An approach to develop a smart and intelligent wheelchair

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Abstract— The Smart Wheel chair system proposed in this paper helps to physically disable people or adulthood people to move around without others help. Normal wheelchairs are manually operated and heavy to move. It makes suffered people to depend on others. These wheelchairs that are equipped with sensors and a data processing unit constitute a special class of wheeled mobile robots, termed smart wheelchairs in general literature overviews. n the existing system, the wheel chair movement is controlled by joystick and buttons are used to start and stop the wheel. This is difficult to handle the differently able person to press the button. In the proposed system, the physically disabled person can control their wheel by manual. MPU6050 sensor is used for gesture symbol. In manual mode MPU6050 sensor and accelerometer is used to control the direction of the wheel of the motor. The proposed system contributes to the self dependency of differently able and older person. The robot will be access both manual and automatic mode. Blood oxygen sensors monitor the oxygen level of blood in patient body, blood pressure sensor monitor the patient heart rate parameter and the temperature sensor is used to calculate the body temperature, these sensor are monitor by the microcontroller and the microcontroller collect the data are sending to mobile phone via Bluetooth module.

Keywords— Arduino UNO, LM-35, Gigbee, Matlab,spo2 sensor.

1. INTRODUCTION

Robotic technologies have the potential to improve the lifestyles of people suffering from one or more disabilities [1]. Related developments are often grouped under the terms Rehabilitation Technologies or Assistive Technologies. They plan to restore human abilities that are reduced or lost by disease, accident, or old age. Mobility is one such function. There are many reasons why a person may not be able to travel freely, including motor control problems, spinal injuries, and amputation. A wheelchair may be a robot which will often assist. It effectively uses wheels and mechanical support to beat a loss of legs or leg control. Manual wheelchairs are often operated by persons who have the utilization of their upper body or someone available to help . Powered wheelchairs are developed for when either of those cases doesn't apply. However, these devices typically require a high level of user control and this is often something precluded by many severe sorts of disablement. In recent decades many groups have researched the possibilities of robotic wheelchairs. These endeavours are aimed toward creating ‘intelligent’ devices which will sense information from their environment and respond in useful ways. The UOW Robotic Wheelchair was developed from scratch. It consists of a car seat, two pneumatic tyre’s and two castor wheels mounted on a metal chassis. The system is powered by two 12V batteries stowed beneath the seat. An unusual feature of this design is that the drive wheels are located at the front and the supporting castor wheels are at the rear. Most similar designs use a contrary placement of wheels. This configuration allows the chair to cross more obstacles than would otherwise be possible, but it also complicates the system dynamics and makes control more difficult.

Optical position encoders are installed within the wheelchair motor casings. These sensors provide feedback for speed and position control. Four ultrasonic sensors, two at the front and one on each side, provide information for navigation and obstacle avoidance. The electronic subsystems are mounted behind the chair on a metal platform. There are circuits for power supply filtering, motor operation, feedback control, sensor operation and autonomous control.

The UOW Robotic Wheelchair is distinguished from most other similar projects in its attempts to produce practical results using a minimum of equipment and computing power. These aims are often further defined through three distinct criteria;
1. Cost Effectiveness A robotic wheelchair will benefit the most individuals if the cost is not prohibitive. This factor currently precludes certain sorts of sensor, like laser range finders and GPS units.
2. It must use practical components. Components should consider total system weight and dimensions. They should seek to maximize on-board battery life through power efficiency and minimize maintenance concerns through simplicity and sturdiness
3. It must respond smoothly in real-time. The wheelchair shouldn't require any offline processing, nor should it halt to guage information whilst operationally engaged.

One of the methods used to monitor with electrophysiological is EEG sensor which is utilized for recording electrical automated performance of the brain. The general arrangement of electrodes have been established with scalp but for some cases invasive electrodes have utilized in EEG that measured voltage fluctuation with an outcome from ionic current present over neurons in the brain. However, the clinical analysis in EEG shown in Figure 1 has referred to the records of an impulsive automated performance occur over brain within a time span gets recorded from several electrode placed on the scalp.

