iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VII **Month of publication:** July 2021

DOI: https://doi.org/10.22214/ijraset.2021.36884

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

Home Automation Using Gestures

Rajesh Gauns[1], Saurabh Naik[2], S. Joshua Richin[3], Mugdha Kamat[4], Elrich D'Souza[5], Hemlata Pednekar[6], Austyn Francis Rodrigues[7]

[1, 2]*Assistant Professor, Department Of Computer Engineering, Agnel Institute Of Technology and Design, Goa, India*

[3, 4, 5, 6, 7]*Department of Computer Engineering, Agnel Institute Of Technology and Design, Goa, India*

Abstract: The proposed system "Home Automation models using gestures" is designed for providing ease of control of home appliances to the people, especially elderly or those who are physically unable to efficiently perform day-to-day activities. Initially the images of the gestures are captured in real time using a camera placed in the room and are processed to be compared with the existing set of gestures. Based on the gesture shown, the image is then processed to attain the actual meaning of the gesture. So if the gestures match, then the particular appliance in that room is switched on or off by which it helps the user to stay at his place in the room and doesn't need to actually move to the switchboard to turn on the appliances.

Keywords: Image Processing, Raspberry Pi, Python, OpenCV, MediaPipe, Hand Landmarks

I. INTRODUCTION

Traditional home automation systems are not suitable for aging populations or disable persons. It's for those who cannot perform basic activities efficiently. Gesture-based automation provides an advantage to those people who are physically unable to efficiently perform the day-to-day activities. Many gesture tracking technologies which predominantly include attached hand gloves to sensors or special feature gloves where the user has to again and again attach the gadget to his hand which becomes inconvenient. A person always has to get up and walk to the switchboard to control which becomes tiresome after finishing the day's task. As technology is rising more advancements are made in making the life of these people easier by providing methods easy to monitor and manage. The previous methods have seen the use of gadgets which are fixed on the hand as they are considered to be the best tool for carrying out such practices. These models are accurate but not flexible and portable since the user has to hold it everytime. In order to benefit the physically disabled individuals, a room with a specific area will be equipped with the proposed system by which the user will be able to control his daily-used home appliances very comfortably. Our system is based on the gestures the user will perform. The system will contain a wall-mounted camera at a specific position in the room which captures the user's gesture and sends the image to the Raspberry Pi for further processing. The gestures captured should be from an authenticated user only. In our system, the captured image will undergo certain Image Processing techniques like Grayscale, Median Filtering, Thresholding and Hand Landmarks Detection. Image processing systems have various applications in pattern recognition. It is a processing of input images producing output that is features or parameters related to images.

It is built based on the Raspberry Pi with camera module and programmed with Python programming Language supported by Open Source Computer Vision (OpenCV) library. The Raspberry Pi is a basic embedded system and being a low cost single-board computer used to reduce the complexity of systems in real time applications. Raspberry Pi embeds with an image-processing algorithm. Using the algorithm, the processed image will be categorised according to the predefined gestures. Only a specific predefined hand gesture will be used as an indication to change the current gesture for the appliance and henceforth the newly assigned gesture will be used to control it. Once the processed image matches with the existing data, a signal will be sent from the raspberry pi to the relay to control the connected appliance.

The main purpose of the work presented in this is to make a system capable of detecting and monitoring some features for objects that are specified according to image processing algorithms using Raspberry Pi and camera module. The algorithm used, programmed with Python supported by OpenCV libraries, and executed with the Raspberry Pi attached with an external camera. Once the correct gesture gets detected, a signal will be sent from the raspberry pi to the relay to control the connected appliance. The essential aim of hand gesture recognition systems is to establish communication between human and computerized systems for the sake of control. The proposed method allows users to flexibly and portably control multiple household appliances with simple gestures.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

II. EXISTING SYSTEMS

A. Bluetooth Based home Automation System using Cell Phone

The smart home concept in the system increases the standard of living .In Bluetooth based home automation system the home appliances are connected to the Arduino BT board at input output ports using relay. The program of the Arduino BT board is based on the high level interactive C language of microcontrollers; the connection is made via Bluetooth. The password protection is provided so only authorized users are allowed to access the appliances. The Bluetooth connection is established between Arduino BT board and phone for wireless communication. The main control system uses wireless Bluetooth technology to give remote access from PC/laptop or smartphone.

