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Research and Development of Hybrid Electric Wheelchairs

Hirofumi Maeda

Abstract*: In Japan, the "Act on Promotion of Smooth Transportation, etc. of Elderly Persons, Disabled Persons, etc.: Barrier-Free Act" was enacted in 2006 to improve the accessibility of public transportation, roads, parks, and buildings, enabling elderly individuals and persons with disabilities to lead independent daily and social lives. At that time, public elementary and junior high schools, etc., were added to the list of "special designated buildings" under the Barrier-Free Act. Therefore, in facilities of public elementary and junior high schools, as well as other similar institutions, compliance with barrier-free standards is not only mandatory for construction projects of a particular scale or larger, but existing buildings are also subject to a duty to strive for compliance with these standards. However, since the budget required to rebuild facilities cannot be secured, barrier-free modifications are often implemented through renovations to existing facilities. Therefore, the upgrades have been limited to measures such as installing handrails and ramps, and sufficient width for passageways has not been secured. Especially in schools other than higher education institutions, insufficient land area is often secured, making the space feel cramped for wheelchair users. Furthermore, such schools have a higher population density than other facilities and a greater number of immature students, leading to frequent occurrences of running, sudden changes in direction, and unexpected movements. This must be considered a hazardous environment for wheelchair users. Therefore, this paper describes the implementation of a hybrid system combining manual and automatic control by installing a versatile, dedicated joystick for electric wheelchairs onto a commercially available, low-cost electric wheelchair. It also details the modification methodology and confirms that the hybridization does not compromise the inherent performance of the electric wheelchair itself.

***Keywords*: Electric Wheelchair, Hybrid, System Construction, System Control, Educational Site**

Abbreviations:
ROS: Robot Operating System
JIS: Japanese Industrial Standards
LED: Light Emitting Diode
PC: Personal Computer
I2C: Inter-Integrated Circuit
D/A: Digital to Analogue
A/D: Analogue to Digital
HDMI: High-Definition Multimedia Interface
LCD: Liquid Crystal Display
USB: Universal Serial Bus

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*Correspondence Author(s)
Prof. Hirofumi Maeda*, Department of Information Science and Technology, National Institute of Technology (KOSEN), Yuge College, Ehime Prefecture, Japan. Email ID: maeda@info.yuge.ac.jp, ORCID ID: 0000-0002-7145-3889

I. INTRODUCTION

In Japan, the "Act on Promotion of Smooth Transportation, etc. of Elderly Persons, Disabled Persons, etc.: Barrier-Free Act" was enacted in 2006 to improve the accessibility of public transportation, roads, parks, and buildings, enabling elderly individuals and persons with disabilities to lead independent daily and social lives. At that time, public elementary and junior high schools, etc., were added to the list of "special designated buildings" under the Barrier-Free Act. Therefore, in facilities of public elementary and junior high schools, as well as other similar institutions, compliance with barrier-free standards is not only mandatory for construction projects of a particular scale or larger, but existing buildings are also subject to a duty to strive for compliance with these standards. Additionally, the national subsidy system includes the "Grant for Large-scale School Facility Environmental Improvement for Children with Disabilities", the "Subsidy for Facility Development Costs of National University Corporations and Related Institutions", and the "Subsidy for Facility Development Costs of Private Schools", and regardless of whether they are national, public, or private, barrier-free improvements are advancing in every type of school, from kindergartens to universities. However, since the budget required to rebuild facilities cannot be secured, barrier-free modifications are often implemented through renovations to existing facilities. Therefore, the renovations have been limited to measures such as installing handrails and ramps; however, sufficient width for passageways has not been ensured. Especially in schools other than higher education institutions, insufficient land area is often secured, making the space feel cramped for wheelchair users. Furthermore, such schools have a higher population density than other facilities and a greater number of immature students, leading to frequent occurrences of running, sudden changes in direction, and unexpected movements. This must be considered a hazardous environment for wheelchair users.

The use of electric wheelchairs within school grounds, utilizing their autonomous driving capabilities to avoid collisions with people, is expected to create a safer living environment. Autonomous driving services by WHILL are already being implemented at airports and other locations [1]. Furthermore, WHILL has also begun utilizing in special nursing homes for older people. WHILL also sells models compatible with ROS (Robot Operating System) Operating System) [2], and many researchers are engaged in research and development [3]. However, due to its high cost and large size, this model is limited to facilities with enough space.

