The Design and Construction of Surrounding Control System for The Rehabilitative Walker Using Mecanum Wheel

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***Abstract*— Nowadays, the number of stroke and elder citizens are growing up which make these patients have difficulty in walking and living. Stroke patients have the weakness of the leg muscles and postural impairment resulted in the loss of ability to walk. For the elderly, the functions of various body systems are decline and cause defects of the skeletal system and the muscles, loss of ability to walk, together with the issue osteoarthritis was found. From these problems, they can be restored the ability to walk by using the walker.**

At present, the technology of the walker in Thailand driven by the use of normal wheels is mainly based on two of the rotation movements. These normal wheels make the walker cannot move to any direction which the patient wants and contain the inability in turns.

The project team members aware of this problem and we strongly believe that we can be a part to help these patients have a better quality of life. So, we propose the design and construct of surrounding control system for the rehabilitative walker using the mecanum wheel that will restore the patients to practice walking.

***Keywords*— walker, mecanum wheel, intelligent robotic walker**

I. INTRODUCTION

Nowadays, the number of stroke and elder citizens are growing up which make these patients have difficulty in walking and living. Stroke patients have the weakness of the leg muscles and postural impairment resulted in the loss of ability to walk. For the elderly, the functions of various body systems are decline and cause defects of the skeletal system and the muscles, loss of ability to walk, together with the issue osteoarthritis was found. From these problems, they can be restored the ability to walk by using the walker.

At present, the technology of the walker in Thailand driven by the use of normal wheels which has two of the rotation movements. These normal wheels make the walker cannot move to any direction which the patient wants and contain the inability in turns.

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In the research, a researcher design in dynamic model and control on an intelligent robotic walker [1] developed a motion control algorithm for robotic walker and use mecanum wheel for movement. In addition, Walk-Assist robot [2] proposed control robot assisted walking and moving in steep areas by setting line walking in the area and advising the user to walk to the target effectively. Passive intelligent walker [3] uses servo brakes to adjust tester walking in line.

Objectives of the project are the rehabilitative walker has freedom movements, the robot can move instead of lifting and has two operating modes; automatic mode and manual mode.

II. THE REHABILITATIVE WALKER

A. The mechanic design

The most important feature of the walker is the use of mecanum wheels. The structure of the robot walker is shown in Fig. 1. An arrangement of four mecanum wheels at the bottom of the walker body enables the walker to move in any direction while maintaining its orientation. The mecanum wheel has three degrees of freedom in movement; Firstly, the direction along the orientation wheel, secondly, the rotation of rollers stuck around the wheels in the theoretical angle of rollers can do to whatever angle, and lastly, the rotation at a point of contact between the roller and the ground. Driving the wheels using a DC motor by 4 sets.

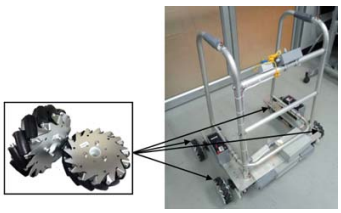


Fig. 1, Robotic walker

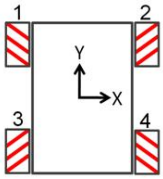
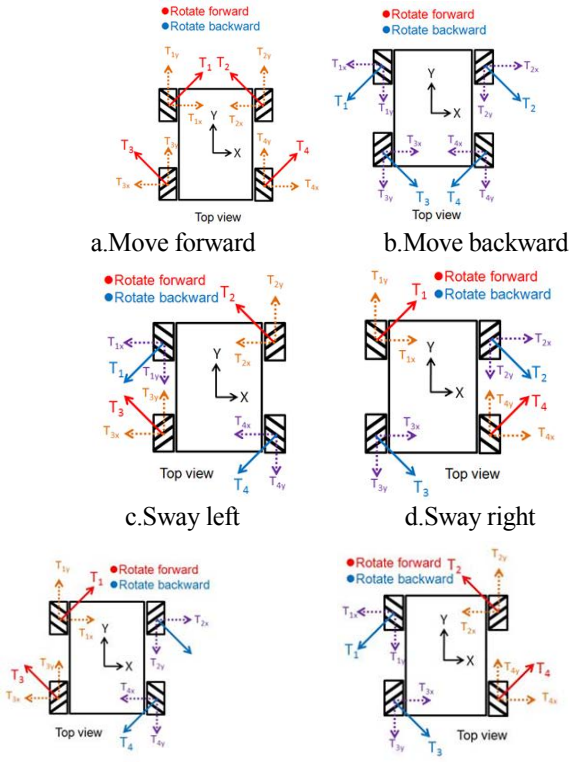