There are several researchers have introduced a wheelchair to the physically disabled person's but in India an advance wheelchair has been introduced from Manay by several sensors namely temperature sensor, speech sensor, sound sensor, etc., for ensuring that these sensor have functioning smoothly. Similarly, the researcher Vaish has mentioned that in order to stop the movement of wheelchair, the users' needs to close their one eye tightly at once.Moreover, the embedded processor has performed an intelligent decision making and controlling of motors whereas all kind of sensor's output are processed using embedded processor and the two DC motor have been controlled based on the requirement of users. In addition, it can perform an automatic reaction namely stop or avoid while hindrances are detected and maintained using embedded processor. The ATMEL ATMega32 single chip with 8-bit Microcontroller has been utilized as an embedded processor for robotic wheelchair prototype whereas this microcontroller consists of flash program memory with 32 KB and the internal Radom Access Memory (RAM) with 2 KB. Thus ATMega32 has involved 8-channels along 10-bit Analog to Digital Convertor (ADC) parallel I/O port, various serial communication interfaces inclusive of Inter Integrated Circuit (IIC), Serial Peripheral Interface (SPI), Universal Synchronous Asynchronous Receiver Transmitter (USART) and three timer have shown in Figure 2. There are various sensors along with actuators are embedded with embedded process for creating robotic wheelchair.

To improve accessibility to training, a robotic wheelchair trainer that steers itself along a course marked by a line on the ground using computer vision, haptically guiding the driver's hand in appropriate steering motions employing a force feedback joystick, because the driver tries to catch a mobile robot during a game of "robot tag". this paper provides an in depth design description of the pc vision and system . in addition, we present data from a pilot study during which we used the chair to show children without motor impairment aged 4-9 (n = 22) to drive the wheelchair during a single training session, so as to verify that the wheelchair could enable learning by the non-impaired motor system, and to determine normative values of learning rates.

2. LITERATURE SURVEY

Presented the "Hand Gesture recognition using a real time tracking method and Hidden Markov Models" which describes the introduction available gesture reorganization system to acknowledge the continual gesture before stationary background. In this system the motion of the object gives the important and useful information for object localization and extraction. Overall system includes four modules like follows real time tracking, extraction, feature extraction, hidden Markov Model (HMM) training. To trace the moving hand and extract the hand region when applied the real time hand tracking and extraction algorithm. To chaacterize the spatial feature and motion analysis to characterize the temporal feature to use a Fourier Descriptor (FD).combine the spatial and temporal feature from input image sequences as our feature vector then apply the HMM model then recognize the input gesture. After studying a design of "Hand Gesture Reorganization employing a real time tracking method and Hidden Markov Models"

It is observed that this system is depend on the HMM model to recognize to recognize the gesture. To recognizing the gesture the complexity is more and accuracy is less so it not beneficial and not compatible to the user.

3. PROPOSEDSYSTEM

In the proposed system, the physically disabled person can control their wheel by manual. Using MPU6050 sensor for gesture symbol. In manual mode MPU6050 sensor and accelerometer is used to control the direction of the wheel of the motor. The proposed system contributes to the self dependency of differently able and older person. The robot will be access both manual and automatic mode. This paper is also used INQ method for searching nearby beacon ID and distance of beacon ID. This system has two beacons one is master and another one is slave. Master beacon is uses INQ method to find slave location. Here some sensors are used to connect to the patient body. Blood oxygen sensors monitor the oxygen level of blood in patient body, blood pressure sensor monitor the patient heart rate parameter and the temperature sensor is used to calculate the body temperature.

