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"TONGUE CONTROLLED WHEELCHAIR"

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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.

INTRODUCTION

This project involves the design of a wheelchair controlled by tongue drive system that helps the severely disabled people to make them more interactive with the community. Quadriplegia is an inability to move the arms and legs; it's a phenomenon restrict the movement of a body to move by himself and he has to depend on others. This system must be proper for paralyzed people by considering several factors such as suitable speed, safety, accuracy and inexpensive. Low speed is required to maintain the safety of the patient, and to increase the safety of the wheelchair obstacles will be detected using proximity sensor. For accuracy a change detection feature is implemented in the XBee to handle input errors. Transmitting side consists of several parts which are the permanent magnet, sensors, and buck converter.

The permanent magnet produces a magnetic field which will be sensed and detected by the sensors. The signals produced by the sensors will be read by the wireless module. These parts will be arranged in a headset to meet the conditions of movable, compact, and wearable equipment In the receiving side, the transmitted signal will be received through wireless communication. First, to check the system a prototype is used. In the prototype, the received signal will enter the receiver module, and then the microcontroller will understand the command and send it to the H-drive. The H-drive will move the motor in the desired direction. While, in the final design which is the wheelchair things change. Again the received signal will enter the receiver module, and the microcontroller will understand the commands.

TECHNOLOGY

Transmitting side consists of several parts which are the permanent magnet, sensors, and buck converter. The permanent magnet produces a magnetic field which will be sensed and detected by the sensors. The signals produced by the sensors will be read by the wireless module. These parts will be arranged in a headset to meet the conditions of movable, compact, and wearable equipment. This chapter will discuss these parts. After checking that the system is working fine, the wireless module is used between the two Arduinos to make sure that the system is working accurately with the wireless communication. But instead of using the h-bridge motor driver, Conceptually, we have combined both Sample Rate and Change Detect rate so thatthe XBee which transmits the Hall Effect input would only transmit a change in status after 10ms of continuous input. This is a very common practice for XBee communication where a longer interval is needed for periodic sampling. Change detection feature in XBee allows for change of state detection for input pins. This was implemented to monitor the four digital I/O pins for a change of state from the Hall Effect sensors.

A sample is transmitted whenever this change of state occurs. In change detection sampling, a request is made to send a sample of data whenever there is a change in state at one or more digital I/O pins for a defined number of cycles or in another word specific time.

METHODOLGY

The architecture of proposed system. 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 RF receiver receives signal from RF transmitter which are generated by hall effect sensor as shown in fig 3.1. Then these passes through the Arduino and give input to the motors for movement Transmitting side consists of several parts which are the permanent magnet, sensors, and buck converter. The permanent magnet produces a magnetic field which will be sensed and detected by the sensors. The signals produced by the sensors will be read by the wireless module as shown in fig 3.1. These parts will be arranged in a headset to meet the conditions of movable, compact, and wearable equipment. This chapter will discuss these parts. After checking that the system is working fine, the wireless module is used between the two Arduinos to make sure that the system is working accurately with the wireless communication. But instead of using the h-bridge motor driver, Conceptually, we have combined both Sample Rate and Change Detect rate so that the XBee which transmits the Hall Effect input would only transmit a change in status after 10ms of continuous input. This is a very common practice for XBee communication where a longer interval is needed for periodic sampling. Change detection feature in XBee allows for change of state detection for input pins. This was implemented to monitor the four digital I/O pins for a change of state from the Hall Effect sensors. A sample is transmitted whenever this change of state occurs. In change detection sampling, a request is made to send a sample of data whenever there is a change in state at one or more digital I/O pins for a defined number of cycles or in another word specific time.

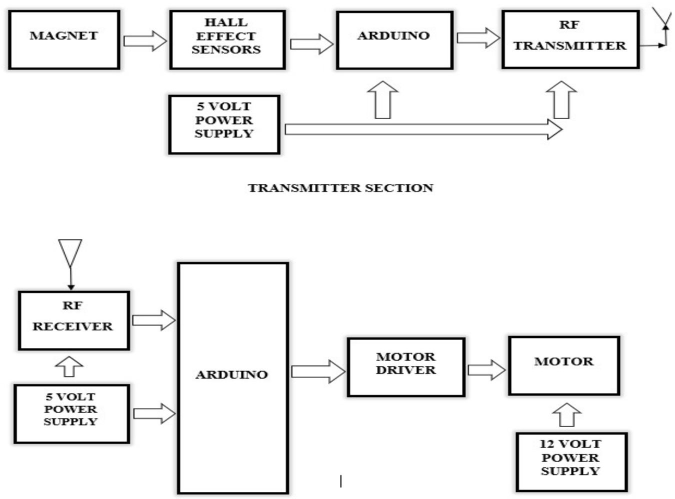

Fig 3.1: Block diagram

WORKING PRINCIPLE

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 centre 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.