To date, numerous electric wheelchairs, including scooter-type and joystick-type models, have been developed in Japan [4]. Furthermore, laws and systems have been established, and as adoption has spread, JIS standards have been developed. The display of the JIS mark serves as a reference point for consumers when making purchases. In the early stages of research, basic studies focused on factors such as road surface irregularities [5], wheelchair ramps [6], a person's instability [7], and caregivers [8] to consider the ride comfort of wheelchair users. Subsequently, with the widespread adoption of electric wheelchairs, attention shifted to the impact these devices have on users—not only in terms of trunk support [9] and ride comfort [10], but also in terms of psychological burden [11], ease of handling [12], and safety [13]. Furthermore, to enhance convenience even more, improvements have been made not only to driving performance itself [14] but also to safety in autonomous driving, including collision avoidance, obstacle avoidance and driver assistance.

This study describes the research and development of a hybrid electric wheelchair, aiming to create an inexpensive and safe electric wheelchair that builds upon prior studies. Past research has focused on autonomous driving itself, resulting in few electric wheelchairs capable of both manual and autonomous operation. The few hybrid models available are expensive and bulky. Therefore, we propose realizing a hybrid electric wheelchair that is easy to handle by modifying the control unit of an inexpensive electric wheelchair. Note that the performance testing of the hybrid electric wheelchair in this paper utilizes a system designed for remote operation via a game controller, rather than autonomous driving. However, since control commands are used to operate the electric wheelchair, conversion to autonomous driving is straightforward.

II. ELECTRIC WHEELCHAIR

Figure 1 shows the Tripaide 25KM electric wheelchair used in this study. Next, the specifications for the 25KM are shown in Table 1.

[Fig.1: Tripaide 25KM]

Table-I: Specifications of 25KM

Item	Details
Size when expanded	94 cm (D) × 61 cm (W) × 109 cm (H)
Size when folded	33 cm (D) × 61 cm (W) × 81 cm (H)
Seat size	45 cm × 45 cm × 51 cm
Turning radius	83 cm
Weight	28.5 kg (including two batteries)
Battery Charging Time	6 - 8 hours
Battery Type	Lithium-ion
Battery Capacity	10 Ah × 2 batteries
Climbing Angle	12°
Speed	0 - 8 km/h
Range	25 km
Motor	2 × 250 W Brushless Motors
Load Capacity	100 kg
Front Wheel Size	7 inches
Rear Wheel Size	12 inches
Tire Material	Rubber
Frame Material	Aluminum Alloy
Brake System	Intelligent Electromagnetic Brake System

The 25KM possesses the functions of a widely available standard electric wheelchair. Standard electric wheelchairs typically use joystick control. This joystick section features a power switch, an LED for checking battery capacity, an alarm speaker and alarm button, downshift and upshift buttons for switching between speed modes, and a speed indicator for confirming the current speed mode, as illustrated in Figure 2.

[Fig.2 Joystick of 25KM]

The drive unit typically utilizes motors rated at approximately 250 watts and a 24-volt battery. Thus, electric wheelchair systems are standardized across many manufacturers. However, the internal circuitry of the joystick differs between manufacturers. Therefore, in this study, to ensure the developed system has versatility, the joystick used is the WB5003 manufactured by MLAUH Co. Ltd., as shown in Figure 3. The WB5003 is a joystick designed explicitly for electric wheelchairs, compatible with 24 V and capable of handling currents of up to 50 A.

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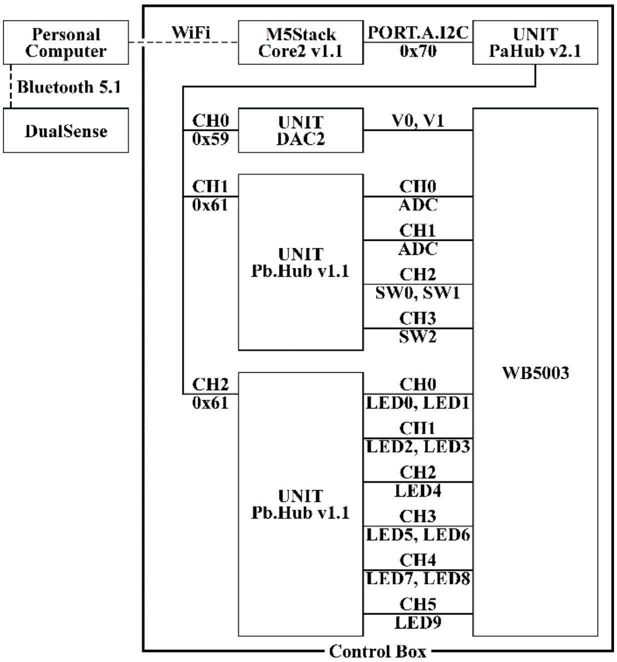
[Fig.3: Joystick of WB5003]

