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Head and Tongue Oparated Wheel Chair Using Hall Effect & MEMS Sensor

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Abstract - *Electric wheelchairs are designed to aid paraplegics. Unfortunately, these can not be used by persons with higher degree of impairment, such as quadriplegics, i.e. persons that, due to age or illness, can not move any of the body parts, except of the head. Medical devices designed to help them are very complicated, rare and expensive. In this paper proposal a microcontroller system that enables standard electric wheelchair control by head motion is presented. The system comprises electronic and mechanic components. tongue drive consist of an array of hall effect magnetic sensor mounted on dental retainer on the outer side of teeth to measure the magnetic field generated by a small permanent secured on the tongue .The sensors signals are transmitted across wireless link and operate power wheelchair.*

Keywords- *TOS – Tongue operated system , HOS – Head operated system.*

I. INTRODUCTION

The main reason behind the implementation of this project is to give a helping hand for the sufferings of the challenged people. They have no way to get rid of from the bed due to their lack of movements. Degeneration of nerve cells and muscle fibers can lead to the challenges. To defeat the challenges is the main objective of this project. By designing the wheelchair for the challenged people can reduce the sufferings of the patients to an extent. Powered wheelchairs play a vital role in bringing independence to the severely mobility– impaired and allow people to get on with their activities of daily living. Many people who suffer from mobility–impairments rely on powered wheelchairs .Assistive technologies are critical for people with severe disabilities to lead a self supportive independent life. Persons severely disabled as a result of cause ranging form traumatic brain and spinal cord injuries to stroke generally find it extremely difficult to carry out everyday tasks without continuous help.

II. USE OF TONGUE & HEAD FOR MANIPULATION

Tongue driven wireless assistive technology consists of an array of Hall Effect sensor and small permanent magnet. It translate user's command into control commands by detecting and classifying their voluntary tongue motion by using small permanent magnet, held on the tongue using tissue adhesive or tongue piercing. The magnetic field generated from the magnet will change inside and outside the mouth as the user will move his tongue. These variations are sensed by the three Hall Effect sensors that are placed as an array outside the mouth. Now depending upon the strength of the magnet field the output of the sensor will vary. As the output of these sensors is of analogue type, it should be converted into digital. The three ADC channels of microcontroller are used to convert the analogue signals coming from sensor into digital values. The microcontroller will compare the sensors output with the predefined threshold value and based on the programming in will check user has issued which command. Depending upon the command, microcontroller will send particular characters to the transmitter. Transmitter will transmit the encoded data wirelessly. Receiver will receive the transmitted data, decode it and feed it to microcontroller unit of receiver section. The microcontroller is the main controlling unit that will control the movement of wheelchair.

The wheel chair will work based on the head movement of the user. The recognized gestures are used to generate motion control commands to the controller so that it can control the motion of the wheel chair according to the user intention. The head movement is the gesture which can be performed by the quadriplegic patients whose body parts below the neck is paralyzed. So the head movement is possible for the patients. The wheelchair includes the accelerometer sensor which detects the movement of head and the controller will process the signal and will transmit to the wheel chair for its navigation. The wheel chair is implemented in a cost effective way which reduces the complexity in the design. It is intended to be used as a human-friendly interface for elderly and disabled people to operate wheelchair using their head gestures rather than their hands. This autonomous navigation ensures safety, flexibility, mobility, obstacle avoidance and an intelligent interface for the users.

