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## Development of Real Time Hand Gesture Recognition for Dumb and Deaf using Machine learning and Deep Learning

1Tushar Shelke, 2Vaishnavi Nerkar, 3Trupti Nandanwar, 4Neha Barapatre, 5Diksha Umare  
1Assistant Professor, Department of Information Technology, Nagpur Institute of Technology, Nagpur, Maharashtra, India.

2,3,4,5UG Students, Department of Information Technology, Nagpur Institute of Technology Nagpur, Maharashtra, India.

**Abstract:-** *In past few decades there is a rapid growth in the rate of talented people. They are using best use of them. But in case of dumb people situation is different due to their issues. We all know that they are also as talented as normal people. For them, Now using new age technology and strategic approach, We are developing hand gesture recognition for dumb and deaf people. As this is helpful to communicate with them and they also can communicate with each other. This project develop “Development of video based hand gesture recognition and it’s conversion into speech for dumb and deaf people using deep learning and machine learning” in managing the communication between other and themselves. The hand gesture recognition will recognize the gesture of the person and using various libraries convert it to text and also audio format . This project also aims at encouraging further research in the topic of deep learning based numeric and alphabetical library used system.*

*Talking about gestures makes us return to the historical beginning of human communication, because, in fact, there is no language completely free of gestures. People cannot communicate without gestures. Any action or movement without gestures is free of real feelings and cannot express the thoughts. The purpose from any hand gestures recognition system is to recognizes the hand gesture and used it to transfer a certain meaning or for computer control or and device. Our paper introduced a low cost system to recognize the hand gesture in real-time. Generally, the system divided into five steps, one to image acquisition, second to pre-processing the image, third for detection and segmentation of hand region, four to features extraction and five to count the numbers of fingers and gestures recognition. The system has coded by Python language, PyAutoGUI library, OS Module of Python and the OpenCV library.*

### I. INTRODUCTION

In this paper, Gesture recognition is a technique which is used to understand and analyze the human body language and interact with the user accordingly. This in turn helps in building a bridge between the machine and the user to communicate with each other. Gesture recognition is useful in processing the information which cannot be conveyed through speech or text. Gestures are the simplest means of communicating something that is meaningful.

If there is a common interface that converts the sign language to text the gestures can be easily understood by the other people. So research has been made for a vision based interface system where D&M people can enjoy communication without really knowing each other's language. The aim is to develop a user friendly human computer interfaces (HCI) where the computer understands the human sign language. There are various sign languages all over the world, namely American Sign Language (ASL), French Sign Language, British Sign Language (BSL), Indian Sign language, Japanese Sign Language and work has been done on other languages all around the world.

This paper involve implementation of the system that aims to design a vision-based hand gesture recognition system with a high correct detection rate along with a high-performance criterion, which can work in a real time Human Computer Interaction system without having any of the limitations (gloves, uniform background etc.) on the user environment. The system can be defined using a flowchart that contains three main steps, they are: Learning, Detection, Recognition as shown in Figure 1.

## Learning

It involves two aspects such as

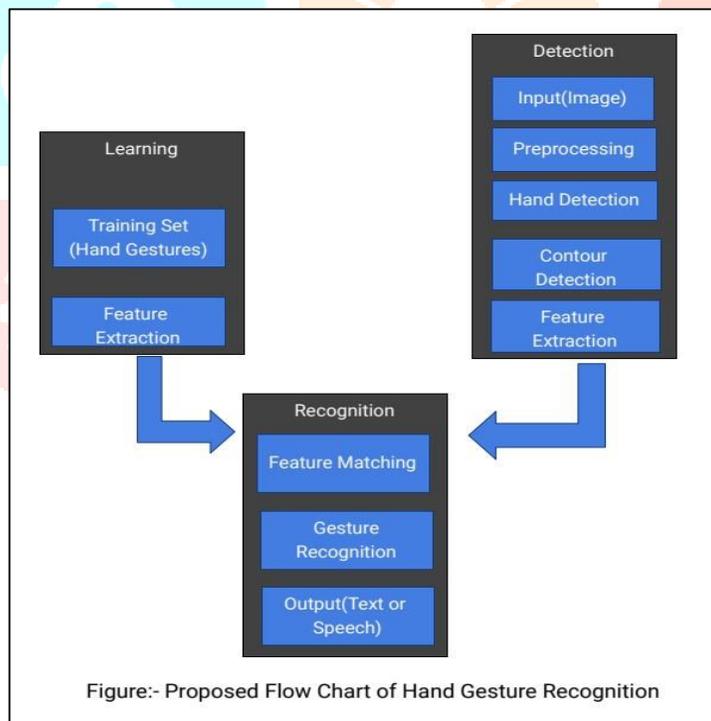
- Training dataset: This is the dataset that consists of different types of hand gestures that are used to train the system based on which the system performs the actions.
- Feature Extraction: It involves determining the centroid that divides the image into two halves at its geometric Centre.

