt is wonderful for getting rid of the ice, it can hurt a dog's paws. Blind dog guide users won't always know if or where salted spots located, so they must take additional precautions to prevent their four-legged companions from getting their paws hurt. Dog boots can help keep the paws warm and prevent injury from the salt or other sharp objects hidden under the ice and snow.

3.Design and implementation of Snow-cane

3.1. Design of snow-cane

The smart cane is an upgraded version of the white cane. The sophisticated machine vision technology used for detecting path in a snow-covered terrain. PiCamera used for detecting the snow and path. The data from the PiCamera transferred to the raspberry pi for more data processing. The block diagram of the snow cane is shown in figure 1. The main components of the prototype are

1. Raspberry Pi-3
2. PiCamera
3. Whitecane
4. Led
5. Resistors.

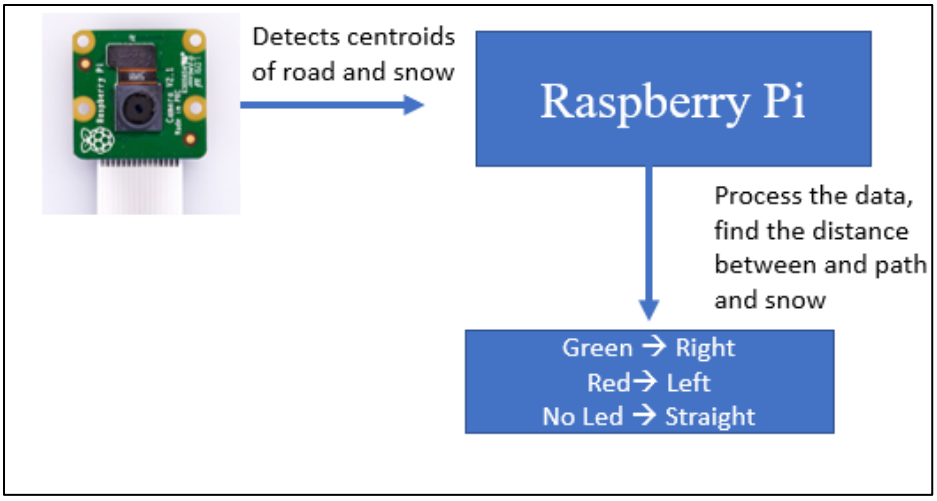

Figure 1

3.2. Image processing using OpenCV-Python

OpenCV-Python is used for processing the image captured by the Pi camera. The frames in real time are processed to extract the centroid of the black and white color. The lower and upper boundaries of the black and white color are defined in the HSV color space. Then series of erosion and dilation can be done for proper noise reduction of the frame. The centroid of the snow and the path can be detected separately. The black and white frames are located by using inRange function in OpenCV. The contour area of the black space has been taken in such a way that the camera could detect only one centroid for the black path. The algorithm cv2.minEnclosingCircle() is used for finding the minimum enclosing circle of the centroid of the path.

3.3. Detection of Left and right snow centroid

Snow centroid was detected in such a way that only two centroids can be detected for left centroid and the right centroid of the snow. Then all the three centroids are sorted in the order of centroid of the left snow, the centroid of black path and centroid of the right snow.

3.4. Shortest distance between the centroids

Then shorted distance between all three coordinates have taken and compare them. Based on the output of the comparison light-emitting diodes can give the output to the user which direction to move.

3.5. Prototype implementation

The environment of the prototype was looked like figure 2

Snow-cane

Figure 2

We tested different condition that can probably happen in snow weather.

Test condition 1: Road is fully snow covered

In this case, there is no contour of the road can be detected and informed the user to stop and move back.

Test condition 2: Both sides of the road is snow covered

In this case, the algorithm will detect two contours for snow and corresponding centroids. Then all the centroids are sorted, and centroids with least x-value are the centroid nearer to the frame and which is the centroid of the left snow and middle tuple being the centroid of the path and the right tuple is the centroid of the right-side snow. Green LED is used to indicate 'Move left' and Red LED is used to indicate 'Move Right.'

LED is used to indicate 'Move left.'

LED is used to indicate 'Move right'

Figure 3

Snow-cane

Test condition 3: Only one side of the road is snow covered

In this condition, the centroid of the path and only one centroid of the snow has been taken. Then found the shortest distance between the points and based on the comparison of the distance the algorithm could detect the snow is on the right side or the left side.

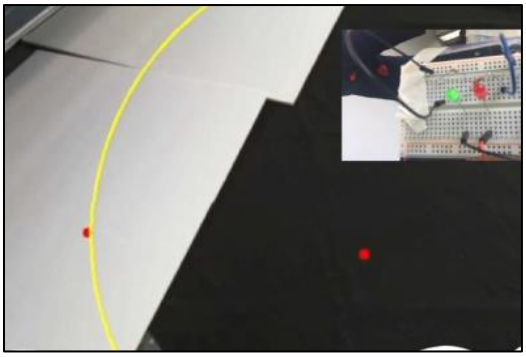

Figure 4

4. Conclusion and Future work

The path detection in the snow was able to achieve by using the prototype. The prototype was tested outdoor conditions also. Snow cane could detect the path in the snow-covered road and would able to instruct the user accordingly.

The prototype has been constructed under time constraints with a limited range of materials. In the future more, components can be added to the prototype to test the different scenario in the snowy weather conditions. Neural network method is one of the best addition in technology side to improve the efficiency of the device since the chance of considering the color changes of the snow due to the pollution. Also, the position of the camera needs to be calibrated in such a way that it can detect centroids of the colors efficiently. Depth sensing sensors are another good option for getting intense of the snow.

5. References

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