PATHFINDER:
Device for Obstacle Detection and Avoidance to Help the Mobility of Visually Impaired People

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ABSTRACT

Pathfinder is a wearable computer vision device that aims to assist in the mobility of the visually impaired. The Shi-Tomasi Algorithm was applied to detect the feature points and these features were the basis for detecting the obstacles along the path. The software was installed on a Raspberry Pi. The input was a live video feed captured by the Raspberry Pi Camera. The device gave directions to the user using the sounds produced by the buzzers attached to the device. The application was tested in terms of the accuracy of the obstacles being detected and it yielded 83% precision and 100% recall. In testing the usability of the device, nine blindfolded users were asked to wear the device while walking through a path with obstacles. They evaluated the device in terms of how quickly they were able to adapt to using it, effectiveness, usefulness, and reliability. Although the users were not able to quickly adapt to using the device in traversing the path, they agreed that the device was somewhat effective in helping them avoid the obstacles. They also agreed that the system was useful and reliable in guiding the visually impaired.

OBJECTIVES

This study aims to create a portable device prototype which will help the navigation of visually impaired people. Specifically, the study aims to:

- To use digital image processing “techniques” for obstacle detection.
- To detect obstacles within 3 meters from the user.
- To notify the user of the obstacle and redirect them to avoid it.

METHODOLOGY

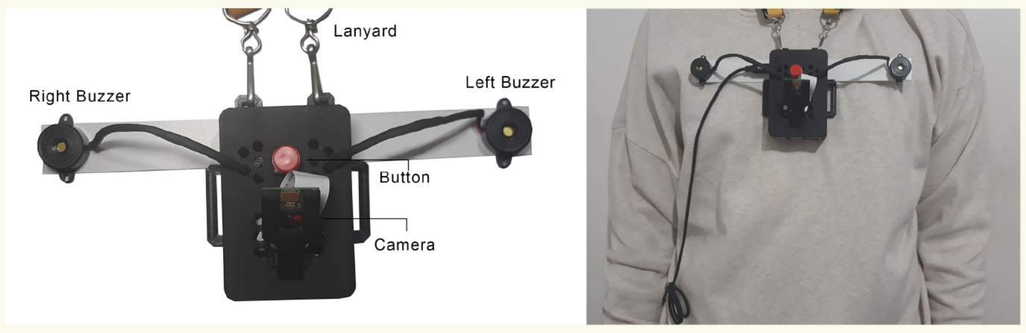

Figure 1. The completed device and the device worn

Instrument Build Specifications
- Raspberry Pi 4 (16GB storage, 4GB RAM)
- Raspian Buster OS
- 5MP Raspberry Pi camera module Rev 1.3
- 12000mAh powerbank / DC 5V 2.1A output
- Peizoelectric Buzzers
- 3D Printed Housing

Output View
1. Grayscale
2. Gaussian Blur
3. Shi-Tomasi
4. Overlay Search Space

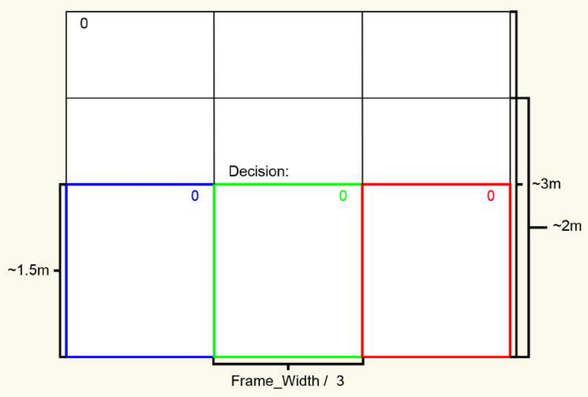

Figure 2. The search space

Figure 3. Outputs per methodological step

End-user Testing
- Users take 3 tests by walking along a path filled with obstacles
- Test 1: Blindfold only
- Test 2: Blindfold and cane
- Test 3: Blindfold and device
- Users answer a survey

