An Efficient Method For Device Control Using Hand Gesture In Python

Rajeith Thanumalaya Perumal Pillai[1], Vimal kirubashankar[2]

Abstract- *Home Automation uses the Android application to simplify the control of home appliances, especially for the elderly or the physically challenged. More and more technology is being used to make these people's lives easier by providing them with easy-to-use monitoring and management methods. In previous methods, accelerometers were used, which are attached to the hand, because they are considered the best tool for performing such practices. There is no flexibility in these models and they are not portable. In this proposed system, we will examine the implementation of a hand gesture control system for remote control of electronic devices in the complex environments by integrating Raspberry Pi into an embedded system with a Raspberry Pi as a controller. With this system, the Pi camera is used with Raspberry Pi, a popular device because of its inexpensive price as well as reliable performance. In each frame, the hand gestures are detected using radian fingertip analysis technique which does not require any prior training. As a result of this technique, light effects and complex environments can be handled with good robustness.*

Keywords- Raspberry Pi, Pi camera, Hand Segmentation, Gesture Recognition, Image Processing, Home Appliances.

I. INTRODUCTION

A smart home uses wireless control and robust security to enable home appliances to be controlled from anywhere. By integrating electronics and appropriate communication and protocols, home automation automates household activities. In addition to that, it is known as "DOMOTICS". Due to the real estate boom in India, smart homes are a much-needed technology for automated systems that reduce the need for human labor and increase productivity and quality. Smart homes are high on energy saving since everything from fans to lights can be controlled remotely saving human effort. They will be in even more demand with the upcoming smart cities across the country. Recently, consumer electronics and mobile devices have expanded their support for gestures. This system aims to create a system that can control home appliances using either one of the following two methods: -

1. The gesture-based approach

2. A web-based approach.

A web-based automation system or gesture-based automation system can provide an advantage to people who are physically unable to perform the tasks of everyday life. The main idea behind the project "Smart home" is to automate the home using gesture based automation technologies. Using this system, we can control home appliances through hand gesture recognition. In the proposed system, the Raspberry Pi camera will detect the hand gesture and thenthe Raspberry Pi will transmit signal to the home appliances, which will perform the appropriate home automation.

II. RELATED WORK

Neethu P S et al [1] proposed a system wherein they have used classifications for sign recognition and detections which are done automatically. The real-time image is in RGB format which needs to be converted into grey-scaling as a processing method. This processed image is then converted into a multi-resolution image using a Gabor transform. This transformed image or processed image is then used to extract features from a Gabor transform. In this paper, MATLAB Rb is used to simulate the proposed sign language classification system, with 2 GB RAM and Intel Pentium Core 2 duo processor. The dataset is taken from an open-source license.

Kunal A et al [2], avoiding the tedious technique of classifying a single gesture, their system classifies multiple gestures. This system has wide applications like sign language recognition, touchless car assistance systems, and gaming systems. They have produced a Long Short Term Memory(LSTM) based deep network motivated by Encoder-Decoder architecture that classifies gesture sequence accurately in one go. Their system is so efficient that even with limited data they can produce accurate results up to a limited scale. It is a system based on multilayer fuzzy neural-network based classifier. Overall checking of methods available needs to be researched and compared to finalize an optimum solution. A system with maximum efficiency, low cost, an optimal mixture of methods, giving results against complex backgrounds as well, should be preferred. ANFIS is the preferred method by their system.

Manisha U. Kakde et al [3] designed the system that recognizes 9 gestures of sign language in real mode using MATLAB, the PCA algorithm is used to recognize signs. Signs are captured through the web camera and YCbCrcolor transformation model used for feature extraction. PCA compares features of the captured image with the training database and to calculate minimum Euclidean distance. The system consists of the techniques such as preprocessing step, transformation, feature extraction and then classification. The image which is in RGB format is converted into greyscale image i.e. preprocessing method and then this image is converted using Gabor transform into multi resolution image. The result is text to speech. This system brings closer the hearing impaired-mute to the world. Input images captured through a web camera. After preprocessing, the results are compared with the stored database. If the eigenvalue of a processed image is matched with a stored image, then the text is displayed. After that, by using a speech synthesizer to convert that text into speech.

