REVIEW PAPER ON: HOME AUTOMATION TECHNIQUES BASED ON HAND GESTURE RECOGNITION

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Abstract - *This paper shows how a camera may be used to interface with a hand gesture system. The primary goal is to make human life easier and more straightforward. Hand gestures can be used to operate electronics. This will also be useful in the current Covid-19 pandemic situation, where social distance is essential and contact-free appliances provide an added benefit in public spaces. Hand gestures are the most ubiquitous and important ways of communication in modern society. They can assist in the development of secure and comfortable user interfaces for a variety of applications. Color and depth cameras have been used in several computer vision algorithms for hand gesture identification, but effective classification of movements from different people remains a challenge.*

Key Words: **gesture recognition, home automation, machine learning, hand gesture, algorithms**

1.INTRODUCTION

A gesture is a type of nonverbal communication in which the hands or other different parts of the body are moved. Recognition of gestures is the analysis of a human motion by computational resources.
In other words, use motions of the human body, such as hand movements, to interact with computers or other devices. Gestures are read by a camera. The human body's movements and transmits the information to a computer employs gestures as a control input for devices or applications. It is a method for computers to begin to get a hold of body language, emerging in a link between machines and humans than simple text user interfaces or user interfaces (GUIs). Gesture-based apps that allow direct manipulations can be beneficial since they provide natural and straightforward interactions[1].

1.1 Motivation

It's still a problem to make interaction between humans, computers, and various gadgets as natural as possible. Our goal is to make human-computer connection feel as natural as human-to-human interaction. Human existence is made easier by gestures, which are also of tremendous assistance to physically challenged and elderly individuals.

1.2 Need

One of our system's main key goals is to make life easier for persons with disabilities and the elderly. In these pandemic times, it also promotes safety. It enables the use of contactless equipment in public spaces, assuring the safety of those who use it. Light sensors and smart thermostats can also be used to achieve efficient energy usage. With automated heating and cooling, you may reduce energy usage by 48% and save money. Along with these benefits, the primary purpose of home automation is to give users both comfort and peace of mind.

2. Introduction to technology

For dynamic hand gesture identification, we employed a CNN classifier. The hand gesture dataset utilised in this paper is briefly described in Section 2.1. The preprocessing processes for my model, the details of the classifier, and the training pipeline for the two sub-networks are described in sections 2.2 to 2.3. (Fig. 1). Finally, in Section 2.4, I describe a strategy for augmenting spatiotemporal data.

2.1 DATASET

I used a webcam to capture over 100 photographs of five different hand gestures in order to analyse the model. Each image has a resolution of 64x64 pixels.The colour image's skin pixels are removed and then converted to black and white. These black-and-white photos have been reduced to 50x50 pixels in size. Figure 1 shows a sample image for each of the five hand gestures.

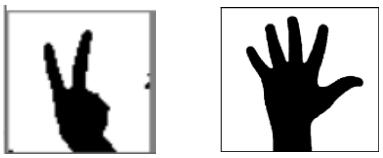

Fig -1: Name of the figure

2.2 OPENCV

OpenCV is a free, open-source and real-time image processing library which can detect and recognise a wide range of objects, but our current focus is on developing strategies and methodologies for detecting and recognising human hand movements. The application is provided by this library, however you will also require hardware components. In the hardware category, a built platform capable of running the OpenCV library, cameras, and 3D sensors such as Kinect are commonly used for image classification, object identification, and detection. 3D networks or CNNs are frequently utilised for image classification, object recognition, and detection. The outcome of backpropagation during training of CNN are kernel filters which are applicable in the convolution layers .

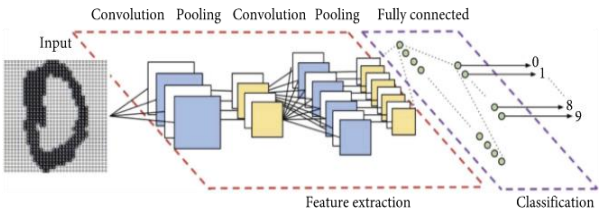

Fig -2: CNN

2.3 CNN

Some network architectures, including LeNet, InceptionResNetV2, InceptionV3, VGG16, VGG19, ResNet50, and DenseNet201, have already been defined in the literature.

The CNN input in image classification is an image represented by a random colour model. In the CNN layer, every neuron has a kernel window which is convolved during training of CNN with input image.

It's customary to apply a pooling layer after a convolution layer. This is significant because pooling lessens the dimensionality of feature maps, resulting in faster network training. Convolution and pooling are alternated in certain topologies; for example, GoogLeNet has 5 CNN layers and then by a pooling layer, lines, and texture.In subsequent layers, the retrieved features are further tuned. It is critical to stress that the values of the features, like edges, circles[4].

