A Study on the fall prevention device in walking for the elderly people

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1. Introduction

In recent years, the aging in Japan is advancing quickly. So it is very important that elderly people do not become bedridden, but become independent in order to ease the problem which maintains the quality of elderly people's life and to ease the problem which it makes medical expenses increase. A major cause of bedridden is a fracture at the time of fall. From the study of the biped robot, falls have been found to be related to the movement of the leg and of the center of gravity[1][2], but mechanisms of falls in the elderly people is still unknown. So, in this paper we consider the mechanism of the fall of young people quantitatively from a motion of a waist and a knee part and assume the walking elderly people. We think it is useful for the apparatus that can prevent falling in the future.

2. Experiment

2.1 Outline

In this research, it is assumed a fall occurs under the following conditions.
・Elderly people who can walk happen to.
・Fall by the failure.
Since a fall experiment is accompanied danger, it is conducted by young people.

2.2 Experimental Parameter

Movements of the waist, the knee and a center-of-gravity were measured with a magnetic position sensor and a force plate which was consist of four load cells and a plate on them. The measurement items were time-series data of force and its position on the force plate. Their speeds and accelerations were calculated using that data.
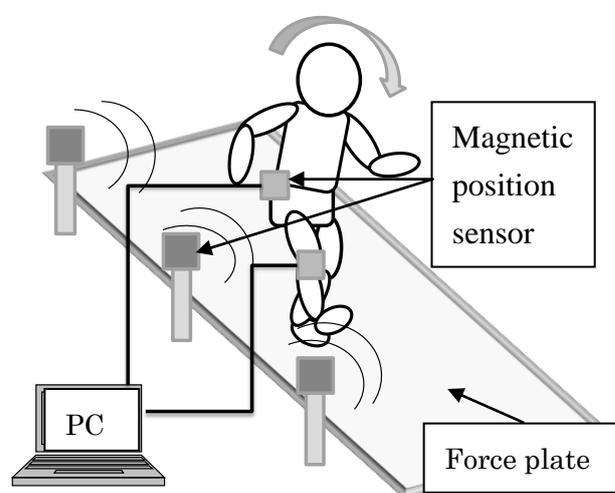 (Fig.1)

Fig.1 Experimental apparatus

2.3 Exploratory Experiment

In order to examine how to cause a fall arbitrarily, we did the preliminary experiment with two subjects. We got subjects to do a three meters walk, and when the subject reached a point decided, we made them fall down by fixing their feet. We concerned about the condition; how to fix their feet.

We tried four fixing patterns;
(a)Tiptoe-Get-off   (Fig.2,4),
(b)Ankle-Get-off   (Fig.2,5),
(c)Tiptoe-Max-speed   (Fig.3,4),
(d)Ankle-Max-speed   (Fig.3,5).

 "Get-off" and "Max-speed" points out the time when a subject begins to fall down. "Get-off" is the time when a foot has got off

to the floor, and "Max-speed" points out the time when foot speed was the maximum in a walk. (Fig.2) And "Tiptoe" and "Ankle" points out the subject's part fixed. (Fig.3)
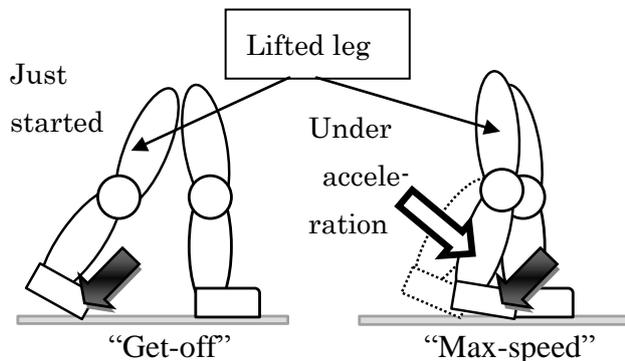

"Get-off"   "Max-speed"
Fig.2 Falling time(1)   Fig.3 Falling time(2)

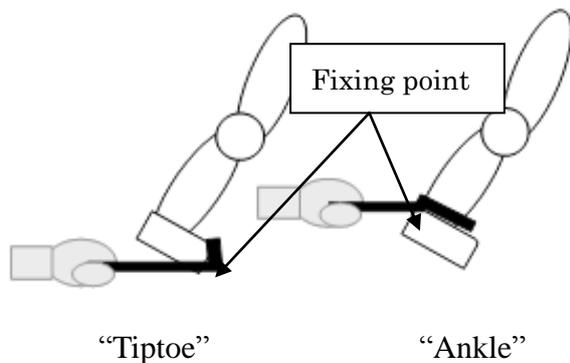"Tiptoe"   "Ankle"
Fig.4 Fixing point(1)   fig.5 Fixing point(2)

As a result, pattern (a), (b), and (c) were not successful. In case of pattern (a) and (b), we consider that subjects were so stable because they could support their weight at the ground. And in case of pattern (c), even if tiptoe in fixed, they were also stable become they can rotate their ankles.

2.4 Like Elderly Walking

And if young people walk like elderly people, for example, they need try short steps or walk with leg dragging, but they could so stably walk. So, in this experiment, we ask young people to walk naturally at smaller steps than usual.

2.5 The Range of fall down

In order to determine the position of sensor, we measured subject's steps when their fell down. The step was between 700mm from 900mm. So, we decided the range of the length of measurement in two meters; one meter walking and one meter falling.

3. View of the research

We will compare movement toward a walk with movement toward a fall, and consider the mechanism of a fall. We must be careful of there being individual difference toward a walk. And we also consider about the difference between youth walk and elderly walk. We understand the feature of the elderly people's walk using elderly people's walk data, and find out common feature with a youth result.

4. Conclusion

It is as follows that we understood until now.
(1) The optimal method for causing the fall of young people was fixing the ankle of a front start leg.
(2) Elderly people's walking method is very stable, even if youth people walk like elderly people, they cannot fall down.
(3) The step ahead taken out at the time of a fall was between 700mm from 900mm.
(4) It is important to find a common feature, considering the individual difference of a walk, and the difference between elderly people and youth.

Reference

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