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DEVELOPMENT OF WALKING ASSIST SYSTEM WITH PNEUMATIC ACTUATOR

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ABSTRACT

The purpose of our study is to develop "Walking Assisting System" that assists the aged and alternative people to walk by themselves, and that can be used as a welfare system to take care of them. Since this system moves by compressed air, no harmful substances are used, and it can apply power as flexibly as human muscles do. Additionally, even in any unexpected situations, the shock and burden to the person using the system are kept to the minimum.
This system not only supports walking on level ground but also assists the movement of the knee joint in walking up and down the stairs, by sensing and acknowledging the walking place of the user and sending compressed air into the pneumatic cylinder at the appropriate timing. In this study, we have installed the acceleration sensors instead of previous inclination sensors, and collected walking data from a wide variety of people with different body sizes and walking speed. Then, we have pursued a control system which can distinguish and assist steady walking in any condition, by generalizing the unique personal factors of various people and determining the discrimination conditions for each of them.

KEY WORDS

Walking Assist System, Air Cylinder, Welfare Care

INTRODUCTION

Today, the aging society is gaining importance in Japan, and one of its reasons, the falling birthrate is also a serious issue. If no changes are made to the current assisting system, the aged or alternative people will not be able to receive sufficient care, therefore being prevented from taking part in society. Thus, in this study, we have made research and development of a walking assisting equipment for those having difficulty in walking by themselves including the aged or alternative people, and have developed a new type of equipment as well.

THE SYSTEM

An outline of walking assist system is shown in Figure 1.This walking assisting system measures the floor reaction force by a pressure-sensitive sensor attached on the sole part, and then amplifies the signal through a sensor amplifier. At the same time, the walking condition of the experiment subject is figured out by measuring the femoral angle with angle sensors and importing the A/D converted data into a H8 micro-computer.

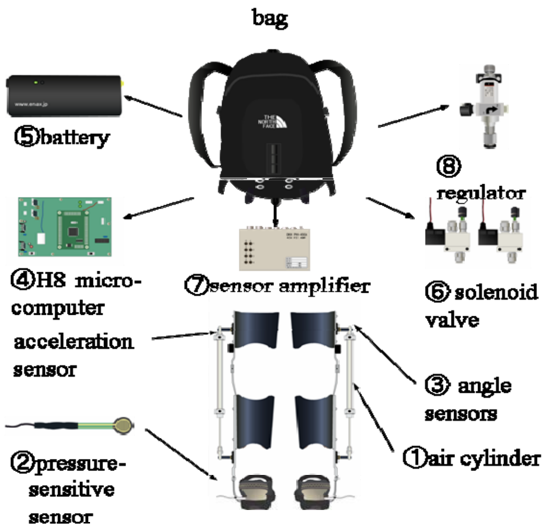

Figure 1 Walking assist system

Then the assist commands are output to the solenoid valve as digital signals. Then the solenoid valve opens, and supplies compressed air. The cylinders are actuated by this compressed air, and start to assist walking. This system had a problem to be improved, that is, the equipment could not be surely fastened to the human leg. This caused inability of grasping the correct walking condition because the measurement accuracies of the sensors are decreased by the equipment's slipping-off phenomenon. Moreover, it became a burden rather than help for the user because it could directly touch the heel or ankle, causing discomfort. We improved this problem by combining the femoral, calf and ankle part all together with shoes, and have succeeded in lessening the user's discomfort and heightening the judgment accuracy of walking condition with this specialized equipment made for the system.

Furthermore, the problem of the inclination sensor still remains. The sensor has liquid as a working medium in it, and the detecting error is seen sometimes caused by liquid waving. So we change the angle sensors into acceleration sensors. The merit to use of acceleration sensor is not only the minimizing size and weight, but also becoming the signal clearly in the change of walking conditions, shown as Figure 2 and Figure 3. As a result, the recognizing of walking condition becomes more correctly, as shown Figure 4.

CONCLUSION

Although we have succeeded in making the current system more useful by this improvement, we still have restrictive conditions such as reduction of the equipment weight and the inability of acknowledging over all specific walking habits of each individual. We seek to develop a more generalized system by verifying use of acceleration sensors more usefully, and evaluating the user's load using muscle electric potential.

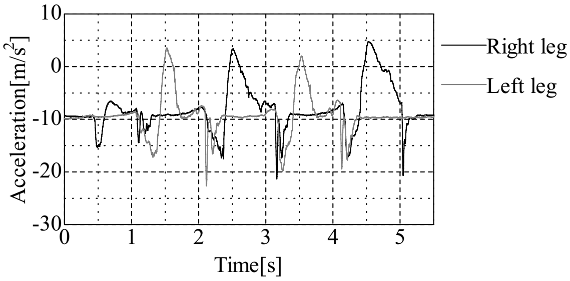

Figure 2 Dynamic wave form change of acceleration

(Flat)

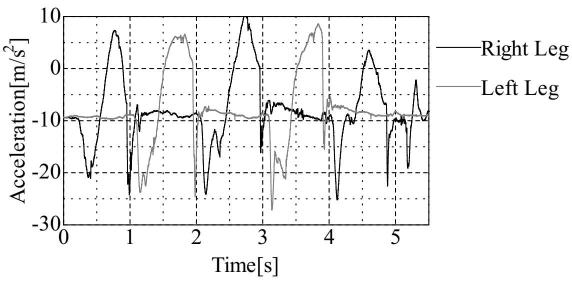

Figure 3 Dynamic wave form change of acceleration

(Up stairs)

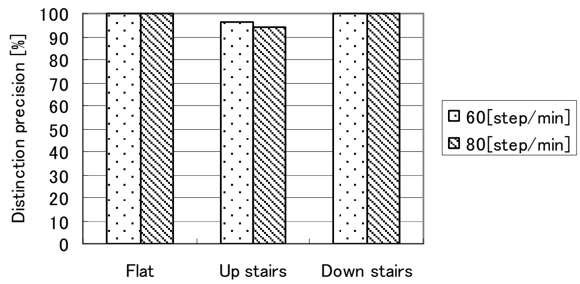

Figure 4 Distinction precision

(new model)