Fig. 2, Arrangement of mecanum wheels in a vehicle

Figure 2, shows the infrastructure of robotic walker consistory of wheels on all four wheels and the movement of the wheels driven by the torque of the four wheels (T_1, T_2, T_3, T_4). By moving forward or moving backward, it will depend on force distribution shows in figure 3 (a) and (b). The movements of the walker to the left and right are shown in figure 3 (c) and (d). The movements of clockwise and counter clockwise are shown in figure 3 (e) and (f).



a.Move forward b.Move backward

c.Sway left d.Sway right

e.Spin clockwise f.Spin counter clockwise

Fig. 3, Direction of the friction forces

B. The embedded system designs

The embedded system used microcontroller dsPIC24HJ256GP210 is shown in figure 4 with C-language program.

Fig. 4, PIC24HJ256GP210

C. The controlled design

Figure 5, show the control part consists of a display, adjusting speed, adjusting distance, adjusting brightness and the controlled switch.

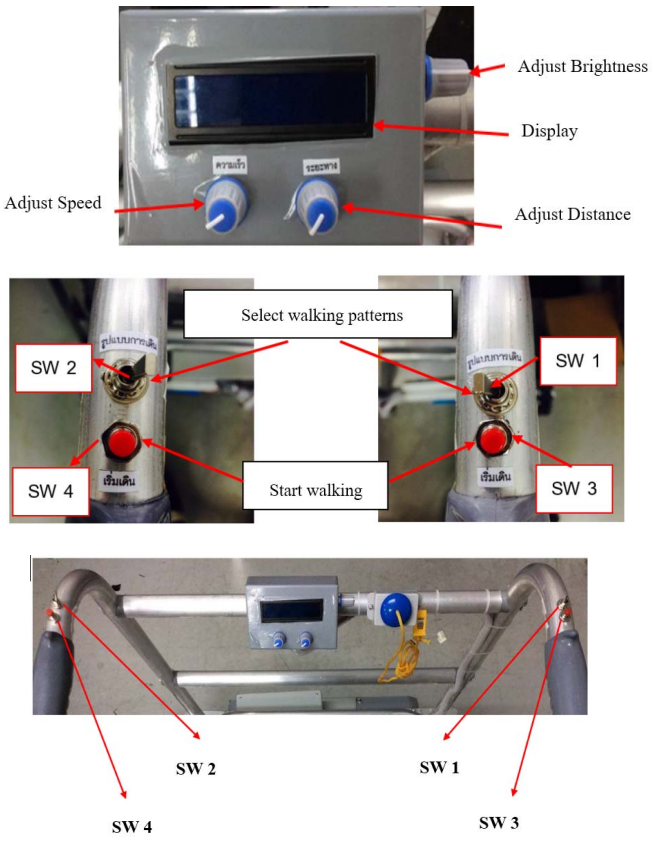


Fig. 5, The control part

D. The display designs

The display part comprising of liquid crystal display to showing the speed, distance, and training program for walking are shown in figure 6.

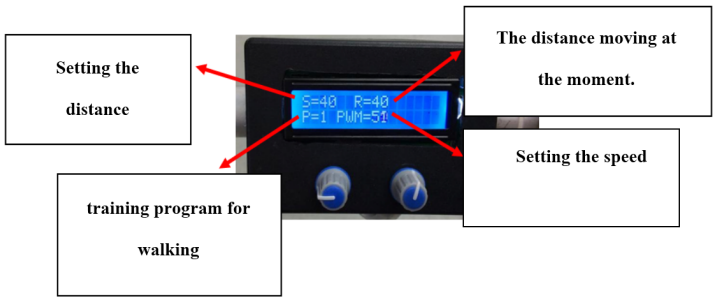


Fig. 6, The display part

E. The safety designs

The safety part composed of a reed switch by the rehabilitative walker. It stops moving immediately when the user falls. Infrared sensors are the detection step to prevent the movement of the walker device while the user is not ready to walk as shown in figure 7.

