KEMENTERIAN PENGAJIAN TINGGI
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI

POLITEKNIK MALAYSIA
TUANKU SYED SIRAJUDDIN

National Conference on TVET for Undergraduate Students

e-Proceedings NCTS 2022

NATIONAL CONFERENCE ON TVET FOR UNDERGRADUATE STUDENTS

E-PROSIDING
NATIONAL CONFERENCE
ON TVET UNDERGRADUATE STUDENTS
2022

This book contains information submitted by the author based on his knowledge, experience and expertise in the field of teaching cost accounting. In addition, this book also contains some information obtained from other parties whose original source is stated through reference.

However, since this book only covers topics related to element costs then readers are encouraged to refer to the contents of other related books to gain a detailed understanding in cost accounting.

Published by:
Politeknik Tuanku Syed Sirajudddin (PTSS)
Pauh Putra, 02600 Arau, Perlis
Tel No. : 04-988 6200
Fax No. : 04-988 6300
www.ptss.edu.my

e ISBN 978-967-2258-97-1

9 7 8 9 6 7 2 2 5 8 9 7 1

e-Proceedings NCTS 2022

The Development of Motorized Rehabilitation Bike for Stroke Patient

Khairunnisa Izzati binti Mohd Azhar[1], Pushpa A/p Jegannathan[2]

[1] Department of Electrical Engineering,
Politeknik Sultan Salahuddin Abdul Aziz
Shah, Shah Alam, Selangor, Malaysia.
khairunisaizzati14@gmail.com

[2] Department of Electrical Engineering,
Politeknik Sultan Salahuddin Abdul Aziz
Shah, Shah Alam, Selangor, Malaysia
pushpa@psa.edu.my

Abstract

Globally, stroke is still one of the major causes of death and disability and it may be quite difficult to live with. Stroke can occur at any age, but it is significantly more common in older people than in younger people. However, the existing equipment is mostly operated manually, with more focus on the legs. Furthermore, every patient who needs physiotherapy in the hospital needs an alternative way to do their therapy at home or a rehabilitation centre. To address these issues, we have developed a motorized rehabilitation bike for stroke patients. This product is an automatic, motor driven pedal system for both the hands and the legs that will be more effective for the treatment of the user while being able to keep up a healthy lifestyle while doing therapy at home or facility. This device consists of a digital infrared sensor, microcontroller, ESP32, and a Thingspeak application that can record the data automatically. This device can be operated by using an application that can display the patient's data namely the speed of the pedal and the number of cycles, which can be recorded to the cloud system that could then be accessed by physiotherapists and users. This product will benefit patients suffering from a stroke while simultaneously saving both time and money.

Keywords: Stroke, Manual, Automatic, Digital Infrared sensor, ThingSpeak.

1. Introduction

In the majority of countries, a stroke is either the second or third most common cause of death, and it is also one of the primary causes of acquired adult impairment. Stroke is a leading cause of long-term disabilities, such as hemiparesis, inability to walk without assistance, and dependence of others in the activities of daily living (Barbosa et al., 2015). Besides, in Malaysia, stroke has become a significant public health issue (Ganasegeran et al., 2020). The purpose of

stroke rehabilitation is to assist you in relearning abilities that were lost when a stroke impacted a part of your brain. The cycling provides the mechanical coupling between the two legs helps the stroke patients to pedal cyclically so that a steady pattern of excitation emerge in the affected limb (Khichadiya & Kanase, 2017). Rehabilitation assists people who have had a stroke in relearning abilities that are unexpectedly lost when a part of the brain is injured.

