2021 43rd Annual International Conference of the
IEEE Engineering in Medicine & Biology Society (EMBC)
Oct 31 - Nov 4, 2021. Virtual Conference

Obstacle Detection and Feedback Device for Omnidirectional Electric Wheelchair

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***Abstract*—The omnidirectional electric wheelchair was developed to support self-mobility of the elderly or disabled people. This wheelchair has the risk to collide obstacles due to its omnidirectional movement. The omnidirectional electric wheelchair should detect obstacles before collision. Thus, the aim of this study is to develop the obstacle detection and feedback device for omnidirectional electric wheelchair. The proposed device detects obstacles by infrared sensors. Furthermore, the proposed device informs a rider of the approach of obstacles by vibration motors. In this study, the suitable combination of placement of vibration motors and thresholds of obstacle detection were investigated via driving tests. The results showed that vibration motors should be placed both a joystick and armrests. In addition, the suitable threshold for obstacle detection was 300 (mm). These results provide suitable setup of obstacle detection and feedback device.**

***Clinical Relevance*— This study can provide obstacle detection and feedback device for safety of the omnidirectional electric wheelchair.**

I. INTRODUCTION

The omnidirectional electric wheelchair was developed to support self-mobility of the elderly or disabled people [1]. This wheelchair has the risk to collide obstacles due to its omnidirectional movement. The omnidirectional electric wheelchair should detect obstacles before collision. Previous studies developed collision detection devices for the omnidirectional electric wheelchair [2]. Our previous study developed collision detection devices using bumpers, potentiometers, and tension spring dampers [2]. However, these devices cannot detect obstacles before collision [2]. Thus, the aim of this study is to develop obstacle detection and feedback device using infrared sensors and vibration motors. In addition, this study investigates suitable setup for the proposed device.

II. METHODS

The proposed device consists of 1 master controller, 4 infrared sensors, and 4 vibration motors (Figure 1). The controller obtains distance from obstacles by infrared sensors. When distance from obstacles is shorter than the threshold, the controller informs a rider of obstacles via vibration motors.

The suitable combination of placement of vibration motors and thresholds of obstacle detection were investigated via driving tests. There were two placements of vibration motors and two thresholds (300 (mm) and 500 (mm)) for obstacle detection. Note that at least two vibration motors were placed on joystick. Three participants drove the omnidirectional electric wheelchair with the proposed device in the test course including straight, curve, backing up, and obstacles. The participants drove 4 trials with different combination of thresholds and motor placements. Number of collisions and total time for each trial were evaluated.

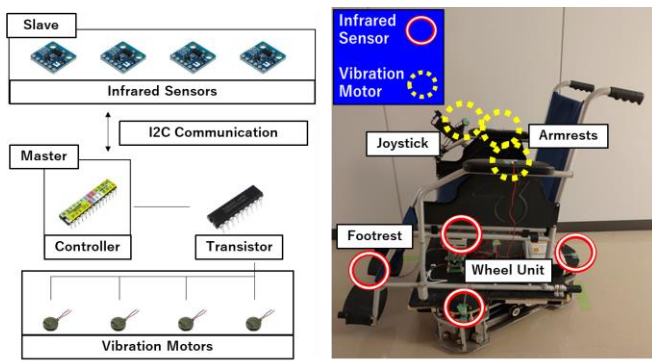

Figure 1. Obstacle detection and feedback device.

III. RESULTS & DISCUSSION

The results showed that vibration motors placed both a joystick and armrests with 300 (mm) threshold for obstacle detection provided the greatest performance (Table I). These results indicate that vibration motors should be placed both a joystick and armrests. In addition, the suitable threshold for obstacle detection was 300 (mm).

TABLE I. RESUTS OF DRIVING TEST

Setup for Proposed Device			Performance (mean)	
Thresholds for Detection (mm)	*Number of Motors*		*Number of collisions*	*Time (sec)*
	Joystick	*Armrests*		
300	4	0	2	65.43
	2	2	**1**	**58.62**
500	4	0	3	65.88
	2	2	2	70.37

IV. CONCLUSION

This study proposed the obstacle detection and feedback device for the omnidirectional electric wheelchair. Furthermore, suitable setup for the proposed device was investigated via experiment.

REFERENCES

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