International Journal of u- and e- Service, Science and Technology
Vol.8, No. 6 (2015), pp.229-234
http://dx.doi.org/10.14257/ijunesst.2015.8.6.22

Application of Mobile Robots by Using Speech Recognition in Engineering

P. V. L. Narayana Rao[1] and Pothireddy Siva Abhilash[2]

[1]*Computer Science Engineering, Dept. of Information System, College of Computing & Informatics, Wolkite University, Wolkite, Ethiopia,*
[2]*Software Engineer, Staffordshire University, Staffordshire, United Kingdom*
prao9039@gmail.com, sivaabhilash474@gmail.com

Abstract

This paper presents an expected technique of speech recognition system and it relates to voice control of electromechanical application, especially voice controlled mobile robots or intelligent wheelchair for handicapped people. Our aim is to interact with the robot using natural and direct communication techniques. The aim of this Chapter is that how the voice can be processed to obtain proper and safe wheelchair movement by high recognition rate. In order to make voice an effective communication tool between human and robots, high speech recognition rate must be achieved. But one hundred percent speech recognition rate under a general environment is almost difficult to achieve. In this Chapter, proposed technique called (Multiregdilet transform) is used for lonely words recognition. Finally use the outputs of neural network (NNT) to control the wheelchair through computer note books and special interface hardware. A successful recognition rate of 98% was achieved.

Keywords*: Artificial Neural Network, Multiridgelet Transform, Multiwavelet Transform, and Interfacing Circuit*

1. Introduction

Since human usually communicates each other by voices, it is very convenient if voice is used to command robots. A wheelchair is an important vehicle for the persons physically handicapped. However, for the injuries who suffer from spasms and paralysis of extremities, the joystick is a useless device as a manipulating tool.

2. System Design

The following 5 voice commands have been identified for various operation of the wheelchair FORWARED, REVERSE, LIFT, RIGHT, and STOP. Chair starts moving in corresponding direction on voicing the command forward in forward direction and stop if the command is stop and so on.

2.1 Data Base of Speech

Every speaker recognition system depends mainly on the data input. The data that used in the system is speech. The speech uttered by using 15 speakers, 8 males and 7 females, 10 of them used for training purpose (5 males, and 5 females) and each speaker utter the same word 5 times.

2.2 Multirighelet Transform

ISSN: 2005-4246 IJUNESST

To improve the performance and to overcome the weakness points of the Ridgelet transform, a technique named the Multiridgelet transform proposed. The main idea of the Ridgelet transform is to map a line sampling scheme into a point sampling scheme using the Radon transform, then the Wavelet transform can be used to handle effectively the point sampling scheme in the Radon domain [Minh, *et al*., 2003]. While the main idea of Multiridgelet transform depends on the Ridgelet transform with changing the second part of this transform with Multiwavelet transform to improve the performance and output quality of the Ridgelet transform.

3. Neural Network

Artificial Neural Networks (ANN) refers to the computing systems whose central theme is borrowed from the analogy of 'biological neural networks'. Many tasks involving intelligence or pattern recognition are extremely difficult to automate [Ram Kumar, *et al*., 2005].

3.1 The Model of Neural Network

We used random numbers around zero to initialize weights and biases in the network. The training process requires a set of proper inputs and targets as outputs. During training, the weights and biases of the network are iteratively adjusted to minimize the network performance function.

4. General Procedure of Proposed Systems

This Chapter contain two part, part one contains the theoretical work (simulation in computer with aid of matlab 7), and the second one puts interface between computer and connected to wheelchair.

4.1 The Preprocessing: In this section, the lonely spoken word is segmented into frames of equal length of (128 samples). Next the result frames of each word is converted into single matrix (2- dimensional), and this matrix must be power of two. So the proposed length for all word is 16348 (one dimensional), and this length is power of two and can divided into matrix have dimension (128×128, and this is 2- dimensional and power of two matrix).

4.2 Classification: This step begins when getting on 2-D discrete Multiridgelet transform coefficient. The coefficient splitter into two parts, the first part used as a reference data, and the second one used as tested or classified data. The strong method that can be recognized signal simply is neural network that use an algorithm of back propagation training algorithm as a classifier after training the reference data (coefficient) resulting from 2-D discrete Multiridgelet transform.

4.3 Computation: FDMWT for 1-D Signal by using an over-sampled scheme of preprocessing (repeated row), the discrete multiwavelet transform (DMWT) matrix is doubled in dimension compared with that of the input, which should be a square matrix NxN where N must be power of two. Transformation matrix dimensions equal input signal dimensions after preprocessing.