Stationary cycling exercise utilized with numerous different interventions in the clinical (Raza et al., 2021). Everyone heals differently after a stroke, and the duration of your recovery will be determined by a variety of factors. Besides, the patient is required to visit the rehabilitation center at least twice a week, which is inconvenient for the patient and the guardian. Thus, it becomes imperative to have a method to monitor and quantitatively assess in-home rehabilitation exercises (Lee et al., 2019). Currently there are many motorized single rider stationary exercise bikes that are commercially available and that can provide a preprogrammed speed for the rider (Romero-laiseca et al., 2019). Nowadays, technologies with these characteristics are becoming more attractive for motor rehabilitation at home, thus respecting the social distancing that is required at this time of the COVID-19 pandemic, which presents a high risk to the elderly and can cause severe neural diseases (Cardoso et al., 2021).

This project will design and innovate a bicycle rehabilitation device from manual to automatic mode. This device will detect the fingers and foot when it starts to approach both paddles by using a digital infrared sensor and the paddle will start to move. We also use a rechargeable battery as a source since it is portable. This is a stationary bike development for rehabilitation that uses an existing bike with the ability to adjust the speed of both paddle and a step counter so that patients can observe their cycles. A stroke patient with upper and lower limb paralysis will benefit from this device. This bike also allows the patient to do therapy anywhere and at any time.

2. Methodology

For this chapter, it consists of block diagram, flowchart, estimation cost of project, design of project and circuit diagram. This section contains the flowchart used in constructing The Development of Motorized Rehabilitation Bike for Stroke Patient, as well as the procedure and application of this project.

2.1 Mechanical design of Motorized Rehabilitation Bike for Stroke Patient

The rehabilitation bike in Figure 1 has automatic mode and both pedal has their own sensor and DC motor. This is the left view of mechanical design of the Motorized Rehabilitation Bike using Tinkercad.

Figure 1: Mechanical Design of the Motorized Rehabilitation Bike

2.2 Developing the hardware and Internet of Thing (IoT) implementation of the Motorized Rehabilitation Bike.

Figure 2 shows the system of circuit installation of the rehabilitation bike. There is an ESP32 connection, a motor driver connection and a microcontroller connection which is a PCF8574 connection. The ESP32 NodeMCU works as a device controller, so Arduino software can be used to load programs onto it.

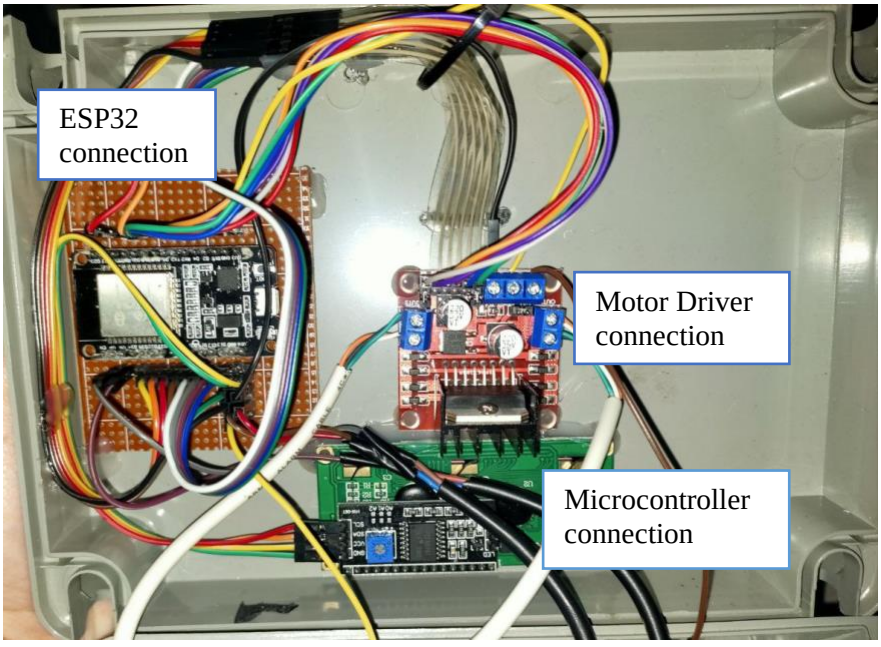

Figure 2 : Circuit installation of the Motorzed Rehabilitation Bike

The development of the electronic and mechanical components of the rehabilitation bike is visualized in Fig 3. Each arm and leg pedal has its own sensor and DC motor to move forward when the patient selects a forward speed. Through the keypad, the patient's desired speed may be selected. Since the ESP32 has been powered on, the DC motor will begin to rotate automatically once the desired speed has been selected. In addition, Figure 4 illustrates the device's keypad for controlling the speed of both pedals. The upper keypad controls the leg pedal, while the bottom keypad controls the arm pedal.

