Study on Smart Wheelchair based on Microcontroller for Physically Disabled Persons

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Abstract: In recent year's enlargement promises a broad scale in developing smart wheelchair for those people disabled belonging to poor community. The research of smart wheelchair begins to depict awareness from both scientific community and industry. This paper includes the smart wheelchair that can monitor the possibility circumstances like temperature, humidity, fire etc... Be in command of voice, eye and joystick. This smart wheelchair informs the doctor/ analyzer via text message or through voice message about the patient conditions. In present world the medical field is center of attention about to be concerned the patients and hence this proposed product will be made user friendly to reduce the load of caretaker and will boost up the confidence level of the disabled person by making him/her self-dependent. The system is divided into 3 main units: Voice recognition through Mobile Phone, Eye Gesture recognition through Microcontroller and Motor control through Joystick. The whole coordination is based on grouping a Mobile Phone with a Microcontroller and Sensors.

Keywords: Automatic wheelchair, 8051 Microcontroller, LCD, Motor, Accelerometer, Analog Joystick, ADC, Ultrasonic Sensor, GSM Modem, Mobile Phone, Eye Gesture recognition and Voice Recognition.

I. INTODUCTION

Now a day's disabled persons in India, 21 million persons obtained through the most recent Population Census and National Sample Survey Organization's broad surveys on disability or we can say 2 percent of the total population in India. A new World Bank Report on disabled persons in India, has observed that, there is growing evidence that people with disabilities comprise between 5 and 8 per cent of the Indian population (around 55 – 90 million individuals). Although government and the public sector would have to play a key role in this Endeavour, it may be neither feasible, nor desirable for them to do it all. There are different types of disability, coupled with variations due to gender, class, place of residence (rural / urban) etc. Population Census and NSS surveys are the major two sources of official statistics in India. According to Census of India rate of disability increase rapidly every year as shown in figure below.

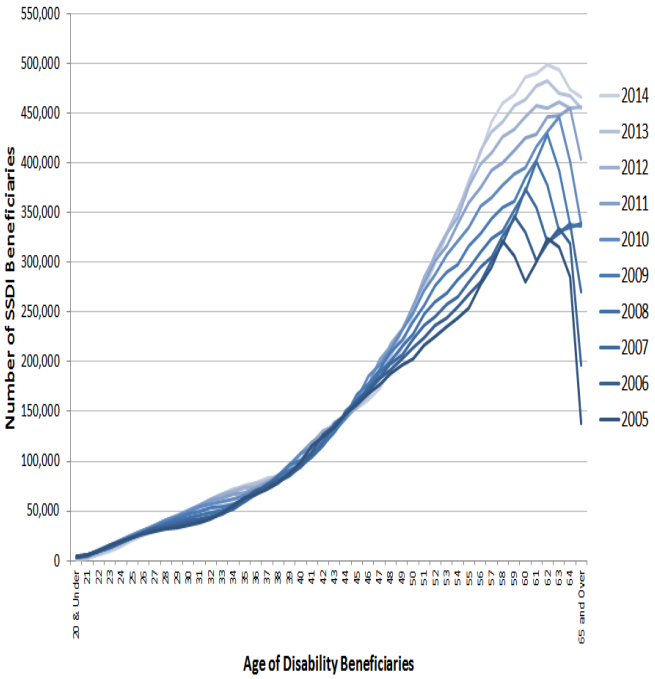

Fig 1: Growth rate of disabled person in India

Disabled Population by Type of Disability India			
Type of Disability	Persons	Males	Females
In Seeing	5,032,463	2,638,516	2,393,947
In Hearing	5,071,007	2,677,544	2,393,463
In Speech	1,998,535	1,122,896	875,639
In Movement	5,436,604	3,370,374	2,066,230
Mental Retardation	1,505,624	870,708	634,916
Mental Illness	722,826	415,732	307,094
Any Other	4,927,011	2,727,828	2,199,183
Multiple Disability	2,116,487	1,162,604	953,883
Total	26,810,557	14,986,202	11,824,355

Table 1: Various type of disability in India

In the year 2011, 75% of the persons with disability belonged to rural areas and only 25% were from urban areas. About 58% of disabled were males while only 42% were females. For the population of the country as a whole, 2.13% were found to have one type of disability or the other.

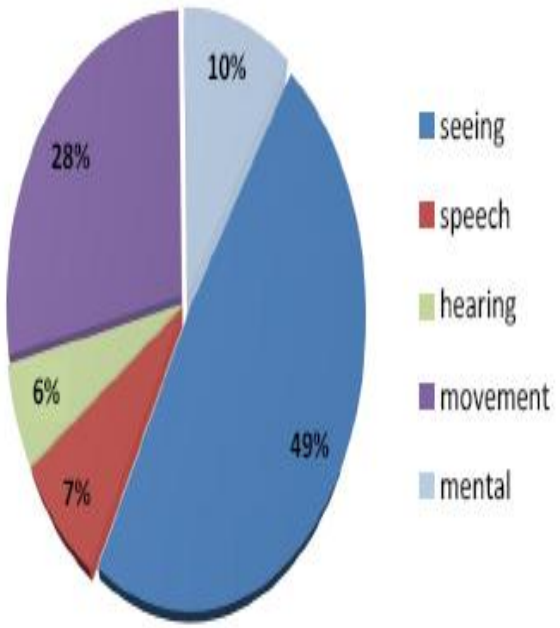

Fig 2: Percentage distribution of disable person by type of disability in India

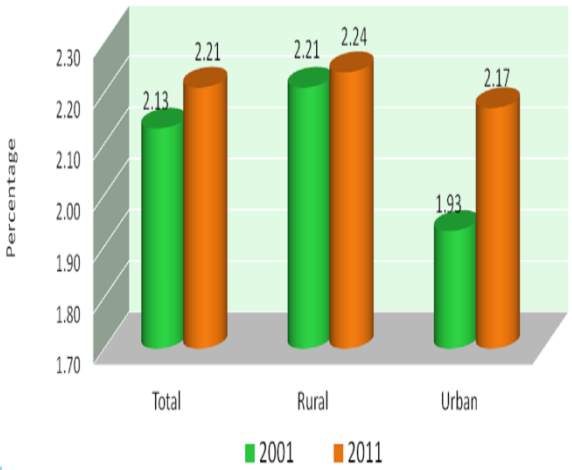

Fig 3: Proportion of Disabled Population by residence India: 2001-11

According to Census 2011 49% means half of them were found to have visual disability, more than a-fourth had movement disability, about 10% were having mental disability, 7% had speech disability and 6% were with hearing disability. In rural India, the occurrence of disability was much higher (2.21%) as compared to that in its urban counterpart (1.93%).

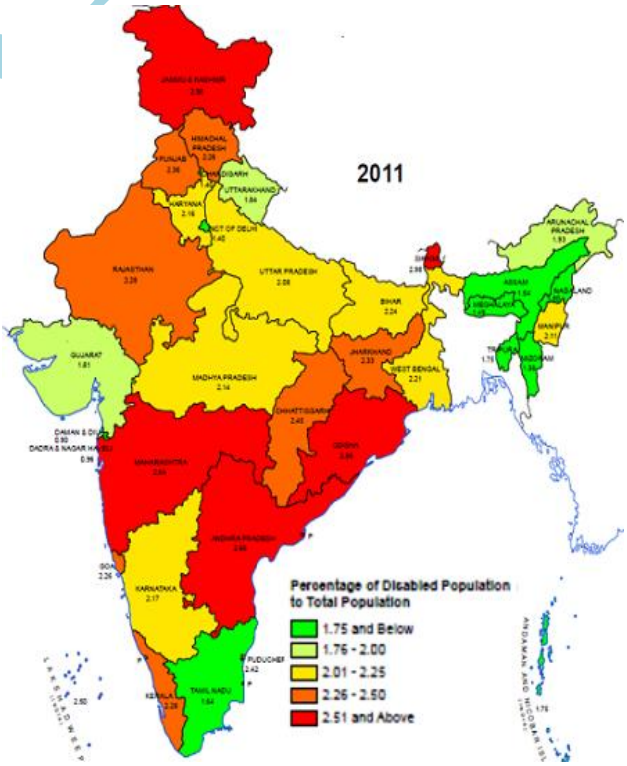

Fig 4: Census of India Proportion of disabled Person

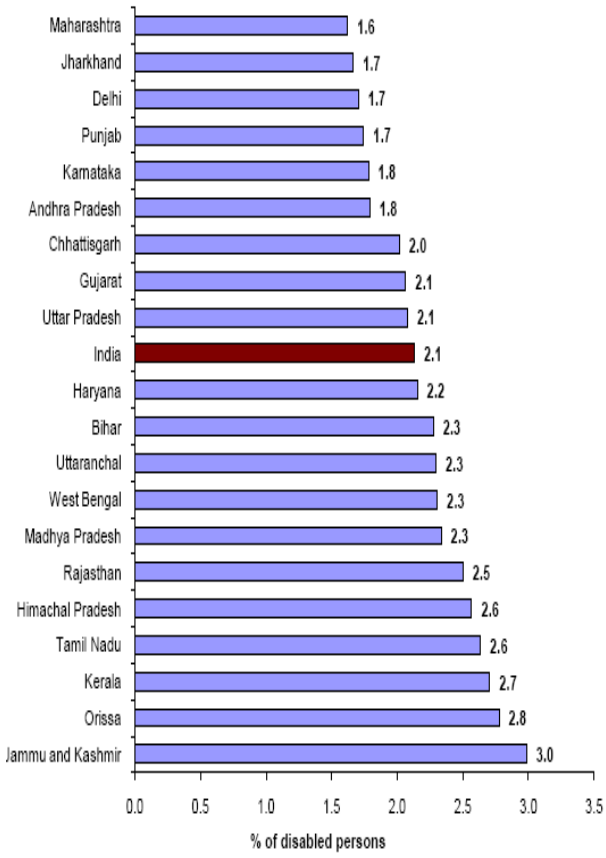

Fig 5: Prevalence of disability in major states of India

Again, among males, the occurrence of disability (2.37%) was significantly higher than that among females (1.87%). The occurrence rate among SC population (2.23%) was marginally higher as compared to the general population; while among ST population, it was noticeably lower (1.92%). There were significant variations from Population Census findings with respect to their composition by type of disability.

The occurrence of disability in various states of India means percentage of disabled in total population was relatively much higher in Jammu & Kashmir (3%), Orissa (2.8%), Kerala (2.7%), Tamil Nadu and Himachal Pradesh (2.6% each) while it was relatively low in Maharashtra (1.6%), Jharkhand, Punjab and Delhi (1.7% each), Karnataka & Andhra Pradesh (1.8% each) etc. if we consider all the states of the country, the occurrence of disability in state population was highest in Sikkim (3.8%). Further, in terms of numbers, about half of the disabled were located in five states, i.e. Uttar Pradesh, Bihar, West Bengal, Tamil Nadu and Maharashtra. The number of disabled males was higher than that of disabled females in any state in general, except for the case of Tamil Nadu. According to the census 2011 fifty percent of the disabled were of age less than 30 and only twenty five percent of disabled persons were of age 50 or more. This is of serious concern as most of the disabled persons were found to be very young.

The aim of the project is to use smart wheelchair easy to operate by using voice recognisation, Eye gesture control and Analog Joystick. According to patient comfort any one of the device can controlled the wheelchair for moving forward, backward, left and right by Eye rotation or Analog joystick and voice recognisation. A smart wheelchair is integrated with Ultrasonic sensors, temperature sensor, Mobile phone, motor and smoke sensor to help patient to achieve some self-directed mobility. The Ultrasonic sensors can help the patient control the smart wheelchair and avoiding the obstacles until the patient is able to handle the situation. The different type of approaches like human voice, Eye gesture movement and Mobile phone allow the patient to use synchronizes with the movement of wheelchair so that they can use it with comfort.

II. LITERATURE REVIEW

2.1 History and Evolution of Wheel chair

In 15th century first wheelchair was invented by king of Spain called Phillip and name of that wheelchair was invalids chair. Afterward Stphen Farfler made three wheel chassis in 16th century as shown in figure 7 below. Later on John Dawson was invented by Bath wheel chair in 1783. In the year 1881 the push rims for self forward motion wheel chair was invented as shown in figure 9 below. In the year 1932, Harry Jennings built the first foldable wheel chair as shown in figure 10.

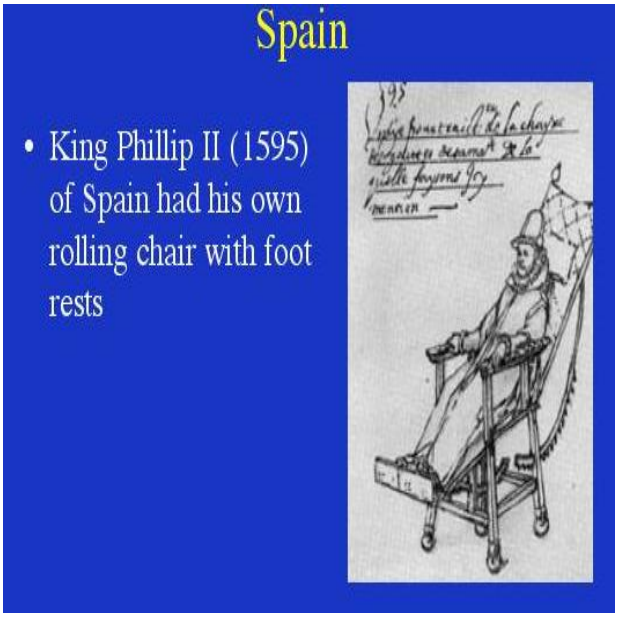

Fig 6: First wheelchair King Phillip II (1595)

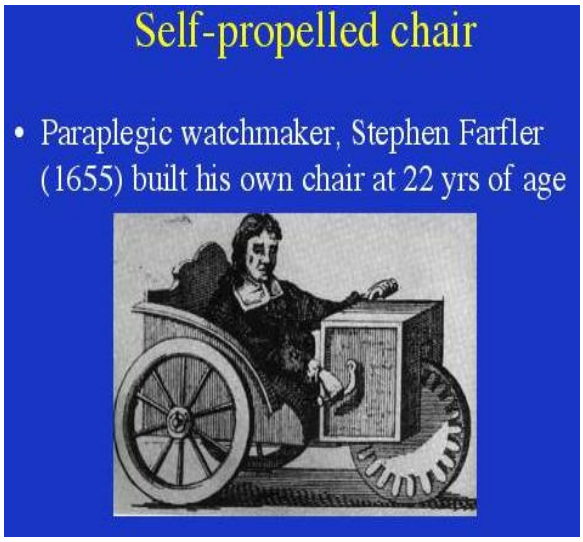

Fig 7: 16th Century wheelchair

Fig 8: 17th Century wheelchair

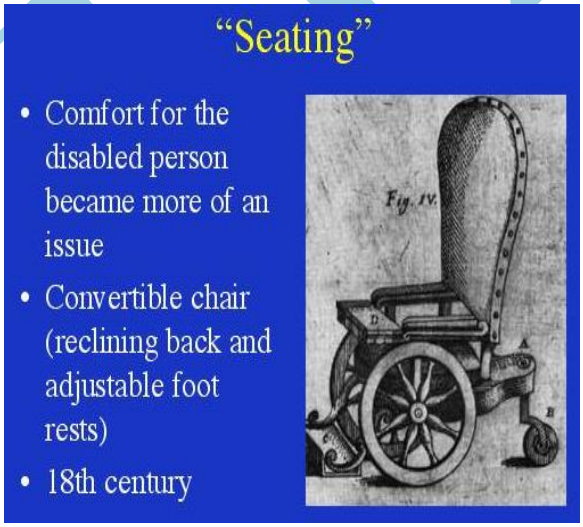

Fig 9: 18th Century wheelchair

Fig 10: 19th Century manual wheelchair

Fig 11: 19th Century Electric Powered wheelchair

2.2 Various Types of Wheel Chairs

Depends on the mode of power we have mainly two types of wheel chairs:

- Manual wheel chair
- Electric powered wheel chair

Manual wheelchairs or self-propelled wheelchairs are drive by the caretaker, usually by turning the large rear wheels like bicycle wheels are those that require human power to move them. Many manual wheelchairs are just as likely to be rigid framed with Light weight and due to light weight cost are high in the market. Transport wheelchairs are designed to be constrained by an assistant using the handles, and the back wheels are rimless and smaller. Transport chair is used to move a within a hospital or in areas where a user's standard chair is unavailable. These chairs are commonly seen in airports for disabled passengers to move from their seats on the plane. Manual wheelchairs are of different types:

1) Standard Wheel Chair
2) Folding Light Weight Wheel Chair
3) Rigid frame wheel chair
4) Special positioning wheel chair

Electric powered wheel chair is a wheelchair that is controlled by small analog joystick with the help of electric motor and that analog joystick is mounted on the wheelchair, rather than manual power. With the help of electric powered wheel chair disabled person can move without any care taker. In the recent years power-assisted wheelchair is the replacement of standard rear wheels with wheels that have small battery-powered motors in the hubs. Electric powered wheelchairs are of different types:

1) Rear Drive Power Chair
2) Front Wheel Drive Power Chair
3) Mid- Wheel Drive Power Chair

2.3 Advantages of Manual Wheel Chair

1) Less weight and easily affordable
2) Low cost due to light weight
3) Low maintenance cost

Disadvantages of Manual Wheel Chair

1) Required more space due to non foldable
2) Footrest is non adjustable
3) Non adjustable back and arm rest
4) The patient cannot move for the bed or any other place only with the other help

2.4 Market Study

Market study is necessity to understand the product market sector, to know the how many competitors in the market, to study their product capacitance and market strategy, to bench mark the product. Following are the competitors present in the Indian market:

1) M. TECHNOLOGIES Manufacturer, Haryana
2) ANAND MEDICAL EXPORTS Manufacturer, New Delhi
3) PARAMOUNT SURGIMED LTD Manufacturer New Delhi
4) VISSCO INDUSTRIES Manufacturer, Pune
5) MANISH STEEL INDUSTRIES Manufacturer, Madhya Pradesh

2.5 Existing Methodology

1) K.Sudheer, T.V Janardhana rao, Ch.Shridevi M.s Madhan Mohan (2012): voice and gesture based electronic powered wheelchair using ARM used combination of speech and gesture recognition .In this speech recognition module, hidden markov model are used. The MEMS sensor is used and it senses the angle of hand. For Voice recognition the voice IC is used.
2) M. Prathyusha, K.S Roy, Mahboob Ali sheikh (2013 April): Voice and touch screen based direction and speed control of wheelchair. The speech recognition system uses programmable speech recognition circuit. The speed controller works by varying the average voltage sent to the motor.
3) Rakhi A. Kalautri , D.K Chitre (2013): Used automatic gesture recognition system based on acceleration sensor here used is 2–axis .By calculating amount of tilt and output of tilt will decide to more in which direction.
4) Jinhua Zeng , Yaoru sun , Fang wang (2012): A natural hand gesture system for intelligent human-computer interaction and medical assistance. The hand gesture vocabulary in the system consist of 5 keys static hand gesture and 3 dynamic components. The hand motion in the vocabulary is limited to metacarphalangeal joint (MCP) abduction and adduction of index finger , ring finger and little finger and the thumb basal joint (TBJ) radial abduction and adduction of the thumb.
5) Nurul Muthmainnah Mohd Noor, Salmiah Ahmad (2012): EOG based wheelchair control: The cornea of the eye is electrically positive relate to the back of the eye, the retina. The eye behaves as if it were a single dipole oriented from the retina to the cornea. Such cornea-retinal potentials are well established and are in the range of 0.0.5-3.5mV. Eye Movements thus produce a moving (rotating) dipole source and accordingly, signals that are a measure of the movement may be obtained. The recording and interpretation of the electrical activity of eye is called electro oculography. Its main application is in Ophthalmological diagnosis and in recording eye movements. Electrodes such as gold surface electrode, Ag-Cl electrodes are used to record the eye potential changes.
6) Alex Dev, Horizon C Chacko and Roshan Varghese, (ICCCE 2012): EYEBALL SENSING method for wheelchair control: The basic principle of this direction sensing is the color of the eyes. There are two main colour pigments in the human eyes. i.e., black and white. The colors show different wavelengths in the spectrum. White being the farthest colour in emits the lowest wavelength. So the wavelength of white light is chosen as the standard parameter. White light can be measured by infrared
7) Sandesh Pai, Sagar Ayare, Romil Kapadia October-2012: Camera based wheelchair control: The eye movement is tracked using a camera mounted on to the headgear. The headgear construction greatly simplifies the optics by using a micro lens video camera for dark-pupil tracking. The headgear is equipped with proper illumination. This headgear is interfaced to the

laptop/desktop via USB interface through which real time video of the eye is sent. The laptop/desktop hosts image processing software which processes the video feed from the camera and determines the position of the pupil. The laptop/desktop then sends signals corresponding to the pupil position to the micro-controller circuitry which drives the motor through motor driving circuit.

III. APPLICATIONS OF SMART WHEELCHAIR

1) Hospitals

2) Sports

3) Physically handicapped individuals

IV. CONCLUSION

We are introducing smart wheel chair which is multifunctional and can be controlled by various devices according to the comfort of patient. With the help of this multifunctional smart wheelchair patients who are disabled physically and mentally can make use of this smart wheel chair without the requirement of caretaker. So this is a multifunctional smart wheel chair the improvement and self-reliability of many disabled people. Modifications made in the established equipment meant for the disabled ones will be of great use in upcoming time. All data provided are precise to the best of our ability. The system uses Mobile phone so that the accuracy is increased. The sensor describes the parameters like light, Temperature, smoke, gas etc. The IR sensor is used for obstacle avoidance. An eye movement wheelchair is any motorized platform for a physical disability person to reduce or eliminate the user's task of driving a motorized wheelchair. The knowledge gained from product design education is used to analyze the existing wheel chair product by means of detailed Market research, product study, problem identification and detailing finalized concept.

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