International Journal of Scientific Engineering and Science
Volume 2, Issue 8, pp. 26-29, 2018. ISSN (Online): 2456-7361

Arabic Recognizing Voice to Control Wheelchair & Obstacle Detection Features

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Abstract— *This work describes wheelchair control using voice recognition and a digital controller based on PWM that sends speed warnings to ensure autonomous chair motion correction by using ultrasonic sensor data. The chair facilitates the handling of physically disabled people who cannot control the movement of their limbs. The wheelchair is powered by electrical power and the tire motors are controlled using a microcontroller and a voice recognition module that recognizes the voice of the user and provides the data stored in the memory of the user. processor to execute the command. The project was successfully implemented on the wheelchair and the results showed accuracy and flexibility in chair control.*

Keywords— *Wheelchair, digital control system, fuzzy speech recognition, ultrasonic sensor, timbre, artificial inelegance.*

I. Introduction

In recent years we have seen an increasing number of people with special needs relying on others for lack of self-mobility. The wheelchair development for paralyzed users is surprisingly new, from conventional wheelchairs to manual wheelchairs to electric wheelchairs. The traditional use of wheelchairs tends to focus exclusively on manual use, which assumes that users are still able to use their hands, except those who cannot. This paralysis is caused by diseases or accidents that affect the nervous system too often because people lose their ability to move their voluntary muscles. Because the voluntary muscle is the main engine that enables people to move the body, paralysis may cause the person not to move to his muscular arm such as the arm and leg, but other forms such as periodic paralysis (caused by genetic diseases) are caused by various other factors. Speech is one of the solutions to compensate the members in the control of the devices. In this work we used the Arabic voice signal to control the wheelchair.

To control the wheelchair [1], a human-machine interface must be created through the voice recognition system [2], [3]. To achieve this interface, the system must consist of two parts: an encoder and decode. The encoder analyzes the signal and extracts a certain number of relevant parameters [4].

When operator wants to use this type of chair, he must pronounce an isolated word, this word is first transformed into a series of vectors Acoustics (MFCC), this input observation is recognized by a Viterbi algorithm, which aligns the observations with the HMM, if this command is recognized, by the voice resonance system [5] which in turn sends the orders to reboot (Run the engines of rebel). The main objective of the paper is to control the wheelchair by voice commands. This project useful for special needs or elderly. In this project we will save six command in Arabic language (أمام-خلف-يمين-شمال-اتصال-قف-عكس).

This paper is organized as follows. In Section 2, the voice recognition module Section 3 describes the control system. Section 4 present the results and evaluation of the algorithm and implementation of the voice control wheelchair.

II. Voice Recognition Module V3

Elechouse is an electronic board used in embedded systems that recognizes spoken words and commands and converts them to control. The built-in electronic circuitry supports up to 80 voice commands. The maximum number of commands running at the same time is 7 orders. Users need to train the unit first before allowing it to recognize any voice command.

A. Method of Control and Recognition Speech

- **Recognizer -** A base where voice command commands are loaded. 7 active commands are loaded. It is an essential part of voice recognition. 80 can be loaded but the maximum 7 is done in one application.
- **Recognizer index** - max 7 voice commands could be supported in the recognizer. The recognizer has 7 regions for each voice command. One index corresponds to one region: 0~6
- **Training Order-** The operation of the voice commands that we will use in the control.
- **Load** -- copy trained voice to recognizer
- **Voice Command Record** -- the trained voice command store in flash, number from 0 to 79

B. Software For Recording and Coding Voice

Open the Access Port driver and click configuration icon.
Put your options in General / serial port sittings (In our situation we select this options)

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Volume 2, Issue 8, pp. 26-29, 2018. ISSN (Online): 2456-7361

