Optimized Hand Gesture Based Home Automation For Feebles

Hithaishi R [1], Anusha M [2], Aishwarya S [3], Abhilasha T S [4]

Department of Information Science and Engineering
Vidyavardhaka College of Engineering, Mysuru, India

Abstract: *Home automation technology is employed to style and implement remote, energy efficient and scalable smart homes with the fundamental features that ensure occupant comfort and safety. A smart home automation system where people with disabilities, elderly people and bedridden patients use hand gestures to automate fans, lights and other home appliances. The system consists of a home network (sensors and device actuators and cameras that describe the controller, and Arduino microcontrollers that communicate with relays that represent the user interface).Smart houses are low cost because they use video processing systems and sensors. We use the MQTT server to send and receive commands. A wireless wifi module called Esp8266 nodemcu is used to enable smooth and unsophisticated wifi usage.*
Keywords: *Hand Gesture Recognition, Home Automation, Image Processing, MQTT, Esp8266.*

I.   Introduction

The hand gesture recognition system has received a lot of attention in recent years due to its applications and its ability to efficiently interact with machines through human-computer interaction. Gestures are a form of communication that is non-verbal and uses body parts such as hands, legs, face, arms, etc. Gesture recognition can be a process of recognizing gestures performed by users to control various devices. The objective of this project is to develop a system to regulate devices like fans, lights etc. Using hand gestures and recognizing patterns given by the user. With the help of IoT and image processing technology as well as mobile applications, we want to build a reliable home automation system.

Image processing is a method of enhancing raw images extracted from cameras/sensors installed on satellites, spacecraft and aircraft, or images captured in typical everyday life for various applications. Several strategies in image processing have been developed over the last four or five decades. Most strategies are created to update images obtained from unmanned space vehicles, space testing, and military observation flights. Image preparation frameworks are gaining popularity due to the easy accessibility of powerful work computers, estimated memory gadgets, design programs, etc.

II.   Literature Review

In [1] Guo Xing, et al. have talked about the Static Gesture Recognition is a critical component of the human-computer interaction intelligence discipline. The depth learning approach is employed in static recognition because traditional machine learning methodologies have constraints when dealing with raw data, however in deep machine learning, raw data may be described as high level features. And the Static Gesture Recognition method, which was developed here, ensures high accuracy and detection speed, making real-time static gesture recognition possible.

In [2] Weixin Wu, et al. provides an approach for real-time video stream recognition in a complex context using deep learning methods. To detect the hand signs efficiently, SSD MobiNet model is used and to track the hand points the Kalman filter is used, and to classify the key points CNNs is used and they are outputted by the CPMs. And the proposed system has accuracy more than 96% in recognizing gestures in a complex environment.

In [3] Jing-Hao Sun, et al. talks about Hand Gestures based on deep learning methods. Since hand gesture techniques are widely used in robotic controls and other intelligent aspects, the AdaBoost classifier based on Haar is used here for the particularity of skin color, edge detection, motion detection and for other properties. Also, The CamShift algorithm is used to monitor the hand gesture in real time, even against a complex background, and CNN is used to identify the hand gesture region.

In [4] Pomboza-Junez Gonzalo, et al. talks about how home automation system can be controlled by hand gesture by using different kind of objects like an armband called MYO® which captures gestures by muscle movement, or the hand gesture controller which can be implemented in smart phone or to embedded

system, or other home devices which can be automated to activate, deactivate or change the mode. This gestural interface gives you complete control over your developments and eliminates the require for a touch client interface

In [5] J. F. Henriques, et al. talks about Stereo cameras which are made up of different hardware components i.e, two webcams. The image which is captured by the webcam is later converted to a different color space, the applied color spaces will be HSV. HSV can easily regulate the threshold values. RGB images will have the input sequences that get transfigured into YCbCr images (Green(Y), Blue (Cb), Red (Cr)) i.e, digital video color space. Compared to different light states, RGB color space is more delicate. The stereo camera helps to calculate the distance of detected objectsThe image which is captured by the webcam later converted to a different color space, the applied color spaces will be HSV. HSV can easily regulate the threshold values. RGB images will have the input sequences that get transfigured into YCbCr images (Green(Y), Blue (Cb), Red (Cr)) i.e, digital video color space. Compared to different light states, RGB color space is more delicate. The stereo camera helps to calculate the distance of detected objects.