a)Heart Rate Sensor

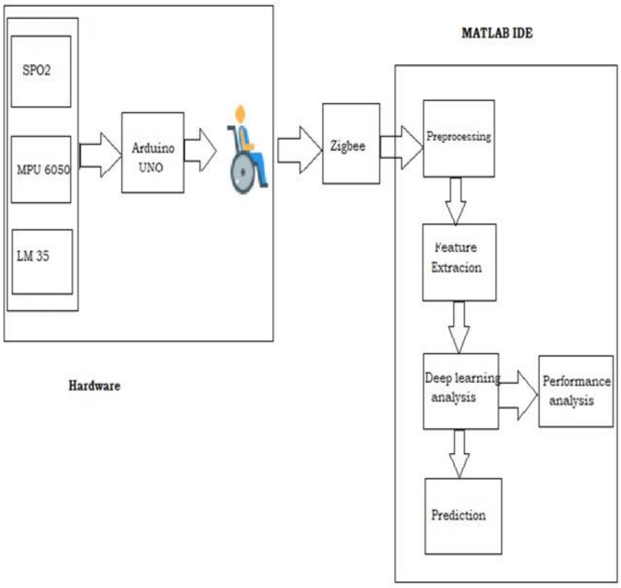


Fig.1: Block diagram of proposed system

Heart rate is a window into your muscles and lungs as it reveals how hard they are working! The need for an accurate, yet affordable heart monitor is essential to ensure ones health quality. So here's a prefatory article to assist you design/build a compact and cost-efficient pulse (pulse rate) monitor which will provide an accurate reading of ones pulse . Remember, your heart rate is a very good indicator of your physical condition!

b) Arduino Uno

The Arduino Uno is an open-source microcontroller board supported the Microchip ATmega328P microcontroller and developed by Arduino.cc.[2][3] The board is provided with sets of digital and analog input/output (I/O) pins which will be interfaced to varied expansion boards (shields) and other circuits.[1] The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a kind B USB cable.[4] It are often powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is also almost like the Arduino Nano and Leonardo.[5][6] The hardware reference design is distributed under an ingenious Commons Attribution Share-Alike 2.5 license and is out there on the Arduino website. Layout and production files for a few versions of the hardware also are available.

c) Zigbee-Transceiver

Zigbee is a high-level communication protocol. Simply, Zigbee is a low-power, low data rate, and close proximity wireless ad hoc network .Its low power consumption limits transmission distances to 10–100 meters line-of-sight, reckoning on power output and environmental characteristics.

d) Robotic Section

The wheelchair system consists of Power Electronics, a Drive Controller and a Master Controller. These subsystems are interconnected The Power Electronics controls current to both DC motors in order to create the torque requested by the Drive controller.

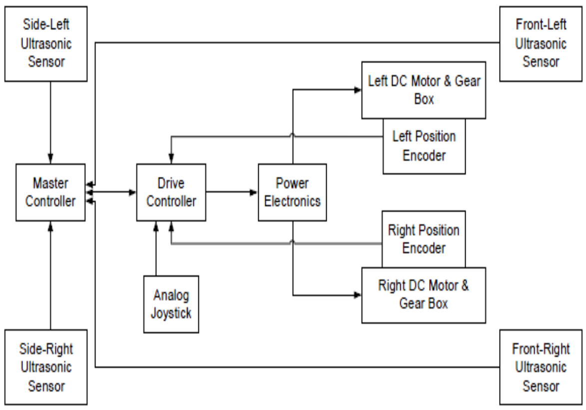


Fig.2: Robotic section

The Drive Controller receives input from either an analogue joystick or the Master Controller. It combines this information with position and velocity feedback from position encoders by way of two control loops to work out appropriate signals for the facility Electronics. It aims to move the wheelchair in a specified direction at a given speed. The Master Controller receives environmental information from four ultrasonic sensors and movement information from the Drive Controller. It is ready to instruct the Drive Controller via a serial connection .

e) **LM-35 Sensor**

LM- 35 is a small and cheap IC which can be used to measure temperature anywhere between -55°C to 150°C. It can easily be interfaced with any Microcontroller that has ADC function or any development platform like Arduino Power the IC by applying a regulated voltage like +5V (VS) to the input pin and connected the ground pin to the ground of the circuit. Now, you can measure the temperate in form of voltage.

The sensing system utilized in our experiments for hand gesture data collection and is actually a MEMS 3-axes acceleration sensing chip integrated with Micro Control Unit (MCU) and Bluetooth wireless data chips. The algorithms described in this paper are implemented and run on a PC.

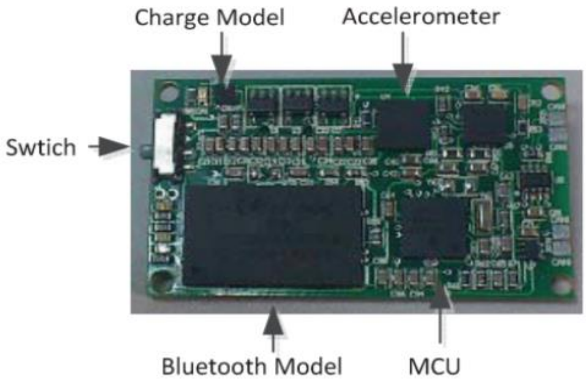


Fig.3: Sensing system

f) System work flow

This means computers are going to be permeating everything around us — ubiquitous embedded computing devices, uniquely identifiable, interconnected across the web . Because of low-cost, networkable microcontroller modules, the Internet of things is really starting to takeoff.

