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Advanced Gesture-Controlled Wheelchair for Locomotor Disabled and Elderly People

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Abstract: ***The primary objective of this paper is to present a feasible and effective technique by which wheelchairs can be controlled. This focuses on making the lives of physically challenged and elderly people easier. Physically disabled people face a lot of difficulty in operating a wheelchair on their own. There are a lot of people facing problems in their daily life due to their physical disability. We devise a method with the use of micro-controllers and embedded programming that will reduce the effort given by a locomotor disabled person to move around. The solution put forward has a socio-economic outcome as it helps the needy by apt use of technology. Using this technique one can pose a limited set of hand-gestures and the robotic wheelchair will move in the corresponding direction. The technique involved has a fast, highly accurate algorithm that makes the wheelchair move by hand gestures.***

Keywords: Accelerometer, Gesture-control, Micro-controller, Motion Sensing, Locomotor Disability

1. Introduction

As years pass by, the number of physically disabled people in India is on the rise. There have been a lot of organizations which help the needy, but most of these fall under the category of Non-Governmental, non-profit organizations/groups. There is a need to help groups that focus on socio-economic goals and these are the need of today. The development of NGOs into Social enterprises can pave the way for the building of a more sensible society. The proposed idea will help the elderly population in addition to its main objective of serving people having movement disabilities.

There have been a lot of methods to control wheelchairs without using mechanical effort. [1] A wheelchair having a remote controlled electric drive system is proposed so that the user is able to move the wheelchair away or retrieve it without the assistance of another person. The electric drive system includes multiple safety features for precluding hazardous situations that result from accidentally or unintentionally setting the drive system in motion while the wheelchair is occupied. [2] A similar method has been used in this paper where the control of the wheelchair is in a joystick. This encourages the way for automation in wheelchairs which are currently rising in the market. [3] In this paper, a robot is controlled by Bluetooth mechanism and the receiver of the microcontroller will receive the data. The date is sent to the motor driver connected to the motors and based on the gestures the wheels are rotated. The idea is to implement a similar product by replacing Bluetooth controlled robot with wireless Radio-Frequency transmitted wheelchair. These wheelchairs will be cost-effective as compared to their existing counterparts in the market.A motion-to-electrical sensor has to be used to detect the gestures and move the wheelchair correspondingly.

2. Background Study

The primary aim of the projectis to help the locomotor disabled and elderly people by producing Hand-gesture controlled Wheelchairs. This can be of use to the deceased people who are not able to move around freely, i.e., people affected by diseases such as leprosy. This work emphasizes the importance of helping disabled and elderly people, at the same time, suggests a suitable solution. In India out of the 121 Cr population, 2.68 Cr persons are disabled which is 2.1% of the total population. Among the disabled population, 56% (1.5 Cr) are males and 44% (1.18 Cr) are females. In the total population, the male and female populations are 51% and 49% respectively. A majority (69%) of the disabled population resided in rural areas (1.86 Cr disabled persons in rural areas and 0.81 Cr in urban areas). In the case of total population also, 69% are from rural areas while the remaining 31% resided in urban areas.About 10% of the global population, i.e. about 650 million people, have disabilities. Studies indicate that, of these, some 10% require a wheelchair. In 2003, it was estimated that 20 million of those requiring a wheelchair for mobility did not have one. As the economic gap between the rich and poor has widened, the number of people who do not have access to wheelchairs would have definitely risen.

3. Methodology

A normal wheelchair helps locomotor disabled people to translate freely. With the help of an advanced wheelchair, a disabled person with hindered movement will not find it difficult to move around. The whole circuitry consists of two parts – A transmitter, which senses and transmits the electrical signals to the motor-driven wheelchair and a receiver part, that decodes the signals received and acts correspondingly on the wheels.

An accelerometer-based motion sensing technique is proposed to detect the hand-gestures given out by the user. The user has to wear a glove or a similar kind of chain on his/her hand, on which the accelerometer is mounted. Any movement or tilt of the hand will be sensed by the accelerometer and this will be conveyed to the microcontroller. The micro-controller has been coded to sense the tilt and decide on the action to be performed by the

wheels. The wheels move in particular directions based on the direction of tilt. It transforms the movement into electrical signals. These are encoded in a form which can be transmitted to the receiver part of the circuit using radio-frequency transmission. Radio transmission has been chosen due to its fast working and high accuracy. The sensitivity of the tilt sensor can be changed by modifying the codebook used in the microcontroller. At the receiver side, the signals coming in are accepted by the receiver and converted into a suitable form by the decoder. Depending on the signals received, the motor driver toggles specific motors to which the wheels are connected. This part involves the identification of received signals and turning on/off the particular set of motors. At the end stage, the wheels are rotated according to the polarity of voltages received at the motor driver outputs. This system uses a wireless-based hardware approach to send and receive electrical signals given off by the hand gestures.