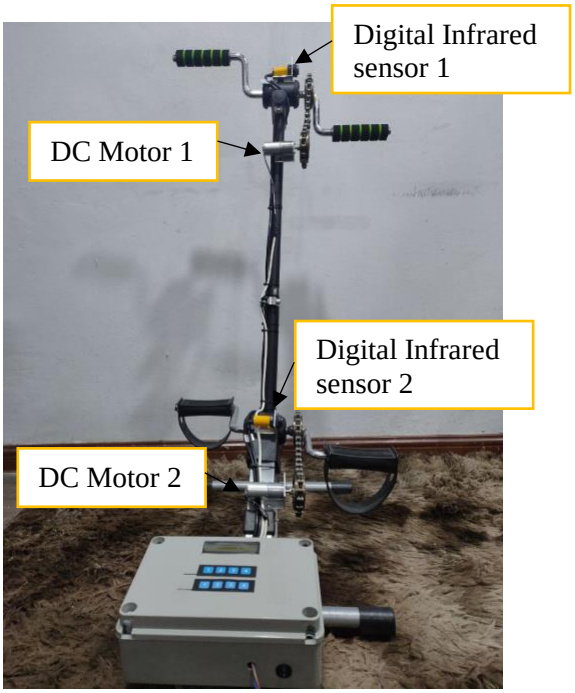

Figure 3: The Development of Motorized Rehabilitation Bike for Stroke Patient

Figure 4: Keypad to control the speed

This is the interface of the Internet of Things (IoT) implementation utilizing the Thingspeak application for showing the number of cycles and evaluating the data. Referring to Figure 5 shows the graphical representation. Any device, even a smartphone, is capable of opening the ThingSpeak program provided it is hosted on a web server. The program known as ThingSpeak is a real-time data stream that runs on the cloud server.

