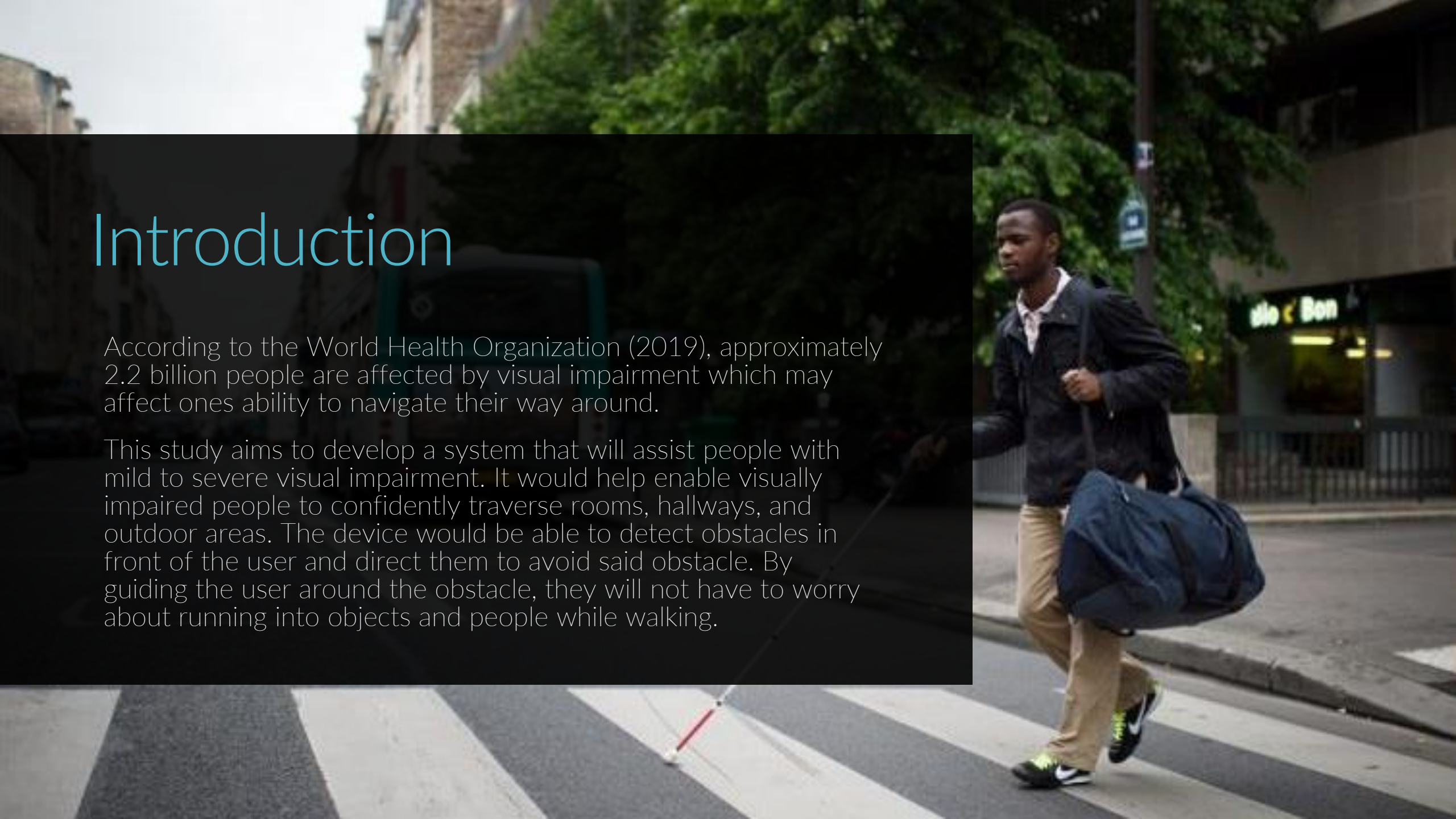
PATHFINDER

Device for Obstacle Detection and Avoidance to Help The Mobility of Visually Impaired People

Introduction

According to the World Health Organization (2019), approximately 2.2 billion people are affected by visual impairment which may affect ones ability to navigate their way around.

This study aims to develop a system that will assist people with mild to severe visual impairment. It would help enable visually impaired people to confidently traverse rooms, hallways, and outdoor areas. The device would be able to detect obstacles in front of the user and direct them to avoid said obstacle. By guiding the user around the obstacle, they will not have to worry about running into objects and people while walking.