## Detection

- Capture scene: Captures the images through a web camera, which is used as an input to the system.
- Preprocessing: Images that are captured through the webcam are compared with the dataset to recognize the valid hand movements that are needed to perform the required actions.
- Hand Detection: The requirements for hand detection involve the input image from the webcam. The image should be fetched with a speed of 10 frames per second. Distance should also be maintained between the hand and the camera. Approximate distance that should be between hand and the camera is around 30 to 100 cm. The video input is stored frame by frame into a matrix after preprocessing.

## Recognition

- Gesture Recognition: The number of fingers present in the hand gesture is determined by making use of defect points present in the gesture. The resultant gesture obtained is fed through a 3Dimensional Convolutional Neural Network consecutively to recognize the current gesture.
- - Performing action: The recognized gesture is used as an input to perform the actions required by the user.



## II. LITERATURE SURVEY

In This project presents the critical analysis of the existing literature which is relevant to the IOT based garbage monitoring system. Though, the literature consists of a lot many research contributions, but, here, we have analyzed some of the research and review papers. The existing approaches are categorized based on the basic concepts involved in the mechanisms. Finally, the findings are summarized related to the scanned and analyzed research papers. Chapter concludes with the motivation behind the identified problem.

Sr.No	Title of the Project	AUTHOR	OBJECTIVES	LIMITATIONS
[1]	Hand Gesture Recognition using Machine Learning Algorithms. (1 May 2019)	1.Abhishek B 2.Kanya Krishi 3.Meghana M 4.Mohammed Daaniyal 5.Anupama H S	This paper describes how the implementation of the system is done based upon the captured images and how they are interpreted as gestures by the computer to perform actions.	The system does not provide the voice whenever the gesture is detected.
[2]	A new hand gestures recognition system. (April 2020)	1.Ahmed Kadem Hamed Alsaedi 2.Abbas H. Hassin Alsadi	This paper recognized six gestures and solved the challenges of rotation ,orientation and scaling and got the same results.	The system provide limited gestures and they used only right hand.
[3]	Static Hand Gesture Recognition Using Artificial Neural Network. (March 2013)	1.Trong-NguyenNguyen 2.Huu-Hung Huynh	This paper mainly advantages in low computational cost features for identification and easy to install and execute in real time.	The system limitation still need to overcome to make this method more effective such as differentiating different gestures.

- I. M.M. Hassan applied scaled normalization for gesture recognition based on brightness factor matching. Initially, the input gesture image is divided into 25x25 blocks (each of 5x5 block size), which is then colour segmented by HSV colour model and thresholding technique. Each segmented images are normalised by using centre of mass technique. After being normalized according to its respective normalization technique, these images are then being analyzed by using local brightness value mathematical equation.

$$\text{Recognition(\%)} = \text{number of matched features} / \text{total number of blocks} * 100\%$$

- II. Thomas et. al on the other hand had compared three different types of methods which can be used to recognize hand gestures. These three methods are pixel-by-pixel comparison, edges method and orientation histogram. Pixel-by-pixel comparison is a method where each and every frame is being compared with the image in the database. Edges method on the other hand is used to find out which portion of the image produce the highest gradient value. Orientation histogram method is actually a method where it combines both edges method and pixel-to-pixel comparison method. Each pixels of the image (x,y) has its own gradient. If the gradient magnitude is greater than threshold, the gradient direction is detected and the frequency is incremented. As the last steps, all three methods (pixel-by-pixel comparison, edges method and orientation histogram) used Euclidean Distance to determine the differences between image and its database.

III. Dnyanada R Jadhav, L. M. R. J Lobo, Navigation of PowerPoint Using Hand Gestures, International Journal of Science and Research (IJSR) 2015.

IV. Ruchi Manish Gurav, Premanand K. Kadbe, Real time finger tracking and contour detection for gesture recognition using OpenCV, IEEE Conference May 2015, Pune India.

V. Pei Xu, Department of Electrical and Computer Engineering, University of Minnesota, A Real-time Hand Gesture Recognition and Human-Computer Interaction System, Research Paper April 2017.

VI. H.S. Yeo et. al and A. Dhawan et. al on the other hand implies quite similar technique of feature extraction in their research. Both researchers employed convex hull and convexity defects method to determine both hand and fingertips contours. However, they used difference type of input sources in their researches. A. Dhawan et. al only focuses on single camera as an input source, while H.S. Yeo et. al compares the results of image recognition using single camera and depth camera. In H.S. Yeo et.al studies, he has proved that user can interact with computer without using any physical controllers. Another findings by H.S. Yeo et. al , single camera does not works well under low light condition.

