

Wheelchair-Stretcher Designed For Enhanced Patient Mobility

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ABSTRACT: People who are physically challenged or disabled use wheelchairs as assistive technology to help them move about. However, physically challenged people can have trouble operating a wheelchair by hand. The creation of a mechanism that combines the benefits of a stretcher and a wheelchair is suggested in this work. The conversion of a wheelchair into a stretcher is accomplished using a basic, automatically operating system. We should prioritize ergonomic design and abide by safety regulations in order to achieve that mechanism. It is controlled by an Arduino micro controller that is connected to a sensor in the manner described below: obstacles are detected using an ultrasonic sensor, and data is transferred to a mobile app using an Internet of Things module (Node MCU module). This work has the advantage that makes it easier for medical personnel to move patients from chairs to beds because the chair can be adjusted to fit the height of the bed and functions as a stretcher.

KEYWORDS: Arduino Micro controller, IoT module, Ultrasonic sensor, Physically challenged, Stretcher.

I. INTRODUCTION

The issue of an aging population is getting worse. Wheelchairs are an essential mode of transportation for those with disabilities, as they comprise around 15% of the global population, 285 million of whom are blind or visually impaired. The annual demand for wheelchairs among this demographic is significant. Wheelchairs that can reach more than 30 million [1]. Medical device innovation has been spurred by the need for improved patient mobility options, especially in the design of wheelchairs and stretchers. Among their innovations, the ergonomic wheelchair stretcher has become a useful and indispensable instrument in medical environments. This innovative tool offers a flexible option for patient care and transportation by fusing the features of a stretcher and a wheelchair. The ergonomic wheelchair-stretches are made with the patient's comfort, safety, and ease of use in mind. They

guarantee that patients feel as little discomfort as possible during transfers and give medical staff a dependable and effective way to move patients. The present introduction develops into the characteristics and advantages of the ergonomic wheelchair provided by the stretcher, emphasizing its importance in augmenting patient mobility and elevating the overall quality of healthcare service. With the use of an Internet of Things (IOT) integrated smartphone app, hospital staff will find it easier to move patients, even if the patient is seated in a wheelchair that can also be used as a stretcher. Servo motors facilitate the effortless adjustment of the foot pedal and backrest, allowing for a wide range of patient positions and maximum comfort throughout the transport process. Our concept uses an ultrasonic sensor for obstacle detection. Here, the wheelchair can be moved to the right, left, forward, and reverse thanks to the relay unit's operation of the DC gearmotors. The wheels will abruptly stop if the ultrasonic sensor picks up an object. The Arduino micro controller is used to control the sensor and motors. The wheelchair-stretcher has an adjustable fluid stand attached to it that senses the fluid level and alerts the user before the fluid runs out. Our project's foundation is affordability and ease of usage.

II. LITERATURE SURVEY

This paper focuses on the creation of a head-controlled smart wheelchair that will help those with physical disabilities. The needs of those with physical restrictions that prevent them from using standard hand-operated wheelchairs are met by this creative solution. People with upper limb limitations face difficulties operating traditional electric wheelchairs because they are usually operated by hand. The goal of this initiative is to offer an alternate kind of control that will increase these people's freedom and mobility. The wheelchair is controlled by