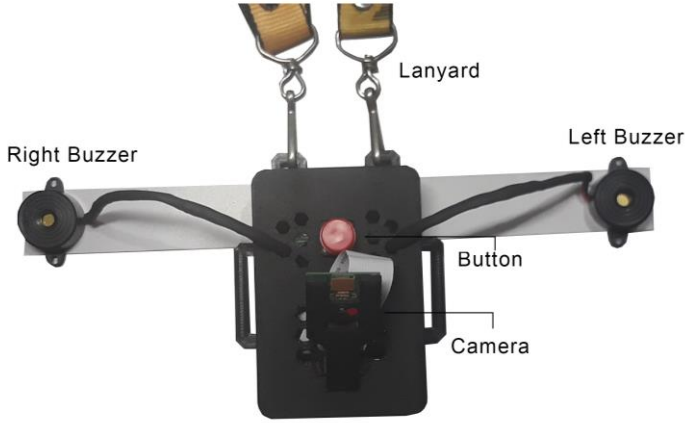
Objectives

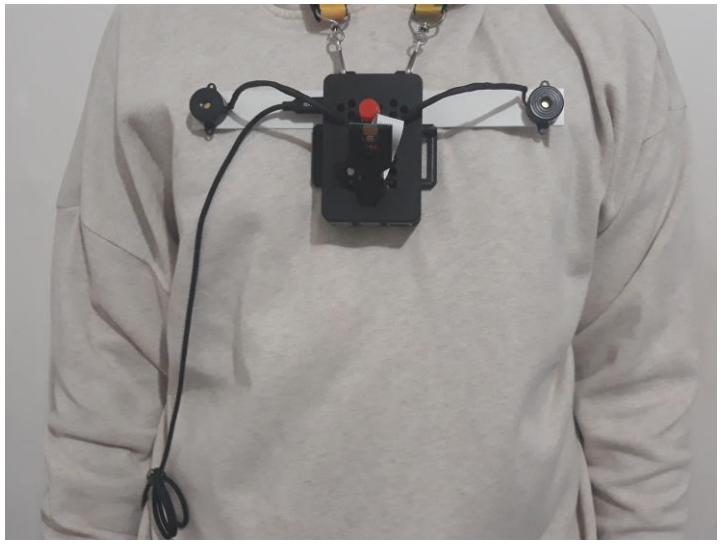
This study aims to create a portable device prototype which will help the navigation of visually impaired people

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





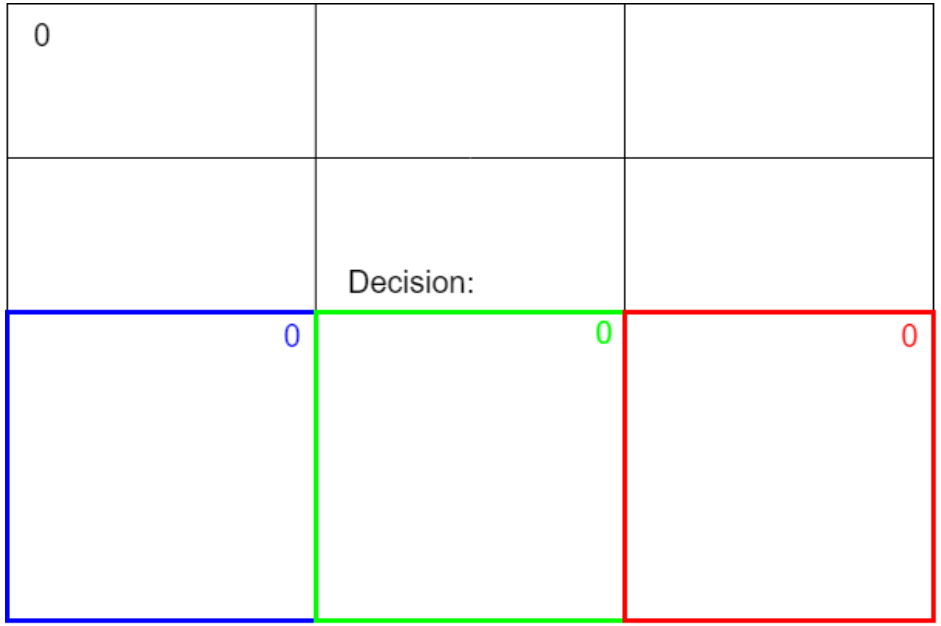
Methodology

Instrument Build Specifications

Components

- 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

3D Printed Housing



Methodology
Obstacle Detection

Edge Detection
- Shi-Tomasi Algorithm

Pre-processing
- Grayscale
- Gaussian blur

Questions for Blindfold Only	
1	It is easy for me to navigate through the path.
2	It is easy for me to adjust to walking blindly.
3	Given that I am blindfolded, I need a guide in order for me to easily navigate through the path.

