International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 3 Mar. 2021, pp: 183-189 www.ijaem.net ISSN: 2395-5252

Action Recognition for Controlling Electronic Appliances in Homes

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Submitted: 25-02-2021 Revised: 05-03-2021 Accepted: 10-03-2021

ABSTRACT: The basic goal ofthe Hand Gesture Recognition is to improve the interaction between users and electronic devices by making those devices more receptive to user needs. The use of a physical controller like remote, switches for human interaction with electronic devices available in homes hinders natural interface as there is a strong barrier between the user and electronic devices. In this project, a robust marker less hand gesture recognition system was designed which can efficiently, track the static gestures using TensorFlow Handpose Model. This system translates the detected static gestures into IR signals to perform actions for controlling electronic appliances. The static gestures are used to controlelectronic devices like Power(On/Off). As a result, intuitive interaction between human and electronic devices can be achieved with minimum hardware requirements using webcam integrated with the electronic devices to recognize hand gestures.

KEYWORDS:Hand Gesture Recognition, TensorFlow Handpose Model, Human Interaction, IR signal.

I. INTRODUCTION

Action Recognition using Image processing has come a long way in the past decades. The things that can be done, and the time spent on electronic devices has increased tremendously as well. Hand Gesture Recognition plays an important role in Human Interaction with electronic devices to improve the interaction between users and electronic devices by making the electronic devices more receptive to user needs. Human Interaction with electronic devices today is not just limited to key controlled remotes and switching based interaction. Interaction between human beings comes from different sensory modes like gesture, speech, facial and body expressions. Being able to interact with electronic devices naturally is becoming ever more important in many fields of Automation. The non-vision and Visionbased approaches have been used to achieve hand gesture recognition. An example of a non-vision-based approach is the detection of hand gesture movement with a pair of wired gloves. In general,Vision based approaches are more natural as they require no hand devices using Image processing techniques. The hand gestures are classified into two types such as static and dynamic gestures. Static hand gestures can be defined as the gestures where the position and orientation of hand fingers in space does not change for an amount of specific time. If there are any changes within the given time, the gestures are known as dynamic gestures. Dynamic hand gestures include gestures like waving of hand while static hand gestures include joining the thumb and the forefinger to form the different symbols and different orientations of fingers. This project aims to explore the existing system for hand gesture recognition in a common context. Most people use electronic devices in daily life in every aspect.The main focus of this project is to develop a system for controlling those electronic appliances using hand gesture recognition systems with greater accuracy and provide customization options to the system for better integration and compatibility with all sorts of devices.

II. LITERATURE SURVEY

Shashank Kotyan et.al.,author proposed ahome automation systemwhich is controlled by human actions such as hand gestures and fingerposes . This control by humans decreases the automation of home appliances to an extent. Most of the expanded home automation systems use the Internet of Things technology to control the electronic appliances used in day today life at homes. In this paper, they proposed a system which can fully automate the home appliances. They recognize the different actions of a humans like sitting, standing and lying along with the recognition of a bare room. The accuracy of the action recognition systemwas 90% in the real-life

test experiments. With this system,they remove the human intervention in home automation systems for controlling the home appliances and at the same time they ensure the data confidentiality and reduce the energy consumption by efficiently and optimally using those home appliances [1].

Ashish Sharma et.al.,author proposes a system to recognize and classify such hand gestures to their correct meaning with the maximum accuracy possible. Histogram of Gradients, Principal Component Analysis, Local Binary Patterns are the different preprocessing techniques used in this system. The proposed novel model is made using canny edge detection, ORB and bag of word technique. The preprocessed data is passed through several classifiers to obtain effective results. The accuracy of the new models has been found significantly higher when compared with the existing system. The proposed technique exceeds all the other pre-processing techniques for Naïve Bayes, Logistic Regression and KNN classifiers while PCA outstrip all the other techniques for MLP, Random Forest and SVM classifiers. Although the approach gives substantially greater accuracy for recognition ofhand gestures[2].

