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GESTURE CONTROLLED HOME AUTOMATION USING CNN

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Abstract -*Home Automation model using the android application is designed for providing ease of control of home appliances to the people, especially elderly or those who are physically unable for efficiently performing the day-to-day activities. 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 accelerometers, 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. Our system is based on remote control home automation where-in our remote is an android application. In our system, the smartphone camera is used to give gestures as input to the gesture recognition model to filter and predict the gesture. Web-based automation communicates directly with raspberry pi to control home appliances. The proposed method, allows users to flexibly and portably control multiple household appliances with simple gestures.*

Key Words*: *Grayscaling, Filtering, Gesture Recognition, Convolutional Neural Network, Image Classification, Home Appliances, Resizing

1. INTRODUCTION

1.1 Overview

Recently the scope for gestures has been increased for interaction with consumer electronics and mobile devices. The objective of the home automation system is to create a system that can control home appliances using any one of the two assigned methods: - 1. Gesture-based 2. Web-based. Disabled or old aged people who can't walk require an effortless way of accessing things around them which must be served systematically and efficiently. This idea integrates automation with technology. Traditional home automation systems are not suitable for aging populations or disable persons. It's for those who cannot perform basic activities efficiently. Home automation systems are used to control home appliances through remote control (smartphone). Web-based automation and gesture-based automation provides an advantage to those people who are physically unable for efficiently performing the day-to-day activities. Many gesture tracking technologies which predominantly include attached hand gloves to sensors or special feature gloves.

1.2 Objectives of the Proposed System

- To overcome situations where normal cabling is difficult or financially impractical.
- It can be used in home applications system where short-distance communication is required.
- Suitable for physically impaired people to operate the devices within the home.
- To provide comfort and convenience for common users as well, especially in the home system.

1.3 Advantages of the Proposed System

- Low power requirement
- Simple circuitry as it does not require special hardware
- Devices can be controlled more comfortably
- Helps to overcome situations where normal cabling is difficult as well as financially impractical
- Can be used in home theatre system where short-distance communication is required
- Suitable for physically impaired people to operate the devices within the room

2. LITERATURE SURVEY

[1] Real time Hand Gesture Recognition System

This paper [1] proposes 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.

[2] Sign language Recognition for Deaf and Dumb People using ANFIS

In this paper [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.

[3] Hand Gesture Recognition System using PCA

The system [3] is so designed that it 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 YCbCr color 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 grey-scale 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 pre-processing, 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.

[4] Gesture Controlled Robot using Image Processing

In this paper [4], the user controls his/her 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.

3. PROPOSED SYSTEM

The proposed system detects the gestures given as input by the user and controls the home appliance. The main objective is to provide portability and enable blind, deaf and dumb people to control various appliances with ease and comfort. Also, methods of control are needed due to the increase in the number of industrial and home appliances that must be controlled. The gesture input from the user is captured using an android application and sent to the raspberry pi (which acts as a microcontroller) and the raspberry pi then operates on the respective functionality of the appliances. The system uses a Convolutional Neural Network algorithm for image classification. CNN is used in problems such as pattern and image recognition. They have several advantages compared to other techniques. Using the standard neural network that is equivalent to a CNN, will have a much higher number of parameters thus the training time would also increase proportionately.

3.1 System Architecture

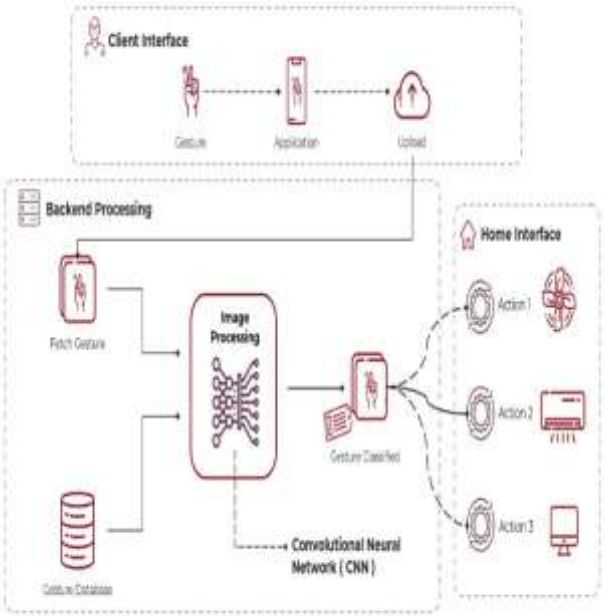

Fig -1: System Architecture Diagram

Our system is divided into three modules as shown in the fig consisting of Client Interface, Backend Processing, and Home Interface. Client Interface is responsible for capturing the input gesture from the user and uploading it on the raspberry pi server. Backend Processing involves image preprocessing and training the CNN model and prediction of image class category of input gesture image. Based on this predicted class of image, respectively assigned actions to take place at the home interface