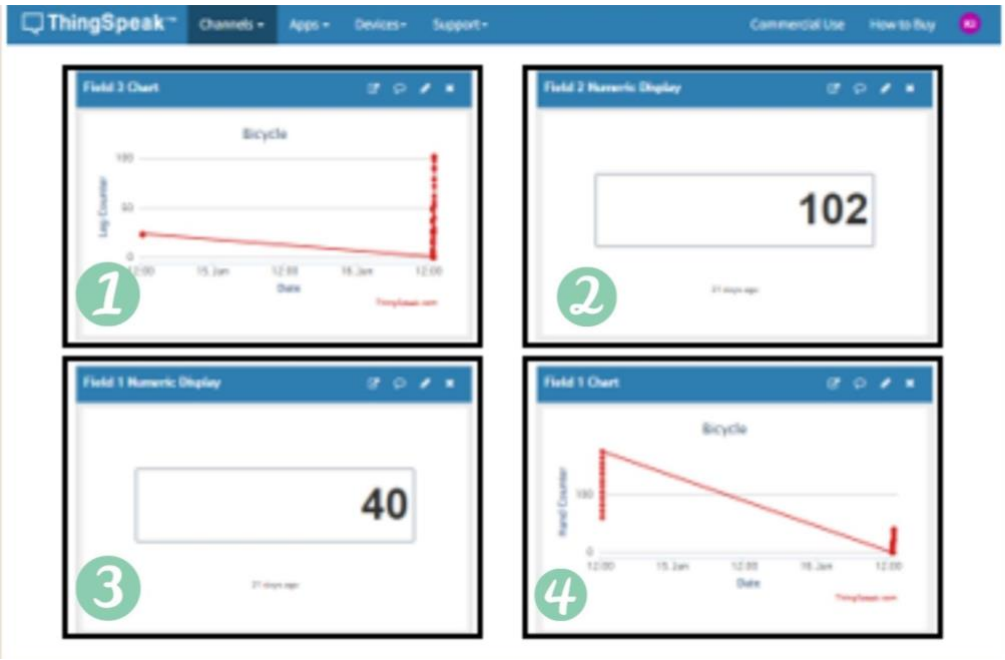

Figure 5: Interface of Implementation using ThingSpeak application

Table 1: Function of the Thingspeak application

NO.	FUNCTION
1	Number of cycles for leg pedal in the shape of graph
2	The number of cycles on leg pedal
3	The number of cycles on arm pedal
4	Number of cycles arm pedal in the shape of graph

2.3 Block Diagram

Figure 6 demonstrates the methodology in further detail. The block diagram illustrates the component of the system, which consists of three major parts: input, process, and output. The input process of the project's block diagram consists of the battery, digital infrared sensor, and motor driver. A digital infrared sensor is responsible for detecting and transmitting a signal as the input sensor. In this project's programming, the PCF8574 serves as the microcontroller. Then, the DC motor serves as the output, while the LCDs the pedal's speed. The ESP32 is utilized to

transmit the input data to the server through a Wi-Fi connection. ThingSpeak is a cloud-based IoT analytics platform service that enables the collection, visualization, and analysis of live data streams. The server's application, which is the ThingSpeak application, will display the number of cycles on a smartphone or other device.

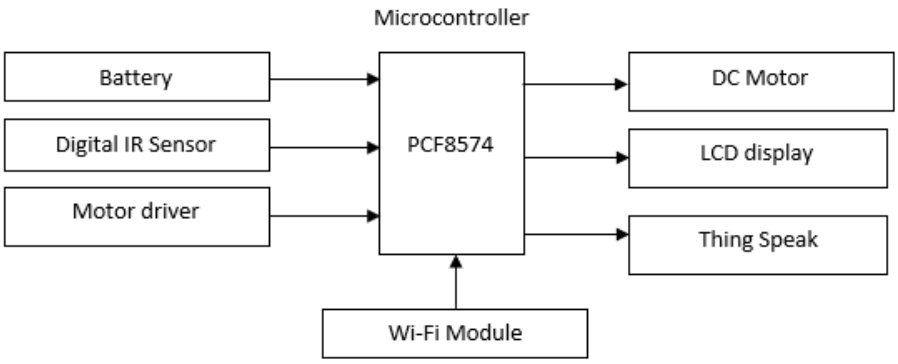

Figure 6: Block Diagram of the Development of Motorized Rehabilitation Bike for Stroke Patient

2.4 Flow Chart of the Operation Device.

Figure 7 is a flowchart depicting the operation of the rehabilitation bike. To activate the device, patients must position a chair in front of the pedal and place both their hands and feet on it. Then, activate the battery to begin. Connect the equipment to a mobile device for the data to be stored in the Thingspeak application. After that, if the sensor senses motion on the pedal, it will flash. The patient can then select the desired speed to regulate the pedal's speed, at which point the DC motor will begin to rotate. The number of cycles will then be displayed on the Thingspeak application, and the user and patient will be able to record the data. The session will conclude following the prepared program.

