Leap Motion Controlled Wheel Chair

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***Abstract*- This paper describes an indigenously developed hands-free wheel chair for physically disabled persons. The proposed device works based on the Hand Gesture Recognition technique by using Leap motion sensor. Leap sensor is used for the hand gesture recognition for the smart wireless controlling. With the change of hand gesture, data is sent wirelessly to the microcontroller based motor driving circuit to control the movement of the Wheel Chair in different modes.**

***Keywords* – Microcontroller, leap motion sensor, intelligent wheelchair and obstacle detection sensor**

I. INTRODUCTION

Old citizens or disabled persons become dependent on other members of the family to navigate through their habitat or within residence. A smart wheel chair can be a useful assistant for them. Recent development in the field of robotics, automation, embedded system, artificial intelligence etc., can be combinedly utilized to design such a wheel chair. It can be controlled wirelessly adopting proper communication system. The chair can be controlled by hand gesture method with directions as needed. By this development the recent wheel chairs are gesture controlled or voice controlled, but the limitations of this kind of technologies is that the wheel chair is getting too bulky and it is to be controlled only by sitting on it. That's why these types of wheel chairs are not giving satisfactory feedback from the users. The proposed model makes the wheel chair a lot easier to assemble and simple in the use, in addition the cost of manufacturing also gets reduced.

II. RELATED WORKS

A. Voice controlled automatic wheel chair

In this system, the wheelchair is operated automatically or manually by turning the wheels using hands or external aids. But this system is not helpful for paralyzed persons. In this technique, the voice based controlled wheelchair robot is developed for particular elder or physically challenged person by predefining their voices in the system. This system presents the construction and design of voice based wheel chair robot. The voice of the person is detected by voice capture module and that compared by voice recognition module with predefined voices loaded into the system. According to the received voice, the destination is automatically understood and the wheelchair moves according to the route which is predefined. It is also equipped with obstacle avoidance technique, where the person may not be able to provide proper voices at the right time. The wheel chair can automatically navigate from one point to other point in the home as per command from the voice module. Thus the above proposed system can be used by elderly and physically challenged people in day to day life even if they are alone at home

Advantages:

- Simple algorithm is used for voice recognition.
- Easy to train a person's voice.

Disadvantages:

- Not suitable in noisy environment.
- Dumb people cannot use.

B. Smart wheelchair based on eye tracking

This project aims to develop a prototype of a smart wheelchair that is controlled with eye movement. The smart wheelchair not only controls the movement of wheelchair but also remotely controls some appliance and also to use for communicate with caretaker via sent message to smartphone. The system consists of four components including imaging processing module, wheelchair-controlled module and SMS manager module, appliance-controlled module. The image processing module comprises of a webcam installed on the eyeglass and C++ customized image processing software. The captured image which is send to Raspberry Pi microcontroller will be processed using Open CV to derive the 2D direction of eye ball. The coordinate of eye ball movement is used as the cursor control on the Raspberry Pi screen to control the wheelchair movement via the wheelchair - controlled module which is the two dimensional rotating stages installed to the joystick of the electrical wheelchair to replace the manual control. The cursor position is also used to control the operation of some equipped appliance and send message to smart phone.

Advantages:

- People who are suffering from quadriplegia, they can use.
- More reliable.

Disadvantages:

- 100% efficiency cannot be provided with dim environment.
- Itching and irritations.

C. Brain controlled wheelchair

Brain–computer interfaces (BCIs) or mind machine interface (MMI) is the direct communication path between brain and external devices. Currently it is difficult for the persons suffering from stokes, amyotrophic lateral sclerosis (ALS) can lead to complete paralysis. Therefore the BCI system may be used to improve the quality of life of such patients. In this paper we overcome this challenge by introducing a BCI system which helps the patient to navigate the wheelchair from one place to another based on motor imagery model to control a brain actuated wheelchair. This allows the user to control the direction for four movements left turn, right turn, forward and backward movement, of the simulation or real wheelchair. Experimental trials are to be conducted to assess the BCI control; both a simulated wheelchair in a virtual environment and a real wheelchair were tested. The system will be realized as a standalone hardware unit and will be tested in the field

Advantages:

- BCIs will help creating a direct communication between human brain and computer.
- High Precision.

Disadvantages:

- Brain impulse varies from person to person
- Complexity is more.

