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INTELLIGENT WHEELCHAIR

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Abstract— **Traditional Wheelchairs though have certain limitations with the flexibility, heavy weight of the chair and limited functions. Tremendous developments have been made in the field of wheelchair technology. However, even these significant developments could not help the quadriplegics to navigate wheelchair independently. Medical devices designed to help the Paraplegic and Quadriplegic patients are very complicated, rarely available and expensive. We aim at designing a simple cost effective automatic wheelchair using MEMS technology for quadriplegics with head and neck mobility. The control system translates the position of the user's head into speed and directional control of the wheelchair. The system is divided into two main units: MEMS Sensor and programmed Arduino uno microcontroller. The MEMS sensor senses the change in direction of head and accordingly the signal is given to microcontroller. Depending on the direction of the Acceleration, microcontroller controls the wheel chair directions like LEFT, RIGHT, FRONT. Moreover backward motion of the head is interpreted as emergency signal by MEMS sensor and emergency text would be sent to a particular person's mobile phone via GSM.**

Keywords - MEMS, Arduino uno, GSM, Proteus software.

I. INTRODUCTION

The number of people moving around the world with the help of artificial means due to illness or accident is increasing at an alarming rate. Today's technology has shifted to automation minimizing the need of human intervention. These automated systems have less manual operations with high reliability and accuracy. Intelligent wheel chairs are very much helpful for severely impaired people who have difficulties in driving standard powered wheel chairs. Persons with high degree of impairment such as quadriplegics are not able to drive electric wheel chairs. Medical devices designed to help such persons are very much complicated and expensive. So, a microcontroller-based system that enables wheel chair movement by head motion is introduced. The system describes a wheel chair for physically disabled people, which use head motion, MEMS sensor interfaced with DC motor and GSM. The MEMS sensor is a microelectronics mechanical sensor, which effectively translates the head movements into computer-interpreted signals. The accelerometer data is calibrated for motion recognition.GSM is used for emergency alert.

II. WORKING OF THE SYSTEM

The system consists of MEMS sensor, microcontroller, DC motors and relay. The paralyzed person will be placed on the wheel chair and sensor is placed on cap on the head. The tilt angles produced by the patients are sensed by the sensor and produces corresponding voltage.

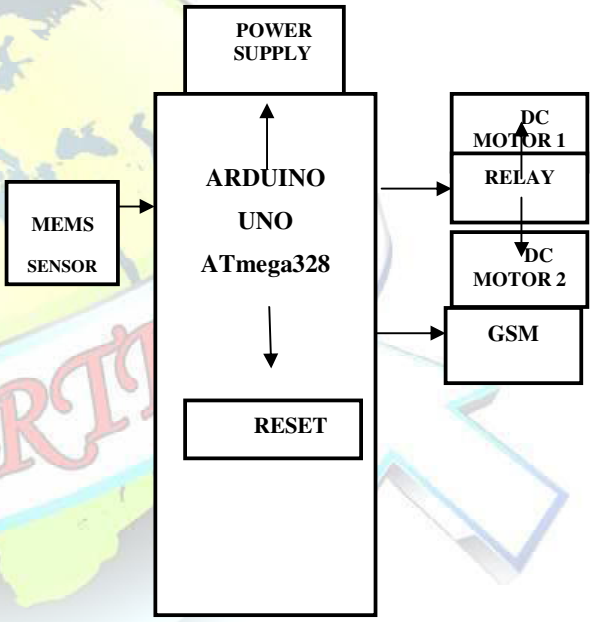

Figure. 1 - Block diagram of automation intelligent wheelchair

Here analog to digital convertor (ADC) converts the input analog variable in the form of voltage produced by the MEMS Accelerometer (in the case of simulation, pot Hg) into digital signal. Basically the digital numbers used hera are binary i.e,'0' and '1'.The '0' indicates the 'off ' state and '1' represents the 'on' state. Hence all the analog values are coverted into digital binary vlues by an ADC. The mems accelerometer will give the analog values at the output after sensing the tilt angle produced by the patients head.The ADC converts these analog values in form of voltage into Binary values.

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This output voltage of the sensor is fed into the microcontroller via ADC in form of binary values. The source code for the microcontroller is written using Arduino IDE. Based on the source code the microcontroller drives the DC motors. Relay section helps to drive the DC motors simultaneously. According to the tilt angles, the motor rotates in forward, left and right directions. This system increases mobility and physical support. It reduces human activity and physical strain.