III. HYBRID ELECTRIC WHEELCHAIR

This chapter describes how to modify the internal circuitry of the WB5003 to enable external access and control of the electric wheelchair. This allows for easy hybridization by replacing the joystick section of a standard electric wheelchair with this system.

A. System Configuration

A schematic diagram of the system is shown in Figure 4.



[Fig.4: Schematic Diagram of the System]

For the hybridization of the electric wheelchair at this time, the M5Stack Core2 v1.1 from M5Stack Technology Co., Ltd is used for external control of the electric wheelchair. Furthermore, as mentioned earlier, this paper utilizes a game controller to implement remote control and conduct performance experiments on the hybrid electric wheelchair. The game controller used is the DualSense, manufactured by Sony Interactive Entertainment Inc. Ultimately, since this system aims for hybrid autonomous driving, a control system based on control commands has been built on the M5Stack Core2 v1.1. Therefore, it is necessary to convert the DualSense signals into control commands. Thus, as shown in Fig. 4, the DualSense is connected to a PC via Bluetooth 5.1. The PC converts the DualSense signals into control commands and then transmits these control commands to the M5Stack Core2 v1.1 via Wi-Fi. Figure 5 shows the actual process of transferring the DualSense signals to the M5Stack Core 2 v1.1 via the PC.

[Fig.5: Control of 25KM using Dual Sense]

The M5Stack Core2 v1.1 must control the WB5003 circuit according to the received control commands. However, the M5Stack Core2 v1.1 alone lacks sufficient functionality. Therefore, functionality is expanded by sending command signals to the company's expansion board using I2C. First, connect to the UNIT PaHub v2.1 to expand the M5Stack Core2 v1.1's I2C ports to three. Then, connect to a total of three boards: a UNIT DAC2 and two UNIT Pb—hub v1.1 units. The UNIT DAC2 houses two D/A converters—the first UNIT Pb. Hub v1.1 handles two A/D converters and three digital outputs, while the second UNIT Pb. Hub v1.1 handles ten digital inputs. The detailed roles of each are described in the next section.

B. Circuit Configuration

Figure 6 shows the WB5003 with the rubber cover removed. The circuit board beneath this rubber cover aggregates input/output signals, enabling the M5Stack Core2 v1.1 to exchange signals with this board. Figures 7 and 8 show the front and back sides of the board.

[Fig.6: Beneath the WB5003 Rubber Cover]

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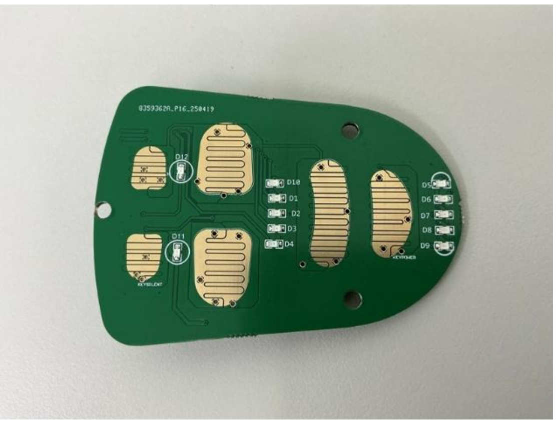
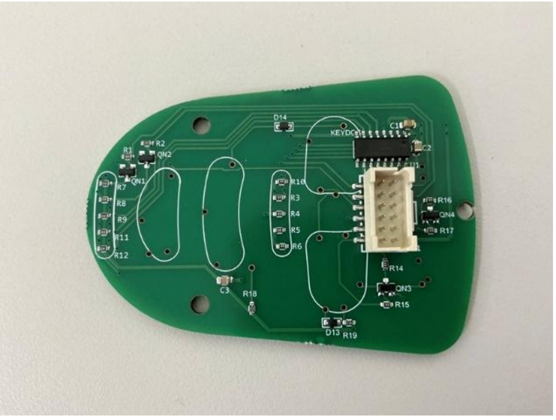
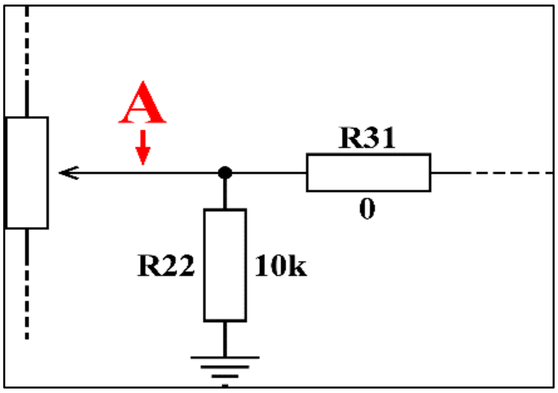