5. Experimental Work

The wheelchair that used in this work has three connecting rod (one in front and two in rear of wheelchair) that connect the two sides of wheelchair; each rod has joint in middle this will enable the wheelchair to be portable. The wheelchair is 65 cm (25.5 inches) wide and 127 cm (50 inches) long, measured with the rear caster extended fully behind the chair. The front of the tray is 76 cm (30 inches) from the ground, and the base of the seat is 51 cm (20 inches) above the ground. The robotic wheelchair used in this work shown in Figure (1) was built by the BEG company (British company) with joystick.

Figure 1. Rear Projection of Used Wheelchair

5.1 Weight of Wheelchair

The weight of wheelchair alone is 17kg, while weight of wheelchair with two motors and with experimental circuit was 20kg. Weight of person that sits down inside the wheelchair and which was accompanied upon him practical experiences was 65kg. The weight of wheelchair with the person sit down inside the wheelchair was 85kg. Maximum weight that the wheelchair can reinforce with respect to the person that sit down inside it and can give the same work and performance is approximately 80kg, and then the maximum weight for the wheelchair with the person approximately 100kg. I make experimental work on wheelchair that has the person sit down inside it has weight was 65kg and this wheelchair shown in Figure (2) and this practical experience gives excellent result and this is illustrated in Table (5). From this Table I conclusion that the proposed method better than the previous works.

5.2 Wheelchair Battery

The battery used in this work is wet type .Wet batteries use the chemical reaction between lead and sulphuric acid to create electrical energy. As the batteries require filling with distilled water, they do have a higher maintenance rate, but are lighter than Gel or AGM (Absorbed Glass Mat) batteries.

5.3 Wheels

Wheelchair has four wheels, two rear wheels and two castor wheels, the two caster wheel are hooked in wheelchair base in front all wheels have the same diameter (18 cm) . The drive wheels are in rear on either side of the base, allowing the chair to turn according to voice command, wheels engages directly to a gear train that transmit torque form motor to wheels by two grooves in each wheel and nut.

5.4 Motors

Motors are arguably one of the most important parts of a mobile robotics platform. Overpowered motors cause inefficiency and waste the already limited supply of power from the on-board batteries, while undersized motors could be short on torque at critical times. The optimal rotation speed and the available speed range of the motor must also be taken into consideration. Too high of an output rpm from the motor shaft will cause the robot to operate at a fast, uncontrollable speed. Too low of an output and the robot will not be able to attain a suitable speed to meet the user's needs. The rotation output of the motor also plays a role in the performance because if the torque is not sufficient, locomotion may not occur in certain situations. Therefore, much consideration was put into the selection of the proper motor for the platform [Philips, 2003].

Figure 2. DC Motor Used In Wheelchair

6. Hardware Components Added to Original Wheelchair

The modification that adds to original wheelchair with removing joystick that designs before (to modifying wheelchair function according to person injury especially for the injuries who suffer from spasms and paralysis of extremities) makes its physical design very real. It is a combination of various physical (hardware) and computational (software) elements that mix the subsystems of the wheelchair to work in one unit. In terms of hardware components the main components that added to wheelchair are interfacing circuit, microphone (headset microphone) and notebook computer (host computer).

6.1 Microphone

A quality microphone is the key when using automatic speech recognition (ASR). In most cases, a desktop microphone just will not do the job. They tend to pick up more ambient noise that gives ASR programs a hard time. Hand held microphones are also not the best choice as they can be clumsy to pick up all the time. While they do limit the amount of ambient noise, they are most useful in applications that require changing speakers often, or when speaking to the recognizer is not done frequently (when wearing a headset is not an option). The best choice and by far the most common is the headset style. It allows the ambient noise to be minimized, while allowing you to have the microphone at the tip of your tongue all the time [Cook, 2002]. Headsets are available without earphones and with earphones (mono or stereo) in this work the headphone type (FANCONG FC-340) is employed.

6.2 Relay Driver Interfacing Circuit

A transmit can be used to switch higher power devices such as motors and solenoids. If desired, the relay can be powered by a separate power supply, so, for instance, 12V

motors can be controlled by the parallel port of notebook computer. Free welling diode can be used to protect the relay contact and prevent damage to the transistor when the relay switches off. An intermediate stage between control signal (output of parallel port) and motors consists of a combination of component relays, transistors, diodes, capacitors, resistors and buffer 74ABT245 as shown in Figures 3 and 5, it uses to protect parallel port against any expected damage, The 74ABT245 high-performance BiCMOS device combines low static and dynamic power dissipation with high speed and high output drive shown in Figure 6.

