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Smart Wheelchair Design for the Disables to Worship at the Mosque

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Abstract

Persons with disabilities with limited walking (leg disabilities) need assistive devices in carrying out life routines, especially praying at the Mosque. Current data show that 10% of the world's population or 65 million people are those with walking limitations (foot disabilities). Therefore, it is necessary to design a wheelchair that is more innovative and responsive so that the movement of people with disabilities is more assisted and flexible. This article will discuss how the author designs and manufactures wheelchairs to help people with disabilities perform prayers at the mosque. The name for the product made is Wheelchair design. To design the product the author uses the prototype method, this method is carried out by identifying problems, analyzing user needs, designing products according to user needs, making products that have been planned. This design is one of the technological development innovations in Islam as a religion that teaches its people to innovate in various scientific aspects. Besides that, this tool is actually very helpful for people with disabilities in making it easier for them to carry out worship at the mosque.

Introduction

Accessibility is a right for every person with a disability. These rights include the use of public facilities, getting proper accommodation, and getting accessibility of worship services (Handari, 2019). According to Indriani & Marlina (2020), related to the accessibility or availability of facilities and infrastructure for persons with disabilities, it is regulated in the Regulation of the Minister of Public Works of the Republic of Indonesia No. 30 of 2006 concerning technical guidelines for facilities and accessibility in buildings and the environment. This PU Ministerial Regulation regulates the technical requirements for facilities and accessibility in buildings and environments that are used or visited by people, in particular, so that they are easily accessible to the elderly and persons with disabilities. Meanwhile according to Riyadi, (2021) the implementation of the fulfillment of the right to accessibility is regulated in Law Number 8 of 2016. Equality of opportunity is a condition that provides opportunities or provides access to persons with disabilities to channel their potential in all aspects of state and community administration.

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However, according to Suciyani & Oktavia, (2020) there are several facilities that have not been fulfilled including: places of worship; zebra crossing; public transportation stops; guide lines; handrails; information centers, and internet access facilities. Accessibility is the convenience provided to create equal opportunities in every aspect of life (Ma'ruf et al., 2018). Accessibility of persons with disabilities in obtaining employment needs to be provided easily. With accessibility, it will make it easier for people with disabilities to carry out their mobility, especially when using public facilities (Fathimah & Apsari, 2020). The need for accessibility is a very important need for persons with disabilities because it motivates their equal participation and independence in society (Syafi'ie, 2014). The right to access accessibility is a basic service need (Oliveira et al., 2020). Accessibility needs have a very important role for persons with disabilities. Persons with disabilities have the same rights and obligations as other Indonesian citizens (Itasari, 2020). The provision of access to improve quality and assistive devices for persons with disabilities should have been fulfilled when using public accessibility (Thamrin & AP, 2022). However, the reality on the ground is that there are still public facilities that pay less attention to accessibility facilities.

According to Bricout et al., (2021) accessibility has a goal for the public interest, especially people with disabilities as an effort to overcome problems for people with disabilities. Good accessibility is the ability to overcome several mobility barriers, both related to physical mobility and non-physical mobility (Ibrahim et al., 2020). Physical mobility is a natural human need that is needed to carry out daily activities in the form of walking, running, joint movement, exercise, and activity ability, while non-physical mobility is an opportunity to work, get problems faced by people with disabilities usually there is still minimal access to information about the importance of doing rehabilitation, lack of public facilities that help people with disabilities and lack of access to jobs for people with disabilities. There are several things that become problems in the use of public facilities for persons with disabilities. Some examples include the absence of ram as a special pathway for persons with disabilities, the absence of handrails in the toilets, and the absence of symbols for persons with disabilities to provide information that these facilities can be used by persons with disabilities. Regulation of the Minister of Public Works Number 30/PRT/M/2006; convenience intended for persons with disabilities in order to apply equal rights and opportunities in terms of life and livelihood. Thohari, (2014) can be used as a technical reference for facilities and accessibility in public buildings and the environment to design public facilities that take into account the needs of persons with disabilities. Education and access to information. According to Lussier, (2019) the Mosque is a community building that functions as a means of worship for Muslims which we can find in almost all places in Indonesia. Qadaruddin et al., (2016) The Mosque is one of the most important facilities for Muslims in carrying out worship. The Mosque is the most crowded place of worship at certain times (Nasution & Wijaya, 2020). Hasanain & Muslimatusshalihah, (2021) mosques do not only function as places of worship, but also have other functions, such as economic, political, educational, social, and science and technology functions. The Mosque has a very important function in Islamic society, both as a media center for developing people and as a place of worship (Ridwanullah & Herdiana, 2018). The function of the Mosque over time will develop because there are many activities that can be carried out in the Mosque, it is hoped that the function of the Mosque will develop, so that visitors from the Mosque will increase both with the aim of worship, education, tourism, social and others. This facility can be used for both normal individuals and individuals with disabilities. However, the reality that develops in society is that there are still many attitudes of discrimination against persons with disabilities. Usually, people with disabilities are more accepting of discriminatory behavior from the surrounding environment (Hall, 2016). Wheelchair user Rade Bunga said that when she came to the Mosque, she was not allowed to enter the Mosque or to the carpeted area because she was worried that the wheels on the wheelchair used would carry dirt from outside. "In the end, I was forced to sit in the back row outside the carpet," said Rade

