



Design and development of smart solar based wheelchair using voice recognition and head gesture control system.

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Abstract: In this paper, we introduce a Solar-based wheelchair with a 3-axis accelerometer (ADXL335) controlled gesture and a Bluetooth module Setup for voice recognition with an ATmega microcontroller that we will configure the entire setup using the Arduino board together with some mathematical algorithms. The movements can be recognized from any kind of physical movement detected by a person's Accelerometer and the voice recognition will function with the help of the Bluetooth module using Android Application, we will only have some command on our Android device, and will be recognized with the help of the Bluetooth module present in the entire unit voice and thus the required action will be taken accordingly. Gesture recognition and voice recognition can be explained as the method or process that explains how the computer understands the human body language and also creates a bridge between the computer and the human world.

Index Terms - Wheelchair, accelerometer (ADXL335), AT mega microcontroller, Arduino board

I. INTRODUCTION

Gesture recognition can be characterized as the identification and recognition of gestures performed by the user by the receiver module is the same with the Voice recognition system where the Bluetooth module comes into play in conjunction with the gesture controlled module. Gestures are just the body's significant movements that are associated with finger, hand, face, or any other part of the body's physical movements, whereas voice is something that comes out of our mouth automatically when we give somebody's commands. In this device the wheelchair perceives the movement of the human hands through an accelerometer and the speech is perceived with the aid of the Bluetooth module, which includes an android smart phone that will obviously contain Bluetooth as the transmitter, and the receiver will be the device that will receive signals on the wheelchair. The accelerometer even begins moving when a person moves the hand and perceives the parameters according to the location of the hand and the receiver begins hearing the voice on the receiver signal when moved into the speech mode which is essentially for the blind. The accelerometer and the Bluetooth receiver detects the motions and voices. Then they are sent to the comparator IC, which assigns the appropriate and varying voltage levels according to the reported movements.

II. RELATED WORK

For a wheelchair service case the main concept of the speech recognition program is a deep need for verbal commands. These verbal ordered wheelchair's most significant parameter is the health of the user – the physically impaired person and people in its vicinity. The wheelchair system is built redundantly so if the speech recognition system fails the wheelchair control system connected with ultra sound sensors would stop the wheelchair in a case of dangerous situation.

VOIC is suitable for users such as quadriplegics, people paralyzed from neck downward and for people that do not control their movements (patients with brain paralysis...). Of course any other physically handicapped person could use it. Not only possible users of this program are disabled people and wheelchair applications. The system could also be used in many different locations or applications like: elevators, doors... This is also applicable in the various situations in industry where in very noisy environments voice data input or controlling the secondary functions of machine tools is needed. There are millions of people with disabilities in this country who need helping hands all the time. Since the conventional electric wheelchair cannot be used by all users, there should be some contact between the user and wheelchair to monitor it. The disabled user has very difficulty driving the wheelchair with their arms. However though there are many methods to push the wheelchair, tetraplegia people are unable to control wheelchair using joysticks. However some people still find difficult to control the path of wheelchair with hands because of paraplegic, old age, handicapped. When there is a partial impairment due to some limb dysfunction, the person feels some degree of limitation to improve as best of his or her abilities as possible. In this case the patient cannot navigate through the arena i.e. workplace or home, even in the worst cases hands or legs can be partially or completely

paralyzed. We've therefore made an effort to develop a wheelchair prototype to overcome all of those. We've planned wheelchair navigation in such a way as to prevent crashes and holes. As there are various techniques to control the electric wheelchair, e.g. voice recognition Technique [1] and [2]; vision based head gesture technique [3]-[7], EMG signal Technique [8] and [9], and EOG eye tracking Technique [10] and [11].

There is at least one disadvantage for each technique i.e. in the case of voice recognition and guidance technique it is not applicable for dumb people and it is also not applicable in noisy areas. Similarly the user is not able to look around freely in the EOG technique. They need to focus on driving the Wheelchair. This driving technique represents a superior alternative to operated wheelchairs (voice, motion). The advantage is that these can be used by patients who have lost the ability to (move, see, and speak). In this work we propose a new methodology to use Infrared Radiation to control wheelchairs. Compared to other alternative methods, it is basically a hand free technology and cost-effective. This control system will drive on the basis of user's eye lids movement. It introduces a new technique, rather than the common manual method. In this type of controlling mode, during navigation, the user can freely look around the surroundings to their destination point.

