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A Gesture Based Home Automation System

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***Abstract:** In recent times, the popularity of home assistance tools like Amazon's Echo or Google Home from Google Inc. has increased. Though these products provide an easy way to provide input to such tools using voice commands, these products cannot of use for people with speech defects. In such cases, the gesture would seem to be the natural way to interact with the system. Gesture recognition refers to recognizing the motion of human body parts such as hands, face. In this proposed work, a Python-based algorithm is used. Python is an open-source programming language and provides for easier and faster up-gradation of the system over time as well as the ability to run on a variety of hardware platforms. Another peculiarity of home assistance tools is their feature to provide feedback to the users in the form of automated voice. The voice feedback was produced using Espeak, a python module that converts a string into an automated voice. Raspberry Pi 3B+ was used to run the algorithm. Raspberry Pi, along with ample IO pins, also provides the ability to run Python programs and interface web cameras, and web servers can also be installed to provide remote access to the user. The proposed system also includes a directory of all acceptable gestures and the corresponding actions they perform.*

I. INTRODUCTION

With the increase in IOT applications and increase in automation of day to day tasks, there has been increase in demand for home assistance tools but these tools that are voice activated cannot be used by people that have some type of speech impairments. A possible way for them to communicate with the automation system would be through gestures. Gesturing refers to providing the commands to the system with the help of various body parts such as hands, fingers, face and several combinations of these. In the proposed model we have defined 6 gestures. These gestures are formed by different formation of the fingers. Once the gesture recognition is successfully achieved, we can program the underlying hardware device-which is Raspberry Pi 3B+ in our case-to send activate a GPIO pin. The above process can be automated by executing a Python script. The reason for opting for Python is its varied developer community that make would quicker updates possible. The TFT LCD touch display provides an interactive manner for users to access the gesture directory or settings. The image recognition used is lightweight to enable the algorithm to be used on a variety of hardware platforms. Espeak-a python-based text-to-speech module-is used provide a audio feedback to the user.
The execution of this project has following steps

1) Image capture, image pre-processing and recognition.
2) Getting the data from sensors to perform the task corresponding the gesture provided.
3) Provide the feedback to the user in the form of automated voice.

II. PROPOSED WORK

A. Formation of Database

For the system to recognize the gestures correctly, it is necessary that correct images are fed to the database of the system. In real-time recognition process, the images captured from the camera are compared with those in the database. For creating a database, then image can be provided using camera. After segmentation and preprocessing feature extraction processing can be completed. The attributes of the image is stored in the database.

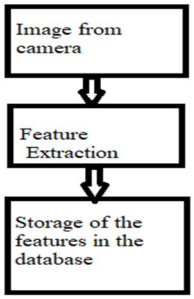


Fig. 2.1 Steps to form database.

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B. Image Processing Steps

The real-time video feed from the camera is converted into individual frames. The preprocessing of the image involves the conversion of the RGB image into HSV format. This is performed in order to eliminate additional information present in images. Further edge detection is carried out in order to determine the region of interest (ROI) in the image. Additionally, various filtering such as Gaussian or Median filtering can be used to improve the efficiency of image recognition. After the feature extraction process, the image in the form of a vector can be compared to those in the database, according to the closeness of the match, the correct gesture id determined.

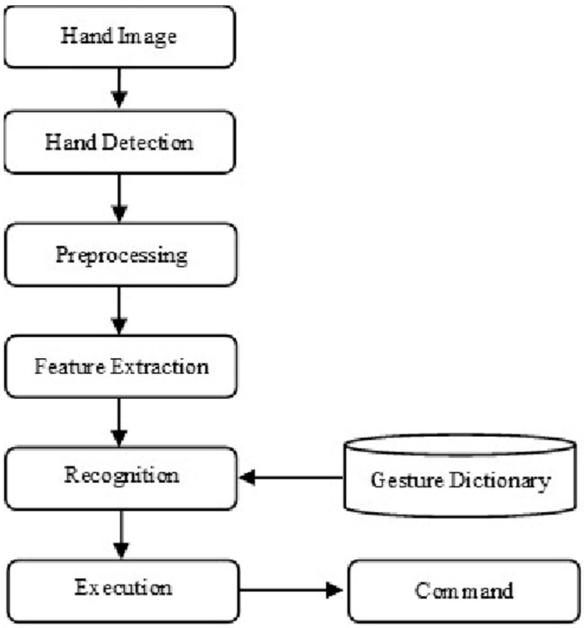


Fig 2.2 Hand gesture recognition process of the proposed model.

C. Block Diagram

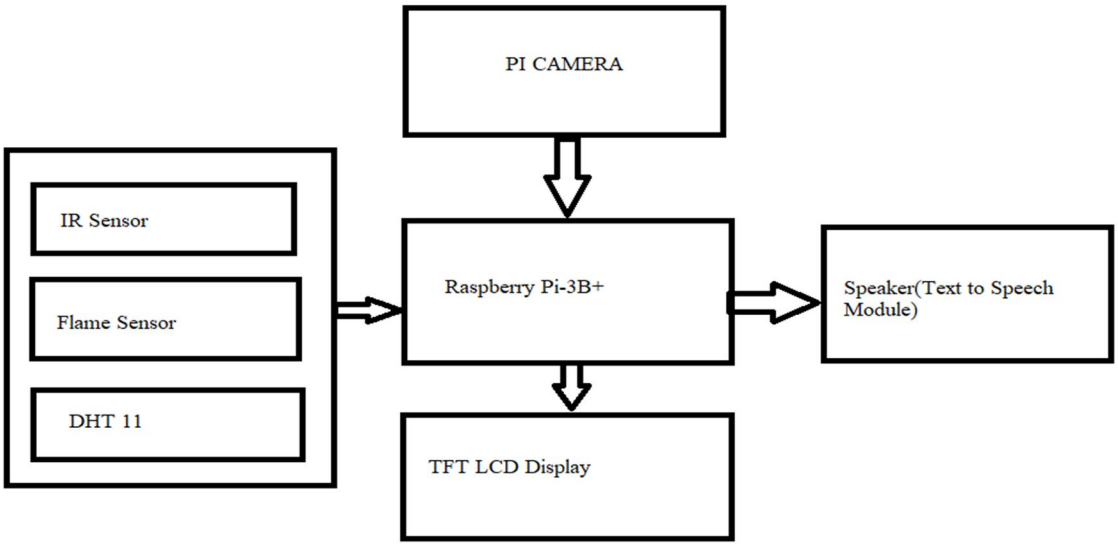


Fig 2.3 Block Diagram of Hardware.

The image is taken from the Pi camera, after the image recognition is performed on the Raspberry pi. Corresponding to the camera the data from the DHT 11 regarding the temperature or humidity is provided to the Espeak module. The voice is then given to the speaker through the aux plug on the Raspberry Pi board. The TFT LCD touchscreen display provides a user-friendly way to interact with the system.

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III. RESULTS

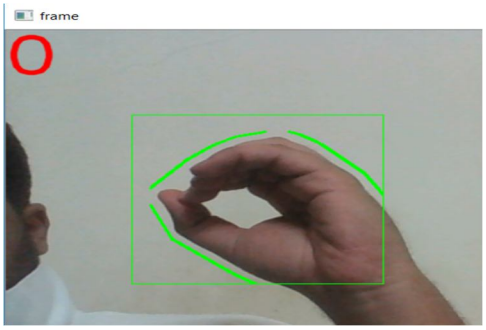


Fig 3.1 Gesture '0' recognized correctly.

A it can be observed that in case gesture 0 is given to gesture recognition module, it is correctly recognized as 0.
As OpenCV is used and the segmentation technique used is not as robust as using a deep neural network background reduction, the degree of correctness of the recognition depend upon factors such as lighting, background, objects.
For maximal efficiency, it is observed than a neutral background such as a white should be used and a light source of fluorescent light should be placed directly above.

IV. CONCLUSION AND FUTURE SCOPE

By using OpenCV for gesture recognition, correct gesture is recognized by the system. The automation module in which IR, flame and DHT 11 sensors are interfaced, is able to successfully manipulate the state of the sensors. The 'text to speech' module is able to convert the input test provided to it into the form of speech which further provides a user-friendly format of displaying the output.
The current system is capable of recognizing 5 individual gestures that are numbers from 0 to 5, for its deployment into the real world as a consumer product, it would be necessary to add a greater number of gestures which would mean a greater number of tasks would be needed for the system to perform. Additional number of components like relay and other circuitry would be required for controlling of real-world appliances such as tube light or fan.
To further improve the functionality of the project, the gestures can be taken from multiple sources like the dedicated camera or the mobile camera can be used to take the gesture input from the user.

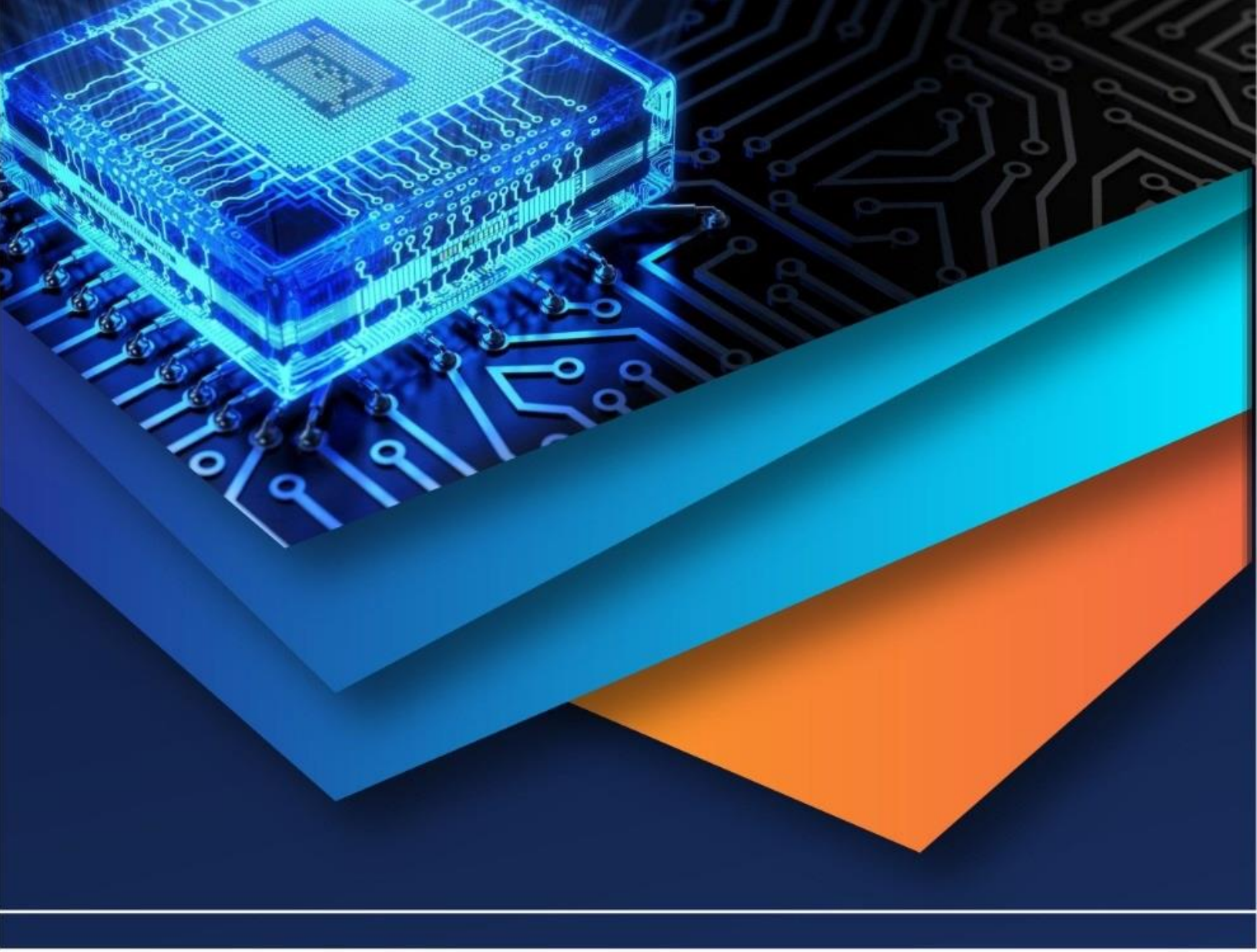
V. ACKNOWLEDGEMENT

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