AN INFORMATION PRESENTATION SYSTEM FOR WOBBLING ELDERLY PEOPLE AND THOSE AROUND THEM IN WALKING SPACES

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ABSTRACT

Before the Tokyo Olympic Games and the Paralympic Games, support for people who have weak locomotors became an urgent issue. It is seen that people who have weak locomotors that encompasses the disabled, pregnant women as well as elderlies find themselves facing difficulty in walking using the pedestrian walking space. Since the walking space is used by both categories of people; the healthy locomotors and the weak locomotors; it is seen that the second category of people experience stress using the same space. Therefore, in order to reduce the stress that is related to walking; smartphones offer as an effective device to present information to both healthy and weak pedestrians. There is a high possibility that most pedestrians own smartphones. It is also considered to be an easier option to present information to both healthy and weak walkers. Based on the above discussion, it is believed that an information presentation system using a smartphone would be the most appropriate solution for reducing the stress of both categories of people in walking spaces. In this paper, a system to achieve this aim is proposed.

Keywords: *universal design, pedestrian guide, locomotor, elderly people.*

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1. INTRODUCTION

Before the Tokyo Olympic Games and the Paralympic Games, support for weak locomotors has become an urgent issue. It is seen that people who have weak locomotors that encompasses the disabled, pregnant women as well as elderlies find themselves facing difficulty in walking using the pedestrian walking space. There are several scenarios in which such people have indicated that they struggle with their daily lives due to the lack of consideration by healthy individuals. This problem is believed to be due to the fact that the environment of the walking spaces makes weak people feel extremely stressed every time they use the space. Healthy people are also expected to pay close attention daily to avoid potential risks that could occur whenever they walk in the same space with weak people. In other words, it is believed that both healthy people and walkers with weak or different physical abilities experience stress when moving in the same walking spaces. As the Tokyo Olympic Games and the Paralympic Games draw closer, it seems that this issue is being treated as a more serious problem.

Regarding the support for people with weak locomotors, although there are several researches conducted, it seems that these problems are not dealt with in its essence. For example, with regards to the research theme of the Tokyo Olympic Games, there are several related studies on technology development for a barrier-free or universal design for pedestrians other than healthy people and foreigners visiting Japan and for pedestrian guidance or human flow guidance to combat congestion [literatures 1 and 2]. In these studies, the flow of people that is provided with an evacuation guidance, or conduct leads [literatures ○ ~ □] were stimulated. The common aim of these technical studies is to capture people as one equal molecule. In reality, however, people have individual differences. Hence, it is not always effective to apply the same approach to everyone. It is necessary to consider the differences of personality and the individual features of each person, such as their attributes as well as their physiological state.

Smartphones are seen as an effective device to present information to both healthy and weak pedestrians, while taking into consideration their individual characteristics, attributes and physiological state in order to reduce the stress related to walking. There is a high possibility that most pedestrians own smartphones. It is also considered to be an easier option to present information to both healthy and weak walkers. It is hoped that the study is able to develop an application that is able to provide necessary information with the aim of mitigating stress and creating a state in which both healthy and weak walkers are able to travel in the same walking space by installing and using the application on their smartphones. In the case of smartphones, it is necessary to register individual features like presence or absence of failure, fast or slow walking, ease or difficulty in walking as well as attributes like user's age and sex. It is possible to assess the physiological state of users by measuring their heart rate and blood pressure by linking the application with a wearable health tracking device.

Based on the above discussion, it is believed that an information presentation system using a smartphone would be the most appropriate solution for reducing the stress of both healthy and

weak walkers in walking spaces. In this paper, a system to achieve this aim is proposed. The concept is outlined in order to gauge and present the information to reduce the stress of vulnerable walkers as well as that of the healthy pedestrians around them. The information is presented using smartphones. Then, an outline of the system is described in detail. Section 2 describes several related researches to the subject matter. Section 3 reports the results of the questionnaire conducted on elderly people. Based on these results, types of information that should be presented to the elderly and healthy people in the vicinity are described and discussions relating to implications of the solution is detailed in Section 4. Additionally, the configuration and functions of the proposed system are described in Section 5.

2. RELATED RESEARCH

In this chapter, related studies that have conducted evacuation guidance or conduct leads are referred in relevance.

