

## A Literature Review on Smart Wheelchair

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### ABSTRACT

In this day and age there are many disabled people who think that it's hard to perform developments or perform day by day exercises. This sort of people are for the most part reliant on others for their help. Be that as it may, they can become self-independent and play out some every day exercises without anyone else with the assistance of assistive gadgets. The most generally utilized assistive gadgets are Wheelchairs. Wheelchairs is essentially a seat fitted with wheels, which can assist individuals with moving around who can't walk due to disease, handicap or damage. In any case, there are many disabled individuals with powerless appendages and joints who can't move the wheelchair. Consequently, smart wheelchair can profit a ton to them and everybody in the public eye. Smart wheelchairs are electric powered wheelchairs with numerous additional parts, for example, a PC and sensors which help the client or watchman going with wheelchair to deal with it effectively and proficiently. The ongoing advancement in the field of Artificial Intelligence, sensor advances and mechanical autonomy help the development of wheelchairs with new highlights. This paper is to survey the ebb and flow condition of specialty of smart wheelchairs and examine the future research in this field.

**Keywords :** Artificial intelligence, Robotics, Sensors, Smart wheelchair, IoT

### I. INTRODUCTION

Any state of body or mind that makes it progressively hard for the individual with the condition to do certain exercises and associate with their general surroundings is named as inability. Evaluation directed in 2001 has uncovered that around 21 million individuals from India for example 2.1% of the absolute nation's populace are experiencing inability or the like. In 2011, the evaluation revealed that there was a slight increment from 2.1% to 2.21%. Out of which individuals experiencing the inability of development is huge [6]. The handicap of development is the deformation of the body because of which individuals experiencing discovers hard to

move one spot to another and perform day by day exercises. The handicap of developments can happen by birth or because of mishaps or different reasons. In this way, the utilization of assistive gadgets can end up being of incredible assistance to such people groups. The assistive gadget is any gadgets that help to beat individuals experiencing disabilities. Most normally utilized assistive gadgets are wheelchairs.

The wheelchair is only a seat fitted with four haggles to be effectively moved to start with one spot then onto the next. Manual/customary wheelchair requires physical power by the client, which can't be considered as an effective way since it might cause distress for the client with feeble appendages and

bones. This is the reason, electric-powered wheelchair are commonly favored over the customary and manual wheelchair. Electric powered wheelchair are anything but difficult to utilize and require insignificant power to control the wheelchair. Electric and customary wheelchair regularly take care of the issue of versatility for disabled people. Be that as it may, there is the sure a portion of a disabled individuals who experiences the ill effects of low vision, visual field decrease, spasticity, tremors, subjective shortfalls, and so forth. These individuals to a great extent depend on others for controlling the wheelchair. Controlling wheelchair independent from anyone else isn't protected. To take care of this issue, analysts have thought of the disclosure of "Smart Wheelchair".

Smart wheelchair are nothing but an electric powered wheelchair which also consists of a computer and various sensors. Smart wheelchair provides great safety of the user and are easy to use. This paper consists of current state of art and discussion about future research. Shown in Table 1 and Table 2.

Sr. No.	Residence	Male	Female	Persons
1	Rural	2.43	2.03	2.24
2	Urban	2.34	1.98	2.17
Total		2.41	2.01	2.21

Table 1. Percentage of Disabled to Total Population India, 2011

Sr. No.	Types of Disabilities	Male	Female	Total
1	In Seeing	17.6	20.2	18.8
2	In Hearing	17.9	20.2	18.9
3	In Speech	7.5	7.4	7.5
4	In Movement	22.5	17.5	20.3
5	Mental Retardation	5.8	5.4	5.6
6	Mental Illness	2.8	2.6	2.7
7	Any Other	18.2	18.6	18.4
8	Multiple Disability	7.8	8.1	7.9
Total		100.00	100.00	100.00

Table 2. Proportion of Disabled Population by Type of Disability India, 2011

While the necessities of numerous people with inabilities can be happy with customary manual or powered wheelchairs, a fragment of the disabled

network thinks that its troublesome or difficult to utilize wheelchairs autonomously. This populace incorporates, however, isn't restricted to, people with low vision, visual field decrease, spasticity, tremors, or psychological shortages. These people regularly need autonomous versatility and depend on a parental figure to push them in a manual wheelchair.