This method has a limitation where the user has to keep the mobile to control the appliances which is not efficient for the blind people.[3]

B. Wi-Fi Based Home Automation System Using Cell Phones

Wi-Fi based home automation systems mainly consist of three modules, the server, the hardware interface module, and the software package. Wi-Fi technology is used by servers, and hardware Interface modules to communicate with each other. The same technology is used to login to the server web based application. The server is connected to the internet, so remote users can access server web based applications through the internet using a compatible web browser. Software of the latest home automation system is split to server application software, and Microcontroller (Arduino) firmware. The Arduino software, built using C language, using IDE comes with the microcontroller itself. Arduino software is culpable for gathering events from connected sensors, then applies action to actuators and pre-programmed in the server. Server application software is culpable of maintaining the whole home automation system, setup, and configuration. This method has a limitation where the user has to keep the mobile to control the appliances which is not efficient for the blind people.[3]

III.PROPOSED SYSTEM

An initiative to automate the basic home controls of turning on/off the appliances by using different gestures from the place where the user is seated rather than controlling using the physical switches on the switch board.

A. Architecture of the Proposed System

1) Block Diagram

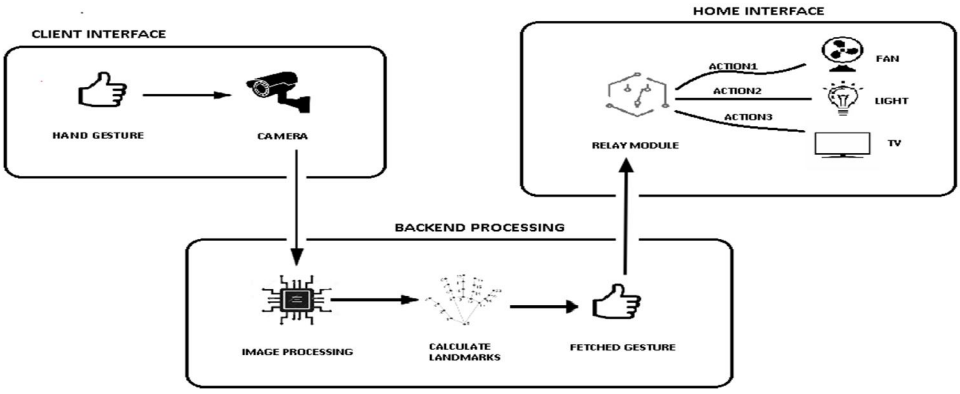


Fig. 1 Block diagram of the entire system

The block diagram of the proposed system consists of the following three main phases:

1) *Client Interface:* Capturing the input gesture using a camera mounted in the room and then sending the image to the centralized controller for further processing.
2) *Back-end Processing:* Here, the image of the hand captured by the camera is processed to estimate the input gesture shown(using hand landmarks) using some image processing techniques. If the calculated hand gesture landmark positions match the predefined conditions, it is ready for further processing at the home interface.
3) *Home Interface*: Once the processed gesture is realized by the Raspberry pi module, a signal will be sent from it to the relay to control the connected appliances. Based on the predicted class of the image , respected assigned actions will take place (turn on/off either Fan, AC, TV or Bulb).

B. Flow of Control

The flow diagram depicts how the system will function in various scenarios. It is a representation of the different conditions and possible outcomes. It highlights the major phases involved for gesture detection by showing the transition between the various phases.

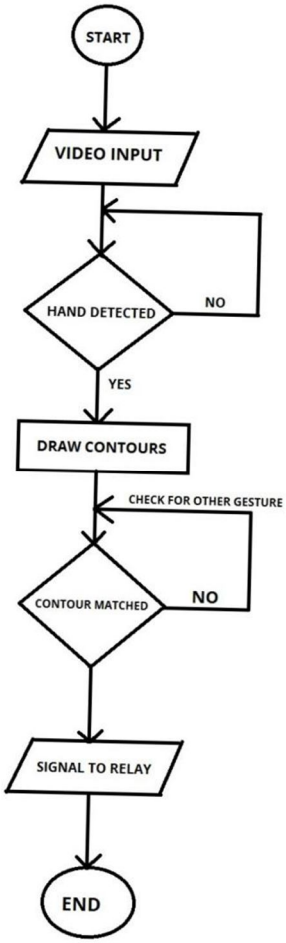
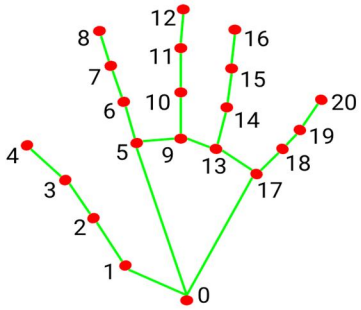


