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Articulate Steer Robot

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Abstract**: Articulate steer Robot (ASR) is a mobile robot whose motions can be controlled by the user by giving specific voice commands. The speech is received by a microphone and processed by the voice module. When a command for the robot is recognized, then voice module sends a command message to the robot's microcontroller. The microcontroller analyzes the message and takes appropriate actions. The objective is to design a walking robot which is controlled by servo motors. When any commands are given on the transmitter, the EasyVR module will take the voice commands and convert the voice commands into digital signals. Then these digital signals are transmitted via ZIGBEE module to the robot. On the receiver side the other ZIGBEE module receives the command from the transmitter side and then performs the respective operations. The Hardware Development board used here is ATmega 2560 development board. In ATmega 2560 there are 15 PWM channels which are needed to drive the servo motors. Addition to this there is camera which is mounted in the head of the robot will give live transmission and recording of the area. The speech-recognition circuit functions independently from the robot's main intelligence [central processing unit (CPU)]. This is a good thing because it doesn't take any of the robot's main CPU processing power for word recognition. The CPU must merely poll the speech circuit's recognition lines occasionally to check if a command has been issued to the robot. The software part is done in Arduino IDE using Embedded C. Hardware is implemented and software porting is done.

***Key Words:** Arduino, ATmega 2560, EadyVR, S*

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I. Introduction

When we say voice control, the first term to be considered is Speech Recognition i.e., making the system to understand human voice. Speech Recognition is a technology where the system understands the words (not its meaning) given through speech.Robots are indispensable in many manufacturing industries. The reason is that the cost per hour to operate a robot is a fraction of the cost of the human labor needed to perform the same function. More than this, once programmed, robots repeatedly perform functions with a high accuracy that surpasses that of the most experienced human operator. Human operators are, however, far more versatile. Humans can switch job tasks easily. Robots are built and programmed to be job specific. You wouldn't be able to program a welding robot to start counting parts in a bin. Today's most advanced industrial robots will soon become "dinosaurs." Robots are in the infancy stage of their evolution. As robots evolve, they will become more versatile, emulating the human capacity and ability to switch job tasks easily. While the personal computer has made an indelible mark on society, the personal robot hasn't made an appearance. Obviously there's more to a personal robot than a personal computer. Robots require a combination of elements to be effective: sophistication of intelligence, movement, mobility, navigation, and purpose.

II. Description of Articulate Steer Robot

Speech Recognition: Speech recognition is the process of capturing spoken words using a microphone or telephone and converting them into a digitally stored set of words.Speech recognition technology has endless applications. Commonly, such software is used for automatic translations, dictation, hands-free computing, medical transcription, robotics, automated customer service, and much more. If you have ever paid a bill over the phone using an automated system, you have probably benefited fromspeech recognitionsoftware**.**

Speaker verificationis the process of using a person'svoice to verify that they are who they say they are. Essentially, a person's voice is used like a fingerprint. Once a sample of their speech is recorded, a person's speech patterns are tested against a database to see if their voice matches their claimed identity. Most commonly, speaker verification is applied to situations where secure access is needed. Such systems operate with the user's knowledge and cooperation.

Hardware tools:

Servo motor: A regular motor rotates 360 degree continuously [example: fan] and cannot stop at any required position as there is no position feedback mechanism.Robots need to rotate the motor shaft to a particular angle precisely as shown in (fig1) .Hence a motor which provides the position information,which in-turn can be used to control the motor, is called a servo motor.

Fig1: Servo motor used in Robot

Analog Servos: In order to achieve this, position feedback is necessary. A potentiometer was added to provide the resistance value, which was used to calculate the current position.This works fine, however has the disadvantage due to the potentiometer design. A potentiometer, due to its physical design constraint cannot rotate 360 degrees and hence the motor shaft attached to it also cannot complete the 360 degree full rotation. This is still used for smaller applications where the motor needs to turn within a particular value.

Digital Servos:Optical encoders were used at the earlier stages to eliminate the 360 degree rotation issue and these digital servos can rotate 360 degrees.Brushless dc servo motors are very efficient servos widely used in Robotics.

Arduino Board:we will learn about the different components on the Arduino board (fig2). We will study the Arduino UNO board because it is the most popular board in the Arduino board family. In addition, it is the best board to get started with electronics and coding. Some boards look a bit different from the one given below, but most Arduinos have majority of these components in common.

Specifications:

Processor

Broadcom BCM2387 chipset, 1.2GHz Quad-Core ARM Cortex-A53, 802.11 b/g/n Wireless LAN and Bluetooth 4.1 (Bluetooth Classic and LE)

GPU

Dual Core VideoCore IV® Multimedia Co-Processor. Provides Open GL ES 2.0, hardware-accelerated OpenVG, and 1080p30 H.264 high-profile decode, Capable of 1Gpixel/s, 1.5Gtexel/s or 24GFLOPs with texture filtering and DMA infrastructure.