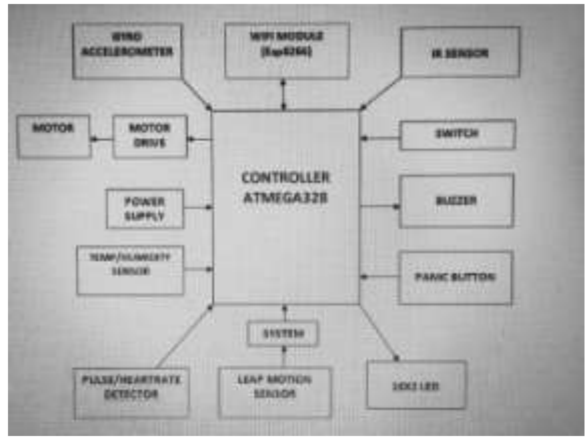
III. PROPOSED FRAMEWORK

The developed structure of wheelchair is so designed that a physically unable person can do their habitat and move around their house without any help of others. Our proposed wheelchair is so designed that it can be easily controlled by the hand gesture command. The most attractive feature of this wheelchair is that it can be wireless controlled. The controlling technique of this device is performed by leap motion controller.

A. System Architecture

When the left or right motion of the hand is detected, the wheelchair can be controlled to move in that direction by giving commands to the wheelchair. Theses commands are transferred to the wheelchair using electrical signals which are used the drive the left or right motor of the wheelchair. There are basically two motors connected to the left and right wheels of the wheelchair. The electrical signals are transferred to these motors using some hardware ports, called the communication ports. Generally, the communication port is the parallel port. There are some basic predefined pins of this parallel port which accept the commands given to the wheelchair in the form of electrical signals. For the purpose of demonstration of wheelchair movement using leap motion, a wheelchair model is designed in this project, which works on batteries

B. Block diagram



C. Leap motion controller

The Leap Motion Controller (Figure 1) is a compact device developed by Leap Motion for gestural control . It is portable and has a brushed aluminum body with a black glass on its top surface that hides two CMOS sensors and three infrared LEDs, which work together to track hands and fingers in interactive applications. The positions of the hands and fingertips are detected in coordinates relative to the center of the controller, taking as reference, the right-handed coordinate system. Several gestures can be natively identified by the Leap Motion

Fig 1: The *Leap motion* device

The computer control is done using its three emitters and two infrared cameras, at a frequency of 290 frames per second. The Leap Motion captures gestural information, and also identifies the main hand joints. In comparison with other devices for gestural identification, currently available in the market, such as Kinect, Playstation Move, Nintendo Wii, etc., the Leap Motion Controller has an advantage, since it is the only device able to identify a native core set of gestures. However, it does not capture sound or color images. According to the manufacturer, the sensors accuracy for position detection is approximately of 0.1mm.

The Leap Motion's field of view has a format similar to an inverted pyramid, whose lower area length measures 25mm and the top one 600mm, with 150o of field of view, as shown in (a) of Figure 2. The gestural tracking precision is inversely proportional to the distance between the device and the user's hands. For accurate identification of the hands, they are positioned at a height which varies between 10 to 20cm.

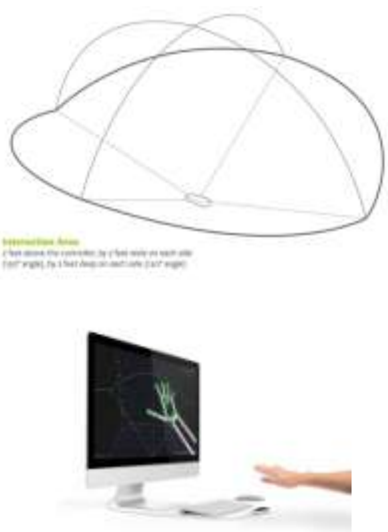


Fig. 2: In (a), The *Leap Motion's* sensor area. (b), The *Leap Motion* positioned between the keyboard and the user.

The *Leap Motion* SDK (available for C++, Java, ObjectiveC, C#, Python, Javascript, etc.) can be used to develop applications that exploit the capabilities of this device, compatible with Windows and OS X operating systems. Currently, it provides high-level functions.

IV. CONCLUSION

This project elaborates the design and construction of Smart Electronic Wheelchair with the help of leap motion sensor. The circuit works properly to move as the command given by the user. After designing the circuit that enable**s** the caretaker to control the wheel using an android application in their smartphone. The detection of any obstacle is successfully controlled by the microcontroller. As the person switches on the circuit and starts moving, any obstacle which is expected to lie within a range of 4 metres will be detected by the IR sensor. This proposed system contributes to the self-dependency of differently abled and older people.

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