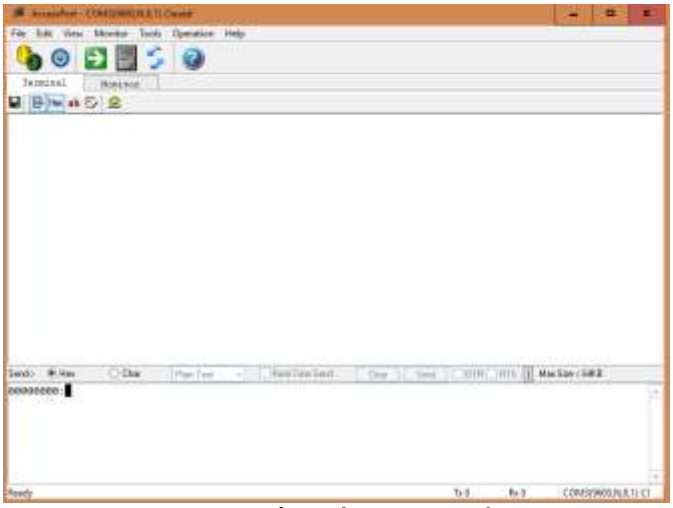

Fig. 1. Interface coding voice control.

C. Train One Record and Set-Ignature

AA : Frame Head
03+SIGLEN: 03+ Write The Number of Bit In Your Command
21 : The Record Operation to Train One Record and Set Signature
RECORD : Voice Command Record Index
SIG : The Signature in Hexadecimal
0A : Frame End

In our situation we record 6 commands and we will see how to write it.

First command was " أماما " and the code will be: **AA 17 21 00 67 6F 0A**
Second command was " خلف " and the code will be: **AA 18 21 01 62 61 63 6B 0A**
Third command was " يمين " and the code will be: **AA 19 21 02 72 69 67 68 74 0A**
Forth command was " شمال " and the code will be: **AA 20 21 03 6C 65 66 74 0A**
Fifth command was " قف
sixth command was " عكس " and the code will be: **AA 22 21 05 72 65 74 75 72 6E 0A**

Write each commands separate in text box and click send you will see in terminal box " speak now " then you should to say that's command you selected then you see "speak again" you repeat the same command again for confirm.

If you see "success" that's mean the command recorded already and if you see "can't match" or "noisy" that's mean the command didn't recorded and you have try again. Now we need to load our command in VR3 by using that format code and we will see how to write it.

AA 08 30 00 01 02 03 04 05 0A

III. Voice Control Wheelchair

In this project used voice recognition module v3 this chip transforms the analog voice input to digital commands, and these data go to microcontroller [6]. Microcontroller will make decision by algorithm we wrote them in the Arduino's program. Fig. 3. The design of the wheelchair has a single driven wheel that is also steered. It requires two motors, two for driving the back wheels and one for turning the front wheel. The advantage of this design is that the driving and turning actions have been completely separated by using two different motors. Therefore, the control software for driving curves will be very simple. A disadvantage of this design is that the robot cannot turn on the spot, since the driven wheel is not located at its center.

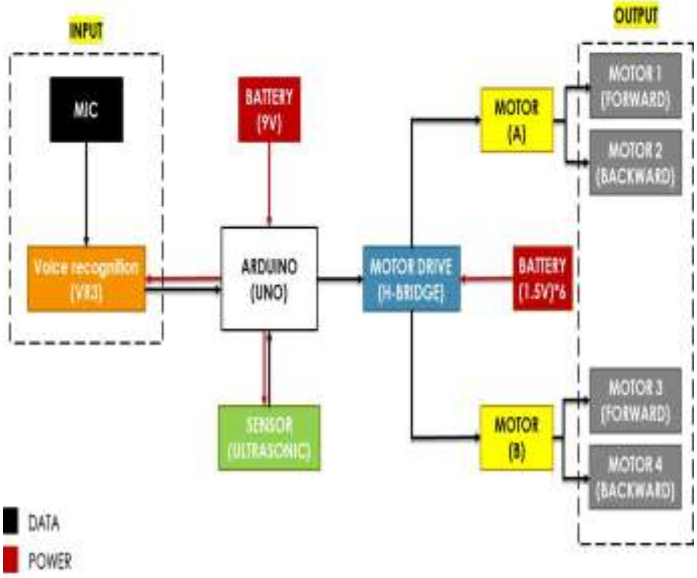

Fig. 2. Control PWM motor driver.