To suit this populace, a few specialists have utilized advances initially produced for portable robots to make "smart wheelchairs." A smart wheelchair commonly comprises of either a standard force wheelchair to which a PC and an assortment of sensors have been included or a versatile robot base to which a seat has been appended. Smart wheelchairs have been structured that gives route help to the client in various manners, for example, guaranteeing crash-free travel, supporting the presentation of explicit assignments (e.g., going through entryways), and self-governing moving the client between areas.

An ongoing review demonstrated that clinicians have a powerful urge for the administrations that a smart wheelchair can offer [6].

Critical review results included:

- Clinicians showed that 9 to 10 percent of patients who get power wheelchair preparing discover it incredibly troublesome or difficult to utilize the wheelchair for ADL.
- When gotten some information about guiding and moving assignments, the level of patients who announced these undertakings troublesome or incomprehensible hopped to 40 percent.
- Eighty-five percent of reacting clinicians announced seeing some number of patients every year who can't utilize a force wheelchair since they come up short on the essential engine aptitudes, quality, or visual keenness. Of these clinicians, 32 percent (27% everything being equal) announced seeing, at any rate, the same

number of patients who can't utilize a power wheelchair as who can.

### Wheel Chair: Past and Present

George Klein created the first PW for individuals with quadriplegia harmed in World War II while he was filling in as a mechanical designer for the National Research Council of Canada [8]. An individual with that degree of handicap is as a matter of course confined to bed in light of the fact that without help from individuals as well as innovation there would be no real way to get up. That being stated, with the correct mix of human and mechanical assets, an individual with quadriplegia can, in any case, have a very rich life and make a significant commitment to society, a way of thinking we want to impart to individuals who have recently encountered the beginning of inability.

While essentially proposed for individuals with versatility handicaps, those experiencing sicknesses bringing about weakness, and torment can likewise profit by a PW. By 1956 Everest and Jennings and the American Wheelchair Company started delivering PWs for mass deals [9]. The fundamental parts of a PW are:

- Chassis, or drive framework, might be front-wheel, back wheel, focus wheel, or all-wheel-drive. Skeleton might be foldable [10], incorporate stair climbing capacity (Fig. 1a), have the standing capacity (Fig. 1b), have off-road tank tracks (Fig. 1c), or 4-wheel off-road drive (Fig. 1d, 1e).



Figure 1 (a): Stair Climbing iBot



Figure 1 (b): Australia's Ability in Motion standing wheelchair



Figure 1 (c): The Tank Chair



Figure 1 (d): Chinese Observer Remains Level on All-Terrain



Figure 1 (e): Patrafour by Toyota Motor East Japan

- Batteries: The first PWs got their capacity from 2-24V wet cell batteries. In any case, these batteries must be expelled from the wheelchair during movement on planes. They were in the end supplanted by dry cell batteries.
- The controller is the interface among humans and machines. Financially accessible controllers include hand joystick, taste n-puff, jawline joystick, and head joystick.
- Seating framework: Seats are commonly moved up to incorporate pads that utilization froth, gel, or air to forestall pressure injuries; Backrests, are regularly cushioned with froth and can be mechanized to tilt and lean back; Lateral backings prevent the client from

tilting side-to-side; and Footrests, are either removable or mechanized to suit an increasingly open to leaning back position.

Medicare solution rules limit PWs to those people who can't utilize a manual wheelchair. In any case, a lot more individuals would profit by a PW, and frequently resort to more affordable, conventional arrangements that regularly don't address the issues of the individual and their specific incapacity.

A few people with quadriplegia wind up causing significant adjustments to their own wheelchairs so as to have extra security measures, similar to lights or reflectors, rearview cameras, and assistive innovation to use as an info technique for processing.

Co-creator, Dr. Jesse Leaman, started his journey to improve the PW client involvement with 1998 while a mid-year understudy at NASA's Marshall Space Flight Center. By 2007, his innovation, the data innovation redesign bundle for PWs, named "Griffin Shield", was perceived as one of the year's best 25 creations by the History Channel and the National Inventors Hall of Fame [11]. By 2010, anyway, the framework had become excessively huge, and substantial for the wheelchair base, and had gotten hard to keep up. The overhaul of "Griffin Shield" is the chair displayed in [12], [13] where we exploit ahead following mouse [14] and a Mount-n-Mover [15].

Fig. 1 shows several recent power wheelchair options that can be used as the platform for a Smart Wheelchair. Some early SWs were mobile robots with a seat attached but most were based on heavily modified commercially available PWs to which computers and sensors are attached. The majority of SWs that have been developed to date have been tightly integrated with the underlying PW, requiring significant modifications to function properly. Ideally the SW system should easily be removable from the underlying wheelchair so that the user can attach it to

a different chair, which is especially important for children, who may go through several wheelchairs before they are all grown-up.

