Wheel Chair Operated By Tongue Motion

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Abstract— **Tongue Drive system (TDS) is a tongue-operated unobtrusive assistive technology, which can potentially provide people with severe disabilities with effective computer access and environment control.**
It translates users' intentions into control commands by detecting and classifying their voluntary tongue motion utilizing a small permanent magnet, secured on the tongue, and an array of magnetic sensors mounted on a headset outside the mouth or an orthodontic brace inside.

We have developed customized interface circuitry and implemented four control strategies to drive a powered wheel chair (PWC) using an external TDS prototype.
The magnetic sensors are nothing but hall-effect sensors. A Hall Effect sensor is a transducer that varies its output voltage in response to changes in magnetic field. In its simplest form, the sensor operates as an analogue transducer, directly returning a voltage. With a known magnetic field, its distance from the Hall plate can be determined.

The control system consists of Hall Effect sensor and microcontroller. Microcontroller collects data from the sensor and Microcontroller makes to move the motors of the wheel chair in appropriate direction. The direction is decided by the microcontroller depending on the magnet present at different Hall Effect sensors. The microcontroller is loaded with intelligent program written using embedded 'C' language.

Index Terms— **Hall Effect Sensor, RF transmitter and Receiver, Arduino**

I. INTRODUCTION

Tongue Drive system (TDS) is a tongue-operated unobtrusive wireless assistive technology, which can potentially provide people with severe disabilities with effective computer access and environment control. It translates users' intentions into control commands by detecting and classifying their voluntary tongue motion utilizing a small permanent magnet, secured on the tongue, and an array of magnetic sensors mounted on a headset outside the mouth or an orthodontic brace inside.

We have developed customized interface circuitry and implemented four control strategies to drive a wheel chair using an external TDS prototype. The magnetic sensors are nothing but hall-effect sensors. A Hall Effect sensor is a transducer that varies its output voltage in response to changes in magnetic field. In its simplest form, the sensor operates as an analogue transducer, directly returning a voltage. With a known magnetic field, its distance from the Hall plate can be determined. The control system consists of Hall Effect sensor and RF Transmitter. The data from sensor is given to transmitter and RF transmitter transmits the encoded data through the RF transmitter. At receiver end RF receiver receives the data through the decoder and fed as input to the micro controller. The controller performs the corresponding actions i.e., wheel chair movement.

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II. RECOMMENDATION FOR FUTURE IMPROVEMENT

In order to reach our goal in this project, which is making the wheelchair move according to the tongue order, a lot of time and effort was needed. Successful results were obtained based on the plans and schedule followed but to make it much more professional, here are some recommendations for future enhancements:

- Another type of sensor might be used. This sensor might be more sensitive and don't need any headset to be placed on.
- A medical chair can be placed on the wheelchair's chassis to give more comfortable sitting situation for the generalized paralysis patient.
- An easier circuit might be used based on wireless connections.
- A more generalized program that would make the wheelchair move in more different directions.
- An advanced way for steering the chair instead of the method used in a tank like steering system.
- The control switches might be placed in a way the patient carries them permanently, where he can control the chair wirelessly to bring it closer to him.
- A system that might make this paralyzed patient gives an order from his tongue to trigger the chair to move upward. These recommendations might give the patient more self-confidence. A set of sensors that prevents the patient to hit a wall in front also might be used.

III. PROPOSED SYSTEM ARCHITECTURE

The architecture of proposed system as shown in Fig1. It consists of two sections transmitter section and receiver section. Transmitter section is placed in the user's mouth and receiver section is placed at the back of the chair.

The components described in the architecture are Motor driver (L293D), Motors (12-volt DC motor), RF Transmitter, RF Receiver, Hall effect sensor, Arduino UNO.