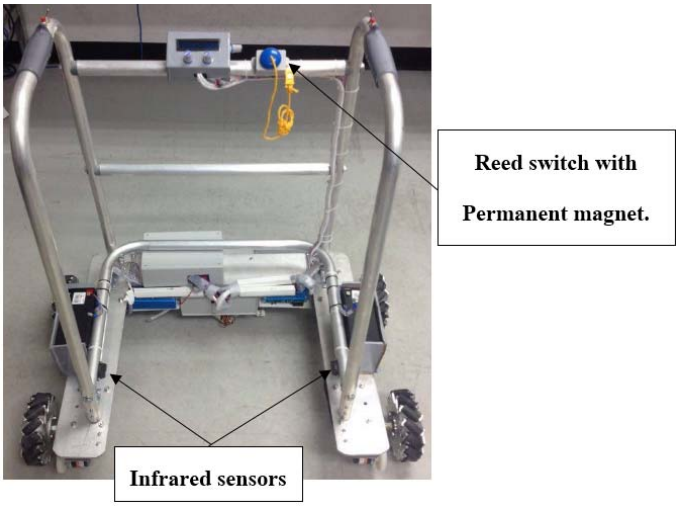


Fig. 7, The safety part

III. EXPERIMENTAL RESULTS

The Figs. 8-13 show the movement performance on the motion of four wheels at the distance forty centimeters, where W_1, W_2, W_3 and W_4 show the motion of the right front wheel, right rear wheel, left front wheel, left rear wheel, forward, backward, spin counter clockwise, spin clockwise, sway left and sway right, respectively.

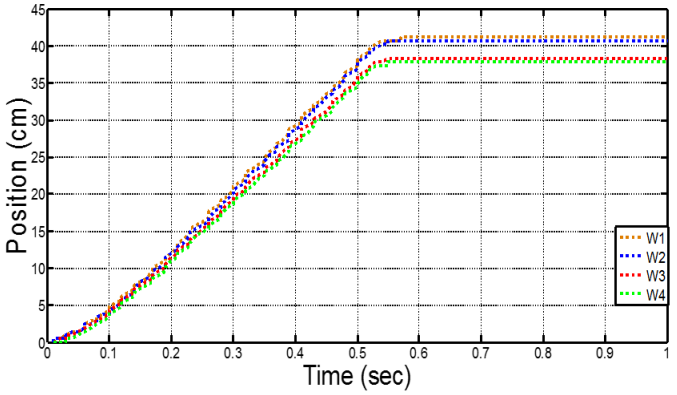


Fig. 8, The performance testing results on moving forward.

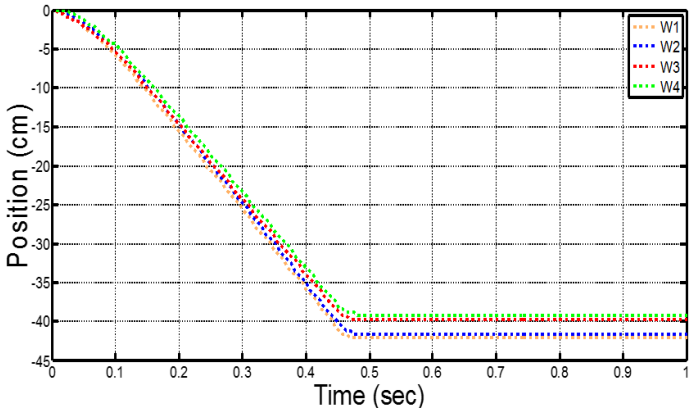


Fig. 9, The performance testing results on moving backward.

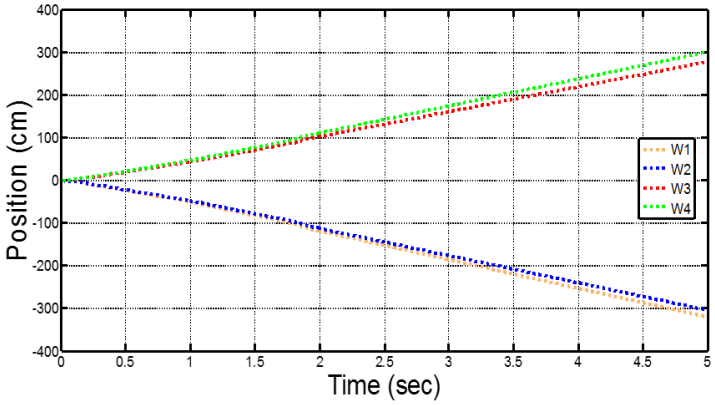


Fig. 10, The performance testing results on moving spin counter clockwise.

