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Review on Design and Construction of Electric Drive -A Smart System for Disabled Person with Therapy Facilities

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ABSTRACT

Physical handicapped people are indivisible part of our society. Many of them are using manual wheelchairs. Now-a-days electric wheelchairs are increasingly demanded because of their advantages and use of simplicity. There are numbers of control systems are implemented in electric wheelchair such as voice operated, gesture controlled, brain controlled etc. The control system is depending upon different parameters such as type of disability, cost, environment in which it is used. Every control system is suitable for different users. The person with severe disabilities required two or more than two control system should be implemented in a wheelchair. This paper focuses on different control system used in electric wheelchair. This paper is mainly literature review of various designs and development of different control systems.

Keywords: Electric Wheelchair, Control Systems, Gesture controlled.

I. INTRODUCTION

In India, according to census-India 2011, the total population of disabled people is 26814994 and there are 5436826 people disabled in movement. This has caused high demand on some form of transport mechanism and thus wheelchairs continue to play a significant role. And facilitate their incorporation into the running world. Wheel chair enables disabled people perform many activities of daily living thus improving their quality of life. Disabled people are increasingly able to lead an independent life and play a more productive role in society. A wheel chair is one of the most important aids for an independent life especially, elderly people in this coming ageing society. Most of the physical handicapped people use manually operated wheel chairs. But these types of wheelchairs are economically not suitable for them. More efforts are required to move forward, reverse, left, right and climb. Electric power wheelchairs have become progressively more essential as assistive technology and therapy devices and the number of users has grown significantly. A wheelchair is a chair with wheels.The device comes in variations allowing either manual propulsion by the seated occupant rotating the rear wheels by hand, or electric propulsion by motors. There are often handles behind the seat to allow it to be pushed by another person. This review paper focuses on the literature review of regarding various methods of controlling the motion direction and other parameter of

wheelchair. There are various methods of controlling such as joystick-operated, voice-operated, tongue-movement operated, Gesture recognition, eye movement, head movement, brain controlled and combination of two or more above mentioned methods etc.A handicapped person with locomotive disabilities needs a wheelchair to perform functions that require him or her to move around. He can do so manually by pushing the wheelchair with his hands. However, many individuals have weak upper limbs or find the manual mode of operating too tiring. Hence, it is desirable to provide them with a motorized smart wheelchair that can be controlled by bio-signal & non bio-signal approach. Since the motorized wheelchair can move at a fair speed with minimum efforts. There are different types of wheelchairs available now days which are discussed below.

A. MANUAL WHEELCHAIRS

These are the type of devices that help a person to move him without any assistance of battery. There are three types of manual wheelchairs namely self-propelled, attendant propelled, and wheelbase. A single-arm drive enables the user to turn either left or right while the two-armed drive enables user to move forward or backward on a straight line. Another type of wheelchair commonly used is a lever-drive wheelchair. This type of chair enables the user to move forward by pumping the lever back and forth [1].

B. ELECTRIC WHEELCHAIRS

A power chair can be used by someone who hasn't got the dexterity or mobility, perhaps, to drive a mobility scooter due to arm, hand, shoulder or more general disabling conditions, and do not have the leg strength to propel a manual chair with their feet. Powered wheelchair can offer various powered functions such as tilt, recline, leg elevation, seat elevation, and others useful or necessary to health function [1].

C. STANDING WHEELCHAIRS

'Redman power chair', it is the world's highest quality standing wheelchair. People with spinal cord injury can reap the health benefits of standing wheelchair. Physical benefits of standing wheelchairs are

- ✓ Decrease urinary tract infection problem
- ✓ Improver blood circulation around the body
- ✓ Standing exercise greatly improve bowl function
- ✓ Wheelchair helps distribute your weight and improve healing bed sores
- ✓ Decrease the amount of muscle stiffness
- ✓ Increase bone density

D. PEDIATRIC WHEELCHAIR

These types of wheelchair provide a key-enabling technology to young children who would be unable to navigate independently in their environment. Standard powered wheelchairs are still heavily dependent on the cognitive capabilities of users. Unfortunately, this excludes disabled users who lack the required problem-solving and spatial skills, particularly young children. For these children to be denied powered mobility is a crucial set-back; exploration is important for their cognitive, emotional and psychosocial development [3].