It is challenging to build an efficient SW that people with all types of disabilities feel comfortable using. The system should be mountable on any make of PW, easily removable for maintenance and travel. Sensor/software packages, like collision avoidance, have had widespread success in the automotive industry, becoming less expensive and more trusted than ever before.

Smart wheelchair consists normally of electric powered wheelchair with a computer and many sensors. Continuous development in field of artificial intelligence, computing and robotics have led to growth in Smart wheelchair. Smart wheelchair consists of computer, which is responsible for the movements of the wheelchairs with help of inputs from the sensors. Sensors collect the data through the input from environment and that data is processed by computer and necessary steps are taken. Smart wheelchair can be also controlled manually by the user just like normal electric powered wheelchair.

### **Classification Factors Of Smart Wheelchair**

Smart wheelchair can be classified based on certain factors as follows:

#### **A. Form Factor**

Some early smart wheelchairs developed were actual mini-robots that were attached to seats. These wheelchairs are expensive compared to other wheelchairs. Other smart wheelchairs which are commercially popular are “add-on” units which can be purchased separately and can be easily attached to normal power wheelchairs. They are preferred because they are compatible with many electric power wheelchairs. The typical use of this “add-on” units are

suitable for Kids because they go through many different sizes of wheelchair due to their body growth.

#### **B. Input Methods**

There can be various input methods for the smart wheelchairs based on user specific preferences. Some input methods for smart wheelchair are biometrics, cloud, touch, voice, computer vision, brain computer interface, haptic feedback, etc. All input methods have their own use and should be selected based on the needs.

#### **C. Sensors**

Various sensors such as infrared sensors, ultrasonic sensors, laser range finder, camera's, etc. are used for providing inputs to the smart wheelchair. Sensors provide inputs from the surroundings and inputs are processed by the computer of the wheelchair. Sensors are generally used for providing safety features to smart wheelchair.

Ultrasonic sensors use sonar technology and are very good in terms of accuracy. Sonar sensors use sound for obstacle detection. The sound is emitted from the sensors and the sound reflected from the surfaces is used for finding the distance between objects.

Infrared sensors are also used for obstacle and collision detection. Infrared sensors use light instead of sound for distance finding. Both these sensors are cheap and are accurate in normal conditions. These sensors can get wrong input if the floors, stairs, surfaces, etc. are smooth, sound absorbent and light absorbent.

However, due to their limitations, they are still used because they are cheap, accurate and their technology is well known.

Laser Range Finder (LRF) are very good alternative to ultrasonic and infrared sensors. They use 1800 two dimensional scan for scanning the environment. Their cost is expensive and are more accurate compared to them.

Cameras are considered to be very accurate. Due to technological advancement in cameras, they have great accuracy rate in scanning the environment. They are smaller in size and can be easily fitted onto the smart wheelchair.

#### D. Operating Modes

Operating modes of wheelchair is another important distinguishing factor of smart wheelchair. Operating modes of wheelchair depend upon the user ability and according to the current situation. Smart wheelchair system can be autonomous or semi-autonomous. Users who cannot control the wheelchair safely on their own are benefited with autonomous systems. Autonomous systems can travel to desired destination automatically and safely and they require pre-knowledge of the environment. These systems use machine learning, navigation, localization and mapping techniques. Users which can control the wheelchair and travel to desired destination safely can use semi-autonomous system. These systems contain collision detection and avoidance technique for safety measures. Additional safety measures can also be added depending upon the user.

## II. CONCLUSION

There are a few issues looked by the makers and analysts which should be tended to so that, smart wheelchair turns into a business achievement and be broadly utilized. One basic principle issue is cost versus exactness. Reasonable and propelled sensors can beat this issue. Smart wheelchairs which can be utilized commonly utilized for a wide range of inability are as yet not accessible. Smart wheelchairs ought to likewise contain the capacity to screen the patient conditions and respond in like manner. At present accessible smart wheelchairs can be effectively utilized in indoor conditions however, for the open-air condition it requires supervision by an ally for security. Likewise, a smart wheelchair for free use by simple-minded individuals ought to be investigated.

The smart wheelchair has incredible breadth in the future and innovative progression in the field of mechanical autonomy and sensors will prompt business accomplishment too.

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