3.2 Work Flow of the System

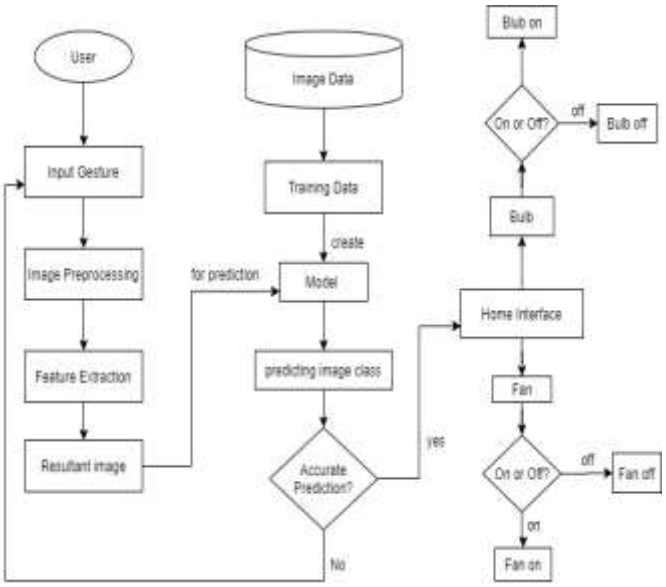

Fig -2: Workflow of the System

Initially, the user captures the image of a gesture using the front camera of an android app. This input image is further preprocessed. The images of each gesture are used for training and to create a CNN model the input image acts as a testing image and based on the trained model the class category of testing image(input image) is predicted. If the prediction is precise then the assigned action according to the image class is carried out (for ex. Bulb on, fan off, etc).

4. STEPS INVOLVED IN SYSTEM WORKING

Let us consider the following set of tuples

P = {Set of predefined gestures}

R= Input gesture

Q = {Set of Response / Results given back to user}

4.1 Capturing gesture from the user

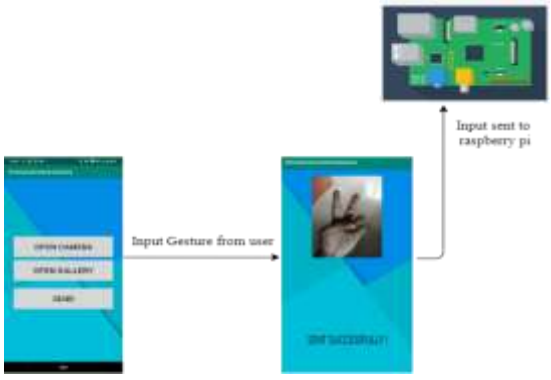

Fig -3: Input to Raspberry Pi

- The user with the help of an android application will give an input gesture(R) from the predefined gestures (P) as shown in fig. 3. P will consist of gestures like palm, thumb, peace, and punch. Each gesture has an action assigned that controls the home appliance. After capturing the image of R, a 'send' button is used to send the image to the raspberry pi server.
- This static image is stored in a specific folder on the raspberry pi which will be further used for image classification. Every time a new R is captured and sent, the previous image is replaced in that specified folder with the currently sent image and acts as a testing image for classification.
- While sending the image on the raspberry pi server, the image is converted into base64 format to make it a normal string that could be decoded at the server end to get the real resource. This image is renamed using a fixed name so that the same path and image name can be specified in the testing part of the algorithm.

4.2 Image Classification of the input gesture

Fig -4: Image Preprocessing

The CNN neural networking algorithm is used for classifying the image. The CNN model is trained using images of each gesture from P. Based on this training data the uploaded image (via android app) is tested. The uploaded image undergoes a few preprocessing steps like resizing, gray scaling and feature extraction before its testing. The class category to which R belongs is predicted.

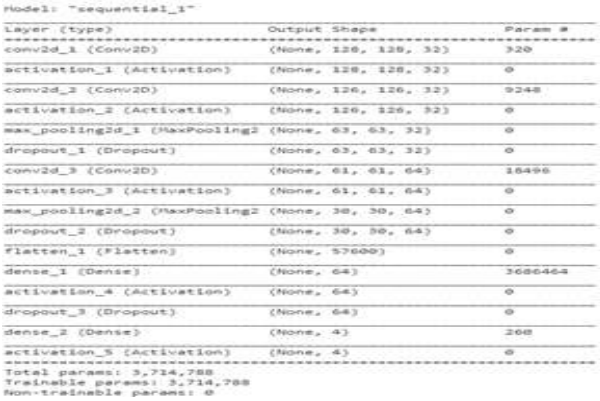

Fig -5: Model Training

After the image preprocessing steps model is trained as shown in Fig. 5.