Figure 3. Relay Interfacing Fixated on Wheelchair

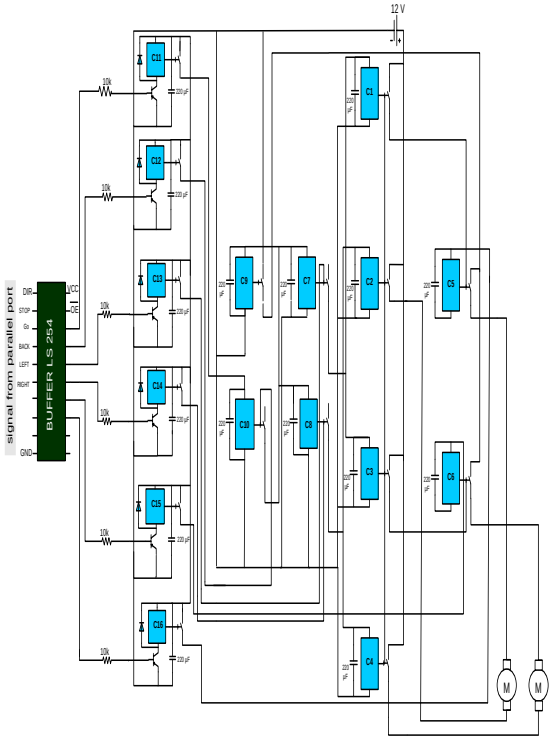

Figure 4. Relay Interfacing Circuit

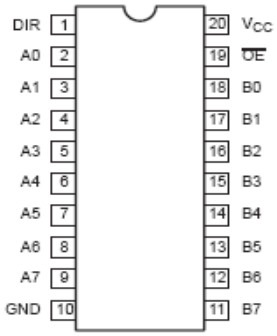

Figure 5. Pin Configuration of 74ABT245

The 74ABT245 device is an octal transceiver featuring non-inverting 3-State bus compatible outputs in both send and receives directions. The control function implementation minimizes external timing requirements. The device features an Output Enable (OE) input for easy cascading and a Direction (DIR) input for direction control [buffer 63].

7. Results Simulation

7.1 Experimental Results

To examine the performance of the proposed algorithm, some experimental tests were done by applying different type of voice command experimentally like (go, back, right …*etc.*).

7.2 Linear Path

Linear path of wheelchair can be obtained by single isolated voice command "GO" and "BACK" according to specified direction that user recommended, Figure (6) shows linear motion of wheelchair, motion of wheelchair either in positive or negative direction of x-axis when the rear (driving) wheels of wheelchair have the same direction of rotation (both wheels are rotate in clockwise or anti-clockwise).

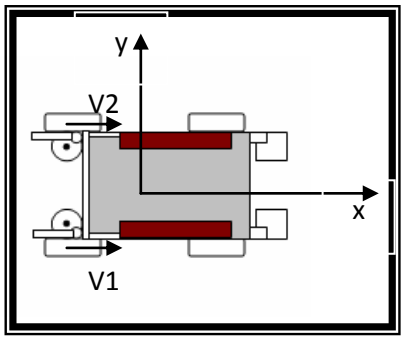

Figure 6. Linear Path Corresponding to "GO" Voice Command

Figure (7) shows error path of wheelchair from the commanded path which represents in figure the x-axis.

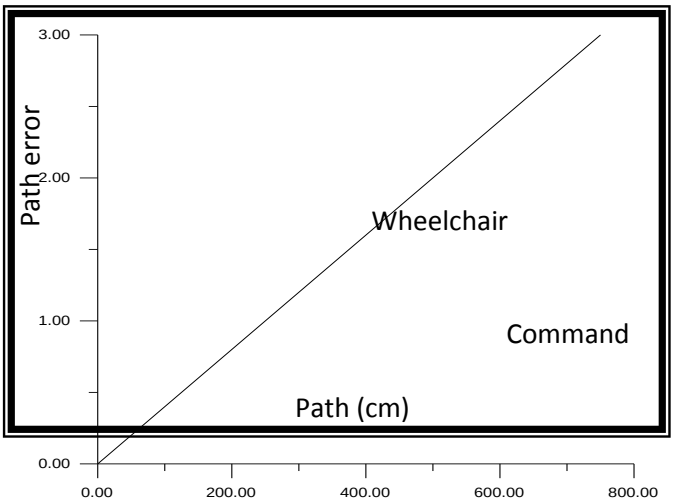

Figure 7. Actual Wheelchair Path in Linear Motion

7.3 Circular Path

Circular path of wheelchair can be obtained by single isolated voice command either "LEFT" or "RIGHT" according to specified direction that user recommended, Figure (13) shows rotational motion of wheelchair in clockwise using voice command "RIGHT" (V1=0, V2= not zero).