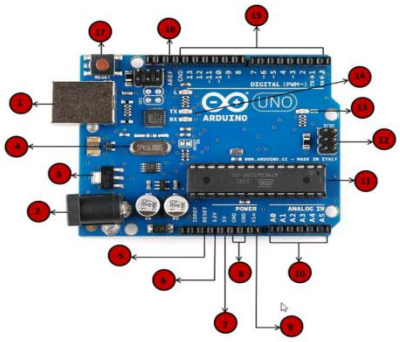

Fig2: Arduino board

Fig3: Raspberry pi3 board

Raspberry Pi 3 Model B:

Memory
1GB LPDDR2
Operating System
Boots from Micro SD card, running a version of the Linux operating system or Windows 10 IoT

Dimensions
85 x 56 x 17mm
Power
Micro USB socket 5V1, 2.A

III. Working

Transmitter Section: On the transmitter section, voice commands are given to the EasyVR module. The EasyVR module will then take the voice commands convert it into digital values by using inbuilt analog to digital converter (ADC) and compare it with the predefined voice commands (for eg: 11 – forward, 12 – backward) and transmits those values according to the voice commands in the form of binary. This binary information is then received by the Microcontroller (ATmega 2560) and enters into the switch case. It will compare the value with the cases and according to it the string with the command is transmitted via ZIGBEE module.

Receiver Section: On the receiver section, the digital signals are received by the ZIGBEE receiver module, and it sends the binary values to the microcontroller (ATmega 2560). The micro controller enters into the switch case and compares those string values with the values in switch case. Then according to the string value it will drive the servo motors in a continuous loop.

The Task:

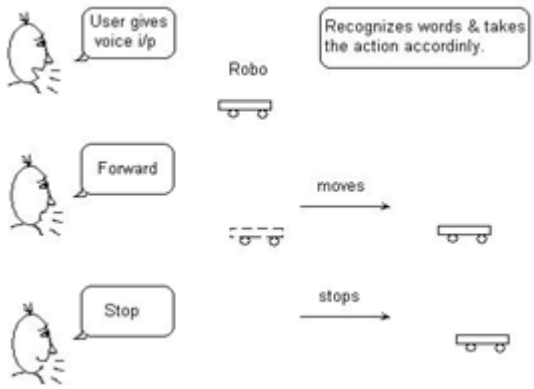

Fig4: Basic Tasks of Robot

The robot can do these basic tasks as shown in table 1.

Algorithm of Articulate Steer Robot:

1. The voice commands should be trained to the EasyVR module.
2. Then the stored voice commands are represented in the form of binary numbers such as move forward – 001, move backward – 010 etc.
3. These binary values are transmitted via zigbee module which is a transceiver.
4. The transmitted binary values are then received by another zigbee module which is present on the receiver side.
5. Microcontroller will take those binary values and performs action(servo motors) according to the binary values.

Table 1 Performances done based on the instructions given by the user:

INPUT(Speaker speaks)	OUTPUT(Robot does)
Forward	moves forward
Back	moves back
Right	turns right
Left	turns left
Load	Lifts the load
Release	Releases the load
Stop	Stops doing current tasks

IV. Results

Training of Voice Module:

For the first time use we need to do some configuration:

1.Select the serial baud rate(default 9600)

2. Select the communication mode:common mode or compact mode

3.Recording five instruction of the first group or second or third as required

4.Import the group you need to use

After all setting above, you can speak or send voice instruction to it. Ifidentified, successfully, result will be returned via serial port in the format.

If voice instruction is recorded, each time after you power it on, you need to import the group before letting it identify voice instructions.

Recording stage:

1.Record indication: D1(RED) flashes 3 times within 600ms,then off or 400ms, and the flashes quickly for 4 times within 600ms. Now the recording indication is over.

2. Begin to speak: D1(RED) is off for 400ms, and then is on. Voice during the time while D1(RED) is on will be recorded by this module.

3. Recording is a voice instruction successfully for the first time:D1(RED) off, D2(ORANGE) on for 300ms

4. Recording failure: D2(ORANGE) flashes 4 times within the 600ms. In case that voice instructions detected twice don't match, or the sound is too large, or there is no sound, recording will fail. You need to start over the recording process for that instruction.

Waiting mode: In waiting mode, D2(ORANGE) is off, and D1(RED)is on for 80ms every other 200ms,fast flashing. In this mode, it doesn't recognize voice command, only waiting for serial commands.

Recognition stage: In identification stage,D2(ORANGE) is off, and D1(RED) is on for 100ms every other 1500ms, slow flashing. In this stage, this module is processing received voice signal, and if matching, it will send the result immediately via serial port.

V. Conclusion

The "ARTICULATE STEER ROBOT" makes the work easy and accurate when compared to the human being. Human beings may able to skip the work due to any problems but a machine cannot. It can be used as Help Desks in many places such as giving Examination details, College details and Transportation details. It converts the text given by human into speech.

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