As an existing study by Asano et al. [4] who proposed and verified a model focusing on the look ahead behaviour of human movement which is considered as necessary solution for capacity expression, and was reproduced as it is better than the existing model. A study by Yamashita et al. [5] that proposed a one - dimensional pedestrian model to calculate the interference between pedestrians and calculation of obstacle avoidance as well as the calculation of the evacuation process at high speed without degrading the reproducibility of movement. In addition to that, a high-speed evacuation simulator NetMAS was developed using a one-dimensional pedestrian model and compared the results of actual evacuation drills to verify the effectiveness of the one-dimensional pedestrian model. An evacuation in a large-scale complex commercial facilities were held to test and simulate NetMAS in order to verify the factors that affect the evacuation's efficiency. The simulation is performed by assuming various evacuation conditions, and the effectiveness of NetMAS is confirmed by applying a statistical method to the data. As a result, by considering the factor of shortening the evacuation completion time from Kitakyushu Arts Theatre as a target of simulation where the multiple regression analysis is applied to numerous trial results obtained by making use of high speed calculation, it is possible to quantitatively grasp the influence of evacuation conditions.

In the previous analysis, people is seen as an equal molecule. However, this study does not regard people as an equal molecule but only acts to present information to both healthy and weak people. There are three ways of presenting information using smartphones. It is as follows.

· How to display a message on the screen

· Audio guidance

· Using vibration function

Among the three above, the method that human beings could react fastest is the use of the vibration function. Therefore, in this paper, the vibration function is used as an information presentation method.

In an existing research conducted by [6], it is found that the vibration function is used in presenting information. In this research, a method to reduce the burden on users by notifying the user the minimum navigation information from the mobile terminal side at an appropriate timing is proposed. In addition to that, navigation information is transmitted using vibration and at the same time, its usefulness is verified.

The previous research does not classify users' navigation systems. It is found that from the specifications of the system, it is possible to give an instruction to turn left or right, but it is impossible to navigate the user to a designation.

A previous study conducted by Asano et al. [7] depicted that a system that realises pedestrian navigation by giving intuitive direction clues by a tractive force sensation that the direction changes according to the position or posture of the hand which entails that the system traces the hand of the user. The system is developed by Asano et al. The walking navigation tool developed by Asano et al. was able to create a force that the asymmetric oscillating mechanism internally rotates, pulling in a 360 degrees of the horizontal plane.

Therefore, in this paper, a method of using the idea of the towing device of [7] is proposed hand in hand with the presentation system in order to assist and reduce the stress felt by the weak walkers as well as all others in the walking space.

3. RESULTS AND DISCUSSION OF THE QUESTIONNAIRE

A questionnaire that uses elderly people as subjects or respondents is conducted. The respondents were 30 people whose are aged between 75 to 85 years old.

As a result of the questionnaire, the following answers were obtained:

· If I am surrounded by a group whose walking pace is faster than mine, I move to the edge and try to walk at my own pace.

· In spaces where a lot of pedestrians are walking in different directions and at different speeds, while looking for a space with fewer people, I walk behind the person who walks at the same pace as myself.

· I plan to walk straight on my own but in reality I will walk to the left and right.

This questionnaire also provided answers regarding the situations in which elderlies often felt stressed:

· When people are walking fast and coming from the opposite direction, or when people pass by on a bicycle

· When I am overtaken by a bicycle

There were numerous elderly people who responded with the following as reasons for feeling such stress:

· The field of vision has narrowed

· Hearing ability has decreased

· Lack of physical strength and quick reflexes

In order to summarize these answers, it turns out that a lot of elderly people are physically challenged to realise the movement of pedestrians or bicycles approaching from the opposite direction. Moreover, it was found that there are a lot of elderly people who find it difficult to recognise the danger that they themselves pose to others.

Based on the results of this questionnaire, potential dangers that could pose problems to elderlies is addressed in advance and the information or an alert for other pedestrians around or in the vicinity to acknowledge elderlies should be proposed. This is to reduce potential dangers faced by elderlies. It is presumed that there is a possibility of avoiding stress. Based on this consideration, it is believed that an information presentation system that encourages elderlies to identify the potential dangers and stressors which draws the attention of the pedestrians in the vicinity is an essential part of solving this problem. Hence, it is decided that the information presentation system should be proposed.

4. OUTLINE OF THE PROPOSED SYSTEM

In this section, an outline is provided for the information presentation system that is proposed to assist elderlies and the healthy people around them.