[Fig.7: Front Side of the WB5003 I/O Board]

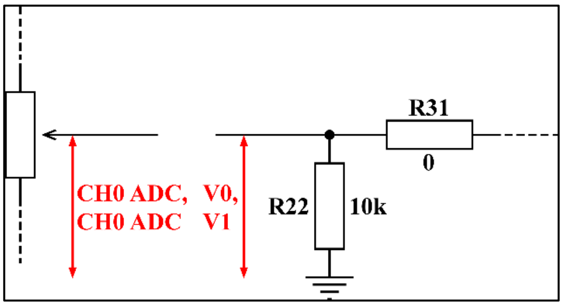


[Fig.8: Back Side of the WB5003 I/O Board]

First, the joystick is described. The joystick section is configured using a standard variable resistor voltage divider, as shown in Figure 9. Two variable resistors are used to process signals for the joystick's forward and backwards, as well as left and right directions. Therefore, the circuit shown in Figure 10 is formed by cutting point A in Figure 9.



[Fig.9: Joystick Circuit Section]



[Fig.10: Access to the Joystick Circuit Section]

The left side of Fig. 10 reads the voltage via an A/D converter, while the right side applies voltage via a D/A converter to control the electric wheelchair's wheels. By directly reproducing the voltage read on the left side via the D/A converter and transmitting it to the right side, pseudo-manual control is achieved. For automatic control, the left-side voltage is ignored, and the voltage required for automatic control is applied to the right side. Point A in Fig. 9 corresponds to the cable section, so the improvement can be completed simply by cutting that cable and connecting it to the UNIT DAC2 and UNIT Pb.hub v1.1. Furthermore, to achieve hybridization while prioritizing user safety, the software is programmed to interpret a joystick tilt exceeding a certain threshold as the user manually taking control, thereby rejecting external control commands. To resume automatic control, send an external control command permitting automatic control.

Here, the measurement data for the A/D converter of UNIT Pb. Hub v1.1 is presented in Tables 2 and 3, respectively. Table 2 shows the digital values of the A/D converter when the joystick is positioned at its maximum in all four directions for each speed mode. Table 3 presents the digital values from Table 2 in terms of voltage values. Next, Table 4 shows the digital values of the UNIT DAC2 D/A converter corresponding to the voltage values in Table 3. Note that the digital values in Table 4 are 2.64 times those in Table 2. The reason is that the A/D converter has a reference voltage of 3.3 V and a resolution of 12 bits, whereas the D/A converter has a reference voltage of 10.0 V and a resolution of 15 bits.

Table II: Relationship between Joystick and A/D Converter Digital Values

Speed	Voltage [ ]			Voltage [ ]		
Mode [ ]	Down	Neutral	Up	Left	Neutral	Right
1	392	1942	3581	383	2135	3638
2	326	1876	3536	343	2198	3577
3	336	1886	3563	364	1978	3626
4	358	1931	3611	370	2055	3631
5	333	1913	3531	377	1988	3640
Average	349	1910	3564	367	2071	3622

Table III: Relationship between Joystick and A/D Converter Voltage Values

Speed	Voltage [V]			Voltage [V]		
Mode [ ]	Down	Neutral	Up	Left	Neutral	Right
1	0.316	1.565	2.885	0.309	1.720	2.931
2	0.263	1.511	2.849	0.276	1.771	2.882
3	0.271	1.519	2.871	0.293	1.594	2.921
4	0.288	1.556	2.909	0.298	1.656	2.925
5	0.268	1.541	2.845	0.304	1.602	2.933
Average	0.281	1.538	2.872	0.296	1.668	2.918