In [6] Y. Zhu, et al. proposed a CNN (convolutional neural network) system which can be used to identify different hand gestures. The various hand gestures are Classified based on the features calculation. In the field of identification CNN is more popular. Most of the adequate procedures are classified into two groups: the primary is edge point border detection, and the moment is skeletonization.The boundary discovery is associated parallel to each other pixels on the borderlines. In skeletonization we ought to recognize the frames.

In [7] S.Birchfield, et al. talks about identifying the hand Gestures images the system has two parts: first one the image processing part, and second one the evaluating part.The source of the incoming video stream was a stereo camera. The process of hand gesture recognition is separated into two parts: detection and recognition. Recognition is classified into two categories: dynamic and static hand gestures. The static hand gesture refers to fixed hand gesture and the dynamic hand gesture means incessant motion recognition. ROI is a part of an image to filter or operate noise which is present in the background. To track the identified To avoid undesired noise, we employ the KCF algorithm. The training and tracking phases of the KCF algorithm are further split.

In [8] Rajit Nair, et al. proposes about the implementation steps that have been involved and help us to get an actual idea of the implementation part, coming to the steps that have been involved are as Image acquisition, Hand detection, Preprocessing, Crop hand Feature extraction, Classification Gesture to speech understanding in detail of this implementation process. Image acquisition captures the scene by the user that is performing or acting hand detection, here we just ignore the unwanted things that appear on the scene and only focus on the hands. The next most important thing is feature extraction Where the number of images will be captured during the image acquisition by adopting the feature generation this would reduce this.

In [9] Jayesh S. Sonkusare, et al. earlier, gesture was the first mode of communication, after the evolution of human civilization they developed the verbal communication, but still non-verbal communication is equally significant. Such non-verbal communication is not only used for physically challenged persons but also it can be efficiently used for various applications such as 3D gaming, aviation, surveying, etc. The basic knowledge of the implementation is Capture of the image Hand tracking and segmentation, feature extraction, classification and recognition And the final is gesture recognition.

In [10] Hamid A. Jalab, et al. talks about majority of the HCI which is based on mechanical gadgets such as console mouse, joystick or gamepad, but developing intrigued in a class of strategies based on computational vision has been developed due to capacity to recognize human motions in a common way. And focuses on ANN where the implementation part includes Image acquisition, segmentation, feature extraction ANN And here the most ANN algorithm is used for the classifier purpose its nothing but the back propagation algorithm wherein the back propagation considers as supervised learning in which the desired input and output will be there. The ANN is trained to classify users' hand gesture features. The computer vision algorithm is proposed that recognizes the four hand gestures namely: play, stop, forward, reverse for controlling the media player using the neural network. And here it uses the ANN and here classification was made without the need for using any special gloves.

In [11] Rafiqul Zaman Khan, et al. focuses on the human computer interaction (HCI) where this references to the relation between the human and the computer or more precisely the machine and the main aim of the gesture recognition is about to create a natural interaction between human and computer. The main thing that has been focused here is in machine learning technology Well in this also the main implementation part is extraction method feature extraction classification Coming to the conclusion of this paper Here methods are discussed for gesture recognition these methods include from neural network, HMM, fuzzy, c-means, clustering, besides using orientation histogram for feature representation.

In [12] R Jayanthi, et al. presents a Back Vector Machine (SVM) and Convolution Neural Arrange (CNN) based hand motion acknowledgment framework to robotize different domestic gadgets like lights, fans, etc. This system employs genuine time picture handling for hand motions acknowledgment by employing a

straightforward android-based application and Arduino UNO microcontroller. The captured real-time picture by the android application will be prepared utilizing the computer application. The proposed framework performs a picture preparation calculation based on SVM and CNN are utilized to recognize the input hand gesture. A pre-trained CNN organized Resnet50 is utilized to include extraction.The CNN highlight extraction method is exceptionally effective, and it beats existing hand-crafted highlight extraction techniques like HOG,LBP and SURF. The CNN and SVM utilized together comes about in more precise gesture acknowledgment which progresses the execution of the framework. The framework offers an additional commend design acknowledgment module which too can be utilized by the client for controlling the domestic appliances.