A. Voice Control Wheelchair

Voice Recognition Module (Elechouse) is an electronic board used in embedded systems that recognizes spoken words and commands and converts them to control. The built-in electronic circuitry supports up to 80 voice commands. The maximum number of commands running at the same time is 7 orders. Users need to train the unit first before allowing it to recognize any voice command.

This board has 2 controlling ways: Serial Port (full function), General Input Pins and general Output Pins on the board could generate several kinds of waves while corresponding voice command was recognized. On V3, voice commands are stored in one large group like a library. Any 7 voice commands in the library could be imported into recognizer. It means 7 commands are effective at the same time.

B. The Motor Driver Module

The Motor Driver Module is a compact board that can be used to drive very small robots [10]. Also, it has two independent HG7881 (L9110S) motor driver chips which can each drive up 800mA of continuous current. The module controlled the DC motors, which works with a feeding voltage between 5 and 35 volts and a peak current of up to 2A. A set of male header pins is used to connect this module to your robot's microcontroller brain. For controlling speed by PWM, or pulse width modulation is a technique which allows us to adjust the average value of the voltage that's going to the electronic device by turning on and off the power at a fast rate. The average voltage depends on the duty cycle TON, or the amount of time the signal is ON versus the amount of time TOFF the signal is OFF in a single period. For controlling the

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rotation direction, we just need to inverse the direction of the current flow through the motor, and the most common method of doing that is by using an H-Bridge. An H-Bridge circuit contains four switching elements, transistors or MOSFETs

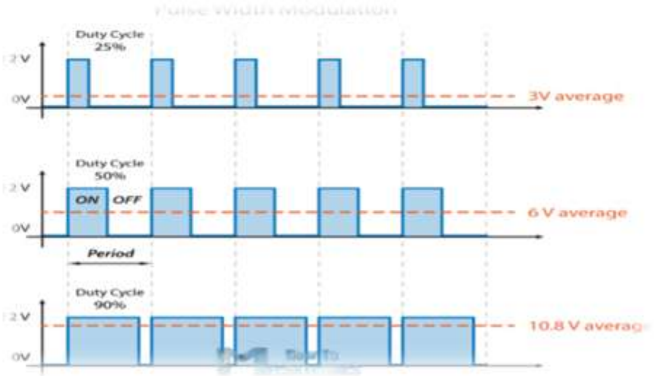

Fig. 3. Control PWM motor driver.

C. Ultrasonic Sensor HC-SR04

We used this sense of automatic control of the chair when the wrong order or sudden traffic or a barrier .The sensor emits an ultrasonic sound at a frequency of 40,000 Hz in the air. If there is an object or obstacle in its path, it will bounce back on the unit. Given travel time and audio speed, you can calculate distance. [7]. We used the HC-SR04 module in our project and it has the ability to execute microcontrollers such as Arduino

We can calculate how the sensor works. For example, if the wave bounce time of the body is 294 seconds, and the sound speed is 340 m / s or 0.034 cm / the body will be away in the "sensitive" wheelchair approximately 10 cm. It also needs to amplify the signal to allow the sound wave to move forward and recoil. The distance is calculated by the following equation.

$$distance = \frac{speed\ of\ sound\ \times time\ taken}{2}$$

D. Microcontroller (Arduino Uno)

Arduino is a microcontroller board based on the ATmega328P [8]. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. The microcontroller is programmed with c language to control the chairtested with test board and LED fig 4 the flowchart of program in fig. 5.