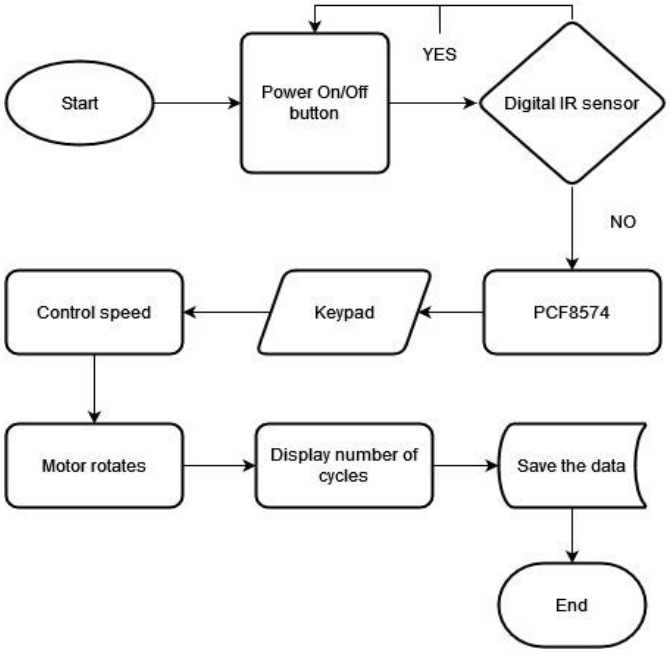

Figure 7: Flow Chart of the project

2.5 Data Analysis Method

After the completion of the final prototype, the results from testing the functionality of the device are collected and analyzed. Testing of both the hardware and the software was carried out to evaluate the suitability of the device for use by stroke patients in the course of their rehabilitation therapy. As can be seen in Figure 8, the subject has examined the device that is being tested.

Figure 8: Testing of the hardware on the subject

3. Result and Discussion

There are manual and automated modes on this device for patients who have had strokes. Three people of varying ages are shown in Table 2 using a motorized rehabilitation bike. All three participants were closely monitored for 10 to 20 minutes to get the optimal result.

	SUBJECT 1 (AGE 56)	SUBJECT 2 (AGE 32)	SUBJECT 3 (AGE 23)
SPEED (ARM)	Number of cycles		
2	17	22	35
4	22	69	93
SPEED (LEG)	Number of cycles		
2	34	74	113
4	48	92	186

Table 2: Result of the subject based on different ages

Figure 9 illustrates a graph based on the speed of each of the three subjects tested. These three individuals were put through their tests using the fastest and slowest pedal speeds available. The plot in Figure 9 demonstrates that older persons may have difficulties pedaling the pedal since it is automated. Pedaling is much simpler for younger folks.