Jyoti Jadhav et.al.,author proposed a system for Hand Gesture controlled user interface. This system used to control the function of various electronic appliances. This system is basically created for the visually challenged people to assist them in operating the home appliances individually. MEMS accelerometer is used to detect hand motion and transmitted using Radio Frequency (RF) are used in this system. This paper poses a low-cost and 3-axis wireless accelerometer-based system to control the Home Electronic devices using ARM7. This system consists of a Gesture identifying and control module with Microelectromechanical systems sensor and home appliances control. ARM7 Is the main part of gesture identification. The MEMS sensor which is connected to hand is a xyz-axis accelerometer which senses the gesture of the hand and the home electronic devices control unit is controlled using LPC2138 controller. This project come up with a simple and easy Method of controlling the home appliances[3].

Rajalakshmi. J et.al.,author proposed a system for controlling electronic appliances by recognizing human action. Usually, sensors are used for tracing the pattern of action recognition like hand movements. Human action recognition and feature extraction are the main challenges of the system, which can be effectively overcome by using deep learning techniques. This approach uses deep learning technique by combining both RNN and CNN network for action recognition either in the form of images or signals. The system uses Mems accelerometer to recognize the gesture or human action and the CNN and RNN networks are used to perform the necessary function for each valid gesture. Combining both RNN and CNN networks will automatically extract the features from the raw data this results in accurate predictions[4].

Ria Nagonkar et.al.,author proposed a unique solution for physically challenged or blind people who find trouble in using electronic devices. This system makes use of well cameras to recognize various human actions such as identification of gestures and various hand moments. This gesture control system makes use of hands gestures with respect to real time image processing in infrared vision using Blob scanner and Arduino. This system is been mainly used for controlling various electronic home appliances. The main objective of the paper is to develop hand gestures based remote controlling electronic appliances which remove the need to look into hand held remotes and to search for a specific key or function in the remote[5].

Sagar P et.al.,author proposed accurate recognition for the detected hand postures using SIFT algorithm. The advantage of using the algorithm is high processing speed which can produce efficient recognition results. The SIFT features in the implementation will reduce the feature dimension vector, to compute at the edges which will be invariant to scaling, rotation, addition of noise. The hand gesture will be used in extracting the key points by scale invariance feature transform (SIFT) algorithm and reducethe dimension of feature vector of an image using Principle Component Analysis (PCA). SIFT features, proposed are features (key points) extractedfrom images to help in reliable matching betweendifferent views of the same object, image classification, and object recognition. The extractedkey points are invariant to scale, orientation and partially invariant to illumination changes, andare highly distinctive of the image. Therefore, the modifiedSIFT isadopted in dissertation work for the bare hand gesture recognition[6].

Mohammad Hasnain.R et.al.,author developed a smart IoT based light control system. Many instances occur in establishments where the electronic home devices are left turned on even if there is no human presence in a room due to human negligence and failed to turn off. This is one of the most outstanding cases of electricity wastage popular in society. Hence there is a need for an automated intelligent system that can ensure both

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efficiency and effectiveness.This project combines powerful modern technologies like IoT, Artificial Intelligence and Image Processing. In this proposed system, object detection methods are used which enable us to control appliances in a specific dimensional region. It also uses conventional IR blaster-based home automation systems which are more efficient than image processing methods. Conventional IR blasters necessarily come with an inconsistency where any and all objects that obstruct the infrared ray trigger whatever response the system was programmed to achieve. These actions can now be activated by any object that are not only meant for actual human beings. This produces an undesired outcome. This paper proposes a system which can efficiently utilize the lighting output and reduce the consumption of electricity by controlling the electrical appliances by detecting changes in the position of the human movements in the room[7].

Nikhil Anand et.al., author proposed a system to control Electronic home devices and gadgets using switches and infrared remote. Now it is the time build a new control system to replace the existing system. The main motive of this new system is to control the gadgets using finger movements and gestures. Home automation means to controlling the home appliances automatically. The proposed system work consists of fast algorithm for classify set of hand gestures using images. Algorithm based on MATLAB is used for this system. It is a tool used for image processing by capturing an image using camera in real time. The captured image of hand gesture is handled using MATLAB and it is related with preloaded hand gestures. If the captured image is matched with specified image then data is sent to microcontroller hardware and the hardware sends signals to devices just same as the remote control does to control it. This system can also be the best solution for the physically challenged peoples. The common hardware devices include camera, PIC microcontroller, fan, light, power supply, LED, GSM module. This hardware module is communicated with simulation software module using a USB to serial converter bus[8].