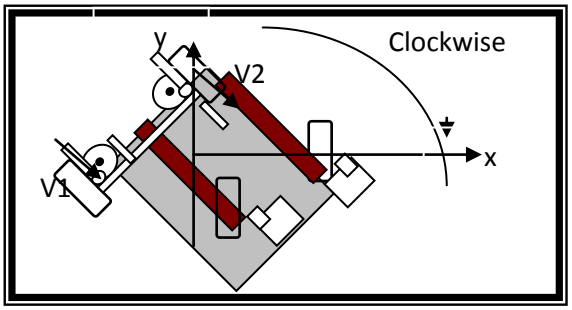

Figure 8. Rotation Corresponding to "RIGHT" Voice Command

These voice commands generate circular path, To stop rotation motion of wheelchair "STOP" voice command is used.

8. Conclusion

In this Chapter a method of isolated word speech recognition system was proposed to control the wheelchair and therefore make proposed technique be more efficient in real time operation used in control of mobile robot. This Chapter presents a proposed 2-D Multiredgelet transform computation method that verifies the potential benefit of Multiwavelet and gain a much improvement in term of low computation complexity.

References

[1] S. Cook, "Speech Recognition How To", Revision v2.0, **(2002)** April 19.
[2] E. Hosseini, J. Amini and M. R. Saradjian, "Back Propagation Neural Network for Classification of IRS-1D Satellite lite Images", Tehran University, **(1996)**.
[3] M. Hrnčár, "Voice Command Control For Mobile Robots", Department of Control and Information Systems Faculty of Electrical Engineering, University of Žilina, Žilina, **(2007)**.

[4] K. Komiya, K. Morita, K. Kagekawa and K. Kursosu, "Guidance of a Wheelchair by Voice", proceeding of IEEE, **(2000)**, pp. 102-107.
[5] J. Li, Q. Pan, H. Zhang and P. Cui, "Image recognition using Radon Transform", Proceeding of IEEE, **(2003)**.
[6] S. Lim and J. Jeon, "Multiple Mobile Robot Interface Using a Low Cost Voice Recognition Chip", Department of Mechatronics, School of Electrical and Computer Engineering, proceeding of IEEE, **(1997)**, pp. 402-407.
[7] R. Mahoney, "Robotic products for rehabilitation: Status and strategy", Proceeding of IEEE, **(1997)**.
[8] N. Minh and M. Vetterli, "The Finite Ridgelet Transform for Image Representation", Proceeding of IEEE, **(2003)** January.
[9] I. Moon, M. Lee, J. Ryu and M. Mun, "Intelligent Robotic Wheelchair with EMG, Gesture, and Voice-based Interfaces", Proceeding of IEEE, **(2003)** October, pp. 3453-3458.

Authors

P. V. L. Narayana Rao Pothireddy, he was born in Vijayawada, Krishna District, Andhra Pradesh, India. He completed M.Tech. in Information Technology from Sam Higginbottom Institute of Agriculture, Technology and Sciences Deemed University, Allahabad, Uttar Pradesh, India and PhD in Computer Science Engineering from Lingaya's University, NCR, New Delhi [Faridabad, Haryana State], India. He has 8 years of Teaching and Research experience in reputed Indian Post Graduation Engineering Colleges, 14 years of Teaching and Research experience in different Universities of Foreign Country ETHIOPIA, East Africa and 4 years Industrial Experience in India as a System Analyst, Systems Developer and Networks Administrator. He is presently working as Professor (CSE), Wolkite University, SNNPR, Wolkite, Ethiopia, and East Africa. He is a member of various professional bodies like WASET, USA, IAEng, Hong Kong and EDAS, New York, USA, CSE, Ethiopia. He has various publications in the reputed National and International Journals, Conference Proceedings. His email id is **prao9039@gmail.com** and alternative email ids

Pothireddy Siva Abhilash, hewas born in Vijayawada, Krishna District, Andhra Pradesh, India. He completed M.S degree in Tele Communication Engineering from Staffordshire University, Staffordshire, United Kingdom in 2013. He is working as Software Engineer in Hyderabad, Telangana State, India. He has various publications in the International Journals. His email id is sivaabhilash474@gmail.com.

