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HuBot – Voice Controlled Human Assistant

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ABSTRACT: With the need to assist the humans at places where their capabilities fail, the technology can be of great support. The inability of the humans due to age or any medical incapability stops them from performing their daily simple tasks. This presents a robot assistant that will help the needful in hospitals, care facilities and homes. The main objective is to develop a voice controlled machine to overcome the disability or immobility. HuBot is a wireless robot that helps a patient by performing the tasks by taking user's voice as input. HuBot is designed as a wireless voice controlled robot using, RF module. HuBot can be used effectively with voice commands and is designed and developed with a vision to help and support the people and is developed with low cost so that it can be accessible to the people very easily.

KEYWORDS: HuBot

I. INTRODUCTION

Medical disabilities have been affecting humans since the very existence of living beings on the planet. As the technology to cure these disabilities has evolved, so have the criticalities of the medical issues increased. The increasing and critical disabilities require some special care and assistance for the patients. As time has passed by, the humans have become busier and caught up in work and so the assistance required for these patients gets a bit neglected. Keeping the importance of time and the need to assist the physically challenged patients in mind this project aims at providing a prototype model of a human assistant robot which is referred to as the HuBot to assist the physically challenged patient in the absence of any human to perform the basic tasks. As the most natural and expressive means of communication, speech is a suitable choice for the human robot interaction. Applying speech in robot control would be very convenient as the patient only needs to speak the command to the robot to make it achieve the task.

II. LITERATURE REVIEW

The study of literature for Voice Controlled Assistant – HuBot revealed efforts made by the researchers/scholars in the different disciplines.

1. Anup Kumar, Ranjeeta Chauhan, "Voice Controlled Robot", 2014 IJIRT Volume 1 Issue 11 ISSN: 2349-6002

Abstract: This paper includes that how a robot works with the input given in voice. This paper explains that how a robot interface with user with voice command given by the user and the processing being done with the help if Arduino UNO and microcontroller.

2. AkifNaeem, Abdul Qadar, WaqasSafdar, "Voice Controlled Intelligent Wheelchair using Raspberry Pi", International Journal of Technology and Research

Abstract: An intelligent wheelchair is designed to help physically disabled patients by using speech recognition system to control the movement of wheelchair in different directions.

3. Jonathan Gatti, Carlo Fonda, LivioTenze, Enrique Canessa, "Voice-Controlled Artificial Handspeak System"

Abstract: A man-machine interaction project is described which aims to establish an automated voice to sign Language translator for communication with the deaf using integrated open technologies. The core automation comprises an Arduino UNO controller used to activate a set of servo motors that follow instructions from a Raspberry Pi mini-computer having installed the open source speech recognition engine.

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THE BUILD UP

The proposed idea is to make a prototype model which would help the needful as and when required. To implement the model which provides proper functionality, the components which have been used are-:δt it calls the optimization function to select the path and send RREP. Optimization function uses the individual node's battery energy; if node is having low energy level then optimization function will not use that node.

A. *Raspberry Pi*

Developed in the United Kingdom and launched by 2012, by the Raspberry Pi foundation to promote and enhance the teaching of basic computer science and programming skills, Raspberry Pi is a computer which is of the size of a credit – card. Providing less speed of computing and processing, Raspberry Pi often referred to as RPi is a complete Linux based computer which can provide and fulfil all the expected abilities that imply at a low power consumption level.

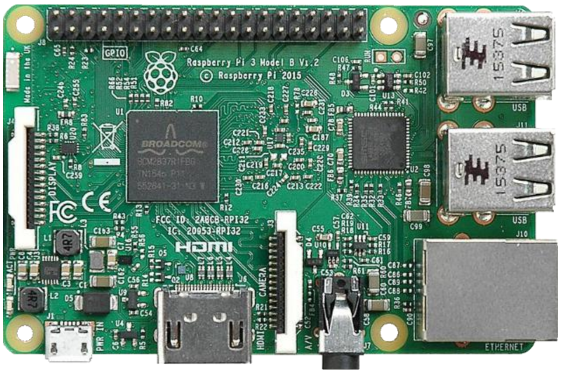

Figure 1: Raspberry Pi 3 Model B
courtesy:https://www.raspberrypi.org/products/raspberry-pi-3-model-b/