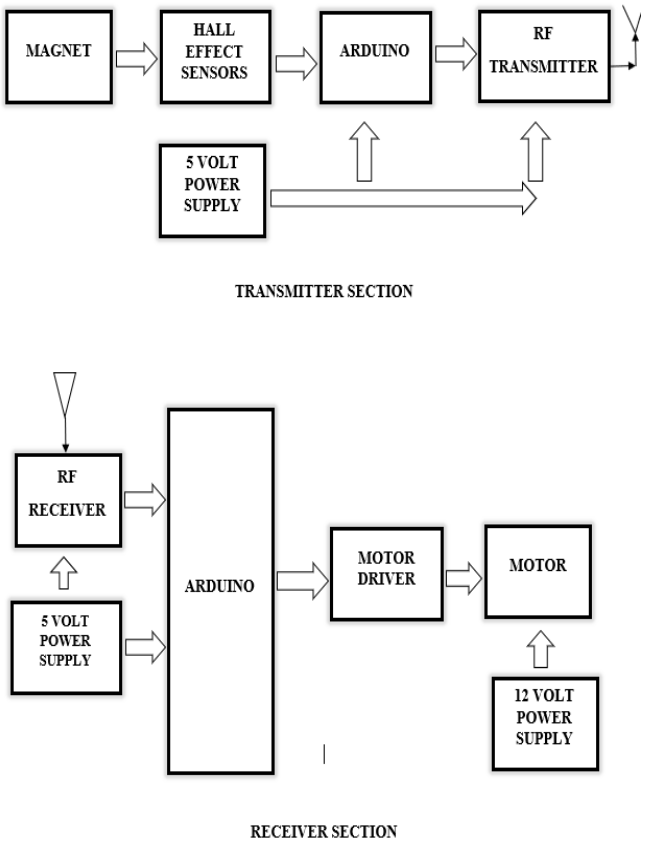

Fig1: Architecture of the Proposed System

RF receiver receives signal from RF transmitter which are generated by hall effect sensor. Then these passes through the Arduino and give input to the motors for movement.

IV. WORKING

Wheelchair is controlled by tongue motion as its name implies. We can use the tongue for controlling wheelchair. There are two sections transmitter section and receiver section. Transmitter section is placed in the user's mouth and receiver section is placed at the back of the chair. We can design this project for handicapped or particularly for paralyzed person who have to depend on the other person for their day to day activities. In the transmitter section we can place the magnet at the center of the tongue and the three Hall Effect sensors are placed at the outer side of the teeth. We can fix the magnet either permanently or temporarily. The permanent magnet fixing method is known as tissue piercing and temporarily magnet fixing method is known as tissue adhesive. When magnet is touched to the left sensor then chair can be moved to the left side. when magnet is touched to the right sensor then wheel chair can moved to the right side. we can fix the magnet permanently by using operation of temporally by using one type of liquid.

V. HARDWARE DESCRIPTION

1. *Arduino:*

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, 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 [8].

Fig 2: Arduino UNO

Sensors Interfacing to Arduino: The Arduino comprises of 28pins, where there 20 I/O pins. There are 14 digital pins and 6 analog pins. Here in this system all the respective sensors are connected to the analog pins of Arduino. The analog pins AO, A1, A2, A3, A4, A5 from Port B of Arduino are used for interfacing with the sensors. The digital pins (2, 3, 4, 5, 7,6,7,8) Port C of Arduino are used here to connect to the data lines of respective LCD display. The power supply of 5v is supplied to the Arduino through the USB cable. The output pin of Arduino i.e.t. The main components of this project i.e. RF transmitter and receiver are connected to Arduino. Hence in this proposed system the Arduino is completely used for implementation of the controlling of wheelchair.

2. *Magnetic Hall Effect Sensors:*

A Hall effect sensor is a device that is used to measure the magnitude of a magnetic field. Its output voltage is directly proportional to the magnetic field strength through it. Hall effect sensors are used for proximity sensing, positioning, speed detection, and current sensing applications.

Frequently, a Hall sensor is combined with threshold detection so that it acts as and is called a switch. Commonly seen in industrial applications such as the pictured pneumatic cylinder, they are also used in consumer equipment; for example, some computer printers use them to detect missing paper and open covers. They can also be used in computer keyboards, an application that requires ultra-high reliability. Another use of a Hall Sensor is in the creation of MIDI organ pedal-boards, where the movement of a 'key' on the pedal-board is translated as an on/off switch via Hall Sensors.