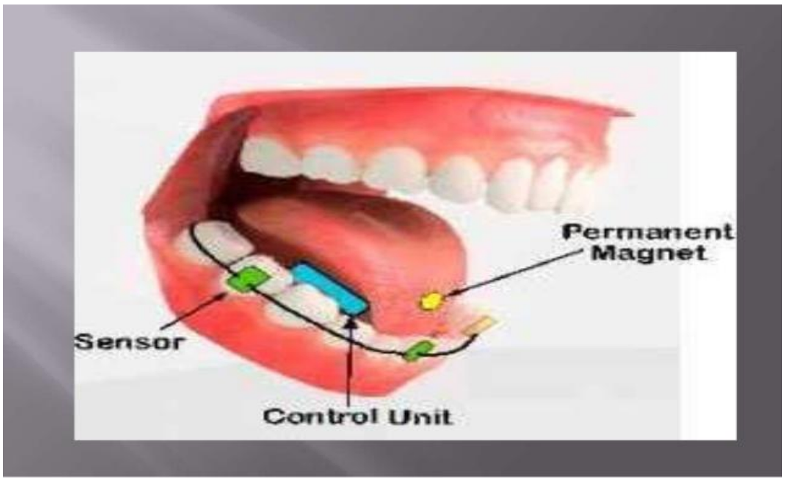

Figure 1. Mouthsetup

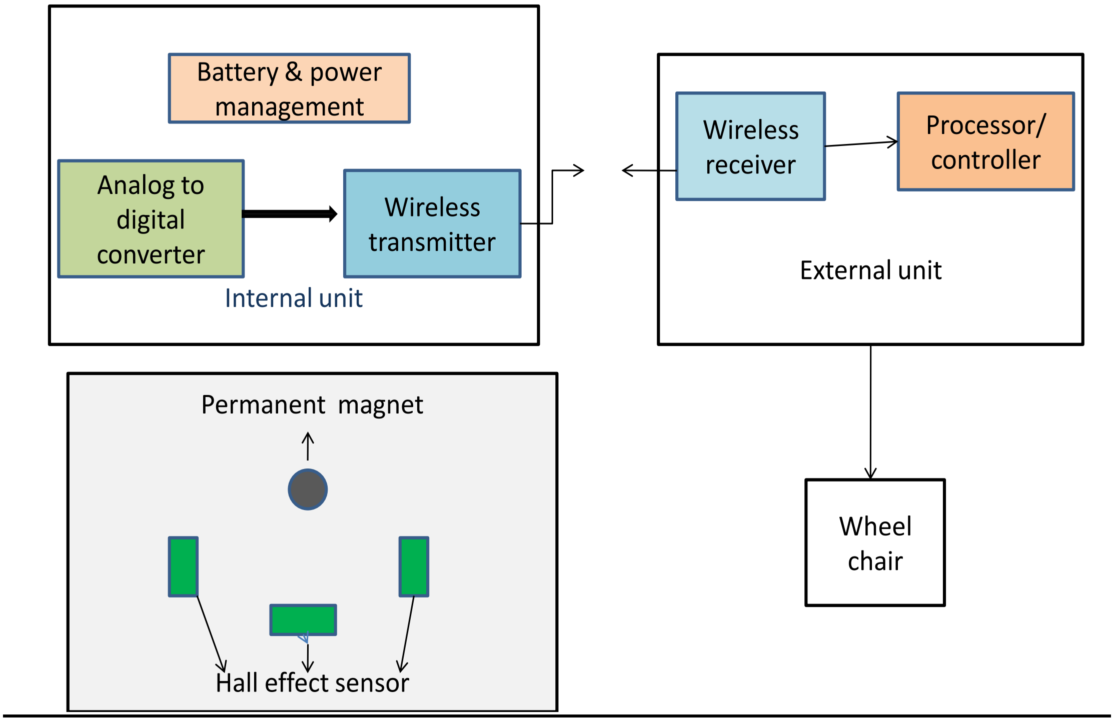

Figure 2. Block Diagram of Tongue Drive System

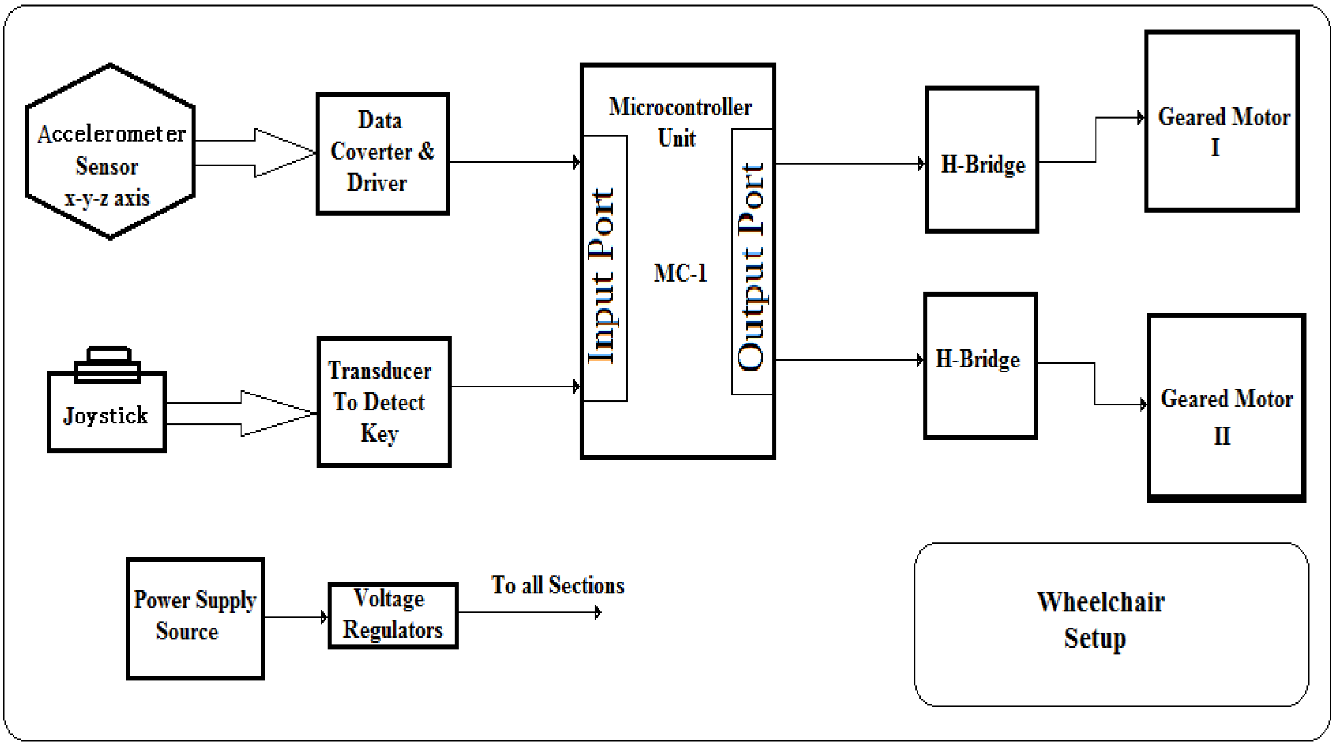

Figure 3.Block diagram of head controlled wheelchair.

III. SENSOR USED

(A). HALL EFFECT SENSOR :- The Hall effect phenomena is known for over one hundred years, but has only been put to noticeable use in the last three decades. The first practical application (outside of laboratory experiments) was in the 1950s as a microwave power sensor. With the mass production of semiconductors, it became feasible to use the Hall effect in high volume products. MICRO SWITCH Sensing and Control revolutionized the keyboard industry in 1968 by introducing the first solid state keyboard using the Hall effect. For the first time, a Hall effect sensing element and its associated electronics were combined in a single integrated circuit. Today, Hall effect devices are included in many products, ranging from computers to sewing machines, automobiles to aircraft and machine tools to medical equipment [1,4,22]. The Hall effect is an ideal sensing technology. The Hall element is constructed from a thin sheet of conductive material with output connections perpendicular to the direction of current flow. When subjected to a magnetic field, it responds with an output voltage proportional to the magnetic field strength. The voltage output is very small (μV) and requires additional electronics to achieve useful voltage levels. When the Hall element is combined with the associated electronics, it forms a Hall effect sensor. The heart of every MICRO SWITCH Hall effect device is the integrated circuit chip that contains the Hall element and the signal conditioning electronics. Although the Hall effect sensor is a magnetic field sensor, it can be used as the principle component in many other types of sensing devices (current, temperature, pressure, position, etc.