4. GESTURESECTION

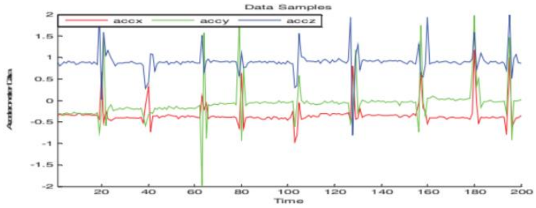
a) Data Acquisition and Preprocessing

To collect reliable hand gesture data for the sensing system, the gesture should be performed as indicated and there should exist interval between two gestures in order that the segmentation program can separate the gesture sequence correctly. Raw data received from the sensors are preprocessed during the data acquisition stage as follows:

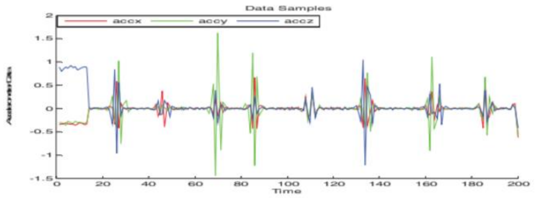
1) Slide average filter to filter the high frequency noises which introduced by the environment.
2) Hamming band-pass filter with the band between 10Hz to 40Hz to filter the gravity interference and only reserve the main gesture motion, as shown in Fig
3) the sensor data are normalized to unify the various amplitude of gestures.

b) Segmentation

When the preprocessed data stream arrives to the computer, it passes through a segmentation module which identifies the beginning and the end of gestures. Now most segmentation is button-based, which means that the user needs to sign the beginning and the end of the gesture by pushing a button. This kind of interaction is very unnatural. In this paper, we propose an automatic gesture segmentation method. The detail is as follows:



a)Sampled data



b) Hamming Band-pass filtered data

Fig.4 :Sampled and Hamming data

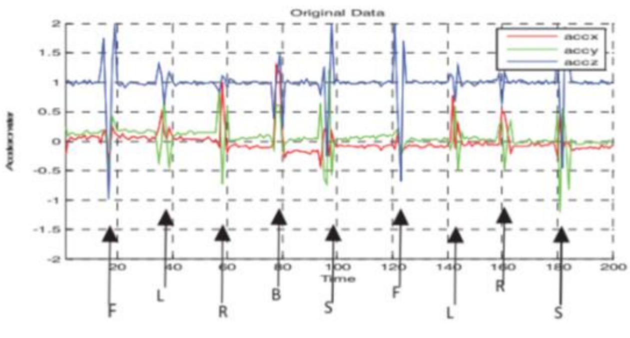
5. EXPERIMENTS

In our experiments, we defined five gestures which separately control the motion of wheelchair: Left turn, Right turn, Forward, Backward and Stop.

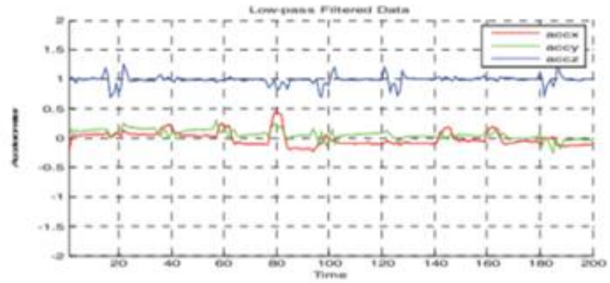
During the training, participant was asked to perform each indicated gesture 9 times and then the sampled data were saved to train the HMM model. After training, the HMM models were saved and the participant was asked to randomly perform the gestures as the motion commands to the wheelchair. It was demanded that there should exist some time interval between two consecutive gestures for the purpose that the segmentation program can separate each one of the gestures correctly.

In the experiment, the gesture sequences which the participant did were: Forward(F) Leftturn(L) Rightturn(R)backward(B) Stop(S). Fig shows the original sampled sensor data. Obviously during performing gestures, the acceleration values vary greatly while in the interval of the gestures the data are relatively steady.Fig. show the data after slide low-pass filter and band-pass filter which filter the environment and gravity interference. gesture sequences are segmented based on the distance principle. We can see that the main gesture sequences were segmented and there also exist disturbance sequences.