III. LITERATURE SURVEY

While the needs of many individuals with disabilities can be satisfied with traditional manual or powered wheelchairs, a segment of the disabled community finds it difficult or impossible to use wheelchairs independently. This population includes, but is not limited to, individuals with low vision, visual field reduction, spasticity, tremors, or cognitive deficits. These individuals often lack independent mobility and rely on a caregiver to push them in a manual wheelchair. To accommodate this population, several researchers have used technologies originally developed for mobile robots to create "smart wheelchairs." Smart wheelchairs have been the subject of research since the early 1980s and have been developed on four continents.

A smart wheelchair typically consists of either a standard power wheelchair to which a computer and a collection of sensors have been added or a mobile robot base to which a seat has been attached. Smart wheelchairs have been designed that provide navigation assistance to the user in a number of different ways, such as assuring collision-free travel, aiding the performance of specific tasks (e.g., passing through doorways), and autonomously transporting the user between locations. Smart wheelchairs will remain fertile ground for technological research for many years to come. Smart wheelchairs are excellent test beds for sensor research, particularly machine vision. Smart wheelchairs also provide an opportunity to study human-robot interaction, adaptive or shared control, and novel input methods, such as voice control, EOG, and eye tracking[10].

IV. AUTOMATION INTELLIGNT WHEELCHAIR

The automation intelligent wheelchair consists of hardware and software units.

1. SYSTEM HARDWARE

A. ARDUINO UNO

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 crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. The Uno is the latest in a series of Arduino uno and 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. The Uno and version 1.0will be the reference versions of Ardunio, moving forward. The Advanced RISC Architecture in Ardunio Uno performs Full Static Operation. The Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby, and Extended Standby.

B. MEMS

MEMS is a technology that in its most general form can be defined as miniaturized mechanical and electro-mechanical elements (i.e., devices and structures) that are made using the techniques of micro fabrication. The critical physical dimensions of MEMS devices can vary from well below one micron on the lower end of the dimensional spectrum, all the way to several millimeters. Likewise, the types of MEMS devices can vary from relatively simple structures having no moving elements, to extremely complex electromechanical systems with multiple moving elements under the control of integrated microelectronics. The one main criterion of MEMS is that there are at least some elements having some sort of mechanical functionality whether or not these elements can move. The functional elements of MEMS are miniaturized structures, sensors, actuators, and microelectronics, the most notable (and perhaps most interesting) elements are the micro sensors and micro actuators.

The one main criterion of MEMS is that there are at least some elements having some sort of mechanical functionality whether or not these elements can move. The term used to define MEMS varies in different parts of the world. In the United States they are predominantly called MEMS, while in some other parts of the world they are called “Microsystems Technology” or “micro machined devices”.

There are numerous possible applications for MEMS and Nanotechnology. As a breakthrough technology, allowing unparalleled synergy between previously unrelated fields such as biology and microelectronics, many new MEMS and Nanotechnology applications will emerge, expanding beyond that which is currently identified or known.

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C. GSM

GSM (Global System for Mobile communication) is a digital mobile telephony system that is widely used in the world. GSM uses a variation of time division multiple access (TDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1800 MHz frequency band.

Whereas GPRS is an upgrade over the basic features of GSM. So in this project M590E is a kind of single-chip GPRS industrial wireless module with data only. It has SMS, data service and other functions. It is widely used if different kinds of industrial and commercial fields. It works on dual band of 900/1800 MHz. It has good network compatibility which had been certified by the lobal GPRS R4 agreement and with operating temperature between -40 to 80ºC. Moreover it has high reliability with EMI/EMC design, very steady in bad electromagnetic environment. It supports various protocols such as: TCP/UDP/FTP/DNS and Multi-channel link. [5] proposed a principle in which another NN yield input control law was created for an under incited quad rotor UAV which uses the regular limitations of the under incited framework to create virtual control contributions to ensure the UAV tracks a craved direction. Utilizing the versatile back venturing method, every one of the six DOF are effectively followed utilizing just four control inputs while within the sight of un demonstrated flow and limited unsettling influences.

D. DRIVER CIRCUIT

Driver circuits are most commonly used to amplify signals from controllers or microcontrollers in order to control power switches in semiconductor devices. Driver circuits often take on additional functions, which include isolating the control circuit and the power circuit, detecting malfunctions, storing and reporting failures to the control system, serving as a precaution against failure, analyzing sensor signals, and creating auxiliary voltages.