Questions for Blindfold with cane/stick	
1	It is easy for me to navigate through the path with a cane.
2	Navigating through the path is easier with a cane than without a cane.
3	It is easy for me to detect the obstacles along the path.
4	The cane is useful in finding the obstacles along the path.
5	I can rely on the cane in finding the obstacles along the path.

Results and Discussion

Sets of questions for the survey

Questions for System use	
1	It is easy for me to use the system.
2	Navigating through the path is easier when using the system than just navigating without any tool or assistance.
3	Navigating through the path is easier when using the system than using the cane.
4	Navigating through the path is easier when using the system and the cane at the same time.
5	The directions given by the system are helpful in successfully navigating through the path.
6	The directions for navigating are given by the system in a timely manner.
7	It is easy for me to understand the directions given by the system.
8	I am able to follow the directions given to me by the system when navigating through the path.
9	The directions given by the system were reliable.
10	The system is useful in navigating through the path.
11	The system is able to properly detect the obstacles along the path.
12	The system works properly without any errors encountered.
13	The system works but with minimal errors encountered.
14	The system works but there are a lot of errors encountered.
15	The system does not work at all.

Questions	User									Mean
	1	2	3	4	5	6	7	8	9	
1	2	2	4	4	1	3	2	2	1	2.33
2	2	3	5	4	1	3	4	3	1	2.89
3	5	3	4	5	5	5	4	4	5	4.44

Questions	User									Mean
	1	2	3	4	5	6	7	8	9	
1	4	2	4	4	3	5	5	5	4	4
2	5	4	5	4	4	5	5	5	5	4.67
3	4	3	4	3	4	5	5	5	5	4.22
4	5	3	4	5	4	5	5	5	5	4.56
5	4	3	5	3	4	5	5	5	5	4.33

Questions	User									Mean
	1	2	3	4	5	6	7	8	9	
1	3	4	3	3	4	5	2	2	3	3.22
2	3	3	4	5	3	5	2	2	4	3.44
3	2	4	3	4	3	3	2	2	2	2.78
4	3	3	2	3	5	5	4	4	2	3.44
5	3	4	4	3	5	5	4	4	4	4
6	3	4	4	4	5	3	3	4	4	3.78
7	3	4	2	2	4	4	4	3	3	3.22
8	3	4	3	3	4	5	2	3	4	3.44
9	4	3	3	4	4	4	3	4	4	3.67
10	4	4	4	4	4	4	4	4	4	4
11	4	4	4	4	4	4	2	4	4	3.78
12	3	3	3	4	2	3	2	3	4	3
13	4	4	4	4	2	3	4	2	2	3.22
14	2	4	4	5	3	3	4	4	4	3.67
15	3	4	5	5	5	4	5	5	5	4.56

Results and Discussion

Users' Response

Results and Discussion

Time and Mistakes

Test No.	User									Mean
	1	2	3	4	5	6	7	8	9	
1	20.29	20.08	16.31	17.04	31.88	36.64	43.55	22.62	38.00	27.38
2	28.24	17.21	18.07	17.02	22.90	20.91	36.64	24.22	32.62	24.2
3	36.92	16.95	19.70	18.37	29.33	41.23	40.65	23.00	39.70	29.54

Test No.	User									Mean	Mode
	1	2	3	4	5	6	7	8	9		
1	6	3	2	2	4	3	3	2	6	3.44	2, 3
2	2	0	0	0	0	0	0	0	0	0.22	0
3	2	0	0	0	2	2	2	2	1	1.22	2

Conclusion and Recommendations

4.56

Average Rating on production of a successful device.

1.22

Average Mistakes made with the device following the 0.22 average mistakes with the cane.

Hardware

Gymbal system

Buzzers

Software

Distance Covered instead of time

Wall Detection