Gesture Controlled Wheelchair

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Abstract- *This paper displays a model for smart wheelchair that adopts the usage of gesture-controlled user interface (GCUI) technology. We present a unified approach to real time detection, gesture-based glove technique that takes charges over the movements of the wheelchair. The ArduinoLilypad that acts as the brain of the system is the main component that aids in the working of the model. The paper proposed an inexpensive and a 3-axis wireless accelerometer (ADXL335) based system to control the wheelchair using an ArduinoLilypad. The system consists of a gesture recognition module with ultrasonic sensors and wheelchair control. In the gesture recognition module, the heart of the system is the ArduinoLilypad (Atmeg 328P). The 3-axis accelerometer detects the angle of the hand, i.e according to the tilt of the hand the voltage would be supplied to the Arduino Lilypad. The wheelchair would then come under the control of the gestures. The proposed movements that would be achieved are stop,backward,forward,left and right. Convincingly, the outcomes of the test conducted are presented and discussed. Experimental outputs show that the system can identify the input gestures rapidly with reliable rate. The users are privileged to perform most of the interaction tasks by this accelerometer-based device.*

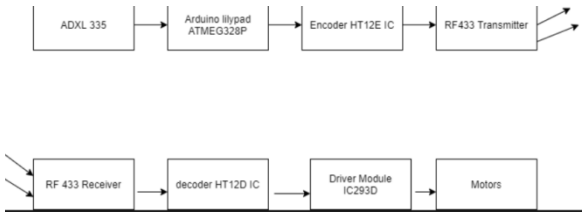
Keywords- Hand gestures, Arduino Lilypad, transmitter and receiver.

I. INTRODUCTION

The immense increase in human-machine interaction in our day to day lives has made automation and interaction technology increasingly important. Physical gestures as the primary expression will greatly aid the interaction process and facilitate humans to more naturally command computers or machines. For example, the application has reached extreme heights that helps in designing systems that can control television sets remotely, enabling a hand as a 3-D mouse using hand gestures as a control mechanism in virtual reality. In today's rapidly developing world people take less initiative to care about the old and physically challenged people. It's very difficult for these kinds of people to actuate themselves inside the house without any external aid. This kind of technology would help the elderly with easy locomotion. The aim of this project is to make an inexpensive and a user-friendly wheelchair that aids the physically challenged and the elderly to move around using hand gestures for operation. The present wheelchairs lack the integration of technologies for their work. Constant monitoring is required by the helper. Traditional wheelchairs are bulky, less flexible and have very scarce functions [1]. The contemporary advancements in the robotics artificial intelligence or sensor technology assures an enormous scope for building an advanced wheelchair. Some existing wheelchairs are fitted with pc for the gesture recognition or voice recognition [2]. But making use of the pc along with the chair makes it bulkier and increases complexity and less affordable. This complexity is reduced by using an accelerometer and ArduinoLilypad [3-4], which is compact and can be placed onto the gloves of the patient. The patient would not find this attachment a burden as they are not heavy. Our approach allows the users to use human gestures of movement like hands and synchronize them with the movement of the wheelchair so that they can use it with comfort and ease on all kinds of terrains without the hurdle or cardiovascular problems or fatigue. In this project we are trying to include some sensors to develop an automated wheelchair which can help the patient to control the direction of the wheelchair based on gesture [5].

II. ANALYSIS

The objective of this project is to use the concept of gesture recognition to control a wheelchair. For gesture recognition the accelerometer data is calibrated and filtered. The accelerometers can measure the magnitude and direction of gravity in addition to movement induced acceleration. In order to calibrate the accelerometers, we rotate the device's sensitive axis with respect to gravity and use the resultant signal as an absolute measurement. The four proposed movements that will be tried to achieve are backward, forward, stop, left and right.



III. LITERATURE SURVEY

Many research papers which are related to the detection of gesture-controlled wheelchair and there are many other technologies that are being used in various other papers.

In the paper [1] Hand gesture recognition is done with the help of Artificial Neural Networks (ANN) for which the data sets are generated using an accelerometer which processes hand gestures of certain geometric shapes and letters.

Paper [2] This uses Virtual Office Environment System (VOES) and avatar which is used to interact and navigate with the participants in the real world. This also uses hand gestures which is used by Avatar to interact and navigate in the virtual environment.

Paper [3] and [6] use Micro-electromechanical systems (MEMS) sensor which acts as a gesture recognition module to control the wheelchair. This MEMS accelerometer senses the tilt of the hand and is used to control the movement of the wheelchair.

Paper [4] uses three modules. The first module is fed by the frame acquired by the webcam which identifies the hand image in the scene. The second module is a feature extractor which represents the image as a nine-dimensional feature vector. The third model performs classification based on learning vector quantization.

Paper [7] makes use of an acceleration sensor which is controlled by head movement in order to navigate the wheelchair. The acceleration sensor detects the tilt of the head and makes use of it to move the wheelchair in the desired direction.

Paper[8] uses a color glove which is read by a frame which recognizes the hand and converts it into three-dimensional vector and uses that information to move the wheel chair.Thus different type of technologies are used in these different papers.

IV. WORKING MODEL

There are two main steps involved in this system. They are gesture recognition and the direction of the wheelchair which is controlled by the ArduinoLilypad. The transmitter section consists of an Arduino Lilypad, an ADXL 335 accelerometer, a HT12E encoder and a RF433 transmitter. The hand gesture is sensed by the accelerometer using the instrumented glove approach. The ADXL 335 accelerometer converts the hand position into 3-Dimensional Output. The analog values from the accelerometer are converted into digital values so they can be used by the Arduino. These values are encoded using a HT12E encoder and transmitted to the receiver part via RF433 transmitter. The receiver part has a RF433 receiver and a HT12D decoder which decodes the signals from the transmitter and sends it to the IC293D driver module which controls the movement of the wheelchair according to the gesture recognized from the hand.

