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Multimodal Human-robot interaction

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ABSTRACT : This paper presents a multimodal Human-Robot interaction based on fusion of speech and gesture. Interface, a robot control command is designed ,which can transform the specch and gesture of users into commands that robot can execute.The advantage of the proposed method is that the combination of speech and gesture makes the human-robot interaction more convenient and direct. Finally, a series of experiments were carried out to validate our method and prove that it performed better than other proposed methods

IndexTerms - Automation, Machine Learning, Color Rendering, Indoor Farming.

1 .INTRODUCTION :

In the future of the word ,th robot will become a good helper of the mankind. Therefore the communication between human being and robot is inevitable. Human beings are comfortable using gesture and speech and speech to communicate with each other in daily life. So people can easily interact if robots are programmed to identify gesture and speech.

Using gestures for human-robot interaction is an ideal way.Gestures generated from a persons hand can be used as the basic commands for the movement of an robot.As

humans are adapt to use normal bodily gestures and speech for communication, few people may find it difficult to interact with a robot using normal methods i.e. joystick and computer generated commands.So we came up with this method of interaction where a person can use hand gesture or other gestures for communication and command a robot.

Alternatively, if it is not possible to interact using gesture ,we have implemented the use of audio as the alternative mode as in some instances we may not be able to use gestures to communicate, during this time we can use audio as alternate source of interaction with the robot.

We have used multiple methods to interact as many environmental and human tendancies may not be favorable or accurate, so it may be difficult to accurately verify and execute a command, to avoid difficulties we have to use different modes of communication so if it is not possible with one method other alternate method can be used for communication.

There are many models which focus on gesture and audio but in our model we try to make the model more cost efficient, we try to intigrate both modes of interaction by using android devices. For user convenience we try to make the use of software as minimal as possible,so the method of interaction can be used by any age group without much difficulty.

The main objective of our project is to implement user friendly human robot interaction. though technology has gone through many improvements in the last two decade many people still find it difficult to cope with the present technological progress, so to make it easy and appropriate for them to use we try to minimize the use of technology as much as possible for user interface.

This project is designed and implement by the use of raspberry pi.in this project when an user shows gestures to the installed webcam, the data is received and processed by the raspberry pie , then the movement of the robot takes place.

Use of android phone is common these days so we have made use of an android application for giving command through audio using Bluetooth.the raspberry pi supports both Bluetooth and wifi so we can multiple modes of interaction by using different hardware sources for sending the data

2. METHODOLOGY

2.1 Platform setup

This paper is about the develop a multimodal interaction robot. Robot can gathered audio and video detection information by humans.

We used open cv for computer vision application, that is identification of gestures. We have implimented this by writting the code using python programming.For hand gesture input we used the zigbee for wireless interfacing communication. For voice input we used wifi by communicating andriod phone interfacing by raspberry model.

The hardware mainly depends upon raspberry pi module. Raspberry pi model works as the cpu in this model proposed ,in this model we use zigbee and Bluetooth module to connect the model with computer and android.

Raspberry pie module is the central working system of the model. It acts as a bridge for communication between the user and the model,it process the command given by the user and it further commands or gives signal for operation of the other mechanical parts of the model