Fig. 2 General flow of Control (For single detection)

C. Algorithms

1) *Hand Landmarks Detection*: Hand Landmarks Detection is a very important step in achieving the goal of the proposed system. This step is achieved by importing a trained Machine Learning module known as MediaPipe in python. This module will expose us to the functionality we need to do the estimation of hand landmarks. After this, we will access two sub modules, namely drawing_utils, which includes some helper functions to draw detections and draw landmarks over the input image, and the hand module, which consists of Hands class that will be used to perform the detection of landmarks.



0. WRIST
1. THUMB_CMC
2. THUMB_MCP
3. THUMB_IP
4. THUMB_TIP
5. INDEX_FINGER_MCP
6. INDEX_FINGER_PIP
7. INDEX_FINGER_DIP
8. INDEX_FINGER_TIP
9. MIDDLE_FINGER_MCP
10. MIDDLE_FINGER_PIP
11. MIDDLE_FINGER_DIP
12. MIDDLE_FINGER_TIP
13. RING_FINGER_MCP
14. RING_FINGER_PIP
15. RING_FINGER_DIP
16. RING_FINGER_TIP
17. PINKY_MCP
18. PINKY_PIP
19. PINKY_DIP
20. PINKY_TIP

Fig 3 Landmarks of hand according to MediaPipe

2) *MediaPipe:* MediaPipe is an open source cross platform framework for building pipelines that process perceptual data such as audio or video. It provides high-fidelity hand and finger tracking by using machine learning (ML) to infer 21 3D keypoints on a hand from just a single frame. It basically helps in creating and tracking a skeleton model of a hand. Detecting hands is a complex task, the model has to work across a variety of hand sizes with a large scale span relative to the image frame and be able to detect occluded and self-occluded hands. To overcome this complexity it uses the following models:

a) *Palm detector Model:* It operates on an image and returns an oriented hand bounding box.To detect the palm it uses contextual cues like arm and body to accurately locate the region of interest.

b) *Hand Landmark Model:* After the palm detection over the whole image our subsequent hand landmark model performs precise keypoint localization of 21 3D hand-knuckle coordinates inside the detected hand regions via regression, that is direct coordinate prediction. The model learns a consistent internal hand pose representation and is robust even to partially visible hands and self-occlusions. All the detection is done using and manipulating and referring to these 21 landmarks.