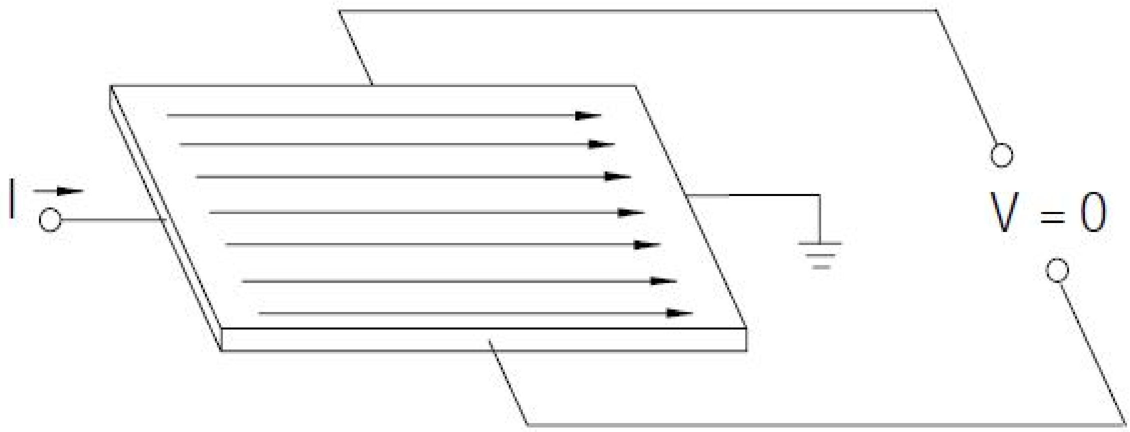

Figure 4. Hall Effect sensor without magnetic field

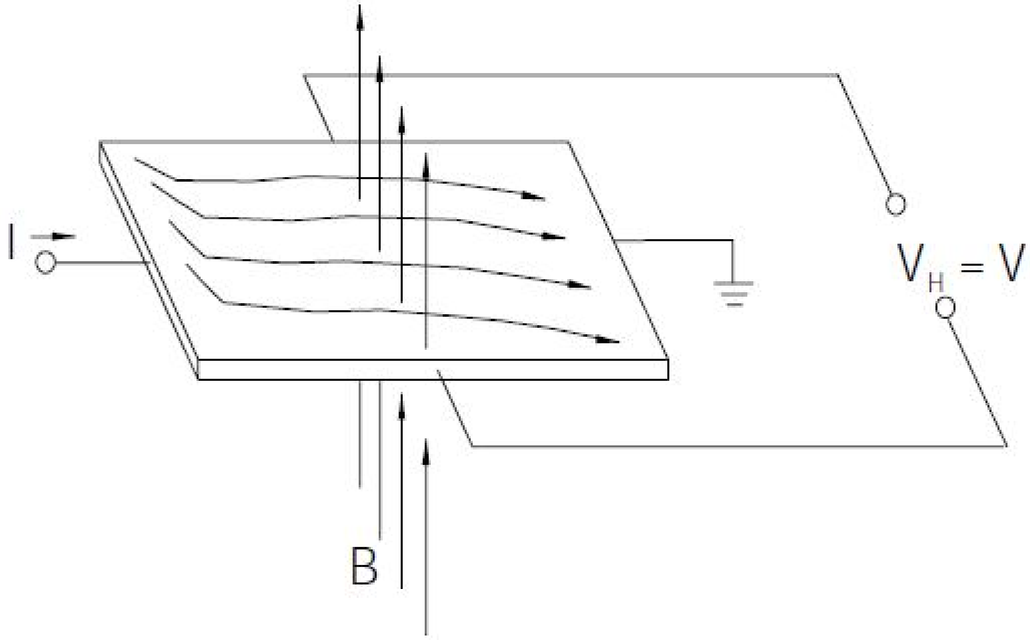

Figure 5. Hall Effect sensor with Magnetic Field

(B) MEMS SENSOR :- MEMS is a micro electro mechanical systems , it is technology that in its most general form can be Miniaturized mechanical and electro mechanical element, it convert a measured mechanical signal Into an electrical signal Micro electro mechanical sensor (MEMS) technology is one of the most advanced technologies that have Have been applied in the marketing of most of the modern devices like video projects bi analysis chips and Also car crash airbag sensors . This concept was first explained by professor R. since then many prototypes Have been released and revised and has thus become an integral part of the latest mechanical product available In the market today . During its early Stage The MEMS chip has two parts one part include the main structure of the chip and other part include every thing need for signal conditioning . the main idea behind this technology is to use same of the basis mechanical devices and membranes to have the same qualities of electronic circuit .

IV.ATMEGA-16A MICRO- CONTROLLER

- A micro controller is a IC chip that executes programs for controlling devices or machine .
- It is a micro (small size as it's a integrated circuit chip) device which is used for control of other devices and machines that's why it is called micro controller.
- It is a micro processor having RAM, ROM and I/O ports .

The Atmel AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers. The ATmega16A provides the following features: 16Kbytes of In-System Programmable Flash Program memory with Read-While-Write capabilities; 512bytes EEPROM; 1Kbyte SRAM; 32 general purpose I/O lines, 32 general purpose working registers; a JTAG interface for Boundary-scan; On-chip Debugging support and programming; three flexible Timer/Counters with compare modes; Internal and External Interrupts; a serial programmable USART; a byte oriented Two-wire Serial Interface, an 8-channel; 10-bit ADC with optional differential input stage with programmable gain (TQFP package only); a programmable Watchdog Timer with Internal Oscillator; an SPI serial port; and six software selectable power saving modes.