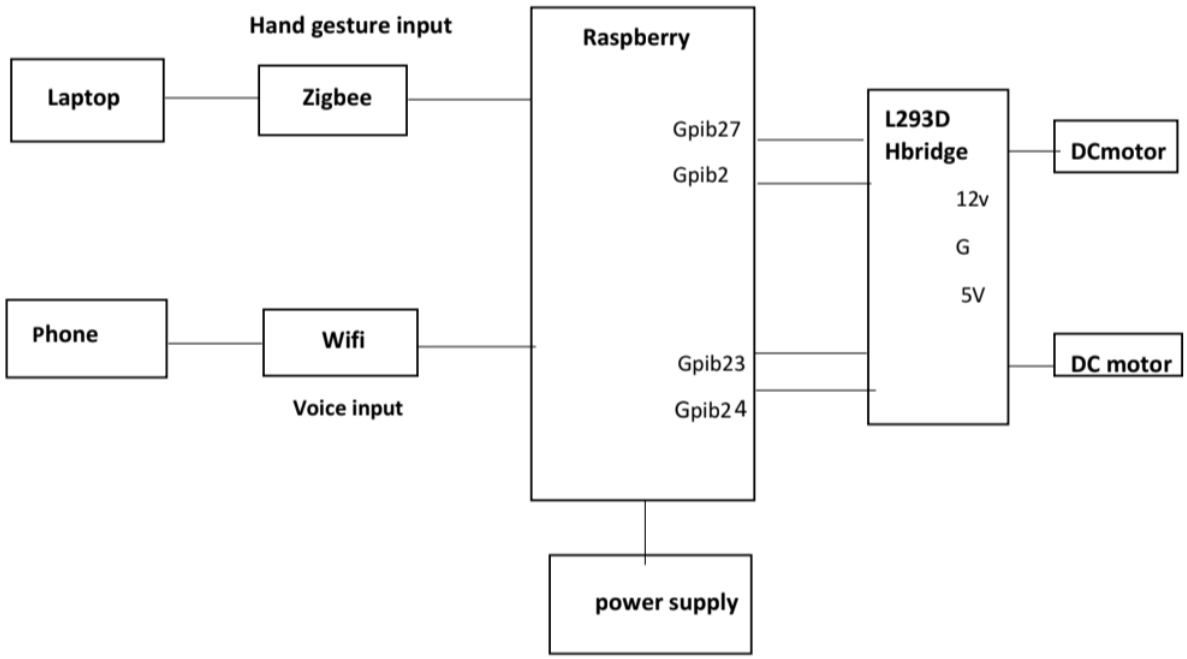
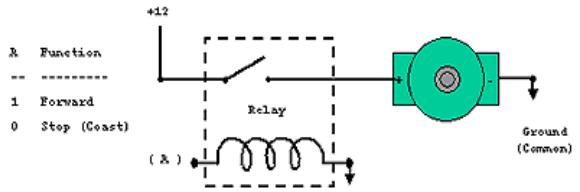


Fig 1: Hardware and software setup

Zigbee is used for wireless connection from computer to the raspberry pie module, it acts as the connecting bridge to the model. Bluetooth model is used for connecting android device with the raspberry pie model, android device is used for audio interaction with the robot.

Two DC motors are used to move the robot from one location to another, dc motor are connected to the raspberry pie module through L293D Hbridge .



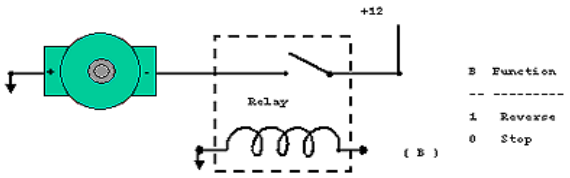


Fig 2 : connection for clockwise rotation of motor **Fig 3 : connection for anticlock wise rotation of motor**

L292D hbridge acts as bridge between DCmotor and IC. The above representation shows the connection with the bridge and motor for clockwise and anticlkwise movement for motors.

For the construction of the model we have used multiple sensors which facilitates the robot movements.ultasonic sensor and light sensors are used, ultrasonic for obstacle detection and prevention of collision, ligtht sensors for automatic lightning when dark.

2.2 Hardware and software requirement

Zigbee :

Zigbee is a wireless technology used to empower machine to machine connectivity. Zigbee uses low power and is cost efficient.the advantage of zigbee is that it can wirelessly connect any machine device which has been equipped by zigbee receiver, zigbee connectivity has an rane of upto 100meters.

Raspberry pi :

it is an low cost small sized computer which can used to run small machine funchions ,it has high data processing speed which helps to get the desired result smoothly. Raspberry pi module ius equipped with inbuit wifi and Bluetooth module which can be use for connecting other hardware component or an computer. in this project raspberry is the main processing unit.

L293D H-bridge :

L293D is an electric circuit ,through which we can get two outputs, i.e two different circuits can be connected to it and we can control the direction of the current flow for both the circuits.

DC motor :

dc motor is for the movement of the robot,wheels are connected to the motor.

Ultrasonic sensor :

It is used for obstacle detection, ultrasonic sensors are devices which sense ultrasound energy. Here it is used for collison prevention.

OpenCV :

It is a computer vision library which is used for image analysis,detection and recognition.

Mediapipe

:Is the framework which associated with google, which is used for media processing. It depends upon opencv for image and audio handling

3. WORKING

the overall working of the system is shown in the below fig.4, shows the process of interaction with the robot.