the suggested system using an ultrasonic sensor in conjunction with an accelerometer. The wheelchair is given directional controls based on head movements detected by the accelerometer. When obstructions are detected by the ultrasonic sensor, the system can halt the wheelchair autonomously to prevent crashes [2]. This work focuses on the creation and usage of wheelchair-cum-stretcher devices, especially for older and disabled people. Frequent transfers between wheelchairs, stretchers, and hospital beds are necessary in India due to the country's rising patient population. This leads to dangerous situations, highlighting the need for creative fixes like wheelchair-cum-stretchers that can enable safer and more effective patient management. A single device that combines the capabilities of a stretcher and a wheelchair solves important patient transportation issues and has both practical and financial advantages. Innovations like these are crucial to improving the lives of people with mobility limitations and to make healthcare facilities safer and more effective [3]. This article examined the use of Human Computer Interfaces to operate home appliances for individuals. It is primarily based on various biological cues. Control signals from surface electromyography (sEMG) and electrooculography (EOG) were employed. Biosignal acquisition systems are utilized to capture the signals. The brain-computer interface (BCI) facilitates direct communication between humans and computers [4]. This paper discusses wheelchairs, which are chairs with wheels used to transport people or patients who are unable to move. This could be because the user/patient is physically impaired, has an illness that causes weakness, or is elderly. As a result, when they return to or leave their beds, they make the transition from wheelchair to bed or bed to wheelchair. Many studies and surveys have found that this shift is time-consuming and damaging to both the patient and the caregiver. A provision can be made to transform the wheelchair into a bed using hydraulics [5]. They had a discussion regarding the ARM7-based smart wheelchair for multipurpose use. Power wheelchairs have made it possible for elders and the disabled to go farther on their daily activities. Our project aims to create a power wheelchair that allows the elderly and disabled to have the same level of movement as healthy individuals, allowing them to completely and enthusiastically reintegrate into society. In order to achieve this, we use a economical Omni-directional mechanism that offers three degrees of freedom, much like a healthy person. Furthermore, we suggest a

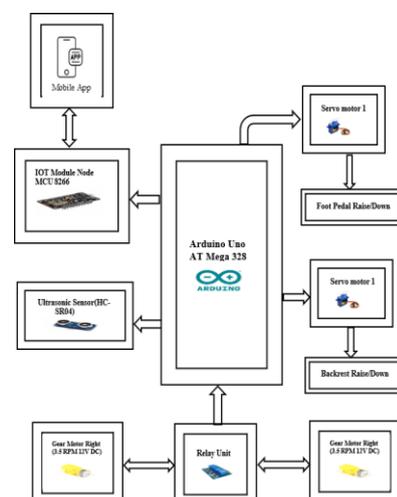
brand-new steering interface for a holonomic Omni-directional power wheelchair that perceives user actions like bending the waist or tilting the upper body to ascertain the user's intention. To develop a new wheelchair, we created a huge omni wheel and determined seat measurements based on standard Japanese physical constitutions. We also created a model of a human riding in a wheelchair to evaluate the movement of his upper body. The designed wheelchair has fast acceleration and speed, enough to play a sport like tennis [6]. According to the research article, it uses infrared sensors to recognize gestures. In this technology, IR sensors are utilized to recognize simple movements that allow the powered wheelchair to travel in any direction. In the proposed prototype system, a gesture pad with IR sensors, MCU, and power management circuit is constructed for gesture recognition and identification, as well as a motor controller. The biggest issue with IR is that its sensitivity is lower during daylight, which makes it difficult to process subsequent programs. Furthermore, utilizing infrared sensors to recognize precise motions is challenging [7]. This paper discusses the electric driven wheelchair, with the goal of reviewing concepts and prior work on velocity control, traction control, suspension control, stability control, stair-climbing wheelchairs and wheelchair navigation. The information acquired in this study is designed to raise awareness of the current state of powered wheelchair control technology and boost functional mobility in persons who use EPWs, however it has a significant disadvantage in terms of cost effectiveness. It's quite pricey when compared to standard wheelchairs [8]. In this paper, they focus on the wheelchair system and the terms of wheelchair occupant perception. Zhang Zhen constructed a safety monitoring system for wheelchairs, installed sensors for positioning, pressure sensing, and body temperature measurement on the wheelchair, and was able to view various types of information about the wheelchair in real time on his mobile phone [9]. They have shared their opinions regarding the current design and implementation of an electric chair for patients that has the ability to climb stairs; this function is achieved through the incorporation of automatic controlling. The seat can be moved in every way. The ramps are raised in order to complete the climbing functions. The chair is supplied with an input DC voltage. The chair's electromechanical components include a DC motor, an electric control circuit, and a hydraulic electrical mechanical jack. Its dimensions are around 125 by 88 cm, and its weight is 90 kg.