E. DC MOTOR

It is a device that converts direct current into mechanical energy. It contains a current carrying armature which is connected to the supply. Fleming's left hand rule is used to determine direction of force acting on the armature. The rule states that if index finger, middle finger and thumb of left hand are extended in such a way that if current carrying conductor is placed in magnetic field (index finger) perpendicular to the direction of current (middle finger), then the conductor experiences a force in mutually perpendicular direction (thumb). DC motors have electro mechanical mechanism to change the direction of current flow. The speed can be controlled either by using variable supply voltage or changing the strength of current in field windings.

F. POWER SUPPLY

A power supply is an electronic device that supplies electric energy to an electrical load. The primary function of a power supply is to convert one form of electrical energy to another and, as a result, power supplies are sometimes referred to as electric power converters.

2. SYSTEM SOFTWARE

A. ARDUNIO IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

B. HYPER TERMINAL

HyperTerminal can be used to set up a dial-up connection to another computer through the internal modem using Telnet or to access a bulletin board service (BBS) in another computer. It can also be used to set up a connection for data transfer between two computers (such as your desktop computer and a portable computer) using the serial ports and for serial-port control of external devices or systems such as scientific instruments, robots, or radio communications stations. HyperTerminal can also be used as a troubleshooting tool when setting up and using a modem. You can send commands through HyperTerminal to make sure that your modem is connected properly.

C. PROTEUS

Proteus is a suite that combines the environment simulation of electronic circuits ISIS program and the design of printed circuit Ares professional.

The Proteus is a simulation software for microprocessors , schematic capture, and printed circuit board (PCB design). It is developed by British company LABCENTER Electronics .

D. DESIGN SUITE

The Proteus Design Suite combines schematic capture, SPICE circuit simulation and PCB design to make a

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complete electronics design system. Add to that the ability to simulate popular micro-controllers and run your current firmware, and you have a package that can dramatically reduce development time when compared with a traditional design process.

The Proteus Design Suite Includes : **ISIS** - Tool network Eagle very similar to, but with the possibility of simulating programmable IC's, such as Microchip PIC, Atmel, etc. **ARES** - for PCB layouts, putting automatic point and / or routing can be achieved with the import schema ISIS.

V. RESULT

The source code for the microcontroller is written in arduino ide which is simulated using Proteus 8.1 software. After simulation, the HEX codes will be generated after compiling microcontroller program. These codes are then burned into the microcontroller's memory to perform the logic.

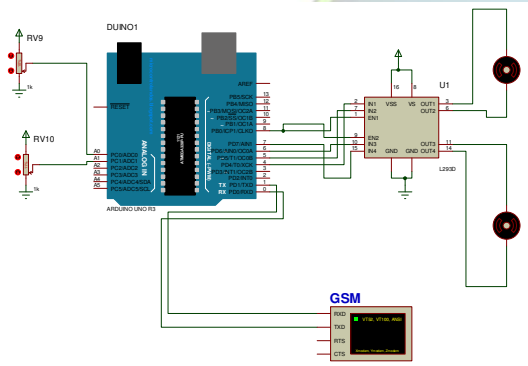

Figure 2: Complete simulation layout of the automation controlled wheel chair

The above Fig. 2 shows the complete simulation layout of the automation controlled wheel chair. Based on the source code the microcontroller drives the DC motors. In Fig. 3, we can observe the movement of the wheels which is accelerated by dc motor.

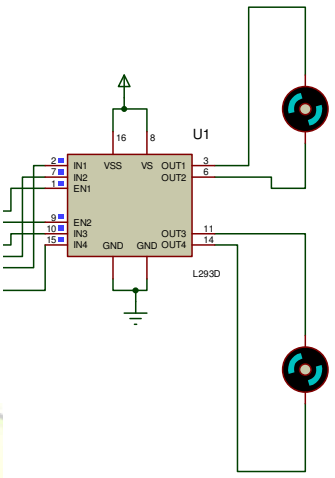

Figure 3 Movement of the wheels

VI. CONCLUSION

The simulation of Automation Intelligent Wheelchair is completed successfully. The head motion controlled wheel chair system is implemented as an example of companionship of human and machine. Independent movement is achieved with the help of the system. Errors appearing when the user makes free head motions can be reduced to a certain extent using an enable switch. It is designed to be characterized by low price and higher reliability. But as a future work, the wheelchair should detect the obstacles and will change its navigation path according to that. Even though the automatic detection of the obstacle already exists and it will navigate by avoiding the obstacles rather than producing an alarm. It will help the user to navigate the wheelchair by automatic detection of the obstacles in the pathway. It won't require user control and it will be automatically change its navigation path while detecting the obstacle. By combining the eye tracking and head movement gestures, it will become more effective than individual gestures.

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