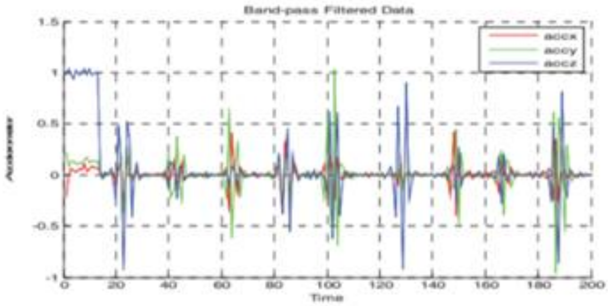
While these sequences are not satisfied with the length requirement or interval requirement and would be deleted or combined. Fig shows the velocity commands which are determined by the corresponding gestures after the HMM recognition and Bayes judgment. The velocities are still not smoothed. In Fig.9.f , the smoothed velocities after using the S-curve connection are shown.



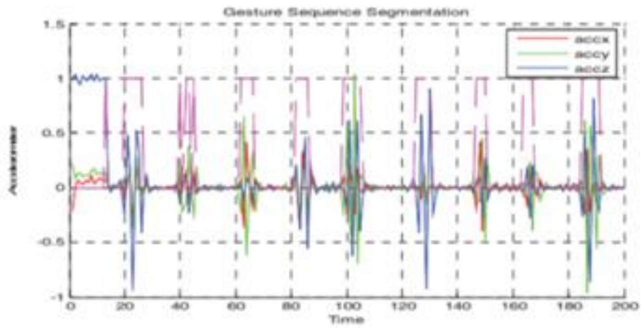
a) Original sampled data



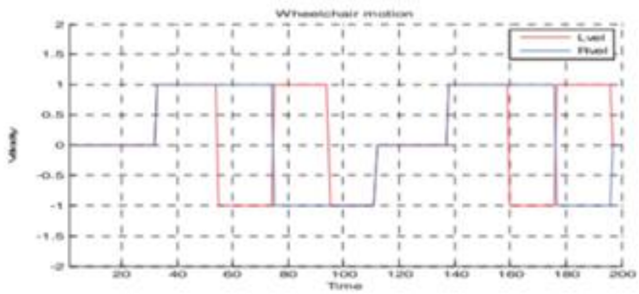
b) Low-pass filtered data



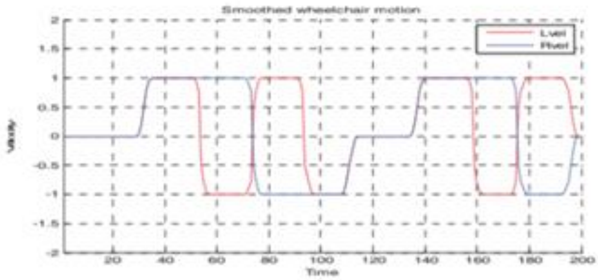
c)Band-pass filtered data



d) Gesture sequence segmentation



e) Corresponding wheelchair velocities



f) Smoothed wheelchair velocities

Fig.5: Results of Experiments

6. CONCLUSION

The system not only provided a secure , fun context for automating driver's training, but also enhanced motor learning by the non-impaired motor system, presumably by demonstrating through intuitive movement and force of the joystick itself exemplary control to follow the course. The case study indicates that a toddler with a motor system impaired by CP also can gain a short-term enjoy driver's training with haptic guidance. Independent mobility is crucial for children' cognitive, emotional, and psychosocial development [1–5]. Providing a toddler with self-controlled, powered mobility provides motivation for learning since the chair becomes a tool for exploration, locomotion, and play. However, many children with disabilities don't achieve independent mobility, especially at a young age, when this stimulus of mobility particularly influences development. It seems likely that this example is caused partially by limited training time: children with severe disabilities can and do learn new motor skills, but often more slowly than children without developmental disorders. Because the traditional approach for powered wheelchair driver's training is dear and labor-intense, typically requiring the hand-over-hand assistance of a talented therapist to facilitate learning and ensure safety during training sessions, children who don't learn quickly may experience limited training time, preventing them from achieving independent driving ability.

7. REFERENCES

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