The model used in this project is the Raspberry Pi 3, Model B which was launched in February 2016. Few salient features of the Raspberry Pi 3 are –

- A 1.2GHz 64-bit quad-core ARMv8 CPU
- 802.11n Wireless LAN
- Bluetooth 4.1
- Bluetooth Low Energy (BLE)
- 1GB RAM
- 4 USB ports

Along with these, the Raspberry Pi 3 also includes 40 GPIO pins which are programmable by the user with full support of HDMI display and a 3.5mm jack for audio output. For internet connection it provides an Ethernet port to plug in the Ethernet cable and a micro SD card slot to load in the OS.

B. *RF Communication Module*

Clearly indicating through its name, the RF communication module operates at the RF (Radio Frequency) range which varies from 30KHz to 300GHz. To communicate at such high frequencies the module chooses the Amplitude Shift Keying(ASK) modulation technique.

The module consists of a transmitter and a receiver which function at a frequency of 434 MHz which lies within the RF range. The RF communication occurs with a data rate varying from 1Kbps to 10Kbps.

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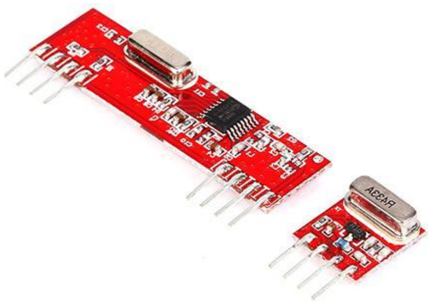

Figure 2: RF Module

C. *Encoder & Decoder*

Along with the RF communication module, often a pair of Encoder and Decoder IC is required to perform the Parallel to Serial conversion (Encoder) and the Serial to Parallel conversion (Decoder) as the RF communication takes place serially and the data present is in parallel form. HT12E and HT12D, manufactured by HOLTEK are the respective encoder and decoder IC's used in this project to support RF communication.

Figure 3 Encoder & Decoder IC

D. *Microcontroller*

An Integrated Circuit or chip with a processor fit in for a particular application with memory, I/O ports and serial communication interface already built in a microcontroller is active device which functions on TTL. The provided I/O ports are user programmable through assembly language or embedded C language according to the convenience and application of the user. The microcontroller used in this project is the 89S51, which is the member of the Intel 8051 microcontroller family, which is the most popular microcontroller ever produced in the market.

Figure 4: Microcontroller

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E. *Motor Driver IC*

To drive the robot, motors are required and to drive the motors, motor driver IC's are required. As the current delivered by the microcontroller is too low and the motors require high current, motor driver IC's are used as they act as current amplifiers which take in low current input and provide high current output which is sufficient enough to drive the motors. The motor driver IC used in this project is the L293D which is a dual H-bridge motor driver IC.

Figure 5: Motor driver IC

III. IDEOLOGY

The basic and the most important need of the project is voice of a user, the essential and mandatory requirement becomes recognition of the speech which would be spoken.

The growth of technological advancements has amazed and benefited the society over the years, and with that has introduced many new techniques for the process of speech recognition which is required in this project. In this project, the voice recognition module developed by Steven Hickson for Linux Based systems is used, which is configured and set according to the need of the user.

For the speech recognition software to work ahead, few keywords need to be provided, that when detected by the speech recogniser would make a specific task happen. The keywords used in this project are –

- front – moves the robot front
- back – moves the robot back
- left – moves the robot left
- right – moves the robot right
- grab – grabs the object
- leave – leaves the object
- pick – picks the object
- keep – keeps the object
- stop – stops doing any work

These keywords when recognized by the speech recogniser change the state of the GPIO pins through a python script written.

The state of the GPIO pins is given to the microcontroller through the RF communication module. This received data at the microcontroller drives the motor through the motor driver IC which are connected to the programmed ports of the microcontroller.