III. EXISTING SYSTEM

In the existing system MEMS accelerometer-based home appliances-controlled system is designed for visually challenged person and partially paralyzed persons. The existing gesture control system consist of accelerometer, microcontroller, one RF transmitter module and one receiver Module and the communication is through RF signals. The accelerometer is used to senses different hand gestures and appropriate signal is transmitted to receiver region through RF transmitter. The hand gestures are detected by using three axis MEMS accelerometers which is fixed in the gloves to be tattered by the person. RF receiver module receives the transmitted signal compares it with the previously stored gestures and when hand gestures are matched with each other, then the home appliances are controlled.Some systems also use hard coded recognition system and therefore makes it very difficult to upgrade the system.

IV. PROPOSED SYSTEM

In our proposed system TensorFlow Handpose Model is used to recognize and identify hand gesture where most of the hand gesture system uses edge detection and other action recognizing techniques using sensors.TensorFlow Hand pose Model provides more flexibility for gestures as it tracks the joints and other hand gesture features in accurate manner.So different hand orientation would make different gestures which can be easily recognized and identified with greater accuracy by using this model.If he recognized gestures are matched with specified gesture in pretrained module which then converted as IR signals respective to the gesture identified. The IR signals are used to perform actions for controlling electronic appliances and its parameters.

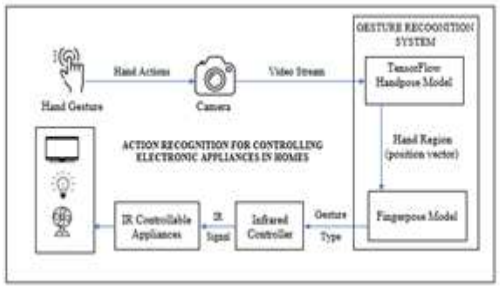

Fig 1.1. Block Diagram

V. WORKING PRINCIPLE

Our Gesture Recognition system is developed by utilizing TensorFlow Handpose model and pipelining with Fingerpose package and communicating with Arduino through USB serial port and controlling IR controlled devices through this. In case of any other computational unit like Raspberry pi and other Microprocessors, we are not in need of serial port communication. There are number of possibilities with this system on future upgradation, we can easily add Bluetooth and Wi-Fi communication to achieve centralized control system for all type of electronic appliances. We also have a good advantage over system with the ability to configure action through a simple UI.

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WEB CAMERA

A web Camera is a videocamera that feeds or capture an image or video in real time. A camera unit in the system will be continuously capture video steam and is attached with the video element in the webpage configured. It is important to have a Chromium based browser installed as we are accessing the camera through the browser for recognize the various hand gestures and also, we use browser specific functions.

TENSORFLOW HAND POSE MODEL

The video element is now passed to the Handpose model and it will process the frames and find the presence of hand in that frame and if found will find some reference points of the hand and return an array with all the found reference points as coordinates with video elements size as the measure.
Fig 1.2.TensorFlow Hand Pose Model

FINGERPOSE MODEL

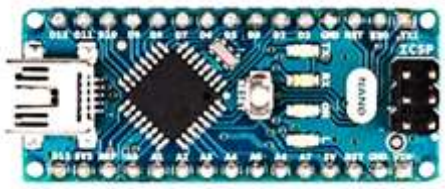
The Coordinates extracted by Handpose Model is now passed on to Fingerpose model and it has some methods to calculate the direction and curliness of each finger, hence providing us to define our own custom Hand Poses using these parameters. When the coordinates are passed in to it, it will compare it with all our defined gestures and provides result for each gesture telling how well the coordinate matches with the defined gesture. Our system will take up the gesture with high relevance and pass it on to the next stage.