For image processing, it involves multiple steps, i.e prepairing and labelling data sets, then training and finally recognition.

Preparing and labeling data sets involves taking the images which we use for gesture and we give unique names for each image so it gets an different identification, each image has to have its own unique name for identification , so it can be idintified when called.

After labelling the data the images are trained to the model ,which is stored in the model for further use. Which is then used for comparison of the command given by the user this process, where image is recognised and the labelled action is performed.

After initializing the connections, we first send a command to the system through a computer ,the command from the computer is sent in the form of gestures ,the gesture is taken from the computer webcam or an external camera connected to thecomputer.

The raspberry pie module receives the command sent from the system through the zigbee connecter which is connected to the raspberry pie module. The raspberry pie then process the command sent to it and then the command is executed. For instance if we have set one fingure image as forward in the code, the rasberry pie model recevies the image and then the image is decoded and the command is executed.

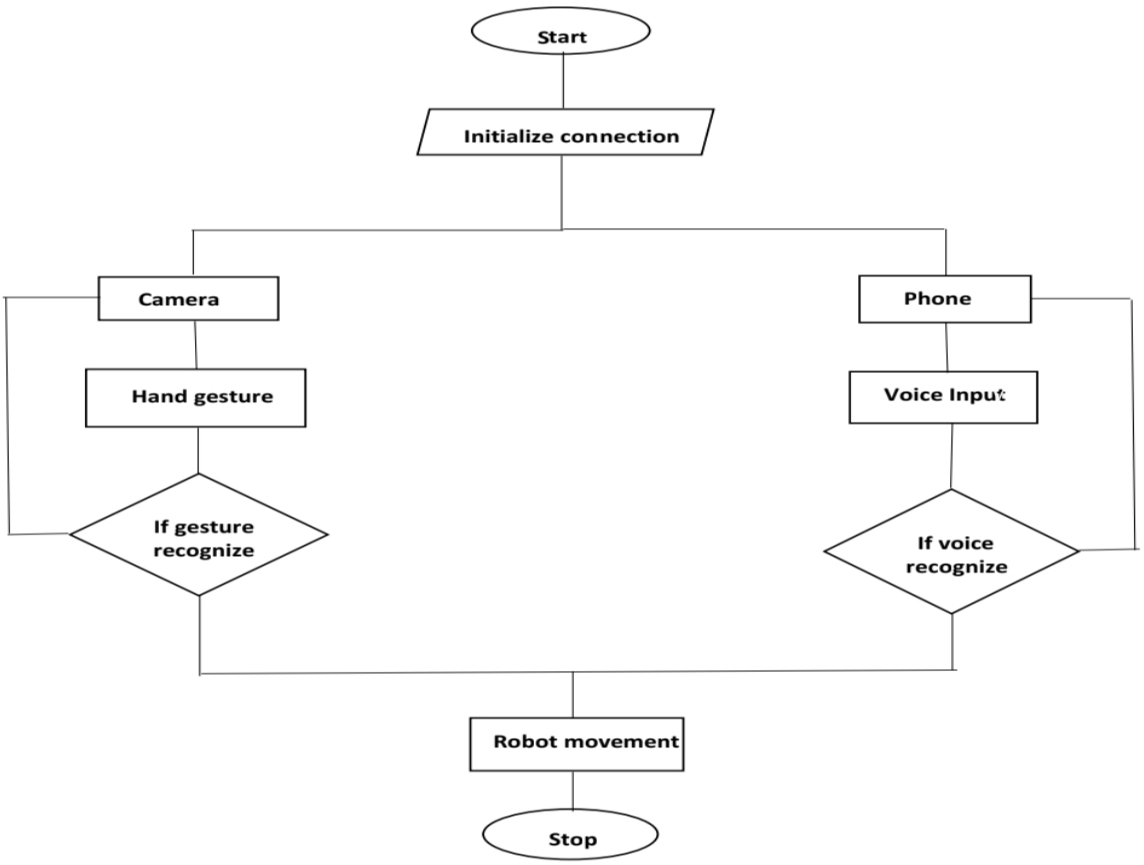


Fig 4 : working methodology

For the audio mode of interaction with the robot ,we first have to remove zigbee connector and add bluetooth module to the raspberry pie. We can connect both of the modules simuntanioously by connecting an additional multiplexer so both zigbee and bluetooth module may be used at the same time or simuntaniously.

