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TONGUE CONTROLLED WHEEL CHAIR

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Abstract – This paper enumerates the application of tongue motion to control the movement of a wheelchair. The tongue drive system is a tongue operated assistive technology that is developed to aid the people with reverse locomotive paralysis in controlling their environment. This system uses an array of Hall Effect magnetic sensors mounted on a mouthpiece in addition to a small permanent magnet on the surface of the tongue. These Hall Effect sensors measure the change in the magnetic field generated by the motion of the small permanent magnet. The sensed signals are then transmitted via a wireless link to the micro-controller which processes it and hence maneuvers the wheelchair. This technology not only provides ease of access and control to the individual but also help them in living independently in an efficient and cost-effective way. The following paper uses expounder on this project.

1.INTRODUCTION

People severely disabled due to various reasons like trauma to the brain spinal cord injuries and strokes find it extremely difficult to live a self-dependent lifestyle. They have to look for continuous help to perform the most mundane of tasks. Assistive technology is most useful to people like these. Assistive technologies not only help them communicate effectively but to also control some variables of their environment.

This particular technology of the tongue drive system would improve their lifestyle immensely by providing them with an easily accessible, cost-effective and efficient means of locomotion.

Tongue Drive System (TDS) is a tongue operated unobstructed wireless assistive technology that can provide severely disabled people with effective computer access and environment control. As its name implies, this wheelchair is controlled by the motion of the tongue. There are two sections in this setup: the transmitter section and the receiver section. The transmitter section is placed in the user's mouth and the receiver section is placed at the back of the chair. In the transmitter section, a small magnet is placed at the center of the tongue and three hall effect sensors are placed at the outer side of the teeth. The magnet can be fixed either permanently or temporarily. When the magnet makes contact with the left sensor the chair moves to the left and similarly contact with the right sensor makes the chair go right.

This technology converts the users' intentions to control commands by detecting their voluntary tongue motion using a small permanent magnet placed on their tongue and an array of magnetic sensors situated on a headset outside the mouth or on an orthodontic brace inside. To drive the wheelchair an interfaced circuitry has been developed and is implemented using four control strategies using an external TDS prototype. The magnitude sensors used are hall effect sensors. The sensors operate as an analog transducer which returns the voltage directly with a known magnetic field, the distance from the Hall plate can be calculated.

The control system consists of hall effect sensors and an RF transmitter. The data from the sensor is received by the transmitter which then transmits the encoded data. At the receiver, the decoder gives the data to the RF receiver which then feeds the data to the microcontroller as input. The controller then performs the wheelchair movement.

The wheelchair is made of high torque geared DC motors whose directions are changed via a set of instructions given by the Hall effect sensors. The actions of the said instructions are clearly loaded into the microcontroller by embedded C programming. Through RF transmitter the RF receiver provides the information to the microcontroller which then judges the instructions based on the tongue movement and hence controls the motion of the wheelchair.

2. SYSTEM OVERVIEW

Components of the block diagram:

- Microcontrollers
- Transistor as switch
- Buzzer
- Power supply
- Motor drivers and motor
- RF transmitter
- RF receiver
- HT12E encoder
- HT12D decoder
- Hall effect sensor module

Microcontroller

This device is manufactured using Atmel's high-density nonvolatile memory technology. It is low power and high-performance CMOS 8-Bit microcomputer 4K bytes of Flash programmable and erasable ROM (PEROM). The 8^n chip flash allows it to be reprogrammed in-system or by using a conventional non-volatile memory programmer. Atmel AT89C51 becomes a powerful microcomputer when the flash is combined with versatile 8-bit CPU over a monolithic chip. This provides a highly flexible and cost-effective solution to various embedded control applications.

Transistors as switch

As the output of the microcontroller is not enough to drive the buzzer directly, transistors have to be used as a switch to drive the buzzer.

Buzzer

It is an output device. As a default, the buzzer remains turned off. It turns on when data is received from the tongue.

Power supply

The project requires a +12vdc supply. The +5 volt is needed for the microcontroller 89C51 board and +12volt is needed for the buzzer, motor drivers, and motors.as the chair is moving 12-volt dc battery is used.

Motor drivers and motor

Dc gear motor is being used by the project. These motors are connected to the output of the motor driver.1293D is a quad, high current, half-H driver design to give bidirectional drive currents of up to 600mA from 4.5v to 36v. this makes it easier to drive the DC motors. L293D has four drivers-pins IN1 through IN4 are the input pins and OUT1 to OUT4 are output pins of driver 1 to driver 4. The direction of the motor decides the direction in which the chair would move.