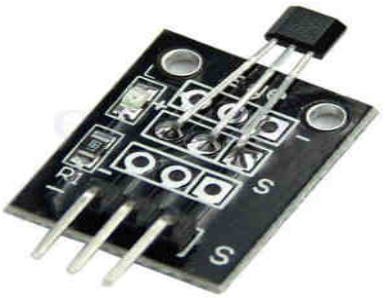

Fig. 3: -Magnetic hall effect sensor module

3. *Voltage Regulator IC 7805:*

This is most common voltage regulator that is still used in embedded designs. LM7805 voltage regulator is a linear regulator made by several manufacturers like Fairchild, or ST Microelectronics.

They can come in several types of packages. For output current up to 1A there may be two types of packages: TO-220 (vertical) and D-PAK (horizontal).

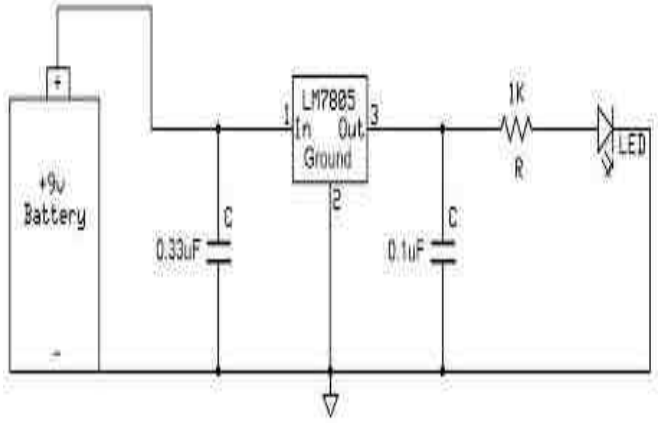

Fig. 4: -IC 7805 & circuit diagram

4. *RF Transmitter and Receiver:*

The transmitter and receiver (Tx and Rx) pair operates at a frequency of 434 MHz An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter

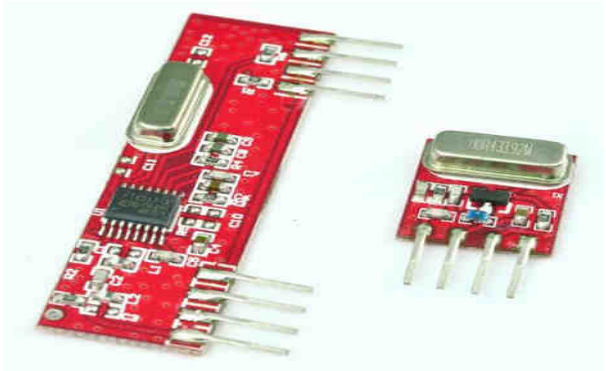

Fig. 5: - RF Transmitter and Receiver

5. *Wiper motor*:

A wiper motor is a DC motor with two permanent magnets that serves as a field for the motor, arranged around the armature where the power is connected to the commentator of the armature with two brushes, the armature is a set of electromagnetic coils that is each connected to its own two segments in the commentator so that the power is connected to only one coil at a time to generate a magnetic field in the armature, this field will oppose the field of the permanent magnet field, where the one field will push the other away and make the motor to turn.

Wiper Motor, the power source of the wiper blade, is the core of the whole wiper system. Therefore, the quality of the wiper motor must be guaranteed to ensure its performance. The wiper motor is a permanent-magnet direct current (DC) one. It is equipped on the front windscreen glass with the mechanical parts of the worm gear. The worm gear functions to slow down and increase torque. Its output shafts spur four bar linkage, by which the movement is changed from rotary to swinging.

Three-brush structure is adopted to make speed change more convenient. The intermittent relay, by which the interval is controlled, utilizing the return of switch contacts and the charge-discharge function of the resistor-capacitor in the relay, drives the wiper to wipe in a certain cycle. The wiper blade tape, the tool to clean the rainwater and the filth on the glass, presses the surface of the glass with springs. Only when the tip of the blade is in a certain angle with the glass, can the required function be realized.