It is assumed that all elderlies and healthy people in the vicinity carry a smartphone while walking as well as having a certain application that is installed in the smartphone and wear a wearable Bluetooth device that is connected to the smartphone. Although currently, wearable devices have not become popular worldwide, it is projected that the above assumption is valid as wearable devices will become ubiquitous in the near future.

An application installed on the smartphone detects a state in which an elderly person is unintentionally wobbling and estimates the potential danger of that person. When this happens, the smartphone application alerts the elderly person and the surrounding pedestrians about his/her unintentional wobbling state through vibrations from the wearable device. For the elderly person, the vibrations mean, “Please take care to walk straight” and for other pedestrians in the

vicinity, they mean “There are elderly people who are easy to knock down, do not go through the vicinity at high speed. Please be careful.” This content is set up in advance in the application. The vibration function is used only to notify users about elderlies wobbling to the left and right.

5. EXAMPLE OF OPERATION OF THE PROPOSED SYSTEM (SCHEDULED TO INCLUDE PUNCH PAINTING, HAND WRITTEN)

A proper example of presenting information to elderlies who are wobbling sideways, as well as to pedestrians in the vicinity is described using a scenario.

It is known that a walking space is a sidewalk by a road where the roadway and the sidewalk are firmly separated. It is in the evening, when different kinds of people such as workers leaving their companies after working hours and headed for the station, while others are heading to kindergartens or nursery schools to pick up their young children, and they are all walking at their own pace. Meanwhile, an elderly person with wobbly feet and weak balance begins to feel crowded while trying to walk at his own pace. However, unintentionally he ends up wandering to the left and right instead of walking straight. Hence, the situation requires other pedestrians to anticipate and react instantly to hinder a potential danger whether of a person walking fast, coming from the opposite direction, or of a passing bicycle speeding by the elderly person at a close distance. The image diagram is as shown in Figure. 1 below.

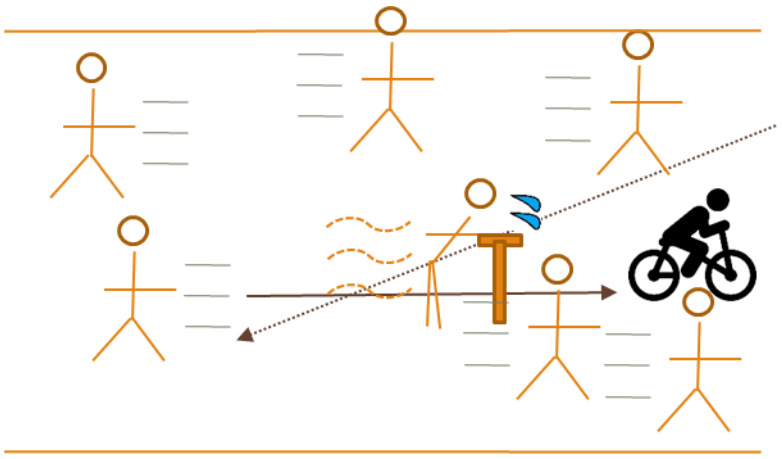


Image diagram of wobbling elderly people in pedestrian space and pedestrians passing around

The approach to the elderly person and the pedestrians around him in the above situation is described as follows:

For elderlies who are unintentionally wandering, a vibration alert from the smartphone that is synchronised with a wearable device displays an alert, "Watch out! Let's be conscious of walking straight ahead because we are staggering!" The image diagram is as shown in Figure. 2 below.

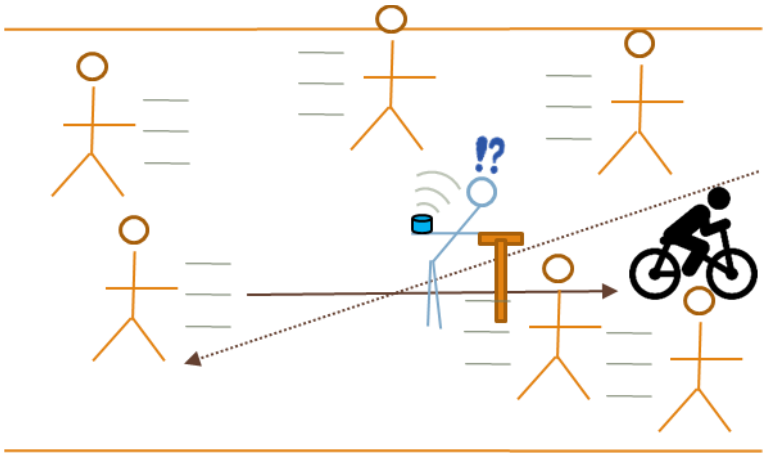
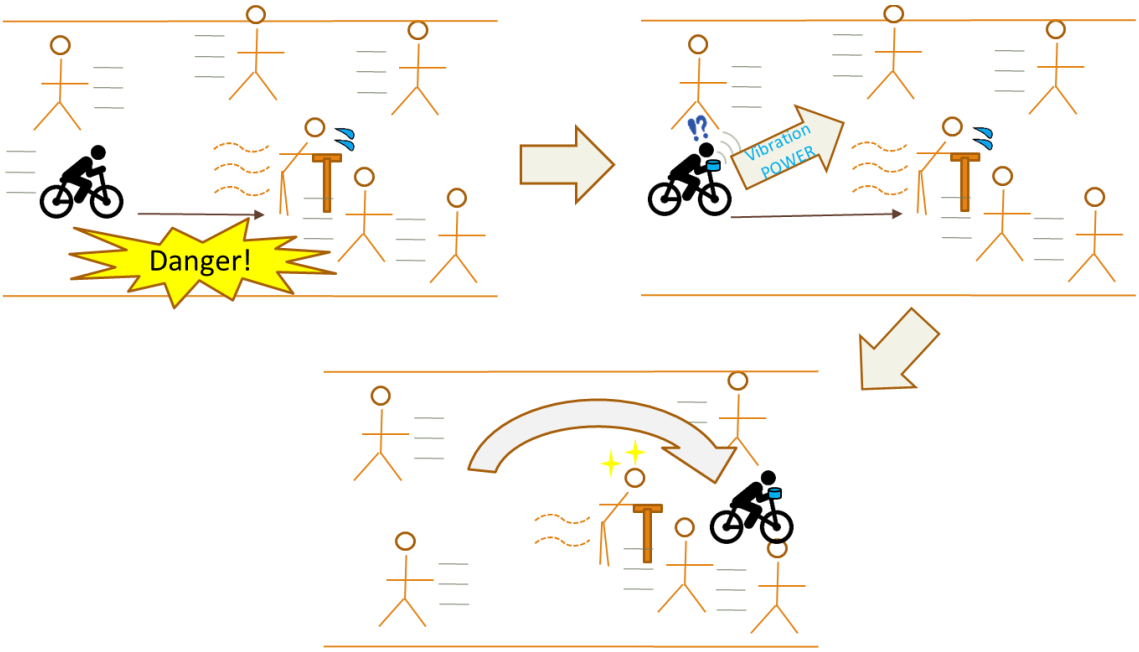


Image diagram showing how the elderly person noticed notification by vibrating wearable device

Figure. 2 explains that the blue object at the elderly person's hand of the light blue is a wearable device. Figure. 3 below is an image of the screen of the smartphone when the elderly person receives a notification notifying the crisis from their wearable device.

Smartphone screen image when notified to the message of wearable device

Therefore, with regards to other people moving forward or backward at a certain speed towards the elderly person who is unintentionally wobbling, or for those within a specific fixed distance zone around such elderly people, vibrations increase to a certain extent for these pedestrians to be guided to walk in a particular direction. The image diagram is as shown in Figure. 4 below.



An image diagram that it is guiding towing in a safe direction by vibrating (when the bicycle seems to hit the elderly person)

From the above, both sides are conscious about walking in a more straightforward manner. This also alerts the elderly person who wobbles unintentionally to walk straight and pedestrians will move out of the close range of the elderly person, thereby reducing stress and eliminating potential hazards.

6. SUMMARY

In this paper, an information presentation system is proposed to reduce the stress faced by elderlies that have trouble wobbling in walking spaces and with other pedestrians around them.

In this paper, it is assumed that all pedestrians possess smartphones, a different context information service application, and a wearable tracking device. A projection mapping around the wobbling elderly is also used. If one can display information that there is a senior citizen nearby, it could also be possible to send a signal to others as well as the senior citizen himself/herself to raise awareness. Further research on such ideas will be conducted.

Moreover, it is possible to estimate stress by having physiological data that was measured by a wearable health tracking device. Therefore, weak walkers especially elderlies who unintentionally sway from side to side are able to automatically detect their state of stress. It is believed that it is possible to approach the wider population of weak locomotors, not just elderly people and this is recommended as a future research subject.

Such advanced research is expected to eventually contribute to the creation of a walking space design that minimizes the stress among pedestrians including the weak and elderly.

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