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Human Interaction Robot and Voice Assistant (Piikachu)

[1] Paritosh Choudhary, [2] Prachi Singh, [3] Muskan, [4] Dr. Gopal Krishan

[1][2][3] Student: Department of ECE, IIMT College of Engineering, India

[4] Associate Professor, Department of ECE, IIMT College of Engineering, India

***Abstract*--- Artificial Intelligence and machine learning has seen tremendous growth in both terms of advancement and new innovations. Every year we see a lot of new Technologies, algorithms, and new specifications in this domain. Each better in terms of performance and computation power compared to its predecessors. Similarly we have tried to mimic autonomous robot that is capable of human interaction, following orders, recognising the person in front, having a better understanding of its environment. We have implemented the machine learning approach in order to make the robot a step smarter than the previous day. It achieves this task by collecting the user data with respect to each user that it entertains and make a profile for each one of them separately.It uses libraries like OpenCV, Speech Recognition, Rpi-GPIO, OS, etc. to accomplish its task.**

Keywords--- OpenCV, Face Recognition, Speech Recognition, Raspberrypi, Python, Ultrasonic Sensor, L298N

I. INTRODUCTION

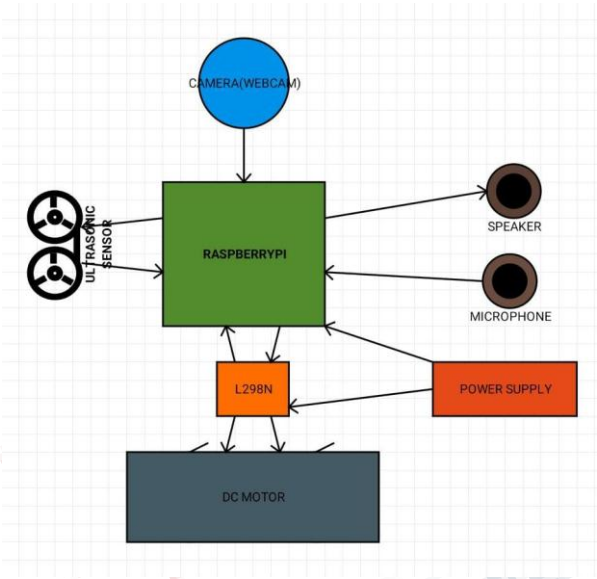

Fig 1. Block Diagram

Fig 1, shows the basic working of our project. It is our take on the autonomous human interaction robot, powered by "Raspberrypi". Raspberry Pi is paired with a set of peripherals and sensors in a specific manner that allows it to understand its surroundings and take actions accordingly. As we have previously mentioned in the name it is a human interaction robot. It is loaded with capabilities of conversation, following, recognising, and replying back with relevant (Accuracy 60-80%) answer to the user query.

From the beginning we wanted to create a personal assistant that is more a friend rather than a piece of machinery. On the path of achieving our goals, we discovered many new dimensions within the fields of AI and machine learning, autonomous robots, robots used for specific task and many more. We tried to make it as autonomous as possible and make sure that only a minute human interference is required in order for the robot to work properly. The robot is capable of recognising the person standing in front of him and marking him as a known or an unknown entity.It can control home appliances that are connected to the same network. [1] It can carry out conversations with its user relevant to the specific user this point will be later explained.

It can also follow the user around while maintaining a safe distance to avoid any crashes. Not a machine, it's more like a friend. Name is Piikachu.[1]

a. Raspberry Pi

Raspberry Pi was our go to choice while making this project due to its multitasking capability and low power consumption.It is a kind of small - board computers. It is used widely in many fields like weather monitoring, robotics etc. Raspberry pi is developed by UK based Raspberry pi foundation. It is also known as Rpi and Raspi. There are many kinds of operating system used in Rpi like Raspberry Pi OS, Linux, Open BSD, Window 10 IoT core, Net BSD etc. One of the most powerful feature of Rpi is the row of GPIO (General Purpose Input/output pins). It is a 40 pin GPIO header & found on all current Rpi boards. These pins work as an interface between Rpi& the peripherals to help establishing connection between the device and outside world. [2]

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b. L298N-Motor-Driver

L298N module or L298N motor driver module is a dual H-bridge or high power motor driver module. It is used to control the speed and direction of two or four DC & stepper motors at the same time. It consists of an L298 motor driver IC and a 78M05 5V regulator. Driver voltage of this module is 5-35V with a peak current of up to 2A.
It is a low power high efficiency device and is suitable for small projects with low power input.It is controlled by the input/output of GPIO pins. Hence making it the ideal choice for the build.[3]

c. Ultrasonic Sensor

Ultrasonic distance sensor HC-SR04.It is a device that is used to measure the distance between the ultrasonic sensors to the target object by emitting ultrasonic sound waves. It uses sound waves above 20 KHz which is beyond human hearing. Ultrasound is reliable in any kind of environment.
The idea of using an ultrasonic sensor in this project is to avoid collision between a bot and other objects. It is best in the non-contact detection of Presence, Level, Distance and Position.It is controlled by the input/output of GPIO pins. Hence making it the ideal choice for the build.[4]

d. Python

Python is an object-oriented programming language, general purpose interpreted language.
Created by: Guido Von Rossumfeatures of Python
*Easy-to-learn
* Easy-to-read
* Easy-to-maintain
* A broad standard library
* Interactive mode
*It supports Junction & structured programming methods as well as OOPS.
* It can be used as a scripting language can be compiled to byte-code forbuilding large applications.
* It can be easily integrated with C_1 C++, COM, and Python 3:0 (also known as "Python 3000" and"py3k").

e. Libraries

i. *OpenCV:* OpenCV is an open source computer vision library. OpenCV project was initially an "Intel-Research" initiative to advance CPU-intensive applications, officially launched in 1990. It helps to make real time calculations based upon visual feeds (photos, videos).

ii. *Speech-Recognition:* Speech Recognition is an essay to use speech to text library used to convert the audio input into text format so, that it can be used in the program as a command input.

iii. *OS:* This library helps the program to access the os and work according to the command input without any restrictions.

