International Journal of Information & Computation Technology.
ISSN 0974-2239 Volume 4, Number 12 (2014), pp. 1229-1235

http://www. irphouse.com

Voice based Control Signal Generation for Intelligent Patient Vehicle

Sourav Kundu[1], Simrat Sahni[2], Sanjeev Kumar[3], Amod Kumar[4]

[1]Indian Institute of Engineering Science and Technology, Shibpur, West Bengal
[2, 3, 4]CSIR-CSIO, Chandigarh

Abstract

In the modern world everyone is moving towards new technology, new device, and new instruments, then why aged person or physically handicapped left behind. For mobility assistant, they need vehicles to move from one place to another. In early days, mechanical wheel chair was used for mobility assistant which is moved with patient itself or required the assistance of one other person. Next electrical motor control wheel chair was available which is driven by the battery power. As there are many techniques to operate the control of electrical wheelchair, in the present paper, speaker dependent Dynamic Time Warping (DTW) algorithm is used to generate the control signal which has been implemented on Easy VR module. For speaker independent recognition hidden markov model (HMM) is used. The module recognizes the word and transfer a signal to control board (ARDUINO). The control board then generates the control signals for the motion of the patient vehicle for the left, right, forward, backward movement and speed control. The speed control of the vehicle is implemented using pulse width modulated (PWM) technique.

Key words: speech recognition, DTW, HMM, linear predictive coding, PWM.

I. INTRODUCTION

Intelligent robots are currently being developed to cater to the needs of physically challenged and elderly. As the number of elderly people increase, so demand for intelligent patient vehicle increase. In this work a simple powered wheel chair is controlled by a using DC motor, digital signal processor, microcontroller, driving circuit. Now a day basically two type of wheelchair mostly used – hand operated and joystick operated. It is difficult to operate a normal wheel chair in normal

environment by a normal people. In case of hand operated you need muscle power to drive the wheel of chair and in case of joystick operated you need skill. So it is difficult to operate this type of wheel chair by any physically challenged person.

So there is much option to interface with chair like voice, direction of face, eye gaze, Electromyogram (EMG) [1] signal from neck muscle, eye-control method based on electrooculography (EOG)[2] etc. But sometime the movement of face and eye are happened unconsciously. Also to acquire EMG or EOG is a cumbersome process. On the other hand voice is a natural medium of communication so here we pick it as interface medium. Practically speech application improved production rate and change the way of our daily life experience. Here recognition is speaker dependent and it is done through dynamic time warping (DTW) [3].

II. System Model

The system has been implemented on commercially available 'tetra T15' wheel chair.

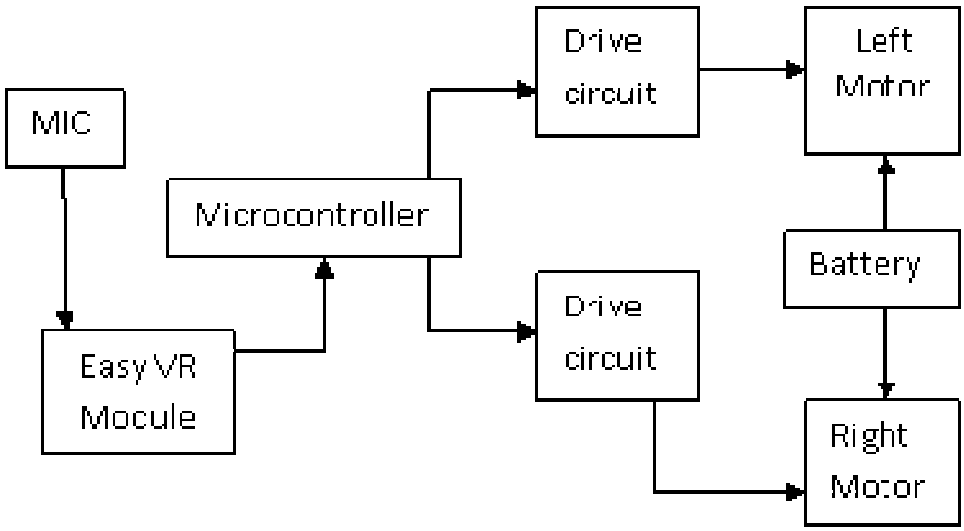


Figure*2. 1 Experimental block diagram*

This system is consist of ARDUINO board, Easy VR module and Pololu motor driver circuit. Easy VR is a slave module communicating via an asynchronous serial interface. In wheel chair there are four wheels but for movement of the wheelchair we have to just control two rear wheels. Two front wheels are free wheels, it can move any direction.