Table IV: Relationship between A/D Converter and D/A Converter

Speed	Voltage [ ]			Voltage [ ]		
Mode [ ]	Down	Neutral	Up	Left	Neutral	Right
1	1035	5127	9454	1011	5636	9604
2	861	4953	9335	906	5803	9443
3	887	4979	9406	961	5222	9573
4	945	5098	9533	977	5425	9586
5	879	5050	9322	995	5248	9610
Average	921	5041	9410	970	5467	9563

Next, the alarm button, downshift button, and upshift button are described. As shown

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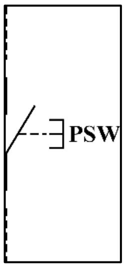
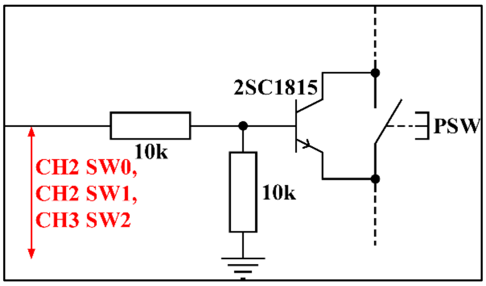
in Fig. 7, the circuit determines whether the signal is on or off based on whether the push switch depicted in Fig. 11 has been pressed. Therefore, as shown in Figure 12, transistors are used to enable each button to accept the input signal from UNIT Pb—hub v1.1.



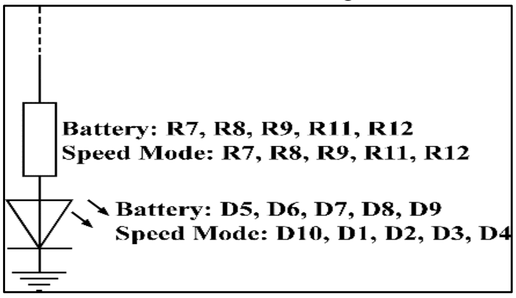
[Fig.11 Switch Circuitry]



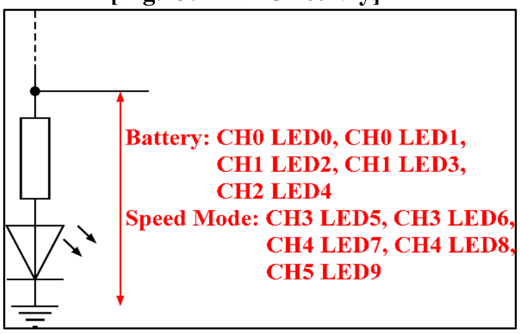
[Fig.12: Access to Switch Circuitry]

Additionally, the downshift and upshift buttons are managed by software to prevent consecutive speed mode changes unless the driver releases the button, ensuring safety. Furthermore, similar to the joystick, the software is programmed to recognize pressing the downshift or upshift button as a manual operation by the driver and to reject external control commands.

Finally, the LED for checking battery capacity and the speed indicator are described. The LED circuit is a standard design, as shown in Figure 13, and operates in an active-high mode. Therefore, to read this LED information, the voltage across the LED circuit is measured using the digital output of the UNIT Pb. Hub v1.1, as shown in Figure 14.



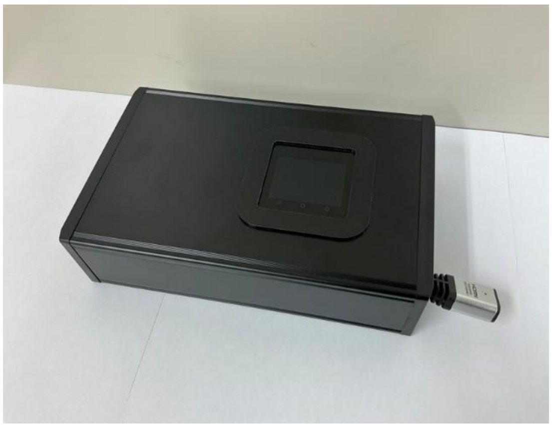
[Fig.13: LED Circuitry]



[Fig.14: Access to LED Circuitry]

The actual wiring is shown in Figure 15. The extracted signal lines are routed externally via an HDMI cable and connect to the control box, which is installed externally, as shown in Figure 16. The interior of the control box is shown in Figure 17, which houses the M5Stack Core2 v1.1 and its expansion board, as mentioned in the previous section. The control box is stored in the pocket behind the 25KM's backrest, as shown in Figure 18. Furthermore, during operation, the system's operational status can be monitored via the M5Stack Core2 v1.1's LCD screen, as shown in Figure 19.