V. PROPOSED SYSTEM

The proposed system makes use of Arduino Lilypad, RF433, HT12E, HT120, IC293D module for transmitter and receiver circuit where the transmitter encodes the hand gesture direction and transmits it to the receiver circuits. The receiver circuit decodes the encoded message from the transmitter and sends it to the driver module which moves the wheelchair in the particular direction.The advantage of this system is that very slight motion in the hand can be recorded by the transmitter circuit which maybe in the form of glove or a component attached to the patient's hand externally.The patient can simply tilt their hand in the particular direction they are intended to move and these gestures and converted into electronic signals and then it is converted into mechanical energy which moves the wheelchair. Therefore, this system aids people who are incapable of performing complicated movements.

VI. FUTURE SCOPE

As we all know, these days our nation is sick of massive health issues and most no. of people are suffering from malfunctioning of body. To avoid such health hazards issues technological power must exceed human power.

We can make use of technology as a replacement or a help for the malfunction of the human body. In this paper we introduce hand gesture detecting technology to ease human effort while using their wheelchair. We can further develop this technology by implementing them in various devices that we use in our everyday life such as automobiles, television sets and much more. This would help the physically challenged and elder people do things like normal people with ease. This developed prototype of the gesture-controlled wheelchair can also be developed further by setting up modules for changing the heights and adding some more safety features.

VI. COMPONENTS

Accelerometer:

The ADXL335 accelerometer is a device that is used for measuring acceleration of any object. It measures the acceleration in the form of analog inputs, in three-dimension directions such as X, Y and Z. It is low noise and less power consuming device. When it is used for acceleration measure purposes then it is interfaced with any type of controller such as microcontroller or Arduino etc. It is mostly used in construction working machines such as drilling, driving piles and demolition etc., human activities machines such as running, walking, dancing and skipping etc.

IC 293D:

L293D is a typical Motor driver or Motor Driver IC which allows DC motors to drive in either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC

RF 433 transmitter and receiver:

One of the easiest and cheapest ways to implement wireless communication is using RF Module (Radio Frequency Module).RF Module is a cheap wireless communication module for low cost application. RF Module comprises a transmitter and a receiver that operate at a radio frequency range. Usually, the frequency at which these modules communicate will be 315 MHz or 434 MHz

Lilypad Arduino:

The Lilypad Arduino is a microcontroller board designed for wearables and e-textiles. It can be sewn to fabric and similarly mounted power supplies, sensors and actuators with conductive thread. The board is based on the ATmega168V (the low-power version of the ATmega168) or the ATmega328V

Specifications:

Microcontroller ATmega168V or ATmega328V
Operating Voltage 2.7-5.5 V
Input Voltage 2.7-5.5 V
Digital I/O Pins 14 (of which 6 provide PWM output)
Analog Input Pins 6
DC Current per I/O Pin 40 mA
Flash Memory 16 KB (of which 2 KB used by bootloader)
SRAM 1 KB
EEPROM 512 bytes
Clock Speed 8 MHz

HT12E and HT12D Encoder Decoder IC:

HT12E is used to encode the data for RF Transmitter and HT12D is used to decode the data received by RF receiver.

The HT12E Encoder ICs are a series of CMOS LSIs for Remote Control system applications. They are capable of Encoding 12 bit of information which consists of 8 address bits and 4 data bits. Each address and data input is externally programmable or fed in using switches.

The HT12D Decoder ICs are a series of CMOS LSIs for Remote Control system applications. These ICs are paired with each other. For proper operation a pair of encoder/decoder with the same number of address and data format should be selected (HT12E is paired with HT12D). The Decoder receives the serial address and data, transmitted by a carrier using an RF transmission medium and gives output to the output pins after processing the data.

VIII. RELATED WORK

The gesture recognition based on data from an accelerometer is an emerging technique for gesture-based interaction after the rapid development of the MEMS technology. The implementation of accelerometers is very common in the new generation personal electronic devices such as Apple iPhone, Nintendo Wiimote which provide new possibilities for interaction in a wide range of applications, such as home appliances, in offices, in video games and most important in medical centers. Gesture recognition has been extensively investigated. This system uses gesture-controlled user interface (GCUI) that detects the hand gesture using a 3-axis accelerometer and displays the movement onto a screen and the MEMS sensor is affixed to the hand. The MEMS sensor is cost effective and works very efficiently.

IX. CONCLUSION

Accelerometers have a secure place in the movement of equipment based on actions done. The system can be made free from challenges and will be cost effective in the near future. Calibration though at times is a problem but with more introspection and research better calibration and performance can be achieved. The system developed by us despite calibration errors and problems still is able to achieve accuracy of 88-95%, further improvements can be used to achieve an accuracy of 95-99%. The system proves a very

competitive performance computationally and in terms of recognition accuracy. Interesting topic to research is the problem of tilting. As mentioned earlier, tilting of the remote can lead to erroneous recognition if not taken into account. Therefore, in our proposed system, subjects were requested to hold the remote in a natural way while performing the gestures and to avoid any tilting of the remote as much as possible. However, this way of holding the remote can result in some inconvenience to users of the system. Consequently, a system which is immune to tilting of the accelerometer is definitely a desirable one.

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