The Idle mode stops the CPU while allowing the USART; Two-wire interface; A/D Converter; SRAM; Timer/Counters; SPI port; and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next External Interrupt or Hardware Reset. In Power-save mode, the Asynchronous Timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except Asynchronous Timer and ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low power consumption. In Extended Standby mode, both the main Oscillator and the Asynchronous Timer continue to run.

The device is manufactured using Atmels high density nonvolatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed in-system through an SPI serial interface, by a conventional nonvolatile memory programmer, or by an On-chip Boot program running on the AVR core. The boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read- While-Write operation. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega16A is a powerful microcontroller that provides a highly-flexible and costeffective solution to many embedded control applications.The ATmega16A is supported with a full suite of program and system development tools including: C compilers, macro assemblers, program debugger/simulators, in-circuit emulators, and evaluation kits.

V .ENCODER & DECODER

- The 212 encoders are a series of CMOS LSIs for remote control system applications. They are capable of encoding information which consists of N address bits and 12 N data bits. Each address/data input can be set to one of the two logic states. The programmed addresses/data are transmitted together with the header bits.
- The 212 decoders are a series of CMOS LSIs for remote control system applications. They are paired with Holtek s212 series of encoders (refer to the encoder/decoder cross reference table). For proper operation, a pair of encoder/decoder with the same number of addresses and data format should be chosen.The decoders receive serial addresses and data from a programmed 212 series of encoders that are transmitted by a carrier using an RF or an IR transmission medium. They compare the serial input data three times.

VI. RF TRANSMITER & RECEIVER

The RF module ,as the name suggests operate at radio frequency . The corresponding frequency range varies between 30KHZ & 300GHZ . In this RF s system , the digital data is represented as variations the amplitude of carrier wave
This kind of modulation is known as Amplitude shift keying (ASK) Transmission through RF is better than IR (infrared) because of many reason . Firstly signals through RF can travel through larger distances making it suitable for long range applications . also while IR mostly operate in line of line of sight mode , RF signals can travel even when there is an obstruction between transmitter & receiver . Next RF transmission is more strong and reliable than IR transmission . RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources . This RF module comprise of an RF Transmitter and an RF Receiver . the transmitter / receiver and an RF Receiver . The Transmitter / receiver pair operate at a frequency of 434 Mhz An RF transmitter receives serial data and transmit it wirelessly though RF though its antenna connected at pin4 . The transmission data is received by an RF receiver operating at the same frequency as that of the transmitter .The RF module is often used along with a pair of encoder/ decoder .

VII. CONCLUSION

This paper presents the model of a wheelchair that is controlled using accelerometer. The accelerometer is controlled by the head tilt motion and is used to steer the wheelchair. Along with making the movement and control of the wheelchair easy for a handicapped person we also try to give more independence to these people .Tongue drive wireless assistive technology works by tracking the movements of a small permanent magnet secured on the tongue with the help of an array of Hall Effect sensors. The sensor outputs are a function of the position-dependent magnet field generated by the permanent magnet. This system can potentially benefit people with severe disabilities by enabling them to control their environments, access computers, and operate power wheelchair using their tongue motion. The performance of the system was evaluated by carrying out task related experiment carried out by six able-bodied subjects. For evaluating the performance two parameters were considered namely completion time and number of navigational error. Subjects navigated the wheelchair model over the track for five sessions. A significant performance improvement was observed in the second session. This improvement continued over the next three sessions but at a slower pace. This technology provides faster, smoother and more convenient proportional control as compared to many existing assistive technologies. Also tongue and jaw muscle does not fatigue easily. Other advantages of the Tongue Drive system are being unobtrusive, low cost, minimally invasive, flexible, and easy to operate.

VIII. ADVANTAGES

The principal advantage of the TDS is that a few magnetic sensors and a small magnetic tracer can potentially capture large number of tongue movements, each of which can represent a particular user command. A set of specific tongue movements can be tailored for each individual user and mapped onto a set of customized functions b These would offer smoother, faster, and more natural controls as the user is saved the trouble of multiple on/off switch operations In Tongue Drive system on the other hand, the additional switches are unnecessary since a specific tongue movement can be assigned to the button press. on his or her abilities, personal preferences and lifestyle. The user can also define a command to switch the TDS to standby mode when he or she wants to sleep, engage in a conversation, or eat .Advantages of head moment :-(a). User Friendly ,(b). Helpful for the paralysis stroke people who do not have much stamina in the hands ,(c.) Reduces the human activity. (d). Reduces the physical strain,. (e). Spontaneous output.

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