

Development and Usability Evaluation of Automated Set Box for Mobility Scooter

Chotaro Yamamoto¹⁾ Mai Saito¹⁾ Kota Ogawa¹⁾ Shell Yamauchi¹⁾ Yifei Xue¹⁾
 Chi-Shen Chao¹⁾ Shuncong Shen¹⁾ Toshio Ito²⁾ Toshiya Hirose³⁾

1) Shibaura Institute of Technology, Graduate School of Engineering and Science
 307 Fukasaku, Minuma-ku, Saitama City, Saitama, 337-8570, Japan (E-mail: mf21131@shibaura-it.ac.jp)
 2) Hyper Digital Twins Co., Ltd., Niu Building 2F, 2-1-17, Nihonbashi, Chuo-ku, 103-0027, Japan
 3) Shibaura Institute of Technology, 3-7-5, Toyosu, Tokyo, 135-8548, Japan

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Research and development on automated driving technologies are being conducted by companies and research institutes not only in Japan but also around the world. It is expected that fully automated driving mobility will be available for practical use soon, and there is a need to develop relatively inexpensive automated driving mobility systems that can be easily used in daily life, and that can be used in town and residential areas. Automated driving mobility is considered to be effective for the physically handicapped and the elderly when they have difficulty getting around by themselves. Therefore, it is desirable to develop automated driving mobility that can be easily used by anyone. Automated driving mobility vehicles can move freely from home to train stations and inside facilities. Automated driving mobility is expected to allow passengers to board public transportation from their homes and travel to their destinations without having to get in and out of their vehicles. However, there are legal and cost challenges in developing automated driving mobility.

To solve this problem, we have focused on mobility scooters and are working on the development of an automated driving set box that can be retrofitted to enable automated driving. The Mobility scooter is a single-seat battery-powered car designed for the elderly. It has the advantages of no license required, a maximum speed of 6 km/h, pedestrian treatment, no helmet requirement, no taxes, and is electrically powered. Automated driving mobility uses multiple sensors to recognize the outside world. Therefore, the automated driving set box does not modify existing mobility scooters, but allows them to drive only with a retrofitting mechanism. The components are built using only commercially available parts, and the software is developed based on open-source software. By installing an automated set box in each household's mobility scooter, it is possible to encourage the elderly and physically challenged to participate in the social community.

We develop an automated set box that can be attached to an existing mobility scooter to automate driving as shown in Fig.1. By automated mobility scooter with a retrofitted set box, an existing mobility scooter can be automated without any internal modifications. Therefore, it is not necessary to buy a mobility scooter equipped with automated driving, and the price can be kept low. This makes automated driving technology available to a larger number of people. As shown in Fig.2, The automated driving set box, in which a 3D LiDAR is installed in front of the mobility scooter to detect obstacles in the driving environment and match them with the 3D map. An omnidirectional camera is installed above the 3D LiDAR and is used to detect pedestrians and to judge the state of the driver. In addition, a servo motor connected to the steering wheel of the mobility scooter with a link mechanism is installed in the automated driving set box. A servo motor is also attached to the gas pedal lever. The steering servo motor control is operated from an Arduino connected to a processing PC. This experiment was conducted in Saitama Shin-Toshin, Cocoon City. The purpose of this experiment was to test the automated driving system for automated driving mobility and to evaluate the experience of the participants in the experiment. The automated driving system runs on the two courses. Cocoon City is a shopping mall directly connected to Saitama-shintoshin Station via a deck. Both courses start from the front of the station, circle around the shopping mall, and return. Both courses are pedestrian-only paths. For safety reasons, a staff member with an emergency stop button monitors the automated driving system to ensure the safety of the participants as shown in Fig.3. In addition, two staff members are stationed around the automated driving mobility scooter to ensure the safety of the surrounding environment. Participants were asked to complete a questionnaire to evaluate automated driving mobility. The questionnaire included items on the quality of driving performance of automated driving mobility, the usability of the UI, expectations regarding automated driving, and the budget for future purchases. Participants completed the questionnaire after the driving test.

As a result, it was found that many participants have high expectations of automated driving systems. The participants also felt that the driving speed of the automated driving mobility scooter was appropriate. The need for a contactless UI in automated driving mobility was found. However, from the questionnaire on the purchase price required for an automated driving set box, it was found that it is necessary to construct a system using less expensive sensors and PCs.



Fig.1 Automated Set Box for mobility scooter

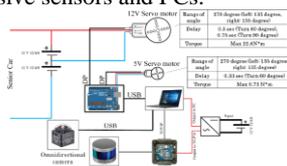


Fig.2 The composition of system



Fig.3 Status of the experiment