III. SPEECH RECOGNITION TECHNIQUE

In this work speaker dependent and Easy VR module use Dynamic Time Warping (DTW)[4] technique to detect the speaker. In DTW there is a comparison between two time dependent sequences. These sequences may be discrete signal or more

generally feature sequences sampled at equidistant points in time. To compare between two features set one need local cost measurement. If these two sequences are same then the value of cost matrix is zero and if there is any mismatch the value increased. There is a fixed threshold after that we can say these two sequences are different.

IV. Working Principle

To reach one place to another one need forward, backward, left and right movement [5]. For

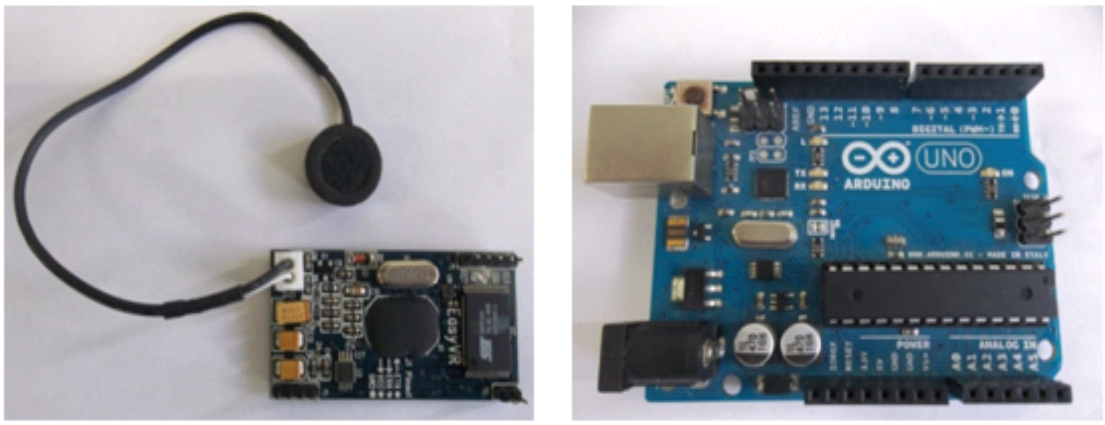
- Forward: both wheels are in forward motion.
- Backward: both wheels are in back ward motion.
- Left: In left there is left rotation and revolution. For rotation left wheel in backward motion and right wheel in forward motion. For revolution left wheel is stop and right wheel in forward motion.
- Right: In right there is also right rotation and revolution. For rotation right wheel in backward motion and left wheel in forward motion. For revolution right wheel is stop and left wheel in forward motion [6].

The code is written in Arduino such that the speed of the motor can be controlled by PWM wave generated through Arduino pin. Here for speed variation 40%, 60%, 80%, 100% duty cycle is used.

Duty cycle= $\frac{\mathbf{Ton}}{\mathbf{Ton+Toff}}$, T_{on}+ T_{off} = Total time period.

For jerk reduction output should reduced with a constant ramp slope.

V. HARDWARE DESCRIPTION



(a) **(b)**

Figure5*. 1:* (a)Easy VR module, (b) ARDUINO module

A: Easy VR module: This is a multi-purpose speech recognition module designed to easily add versatile, robust and cost effective speech recognition capabilities to virtually any application. It is capable of both speaker dependent and speaker independent word recognition. It is connected with the master controller Arduino. RSC-4128 is the heart of the Easy VR module. This is used to store voice feature.

B: Arduino module: Heart of the Arduino module is ATmega 328p microcontroller. It has 14 digital input-output pin out of which 6 is PWM pin. It has 6 analog input pin to read analog data from environment and a 16 MHz ceramic resonator.

