VOICE CONTROLLED SMART WHEELCHAIR

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ABSTRACT

This project extends the functionality of wheelchair, the way it is used and also the advance technology associated with it. Disabled and elderly individuals, mostly use the wheelchair to move from one point to another. To make their life somewhat simpler, numerous improvements in wheel seats came into existence, for example, electric-controlled, motion-based, and so forth. The system has two segments, specifically; hardware and programming. The hardware contains an embedded structure that relies upon Arduino Uno board, a Bluetooth Module, Motor Driver and an Android phone. The Bluetooth Module gives the correspondence media between the customer through the android phone and the system through voice request given to the android phone. The customer discusses the ideal request to the item application presented in the android phone that is connected through Bluetooth with Bluetooth Module HC05. The voice is changed over to an assortment of strings and the string is passed to Arduino Uno related with it. At the point when the Bluetooth Module gets the message, the request sent will be removed and executed by the microcontroller associated with it and depending upon the orders dealt with to the Motor Driver, the motors will work properly. The system will translate the orders and control the Wheelchair similarly through the android application.

Keywords: Team plate, process, Metrics Reporting, Task Views Reporting

INTRODUCTION

In today's era, technology has dawned on mankind and has successfully transformed their way of life into one that is effortless. Everything is at our disposal, from education to business to butchery. Innovation has been the sole driver of worldwide advancement and modernization. The effect has been significant to such an extent that nothing seems, by all accounts, to be inconceivable today [1].

Moving advancements like man-made reasoning, 3D printing, nanotechnology, and mechanical technology are forming the eventual fate of medical care. Advanced innovation in the clinical field can aid the change of unreasonable medical care frameworks into manageable ones by keeping a harmony between clinical experts and patients and giving cheap, proficient, and viable illness battling arrangements. The extent of the populace that is beyond 65 years old is quickly expanding [2,3].

Traditional healthcare solutions are being supplanted by the rapid evolution of health monitoring systems [4]. Maintaining patient health records online has proven to be not only beneficial for doctors, but also a wellspring of important information for experts to deliver significant data about the patient. These frameworks are wasteful; however, they additionally permit patients who need to live autonomously to get to wellbeing administrations on the web. Wellbeing observing frameworks are particularly helpful for patients who live in far off regions. They can only communicate with their doctors directly if they access the services online in an emergency. [5], Subsequently, the old can stay away from associations with nursing homes, crisis centres, and various workplaces for to the degree that this would be conceivable, decreasing the strain on the medical care framework. Since weakened patients

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can't tolerate traveling, savvy medical services frameworks help them in accessing medical services. A potential answer for checking their wellbeing status is to foster a wellbeing observing framework dependent on a shrewd wheelchair since it is appropriate for a more extensive scope of crowds and doesn't require as much support as wearable frameworks. Many people are disabled, either temporarily or permanently, as a result of illnesses or accidents. The use of a wheelchair is becoming increasingly important in cases where walking is difficult or impossible. Most low and medium level disability cases where patients can use the wheelchair independently are satisfied by manual or electrical wheelchairs [6] However, in severe cases, using wheelchairs independently is difficult or impossible. Wheelchair users in these situations frequently lack independent mobility and must rely on someone else to operate the wheelchair. To address such issues, wheelchair researchers are working to develop smart wheelchairs. There have been devices built to make wheelchairs "smart" in terms of motion, with the patient controlling the wheelchair movements. Wheelchairs are the most commonly used assistive devices for improving disabled people's personal mobility. A wheelchair is a physically or force driven gadget planned principally for use by individuals with handicaps. A manual wheelchair is comprised of a seat, footstools, two enormous wheels toward the back, and two caster wheels in front. The hand edges that are connected to the wheels are marginally more modest in distance across than the actual wheels. Most manual wheelchairs have push handles at the back to take into consideration manual impetus by helping individuals. Manual wheelchairs are the essential method of transportation for individuals with lower appendage handicaps. On account of a client moved manual wheelchair, the crippled client controls and drives the wheelchair. Nonetheless, hand work is not so much effective but rather more burdening than leg work. Long haul utilization of manual wheelchairs lessens the client's actual capacity, so it isn't suggested.

To have the option to perform explicit errands, savvy wheelchairs are ordinarily furnished with sensors, cameras, and a PC based framework as the principal handling unit. [7], Autonomous savvy wheelchairs are constrained by a human UI, in which the human settles on the main choices and the keen control innovation computerizes the remainder of the movement. The headways in self-ruling savvy wheelchairs are implanted with PCs and spot a solid accentuation on PC bunch engineering. Regardless of their inabilities, insight is added to a wheelchair stage around client control, making the investigation of the human-machine interface (HMI) between the client and the wheelchair a significant assistive automated field of study. A standard electric wheelchair has little PC control and some engine control by means of a joystick. Thus, specialists are focusing on PC controlled wheelchairs that coordinate sensors and knowledge to decrease the requirement for human intercession. Nonetheless, most endeavours to foster shrewd wheelchairs need power moving control, discernment, and control methods [8]. Ground vehicles intended for shrewd route arrive in an assortment of shapes and sizes. When planning a brilliant wheelchair, it is basic to think about the stage's working conditions, both as far as the climate and client connection with the framework controls. A savvy wheelchair stage can be underlying an assortment of ways, for example, by altering an EPW, changing over a manual wheelchair, or adding a seat to a portable robot. At the point when gadgets are added to an EPW to make a shrewd wheelchair, the savvy highlights are associated with the consolidated EPW regulator to get to the inserted drive train. Associating savvy include gadgets to an EPW movement regulator likewise enjoys the benefit of being viable with industrially accessible regulators, the two joysticks and elective regulators for individuals with various incapacities.

LITERATURE REVIEW

Physically challenged people who are suffering from some physical problem face a major challenge in their life as they are unable to do their daily work and depend on the third person for care. According [9], for physically disabled person wheelchair plays an important role in

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their life as it enables the person to work and makes life easier. With a help of voice controlled smart wheelchair consists of some parts like voice control, electric power mode, line follower etc as the its control units consists of AVR microcontroller with Bluetooth, some sensors, motor driving circuit for controlling speed helps the disabled person ease of life. Wheelchair as a best asset for physical disabled people is not cost effective as they are easy to operate.

According to [10], a cost-effective wheel chair consists of smartphone and a touch sensor with mega processor, motor driver, gear motors, IP camera and Bluetooth are the new design to approach for smart wheel chair. According to [11], states that World Health Organization presents 15% of the world's population as physically disabled as the access to health care services is limited to each individual. Utilization of batteries in power wheelchair are capable for extraordinary condition towards disabled people. Solar powered multi-controller smart wheelchair presents design and development as the smart wheelchair users eye blink sensor and the results shows the safety measure.

According to [12], highlights about the use of wireless sensor network as it consists of huge number of tiny devices connected with one or two sensors and processing circuit with wireless transceiver. It senses some parameters like temperature, humidity, pressure, light and chemical activity. According to [13], projected a wheelchair and named it as voice controlled automatic wheelchair as it consists of voice recognition module, motor system and microcontroller. Use of Arduino Uno board as a central controller system was done and the voice recognition module was attached to the Arduinoto microphone. As this type of wheelchair users uses voice recognition and helps the user in navigating in the environment and helps in facing many challenges and makes easy to live.

Another author [14] highlighted a efficient solution and named it as ROS- Based Indoor Autonomous Exploration and route Wheelchair as it solves many problems like high price, complex mechanism as well as making and deficient reusability of the required system. The program is based on the Robot Operating System and the camera is used to detect the environment. The data which is collected is used for map building and the Adaptive Monte Carlo Localization algorithm is used for position and orientation of the wheelchair.

Supported a proposed design for voice command detection for disabled people. In this type of wheelchair buttons and gestures were used for controlling wheelchair [15]. With the help of Node Mcu microcontroller that is built with Wi-Fi system controls the command of the wheelchair set by the user. When there is any obstacle, it detects alert and warns the users by pressing the button and it makes some sound. Functioning of the wheel chair through voice command with the help of Amazon Alexa is a virtual assistant of amazon capable of interaction of voice, setting up of alarm, playing music, providing weather report etc. and with the help of Alexa and Node MCU, a open source to IoT platform based with ESP-12 module and control the voice commands.

According to [16], studied the implementation of voice-controlled wheelchair based on artificial intelligence using raspberry pi for controlling device and USB microphone for input of voice.

Another author [17], projected a wheelchair with accelerometer to give input to microcontroller through different head movement posture. It includes two DC motors that are used for movement of wheels and the wheelchair is powered by solar panel. Another wheelchair was developed by [18], in which the head movement was measured by tilt of accelerometer to show approximate value to arm processor with the help of Zigbee trans-receiver as the processor helps the wheels to start rotation.

A proposed novel based head pose controller algorithm was introduced to assist disabled people and author [19], introduced this algorithm. [20], proposed control model use gyroscope to detect the head movement as in the wheelchair two operation modes were set based on the head movements.

According to [21], designed a wheelchair to climb the staircase for this it consists of two long pair of large wheels that are paced at the backside along with star shaped wheel. Gears

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which are used helps to restrict the movement of front and back wheels to give the direction joystick movemet were used, touchpad and gesture-based movement.

A wheelchair [22] was designed with high single step capability and the mechanism was based on the front and the rear wheel clusters connected to power linkages. According to [23], to climb the staircase a wheelchair was design by using two motors for locomotion and the change in its functioning depends upon the rolling on wheels to stepping on legs.

Introduced a wheelchair based on two frequency Modulated continuous wave radar scanner to detecting the stairs [24]. According to [25], a hand gesture-controlled wheelchair was introduced and categorized by two parts one as gesture unit and other as a wheelchair unit also three axis accelerometer was used for sensors to move the wheelchair in desirable direction.

METHODOLOGY

The voice acknowledgment module is the vital component of this venture that is utilized to arrangement the ideal voice order and yield. It comprises of three stages, which is voice customization, voice catch and voice acknowledgment. Voice customization is the way toward coordinating with the ideal voice recorded to the wanted yield signal. Voice catch is the stage that records the ideal individual's voice order and saves the voice dependent on the customization arrangement. The voice acknowledgment stage is the last stage where when voice order has been perceived, this module will convey a particular message to the microcontroller for the fundamental activity. The voice-controlled wheel seat will be additionally constrained by an application for its execution in IoT. This application-controlled execution considers clients other than the essential client to control the wheel seat. The system has two segments, to be explicit; gear and programming. The hardware configuration involves an embedded system that relies upon an Arduino Uno board, a Bluetooth Module, Motor Driver and an Android phone. The Bluetooth Module gives the correspondence media between the customer through the android phone and the structure through voice request given to the android phone. The customer talks the ideal request to the item application presented in the android phone that is related through Bluetooth with Bluetooth Module HC05. The voice request is changed over to an assortment of strings and the string is passed to Arduino Uno related with it. At the point when the Bluetooth Module gets the message, the request sent will be isolated and executed by the microcontroller annexed to it and depending upon the orders dealt with to the Motor Driver, the motors will function as requirements are. The system will interpret the orders and control the Wheelchair in a like manner through the android application.

1. CONTROLS

Forward: The Wheelchair will move forward. All motor will move same direction that is front

Backwards: The wheelchair will move Backwards. All the motors will move in same direction but will be opposite to forward.

Right: only the right motor will move in order to make the wheelchair turn right

Left: only the Left motor will move in order to move the wheelchair left. Stop: All motor will stop types

2. COMPONENTS

Arduino Uno: It contains all that normal to help the microcontroller; partner it to a PC with a USB connection or power it with an AC-to-DC connector. Application: 13 progressed pins and 6 straightforward pins. This sort of pins grants us to interface hardware to our Arduino Uno board distantly. These pins are used as a key for growing the preparing limit of the Arduino Uno into this current reality.

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Bluetooth Module: The Bluetooth module HC-05 is a master/slave module. Obviously, the modern office setting is slave. The Role of the module (Master or Slave) can be masterminded basically by at commands. The slave modules can't begin a relationship with another Bluetooth contraption, anyway, can recognize affiliations. Master module can begin a relationship with various contraptions. It is used for interfacing adaptable application to the Arduino board.

Engine Driver: It consists of all that functions to help the microcontroller; partner it to a PC with a USB connection or power it with an AC-to-DC connector. This grants us to control the speed and direction of two DC motors, or control one bipolar stepper motor easily. The L298N H-interface module can be used with motors that have a voltage of some place in the scope of 5 and 35V DC.

TABLE I
Summary of Hardware Components

S.N	Regular	Model	Vendor
1.	Arduino Uno	Generic Uno R 3 ATmega 3 28P	Robo India
2	Bluetooth Module	HC-05	Robo India
3	Motor Driver	L298N	Robo India
4	Geared Motors		Robo India
5	Jumper Wires		Robo India

3. *WORKING*

The voice request is changed over to an assortment of string and the string is passed to Arduino Uno related with it. At the point when the Bluetooth Module gets the message, the request sent will be isolated and executed by the microcontroller attached to it and depending upon the orders dealt with to the Motor Driver, the motors will fill in as necessities be. The system will unravel the orders and control the Wheelchair properly through android application.

a) CASE-1: Consider a user who wants to move the wheel chair in forward direction using the voice command. It is observed that the Arduino software converts the given voice signals into low and high current signals which in turn moves the motor in forward direction. When the user enters his voice to the app, it is observed that the wheel chair moves in forward direction as seen by the camera.

b) CASE-2: Consider a user who wants to stop the wheel chair. When the user says “STOP” in the app, it is observed that the wheel chair stops from motion as seen by the camera.

c) CASE-3: Consider a user who wants to move the wheel chair in backward direction from the stop position. When the user enters his voice to the app the app records the backward command and it is observed that the wheel chair moves in backward direction as seen by the camera.

4. FIGURES AND TABLES

Figures 1 is a schematic illustration of the wheel chair with the hardware components attached to it. The hardware comprises of Bluetooth module, a
microcontroller, a motor driver, power supply, motors and wheels.

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FIGURE 1
SYSTEM DRAWING

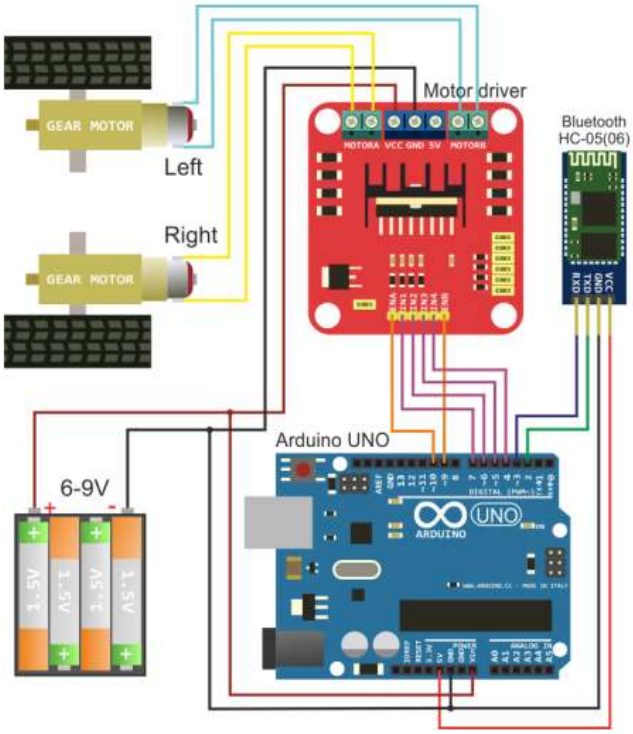

Figure 2 is the schematic illustrations of the app. The micro controller connected to a laptop demonstrates how the proposed idea could work. As voice commands are given to the app connected to the Bluetooth module.

FIGURE 2
SCHEMATIC ILLUSTRATION OF THE APP

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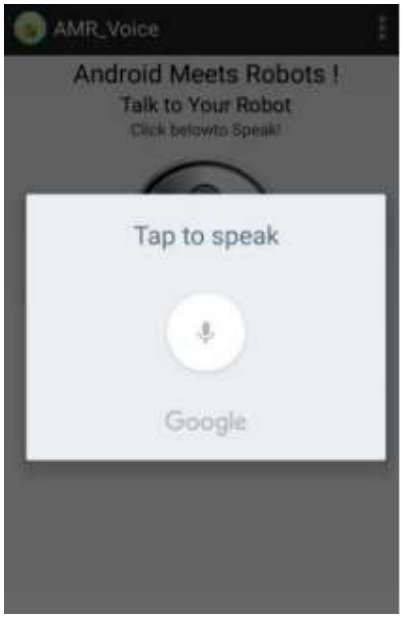
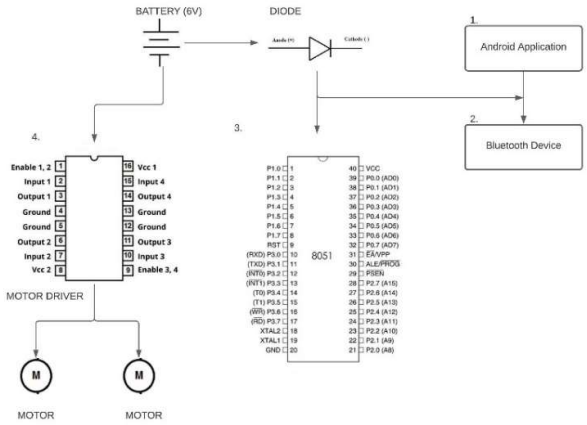


Figure 3 is the system architecture diagram showing various sub systems consisting of Bluetooth module, a microcontroller, a motor driver, power supply, motor and wheels the new apparatus being claimed.

FIGURE 3
LOW LEVEL DESIGN



5. ACCURACY TABLE

To validate the precision and sufficiency of the endeavour, four volunteers were drawn nearer to transform into a piece of testing of the endeavour. Each volunteer was drawn nearer to give 20 orders and ward on the quantity of the orders are followed will give the result. The test was passed on in tranquil and loud environment by both male and female customers. This test will choose the precision and reasonability of the endeavour. There is a biggest of 1 word wrong every on numerous occasions reiterating words provoking a bumble of 10% for instance affirmation rate at any rate 90%. This rate may show up at 100% if the test is done in clear environment with incredible approach to communicate words with moderate time. This test exhibited that there is no tremendous differentiation in RR if the speaker is male or female

TABLE 2
ACCURACY TABLE

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Testing Client	Number of orders declared	Number of times the order is noted correctly	Rightness
A(Male) in tranquil conditions	20	20	100%
B(Female) in tranquil conditions	20	20	100%
C(Male) in clamorous conditions	20	18	90%
D(Female) in clamorous conditions	20	18	90%

RESULTS

To assess the exhibition of the introduced discourse acknowledgment framework to drive the wheelchair following test done to test the viability of the voice acknowledgment to drive the wheelchair. The acknowledgment pace of every Keyword word customized to work when spoken by the client is determined by the accompanying condition: RR% = Number of Recognized Words separated by Number of Tested Words In request to test the precision and adequacy of the venture, four volunteers were approached to turn into a piece of testing of the task. Each volunteer was approached to provide 10 orders and dependent on the number of the orders are followed will give the outcome. The test was conveyed in quiet and boisterous climate by both male and female clients. This test will decide the exactness and adequacy of the venture. There is a most extreme of1 word wrong every multiple time rehashing words prompting a blunder of 10% for example acknowledgment rate at the very least 90%. This rate may arrive at 100% if the test is done in clear climate with great way to express words with moderate time. This test demonstrated that there is no large contrast in RR if the speaker is male or female.

CONCLUSIONS

The model uncovered the effortlessness of a voice-controlled framework like the wheelchair. It portrays how control component can be acquired without utilizing some other control instrument like catches or joystick. By improving the voice gathering and prompting further orders, the gadgets can be mechanized without limit.

REFERENCES

Smart Wheelchair: Integration of multiple Sensors; H. Yuen onf. Series: Materials Science and Engineering 254 (2017) 072008K

H. Soh and Y. Demiris, “Learning assistance by demonstration: smart mobility with shared control and paired haptic controllers,” Journal of Human-Robot Interaction, vol. 4, no. 3, p. 76, 2015.

H. Yuen, J. Pineau, and P. Archambault, “Automatically characterizing driving activities onboard smart

Citation Information: Neema, R & Rajkumar, R. (2021). Voice Controlled Smart Wheelchair. *Journal of Management Information and Decision Sciences*, *24*(S3), 1–9.

wheelchairs from accelerometer data," in Proceedings of the 2015 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), pp. 5011–5018, Hamburg, Germany, September 2015.

M. Ghorbel, J. Pineau, R. Gourdeau, S. Javdani, and S. Srinivasa, "A decision-theoretic approach for the collaborative control of a smart wheelchair," International Journal of Social Robotics, vol. 10, no. 1, pp. 131–145, 2018.

F. Utaminingrum, M. A. Fauzi, R. C. Wihandika et al., "Development of computer vision based obstacle detection and human tracking on smart wheelchair for disabled patient," in Proceedings of the 2017 5th International Symposium on Computational and Business Intelligence (ISCBI), pp. 1–5, Dubai, United Arab Emirates, August 2017.

A. Hartman, R. Gillberg, C. T. Lin, and V. K. Nandikolla, "Design and development of an autonomous robotic wheelchair for medical mobility," in Proceedings of the 2018 International Symposium on Medical Robotics (ISMR), pp. 1–6, IEEE, Atlanta, GA, USA, March 2018.

C. Huang, Z. Wang, G. Chen, and C. Yang, "Development of a smart wheelchair with dual functions: Real-time control and automated guide," in Proceedings of the 2017 2nd International Conference on Control and Robotics Engineering (ICCRE), pp. 73–76, Bangkok, Thailand, April 2017.

J. Leaman and H. M. La, "A comprehensive review of smart wheelchairs: past, present, and future," IEEE Transactions on Human-Machine Systems, vol. 47, no. 4, pp. 486–489, 2017.

Joshi, K., Ranjan, R., Sravya, E., & Baig, M. N. A. (2019). Design of voice-controlled smart wheelchair for physically challenged persons. In Emerging Technologies in Data Mining and Information Security (pp. 79-91). Springer, Singapore.

Noman, A. T., Khan, M. S., Islam, M. E., & Rashid, H. (2018, October). A New Design Approach for Gesture Controlled Smart Wheelchair Utilizing Microcontroller. In 2018 International Conference on Innovations in Science, Engineering and Technology (ICISET) (pp. 64-68). IEEE.

Sharmila, A., Saini, A., Choudhary, S., Yuvaraja, T., & Rahul, S. G. (2019). Solar Powered Multi-Controlled Smart Wheelchair for Disabled: Development and Features. Journal of Computational and Theoretical Nanoscience, 16(11), 4889-4900.

Rubavathy, S. J., Bavithra, P., Priya, M. H., & Umamageshwari, R. (2018). ANDROID BASED VOICE CONTROLLED SMART WHEELCHAIR.

Sumet Umchid, Pitchaya Limhaprasert, Sitthichai Chumsoongnern, Tanun Petthong, and Theera Leeudomwong , Voice Controlled Automatic Wheelchair, The 2018 Biomedical Engineering International Conference (BMEiCON-2018)

Zhengang Li, Yong Xiong, Lei Zhou, ROS-Based Indoor Autonomous Exploration and Navigation Wheelchair, International Symposium on Computational Intelligence and Design,2017

Chauhan, R., Jain, Y., Agarwal, H., & Patil, A. (2016, January). Study of Implementation of voice controlled wheelchair. In 2016 3Rd International Conference On Advanced Computing And Communication Systems (ICACCS) (Vol. 1, pp. 1-4). IEEE.

Romil Chauhan , Yash Jain, "Study of Implementation of Voice Controlled Wheelchair", 2016 3rd International Conference on Advanced Computing and Communication Systems (ICACCS -2016), Jan. 22 – 23, 2016, Coimbatore, INDIA.

Prannah Dey, Md. Mehedi Hasan, "Smart wheelchair integrating head gesture navigation", 2019 International Conference on Robotics,Electrical and Signal Processing Techniques (ICREST).

Sanket Sameer Bagewdi, Shikhar Dev, "Design and Development of Smart System to Assist Quadriplegics", EEE INTERNATIONAL CONFERENCE ON ADVANCES IN ENGINEERING &TECHNOLOGY RESEARCH (ICAETR - 2014), AUGUST 01-02, 2014, DR. VIRENDRA SWARUP GROUP OF INSTITUTIONS, UNNAO, INDIA.

Razvan Solea, Daniela Cernega, "Head Movement Control of Powered Wheelchair", 2019 23rd International Conference on System Theory, Control and Computing (ICSTCC).

Ericka Janet Rechy- Ramirez, Huosheng Hu, "Head movements based control of an intelligent wheelchair in an indoor environment", Proceedings of the 2012 IEEE International Conference on Robotics and Biomimetic December 11-14, 2012, Guangzhou, China.

Sumedh Kulkarni, Beena Ballal, "Staircase Climbing Smart Wheelchair", International Conference on Electronics, Communication and Aerospace Technology ICECA 2017.

Murray J. Lawn, "Modelling of a Stair-Climbing Wheelchair Mechanism with High SingleStep Capability", IEEE TRANSACTIONS ON NEURAL SYSTEMS AND REHABILITATION ENGINEERING, VOL. 11, NO. 3, SEPTEMBER 2013.

Luis A. M. Riascos, "A low cost stair climbing wheelchair" 978-1-4673-7554-2/15/$31.00 ©2015 IEEE.

Sherif Abdulatif, Bernhard Kleiner, "Stairs Detection for enhancing wheelchair capabilities based on Radar Sensor", 2017 IEEE 6th global conference on consumer electronics.

Sharma, H., & Mathur, N. (2021). Smart Wheelchair Remotely Controlled by Hand Gestures. In Research in Intelligent and Computing in Engineering (pp. 757-767). Springer, Singapore.

Citation Information: Neema, R & Rajkumar, R. (2021). Voice Controlled Smart Wheelchair. *Journal of Management Information and Decision Sciences*, *24*(S3), 1–9.