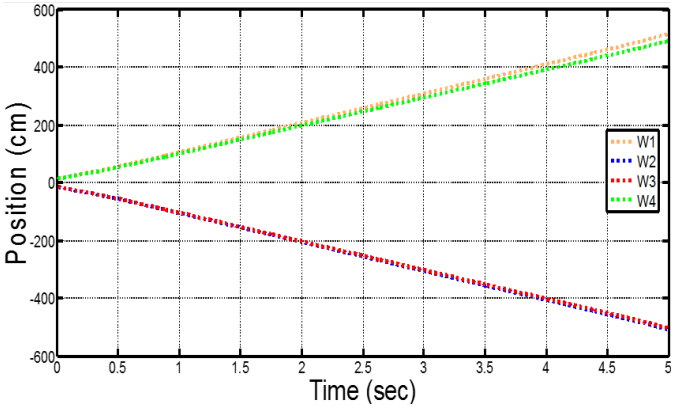


Fig. 11, The performance testing results on moving spin clockwise.

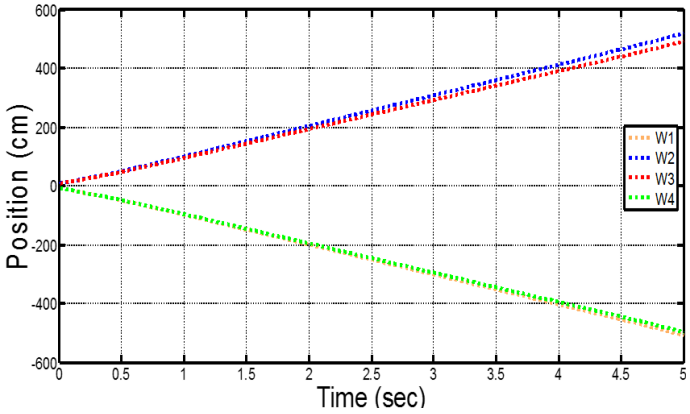


Fig. 12, The performance testing results on moving sway left.

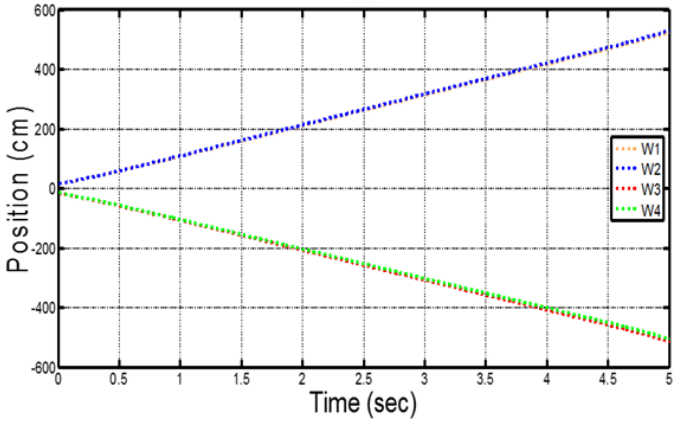


Fig. 13, The performance testing results on moving sway right.

IV. CONCLUSION

This research shows the design and construction of surrounding control system for the rehabilitative walker using mecanum wheel. The rehabilitative walker has freedom of movements, forward, backward, spin clockwise, spin counter clockwise, sway left and sway right. It can move instead of lifting. It has two operating modes which are automatically mode and manual mode. In addition, it can adjust the speed of the step and the distance, stop moving immediately when the user is falling and can detect step to prevent the walker device move while the user is not ready to walk. The accuracy of the security system when a user is falling is 100% safe and the detection step to prevent the walker device move while the user is not ready to walk is 100% safe as well.

ACKNOWLEDGMENT

Acknowledgments This work was supported by Research Institute of Rangsit University.

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