Bunga in an accessibility study with the Jakarta Barrier Free Tourism or JBFT at the El Syifa Mosque in Ciganjur, South Jakarta.

Fig 1. Difficulties, independence, and discrimination of people with disabilities in using manual wheelchairs to worship at the Mosque

A person with a disability needs ease of mobility. Generally, the tool used to help someone with a disability is a wheelchair (Magasi et al., 2018). A wheelchair is a mobility aid for individuals who have special needs, for example, persons with disabilities (King et al., 2019). For wheelchair users, it is certainly not easy to move from a wheelchair to another wheelchair or a regular chair if you want to worship. This is because each wheelchair is designed according to the needs of its users and is safe when operated (Rabhi, Mrabet, & Fnaiech, 2018). It is also quite inconvenient if each wheel in a wheelchair has to be wrapped to ensure its cleanliness before being brought into the Mosque. After all, each wheel on a wheelchair has a different size, according to the model. If there is no one around a person with a disability, it will be difficult for him to move the wheelchair to change positions (Rabhi et al., 2018). Various problems experienced by people with disabilities when they want to worship at Mosque. Starting from the difficulty of operating a wheelchair, being dependent on others, to the occurrence of discriminatory attitudes.

According to Nurhakim et al., (2022) various fields must be used by persons with disabilities so that they are able to get the same opportunities, equality, and rights in life. In Islamic jurisprudence, persons with disabilities need public spaces and friendly facilities to worship and study religion (Jamaluddin & Zahara, 2020). The provision of accessibility for places of worship for persons with disabilities is still far from expectations (Nurhakim et al., 2022). According to Rahayu, (2019) there are 4 principles of accessibility according to the Regulation (Government of the Republic of Indonesia 2006) that are tried to be applied in the context of making a Mosque that is friendly for people with disabilities, where the four principles seek to facilitate access to a place, then ease to enter into a welcoming environment. Desired, besides that the desire to use all existing facilities can be fulfilled, as well as the ease of reaching or entering and using the facilities properly without being an object of pity from others. Article 18 of Law Number 8 of 2016 concerning Persons with Disabilities clearly stipulates that persons with disabilities have the right to have accessibility to utilize public facilities and obtain adequate accommodation as a form of accessibility for individuals. However, in reality the provision of friendly support facilities for persons with disabilities in places of worship is still not optimal (Tamami & Suryawati, 2021).

The Mosque is a vehicle in order to improve human relations with God and fellow human beings, which is included in the category of worship as well as the task of human life (Syarifudin & Ishak, 2020). Every day the Mosque is always visited by worshipers who want to pray. Congregants who come to the Mosque vary, some are physically normal and some are physically abnormal or have disabilities. There should be no difference because the Mosque is the house of Allah, it should also be friendly to people with disabilities because it is to fulfill the obligation to worship at the Mosque (Yusri et al., 2021). The

provision of friendly access for persons with disabilities in places of worship, especially Mosques, is actually a simple and inexpensive activity. This is only a matter of sensitivity to the rights of others. Efforts to prosper the Mosque are carried out in several stages, the first stage is process planning, namely long-term planning and short-term planning and the second stage is organizing functions, this is applied to the division of functions, tasks, and responsibilities to Mosque congregations (Hartanto, 2019). Realizing the prosperity of the Mosque is the duty of every believing Muslim and the prosperity of the Mosque can only be achieved by empowering and functioning it (Hendrik et al., 2023). We as religious and faithful human beings should prosper Mosques, especially in providing accessibility (Jumriani et al., 2022). Therefore, it is the duty of religious people to manifest beauty in the sky into beauty on earth. Realizing the nature of Ar-Rahman and Ar-Rahim Allah in everyday life.

