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Design and Development of an Automated Wheel Chair for Differently Abled Person Using Keypad and Bluetooth Technology

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Abstract- This paper mainly focuses on the design and development of a low-cost automated wheelchair for the patient or patient attender or differently abled person. The entire system is designed based on 24 V operating voltage. The various components/modules such as Permanent Magnet DC motors (PMDC motor), linear actuators, H bridge DC-DC chopper, DC voltage regulator, Microcontroller, keypad, and Bluetooth modules are selected as per the design. An eight-channel relay module is used as an H bridge circuit for linear actuator movements in order to move the left leg footrest, right leg footrest, and back supporting rest independently. Simulation of four quadrant chopper is carried out with an equivalent PMDC motor load to analyze the electrical parameters such as switching pulses, voltage across motor & current drawn by the motor using the MATLAB/Simulink software package. The hardware modules are mounted on the wheelchair and coupled to two PMDC motors and six linear actuators. The input voltage across the motor and current drawn by the motor are recorded using a power quality analyzer HIOKI PW3198 model. The waveforms and results obtained from the simulation of the power converter are in conformation with the hardware results obtained. The navigation mode, left leg footrest, right leg footrest movements, and reclining of the wheelchair are tested independently by using a switch selector to choose either keypad mode or Bluetooth mode and found to be successful with respect to the features considered for the design of the automated wheelchair.

INTRODUCTION

The word disability indicates a condition of the body or human mind where a person with these conditions may experience difficultly to lead daily works or even to interact with the world around him/her. In today's count, more than 650 million of the world's population are currently facing at least one and sometimes multiple forms of disability and incompetence. This number is most likely to increase soon due to the alarming increase in accidents, especially road accidents. The number is also contributed by the increasing number of older people due to medical advancement, in recent years. Studies have suggested that nearly 80% of people who suffer from disabilities reside in developing countries. Due to their financial position, they cannot receive proper facilities and treatment, which generally hampers their livelihood. This leads them to consider themselves as a burden to their family and society which leads to serious mental inferiority complexes and much more. The lack of participation in this enormous part of society decreases productivity to a large extent. Thousands of ill- fated persons become victims of road accidents in Bangladesh, every year. According to research conducted by the Bangabandhu Sheikh Mujib Medical University Report in 2015, shows that almost 47,437 people were victims of road accidents and received major or minor forms of disabilities. They have also presented that about 2-4% of the total population of Bangladesh experience significant difficulties in their daily life due to their disability . Unable to move from one place to another is one of the principal issues among disabled people. Typically, they use a wheelchair to cope up with the problem. But this solution binds them to a confined area as they have to manually move the wheels with hands. Recently, numerous companies and researchers are working on highly assistive, and various guidance systems enabled wheelchairs that can make the navigation system more comfortable for any kind of disabled person. Kalantri et al.

published a research proposal by showing a wheelchair design, where he has implemented a tilted acceleration sensor to navigate the chair in four directions. By applying classic mathematical formulations, they have calculated the tilt and move in the directions accordingly. Pande et al. also suggested a wheelchair design where they have used gesture control using the acceleration technology. They have used an sensor to calculate the hand movement and interpret the direction of acceleration accordingly.. The chair is featured with a “Save Our Souls” (SOS) protocol for the user to access from the user menu. Throughout the research, it was tried to keep the wheelchair user friendly so that the chair can be used as a conventional one.

LITERATURE SURVEY:

The development of automated wheelchairs has significantly evolved over the past few decades, driven by the growing need to empower differently abled individuals with greater mobility, independence, and overall quality of life. Traditional manual wheelchairs require significant physical effort and assistance, which can limit user autonomy. In response, researchers and engineers have increasingly focused on the design of intelligent, motorized wheelchairs that can be controlled through various human-machine interfaces. Among these, keypad-controlled systems have gained popularity due to their simplicity, affordability, and adaptability for users with limited motor function. Kumar et al. (2018) emphasized that keypads offer a tactile and intuitive control mechanism, making them particularly suitable for individuals who may struggle with more complex interfaces such as joysticks or touchscreen devices. These keypads can be designed in various layouts to suit individual preferences and can be customized for sensitivity and accessibility.