[Fig.15: Wiring of WB5003]



[Fig.16: Control Box]

[Fig.17: Inside the Control Box]

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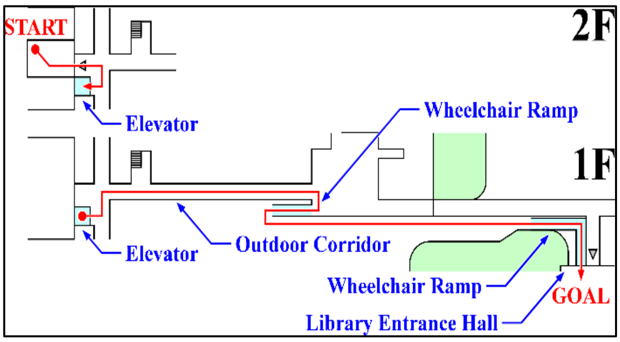
[Fig.18 Placement of Control Box]

[Fig.19: LCD Screen of Control Box During Operation]

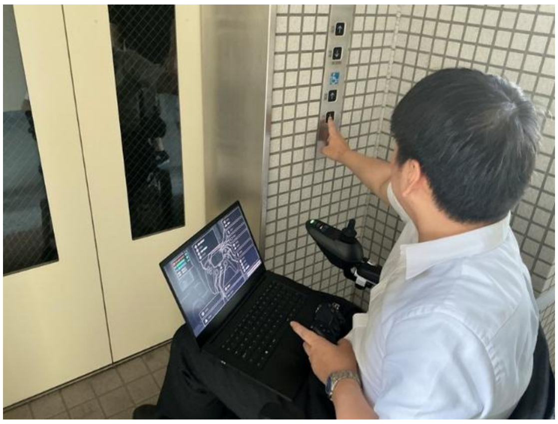
IV. PERFORMANCE TESTING

For the performance testing, the campus of the National Institute of Technology (KOSEN), Yuge College, was utilized. Figure 20 shows the travel route. The route began at the second-floor community space, descended to the first floor via the elevator, and then proceeded eastward along the outdoor corridor. It then descended the wheelchair ramp installed in the hall, travelled eastward on the ground, ascended the wheelchair ramp installed in the library building, and entered the goal location, the library entrance hall. The total travel distance was approximately 116 meters. The performance evaluation for each section is shown below.



[Fig.20: Travel Route]

First, the use of elevators is described. As shown in Fig. 18, the only additional hardware added by hybridization is the control box. Since this box is mounted behind the electric wheelchair, the hybrid electric wheelchair can be used in elevators in the same posture and under the same conditions as a standard electric wheelchair, as shown in Figure 21.



[Fig.21: Using the Elevator]

Next, the straight-line performance is described. As shown in Figure 22, it exhibits straight-line stability similar to conventional electric wheelchairs. However, the DualSense joystick is smaller than that of the WB5003, resulting in less favourable operability. Nevertheless, since the DualSense is not used during automatic control, this does not pose a significant issue.

[Fig.22: Performance of Straight-Line]

Additionally, the ascent and descent of the wheelchair ramp are described. Figure 23 shows the electric wheelchair descending the wheelchair ramp, and Figure 24 shows it ascending. The ramp gradient is approximately 5.2° for descent and approximately 3.1° for ascent. Although the operation was somewhat uncertain because a non-disabled person controlled it, there were absolutely no issues with traversability.

[Fig.23: Wheelchair Ramp for Downhill]

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[Fig.24: Wheelchair Ramp for Uphill]

Finally, the performance of the electric wheelchair navigating the narrow passageway in the entrance hall is described. As shown in Figure 25, stable operation was also achieved here. Through these performance tests, it was confirmed that hybridization was implemented without issues. Furthermore, the ability to make detailed software adjustments enabled improved navigability compared to conventional electric wheelchairs.

[Fig.25: Wheelchair Ramp for Downhill]

V. CONCLUSION

This paper describes the implementation of a hybrid system combining manual and automatic control by installing a versatile, dedicated joystick for electric wheelchairs onto a commercially available, low-cost electric wheelchair. It also details the modification methodology and confirms that the hybridization does not compromise the inherent performance of the electric wheelchair itself. For this performance test of the hybridised wheelchair, a remote control was used via a game controller. However, future work requires replacing this input with a control program to enable switching to automatic operation. Finally, two challenges that must be addressed to achieve this are presented.