RESULTS

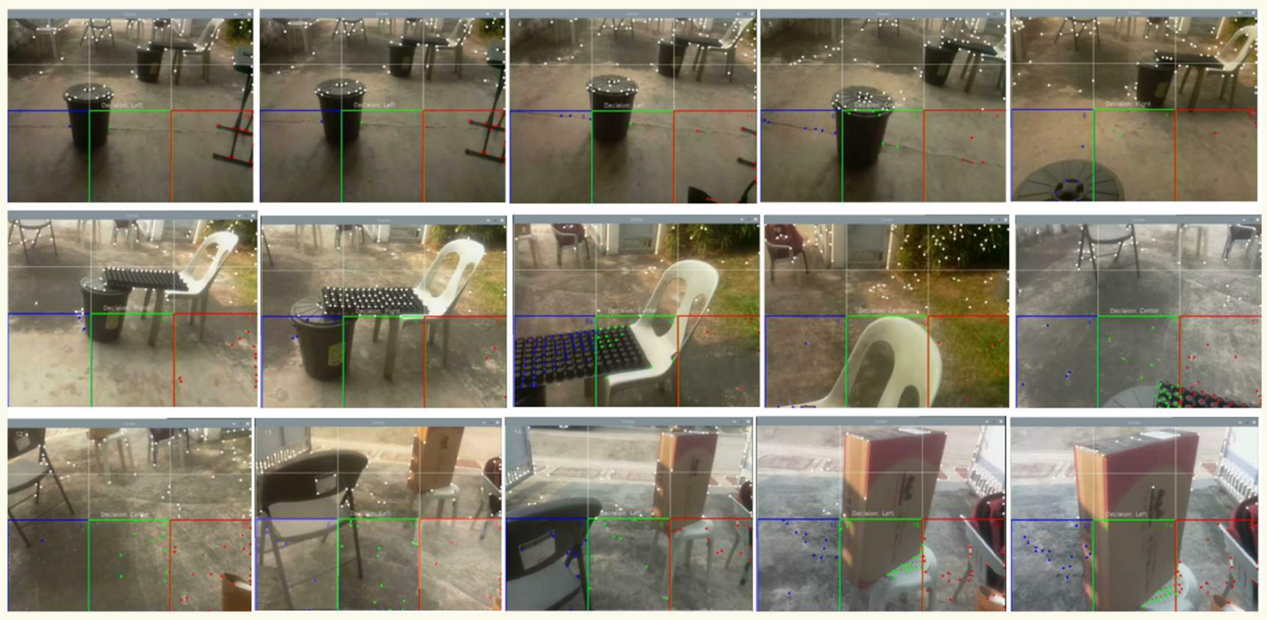

Figure 4. Series of frames showing the tracking of feature points

- The device has an average precision of 83%.
- The device has an average recall of 100%.
- Post-trial surveys showed that users deemed the device sucessful.
- The cane is the most efffective followed by the device.

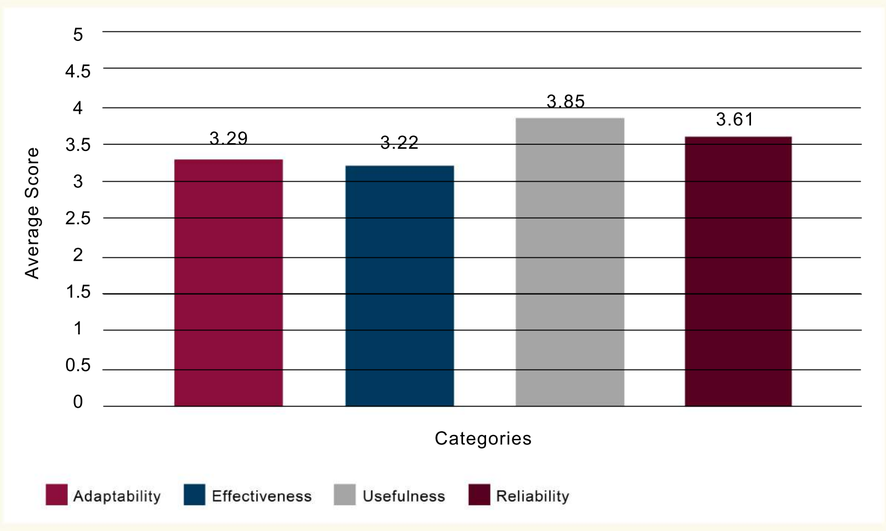

Figure 5. Average score per category for survey results for system use

CONCLUSION

- General approval on the sucess of the device.
- 1.22 Average Mistakes made with the device following the 0.22 average mistakes with the cane.
- The study shows that although the cane was more effective, the device was not far off from becoming an option for obstacle detection for the visually impaired.

ABOUT THE AUTHOR

Moshe F. Nacu is an undergraduate BS Computer Science Student at the University of the Philippines Los Baños. He is the eldest son of Alvin F. Nacu and Ma. Olympha A. Nacu. He is a proud member of the UPLB Computer Science Society, the UP Alliance of Gamers, and the UPLB Gabay Volunteer Corps.