In recent years, wireless technologies have played a transformative role in enhancing the functionality of automated wheelchairs. Bluetooth, a widely used short-range communication protocol, has been successfully integrated into wheelchair control systems to eliminate the limitations of wired connections. According to Wang et al. (2019), Bluetooth communication not only allows the user to operate the wheelchair through a keypad or mobile application but also opens up possibilities for remote control by caregivers or healthcare providers. This wireless approach offers increased convenience, flexibility, and ease of integration with modern smart devices, enabling real-time control and feedback mechanisms that enhance user experience and safety.

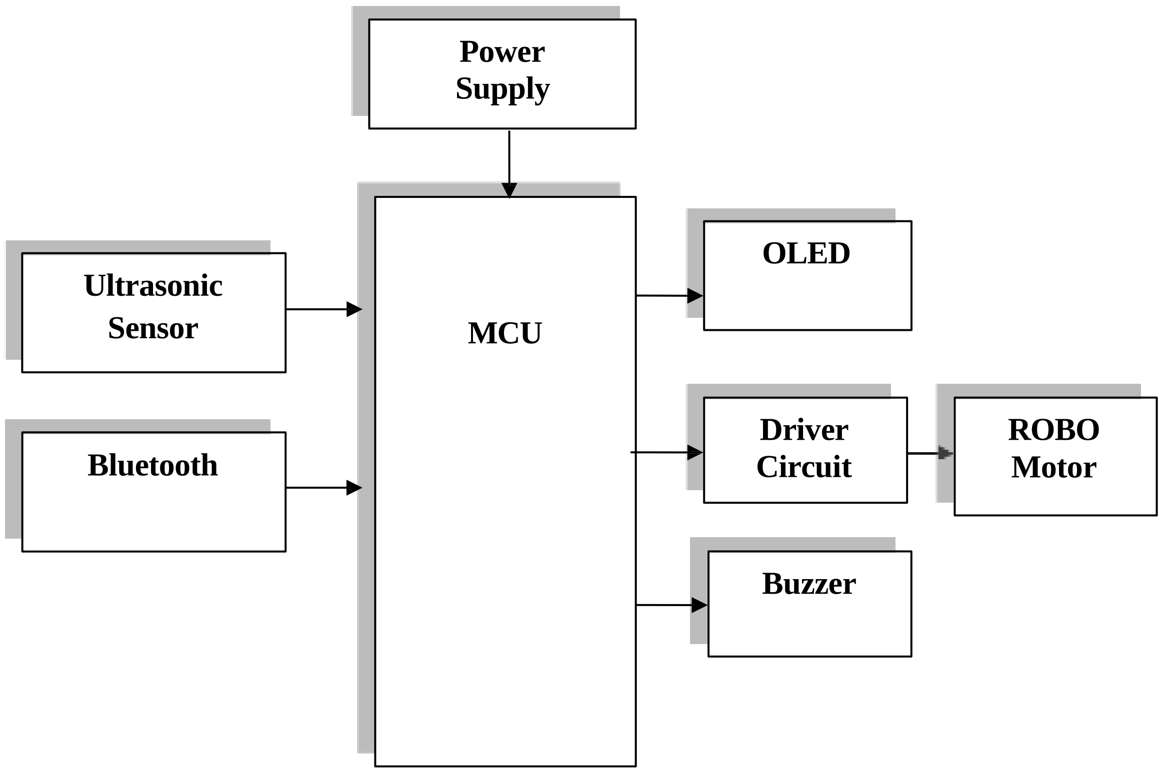
Another major area of advancement in automated wheelchairs is motorization and mobility control. Modern designs typically include DC motors controlled via microcontrollers or embedded systems that regulate speed, direction, and torque. Patel et al. (2018) discussed the importance of incorporating safety features such as emergency stop switches, current limiters, and speed governors to prevent accidents, especially in confined indoor spaces or areas with uneven terrain. These safety systems ensure that the wheelchair can be used by individuals with varying levels of physical and cognitive ability without compromising on safety.