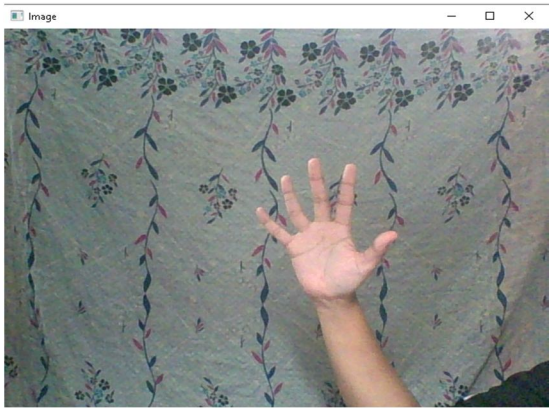


Fig 4 Image Captured by the Camera

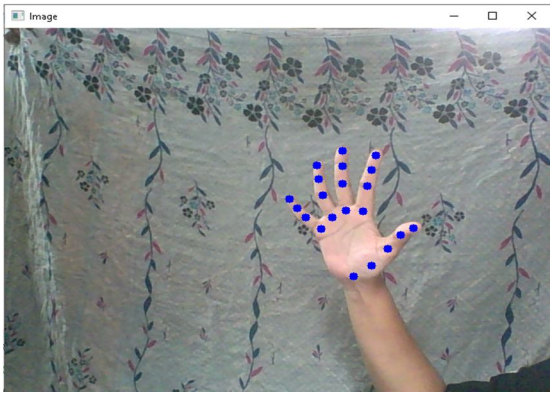


Fig 5 Drawing 21 points over hands

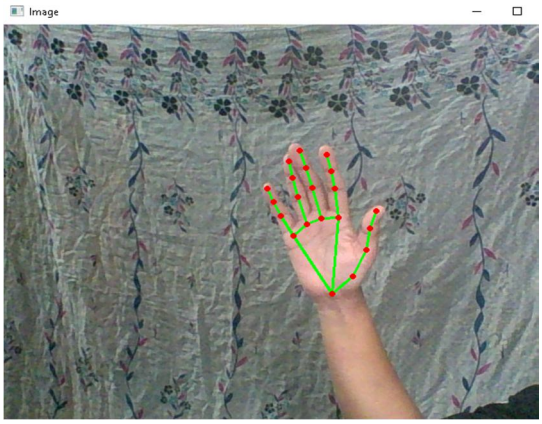


Fig 6 Connecting the points in the image

3) *Passing control to the relays:* Relays will be used as a means of communication between the Raspberry pi and the external appliances through GPIO i.e the General Purpose input/output.The use of relays comes into picture due to the overall cost reduction it offers to the project. As well it is a lower voltage device that has the capability to control higher voltage appliances. A smart hub in comparison would be higher cost, higher maintenance and would require something like voice control.