A. Switching to Wired Communication

This time, communication between the PC and the M5Stack Core2 v1.1 was conducted via wireless communication using Wi-Fi. However, considering system stability, wired communication is preferable. The M5Stack Core2 v1.1 is equipped with a USB Type-C port, enabling serial communication. Switching communication to this port allows for an easy transition to a wired connection.

B. Installation of Sensor

Moving forward with automatic control, installing both internal and external sensors is essential. For internal sensors, mounting encoders on the tires is desirable. This is because while tyres enable tight turning, they are difficult to control. So, to improve operability, tyre speed or position feedback using encoders is necessary. Furthermore, electric wheelchairs are intended for use in areas with heavy foot traffic. Therefore, to avoid contact with people and obstacles, it is required to install external sensors, such as laser rangefinders, that can detect them.

DECLARATION STATEMENT

I must verify the accuracy of the following information as the article's author.

- **Conflicts of Interest/ Competing Interests:** Based on my understanding, this article has no conflicts of interest.
- **Funding Support:** This article has not been funded by any organizations or agencies. This independence ensures that the research is conducted with objectivity and without any external influence.
- **Ethical Approval and Consent to Participate:** The content of this article does not necessitate ethical approval or consent to participate with supporting documentation.
- **Data Access Statement and Material Availability:** The adequate resources of this article are publicly accessible.
- **Author's Contributions:** The authorship of this article is contributed solely.

REFERENCES

1. Noriaki IMAOKA, Hiroyuki UEMATSU, Kazuma KITAZAWA, Hiroyuki SASAI, Duyhinh NGUYEN, Takeshi ANDO, "A Robotic Personal Mobility with Two-step Automatic Stopping Function", The Proceedings of JSME annual Conference on Robotics and Mechatronics (Robomec), 2018, 2P1-H02. DOI: https://doi.org/10.1299/jsmermd.2018.2p1-h02
2. Yuji Iwata, Chisato Kanamori, "Research on Safety Functions of Electric Wheelchairs Considering Their Own Vehicle and Surroundings", 2021 JSPE Spring Conference, 2021, pp. 525-526. DOI: https://doi.org/10.11522/pscjspe.2021S.0_525
3. Daisuke Okabe, Hisakazu Nakamura, "Safety Assist Control of VR Remote Operating Electric Wheelchair", THE 64th JAPAN JOINT AUTOMATIC CONTROL CONFERENCE, 2021, 2H1-3. DOI: https://doi.org/10.11511/jacc.64.0_836
4. Takashi Yamaguchi, Yasuyuki Sejima, "Development of a Resistive Torque-Presenting Joystick Aimed at Improving Operability of Electric Wheelchairs", Proceedings of the Kansai Branch Conference of the Japan Society of Mechanical Engineers, 2016, Paper No. S1110201. DOI: https://doi.org/10.1299/jsmemecj.2016.S1110201
5. Shoichiro Fujisawa, Koya Akabori, Jiro Morimoto, Junji Kawata, Yoshio Kaji, Mineo Higuchi, and Yoshiyuki Booka, "About the Ride Comfort of Wheelchairs Running on Uneven Surfaces", Proceedings of the JSME Conference on Robotics and Mechatronics (ROBOMEC), 2021, Session No. 2P3-D02. DOI: https://doi.org/10.1299/jsmermd.2021.2P3-D02
6. Hiroichi Sano, Ryuya Yanagihashi, "Research on the Impact of Cross Slopes in Wheelchair Assisted Running", Journal of Nursing Science and Engineering, Vol. 12, 2024, pp. 54-66.

