QUADRIPLEGIC AMBULATING ADDENDUM

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ABSTRACT: The exigent problem faced by the paralyzed people is their independent ambulation. They need an external help to perform their daily activities. The person affected by Hemorrhagic disease, a type of stroke which leads to Quadriplegia. These kinds of patients cannot access their limbs where only head tilting is possible. Assist devices used by quadriplegic patients are very complicated, rarely available and expensive. The main objective of this project is to propose an idea for an automated system for the disabled people. The ambulating chair will work based on the head movement of the user. The recognized gestures are used as an input to the controller so that the assist device can be controlled according to the user intension. The wheel chair system is divided into two main units: MEMS Sensor which consists of accelerometer that detects direction of motion and Controller. 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, and BACK with the aid of DC motors.

Keywords: DC Motor, MEMS Sensor, Quadriplegics, ambulation.

1. INTRODUCTION:

The term “QUADRIPLEGIC” refers to the person, who affected by quadriplegia disease, which is paralyzed upper and lower limbs and “AMBULATION” refers to the mobility, that is moving from one location to other location. In general, quadriplegia can be affected primarily due to two reasons; they are embolism stroke or hemorrhagic stroke. Embolism is a type of stroke occurs due to a blood clot that obstructs the blood flow to the brain (area deprived of blood). This can be cured by regular treatment. When they are admitted as in-patient, they use mechanical wheelchair for ambulation. After treatment, they may not in need of the wheel chair for motion, thus comes under permanent cure. Hemorrhagic is an another type of stroke occurs due to deterioration of vessel wall rupture, which causes bleeding in the brain, this leads to permanent damage of limbs. Hence comes under the situation to use the power assisted device for the survival of the patients.

2. LITERATURE SURVEY:

Inhyuk Moon et al. [1] proposed a sovereign robotic wheelchair with human – computer interface (HCI) using EMG signal, face directional gesture and voice based interfaces. In EMG based HCI, levator scapulae muscle (LSM) is used for interface for above-elbow amputee and lower extremities paralysis by spinal cord injury. These experiments were performed efficiently in the indoor atmosphere only. In order to perform outdoor steering, MR. HURI needs to build with GPS system for site mapping. (2003)

In 2005, Kazuo Tanaka et al. [2] projected an Electroencephalogram (EEG) based control of an electric wheelchair to control the wheelchair using brain signals. A recursive training algorithm employed which generates the recognition patterns from the brain signals. Habitually for human and computer interfacing we use keyboard and mouse but they come up with EEG signals to control the track of the electric ambulating machine.

In 2008, Xiaoling Lv et al. [3] planned a voice command rule robot named as HEBUT-II. This paper explains about the system of speech control robot. Initially acoustic signal is grabbed through microphone; the respected voice is recognized by signal processing primarily involved dynamic time warping (DTW). Here the features are extracted using Mel frequency campestral coefficients (MFCC) method. The chief target is to achieve as high accuracy as possible.

In 2009, Akira Murai et al. [4] proposed a voice controlled wheelchair with elevator accessing functionality. Here using voice control commands wheelchair path of movement is inhibited sensors around the chair.

D. J. Kupetz et al. [5] intended to design a powered wheelchair controlled by head and neck motion. In this control system, the motion of the head and neck is tracked by placing 2×2 IR LED array at the backside of the user's head. Camera is used to focus this LED arrangements such that in case any distortion in IR emission due to head motion is detected. The special program called JMyron (C++ functions) is used as a processing program language for video segmentation and tracking.

In 2010, S. Manogna et al. [6] projected an assist device controlling through head motion. Architecture of this assist system comprises of sensor design, Electronic module, and Mechanical module. Sensor design includes Tri axis accelerometer, analog to digital convertor (4 bit 12 channels) and switch. The Tri axis accelerometer is used to sense gravitational force in three axes. The switch is placed on the headrest position to control ON and OFF actions.