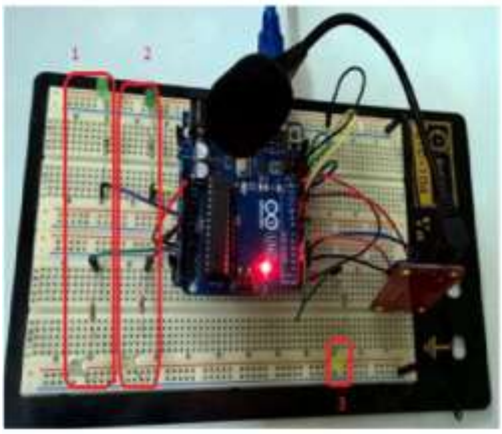

Fig. 4. Test before blending system.

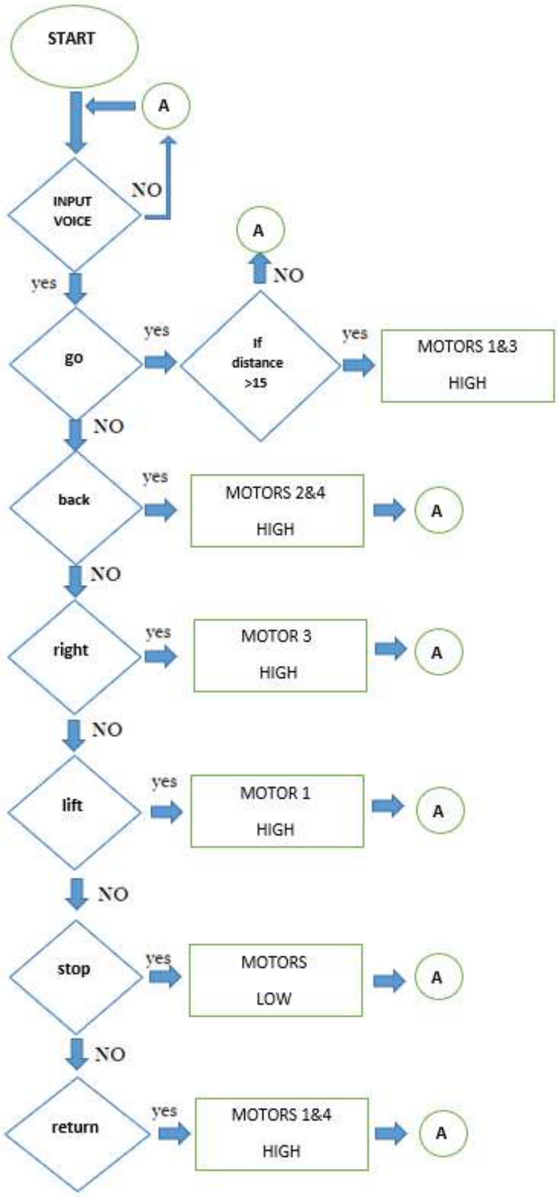

Fig. 5. the Flowchart of programing system.

IV. Results and Discussions

Our wheelchair control system was tested on a wheelchair design in the processor lab and embedded systems at the Technical College of Madinah. The wheelchair control is designed and developed in different interaction units. Based on two important aspects, first, the accuracy of the sound system Second, the speed of the wheelchair through the control tools This design is tested.

This chair will be used for people with mobility disorders. The sound recognition system was tested in a quiet hall with one user at first. The results gave precision in recognizing each word spoken as an order.

The next time we tested it with different users the system was not trained on it. For example, words such as "يمين" were recognized as "writing" in this way, and 5% of the errors occurred in this case. This was because the hearing instrument recognized a different pronunciation. However, after the user

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had to speak the word a number of times, the system had enough examples and correctly defined what the user had pronounced from the word. Having tested this system in a noisy room there are many people talking. There was no problem recognizing the words correctly when the noise was mild but the recognizer found it difficult to recognize the user's voice when so many noise and speech rose.

Fig. 7. Prototype wheelchair system.

V. CONCLUSION

This paper has introduced a newly voice control wheelchair. It is based recognition speech and PWM controlled DC electric motor. We have shown in the use of the chair, there is great flexibility in the control and ease of use especially in people who have an organic problem. This technique can be used to give some commands in the automatic driving of cars. The control can be developed using a camera to be automatically controlled after giving orders and can be used by the visually impaired.

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