Chairs are raised with the use of hydraulic jacks. Here, the gearbox controls how the machine operates while it is operating normally. Patients with disabilities can readily manage this. Then, as the machine turns to face a staircase, the first step is touched by the time machine, which moves the motor to the left and right, raising the staircase. As a result, this paper uses hydraulic jacks that use angle measuring devices to tackle the stability problem [10]. This paper shows how to provide a smart wheelchair with high-quality specifications and features for disabled and elderly people. Various new types of sensors for the safety of the person driving the wheelchair and navigation system are available [11]. In this paper they have discussed about the elderly people with impairment are restricted to using the powered wheelchair because of the risk collision with people as objects. To avoid that an anti-collision wheelchair is designed with the infrared sensors. The infrared sensors detect the obstacle in front of it. With this anti collision wheelchair the elderly people can avoid collision of people and objects. The infrared sensor is unable detect multiple obstacles at a time [12]. They have discussed about the brain-computer interface with wheelchair. Here EEG signal and eye blink act as the control of the wheelchair. Ultrasound is used for finding detect the obstacles in front of the wheelchair. This used for the most of people. Ultrasound will give alarm whenever it crosses an object [13]. They have expressed about controlling a wheelchair in new method. The weight of the wheelchair is less; YOLO algorithm is used to recognizing a person and target location in the environment this wheelchair is useful for the disabled person. Sometimes the real time reorganization is not possible [14]. In this paper they have implemented a robotic wheelchair which is controlled by the onboard computer instead of joystick. The reception and transmission of the signals is done by Brain Computer Interface. Voice and Gesture control channel are used as parameters for BCI processing [15]. They have discussed about the elderly people with impairment are restricted to using the powered wheelchair because of the risk collision with people as objects. To avoid that an anti collision wheelchair is designed with the infrared sensors. The infrared sensors detect the obstacle in front of it. With this anti collision wheelchair the elderly people can avoid collision of people and objects. The infrared sensor is unable detect multiple obstacles at a time [16]. This paper has discussed two sensor (inertial and vision sensor) are used in wheelchair. The vision sensor is a camera which is used to view the

environment and inertial sensor is used for understanding the head rotation of the person who is drive the wheelchair. By using the fusion process the wheelchair moves automatically. This is very useful for the disabled persons. Even if the is simply rotating head also the wheelchair will move [17]. In this paper they have discussed about cloud system which is used in wheelchair. Various sensors are used for monitoring the patient. The sensors used in the wheelchair are pressure sensor, accelerometer to identify the posture and GPS is used to monitor the location. This system is used in realtime which is useful for many people and the patients in critical condition can be monitored by sensors also tracked easily. If the sensors gets damaged it can send the false alarm [18]. They have discussed wheelchair which was controlled by smart phones. When the system becomes user friendly and smart technology, day by day the world was getting updated with new technologies. But in the case of wheelchair usage was high in range so most of us need new invention and updating the existing wheelchair. As the concept of the paper is to using simple component make the new innovation. Main advantage of project is cost effective wheelchair [19]. have discussed about a group design of an wheelchair with computer which interacts with human. It uses both hardware and software integration. Here both sensor and computer processing are used. Through this manner a real time signals processing technique. LabView programs are used for network automation. Also the monitor connected with the computer has touch screen facility for easy access through software. The design concludes that the usage of computers can be reduced to half after the process of optimization [20].

III. MATERIALS AND METHOD

A. BLOCK DIAGRAM



B. METHODOLOGY

Our proposed technology works by producing a user-friendly wheelchair for physically challenged people that detects obstacles or objects based on distance. This project comprises of an ultrasonic sensor. An ultrasonic sensor is used to determine the distance between a wheelchair and the opposing obstacle. When the motor is turned on, the rack connection converts the rotation to linear motion, resulting in downward angular displacement of the backrest that is synchronized with upward angular displacement of the leg rest. The wheelchair will be turned to a bed using this procedure. The Android application uses the Node MCU module to change a stretcher to a wheelchair and vice versa. The wheelchair and stretcher's wheels are powered by geared motors. The electrical power is stored in a lead acid battery, which contains a rechargeable mechanism for moving the wheelchair.