Mohammed Faeik Ruzaij et al. [7] planned the design and implementation of intellectual wheelchair at lost cost. This implementation incorporated the key descriptions like speech recognition system, keypad control and automatic obstacle detection. Voice recognition unit encompass of HM2007 IC (static RAM that stores trained words), external microphone and 4*3keyboard. HM2007 IC receives BCD from voice recognition kit which decoded into voice command at the range of 1-40 and stores up to 40 commands at different languages.

In 2013, Tao Lu et al. [8] planned a motion control scheme of clever wheelchair based on hand gesture recognition. In this proposal, the motion of the wheel chair is guarded by recognizing the hand gestures. This system comprises of five modules as follows: Data acquisition and processing, segmentation, vector quantization, HMM training, recognition.

Deepesh K Rathore et al. [9] anticipated a Novel multipurpose smart wheelchair which presents intelligent wheelchair system composed of navigation, location monitoring, voice guidance system and obstacle detection system. The main goal is to aid the physically challenged and visually impaired persons. (2014)

In 2015, Mohammed Faeik Ruzaij et al. [10] proposed design and implementation of low cost three-modes of procedure tone controller for wheelchairs and rehabilitation robotics. In this proposal we have three algorithms to recognize the right command voice input they are sound dependent (SD) mode with dynamic time warping algorithm (DTW), sound dependent (SD) mode with hidden markov model (HMM) algorithm, sound independent (SI) mode with text to sound independent (T2SI) algorithm and the technology used is DSP. Here we have two voice recognition (VR) units in which three algorithms are employed.

3. EXISTING SYSTEM

In this existing system, a novel auto calibrated head orientation controller for wheelchairs and rehabilitation robotics application is used. The system uses two Orientation Detection (OD) units; each unit includes three MEMS sensors. The orientation data are sent to the ARM cortex M3 microcontroller for processing. The two modules communicate with the microcontroller through the I2C bus. The microcontroller processes the information from the two orientation modules using the auto-calibrated orientation algorithm. The algorithm will give the right decision depending on the user`s head orientation related to the reference orientation. The output control signal is sent to the jaguar lite robot to implement the required movement in direction and speed. The communication with the jaguar lite robot is done using the UARTs communication port from the both sides. The microcontroller communicates with the LCD display using the GPIO pins. The LCD display, view all the executed, control commands and alert message if there are errors in head position or in a case of obstacle detection. The system is designed to implement control command depending on the user head orientation at pitch and roll Euler angles.

4. PROPOSED SYSTEM:

From our reference paper**,** we have acquired only the theme of Head motion control. The term ADDENDUM is used, since we include added features like EEG, emergency voice messages etc to the existing system, in order to overcome the technical irregularities faced by the patients.

So our motive is intended to propose an idea create a cost effective wheel chair to help quadriplegic people who find it difficult to move independently. Our proposed system suits only for the patients who are all affected by hemorrhagic stroke, since they need ambulating system for survival.

Due to the inefficient maintenance, service and high cost, there is no wheel chair manufacturing unit in Tamilnadu for Quadriplegic patients.

This system operated with taking head movement as input signal to control the motion of wheel chair in any direction. A MEMS sensor is used to track the movements. The variations produced by the sensor according to head movement are trapped and fed as input to the microcontroller. The microcontroller takes decision based on the inputs provided and controls the wheel chair. The decisions made by microcontroller are:

- When person tilt twice his head in forward direction, chair will move in forward direction.
- If person tilt twice his head in backward direction above, chair will move in backward direction.
- If person tilt his head in left direction above, chair will move in left direction.
- If person tilt his head in right direction above, chair will move in right direction.