4. Tables

Table 1: Disability statistics of people in India

	Population	Percentage
Total population	1,210,726,932	100.0
Total disabled population	25,425,475	2.1
Locomotor disabled population	5,085,095	0.42

Table 2: Distribution of disabled persons by age group by disability in movement (%) in India - census (2011)

Age group	Number in millions	Percentage
0-19	0.98375	12.5%
20-39	1.6443	21%
40-59	1.2903	23%
Above 60	1.3775	25%

5. Results

As shown in Table 2, almost one-fourth of the elderly population had a movement disability. Between ages 20-60, a large number of people are seen to be locomotor disabled in India. These are the working age and they require an effective means to move around on a daily basis. Around 5 million people are locomotor disabled as given in Table 1. In developing countries, almost 90% of the people who need a wheelchair do not have one (Table 3). This initiative can help the needy to find access to robotic wheelchairs. The prototype uses cheap, reliable and low-cost components for producing gesture controlled wheelchairs. It is observed that most 95% of disabled people have access to wheelchairs in developed countries. The prototype has been successfully tested and it is observed that it has high accuracy and a negligible error rate. The efficiency test has been done in a suitable outdoor environment. The load test has been conducted for the prototype and wheelchairs that support different weights can be designed.

Table 3: Wheelchair statistics for Developed and Developing Countries

	Number of people who require a wheelchair (in millions)	*Percentage of people who require wheelchair*	*Number of people who have access to a wheelchair (in millions)*	*Percentage Of people who have access to wheelchair*	*Number of people who need a wheelchair but don't have one*	*Percentage of people who need a wheelchair but don't have one*
Developed Countries (34 Countries)	10,000,000	1%	~9,500,000	~95%	~500,000	~5%
Developing Countries (156 Countries)	121,800,000	2%	~12,180,000	~10%	~109,620,000	~90%

6. Future Scope

The system has scope for further experimental improvements. The motion sensing can be equipped with a magnitude sensor that can retrieve the angle of tilt of the hand. This can be used to rotate the motor with a particular speed as desired by the user. Hence, the speed of the wheelchair can be controlled. It is a reliable idea to equip the wheelchair with a GSM or Wi-Fi module so that if an emergency is encountered, a triggering message is sent to specific people for help. The modification using an ultrasonic sensor can also prove to be a useful future improvement. This can act as an obstacle sensing module under the wheelchair so that any object which is not seen by the user can do not hinder the movement of the wheelchair.

7. Conclusion

The project idea is mainly focused on the people who are not able to walk due to locomotor disabilities, elderly people who find it difficult due to aging or even people affected by the disease which hinder their movement. As seen from the results, this is a low-cost, reliable technique that can be adopted in the manufacturing of wheelchairs in the future. The robustness and accuracy of the prototype have been tested and found out to be acceptable. The system can be modified using higher-end technology and newer versions can be developed. It has a very wide scope for improvement in the modern market and has the potential to yield much better socio-economic results.

8. Acknowledgment

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9. Declaration

This thesis is a presentation of our original research work.Wherever contributions of others are involved, every effort ismade to indicate this clearly, with due reference to the literature,and acknowledgment of collaborative research and discussions.

References

[1] Barthelt, Hans-Peter. "Wheelchair comprising a remote control." U.S. Patent No. 7,832,515. 16 Nov. 2010.
[2] Roger, Thomas, Christian Mandel, and Tim Laue. "Controlling an automated wheelchair via joystick/head-joystick supported by smart driving assistance." 2009 IEEE International Conference on Rehabilitation Robotics. IEEE, 2009.
[3] Dr. R. V. Dharaskar, S. A. Chhabria, Sandeep Ganorkar, "Robotic Arm Control Using Gesture and Voice", In International Journal of Computer, Information Technology & Bioinformatics (IJCITB), Vol. 1, Issue 1, pp.
[4] www.censusindia.gov.in
[5] www.wheelchairfoundation.org