4.3 Appliance control based on the classified image

G_id	Gesture	Action
1		Fan On
2		Light Off
3		Fan Off
4		Light On

Fig -6: Actions assigned to the Gestures

- The input gesture R is predicted to be belonging to one of the classes of P, based on which respective action Q as a response is generated.
- Each P[i] (where P[i] is nothing but one of the elements of P) is assigned to respective Q[i]. The user is already aware of, which gesture is assigned to what action.

  P= {peace, punch, thumbs up, palm}

  Q= {fan on, fan off, light on, light off}
- Based on R, if its predicted class is accurate (Say P[i]) then the assigned action Q[i] is performed by switching the appliance on/off connected to the raspberry pi.

  If R==P[i] (According to prediction)

  Then do Q[i]
- The user can send another gesture via the android app for other desired actions he wants to perform. Thus preserving its portability and user-friendliness. The appliances can be controlled in an additional way by using the on/off buttons on the web application as well

4.4 Connectivity of Appliances

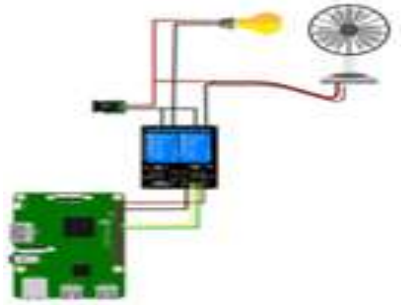

Fig -7: Connectivity of Appliance

- Fig.6 shows the basic connectivity of appliances to the raspberry pi using the relay module as an intermediator. The relay module is used to avoid burning out of Pi since Pi tolerates a maximum of 5V.
- The appliances can be controlled in an additional way that is the web-based method by using the on/off buttons on the web application as well simply by accessing the IP address of the raspberry pi as shown in Fig. 8

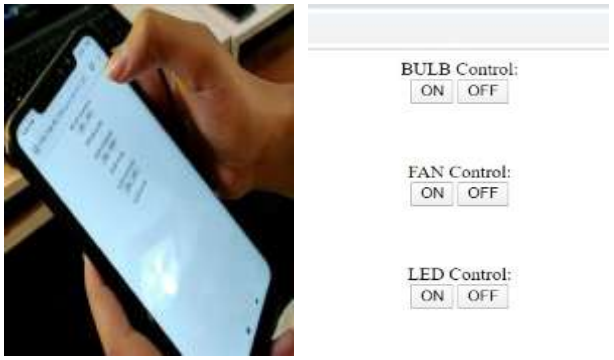

Fig -8: Web Application

5. TOOLS AND TECHNOLOGIES USED

- Tools required in our system include Windows 2010 and Android Studio.
- For our system to be executed we need some hardware which includes a minimum Ram of 4 GB, Raspberry pi 3 Model B, 32 Gb SD Card, some jumper wires, relay module, Bulb, and Fan. For communication and information transfer we need some hardware interfaces like Ethernet, Wi-Fi, and software interface like android application.
- Our system requires several libraries in python which include Keras, OpenCV, and NumPy.

6. CONCLUSIONS

This paper discusses a hand sign recognition system that would be deployed on an android device. The system is developed and tested successfully with an android device. This system is useful for a deaf and dumb person carrying an android device connected with webcam to control appliances. This also provides comfort and convenience for common users, especially in-home systems. Wireless technology is used for home automation for physically impaired. In this system, physically impaired people use home appliances very easily or they are comfortable with using the devices. This system is simple for operating the devices, this will be replaced by the remote-control instate of pushing the button there for this system will be very suitable for operating the home appliance

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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 LanguageRecognition For 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] Priyanka D. Hatwar, Neha A. Wahile, Isha M. Padiya, "Hand Gesture Recognition using ANFIS", International Journal of Emerging Technologies in Engineering Research (IJETER), Volume 5, Issue 3, March 2017

[6] Rafiqul Zaman Khan, Noor Adnan Ibraheem, "Hand Gesture Recognition", International Journal of Artificial Intelligence & Applications (IJAIA), Volume 3, Issue 4, July 2012

[7] Rishad E K, Vyshakh C B, Shameer U Shahul, "Gesture Controlled Speaking Assistance for Dump and Deaf", National Conference On Discrete Mathematics & Computing (NCDMC), 2017

[8] Jagdish L. Raheja, A. Singhal, Sadab, Ankit Chaudhary, "Android based Portable Hand Sign Recognition System", International Journal of Science Engineering and Technology Research (IJSETR), Volume 3, Issue 5, May 2014

[9] Prakhyath Rai, Ananya Alva, Gautami K. Mahale, Jagruthi S. Shetty, Manjushree A. N., "Gesture Recognition System", International Journal of Computer Science and Mobile Computing (IJCSMC), Volume 7, Issue. 5, May 2018, pg.164 – 175