III. Proposed System

The System proposed in this paper is that there is still no Wheelchairs or Wheelchair vehicles which have both hand gesture recognition for the people who are not able to speak for the physically challenged combined with voice recognition using simple Bluetooth module that is present in the every smart phone. This will be helpful for people who are blind and can not do their work on their own nowadays phone, so this system also includes both hand gesture recognition features.

IV. WORKING

A. METHODOLOGY OF HAND MOTION RECOGNITION

Working principle Accelerometer is a measuring device of 3 axes with a range of + -3 g. This device is made using the poly silicon surface sensor and signal conditioning circuit for measuring acceleration. The output of this device is analogous in character and proportional to the acceleration. This apparatus measures the static acceleration of gravity when we tilt it. And gives movement or vibration shape result. The output of this device is analogous in character and proportional to the acceleration. This device measures gravity's static acceleration when we tilt it. And gives vibrational or motion-form result. According to the surface-micro-machined poly silicon structure datasheet adxl335, placed on top of the silicon wafer. Poly silicon springs hang the structure over the surface of the wafer and give resistance to the accelerating forces. The structural deflection is measured using a differential condenser incorporating independent fixed plates and plates attached to the moving mass. The fixed plates are guided by 180 ° -out of phase square waves. The acceleration deflects the moving mass and the unbalances in the differential condenser resulting in a sensor output whose amplitude is proportional to the acceleration. Phase sensitive demodulation techniques are then used to determine the magnitude and direction of acceleration. A manual accelerometer is a three-dimensional, rotatable solid around three orthogonal axes. This rotation occurs as phase is called the X axis and roll is called the next rotation axis Y, and the last rotation is called yaw around the Z axis. One can achieve any orientation by drawing up these three spontaneous revolutions. All manual movements planned in our work for wheelchair control are simple gestures, each of which contains only one of the three rotations of the element. Movements composed of more than one elementary rotation are too complex for these applications. Regulated motion Wheelchair is going by hand as we put the transmitter in our pocket. The wheelchair starts to move forward when we tilt the front hand, and continues to move forward until the next command is given. When we tilt the hand backwards, Wheelchair will change its condition and start moving backwards until it has given another command. Turn left by tilting it to the left side of the wheelchair until next command. Wheelchair turned right when we tilt the right hand side. Then, to stop the wheelchair, we keep our hands steady.

B. METHODOLOGY OF VOICE RECOGNITION

Speech recognition (SR) is the conversion of the spoken words into text. These systems identify and use the specific voice to sharpen recognition of the speech of that person, resulting in more error-free transcription. Speech recognition (SR) is the conversion of the spoken words into text. These systems identify and use the specific voice to sharpen awareness of the speech of that person, resulting in more error-free transcription. The word recognition of voices refers to recognizing "who" is speaking, rather than "what" they say. The word recognition of voices refers to recognizing "who" is speaking, rather than "what" they say. Spoken recognition is the translation into text of the words spoken. Such systems recognize and use the individual voice to sharpen understanding of the speech of that person, resulting in more error-free transcriptions. The L293 and L293D devices are half H-Drivers with quadruple high current. The L293 is designed at voltage from 4.5V to 36V to provide bidirectional drive currents of up to 1A. The L293D is designed at voltages from 4.5V to 36V to provide bidirectional drive currents of up to 600mA. Both devices are designed to drive inductive loads in positive delivery applications, such as relays, solenoids, dc and bipolar moving motors, as well as other high-current / high-voltage loads. Universal Asynchronous Receiver Transmitter is usually a single integrated circuit used for serial communication over a serial port of a peripheral computer or unit. UART is now widely mounted in microcontrollers. A dual UART fuses two UARTS together into one slot. Many modern ICs come with a UART which is also able to interact synchronously. Such devices are named UART. Wheelchair controlled by voice through android application. Now it's easy to use the Bluetooth module HC-05 and Arduino microcontroller to power your wheelchair with your Android smart phone app. All the controlling devices in the system are a microcontroller. The data received via the Bluetooth module from android smartphones is fed to the controller as input. Then the controller acts on the DC motor of the Wheelchair. The project's Wheelchair can be moved in all four directions via the Android phone. Wheelchair direction is displayed on the LCD display of the Wheelchair system. To accomplish the mission the controller is loaded with a program written using embedded "C."