Table 1 shows summary of some hand gesture recognition system: comparison between hand gesture recognition methods are used.

Research	Method	Detection	Feature Extraction	Recognition
M.Hassan, P.K Mishra	Vision-based using single camera	HSV colour space/Threshold method	Classical normalization:Divide the hand image into blocks of intensity features, which is then being extract by using edge information technique.	Classical normalization91%
Ginu Thomas	Vision-based using single camera	RGB colour space/ Otsu	Image captured are being tested in few methods:a)pixel by pixel comparisonb)Edges method	Pixel by pixel method 86% Edges method 92%
H.S. Yeo, B.G. Lee,H.Lim	Vision-based comparision using single and depth camera	YCrCb colour space/ Threshold method	Fingertips recognition by using convexity defects method and convex hull result method around hand contours	Depth camera produced better compare to camera single camera

## **Problem Statement:**

-The aim of this project is to build a machine algorithm - i.e. given an input video of someone signing a word, the model should be able to predict which word is being signed. -The model built should be reasonably robust to variations in camera angle, video quality, distance from the camera to the subject, variations in lighting etc. It has high relevance in the lives of not only the deaf-dumb, but also anyone who interacts with them.

-There are 1.1 million deaf-and-dumb people in India. 98% of these people are illiterate, making sign language their only method of communication. This trend is not expected to change anytime soon, as only 2% of deaf children attend school. **-Relevance in India-** The number of people in the country with hearing impairment was estimated at 13 lakh in the 2011 Indian census. However, this could be a case of significant under-reporting: The National Association of the Deaf estimates that there are 1.8 crore people who are deaf.

## **PROPOSED APPROACH:**

To recognize different hand gestures and achieve efficient classification to understand static and dynamic hand movements used for communications.

This paper presents an overview on several methods to realize hand gesture recognition by using three main modules: camera and segmentation module, detection module and feature extraction module. There are many methods which can be used to get the respective results depending on its advantages. These gestures are processed using hand gesture recognition algorithms such as Hidden Markov models(HMM), Support Vector Machine(SVM).

## **III IMPLEMENTATION**

A hand gesture recognition system was developed to capture the hand gestures being performed by the user and to control a computer system based on the incoming information. Many of the existing systems in literature have implemented gesture recognition using only spatial modelling, i.e. recognition of a single gesture and not temporal modelling i.e. recognition of motion of gestures. Also, the existing systems have not been implemented in real time, they use a pre captured image as an input for gesture recognition. To overcome these existing problems a new architecture has been developed which aims to design a vision-based hand gesture recognition system with a high correct detection rate along with a high-performance criterion, which can work in a real time HCI system without having any of the mentioned strict limitations (gloves, uniform background etc.) on the user environment. The design is composed of a human computer interaction system which uses hand gestures as input for communication as shown.

Input to the system is from the web camera or a prerecorded video sequence. Later it detects the skin color by using an adaptive algorithm in the beginning of the frames. For the current user skin color has to be fixed based on the lighting and camera parameter and condition. Once it is been fixed, hand is localized with a histogram clustering method. Then a machine learning algorithm is been used to detect the hand gestures in consecutive frames to distinguish the current gesture. These gestures are used as an input for a computer application as shown in Figure 3. The system is divided into 3 subsystems:

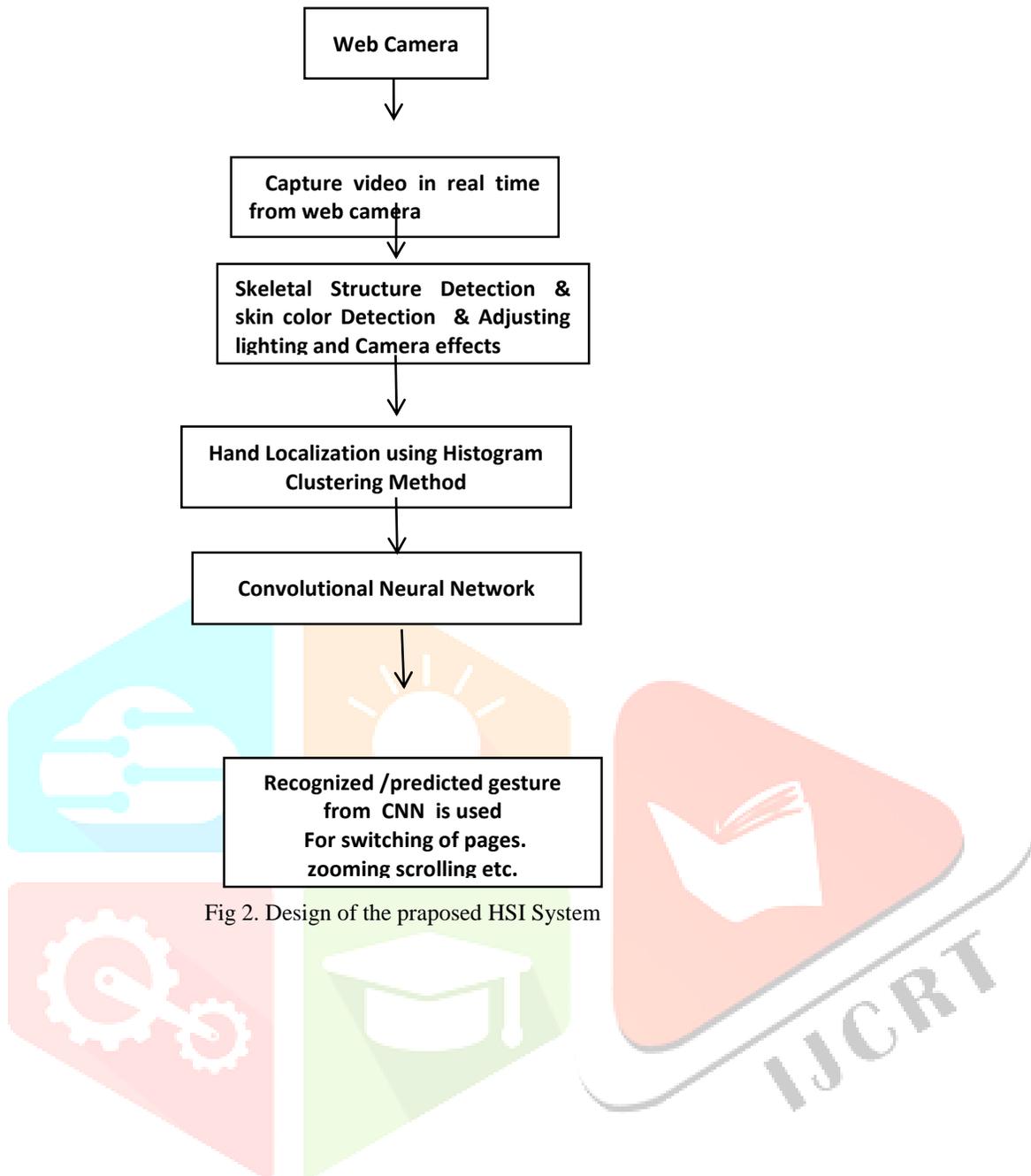


Fig 2. Design of the praposed HSI System

## Hand and Motion Detection

The Web-camera captures the hand movement and provides it as input to OpenCV and TensorFlow Object detector. Edge detection and skin detection are performed to obtain the boundary of the hand. This is then sent to the CNN.

## Dataset

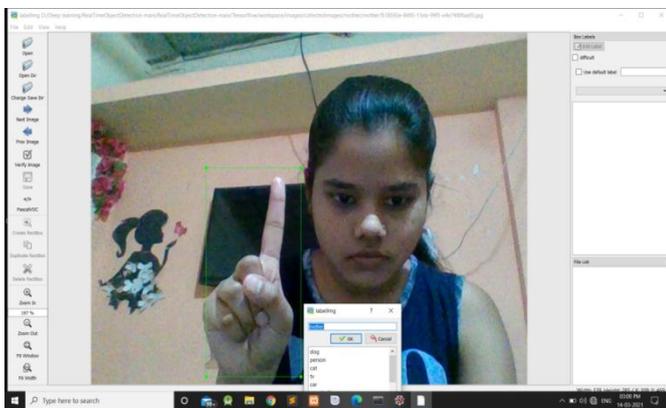
Dataset is used for training the CNN. Two types of datasets are being used – one for the hand detection and the other for the motion or gesture detection. Hand detection uses EGO dataset, Motion or Gesture Recognition uses Jester dataset.

## CNN

CNN's are a class of deep learning neural networks used for analyzing videos and images. It consists of several layers – input layer, hidden layers and output layer. It performs back propagation for better accuracy and efficiency. It performs training and verification of the recognized gestures and human computer interactions take place – turning of the pages, zooming in and zooming out. The interactions with the computer take place with the help of PyAutoGUI or System Call.



Img1. action of women in sign language



Img2. by using both images the action is completed for mother in sign language

## CONCLUSION

The importance of gesture recognition lies in building efficient human-machine interaction. This paper describes how the implementation of the system is done based upon the images captured. Hand detection is done using OpenCV and TensorFlow object detector. And further it is enhanced for interpretation of gestures by the computer to perform actions like switching the pages, scrolling up or down the page.

## ACKNOWLEDGEMENT

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