A wheelchair is one of the most efficient tools for those with foot disabilities or people who are unable to walk to be able to move from one place to another, either from a flat place or from a low place to a higher place. A wheelchair is a tool used for individuals who have difficulty walking, whether it is due to injury, illness, or disability (Akbar et al., 2021). It is often also intended that wheelchairs are useful for increasing mobility abilities for people with disabilities such as: hospital patients who are not allowed to do a lot of physical activity, people with physical disabilities (especially people with leg disabilities), the elderly (elderly), and people with disabilities. people who have a high risk of being injured when walking alone (Kummeneje & Rundmo, 2019).

With the development of science and technology, currently, there are many types of wheelchairs on the market, ranging from conventional wheelchairs to wheelchairs that are controlled for movement (Sahoo & Choudhury, 2023). According to (Al-Qaysi et al., 2018) in general, wheelchairs are divided into two types, namely conventional wheelchairs and electric wheelchairs. Electric wheelchairs are used to help people with disabilities move more freely and independently (Nurmianto et al., 2021).

Fig 2. Manual and Electric Whellchairs

A wheelchair is a useful tool to help people with disabilities who have difficulty or cannot walk. A wheelchair pusher is a person who helps people with disabilities to push their wheelchair to a certain place (Yudiantyo, 2020). There are several reasons why people use wheelchairs, including birth defects, age, post-accident, joint disease, illness due to complications, injury, or disability. According to the Central Bureau of Statistics 2014 through the National Socio-Economic Survey (Susenas) data in 2012, it was found that the estimated population of Indonesia with disabilities was 2.45%. The increase and decrease in the percentage of persons with disabilities was influenced by changes in concepts and definitions in the 2003 and 2009 Susenas which still used the concept of disability, while the 2006 and 2012 Susenas included the concept of disability. However, the comparison between the 2003 and 2009 Susenas and the 2006 and 2012 Susenas showed an increase in prevalence. Based on the 2012 Susenas data, persons with disabilities are persons with more than one type of disability, which is 39.97%, followed by visual impairment, and walking or climbing stairs.

Fig 3. Congregants with disabilities climb the steps of the Mosque using wheelchairs

In this life, humans cannot refuse technological progress, because along with the times, science will develop and therefore technology will also develop (Tripsas & Gavett, 2017). The development of an increasingly sophisticated era has touched almost all fields of work. Work that was originally difficult to do becomes more efficient and effective in achieving it, especially in the field of electronics, many electronic devices are found that help human activities and ease human work. These developments can be seen from various fields, one of which is in the health sector which includes service quality, variety of medical devices, therapy and so on. Many fields of medical equipment in hospitals are starting to use modern tools in the field of electronics, to get results that are faster, more accurate, and more efficient (Anara, 2023). A wheelchair is one of the tools in the health sector that is used to provide convenience to individuals who have physical limitations, especially for those with leg disabilities and the inability to walk due to poor health conditions (Junior & Arifin, 2019).

Statistical data compiled by WHO (World Health Organization) in June 2011 regarding persons with disabilities, it shows that there are 1.1 billion persons with disabilities worldwide. Approximately 15% of the world's population lives with some form of disability, 2-6 percent of whom experience significant difficulties in functioning. Data released by the 2018 Susenas, there are 14.2% of Indonesia's population with disabilities or 30.38 million people. Until now, as an effort to protect people with disabilities, Indonesia has Law Number 4 of 1997 concerning Persons with Disabilities, it is stated that disability/disability is anyone who has physical and mental disorders that can interfere or become obstacles and obstacles to carrying out life properly (Tambariki, 2018).

According to Hidayat, (2020) people with disabilities are people who have certain physical or non-physical limitations that make them unable to carry out activities like humans in general. Meanwhile, according to Spitzer & Endicott, (2018) disability is a condition where individuals who are in their period of growth and development experience abnormalities, which include physical, mental, emotional, and social, so that in making adjustments to the environment they experience obstacles in their behavior. People with disabilities often experience functional difficulties. Functional difficulties are a person's inability to carry out normal daily activities days such as difficulty moving, and difficulty seeing. Based on Indonesian Statistics, there are five functional difficulties that are covered in the 2010 Population Census, namely; Difficulty seeing by 29.63%; hearing difficulties by 7.87%; difficulty walking by 10.26%; difficulty remembering or concentrating by 6.70%; and difficulty taking care of themselves by 2.83%. Among people with disabilities, 10.26% of them experience walking limitations and must use a wheelchair as a walking aid. Their ability to move some parts of the body is limited and requires the help of others for every activity.