V. BLOCK DIAGRAM AND EXPLANATION

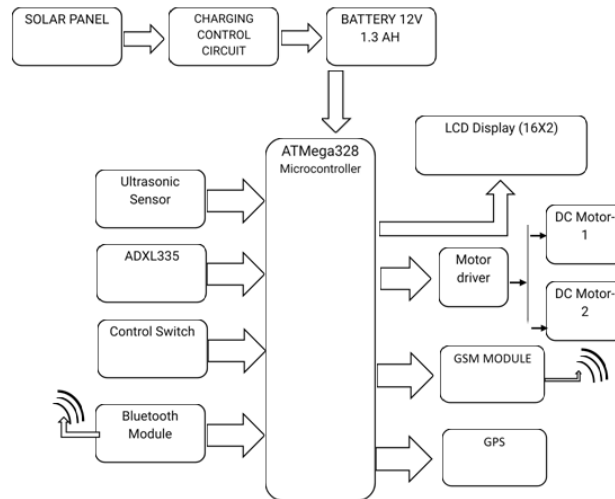


Fig No:1 Block diagram which gives you the overview of the proposed system.

A. FUNCTIONAL UNIT DESCRIPTION:

Here showed the hardware specifications & Technological approach in the way the device is built in Figure No 1. The system consists mainly of parts such as Microcontroller (ATmega328), Sensor networks which are briefly described below.

B. MICROCONTROLLER ATMEGA328

Arduino UNO is an open source, ATmega328 microcontroller-based prototyping tool. It consists of 14 digital I/O pins, six analog inputs, an on-board microcontroller USB connection, a power jack, an ICSP header, and a reset button. It is operated with a 16MHz crystal oscillator and contains everything the microcontroller needs to support it.

C. ADXL335-ACCELEROMETER

The ADXL335 is a complete system for measuring acceleration in 3 axes. The ADXL335 has a total measurement range of ± 3 g. It includes a polysilicon surface-micro-machined sensor and signal conditioning circuitry to implement an architecture for measuring the open-loop acceleration. The output signals are analog voltages which are proportional to the speed. For tilt-sensing applications, the accelerometer can calculate the static gravity acceleration as well as the dynamic acceleration resulting from motion, shock, or vibration.

D. CONTROL SWITCHES

The simple reset switches are used to click on control operations such as motion control, Power ON / OFF etc.

E. BLUETOOTH MODULE (HC-05)

Bluetooth serial module is used to link Bluetooth to serial port. These modules have two modes: Slaver and Master. When out of factory, the device named after even number is defined as master or slaver, and cannot be changed to the other mode. But for device named after odd number, users may use AT commands to set the device's work mode (master or slaver).

H. C-05 specifically includes:

Master device: HC-05-M, M=master

Slave device: HC-05-S, S=slaver

F. ULTRASONIC SENSOR

Ultrasonic sensors are devices that use transformation of electrical – mechanical energy to measure distance from the sensor to the target object. Ultrasonic waves are longitudinal mechanical waves which travel in the direction of wave propagation through the medium as a sequence of compressions and rarefactions. They are also used in ultrasonic material testing (to detect cracks, air bubbles and other product flaws), object detection, position detection, ultrasonic mouse, etc. in addition to distance measurement.

G. GSM TECHNOLOGY

The GSM module is used to establish communication between a GSM-GPRS system and a computer. Global Mobile Communication System (GSM) is an architecture which is used in most countries for mobile communication. Global Packet Radio Service (GPRS) is a GSM extension which allows for higher data transmission rates. The GSM / GPRS package consists of a GSM / GPRS modem mounted along with the power supply circuit and network networking interfaces (such as RS-232, USB, etc.).

H. GPS TECHNOLOGY

GPS Stands for "Global Positioning System." GPS is a satellite navigation system which is used to determine an object's ground position. A GPS receiver uses a method called triangulation to combine signals from different satellites to determine its exact location.

LCD (16X2) DISPLAY

A liquid crystal display (LCD) is a small, flat visual electronic display utilizing the luminous modulating properties of liquid crystals (LCs). LC's do not directly emit light. They are used in a wide range of applications including: computer monitors, TV, instrument panels, displays of aircraft cockpits, signage, etc They are common in consumer devices such as gaming devices, video players, clocks,

watches, calculators, and telephones. In most applications LCDs have displayed cathode ray tube (CRT) displays.



Fig No 2. LCD display

DC MOTORS

A DC motor is a brushless, synchronous electric motor capable of dividing a complete rotation into a large number of steps, such as 200 steps. The motor can therefore be turned to an appropriate angle. Digital signal is used to drive the motor, and it rotates a specific number of degrees each time it receives a digital pulse. For this project the DC motor is used to control hidden door movement based on microcontroller instructions.

MOTOR DRIVER CIRCUIT:

The L293 and L293D are quadruple high-current half-H drivers. For this project the DC motor is used to control secret door movement based on microcontroller instructions. The L293D is designed to produce bidirectional drive currents of up to 600-mA at 4.5 V to 36 V voltages. These systems are designed to drive inductive loads in positive-supply applications, such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current / high-voltage charges.

LEAD ACID BATTERY

12V batteries are attached to provide the engines with a 12V power supply. The Arduino and other parts which require power supply for their effective output are also provided power from these batteries.

SOLAR ENERGY

Solar power is used directly using photovoltaics (PV) or indirectly using concentrated solar power (CSP) to transform sunlight into electricity. 'Photovoltaics' use the photoelectric effect to transform light into electric current. The solar panel used in this project work is rated at 0.8 Amps; under the bright sun it produces a max. power of 10 watts. Photovoltaic (PV) solar panels transform solar energy into electrical energy. The electrical energy generated by the solar panel is stored in the battery, and the energy stored is used to move the charge through the power system. It is the power system's principal feature.

VI. RESULT AND DISCUSSION

The result of this project is that the movement of the wheelchair is controlled using the method of voice recognition using voice commands such as right, left, back and stop. The controls are provided by the patient sitting on the wheelchair using the android application with the aid of the bluetooth module, with few commands already present in the android system. If the patient is paralyzed, the additional aspect is that he can use head movement to regulate the wheelchair moment. We also use the ultrasonic sensor to stop the wheelchair, when there are some obstacles in front of the wheelchair, as shown the figures.



Fig No 3. Head gesture to the back, to move the wheelchair in backward direction.



Fig No 4. Giving the voice commands to move the wheelchair in different directions.



Fig No 5. Using the ultrasonic sensor to stop the wheelchair if any obstacles are present.

This system has two mode control system one based on gesture and the other based on voice control. The result of this project is that the movement of the wheelchair is controlled using the method of voice recognition using voice commands such as right, left, back and stop. The controls are provided by the patient sitting on the wheelchair using the android application with the aid of the bluetooth module, with few commands already present in the android system. If the patient is paralysed, the additional benefit is that he can use head movement to control the wheelchair moment. We can use the ultrasonic sensor to avoid the wheelchair, if there are any barriers in front of the wheelchair as the figures indicate.

VII. CONCLUSION

This paper is intended to design and develop an intelligent wheelchair using voice and head gesture control. The built wheelchair is very user friendly, and has no wheelchair-controlled computer system. So the understanding and process is easy. It contains two modules that control wheelchair movement according to user commands. When any patient can't turn head then voice commands should be used separately for wheelchair navigation. You can install the accelerometer on the head by using any band to identify the head motion. You may use a headset with attached microphone to send voice commands. This system provides the rising disabled population with independent mobility, as well as many intelligent facilities.

FUTURE SCOPE

The future of gesture and voice controlled technology is very promising. The robots can be used in various applications such as by surgeons in medical surgery. One of the biggest challenges world is facing today is proving a better world to handicapped people. This technology is expected to make their life easier. The gesture and voice controlled robot module can be used in wheel chairs of physically challenged people, promising a better life to physically disabled .It also has Entertainment applications. Video gaming will become more interesting and creative with the help of hand gesture control technology. Gesture and voice controlled robots has a potential in growing market all around the world.

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