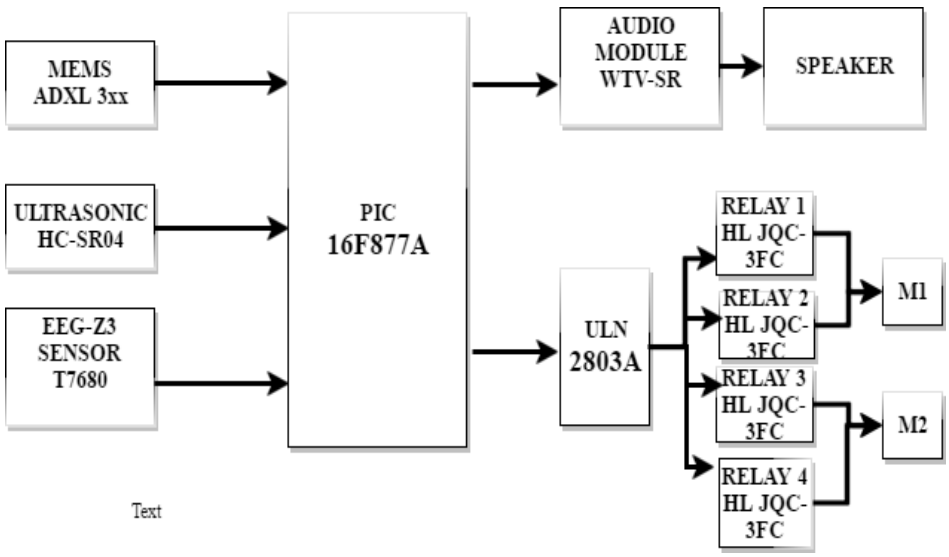


Fig1: BLOCK DIAGRAM

4.1 SYSTEM WORKING

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. This output voltage of the sensor is fed into the microcontroller. The source code for the microcontroller is written in embedded C using Proteus. 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, backward, left and right directions. The direction of movement of wheel chair is displayed by the LCD interfaced with the microcontroller. This system increases mobility and physical support. It reduces human activity and physical strain.