DOI: https://doi.org/10.24462/jnse.12.0_54
Tamotsu Kitabayashi, Shinichi Demura, Hiroki Aoki, "Examination of Effective Body Sway Parameters for Healthy Elderly", American Journal of Sports Science and Medicine, Vol. 6, No. 1, 2018, pp. 22-27. DOI: https://doi.org/10.12691/ajssm-6-1-5

7. Daiki Yokoyama, Shuntaro Tamura, Kazuki Fujisaki, Kenichiro Mitsuyama, Tomohiko Sato, Kazura Kobayashi, Tomohiro Otani, "Influence of caregiver understanding of their capability to perform activities of daily living, disease comprehension, and attitudes on occupational low back pain: a cross-sectional study", Journal of Physical Therapy Science, Vol. 36, No. 9, 2024, pp. 577-582. DOI: https://doi.org/10.1589/jpts.36.577
8. Satoshi Hashizume, Ippei Suzuki, Kazuki Takazawa, Yoichi Ochiai, "Discussion of Intelligent Electric Wheelchairs for Caregivers and Care Recipients", arXiv, December 26, 2019. DOI: https://doi.org/10.48550/arXiv.1912.11729
9. Tetsuaki Kawada, "Study on Passive Link to Improve Running Performance of Joystick-Type Six-Wheeled Electric Wheelchair on Curb Climbing: Part 1", Transactions of the Japan Society of Mechanical Engineers, Vol. 90, No. 931, 2024, pp. 23-00241. DOI: https://doi.org/10.1299/transjsme.23-00241
10. Kazunori KAEDE, Masato UTSUGI, Keiichi WATANUKI, Keiichi MURAMATSU, "Estimation of driving environment with mental strain using operation information of mobility scooter", Transactions of the JSME (in Japanese), Vol. 86, No. 892, 2020, pp. 1-9. DOI: https://doi.org/10.1299/transjsme.20-00162
Cheng-Min Tsai, Chih-Kuan Lin, Sing Li, Wang-Chin Tsai, "Usability Evaluation on User Interface of Electronic Wheelchair", Human Aspects of IT for the Aged Population. Ageing, Design, and User Experience, Lecture Notes in Computer Science, Vol. 10297, 2017, pp. 375–386. DOI: https://doi.org/10.1007/978-3-319-58536-9_37
11. Yoshiki Sanada, Hiroshi Suzuki, Tomoki Matsuo, Akinobu Kuwahara, Takahiro Kitajima, Takashi Yasuno, "Human-Friendly Safe Driving Support System of Electric Wheelchair for Drift Suppression", Journal of Signal Processing, Vol. 24, No. 4, 2020, pp. 199-202. DOI: https://doi.org/10.2299/jsp.24.199
Tetsuaki KAWATA, "Research on commercially electric wheelchairs and improving the running performance of passive link of joystick-type 6-wheel electric wheelchairs on uphill and downhill roads Part 1", Transactions of the JSME (in Japanese), Vol. 90, No. 931, 2024, pp. 1-20. DOI: https://doi.org/10.1299/transjsme.23-00241
12. Koki Kimino, Yudai Yamashita, Hisakazu Nakamura, "Assisting Control of Electric Wheelchair for Collision Avoidance By Using a Depth Sensor", Transactions of the Institute of Systems, Control and Information Engineers, Vol. 34, No. 4, 2021, pp. 113-121. DOI: https://doi.org/10.5687/iscie.34.113
13. Haruna Kokubo, Taro Shibanoki, Takaaki Chin, Toshio Tsuji, "Obstacle Avoidance Method for Electric Wheelchairs Based on a Multi-Layered Non-Contact Impedance Model", Journal of Robotics, Networking and Artificial Life, Vol. 4, No. 1, 2017, pp 45-48. DOI: https://doi.org/10.2991/jrnal.2017.4.1.10
14. Tomoki Matsuo, Hiroshi Suzuki, Akinobu Kuwahara, Takahiro Kitajima, Hisashi Takai, Takashi Yasuno, "Safe Driving Support System for Electric Wheelchair Based on Time to Collision and Degree of Danger", Journal of Signal Processing, Vol. 22, No. 4, 2018, pp. 211-214. DOI: https://doi.org/10.2299/jsp.22.211

AUTHOR'S PROFILE

Hirofumi Maeda is a Professor in the Information Science and Technology Department at the National Institute of Technology (KOSEN), Yuge College. Dr. Maeda's research focuses on the practical application of mechanical engineering, namely, developing rescue robots, pipe inspection robots and natural language processing. Dr. Maeda previously served as a researcher at the NPO International Rescue System Institute. Dr. Maeda is currently a member of the Japan Society of Mechanical Engineers, the Robotics Society of Japan, the Japan Association for College of Technology, and the Japan Institute of Marine Engineering. Dr. Maeda has published 17 peer-reviewed papers and presented 85 papers. Additionally, Dr Maeda received two awards at academic conferences and secured 15 external funding sources.

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