II. HARDWARE SPECIFICATION

A. ARDUINO UNO

Arduino Uno is a microcontroller board built around the ATmega328P. It contains 14 digital input/output pins (6 of which can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB port, a power jack, an ICSP header, and a reset button. It includes everything needed to support the microcontroller; simply connect it to a computer via USB connection or power it using an AC-to-DC adapter. The Arduino Uno includes a number of features for connecting with a computer, another Arduino board, or other microcontrollers.

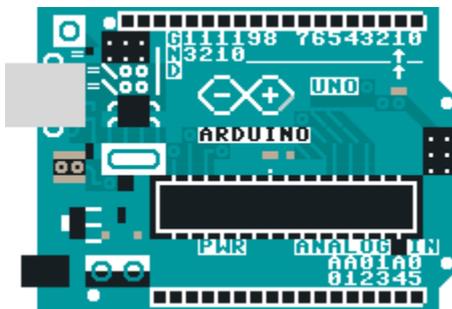


Fig.1 Arduino UNO

B. BUCK CONVERTER

A buck converter's primary function is to convert a higher DC voltage into a lower DC voltage. It is capable of converting 12V DC to 5V DC, for example. Buck converters have an excellent reputation for

efficiency. Because they store and transfer energy using inductors and capacitors rather than releasing it as heat like linear regulators, they frequently achieve 80% to 95% efficiency. Buck converters use feedback methods to adjust their output voltage. To keep the output voltage constant, a feedback loop compares it to a reference value and adjusts the duty cycle of the switch accordingly.



Fig.2 Buck Converter

C. LEAD ACID BATTERY

Ever since they were developed in the middle of the 19th century, lead-acid batteries have been a mainstay of energy storage technology. Because of their affordability, dependability, and durability, batteries continue to be a popular option for a wide range of applications even in the face of emerging technology. The positive plate of these batteries is made of lead dioxide, the negative plate is made of sponge lead, and the electrolyte is sulfuric acid. These elements react chemically to produce lead sulfate and water as the battery discharges, releasing electrical energy in the process. During charging, this reaction can be reversed, returning the original ingredients



Fig.3. Lead Acid Battery

C. GEAR MOTOR

An electric motor and a gearbox are combined to create a gear motor. Because of its ability to produce significant torque at low speeds, gear motors are the perfect choice for applications requiring exact power and control. The gearbox, which is made up of several gears, increases torque while decreasing the motor's speed. This is crucial for uses requiring both slow, deliberate movement and tremendous force. Because of their versatility, gear motors are available in both AC (alternating current) and DC (direct current) motor topologies. Conveyor systems and industrial machinery are two examples of applications where AC gear motors are frequently utilized.

Applications requiring precise control frequently use DC gear motors. such as home appliances, automobile systems, and robots. Their ability to run on several sources of energy, such as batteries, qualifies them for use in mobile and portable applications.



Fig. 4. Gear Motor

D.SERVO MOTOR

Servos are incredibly popular among people who create robots, RC boats, and planes. About 90 to 180 degrees can be rotated by most servo motors. Some can spin at least 360 degrees around. Servos can't drive wheels, though, unless they are changed. Instead, their precise positioning makes them perfect for a variety of applications, such as robotic arms and legs, rack and pinion steering, and sensor scanners. The velocity and angle control loops are relatively simple to install and remain incredibly economical because servos are completely self-contained. Simply connect the red, black, and yellow/white wires to a 4.8–6V supply, ground, and a signal generator (such your microcontroller) to operate a servo.