VI. CONTROL ALGORITHM

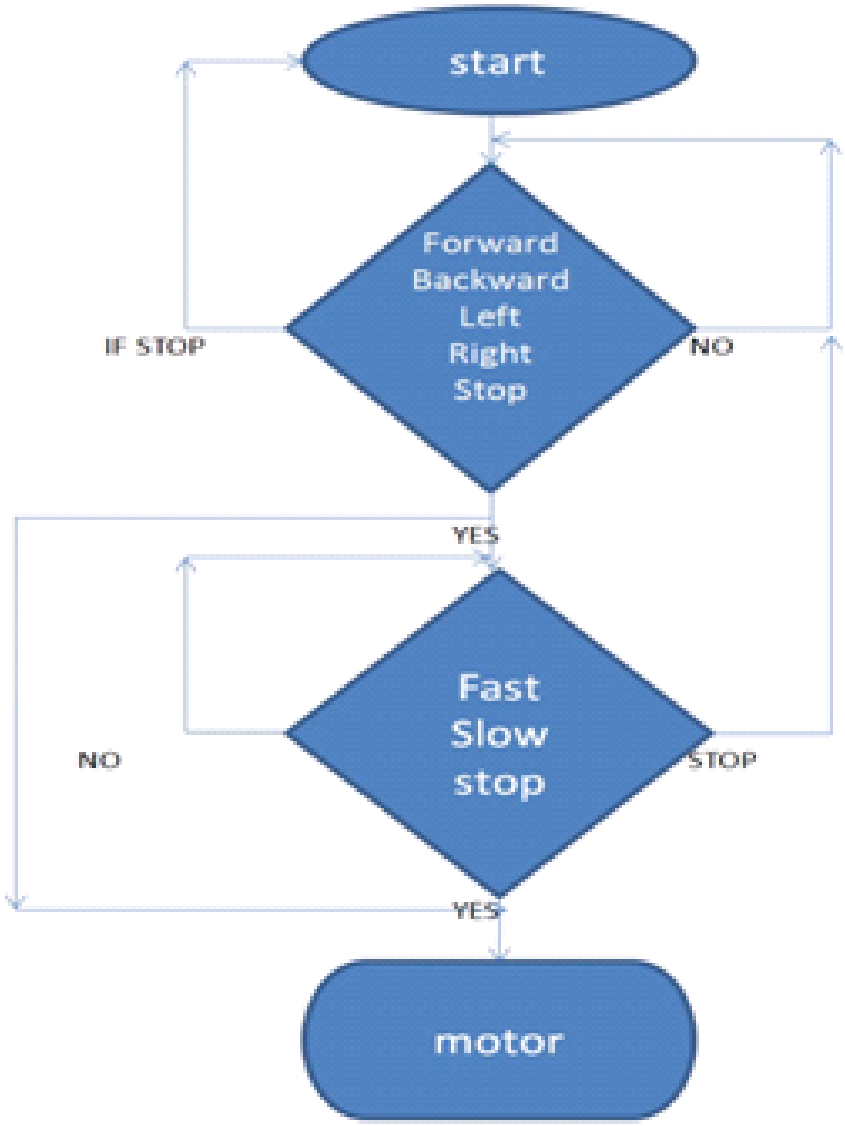
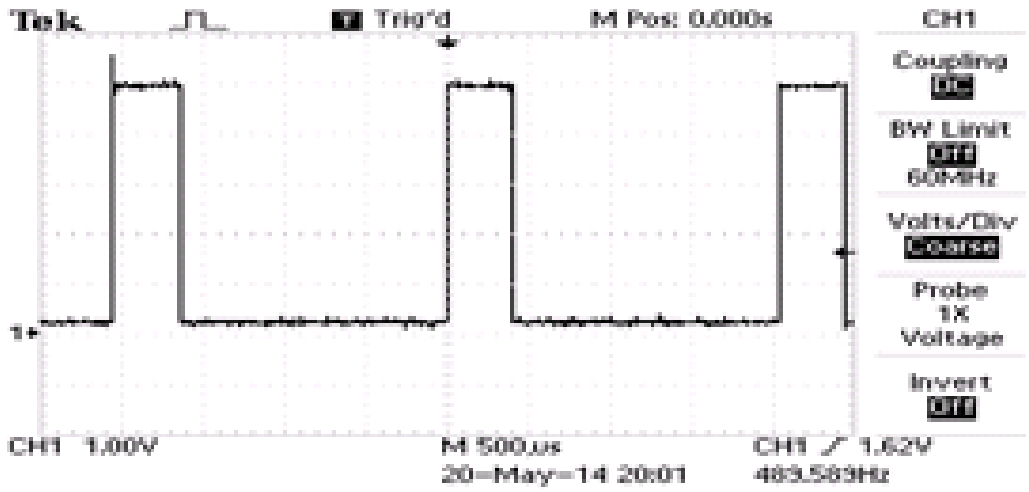