A crucial component of smart mobility systems is the integration of environmental awareness through sensors. Technologies such as ultrasonic, infrared, and proximity sensors have been employed to detect obstacles, edges, and sudden drops, providing real-time feedback to the control system to adjust navigation accordingly. Li et al. (2020) reported that multi-sensor systems can significantly enhance obstacle avoidance and route optimization, thus reducing the risk of collisions and improving user confidence. These sensors can be programmed to operate in different sensitivity modes, adapting to both indoor and outdoor environments.

Furthermore, the role of artificial intelligence (AI) and machine learning is becoming increasingly relevant in the evolution of assistive mobility devices. Intelligent algorithms can learn from user habits, recognize patterns in movement, and even anticipate directional changes based on past behavior. Zhang et al. (2020) demonstrated how AI can be used to develop semi-autonomous wheelchairs capable of navigating complex environments with minimal input from the user. Such features are especially beneficial for users with severe disabilities who require additional assistance with navigation and orientation.

Another critical consideration in the development of automated wheelchairs is the focus on user-centered and ergonomic design. Taylor et al. (2019) stressed the importance of involving end users in the design and testing process to ensure the final product meets their physical, cognitive, and emotional needs. Features such as adjustable seating, customizable control interfaces, and intuitive user feedback systems are essential for ensuring comfort and usability. The inclusion of auditory, visual, or haptic feedback can further aid users with sensory impairments, making the device more accessible and inclusive.

BLOCK DIAGRAM:



POWER SUPPLY :

The power supply section provides a constant +5V output using the IC LM7805. This regulator circuit removes ripples and maintains a stable DC voltage despite input variations or changes in load. The LM7805 is a popular voltage regulator IC that ensures reliable operation of electronic circuits.

ULTRASONIC SENSOR :

Ultrasonic sensors use sound waves above 20,000 Hz to measure distance from the sensor to a target object. These sensors are commonly used in industrial control applications for obstacle detection, navigation, and level measurement. They offer high accuracy and reliability in various environments.

BLUETOOTH :

Bluetooth is a wireless technology standard for exchanging data over short distances. It operates on a frequency of 2.45 GHz and enables communication between devices over a range of up to 10 meters. Bluetooth technology is widely used in mobile devices, headphones, and IoT applications.

OLED (Organic Light Emitting Diodes) :

OLED displays are flat light-emitting technologies that provide high image quality and efficiency. They do not require a backlight, making them thinner and more efficient than LCD displays. OLED displays offer wide viewing angles, fast response times, and high contrast ratios.

MICROCONTROLLER :

RASPBERRY PI PICO

The Raspberry Pi Pico is a microcontroller board based on the RP2040 chip. It features a dual-core Cortex-M0+ processor, 264KB of SRAM, and 2MB of flash storage, making it suitable for embedded electronics projects. The Pico is a versatile and affordable platform for IoT, robotics, and automation applications.