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IV. WORKING

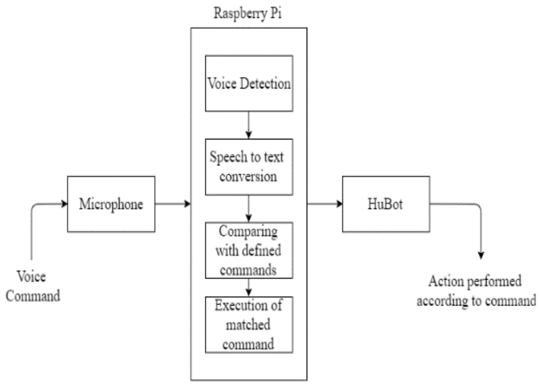

Figure 6: Block Diagram

Figure 6 above, describes the functionality of the project through a basic block diagram. To make the robot understand the speech commands, the Steven Hickson voice recognition software has to be configured.

i. First a python script is created in which the GPIO pins of the Raspberry Pi are programmed to function according to the keywords.
ii. This python script is saved in the Raspberry Pi.
iii. Using the command chmod +x the python script is then converted to an executable file.
iv. In the Steven Hickson configuration file a master keyword is assigned which when spoken would execute the python script and the keyword spoken after the master keyword would execute the command.

Figure 7 shows the layout of the GPIO pins of the Raspberry Pi 3. 4 GPIO pins have been used to perform 9 tasks. The GPIO pins used are – 23,22,17,10.

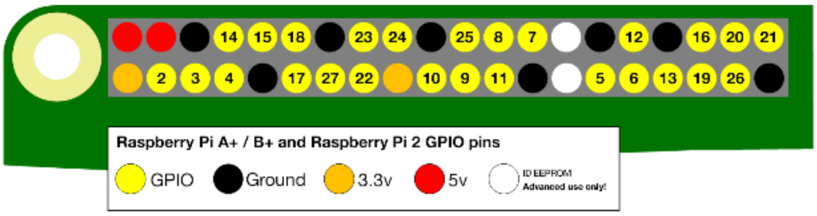

Figure 7: Raspberry Pi GPIO pins layout
https://www.raspberrypi.org/documentation/usage/gpio-plus-and-raspi2/

Table 1: State of GPIO pins according to voice command

Command	23	22	17	10
Front	**1**	0	0	
Back	0	**1**	0	0
Left	0	0	**1**	0
Right	0	0	0	**1**
Grab	**0**	1	1	1
Leave	1	**0**	1	1
Keep	1	1	**0**	1
Pick	1	1	1	**0**
Stop	0	0	0	0

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Table 1 describes the state of the GPIO pin when a particular keyword is spoken. When the state of the GPIO pin is 1, the voltage received is 3.3V and state 0 provides 0V output.

This state of the GPIO pins is forwarded to the data pins of encoder IC (HT12E), which converts the parallel data of the GPIO pins into serial data for RF communication through the RF module. The data received at the data pins of the encoder is replicated at the receiver end (i.e. the robot) decoder IC (HT12D) through the RF module. The decoder converts the serial data into parallel data.

The data from the decoder IC is provided to the microcontroller 89C51. The 89C51 has 4 I/O ports out of which 3 ports have been used – Port 0, Port 1, Port 2. The port 2 is programmed as the input port, which will receive the data from the decoder IC. Port0 and Port 1 are programmed as output ports. Port 1 as output runs the motors which drive the robot and Port 1 drives the motors which handle the hand movements. The decoder gives the input to the 4 pins of port 2 and the rest 4 pins are grounded of the input port. According to the code received at the input port the output ports generate a particular code according to the program burnt in the microcontroller.

The table 2 below shows the data transmitted to the microcontroller input port 2. The microcontroller processes the input data received at the port 2 and gives the respective output. The front, back, left and right movements would be controlled by the output of Port 1 and the movement of the hands of the hands would be controlled by Port 0.

