Tongue Controlled Wheel Chair

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Abstract— The Tongue Drive System is a tongue operated Assistive Technology (AT) developed for people with severe disability to control their environment. Tongue Drive consists of an array of Hall Effect magnetic sensors mounted on a mouthpiece, to measure the magnetic field generated by a small permanent magnet placed on the tongue. The sensor signals are transmitted and processed to control the powered wheelchair. In past a lot of Assistive Technologies have been designed but each one of them had certain demerits. The tongue is connected to the brain by the cranial nerve, which generally escapes severe damage in spinal cord injuries. It is also the last to be affected in most neuro muscular disorders. The tongue can move very fast and accurately within the mouth cavity. It is thus a suitable organ for manipulating assistive devices. The tongue muscle is similar to the heart muscle in that it does not fatigue easily. Therefore, a tongue operated device has a very low rate perceived exertion. The tongue is considered most significant way for severely disabled people to operate an Assistive device. In this project presents an efficient, low cost solution to all the issues encountered in various ATs.

Key words: Tongue, Wheel Chair

I. INTRODUCTION

Assistive technologies are critical for people with severe disabilities to lead a self supportive independent life. Persons severely disabled as a result of causes ranging from traumatic brain and spinal cord injuries to stroke generally find it extremely difficult to carry out everyday tasks without continuous help. Assistive technologies that would help them communicate their intentions and effectively control their environment, especially to operate a computer, would greatly improve the quality of life for this group of people and may even help them to be employed.

A large group of assistive technology devices are available that are controlled by switches. The switch integrated hand splint, blow-n-suck (sip-n-pu_) device, chin control system, and electromyography (EMG) switch are all switch based systems and provide the user with limited degrees of freedom. A group of head-mounted assistive devices has been developed that emulate a computer mouse with head movements. Cursor movements in these devices are controlled by tracking an infrared beam emitted or reflected from a transmitter or reflector attached to the users glasses, cap, or headband. Tilt sensors and video-based computer interfaces that can track a facial feature have also been implemented. One limitation of these devices is that only those people whose head movement is not inhibited may avail of the technology. Another limitation is that users head should always be in positions within the range of the device sensors. For example the controller may not be accessible when the user is lying in bed or not sitting in front of a computer.

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Up until now, very few assistive technologies have made a successful transition outside research and widely utilized by severely disabled. Many technical and psychophysical factors affect the acceptance rate of an assistive technology. Among the most important factors are the ease of usage and convenience in control. Operating the Device assistive device must be easy to learn and require minimum effort on the users part. Finally, a factor that is often neglected is that the device should be cosmetically acceptable. The last thing a disabled person wants is to look different from an intact person. Since the tongue and the mouth occupy an amount of sensory and motor cortex that rivals that of the fingers and a dental retainer and attached on the outside of the teeth to the hand, they are inherently capable of sophisticated motor measure the magnetic field from different angles and provide control and manipulation tasks. This is evident in their usefulness in vocalization and ingestion. The tongue is connected to the brain by the cranial nerve, which generally escapes severe damage in spinal cord injuries. It is also the last to be affected in most neuromuscular disorders. The tongue can move very fast and accurately within the mouth cavity. It is thus a suitable organ for manipulating assistive devices. The tongue muscle is similar to the heart muscle in that it does not fatigue easily. Therefore, a tongue operated device has a very low rate perceived exertion.

An oral device involving the tongue is mostly hidden from sight, thus it is cosmetically inconspicuous and offers a degree of privacy for the user. The tongue muscles not affected by repetitive motion disorders that can arise when a few exoskeletal muscles and tendons are regularly used. The tongue is not influenced by the position of the rest of body, which may be adjusted for maximum user comfort. The tongue can function during random or involuntary neurological activities such as muscular spasms. Also non-invasive access to the tongue movements is possible. The above reasons have resulted in development of tongue operated assistive devices such as the Tongue Touch Keypad (TTK), which is a switch based device. Tongue-mouse is another device that has an array of piezoelectric ceramic sensors, which elements can strength module is fitted within the oral cavity as a dental plate. Tongue point is another tongue operated device that adapts the IBM Track point pressure sensitive isometric joystick for use inside the mouth. The latter two devices have fairly large protruding objects inside the mouth, which can cause inconvenience during speaking or eating.