E. STAIR CLIMBING WHEEL CHAIR

The stair-climbing wheelchair exists at present can be grouped into 3 categories: - continuous stair climbing wheelchair, intermittent-stair climbing wheelchair and auxiliary stair climbing wheelchair. Continuous stair climbing wheelchair has only one set of supporting device, the wheelchair relies on this supporting device for continuous motions. In

Intermittent stair climbing wheelchair the process of climbing stairs of is similar to the people climbing up and down stairs, it is also called walking stair climbing wheelchair. Intermittent stair climbing wheelchair is one of the supporting devices that elevate the wheelchair and other set of support system. In auxiliary stair climbing wheelchair, the attachments rely on another device installed on the wheelchair and it needs assistance to help realize the function of climbing stairs. Stair lift requires wide stair way which is very expensive [4].

II. LITERATURE SURVEY

Ali A. Abed [1] presented the design of voice controlled smart wheelchair. This paper described the design of smart voice controlled chair in which Arduino microcontroller and speaker dependent voice recognition processor have been used to support the navigation of the wheel chair. The direction and speed of wheelchair controlled by predetermined Arabic voice commands. The speaker dependent, isolated word recognition system (IWRS) for a definite sound of Arabic words to suit the user's necessities has been programmed. There is HM2007 speech processor used for processing the sound i.e. removal of noise and extracting the sound. Microprocessor receives the coded digital signals from the IWRS which being appropriately recognizes voice commands to facilitate control the function of the wheelchair accordingly. The wheelchair does not respond to a false voice commands. The system which is implemented in this wheelchair follows only Arabic language commands. The voice recognition rate varies from 90-100%.

Ms. S. D. Suryawanshi et al. [2] explained that design as well as development of voice operated wheelchair. They used ARM processor. The proposed ARM processor is very convenience to operate wheelchair. They implemented another system includes transmitter and receiver and obstacle detection system. It includes two infrared (IR) sensors, these IR sensors senses the obstacles in the route and gives signal to system which is connected to buzzer and buzzer beeps as obstacle appears. At that time signal also sends to wheelchair control system and wheelchair stops. In this way they proposed a wheelchair which is voice operated and assist safety also for the disabled people.

Rakhi A. Kalantri et al [3] described that automatic wheelchair using gesture recognition. The goal of the paper is to design and develop a system that allows the user to strongly cooperate with the wheelchair at different levels of the control and sensing. The movement of wheelchair forward, backward, left and right is depend upon head movement of the user. They use acceleration sensor for sensing head movement, it works on acceleration principle. If user tilts his head in any direction above 20degree angle chair will move in that direction. The working principle of their wheelchair is the principle of acceleration, one acceleration sensor, provides two axes, acceleration sensors whose output is analogs, varies according to acceleration applied to it, by using simple formula amount of tilt can be calculated and output of tilt will decide to move in which direction. They installed AT89C51 microcontroller and L293D driver IC. The software requirement was Kiel uv3 for implanted C programming. They also installed four IR sensors for detecting the obstacles. Mohammed Asgar et al. [4] proposed an automated innovative wheelchair controlled by neck position of person. They used LEDs, photo sensor, motor and microcontroller to control the movement of wheelchair. The proposed wheelchair is particularly designed for the intention of eliminating high price

and also for those who are amputees. Automated innovative wheelchair is a wireless system designed for the physically handicapped people specially. This is a type of wheelchair which even can be easily driven by those who do not have arms or legs or both. Neck-movement of the user will control the motion of the wheelchair. It incorporates LEDs and photo-sensors to achieve this task. LEDs and Phototransistors give very good response in all atmospheric conditions. The components used in this wheelchair do not get affected by the small change in atmosphere. The wheelchair is provided three points at which LED's and photodiodes/transistors can support to generate one of the control signals which were predefined. The user can give two commands to this wheelchair i.e. right and left. To control the straight direction there is no additional sensor. To move the wheelchair in the forward direction it is needed to align any of the LED and photodiode/phototransistor and look straight. And to stop it just bows the head for two seconds. After stopping the wheelchair user is free to move his neck but have to take care that light should not fall on any of the photo sensors else the wheelchair will turn on. In short there is constraint on neck movement. But for user ease they have taken care that will allow the user to move the neck around 60-70 degree in either direction. To avoid any accident numbers of provision are taken in wheelchair. Pothole detector and Obstacle detector are installed in this wheelchair for safety purpose.

Monika Jain et al. [5] explained the design of tongue operated wheelchair. The "Tongue Dive System" is a tongue operated Assistive Technology (AT) developed for people with severe disability. Tongue Drive consists of an arrangement of Hall Effect magnetic sensors mounted on a mouthpiece to quantify the magnetic field generated by a small permanent magnet mounted on the tongue. This technology works by following the travels of a permanent magnet, mounted on the tongue, using an arrangement of linear Hall-effect sensors. This allows a small arrangement of sensors to sense a large number of tongue movements. These sensors send a signal to control panel and then to wheelchair drive system and respective action will be taken. The sensor outputs are a function of position-dependent magnetic field generated by the permanent magnet. Therefore, provides faster, smoother, and more suitable relative control over the wheelchair drive system.