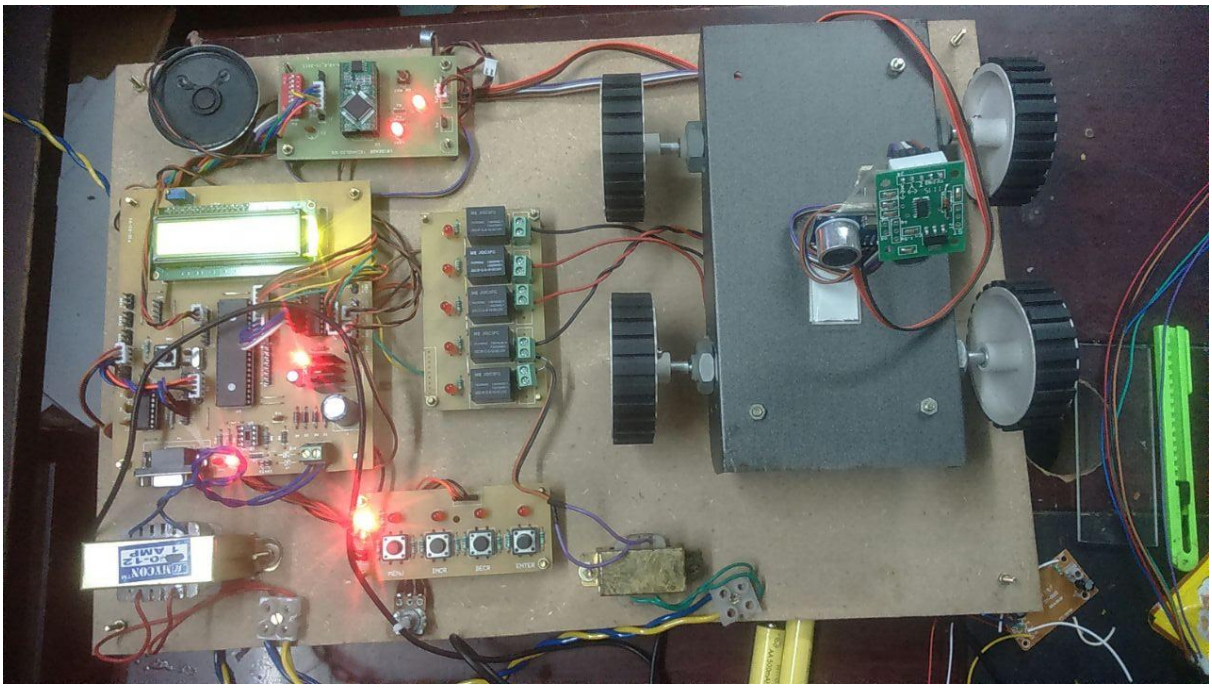


Fig 2: proposed system

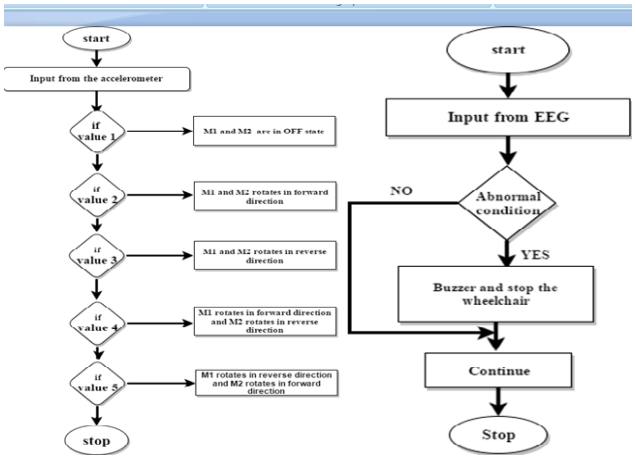
4.2 MODULE DESCRIPTION

1. ULTRASONIC SENSOR:

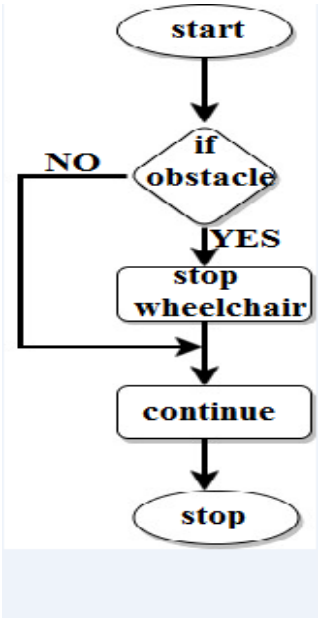
Ultrasonic sensor emits ultrasonic pulses, and by measuring the time of ultrasonic pulse reaches the object and back to the transducer. The sonic waves emitted by the transducer are reflected by an object and received back in the transducer. After having emitted the sound waves, the ultrasonic sensor will switch to receiver mode. We use three electrodes, Difference in voltage between two arms is taken, and right leg electrode serves as the reference. The ultrasonic sensor which we have tested detect at two ranges, short range at 0-300 and long range at 0-500, which is also inefficient in both out-door and in-door environment. Finally, we have included the sensor that could sense at the suitable distance of 0-1500. The full coverage area of ultrasonic sensor is 30-40cm.

2. MEMS SENSOR:

In our system, the accelerometer is used for direction detecting purpose and we were using ADXL 3xx analog accelerometer to find the direction of head motion of the patient. For direction xyz axes tri pins are used and to light up power supply pin also included along with ground. Hence it offers Low Current Consumption this ADXL 3xx accelerometer.



a. Accelerometer b. EEG sensor



c. Ultrasonic

Fig3: flowchart representing the working whole system

In the value testing of MEM sensor we got approximate values, since it has two ways motion we have denoted as X Y parameters and we eliminated the motion in Z direction, hence Z parameter is not considered.

3. EEG SENSOR:

EEG sensor is mainly for continuous pulse check of the patient and also for on and off switch. In the value testing of EEG SENSOR we faced many problems in getting proper

range of value like, First power fluctuations so many adjustments are done to correct the values, secondly problem in pin configuration of audio play back.

4. AUDIO MODULE:

It is mainly used to play back the audio which has been recorded previously. The terminals of audio module are play, delete, record, A0-A4 are the pins used to store the recorded voice.

5. RELAY SECTION:

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Relay section has 5 terminals in which 2 terminals are connected to the motor driver for forward motion, another 2 terminals are connected to the motor driver for reverse motion and remaining one terminal is input or positive terminal.