In [13] Archana Benkar, et al. talks about the risk points to make old electronic devices compatible with remote control for easy and contactless/contactless operation through program operations. As in this time of Covid19, a button is the most common interface connected to the digital world. It can be as simple as a light/fan switch. Therefore, their Keen switch box can be used to replace the existing switches in the home, which cause lightning and fire accidents in some cases. Considering the preferences of Wi-Fi, a computerization framework has been created to control devices in the home. They have used an ESP32 microcontroller which is versatile and versatile. It has 2 exclusive control CPU centers and includes flexible clock recursion from 80MHz to 240MHz. It has built-in Wi-Fi, Bluetooth, ESP-WROOM-32s BLE MCU module. The best reason to use this microcontroller is that it has Wi-Fi capabilities and it can be used to control anything connected to it from anywhere in the world.

In [14] Chinmaya H G, et al. focuses on Live identification of Hand Signals from the camera goes to the Central Processor(Video preparing framework), Control signals from handling units are sent to transfer, from hand-off diverse machines can be controlled based on given gestures. Human Nearness is recognized when human is IN & OUT of the room from sensors, the flag from the sensors is encouraged to microcontroller, at that point the control flag from the microcontroller is given to transfer which controls the ON & OFF of the lights of the room regarded to IN & OUT of humans. Light Force like dim, shining, are identified by the sensors & sent to the microcontroller for preparing; the handled flag is at that point bolstered to hand-off which in turn switches ON or OFF the lights based on force.

In [15] Rakesh Dhotre, et al. had done research themselves to help physically challenged individuals control devices around them. The extension incorporates a glove which is wirelessly associated with different day to day machines such as lights, fan etc. The communication is accomplished through for the most part accessible Bluetooth modules. In this extent two HC05 modules are used wherein one of them joined to gloves which acts as transmitter and the other is joined at the collector conclusion such as appliance. Thus an endeavor made to assist individuals to utilize machines at their comfort.

III.   Proposed System

The automated system developed until now consisted of limited gestures, and they were not very supportive of the gestures made by the individual fingers. Also few of them appeared to be slow in recognizing and computing the input parameters.
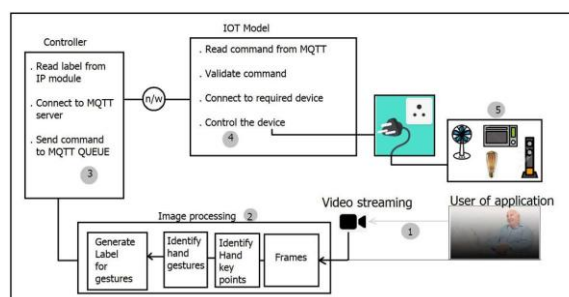
In this paper, tensor flow is efficiently used through desktop applications. Desktop or Personal Computer is used through which mobile interface limitations can be overcome. Accuracy and number of signs defined can be improvised by using Deep Learning models like TensorFlow.

We have implemented a wireless wifi module called ESp8266 nodemcu. The MQTT server is used to send and receive commands.

A special mobile application has been implemented in order to receive emergency alerts when the patient is in trouble. An emergency alert will be triggered to the guardian's mobile device in case of an emergency.

IV.   Application

●   The major focus is on bedridden patients followed by older people, and other individuals with physical disabilities who find it hard time operating home appliances due to their disabilities and weaknesses.

●   Multiple Home Appliances can be controlled with just a hand gesture. It operates 24/7 and hence the access and response time is more efficient. Home appliances like lights, fans, buzzers and many more can be controlled by users with just a hand gesture without the need of a third person's intervention.

●   The emergency alert feature along with the mobile application provides more insight and safety. In this way the patient will not end up in danger.

●   Wireless wifi module eases the working and makes it more advanced.

V.   Conclusion

The hand gesture based home automation system is useful to the general public as well as physically challenged individuals, and nonverbal communication between a computer and a human.There is a need for study because of the growing use of hand gesture recognition systems. This article compares and contrasts several strategies currently in use.

Various approaches for Hand Gesture Based Home Automation are covered in this study, these approaches include from Image Processing, IOT alongside mobile application to deliver emergency alerts through text message for the recipient's mobile device .