II. TONGUE DRIVE SYSTEM

Figure shows the block schematic representation of a tongue drive system. The main components of the system are given in blocks and the arrows indicate the input and output flow of signals in and out of the microcontroller. Tongue drive system hardware mainly consists a microcontroller, hall-effect sensor, dc motor, dc motor drive and power supply.

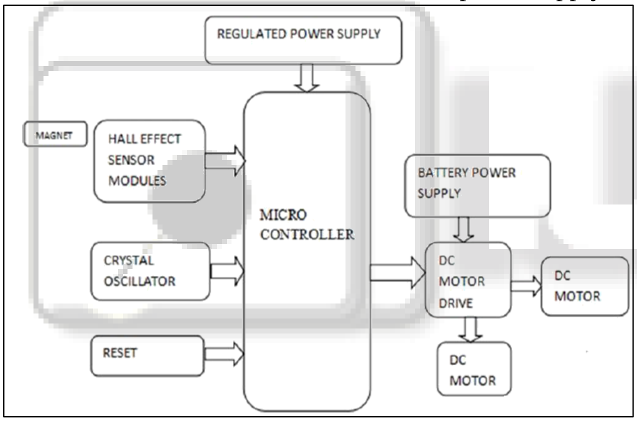

Fig. 1: Block Diagram of Tongue Drive System

A. Microcontroller

The Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. Clock speed of Arduino UNO is 16MHz.The Arduino Uno board can be powered via the USB connection or with an external power supply. The power source is selected automatically. The board can operate on an external supply from 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may become unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

B. Hall-Effect Sensor

A Hall effect sensor is a transducer that varies its output voltage in response to a magnetic field. Hall effect sensors are used for proximity switching, positioning, speed detection, and current sensing applications. In a Hall effect sensor, a thin strip of metal has a current applied along it. In the presence of a magnetic field, the electrons in the metal strip are deflected toward one edge, producing a voltage gradient across the short side of the strip (perpendicular to the feed current). Hall effect sensors have an advantage over inductive sensors in that, while inductive sensors respond to a changing magnetic field which induces current in a coil of wire and produces voltage at its output. Hall effect sensors can detect static (non-changing) magnetic fields. In its simplest form, the sensor operates as an analog transducer, directly returning a voltage. With a known magnetic field, its distance from the Hall plate can be determined. Using groups of sensors, the relative position of the magnet can be deduced.

C. DC Motor

A DC motor is a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor. DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. DC Motor is also used in the field vehicles and projects that require high power. The motor speed is 60rpm and because of the bearing used it has no problem with longer operation times. The motor has 6mm screw holes for mounting and its gear is designed to be on left side of the motor. Two 12V/60rpm DC motors are used to drive the wheelchair. The necessary power required is provided through the motor driver IC. The driver also controls the direction of rotation.

D. Earth Magnet

Earth magnets are strong permanent magnets made from alloys of rare earth elements. Earth magnets are the strongest type of permanent magnets made, producing significantly stronger magnetic fields.

E. Relay Module

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. Each channel needs a 15-20mA driver current. It can be used to control various appliances and equipment with large current. It is equipped with high-current relays that work under AC250V 10A or DC30V 10A. It has a standard interface that can be controlled directly by microcontroller. The 4-Channel Relay Driver Module makes it simple and convenient to drive loads such as 12V relays from simple 5V digital outputs of Arduino compatible board or other microcontroller. It can use any of the control channels independently.

III. WORKING

The circuit diagram clearly reveals various connection to the Arduino board from various components such as Hall effect sensor, motor driver and dc motor The three Hall effect sensors are connected to the A0,A1,A2 pins of Arduino Board Input to the Motor driver is connected the digital pins 2,3,4,5 of Arduino Board .The DC motor is connected to the output pins of the motor driver.

In the Tongue Drive system, the motion of the tongue is traced by an array of Hall-effect magnetic sensors, which measures the magnetic field generated by a small permanent magnet that is contained within a nonmagnetic fixture and pierced on the tongue. The magnetic sensors are mounted on a dental retainer and attached on the outside of the teeth to measure the magnetic field from different angles and provide continuous real-time analog outputs. In this three Hall Effect sensors are used, which are used for the movement of the wheel chair in different directions. The output of the first sensor assists the forward motion. The outputs of the second and third sensors are used for turning left and turning right respectively.