In the receiving side, the transmitted signal will be received through wireless communication. First, to check the system a prototype is used as shown in fig 4.1. In the prototype, the received signal will enter the receiver module, and then the microcontroller will understand the command and send it to the H-drive. The H-drive will move the motor in the desired direction. While, in the final design which is the wheelchair things change.

Again the received signal will enter the receiver module, and the microcontroller will understand the commands. But in this design, the microcontroller will send commands to an electronic speed controller (ESC) through a relay and a buck converter. Before taking an action, the proximity sensor will check the obstacles around the wheelchair for the safety of the patient. The way in which relays work in normally open (NO) is that when power flows through part (1) an electromagnet is activated generating a magnet field which attracts a contact and activates part (2). The spring pulls the contact back to its original position when the power is switched off and by that the whole system is turned off [36]. The used relay on the receiving side of the project is a 5V, 10A, and 2-Channel Relay interface board (from the datasheet). It's able to control several applications and other equipment's using large current. It can operate with 3.3V or 5V from a microcontroller such as Arduino and PIC.

The last step after applying the system on the prototype is to implement the system and apply it on the wheelchair as shown in fig 4.1. The transmitter side is now performed on a headset that will be placed on the patient's head, and the receiver side is on an air wheel placed in the wheelchair. Of course, the wheelchair's system is more complicated since it requires more components to control the motors and needs much more power. But on the transmitter side, the Arduino is decided to be removed for some reasons such that it's more suitable to put fewer components and less size on the patient's head and it will have less power consumption. after doing all tests and checking that the system is working correctly, the system is applied to the h-bridge motor driver instead of the LED's but with the same principle. By that, the goal of the project is almost achieved.

Fig 4.1:The final design of the wheelchair

Change detection feature in XBee allows for change of state detection for input pins. This was implemented to monitor the four digital I/O pins for a change of state from the Hall Effect sensors. A sample is transmitted whenever this change of state occurs. In change detection sampling, a request is made to send a sample of data whenever there is a change in state at one or more digital I/O pins for a defined number of cycles or in another word specific time.

Fig 4.2:The final design of the headset

In this project, Arduino software will be used for the Arduino board . The unit which is used in the code that is uploaded to run an Arduino board is called a sketches shown in fig 4.3. Using IDE (integrated development environment) the sketches are created on a computer. Sketches may give the Arduino instructions to start processing the data in a certain way like combining the data streams, comparing the input with some reference or placing the data into a readable format. Writing and uploading the code to the I/O board is easy because the Arduino has an open-source software environment.

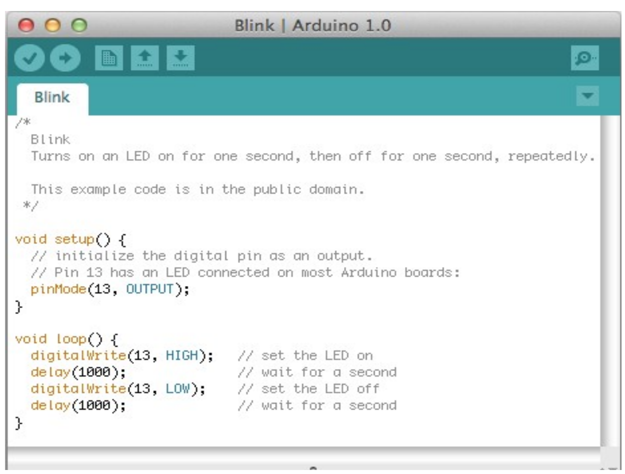

Fig 4.3: Setup and loop functions

ADVANTAGES

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

- Low power consumption.

APPLICATIONS

- Hospitals.
- Health care centers.
- Old age home.
- Physically handicapped individuals.
- In industries as robot to carry goods.
- Automatic gaming toys.
- Communication.
- Control of Mechanical systems.

CONCLUSION

This project concludes the usefulness of its design since it provides the independency by assisting the disabled people to control their environments, and run power wheelchair using their tongue motion. After studying, analyzing, testing and implementing the project aspects which are speed, safety, accuracy and low cost are achieved in the project. Regarding the safety of the system, it does not interfere with mobile phone signals and Wi-Fi signals. Some difficulties were faced during the process of the implementation. Also, for the electronic speed controller it was difficult to control the brushless DC motors with it and hard to understand it since the operation manual was in Chinese, so we faced problems in controlling the reverse direction. Yet, these difficulties will benefit by giving more experience in the future life. TDS is more efficient than the other assistive technologies considering many factors such as speed, and appropriate control. Tongue organ has several advantages over the other muscles that make it preferable, one of them is not to fatigue easily.

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