Figure*6. 1.* Motor control algorithm

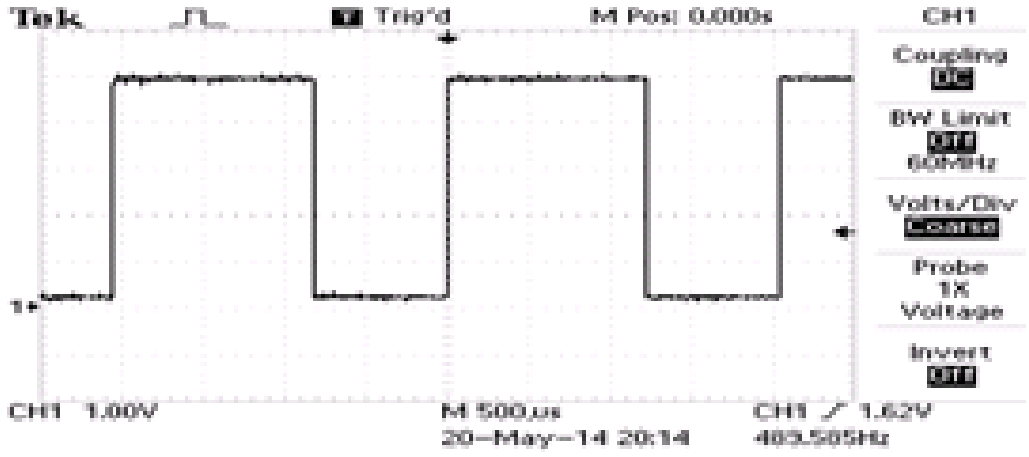
In easy VR there is seventeen group for speaker dependent word storage. Maximum storage capacity of this module is 32 words. First, to start the module one need a trigger word this may be its password. After password verification it will go to group one where “Left”, “Right”, “Forward”, “Backward”, “Stop” command are stored. Now if it detects any word from above it will go to next group. Now if it detects any word from above it will go to next group. In next group it verifies that if the user wants to move fast, slow, rotation or revolution. There two IR sensor is front side of the chair and two at the back side of the chair. If any obstacle is detected in the range then the wheel chair will automatically stopped. These four sensor output is read by the arduino analog input pin.

VII. EXPERIMENTALRESULT

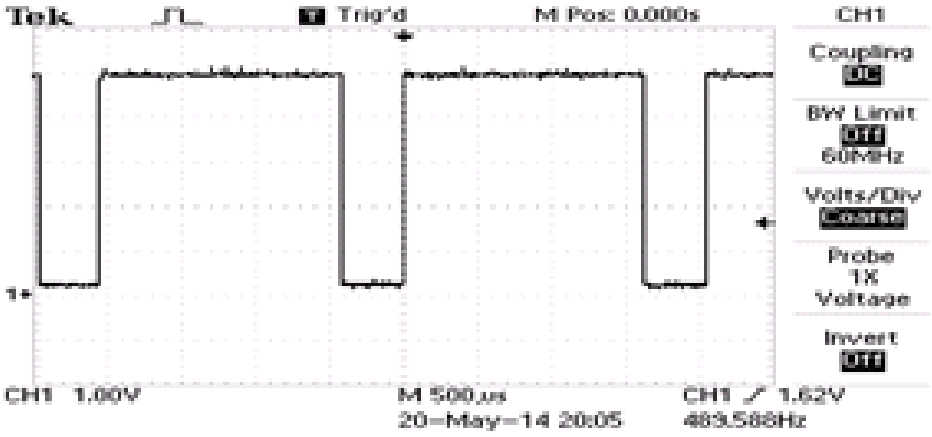
Here with varying duty cycle the speed of wheel is changed. With high duty cycle speed increase and low duty cycle speed is low.