Harish Kumar Kaura et al [4], controls the robot using or with the help of gestures. After the image is processed gesture are extracted from the gesture given by the user. The robot then moves according to the signals received. The main objective is to provide portability and comfort for the user to control a wireless robot in the environment using gestures. For controlling the robot user uses a laptop or PC with good camera quality. Gesture commands are given using hand palm. The robot is also able to move in four directions like forward, backward, left and right.

Dhiraj Sunehra and M. Yeena [5] presented the implementation details of two schemes for home automation and control. The first scheme presents a prototype of Home Automation System (HAS) for remotely controlling the appliances at home through the subject of e-mail. This system is based on ARM11 Raspberry Pi microcontroller board. Python Integrated Development Environment (IDE) is used for developing the necessary software. The second scheme uses Bluetooth technology for controlling the devices when user is at home. It uses a HC-05 Bluetooth module and Bluetooth Controller mobile application for switching on or off the appliances. Relays and LEDs are used as load to demonstrate the working of the system. This prototype design can be extended for several applications including surveillance, power monitoring, fault monitoring, power control and security.

D. Jaya Sree and M. Jhansi Lakshmi [6] presented the overall design of Home Automation System (HAS) with low cost and wireless remote control. This system is designed to assist and provide support in order to fulfill the needs of elderly and disabled in home. Also, the smart home concept in the system improves the standard living at home. The main control system implements wireless Bluetooth technology to provide remote access from PC/laptop or smart phone. The design remains the existing electrical switches and provides more safety control on the switches with low voltage activating method. The switches status is synchronized in all the control system whereby every user interface indicates the real time existing switches status. The system intended to control electrical appliances and devices in house with relatively low cost design, user friendly interface and ease of installation. Due to the advancement of wireless technology, there are several different of connections are introduced such as GSM, WIFI, ZIGBEE, and Bluetooth. Each of the connection has their own unique specifications and applications. Among the four popular wireless connections that often implemented in HAS project, Bluetooth is being chosen with its suitable capability. Bluetooth with globally available frequencies of 2400Hz is able to provide connectivity up to 100 meters at speed of up to 3Mbps depending on the Bluetooth device class.

D.Naresh et al [7] designed home automation and security system using ARM7 LPC2148 board. The design is based on a standalone embedded system board ARM7 LPC2148 at home. Home appliances are connected to the ARM7 and communication is established between the ARM7 and ARM9 with Bluetooth device. The home appliances are connected to the input / output ports of the embedded system board and their status is passed to the ARM7. We would develop an authentication to the system for authorized person to access home appliances. The device with low cost and scalable to less modification to the core is much important. It presents the design and implementation of automation system that can monitor and control home appliances via ARM9 S3C2440A board.

Er. Vikram Puri and Anand Nayyar [8] implemented Smart Home Automation system is being proposed via use of PIC Technology utilizing PIC 16F877A microcontroller. The system contains HC-05 Bluetooth sensor for long range and energy efficient wireless communication and the system is fully operational to control various appliances like TV, BULBS, Tube lights, Fans and A.C. This method shows complete description of various components used and working of all the components integrated with each other. The system also makes use of Android App titled “Smartt Home Control” which provides flexible and easy to use GUI for interface. The system is currently the most cost effective and work-efficient as compared to other systems in the market.

Fredrick R.Ishengoma [9] designed an authentication system for smart homes based on IRT, FRT and ARM7TDMI-S. The system employs two biometrics mechanisms for high reliability whereby initially, system users must enroll their fingerprints and eyes into the camera. Iris and fingerprint biometrics are scanned and the images are stored in the database. In the stage of authentication, FRT and IRT fingerprint scan and analyze points of the user's current input iris and fingerprint and match with the database contents. If one or more captured images do not match with the one in the database, then the system will not give authorization.

III. EXISTING SYSTEM

An existing system proposes ear recognition for authentication in smart homes. Once the user is within the proximity of the smart home, the home server connects to the smartphone to authenticate the user. A system captures an ear image and processes its Monogenic Representation Local Binary Pattern (M-LBP). A pattern is then compared to the template on the server in order to detect it. This system is limited by the requirement that the user must have a smartphone that is configured for authentication every time. Furthermore, it is unclear how the system can be hacked, for example, by a person carrying a smartphone with a picture/3D model of a known user's ear.