4.3 SIMULATION

Embedded systems combine hardware and software to perform special and predefined tasks. The source code for the microcontroller is written in embedded C and simulated using Proteus and its HEX codes will be generated after compiling microcontroller program. These codes are then burned into the memory of the microcontroller to perform the logic.

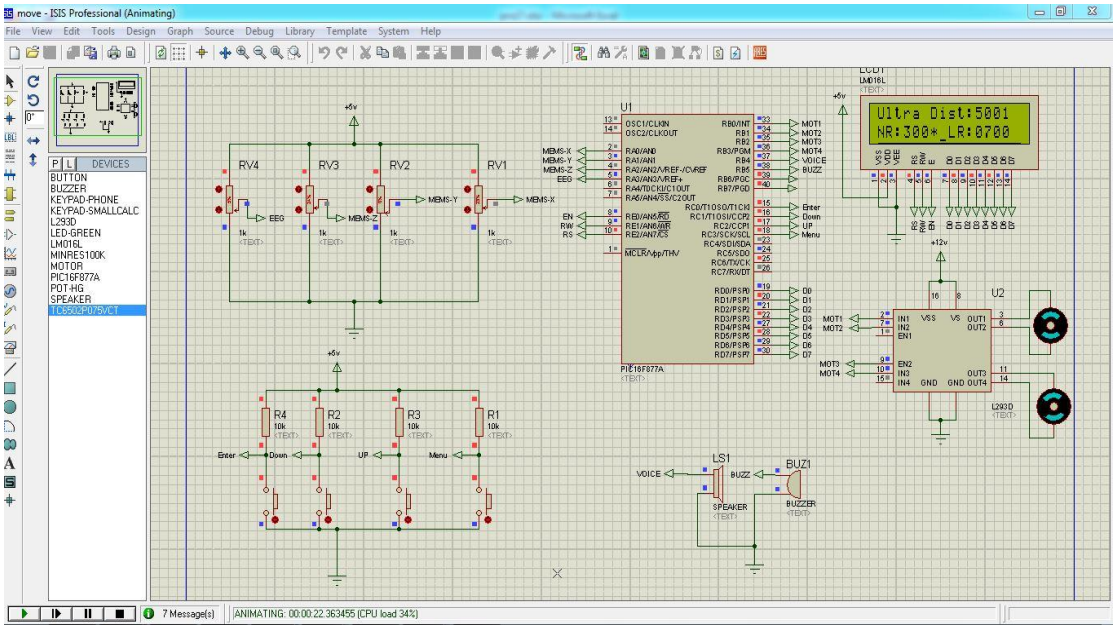


Fig 4: Simulation output

5. RESULT

An idea for the wheelchair which is controlled by the Accelerometer is successfully proposed. The proposed system is intended to create a cost effective wheel chair to help quadriplegic people who find it difficult to move independently. The system uses head movement to control the wheel chair. The tilt angles produced are sensed and corresponding voltages are generated by the MEMS sensor. These voltages are fed into microcontroller which in turn controls the direction of wheel chair.

MEMS DIRECTIONAL PARAMETERS	RANGE	MOTION
X	0 to +125	Forward
X	-125 to 0	Reverse
Y	+125 to +150	Right
Y	-150 to -125	Left

Table 1: OUTPUT OF THE SYSTEM

5.1 ADVANTAGES

- User friendly, reduces the human activity and physical strain.
- Helpful for the paralysis stroke people who doesn't have much stamina in hands and legs.

5.2 APPLICATIONS

- Hospitals
- Sports
- Physically challenged persons for their survival.

6. CONCLUSION:

The proposed system is intended to create a cost effective wheel chair to help quadriplegic people who find it difficult to move independently. This system is customized one i.e. a pre-trained single user only can able to handle it. So the patient has to be trained as per the command system which has been coded. 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. Future works can be enhanced by adding zigbee module, temperature sensor, video camera for live streaming and also can use serial communication port rs232 of PIC for monitoring the patient and also increment in the accuracy by implementing in the effective manner.

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