First after connecting the bluetooth module, we connect our android phone to the raspberry pie moduele through bluetooth ,then by using android tool TCP/UDP tool we can give different types of commad through the android phone , first we can add buttons for movement of the robot,and we use audio for the movemnt wgich is the main objective.

Similar to the process of the gesture movement, when we Use audio ,the audio file is received by the rapberry pie model , the module decodes and compares it to the code we had uploaded earlier and the commad is executed after the it is decoded and analyzed.

For example when we use call ‘backward’ in audio, the data is processed and the command is passed. The data is received by the hbridge which activates the anticlockwise movement of the motor. As we have added ultrasonic sensors , the robot stops if it encounters an obstacle and it changes direction which helps in giving other commands without much obstruction, if we give multiple commands at a time the raspberry pie module process all the data and executes the commands in the given desired order.

4. RESULTS AND DICUSSION :

gesture shown to the camera in real time is detected and identifies by the mediapipe framework, the specified live image is compared to the images trained in the module. Then the specified operation takes place.

In this project we have specified gestures of up,down,one and two fingures for forwaerd,backward,left and right respectively.

The data is stored in mediapipe , OpenCV will analyze the image, and the process of processing detection and recognition is done through OpenCV.

The fig.5 shows the forward movement signal and fig.7 show the operation of the given command displayed in the LCD screen

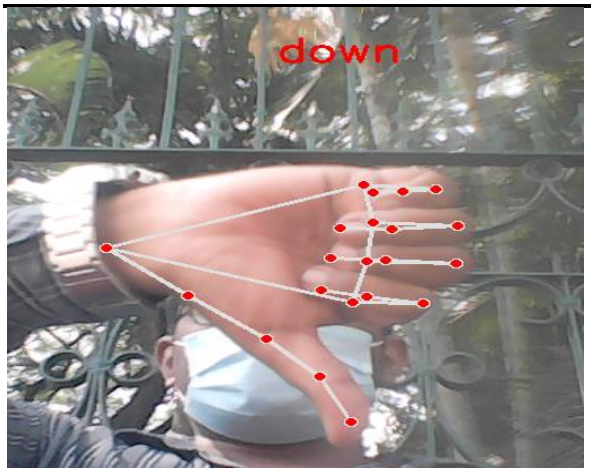


Fig 5 : forward movement signal

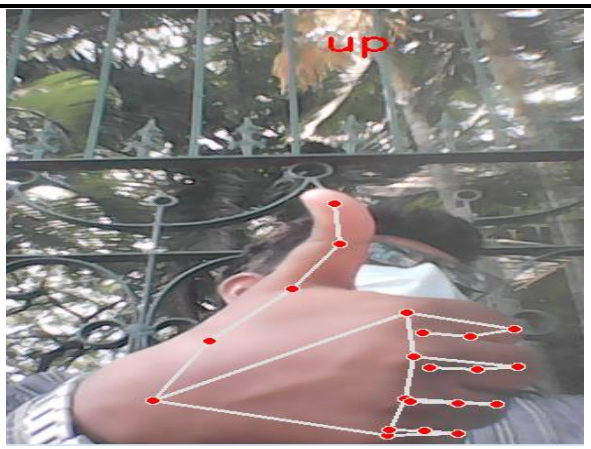


Fig 6 :backward movement signal

Fig 7 : forward movement display

Fig 8 : backward movement display

Fig.6 shows the down signal which indicates backward movement , the fig.8 shows the display of the backward movement which is executed by the robot is displayed in the LED.

5. CONCLUSION :

The goal of our project is using gesture and audio for the mivement and interaction between human and robot. Though many similar system exists which use gesture ast the interaction mode, we have tried to integrate both audio and gesture communication methods and use them together.the present existing systems are not cost efficient and require difficult algorithms for designing the system.We used raspberry pi as the processing system and made the working more simpler,through this all people of any age group can get to know the technique to use gesture and audio for commmunication and interaction with the robot.

6. FUTURE SCOPE :

In this project we have used gesture and audio for the interaction, i.e we have only implemented the movement of the robot. Further addition can be done for the project and can modified be modified so that it can used as service robots or working robots in manufacture units. We can add further sensors and otner motor applications and control the working of the robot through audio or gesture.

7. ACKNOWLEDGEMENT :

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