Table 2: Microcontroller data

Command	**Raspberry Pi GPIO**				**Data to μc**
	23	**22**	**17**	**10**	
front	**1**	0	0	0	01H
back	0	**1**	0	0	02H
left	0	0	**1**	0	04H
right	0	0	0	**1**	08H
grab	**0**	1	1	1	0EH
leave	1	**0**	1	1	0DH
pick	1	1	**0**	1	0BH
keep	1	1	1	**0**	07H
stop	0	0	0	0	00H

V. SIMULATION AND RESULTS

The Raspberry Pi, being a mini computer in itself could be setup with the help of a separate display and a set of hardware mouse and keyboard or could be connected to a working machine and can be run as a remote desktop connection/virtual connection on an existing machine without the need of any hardware.

The Raspberry Pi is viewed on an existing system with the help of VNC viewer. VNC viewer displays the Raspberry Pi as a virtual machine and gives full control to access the Raspberry Pi from the existing machine.

Figure 8: Raspberry Pi virtual connection on a windows 10 machine

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Figure 8 displays the connection of the Raspberry Pi on a windows 10 active machine. After the connection, the configuration of the GPIO pins and the Steven Hickson voice recognition software is carried out. As the setup is done the execution of the whole setup is carried out. The command voicecommand is entered in the Raspberry Pi terminal to activate voice recognition.

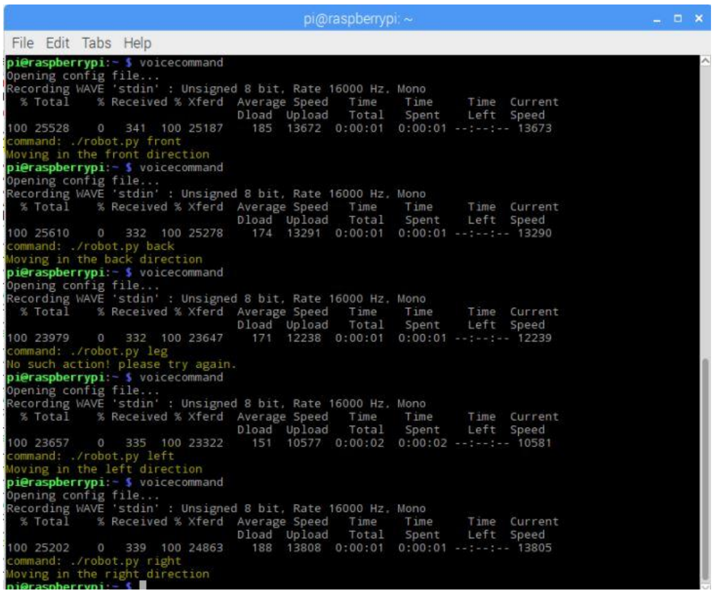

Figure 9: Command execution according to keyword

Figure 9 illustrates the working of the voice recognition software and the python script, and how its software interfacing results in the required action as specified through the spoken keyword. Keywords such as “front”, “back”, “left” and “right” are appropriate commands which are given by the user (through speech) and hence effect the state of the Raspberry Pi GPIO pins and carry out the action. If the keyword specified is an inappropriate command (command “leg” in figure 9), the user is immediately prompted to specify an appropriate command.

VI. LIMITATIONS

The project is an aid to the medical patients and will support them without the need of human assistance, still it has few constraints which need to be considered during the use –

i. The Steven Hickson voice recognition software works on Google API of Speech to Text conversion and hence is highly dependent on internet connectivity.
ii. The RF Communication module limits the range of operation of the system
iii. Line of sight between the patient and the robot is needed so as the patient knows about the surroundings and position of the robot.

VII. FUTURE SCOPE

Keeping in mind the need of the patients with the growing ailments the can be further enhanced and modified based on the following factors –

i. Implementation of a wireless camera which would let the patient view the surroundings of the robot and eliminate the need of line of sight.
ii. Improve the versatility of the project by increasing the degree of freedom.
iii. Enhance the range operation of the system by replacing the RF communication module by a higher range operability module.

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iv. Implementation of the system through IOT at a distant location for Industrial applications.

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