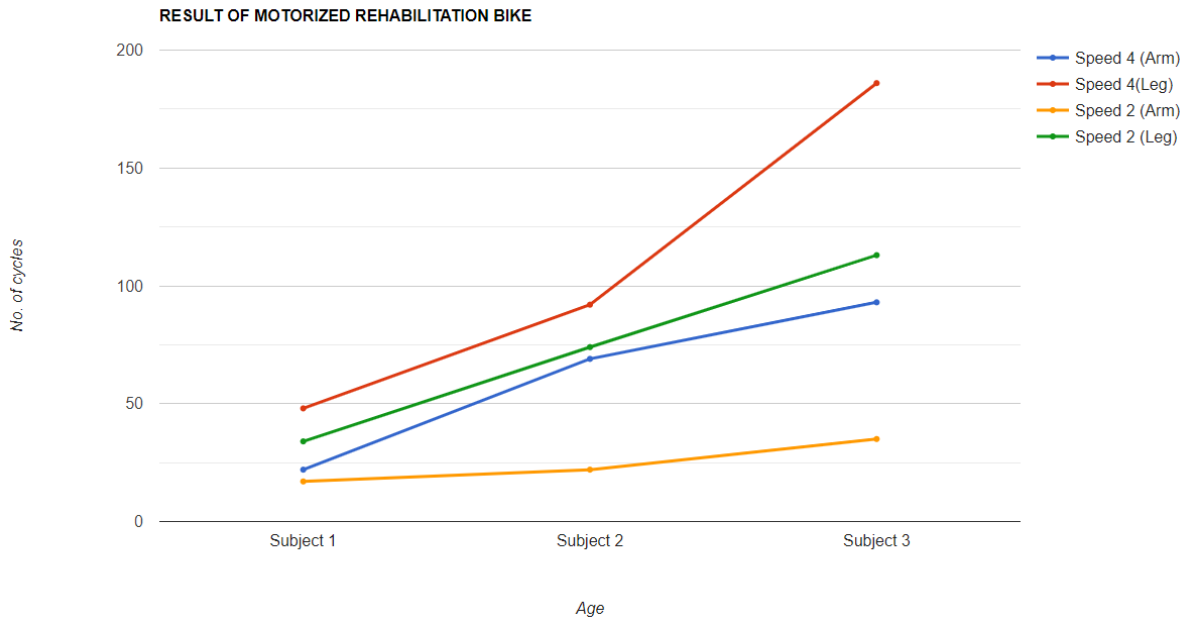

Figure 9: Graph shows the result of motorized rehabilitation bike

4. Acknowledgement

A particular gratitude goes out to my supervisor, Madam Puhshpa A/p Jegannathan, and the other lecturers of Polytechnic Sultan Salahuddin Abdul Aziz Shah. We would like to extend our appreciation to those researchers who have posted technical papers to the Internet. It is of great assistance to me in completing the job.

5. Conclusion

The purpose of the project is to design a stroke-friendly, user-friendly rehabilitation cycling system. Moreover, upgrading the current manual rehabilitation bicycle into an automated model can aid stroke patients' recovery. In addition, the potential to develop an intelligent gadget that aids in muscle recovery and allows the patient to do therapy anywhere dependent on the distance between their house and the rehabilitation center. Moreover, to enhance an innovative rehabilitation bike by storing patient data in a Thinspeak application. In order to properly organize this project, it is important to define the project's background, problem description, objectives, scope and relevance. By adhering to the specifications and goals, we as users can improve it and make it more beneficial to their lives.

6. References

Barbosa, D., Santos, C. P., & Martins, M. (2015). The application of cycling and cycling combined with feedback in the rehabilitation of stroke patients: A review. *Journal of Stroke and Cerebrovascular Diseases*, *24*(2), 253–273. https://doi.org/10.1016/j.jstrokecerebrovasdis.2014.09.006

Cardoso, V. F., Delisle-Rodriguez, D., Romero-Laiseca, M. A., Loterio, F. A., Gurve, D., Floriano, A., Valadão, C., Silva, L., Krishnan, S., Frizera-Neto, A., & Bastos-Filho, T. F. (2021). Effect of a brain–computer interface based on pedaling motor imagery on cortical excitability and connectivity. *Sensors*, *21*(6), 1–13. https://doi.org/10.3390/s21062020

Ganasegeran, K., Ch'ng, A. S. H., Aziz, Z. A., & Looi, I. (2020). Population's health information-seeking behaviors and geographic variations of stroke in Malaysia: an ecological correlation and time series study. *Scientific Reports*, *10*(1), 1–13. https://doi.org/10.1038/s41598-020-68335-1

Khichadiya, P. M., & Kanase, S. B. (2017). *Indian Journal of Physiotherapy and Occupational Therapy*. *11*(2).

Lee, M. H., Siewiorek, D. P., Smailagic, A., Bernadino, A., & Bermúdez I Badia, S. (2019). Learning to assess the quality of stroke rehabilitation exercises. *International Conference on Intelligent User Interfaces, Proceedings IUI*, *Part F1476*, 218–228. https://doi.org/10.1145/3301275.3302273

Raza, M. A., Waris, M., Murtaza, F., Waris, S., Noor, R., & Bashir, S. (2021). Effects of Treadmill Training and Stationary Cycling Training to Improve Ambulatory Function and Cardiovascular Fitness. *Pakistan Journal of Medical and Health Sciences*, *15*(9), 2171–2174. https://doi.org/10.53350/pjmhs211592171

Romero-laiseca, M. A., Cardoso, V., Pomer-escher, A., Longo, B., Nascimento, S. S. G., Lima, J. P. S., Loterio, F. A., & Frizera-neto, A. (2019). *Towards a Lower-Limb Rehabilitation System Based on Motor Imagery and Motorized Pedal for Stroke Patients*. *March*.