Ⅱ. LITERATURE REVIEW:

PAPER 1: Gesture based home automation system
Author: Arathi .N , S.Arthika and S.Ponmithra

Methodology:

The gesture is captured by the camera and handled by MATLAB software. If the preset gesture matches the gesture which is already there, the data is transferred to the microcontroller, which then controls the household appliances. A, PIC microcontroller, light, fan, camera,power supply, LED, and GSM module combinely make up the hardware module.

A USB to serial converter bus, which comes with driver software, is used to connect this hardware module to simulation software. A block diagram of the Gesture-based home automation system is shown below :

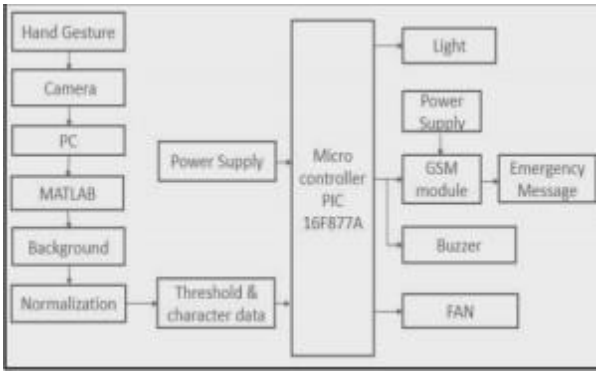

Fig -3: Microcontroller block diagram

Observation :

The image collected by the camera may be processed quickly using gesture detection which is based on the MATLAB simulation software tool. However, exact recognition is difficult to do since matching stored movements to existent gestures is a difficult operation.

The object detection method identifies the object immediately with high precision. This technology is more accurate than using a hand glove to recognise gestures.

The Arduino compatible with MATLAB simulation tool is more expensive and difficult to integrate with a PC than the MATLAB compatible with PIC microcontroller[2].

PAPER 2: Recognizing hand gestures for controlling home appliances with mobile sensors.
Author: Khanh Nguyen Trong , Ha Bui and Cuong Pham.

Methodology:

Smart watches containing accelerometers sensors and gyroscopes sensors, smartphones with finite storage, and popular smart home platforms were employed as devices and equipment in genuine smart home configurations. A proper hand gesture vocabulary based on an investigation

of real smart homes is provided using which users can recall and control their house effectively. To recognise hand movements, two deep neural networks are used: one is a DeepConvLSTM, which is a convolutional and recurrent network, and the other is a DeepConvLSTM, which is a combination of baseline deep convolutional neural networks (CNN)[4].

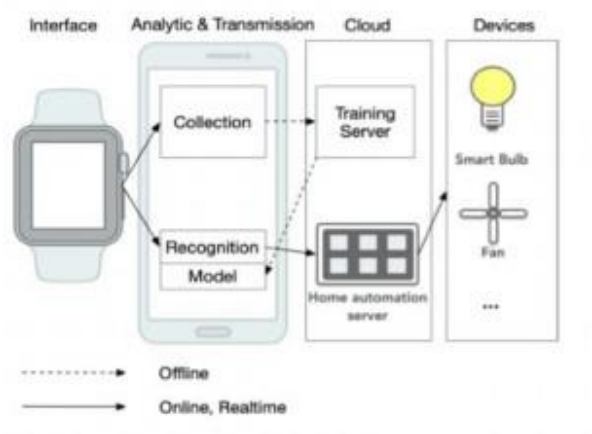

Fig -4: Name of the figure

Observation :
Hand gesture recognition can be completed entirely on a standard smartphone. As a result, users don't require to install more resources, making this system simple to use.

Paper 3: Hand Gesture Recognition and Interface via a Depth Imaging Sensor for Smart Home Appliances
Author: Dong-Luong Dinha , Jeong Tai Kimb , and Tae-Seong Kimc

Methodology:
A synthetic hand database is created, which includes hand part annotated maps. The information in this database is used to train RFs (Random Forests). The image is collected and a hand depth silhouette is extracted during the recognition stage. A synthetic hand database is created, which includes hand part annotated maps. Finally, hand motions were identified using the extracted features, resulting in interface commands[5].

Observation :
A unique hand gesture recognition system for device management in smart homes is provided in this paper, which uses identified hand parts and trained random forests from a hand depth silhouette. Over the four hand motions from five respondents, the average identification rate was 98.50 percent.

PAPER 4: Hand Gesture Recognition for Home Automation

Author : V. Savitha, J.Nandhini,S.Kokilavani G. Kalaiarasi and A.S.Narmadha IJRESM 2019

Methodology : The system's flow can be summarised as follows: Gestures are taken into account as input. For image processing, a MATLAB-based computer programme is employed. The gesture processing is done via a contour point detection technique.
Image Acquisition, Pre-Processing, Expectation Maximization Algorithm, Image Segmentation, and Gabor Feature Extraction are the processes. Data from the photos is transferred to an Arduino-based microcontroller after processing. This gear works similarly to a remote control in that it sends data to the gadgets[6].