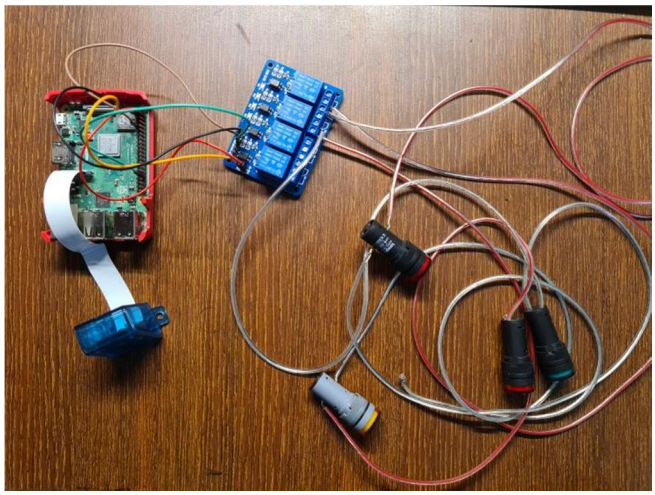


Fig 7 Final Assembly of Hardware

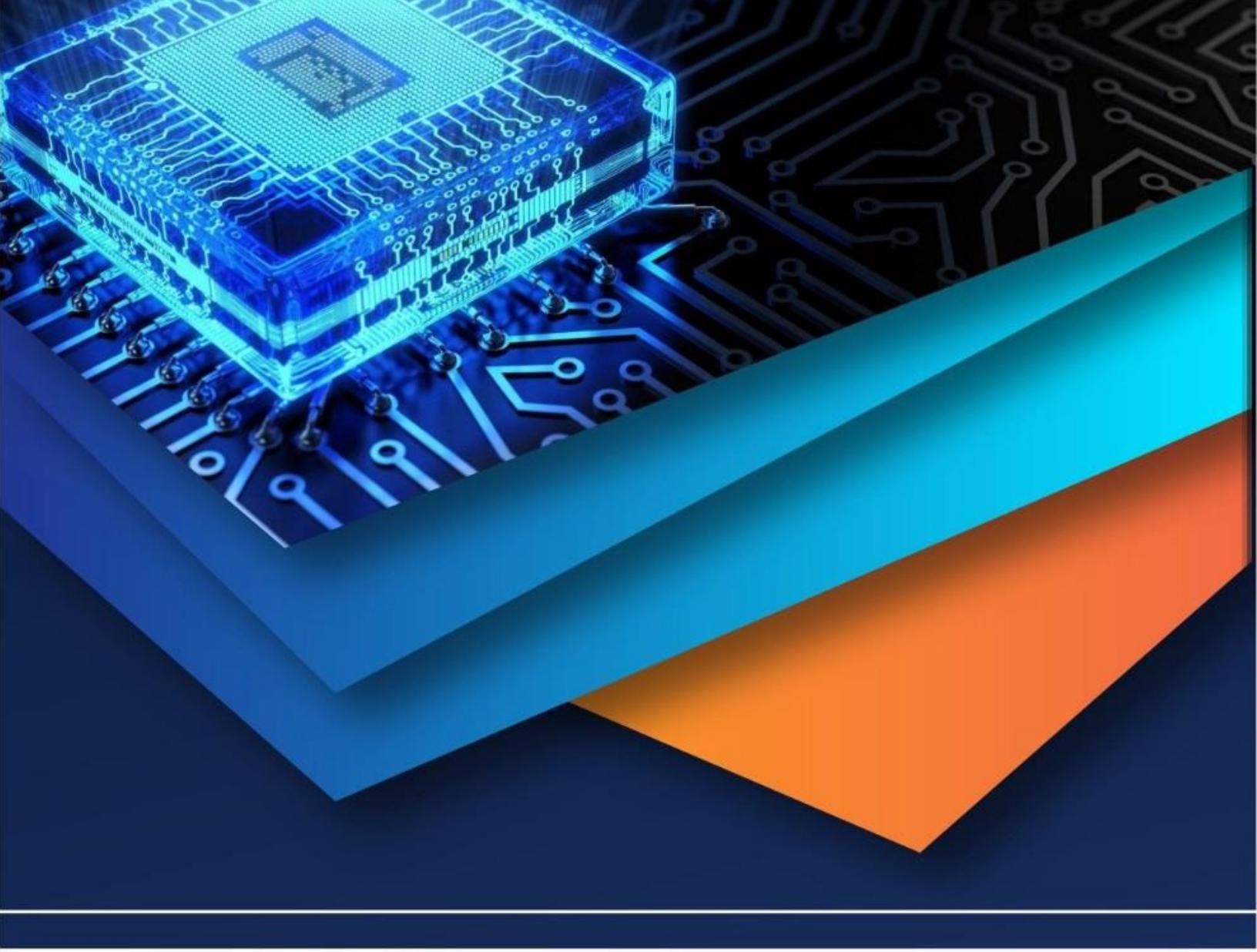
IV. CONCLUSIONS

With the proposed design of the "Home automation using gestures", the system will be able to help the visually impaired to take control of the basic appliances within the house without relying on other individuals. After conducting some research on the existing technologies and learning about their procedures, functionalities and limitations, we were able to develop a prototype that is portable and user-friendly by which the individual can control the system with bare hands rather than using gloves for gesture control or even using mobile phones as a controlling device.

The prototype developed gives efficient outputs with a delay of approximately 1 second, which is less as compared to physically moving to the traditional switchboard.

REFERENCES

[1] GESTURE CONTROLLED HOME AUTOMATION USING CNN,Sushmita Nooka1, Ninad Kheratkar2, Aboli Pathak3 , Shreyash Kumbhar4, Ashwini Jarali
[2] Python-based Raspberry Pi for Hand Gesture Recognition, Ali A. Abed (SMIEEE, MACM) Computer Engineering Department Basra University Basra, Iraq
[3] Comparison of Various Technologies for Home Automation System , Ronik Dhakar
[4] Marcel, S., Bernier, O., Viallet, J. E., & Collobert, D (2000), "Hand Gesture Recognition using Input Output Hidden Markov Models." In Proc. of the FG'2000 Conference on Automatic Face and Gesture Recognition
[5] Home Automation System Based on Gesture Recognition System, Priyanka D. Hatwar1, Neha A. Wahile 2, Isha M. Padiya 3 1, 2, UG, 3 Assistant Professor, Electronics and Telecommunication Engineering Department, DES's COET, Maharashtra, India.
[6] Gesture Controlled Home Automation System Using Internet of Things Smruti, Kshirsagar1, Srushti Sachdev2, Navjyot Singh3, Anushka Tiwari4, Yugchhaya Dhote5, B.E. Computer Engineering Department, VESIT, Mumbai, India
[7] Gesture Based Smart Home Automation System Using Real Time Inputs Chinmaya H G1,a, Nithin kumar N1, Sagar B1, Vinay Raj K M1 1 Student of Dept. of Electrical & Electronics, SVIT, Bangalore-560064, India.
[8] Gesture Controlled Home Automation, Sumanta Dey, Amit Das, Anupam Mishra, Debayan Dutta
[9] Real Time Hand Gesture Recognition for Computer Interaction, Javeria Farooq, Department of Electronic Engineering Balochistan University of Information Technology Engineering & Management Sciences, Quetta, Pakistan.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY