

## 論文内容要旨

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学位論文題目	STUDY OF INTELLIGENT TRAVEL AID DEVICES FOR VISUALLY IMPAIRED PERSON 視覚障がい者のための知的移動支援デバイスに関する研究		
<p>内容要旨</p> <p>World Health Organizations (WHO) has released the statistics for people with disabilities (PWDs) in the world are 10% of the total world population which are about 1 billion people in early 2011. The increment of these statistics is because of increased aging population, health condition and greater accessibility to facilities. In addition, there are 285 million of the blind people which 39 million are fully blind and 246 million are low vision person. Conventionally, blind people usually rely on white canes or guide dogs to assist them to reach their desired destination safely. However, conventional travel aids which are studied are normally used to help the user detect the obstacle at lower level part of their body and have some limitations. There is also a survey in United State that about 300 blind people who were experts using white cane has experienced the collision with head-level obstacles. The survey shows that 39% of respondents experience a head-level accident once a year and 14% of respondents more often than once a month.</p> <p>Moreover, the conventional white cane and guide dog are only working if the path to the destination is already familiar to the blind people. It becomes difficult if the destination is new especially with the environment which is not implemented the universal design concept, especially for blind people. Difficulties still occur when using the white cane for blind people as they are only able to detect path and obstacles from the front by swinging the white cane at the same time trying to feel the tip of the white cane that touches the ground. They do not receive enough information with only the tip of the white cane as feedback. Lack of aid signs built for blind people seems to be one of the difficulties for them. They do not know where to go and cannot recognize their surroundings.</p> <p>Therefore, the study on the needs and requirements to assist the blind person was done. Some discussion and design feedbacks with the Society of Blind Malaysia (SBM) and Malaysian Association for Blind (MAB) was conducted started from 2011. The electronic cane was proposed at first in 2011. However, since the electronic device for the upper body level does not existed, the user-friendly and effective travel aid devices need to be designed and developed. Some continuous study and design improvement of travel aid device through discussion with the society was done. From the brainstorming process, the design concept and implementation of intelligent electronic spectacle for the blind to detect the obstacles at the upper body level are considered by the blind user since the blind user usually used the black spectacle while travelling outside.</p> <p>The overall system configuration that can be used for new electronic spectacle was constructed. Some electronic components such as microcontroller, distance measurement</p>			

sensor, vibrator, single headphone and etc. have been selected through systematical method by using a pair-wise comparison table and weightage method. Thus, the designed electronic spectacle was fabricated successfully with a weight about 70g without battery and the vibration warning system. After all the designed and fabrication of proposed electronic spectacle done, some evaluation process have been successfully conduct initially such as blind spots and the effectiveness of the proposed warning system such vibration warning, beep warning and LED warning device. All of these proposed warning systems are developed inside the electronic spectacle to give direct warning signal to the user for avoiding the obstacles effectively.

Furthermore, the evaluation of power consumption also done successfully for both type of electronic spectacle to ensure the usability of the device. From the result, the simplified type of electronic spectacle can be used up to 38 hours continuously when the condition of obstacles is always existed at all directions. Therefore, the blind user can use it safely and easily. Before the field test was conducted, the experimental method has been submitted to the Ethics Committee of Tokushima University. As the result, the evaluation was passed successfully. Then, the performance evaluations have been done for electronic spectacle inside the experimental field by multiple subjects that volunteered. Some analyses from various sensors such as ultrasonic sensor, gyro sensor and acceleration sensor also have been done successfully to capture the real condition of the proposed electronic spectacle and the user's condition.

In addition, the navigation device also successfully developed to be an option for the blind user when traveling indoor and outdoor environments. The developed navigation device is consisted of the RFID detection system, vision-based tactile detection system, destination input system and the digital compass. Beside, some options that could be used by the blind are researched such as the path planning algorithm to search the shortest path to go to the desired destination. Some simulations and experiments also have been conducted to evaluate the proposed navigation device. Basically, the proposed navigation device are proposed to be attached at the white cane that usually be used by blind user.

The RFID detection system is beneficial to the blind person since it can provide the feedback information regarding the current location, distance and the direction that need to be traveled to get to the desired destination. At the same time, digital compass and the shortest path planning algorithm by using A\* search algorithm are applied and successfully guide the user by providing the accurate distance and direction through the experiment. It could assist and guide the blind for travel independently. Lastly, the effectiveness of developed blind navigation device to navigate the blind user is confirmed. The comparison of the performance evaluation for the human subject and robot subject also successfully done. From the result, it shown that robot was more faster than human subject since it decided precisely while human subject had a doubtfully thought during his decision. In the future, we would like to integrate the developed electronic spectacle and navigation device into one compact device such as auto-navigation system like a mobile robot that could be useful and beneficial to the blind person.