Fig 6: Wiper motor

VI. RESULT

The wheelchair operated by tongue motion was successfully tested and run after the compilation of all hardware and software together. As proposed, it can carry the weight up to 60 kilo-grams. The circuit was designed and tested on Proteus. Every module is placed carefully, thus contributing to the best working unit. The wheelchair will be very useful for patient who have difficulty in movement. With the use of sensor and cutting-edge technology of electronics and electrical circuit a very helpful equipment is designed, keeping in mind the cost aspect, also the power requirement is less.

Advantages

- Wireless controlling of wheelchair can be done using RF module.
- Fast response.
- Efficient and low-cost design.
- Low power consumption.

Disadvantages

- Limited distance.
- Limited direction.
- Move only on plane surface.
- Limited Power.

Applications

- Hospitals
- Health care canters
- Old age home
- Physically handicapped individuals
- In industries as robot to carry goods.
- Automatic gaming toys.
- Communication
- Control of Mechanical systems
- Sports
- Feedback in Computer Based Learning environment

CONCLUSION

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC 's with the help of growing technology, the project has been successfully implemented. Thus, the project has been successfully designed and tested. This system gives independent movement and a psychological advantage of being independent. To avoid physical hardship a TDS is used due to which the slight movement of tongue turns the wheelchair into the desired direction. Some training is essential to use the TDS as its quite sensitive but in the end, there could not be a better use of technology for an individual who is deprived of the same physical strength. A prototype of this system is experimentally tested. A larger number of errors appeared when the user makes free head motions which can be reduced to a certain extent using an enable switch. It is designed to be characterized by low price and higher reliability

SNAPSHOTS OF PROJECT

FUTURE SCOPE

1. It can be extended by using a heartbeat sensor to this system. Heart beat sensor continuously monitors the heart rate, which can be designed such that alarm horns if the heart level goes beyond set level.
2. Instead of using tongue motion it can be used eye retina optical sensor to move wheelchair in different direction. Using retina movement, we would be able to drive a wheelchair.
3. We can use voice command IC to interface our voice signals with microcontroller. The voice stored in IC could be sufficient to analyze speakers voice Command.
4. It can be extended by using nervous system of human. By including GPS, position of the wheelchair can also be known.

REFERENCES

[1] Assistive technology devices, Available in: http://www.wheelchairnet.org/WCNProdServ/Products/OtherATprod.html

[2] X. Xie, R. Sudhakar, and H. Zhuang, "Development of communication supporting device controlled by eye movements and voluntary eye blink," IEEE Trans. Syst., Man and Cybern., vol. 25, no. 12, 1995.

[3] J. Gips, P. Olivieri, and J.J. Tecce, "Direct control of the computer through electrodes placed around the eyes," Human-Computer interaction: Appl. And case studies, Elsevier, pp. 630-635, 1993.

[4] BrainGateTm Neural Interface System, Available in: http://www.cyberkineticsinc.com/content/medicalproducts/braing ate.jsp

[5] Chen YL, Tang FT, Chang WH, Wong MK, Shih YY, Kuo TS. The new design of an infrared-controlled human computer interface for the disabled. IEEE Trans Rehabil Eng. 1999; 7(4):474–81. [PMID: 10609635]

[6] Hutchinson T, White KP Jr, Martin WN, Reichert KC, Frey LA. Human-computer interaction using eye-gaze input. IEEE Trans Syst Man Cybern. 1989; 19(6):1527–34.

[7] Law CK, Leung MY, Xu Y, Tso SK. A cap as interface for wheelchair control. In: Proceedings of the 2002 IEEE/RSJ International Conference on Intelligent Robots and Systems; 2002 Oct; Laussanne, Switzerland. New York (NY): IEEE. p. 1439–44.

[8] Barea R, Boquete L, Mazo M, Lopez E. System for assisted mobility using eye movements based on electrooculography. IEEE Trans Neural Syst Rehabil Eng. 2002;10(4):209–18. [PMID: 12611358]