RF Transmitter

It is a 433.92MHz ASK transmitter module with an output of up to 8mW (which depends on the power supply voltage). The TLP transmitter which is based on the SAW resonator accepts both liner and digital inputs that can operate from 2 to 12V DC. It makes the construction of RF-enabled products very easy. The usual range of this product is 100m in an open area and 30m in an enclosed space, when used with the following the results vary depending on the surroundings, operating voltage, and the antenna.

RF receiver

Due to their size and simplicity, these units are a professional and economical answer for various wireless applications. They exhibit a sensitivity of around 3* VRMS and operate in a range of 4.5-5.5 volts DC within both linear and digital outputs. The usual sensitivity is-103 dbm and on average it consumes a current of 3.5mA for 5V operation voltage. The typical range is 100m in an open area and 30m in an enclosed space. The results vary depending on the surroundings, operating voltage, and antenna.

Ht12e Encoder

The 212 encoder is basically a series of CMOS LS1 for remote control system applications. They are capable of encoding information that comprises of N address bits and 12N data bits. Each set input can be set to either of the one logic statuses. Upon receipt of a trigger signal, the programmed address are transmitted together along with the header bits, using an RF medium. HT12E has the capability to select a TE trigger which further improves the application flexibility of the 212 series of encoders.

Decoder Ht12d

For optimal operation a pair of encoder/decoder having the same number of addresses and data format is chosen using RF or IR transmission medium, a carrier transmits data and serial address from a programmed 212 series of encoders which in turn is received by the decoders. The serial numbers are compared with their local addresses thrice continuously. When no discrepancy is ensured, then the input data codes are decoded and transferred to the output pins. VT pins go high to show a valid transmission. 212 series of the decoder can decode information having 8 address bits and 4 data bits and are designed to be used with HT12E encoder.

Hall Effect Sensor Module

The module can detect a small magnet in a range of few multimeters. The sensor has 2 flat sides, one detects the north pole and the other side detects the south pole of the magnet. The sensor is polarity sensitive. The hall effect sensor is connected to an LM393 voltage comparator IC having an adjustable trigger level (Rb). LED indicator turns off when a magnet is detected. The output is directly connected to a microcontroller port.

3. METHODOLOGY

The magnetic output is sent to the Hall effect sensor module, which then converts the magnetic field into electrical energy. Hall Effect sensors do not get affected by external environmental conditions. It does not get affected by a contact bounce. The isolation between the magnet and Hall effect sensor is comprised of certain material such as gallium arsenide, indium arsenide. It has a four-bit output. When the tongue moves to the left, the sensor goes from high to low. During that time the output of the right sensor and front sensor remain high. This code is then transmitted to the encoder. They also receive an 8-bit address from the DIP pin output which is connected to the RF transmitter. RF transmitter operates on a frequency of 434MHz and has an operating range of 100m in an open area and 30 m in enclosed space.

The data from the transmitter output is received by the RF receiver, which is then given to the decoder. The decoder 8-bit address is then checked by comparing it with the local address, and when they match then the decoder converts the signal to parallel. The output of the decoder is received by microcontroller 89C51. Microcontroller outputs ate sent to the buzzer, motor, and motor driver.

4.RESULTS

Table no.1 is the input table that provides a signal from the tongue.

1	**0**	**1**	**5**	**FRONT**
0	**1**	**1**	**3**	**LEFT**

TABLE NO.1

OUTPUT TABLE

M2		**M1**			
D3	**D2**	**D1**	**D0**	**O/P CODE**	**MOTOR DIRECTION**
0	**1**	**0**	**1**	**5**	**FRONT**
1	**0**	**0**	**1**	**9**	**LEFT**
0	**1**	**1**	**0**	**6**	**RIGHT**
0	**0**	**0**	**0**	**0**	**STOP**

TABLE NO.2

Table no.2 is the output table that sends the signal from the microcontroller to the motor.

• When input signal 7 is received. It shows that the patients want the chair to stop, according to which the microcontroller sends code 00 to the motor, thereby stopping the chair.

• When input code 6 is received, the microcontroller sends code 6 to the motor, making the chair move to the right.

• When input code 3 is received, the microcontroller sends code 9 to the motor, making the chair move to the left.

• When input code 5 is received, the microcontroller sends code 5 to the motor, making it move forward.

5. CONCLUSION

The ultimate goal in developing TDS is to aid people with several locomotive disabilities in experiencing an independent, self-supportive lifestyle. This technology is simple to implement, cost-effective, and easy to operate flexibly. A wide range of tongue movements can be captured using only a few sensors. This assistive technology has adaptive control over the environments and requires very little concentration by the user. It is non-invasive in nature hence offering better privacy to the user. It requires low power for operation thereby making it easily accessible for all. By improving the TDS hardware and SSP algorithms, we can provide a quicker, smoother, and more convenient alternative to pre-existing AT systems.

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