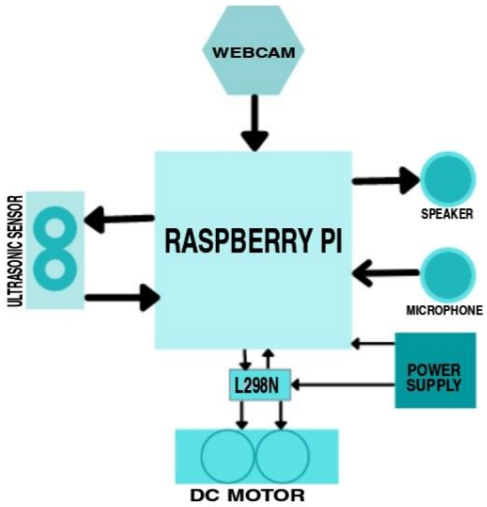
iv. *Pyttsx3:* This library is used to convert the output from the program from text to speech format.

v. *Pyaudio:* This library help python to take input audio to make manipulations over it.

vi. *Rpi-GPIO:* This library gives access of the on board GPIO pins of the raspberry pi and we can easily program them to use them with a peripheral or sensor of our choice.

vii. *Time:* This library helps in introducing delay, keep track of the events the program has performed with time span.

II. METHODS OF IMPLEMENTATION



All the peripherals and libraries mentioned above are synchronised in a manner that they fulfil the user query and provide us the desired output with respect to an input.This task is achieved by systematic placing and interfacing of these various peripherals with our microcontroller (Raspberry Pi). By the means of programming. The various individual blocks are explained below:

A. VISION OF THE ROBOT

This block is powered by a USB Webcam which is connected to one of the USB inputs of the Raspberry Pi and the port index is defined to the code, for it to interact with it properly. Webcam provides imagery to the robot. This imagery in the form of frame are then evaluated by the "OpenCV" module. A set of pre-trained models are

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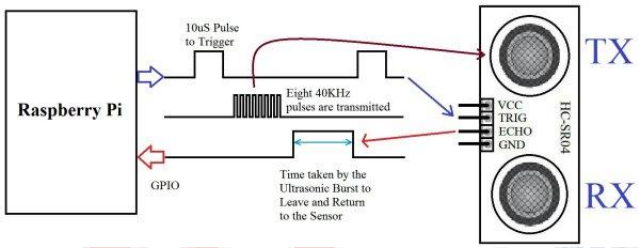
used to identify the objects and entities present in front. Facial recognition is also possible using these models.
A simple algorithm is used to mark-up the face and the body area of the person present in front of the camera, the movement of the person present in front of the camera is calculated based upon the area of the rectangle getting smaller or bigger on the screen. Threshold value for the area of the rectangle is defined to maintain safe distance from the user.[5]
It may also be used for object detection.

B. TWO WAY VOICE COMMUNICATION

This block is powered by two peripheral. One is a microphone and second is a speaker.
Microphone is used to provide voice input to the Raspberry Pi. USB microphone is used as it is the best one to interface with the Raspberry Pi.
Speaker is a simple 3.5 mm jack output audio device. It assist in providing the output from the robot in voice form.

C. FEET OF THE ROBOT

This is one of the most important block for the whole robot setup. This block is consists of three components:
i. L298N motor Driver
ii. DC motors
iii. Ultrasonic sensor



Four DC Motors are used connected with the motor driver module and the module connected to the Raspberry Pi for further communication. An ultrasonic sensor is also used and is working in pair with the movement of the robot. The ultrasonic sensor provides input such as the distance of the body from an object or an entity, a small threshold value of distance is already decided that is to be maintained from a object or an entity. The sensor and the motor driver work hand in hand to maintain a safe distance can control the movement of the Motors properly.[6]

III. RESULT

A. Recognizing the person present in front of it, and tagging him as know/unknown entity.
B. It can follow the user around while maintaining a safe distance.
C. It responds to voice commands and replies back in voice format as well.
D. It can control home appliances connected to the same network.
E. It creates individual data-set for every individual it interacts with and save it for further evaluation.

IV. FURURE SCOPE

A. Robotic arm can be implemented with this robot to make it bring objects to its master.
B. Fully autonomous ML based Chatbot capabilities.

V. CONCLUSION

This project have taught us a lot about artificial intelligence, machine learning applications using electronic devices. We learn how sensor interact via GPIO pins. How we can manipulate the inputs that we receive from the sensors. And how we can generate a desired output from the machine.
With the help of Raspberry Pi, python, peripherals, sensors and by the systematic arrangement of these peripherals. We have finally obtained an autonomous Robot that can follow the person, recognise him and interact with him via voice command. It also creates user profiles All the open source libraries used in building up this project are available to everyone.

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