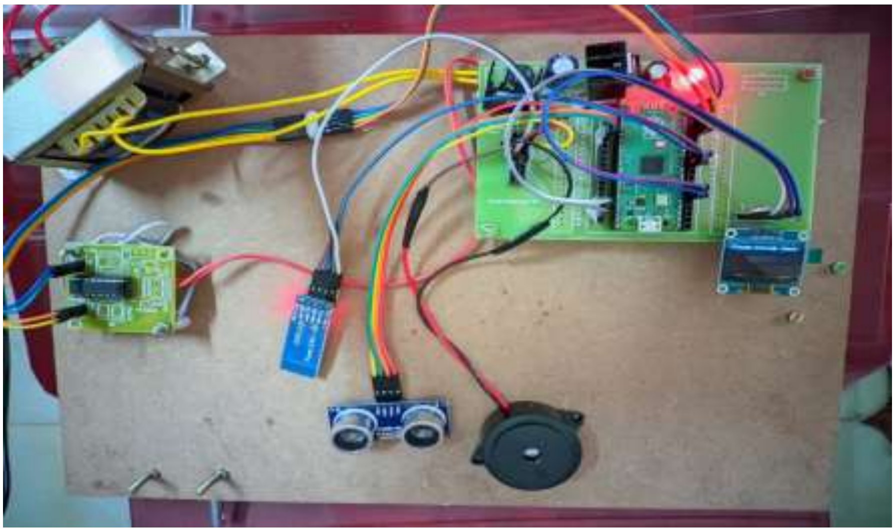
DRIVER CIRCUIT (L293D):

The L293D IC is a motor driver that can control two small DC motors in either direction. It requires just four microcontroller pins and is commonly used in robotics, automation, and mechatronics applications. The L293D offers high current capability and protection features.

BUZZER :

A buzzer or beeper is a signaling device that produces a continuous or intermittent sound. It is commonly used in applications such as automobiles, household appliances, and game shows to provide auditory feedback. Buzzers are simple, reliable, and effective for alerting users.

WORKING:



project titled Design and Development of an Automated Wheelchair for Differently Abled Persons Using Keypad and Bluetooth Technology aims to create a smart mobility solution that enhances the independence and comfort of users with physical disabilities. The core idea is to integrate modern communication technologies, such as Bluetooth and keypad controls, into a wheelchair system to make it more responsive, efficient, and easier to operate. The system uses sensors, microcontrollers, and wireless modules to achieve automatic navigation and obstacle avoidance, ensuring safety and convenience during movement. It is designed to be both user-friendly and cost-effective, making advanced mobility technology accessible to a broader population.

The central part of this system is the use of ultrasonic sensors for detecting obstacles. These sensors employ a ceramic transducer that vibrates when supplied with electrical energy, producing ultrasonic sound waves. The waves travel through the air and bounce back after hitting an object. The sensor then measures the time it takes for the echo to return, which is directly proportional to the distance between the wheelchair and the object. This mechanism enables real-time monitoring of the surroundings, preventing collisions and enhancing the safety of the user. The transducer performs both transmission and reception of sound, forming a simple yet powerful feedback loop for distance measurement.

The circuit design revolves around a microcontroller and the HC-SR04 ultrasonic sensor module. When triggered, the ultrasonic module sends out a pulse and waits for the reflected signal. Upon receiving the echo, it generates an output signal whose duration corresponds to the distance measured. The microcontroller processes this signal and can display the distance on a three-digit seven-segment display, offering visual feedback. This feature is particularly useful in various robotic applications, including automatic parking systems, obstacle warning alerts, industrial range finding, and terrain detection robots. The HC-SR04 sensor offers high accuracy with a resolution of 0.3 cm and a measuring range of 2 cm to 500 cm. It operates on a 5V DC power supply and consumes very little current, making it energy-efficient for portable applications like wheelchairs.

The sensor module is designed to be standalone, requiring only basic interfacing with a controller. It features four pins: VCC for the 5V supply, Trigger to initiate the ultrasonic signal, Echo to receive the reflected wave, and GND for ground connection. A 10-microsecond pulse sent to the Trigger pin initiates the transmission of an 8-cycle 40 kHz ultrasonic burst. The Echo pin then returns a high signal proportional in duration to the time taken by the echo to return. This simplicity in design makes it easy to integrate the sensor into the automated wheelchair system, allowing for real-time distance sensing and collision avoidance.