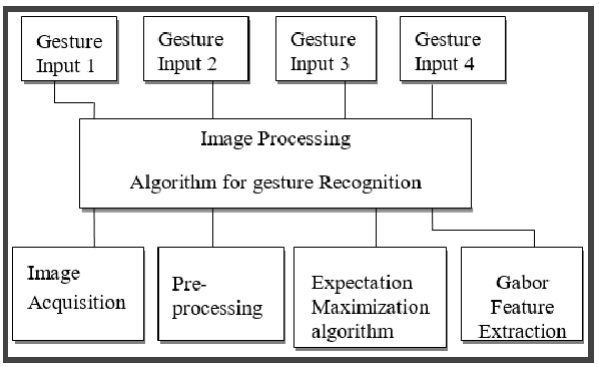

Fig -5: Image processing algorithm

Observation :

Hand movements from the database are captured in this suggested study, and the gesture is then analysed with the use of a simulation tool called MATLAB. Various threshold values are generated based on the motions made, and the arduino microcontroller controls the home appliances.This gesture identification algorithm is totally efficient for light backdrops, and the threshold values for gesture detection for dark backgrounds and noisy settings will differ.The gesture processing technique is based on the contour point detection algorithm, which is noiseless and effective in recognising each gesture. This technology is more accurate than using a hand glove to recognise gestures[5].

Ⅲ.Proposed method:

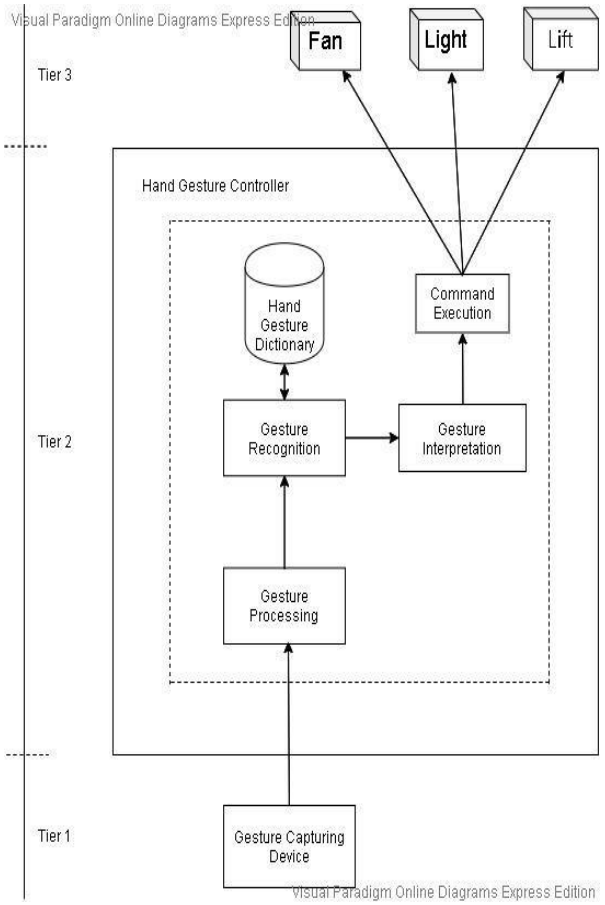

Fig -6: System Architecture

WORKING :

Anaconda is used to build the project. There are three major steps.

i) Data collection Data is gathered in order to train the neural network. Gestures captured with the webcam are kept in folders.

ii) Training

Machine learning models are put through their paces. Keras is used to create CNNs (convolutional neural networks). The classifier object is initialised using the sequential class. The neural network is the classifier object, and it has layers. The relu activation function is utilised. Pooling, CNN layers are employed and are linked. They aid in the filtering of images and the extraction of certain features from them. The classification is done in the output layer, and the activation function employed is softmax.

Images are now captured and supplied to the neural network to prepare the data for training. The number of photos in the training and test set are taken into account when training the model, training and test set.

iii) Make a prediction

During the training phase, new predictions are made using the model. The final step is to use the trained model to anticipate the gestures[1].

3. CONCLUSIONS

Ways to recognise hand gestures using various machine learning algorithms have been investigated in this review paper. The effectiveness and application of numerous approaches have been investigated. Four research papers were surveyed to see how to achieve the main goal, which is to use hand gestures to operate appliances. Each paper takes a unique strategy in achieving the intended result.

In the foremost paper, the use of a pic microcontroller and matlab, and gesture recognition is a difficult operation. Hence use of hand gloves allows for exact recognition of motions.

The subsequent paper suggests smartwatches and smartphones to be used to draw gestures onto them, which are then used to operate the gadgets. The plus point of using IoT principles is that users don't require to install any additional resources, making it more convenient for them to use this system.

To summarise, utilising machine learning and hand gestures, the user's input will be identified and the system's output will be remotely controllable appliances.

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