A gesture-based recognition system that recognises movements in real time has been built using a Web camera. Our image processing techniques will accurately detect movements in real time.

The type of recognition algorithm to use is determined on the application needs. As a result, we are improving the existing system by adding additional features such as mobile applications and wireless Wi-Fi modules.

VI.   Future work

As a future work, we need to extend the hand gesture library in the future to change the framework based on the user's profile. Each customer's comfort level is different, so the frame may require different use. We need to extend the application to mechanical control where the motion interface should be more accurate.

Apparently, the existing home automation system comes with limited features and accuracy. Further developments can be made by integrating high accuracy by involving advanced tensorflow data models.

Multiple devices can be connected and automated. Usage of high end cameras can be performed which supports farther distance object recognition.

References

[1].   Guo Xing, XuWu, Tang Wen Quan, and Wen Cong, "Research on Optimization of static gesture recognition based on convolution Neural Network", 2019 4th International Conference on Mechanical, Control and Computer Engineering (ICMCCE).

[2].   Weixin Wu, Meiping Shi, Tao Wu, Dawei Zhao, Shuai Zhang, and Junxiang Li, "Real-time Hand Gesture Recognition Based on Deep Learning in Complex Environments", The 31th Chinese Control and Decision Conference (2019 CCDC).

[3].   Jing-Hao Sun, Ting-Ting Ji, Shu-Bin Zhang, Jia-Kui Yang and Guang-Rong Ji, "Research on the Hand Gesture Recognition Based on Deep Learning", 2018 IEEE.

[4].   Pomboza - Junez Gonzalo and Holgado - Terriza Juan A, "Control of Home Devices based on Hand Gestures", 2015 IEEE 5th International Conference on Consumer Electronics Berlin (ICCE-Berlin).

[5].   J. F. Henriques, R. Caseiro, P. Martins and J. Batista, "High Speed tracking with kernelized correlation filters," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 37, no. 3, pp. 583–596, 2015.

[6].   Y. Zhu, C. Huang, and J. Chen, "Face detection method based on multi-feature fusion in YCbCr color space," in Proc. The 5th International Congress on Image and Signal Processing, Chongqing, China, October 16–18, 2012.

[7].   S. Birchfield and C. Tomasi, "Depth discontinuities by pixel-to-pixel stereo". Int. Journal of Computer Vision, Vol. 35(3).

[8].   Rajit Nair, Dileep Kumar Singh, Ashu Shivam Yadav, and Sourabh Bakshi, "Hand Gesture Recognition system for physically challenged people using IoT", 2020 6th International Conference on Advanced Computing & Communication Systems (ICACCS).

[9].   Jayesh S. Sonkusare, Nilkanth B. Chopade, Ravindra Sor, and Sunil.L. Tade, "A Review on Hand Gesture Recognition System", 2015 International Conference on Computing Communication Control and Automation.

[10].   Hamid A. Jalab, and Herman.K. Omer, "Human Computer Interface Using Hand Gesture Recognition Based on Neural Network", 2015 IEEE.

[11].   Rafiqul Zaman Khan, and Noor Adnan Ibraheem, "Hand Gesture Recognition: A Literature Review", International Journal of Artificial Intelligence & Applications (IJAIA), Vol.3, No.4, July 2012.

[12].   R Jayanthi, A Bhuvaneswari, S Rajkumar, and K P Rama Prabha, " Vision based Hand gesture pattern recognition enabled home automation system using Internet of Things", ISSN: 0011-9342, 2021.

[13].   Archana Benkar, Abhishek Duduskar, Shivani Gandhamwar, and Prof. P. A. More, "Gesture-Based Smart Switch", International Journal of Advanced Research in Science, Communication and Technology (IJARSCT) Volume 6, Issue 1, June 2021.

[14].   Chinmaya H G, Nithin Kumar N, Sagar B, and Vinay Raj K M, "Gesture Based Smart Home Automation System Using Real Time Inputs", International Journal of Latest Research in Engineering and Technology (IJLRET).

[15].   Rakesh Dhotre and Rounak Agarwal, "Gesture Controlled Home Automation", International Journal of Scientific & Engineering Research, Volume 8, Issue 9, September-2017.