The transmitter unit of the sensor module is built using an NE555 timer IC configured as an astable multivibrator, which oscillates at 40 kHz to generate the ultrasonic signal. This output is amplified using a complementary transistor pair and then transmitted via the ultrasonic transmitter component. A push-button switch activates the transmitter manually. The receiver part, which detects incoming ultrasonic signals, uses another transducer that converts sound into a weak electrical signal. This signal is then amplified through a two-stage amplifier using transistors, followed by rectification through diodes. The resulting signal is compared using an operational amplifier acting as a comparator. If a valid signal is detected, the output from the op-amp activates transistors to drive a relay, which in turn controls external devices connected to the system. A diode is used as a flyback or freewheeling diode to protect the circuit from voltage spikes generated when the relay is switched.

The Bluetooth module allows for wireless operation via a smartphone or other Bluetooth-enabled device, while the keypad offers a manual method of control, accommodating users with different levels of dexterity and preferences. This dual- control mechanism enhances accessibility, empowering users with varying abilities to interact with the system easily.

RESULT

The implementation of the automated wheelchair system marks a significant advancement in assistive mobility technologies. The project achieved its primary goal by successfully designing and developing a working prototype of a dual-mode controlled wheelchair—operable via both keypad inputs and Bluetooth-based wireless communication. This system is particularly beneficial for individuals with upper and lower limb disabilities, as it reduces the physical effort required to control the wheelchair manually. The Bluetooth module enables users to control the wheelchair remotely using a smartphone application or any compatible device, which is especially helpful for users with limited hand movement. The keypad control serves as an alternative or backup method, ensuring the wheelchair remains functional even when wireless communication is not available. The use of a microcontroller programmed in Embedded C and integrated using Arduino IDE allowed for effective communication between hardware components and ensured efficient control logic execution. The integration of software and hardware components demonstrated a practical and scalable solution for assistive technology.

CONCLUSION

In this paper, we have designed a motor-driven wheelchair which can be driven by several input methods. It also allows the user to access its functionalities through manual movement as well as through the voice-recognition. Furthermore, we have incorporated some medical and emergency protocols in case of any emergency. Furthermore, the device gives freedom and self dependency to physically handicap and elderly peoples once more. Easy to access control system combined with a rigid build of the chair and a well-managed medical and alert system will surely give the user and their dear one's level of confidence using the device in their daily.

REFERENCES

[1] Disability Statistics: Information, Charts, Graphs and Tables, Disabled World, (last accessed 10th February 2019). https://www.disabledworld.com/disability/statistics

[2] T. Iwaya, T. Doi, A. Seichi, Y. Hoshino, T. Ogata, and M. Akai. "Relationship between physician-judged functioning level and selfreported disabilities in elderly people with locomotive disorders," Quality of Life Research, vol. 26, no. 1 pp 35-43, 2017.

[3] Z. Sultana, "Agony of persons with disability-a comparative study of Bangladesh," J. Pol. & L. vol. 3 pp. 212, 2010.

[4] D. Goodley,, B. Hughes, and L. Davis. "Introducing disability and social theory," In Disability and Social Theory, pp. 1-14, 2012.

[5] A. M. Roungu, and M. N. Islam. "Impact of Disability on Quality of life of urban disabled people in Bangladesh," International Journal of u-and e-Service, Science and Technology vol. 7, no. 4, pp. 227-238, 2014.

[6] Bangabandhu Sheikh Mujib Medical University Report 2015, Bangabandhu Sheikh Mujib Medical University.

[7] Hoque, M. M. "Road planning and engineering for promoting pedestrian safety in Bangladesh." In Road Engineering Association Of Asia And Australasia (Reaaa) Conference, 2000.

[8] P. Martín, M. Mazo, I. Fernández, J. L. Lázaro, F. J. Rodríguez, and A. Gardel, "Multifunctional and autonomous, high performance architecture: application to a wheelchair for disabled people that integrates different control and guidance strategies," Microprocessors and Microsystems vol. 23, no. 1, pp.1-6, 1999.

[9] R. A. Kalantri, and D. K. Chitre. "Automatic wheelchair using gesture recognition," International Journal of Engineering and Innovative Technology (IJEIT), vol. 2, no. 9, pp. 216-218, 2013.