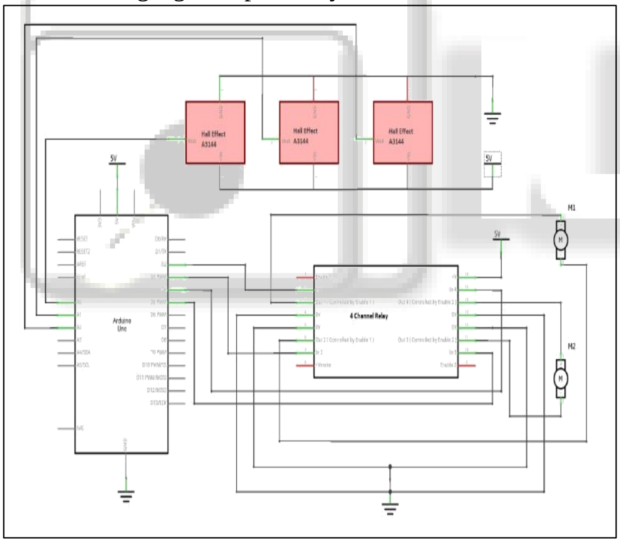

Fig. 2: Circuit Diagram of Tongue Controlled Wheelchair

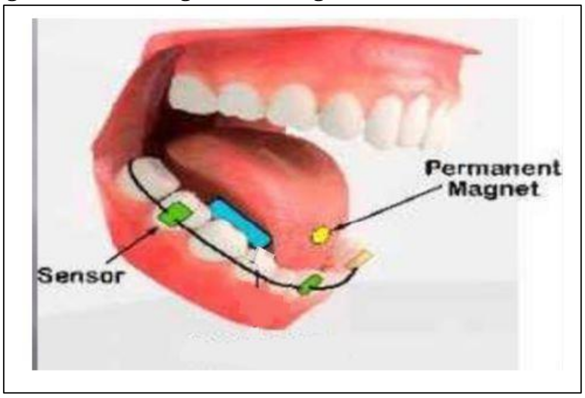

Fig. 3: Arrangement of Hall-Effect Sensor

IV. SOFTWARE SIMULATION

The software simulation has been done in proteus. It consist of microcontroller, three sensors, dc motor driver, crystal oscillator and two dc motors. When sensor detect the magnetic field, motor starts to rotate.

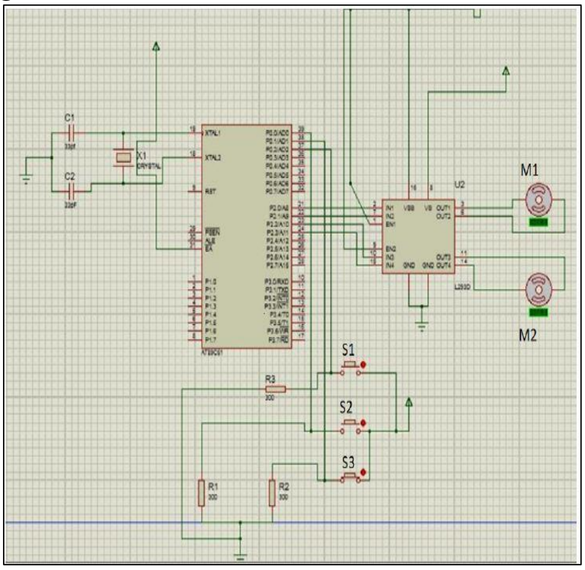

Fig. 4: Simulation in Proteus

A. *Simulation Output*

When the switches S1 and S2 are closed then both the motor rotates in clockwise direction, then the wheelchair move towards forward direction .If the switch S1 is closed and the switch S2 is open then the motor M1 rotates in clockwise direction, then the wheelchair move towards right. If the switch S1 is open and the switch S2 is closed then the motor M2 rotates in clockwise direction, then the wheelchair move towards left. The switch S3 is used to stop the both motors.

V. CONCLUSION

This project has designed the wheelchair for the physically disabled people those who cannot walk, so that they can easily handle it by simply moving their tongue. Tongue Controlled Wheelchair, is one of the major assets in the Bio-medical area, where a crippled loss of his/her motor abilities can still be encouraged of his/her right to explore the surroundings. Much further reach of the idea is to replace remote controls. Every human can control almost everything just by the slip of his/her tongue. The project is the testimony to the might of electronics and its impact to human life. We conclude our report, with a promise to encourage and motivate innovations using the wide spectrum of electronics for Humans in the coming time.

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