Fig 1.3. Handpose Model

INFRARED CONTROLLER

The controller here refers to Arduino, the IR code for the resultant gesture from previous stage is retrieved from the database and send to the controller via USB serial port and it is used by the controller to pass on the IR Signal through the IR transmitter. TheController here is also used to register new IR signal.
Fig 1.4. Arduino Nano

IR REMOTE



It is an IR Transmitter that is given along with IR controllable devices and it sends specific data as IR Signal when we press each button, The data is the one which is used to make different actions on a device.

Fig 1.5. IR Transmitter

INFRA RED RECEIVER

It is a component that receives the IR encoded signals and convert itinto digital format which can be processed by the computational unit.

The Name of the signal is received through an User Interface and it is then saved along with the code in the database for further use. By this way we can add new IR signals to our system and control any IR controlled system.

Fig 1.6. IR Receiver

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VI. EXPERIMENTAL SETUP

In our experiment we developed a hand gesture recognition system for controlling electronic appliances. The hand gestures are captured as a video stream using web camera integrated with computationalunit. The recognised hand gestures are processed using TensorFlow Handpose model with Fingerpose model to identify the hand gesture specified using JavaScript defined with hand gesture coordinates.The various type of hand gesture is identified using above model and it is connected with IRcontroller unit which is Arduino Nano throughUSB serial port. The actions configured with respective hand gestures in simple user interface where we can customize our own gestures with various action parameters.

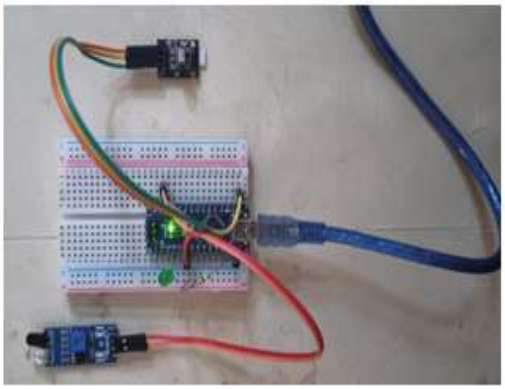

Fig 1.7. Experimental Setup

For developing User Interface for the Gesture Control System and configurations, we have used NodeJS, MySQL, Sequelize ORM, VueJS, CSS, C++.

Fig 1.8. UI to Configure New IR Signals

If the recognised hand gesture is matched with the gesture configured in the database, the respective IR code signal for the matched hand gesture is transmitted to the IR receiver from IR transmitter connected with Arduino Nano. The IR receiver connected with electronic appliances like Tv, fan, light etc. Based on the IR signal the respective actions are performed for controlling the devices and its parameters.

Fig 1.9. UI to Configure Actions

VII. RESULTS

As a result,our hand gesture recognition system able to control electronic appliances such as television controlling parameters like power (ON/OFF), volume (Increase/decrease), channel (Increase/decrease).

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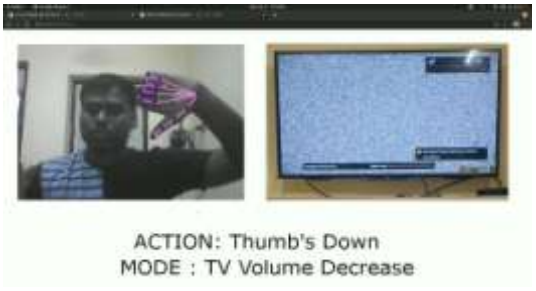

VIII. CONCLUSION

Our project focus is to develop a robust gesture recognition system that does not utilize any hardware components or markers to control home appliances, hence making it more user friendly and low cost. The system translates the detected hand gesture into IR Signal code which is used to perform actions for controlling electronic devices in homes rather than using IR controlled remote systems and key controls.

IX. FUTURE WORKS

In future we would like to improve the accuracy further and add more gestures to implement more functions to manage and control home appliances at ease of hands. Finally, we target to extend our domain scenarios and apply our action recognition tracking mechanism into a variety of hardware components used in daily life. We also aim to extend this mechanism to a range of users including differently abled users and aged people.

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International Journal of Advances in Engineering and Management
ISSN: 2395-5252

IJAEM

Volume: 03 Issue: 03 DOI: 10.35629/5252

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