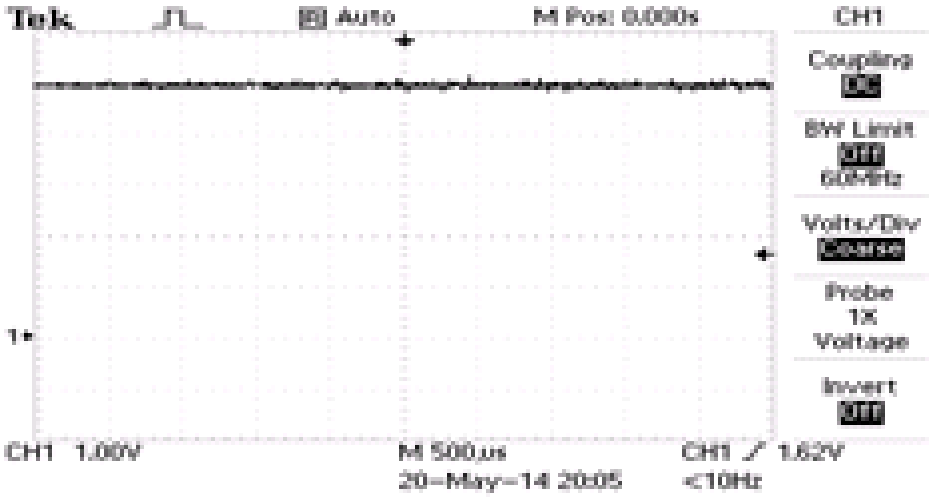
(a)



(b)



(c)



(d)

Figure 7. 1. Varying PWM output (a) duty cycle 20%, (b)duty cycle 60%, (c) duty cycle 80%, (d) duty cycle 100%

For jerk reduction area of PWM wave reduction as follows

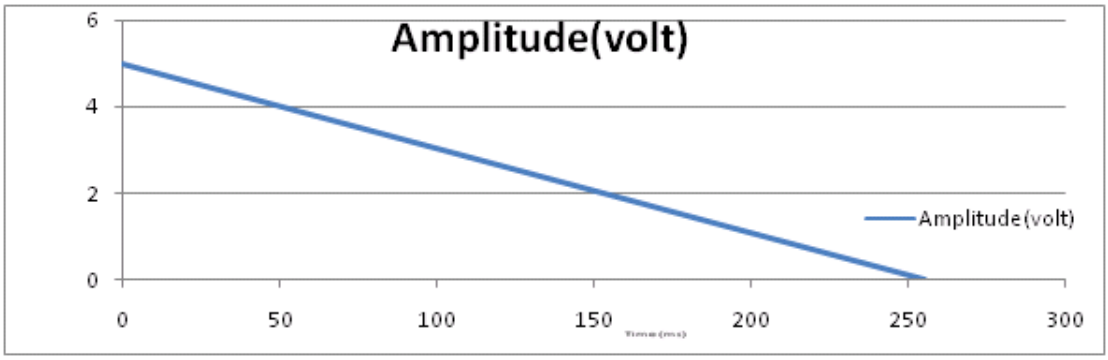


Figure 7. 2. Control signal for stop comment

VIII. CONCLUSION AND LIMITATION

This work provides a low cost solution for aged, paralysed or handicapped person who are physically challenged but they can speak. There are many solutions available where a laptop or mother board is used for recognising the voice but cost of the laptop or mother board is high, so overall cost of the wheel chair is increased. It is difficult for a normal person to accommodate this kind of chair. That's why microcontroller based approached is adapted here, so that the cost of the chair is within the range of common people

As speech is highly amplitude dependent and amplitude is easily distorted by noise. So in noisy environment this module is not so efficient to recognise the spoken word. In industrial area or road side where noise level is more Easy VR module is failed to recognise. It is suitable for home environment where noise level is low.

REFERENCES

[1] "Human-machine interface for wheelchair control with EMG and its evaluation" by Jeong-SuHan, Dept. of Electr. Eng. & Comput. Eng., Korea Adv. Inst. of Sci. & Technol., Daejeon, SouthKorea Zenn Bien, Z. ; Dae-Jin Kim; Hyong-Euk Lee; Jong-Sung Kim.

[2] "Wheelchair Control Using an EOG- and EMG-Based Gesture Interface" by Masafumi Hashimoto, Kazuhiko Takahashi, and Masanari Shimada

[3] "http: //www. veear. eu/" EasyVR website

[4] "Dynamic Time Warping" chapter 4 by Springer.

[5] "Voice and Touch Screen Based Direction and Speed Control of Wheel Chair for Physically Challenged Using Arduino" by M. Prathyusha, K. S. Roy, Mahaboob Ali Shaik.

[6] "Voice And Vision Controlled Wheelchair For Disabled" by G UdayKiran, N NiteshChakravarthi, K R Radhakrishnan.