Fig 5. Servo Motor

E. NODE MCU MODULE

An open source IoT platform is called NodeMCU. It consists of hardware based on the ESP-12 module as well as firmware running on the ESP8266 Wi-Fi SoC. The NodeMCU apps in these samples are developed in the scripting language Lua, which is quite straightforward and quick to learn. Smart sensor networks, remote data logging, and home automation systems are some of its main uses. It can be used, for example, to build weather stations that broadcast data to the cloud, automate heating systems, and regulate lights in homes. But you should be aware of how much power it uses, particularly when using Wi-Fi, and take

into account the RAM and GPIO pin limits.



Fig 6. Node MCU Module

F. ULTRASONIC SENSOR

Ultrasonic sensors estimate the distance between a target object and the sensor by transforming electrical and mechanical energy. Ultrasonic waves are longitudinal mechanical waves that go through a medium in a direction that is followed by a series of compressions and rarefactions. In addition to measuring distance, they are also utilized in object detection, position detection, ultrasonic mouse, and ultrasonic material testing (which looks for cracks, air bubbles, and other product faults). Based on how they function, these sensors are divided into two groups: piezoelectric sensors and electrostatic sensors. Here, the piezoelectric principle is used to discuss the ultrasonic sensor. The ultrasonic waves in piezoelectric ultrasonic sensors are produced by a piezoelectric substance.



Fig 7. Ultrasonic Sensor

TABLE 1 SPECIFICATION TABLE OF COMPONENTS

S.NO	MATERIALS	SPECIFICATION
1	Arduino UNO	5Volt, Input Voltage 7-12Volt:
2	Lead Acid Battery	12V, 7.6AH
3	Dc Geared Motor	3.5 RPM, 12V DC ,6mm
4	Servo Motor	4.8V to 6V

IV.RESULT AND DISCUSSION

The development of the proposed wheelchair-stretcher hybrid system has successfully met its primary objectives, providing enhanced mobility and versatility for users with physical challenges. The

automated wheelchair-to-stretcher conversion mechanism was implemented effectively through the use of an Arduino microcontroller, ultrasonic sensors, and a NodeMCU- based IoT module. The mobile application enabled smooth, remote control of the device, allowing for easy adjustments in movement and mode (bed or chair) with minimal physical effort. In testing, the ultrasonic sensors proved to be reliable in detecting obstacles, ensuring safe navigation for the user. The height-adjustable stretcher feature facilitated easy patient transfers, making it convenient for medical personnel to move patients between beds and chairs. Additionally, the system demonstrated space efficiency and required minimal maintenance, aligning with the initial design goals of creating a compact, low-maintenance solution.



Fig 8. Prototype

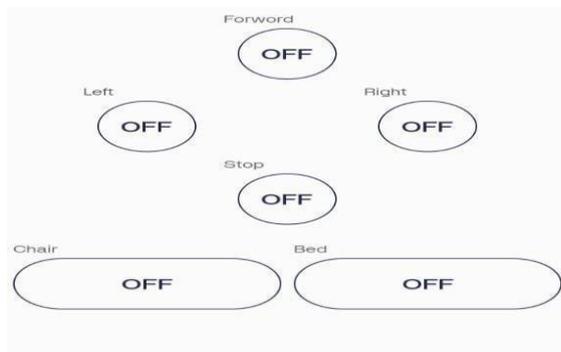


Fig 9. IOT App

VII. CONCLUSION

Our project's prototype was ready and tested without any problems. The wheelchair to stretcher device also operated well. The mechanism's goal in design and development is to lessen human tiredness.

Additionally, it makes it easier for nurses to assist in managing patients in more serious situations. With this device, moving a patient from a bed or stretcher to a wheelchair is eliminated, and vice versa, improving the nurturing and independence of the disabled person's life. The purpose of this research was to

propose a proposal for a wheelchair convertible stretcher that would save space, avoid patient strain, and ensure patient safety. This design might cost a little more than an average wheelchair. We now hope that there is a lot of room for advancement in the future.

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