The drawbacks in the existing system are

- Stolen Problem
- Duplicate image can be used
- Less reliable
- More expensive

IV. PROPOSED SYSTEM

The proposed system consists of Raspberry Pi, Pi Camera, Relays and AC loads. The input data can be a frame or a sequence of video frames, taken by a Raspberry Pi camera module pointed toward user's hand. The frames captured with simple background and stable light that are needed to ensure successful capture. The Region of Interest (ROI) is the hand region, so it captured the images of the hand and converts them to grayscale in order to find the ROI. In image processing, threshold process is used for frame segmentation that creates binary images from grayscale images. Using hand segmentation technique, the user's hand is separated from the background in the frame. Then the segmented hand regions are used to find hand gestures. These recognized hand gesture signal is send to the Raspberry Pi. The Raspberry Pi send signal to the relay to open or close the pole of the relay which is connected to the AC load based on hand recognition. Finally, the relay helps to ON or OFF the home appliances (AC load) in the home.

4.1 BLOCK DIAGRAM

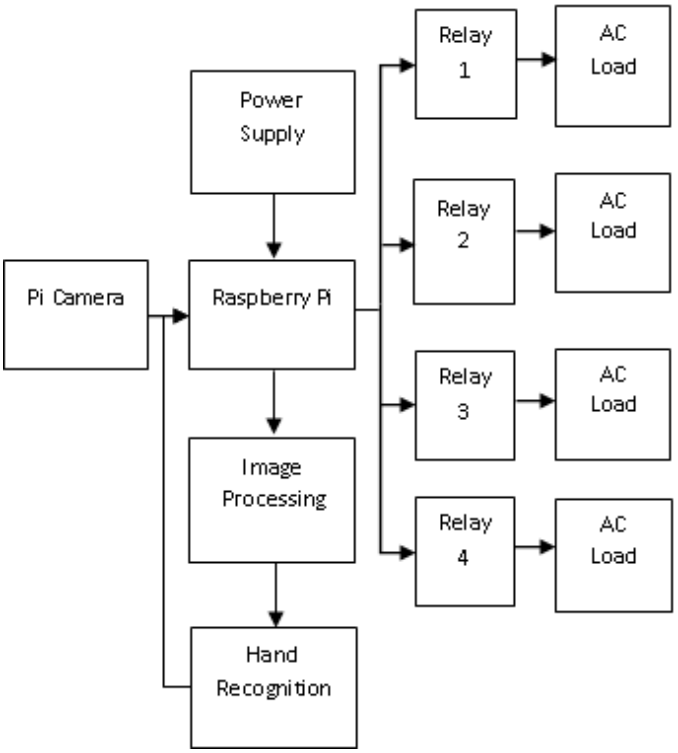

Fig.1 Block Diagram of Proposed System

4.2 FLOW CHART

The flow chart algorithm is given below in Fig. 2 the explanations are going here,

Step 1: Start the process
Step 2: Check whether the power supply is ON or OFF.
Step 3: Capture user's hand video.
Step 4: Convert RGB image into grayscale image
Step 5: Apply thresholding method for hand segmentation.
Step 6: Find and predict hand gesture.
Step 7: Send signal to Raspberry Pi.
Step 8: Send signal to Relay.
Step 9: ON or OFF the home appliances.
Step 10: Stop the process

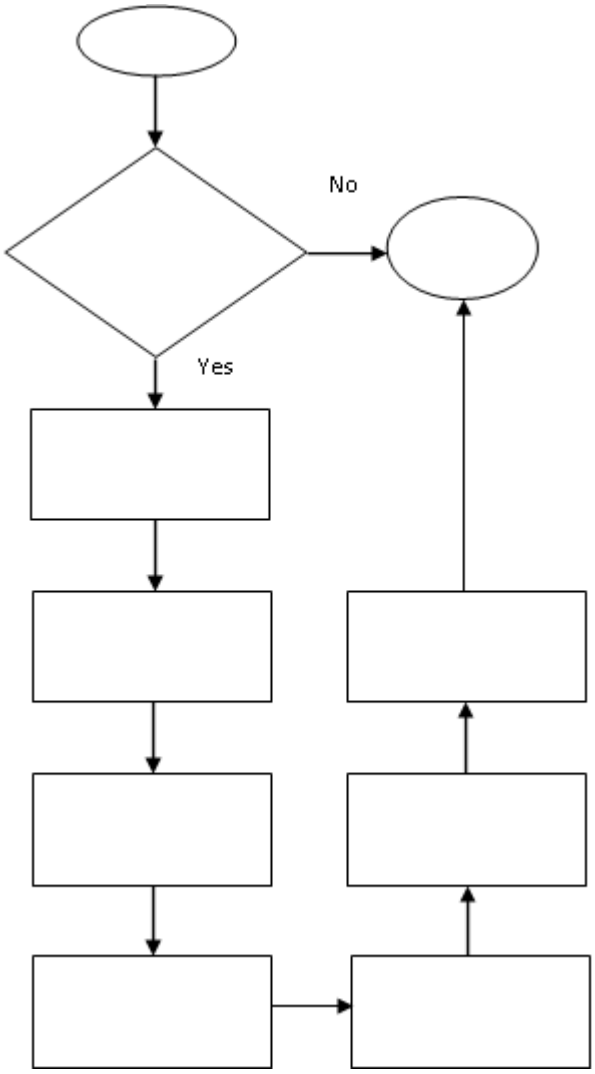

Fig. 2 Flow Chart of Proposed System

HARDWARE IMPLEMENTATION

The system compromises numerous tools that are utilized to obtain the desired system. In order to apply the automation process on a given system, camera, controller and relays are required.

The Raspberry pi 3 microprocessor is used since this is compact in size and the power consumption is too low. Broadcom chip BCM2836 SoC is placed in it and it has a memory of 1GB RAM with 900MHz frequency. Raspberry Pi 3 board is selected because it is fast when compared to the earlier versions. Many sensors or peripherals can be interfaced with it at the same time and can work very fast as the quad core processor is used in it. This processor allows us to interface many modules at a time. It has 26 GPIO pins, two 3.3V pins, two 5v pins and 8 ground pins. It has 4 USB ports also which allows us to connect the camera, Wi-Fi module etc. Relays help to make small currents activate large currents. It can be used to control various appliances, and other equipment's with large current. It can be controlled directly with 3.3V or 5V logic signals from a microcontroller. In this project 5v relay module is being used to drive the loads. The relay used has a maximum switching power of 336w 2500VA and a maximum switching voltage is 110VDC, 380VAC. 12A is the maximum switching current of the relay used.

A Pi camera is connected to the board. The camera captures and sends the live video signal to the receiver.

SOFTWARE IMPLEMENTATION

The RASPBIAN OS is used in the raspberry pi board. It is a free operating system that is based on Debian which is particularly optimized for the Raspberry Pi hardware. It comes with over 35,000 packages and pre-compiled software bundled in a simple format for easy installation in the Raspberry Pi. The coding for all the sensors and the robot movement are done using the python coding. Python is preferred since it is a simple and a minimalistic language. It is also free and open source software. This can be used in many platforms such as Linux, Works, and Pocket PC etc. Also, it supports procedure-oriented programming as well as OOPS. Since Pi camera is used it must be initially installed in the raspberry pi 3 board using the linux commands.The Pi camera is helpedto control appliances through hand recognition.

ADVANTAGES OF PROPOSED SYSTEM

- An extremely low power consumption
- The circuitry is simple because it does not require any special hardware
- It makes it easier to control devices
- A solution that overcomes the feasibility of traditional cabling
- Suitable for use in home theatre systems that require short-distance communication
- Suitable to operate devices in the room for people who are physically impaired

APPLICATIONSOF PROPOSED SYSTEM

Providing brand-new applications for the new digital consumer, home automation is expected to reinvigorate consumer expectations. The following areas are where consumers can expect hand gesture-enabled home automation:

- Lighting control
- HVAC
- Lawn/Gardening management
- Smart Home Appliances

- Improved Home safety and security
- Home air quality and water quality monitoring
- Natural Language-based voice assistants
- Better Infotainment delivery
- AI-driven digital experiences
- Smart Switches
- Smart Locks

V. CONCLUSION

In the world of IoT, the use of Raspberry Pi through hand gesture recognition is an important undertaking. With improved convenience, comfort, and energy efficiency under the Internet of Things domain, both individuals and society have benefited. The proposed system proposes a cost-effective, flexible, and gesture-controlled smart home automation and security system based on Raspberry Pi technology.

REFERENCES

[1] Neethu P S, Dr. R Suguna, Dr.Divya Sathish, "Real Time Hand Gesture Recognition System", International Journal of Emerging Technologies in Engineering Research (IJETER), Volume 5, Issue 3, March 2017.

[2] Mr. Kunal A. Wankhade, Prof. Gauri N. Zade, "Sign Language Recognitionfor Deaf and Dumb People Using ANFIS", International Journal of Science Engineering and Technology Research (IJSETR), Volume 3, Issue 5, May 2014.

[3] Manisha U. Kakde, Amit M. Rawate, "Hand Gesture Recognition System for Deaf and Dumb People Using PCA", International Journal of Engineering Science and Computing, Volume 6, Issue 7, July 2016.

[4] Harish Kumar Kaura, Vipul Honrao, Sayali Patil, Pravish Shetty, "Gesture Controlled Robot using Image Processing", International Journal of Advanced Research in Artificial Intelligence (IJARAI), Volume 2, Issue 5, 2013.

[5] Dhiraj Sunehra, Veena M, "Implementation of Interactive Home Automation Based on Email & Bluetooth technology", International conference on Information Processing (ICIP) Vishwakarma Institute of Technology, Dec 2015.

[6] D. Jaya Sree, M. Jhansi Lakshmi, "Android Mobile based Home Automation Using Bluetooth", International Journal of Advanced Research in Computer Engineering and Technology (IJARCET). Vol.3, Issue 9, September 2014.

[7] D.Naresh, B.Chakradhar, S.Krishnaveni, "Bluetooth Based Home Automation & Security using ARM9", International Journal of Engineering Trends and Technology (IJETT), Vol.4, Issue9, Sep.2013.

[8] Er. Vikram Puri, Anand Nayyar, "Real Time Smart Home Automation Based on PIC Microcontroller, Bluetooth and Android Technology", 2016, 3rd International Conference on Computing for Sustainable Global development (INDIACom), October 2016

[9] Fredrick R.Ishengoma, "Authentication System for Smart Homes Based on ARM7TDMI-S and IRIS- Fingerprint Recognition Technologies". CiiT International Journal of Programmable Device Circuits and Systems, volume 6, Issue 6, August 2014.

[10] Gurek A, Gur C., Gurakin C, Mustafa Akdeniz, SenemKumovaMetin. "An Android Based Home Automation System", 10th International Conference on High Capacity Optical Networks and Enabling Technologies (HONET- CNS), Magosa, 11-13 Dec.2013, IEEE, pp.121-125.

[11] J P Pienaar, R M. Fisher & G.P. Hancke. "Smartphone: The key to Your Connected Smart Home", 2015 IEEE 13th International Conference on Industrial Informatics (INDIN), pages 999-1004, 2015.

[12] Kanv Kumar, Kishan Kumar, Shyam Nandan, Ashutosh Mishra, and V.K.Mittal "Biometric Access for a Secure Smart Robot", 2015 International Conference on Signal Processing, Computing and Control (2015 ISPCC). Date Added to IEEE Xplore: 11 January 2016.

[13] Md. Tanvir Ahammed, ParthaPratimBanik. "Home Appliances Control Using Mobile Phone" Proceedings of 2015 3 rd International Conference on Advances in Electrical Engineering 17-19 December, 2015, Dhaka, Bangladesh. Date Added to IEEE Xplore: 11 July 2016.

[14] Ming Yan, Hao Shi. "Smart Living Using Bluetooth-Based Android Smartphone". International Journal of Wireless & Mobile Networks (IJWMN). Vol.5, No.1, February 2013.