Nikhil R. Folane et al. [6] presented Electroencephalogram (EEG) based brain controlled wheelchair for physically disabled people. If user has serious disability and no control on muscles cannot use the other control system like joystick etc. Therefore Brain Computer Interface (BCI) system has been developed for controlling the movement of wheelchair. In proposed system brain send command directly to physical devices. Mostly there are two types of Brain Computer Interface techniques, invasive and noninvasive technique. In invasive technique the brain signals are recorded by an implanting electrode directly into cortex of brain. In noninvasive technique electrode is located on scalp of brain. Electroencephalography (EEG) is an example of noninvasive technique of detecting brain activity. Their system is primarily depends upon EEG waveforms. Brainwave sensor, MATLAB and ARM Controller are the significant factors of system. Brainwave Sensor senses the brain activity and generates the signal which sends to computer system. In computer system MATLAB receives the signal and analyses it and Artificial Neural Network (ANN) based algorithm is use for decision making. This algorithm receives values from sensor and analyzed it and produces relevant command. To use this type of system user have to take training for better stability.

Srishti et al. [7] proposed design and development of smart wheelchair using voice recognition and head gesture control system. This system is combination of voice control and head gesture control system. This wheelchair is built-in with acceleration sensors, ultrasonic sensor and voice recognition module. By tilting the acceleration sensor, wheelchair can be moved in the four directions. Using the voice recognition module, the occupant can manage the movement of chair by giving the voice instructions such as Forward, Backward, and Left & Right. And also ultrasonic sensor is used in this wheelchair to sense the obstacle in the path. Voice Recognition Module V2 is build in this system to recognize the voice
and it supports 80 commands and 7 commands can work at a time. The accelerometer ADXL 335 is an electromechanical sensor is used for recognizing gesture. This 3 axes accelerometer sensor produces voltage in 3 direction based on gestures. The microcontroller ATMEGA2560 is programmed using C language for the controlling of wheelchair using gesture control. If person is unable to move head then he or she can control the movements by giving command by voice. This system is more user-friendly.

III. DRAWBACKS OF PRESENTLY AVAILABLE WHEELCHAIRS

Most significant technical issue in the currently available wheelchairs is cost versus accuracy. Unavailability of wheelchairs for particular disabilitiy is also a considerable issue. Also, the present systems are unable to monitor the surrounding conditions and the health condition of the patient. There is also no wheelchair available till date for the bed lying patient. No wheelchair available for mentally challenged people also. Above all the other important aspect to consider is the physical barrier that place additional requirement on strength and durability of wheelchairs.

IV. DISADVANTAGES OF ELECTRIC WHEELCHAIR

As wonderful as a new electric wheelchair may be to help user recover some mobility, they aren't for everyone. They do have limitations, which need to be taken into consideration.

1. **Maintenance & repair:** The cost of maintaining and repairing an electric wheelchair can be significantly higher than a manual wheelchair.
2. **Initial expense:** Electric wheelchairs are typically more expensive than manual wheelchairs.
3. **Size:** Electric wheelchairs are larger than manuals and may not be suitable in every home.
4. **Weight:** Electric wheelchairs are much heavier than manual chairs. The size and weight makes them less portable than manual chairs and perhaps be too heavy for some lifts.
5. **Limited power:** If the battery packs are not recharged properly, user may end up with a dead battery before user return home.
6. **Difficult for others to movement:** If user become unable to move user's electric wheelchair on user's own, pushing it is very difficult because of its weight and its build.
7. **Shouldn't be only chair:** If user has an electric wheelchair, he or she still needs to have a manual chair on standby

V. CONCLUSION

In this study we have concluded that there are number of ways of control system used to control the movements of wheelchair. No any one method is suitable for all type of physical disability. The controls are dependent on environment also, voice

operated control system cannot used in noisy environment. Multiple control system implemented in a wheelchair is quite suitable to overcome this disadvantage. But as control system increases the cost also increases a lot so there is also limitation on implementation number of control system. There is no any system which makes physical disabled people fully independent. Different control system should be used for different type of physical disability. This paper presents a summary of current state-of-the-art smart wheelchairs. Various techniques are available to operate and control the wheel mechanism of wheelchair. Some of operating techniques of wheelchairs have been explained here. This information is gathered to promote awareness of status of existing types of smart powered wheelchair so that the improvement can be incorporated into it.

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