Research there are several obstacles experienced by people with physical disabilities who use wheelchairs in accessing public facilities, namely: 1) unexpected changes in vertical surfaces on sidewalks, stairs, and gutters, avoiding travel paths that can be accessed

manually. Continuously; 2) excessive inclination across the direction of travel on the trail which makes wheelchair control difficult; 3) providing insufficient space to the door and inside the room to allow the dimensions of the wheelchair and the turning circle; 4) not paying special attention to the steps and design of the handle to ensure adequate support; 5) seating that does not consist of waiting areas, at counters, and along long walkways to reduce fatigue; and 6) access vulnerabilities related to doors, including the need to manipulate handles when using a walking aid and difficulty moving.

In general, wheelchairs that are often used in hospitals and in the environment around us still have physical limitations because they use a manual system (Junior & Arifin, 2019). Manual wheelchair in operation requires someone to move the wheelchair, but this is for users who have limitations to move the wheelchair can not do it. Ideally, a wheelchair that is implemented makes the user feel free to adjust the movement of the wheelchair according to his will (Sailana et al., 2021). In fact, this cannot be done by users who have limited hands, so they need a tool to be able to move a wheelchair without depending on other people and stay safe. So we need a tool that can help the mobility of wheelchair users in the form of an electric wheelchair that can move with the help of a motor that is controlled on the control lever (Joystick) on the hand of the wheelchair so that the tool is easily controlled by the user himself.

Method

This article aims to discuss wheelchair design wheelchair innovation as a tool for people with disabilities to worship in Mosque. To make this wheelchair innovation, this author uses the prototype method as the steps for the resulting product. In general, there are three aspects that the writer will explain, first; product design designed, second; devices used in the product, third; product operational processes that have been designed. To make it clearer, the steps for making this product can be seen in the following figure 4:

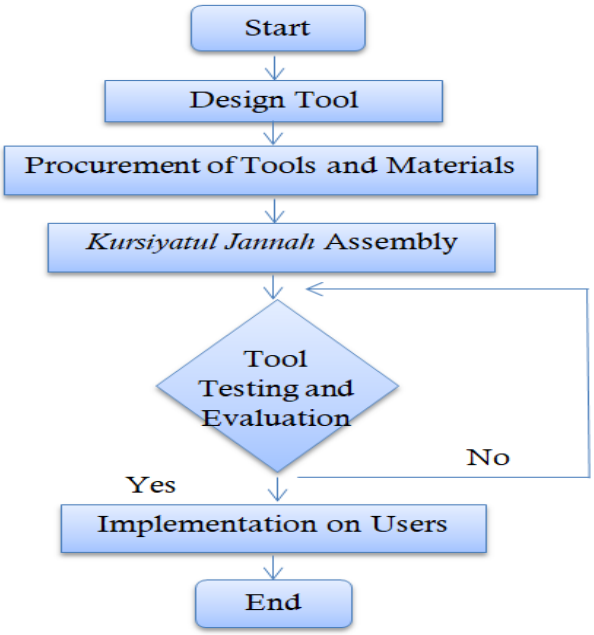

Fig 4. Themethod prototype design of *Wheelchair design* as a tool for people with disabilities to worship at the Mosque

Findings and Discussion

The development of wheelchairs has been carried out a lot, starting from those who can climb stairs, stand up, and so on. However, those who are friendly to the implementation of worship in Mosques are still very minimal. Moreover, a multifunctional wheelchair. So that the author develops a wheelchair that is multifunctional and friendly to the implementation of worship for Muslims. This will also minimize discrimination against persons with disabilities who use wheelchairs. Wheelchair design is a mobility aid used by

persons with disabilities with an external drive from an electric motor with direct current (DC). Along with the rapid development of science and technology, this has influenced the development of many electric wheelchairs, such as the addition of automatic propulsion and standing features that are useful for making users feel sensations like normal people (Seymour, 2019).

The latest innovation applied to wheelchair design is applying technology in the current digital era and is multifunctional. The technology applied is the addition of DC power, DC motor, Joystick and Ultrasonic Sensor. The working system of (wheelchair design) will be regulated through a Microcontroller in the form of Arduino Uno. Wheelchair design has four main functions, including being able to walk automatically without using human assistance, being able to go up and down stairs with adequate safety and security, being aligned to form an angle of 180°, and being able to clean wheelchair wheels automatically. Thus, it is hoped that wheelchair design can help people with disabilities to be able to move more freely from one place to another without requiring the help of others.

This research was conducted to improve the performance and comfort of the design of an electric wheelchair with features that can run automatically, can go up and down stairs, can be aligned to form an angle of 180°, and is equipped with an automatic wheel cleaning feature. The assembly of wheelchair design is done mechanically and electrically. Mechanical manufacture is done by modifying the wheelchair frame. The frame for the manual wheelchair will be cut and then iron and welding will be added, so as to form the skeleton of wheelchair design. Electrical manufacture is done by making circuit schematics and programming. The circuit scheme will be designed using Eagle 9.6 and Proteus 8 Professional software which will then be applied to the Printed Circuit Board (PCB), while the programming will be programmed using the Arduino IDE software. The next stage is to combine the modified wheelchair frame with the circuit schematic that has been made on the PCB board. The DC motor is mounted on the wheel, then connected to the PCB board using a cable.

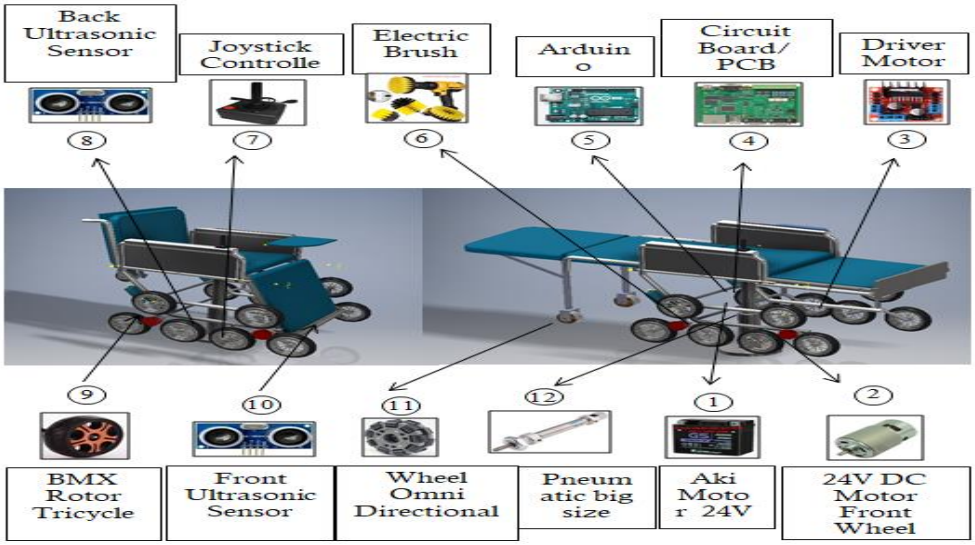

Fig 5. The prototype of *Wheelchair design*

Wheelchair design is equipped with electronic components whose functions include: 1) 24V Motor Battery serves as a source of power in driving wheelchair design, 2) 24V DC Motor Gearbox functions to convert incoming direct current into kinetic energy, 3) Motor Driver functions to drive a DC motor, where the direction of the DC motor changes depending on the value of the voltage input from the driver itself, 4) The circuit board or PCB is a thin board that is used as a place to put and assemble electronic components, 5) Arduino Uno serves as the center of programming input in designing the prototype of wheelchair design, 6) The electric brush serves to clean dirt or unclean on the

wheelchair wheels, 7) Joystick Controller functions as input equipment used to move and regulate the speed of the direction of movement, 8) Sensors Ultrasonic is used to detect objects or objects object in front of the sensor to avoid collisions or collisions, 9) The BMX tricycle rotor serves to support the wheelchair design so that it can go up and down stairs, 10) The omnidirectional wheel functions to facilitate the movement of the wheelchair design when in a supine condition, 11) The large size pneumatic is useful for support the weight of the wheelchair when you want to do wheel cleaning automatically.

The first step in making wheelchair design is planning and designing. In planning, the author conducted a literature study on the condition of persons with disabilities who use wheelchairs in carrying out daily activities, especially when carrying out worship at the Mosque. As for the design process on the design of the tool using the Autodesk Inventor 2018 application by paying attention to the precision of the component layout on the wheelchair design. The selection of electronic components and the procurement of supporting equipment are stages that must be carried out before the tool assembly process. Purchase and procurement of required components such as Arduino Uno, Joystick, DC Motor, Ultrasonic Sensor, and other supporting components.

Arduino is a component that can be used as a microcontroller. Arduino can be easily programmed, erased and reprogrammed at any time. The Arduino platform is designed to provide an inexpensive and easy way to build devices that can relieve them of using sensors and actuators. This simple microcontroller board is a computing platform used to build and program electronic devices (Hasibuan et al., 2021). According to Masnur et al., (2021) the main component on the Arduino board is an 8-bit microcontroller with the ATmega brand made by Atmel Corporation. Various Arduino boards use different types of Atmega depending on their specifications, for example the Arduino Uno uses the ATmega328 while the more sophisticated Arduino Mega 2560 uses the ATmega2560.

Fig 6. Arduino Uno

Joystick is an input device or computer input shaped like a lever or stick that can move in various directions (Weigel & Steimle, 2017). This device can transmit two or three-dimensional directions to a computer. This tool is generally used as a complement to playing video games that are equipped with more than one button, but in the design of wheelchair design this tool will be used as a lever in moving the wheelchair.

Fig 7. Joystick

DC motor is an electrical machine tool that converts direct current electrical energy into mechanical energy or motion energy (Zhou et al., 2020). The most important parts of a DC motor are the rotor and stator. The stator part is the motor body, the brushes and the magnetic pole core. The rotor is the rotating part of a DC motor. The parts that include the rotor are the armature windings, anchors, commutators, ropes, insulators, shafts, and bearings.

Fig 8. DC Motor

Ultrasonic sensor is a sensor that has the function of converting physical quantities (sound) into distance quantities (Yudha & Sani, 2017). The workings of this ultrasonic sensor is based on the principle of reflected sound waves to obtain or interpret (distance) an object with a certain frequency. Ultrasonic waves on the sensor are generated through a component called piezoelectric. This piezoelectric will produce ultrasonic waves with a frequency of 40 kHz.

Fig 9. Ultrasonic Sensor

Wheelchair design which initially only had one controller, will be modified into an electric wheelchair that can be controlled by two controllers. The controller added is the PS2 wireless controller. The user gives a command via the PS2 wireless controller, after that the PS2 wireless controller will send the command data to the receiver which is placed in Wheelchair design. The command data is then processed by Arduino and used as a reference to drive the wheelchair design. The working system of wheelchair design is as follows: 1) Turn on or press the button on/off to activate wheelchair design, 2) Use the Joystick Controller to adjust the speed and move the wheelchair to the desired destination, 3) If you want to climb stairs, direct heavy loads body back so that the load on the front of the wheelchair is reduced, 4) When the tricycle BMX rotor touches the stairs, pull thelever Joystick Controller to increase the speed of the wheelchair, 5) When the wheelchair is walking up the stairs, the pneumatics will work to stabilize the motion of the wheelchair, 6) If you want to go down stairs, direct your body weight backwards so that the speed of the wheelchair decreases, 7) The wheelchair can be aligned to form an angle of 180º if a person with a disability wants to lie down, 8) Pull and align the wheelchair until it forms an angle of 180º, 9) Then lower the wheel frame omdirectional, 10) If you want to go to the Mosque, then lower the pneumatic which is under the exchange rate in wheels, 11) After the weight of the wheelchair is lifted, run the wheel with the Joystick Controller and point the electric brush at the wheel.

After the mechanical and electrical manufacture of wheelchair design is complete, the next is to test the tool, if there is an error in the tool, it will be immediately evaluated, but if the tool works well, it is immediately implemented by the user. The revision of the tool is carried out if there is an error in the tool that has been made which we can know at the previous trial stage. After the wheelchair design has been completed in its entirety and

has been perfected, the next step is to introduce it to the nearest Mosques in the Padang City area by conducting outreach related to the output of the tool to people with disabilities. Planning and design is done by reviewing the theoretical basis that already exists and using it in systematic design calculations, so that it can be known about the desired working mechanism so that wheelchair design is safe in operation.

Conclusion

Wheelchair design is a technological innovation designed as a strategy to realize the SDGs in the era of the industrial revolution 4.0 and society 5.0. The implementation of wheelchair design will be able to increase accessibility for people with disabilities. The wheelchair design is designed to be able to run automatically, can go up and down stairs, can be aligned to form an angle of 180º, and can perform wheel cleaning automatically. It is hoped that with this wheelchair design, people with disabilities will no longer have difficulty when they want to worship at the Mosque and minimize the occurrence of discrimination because they are worried that the wheels on the wheelchair will carry unclean or dirt.

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