Recognition of Hand Gesture for a Paralytic Person Using Convolutional Neural Network

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Abstract: ***According to the Indian statistics, the stroke rate is higher compared to other countries. It is approximately 1.8 million Indians out of 1.2 billion Indians suffering from stroke every year. As a result of this brain cells get damaged which leads to paralysis. To help the stroke patients out of its researchers have found a solution by creating hand gestures that will help them perform daily functions easily. The gesture made by hand will be the input instead of a mouse or keyboard. The main aim is to read and detect the hand gestures by using high-resolution cameras and process the images using convolution neural networks by the process of edge detection.***

Keywords: Hand gesture, Convolution Neural Network, Edge Detection.

I. INTRODUCTION:

The hand gesture is a mode of communication in which the motion of the hand can be recognized. The aim of hand gesture recognition of a paralytic person can be done through edge detection. In this way, we can easily recognize the hand gesture of a paralytic person.Hand signal acknowledgment is considered a noteworthy issue since motions fluctuates among people and for the same individual depending on various settings. The difficulties in this innovation are lightning conditions and quick hand developments. The practical implementation of hand gesture recognition requires devices like high-resolution cameras to track hand movements. In this process, we must deal with many problems like identifying gestures, illumination changes, hand movement, complicated background, and self-occlusions. This paper describes the hand gesture recognition of a paralytic person using a convolution neural network where the system gets trained by both the input and the output based on edge detection. The system is trained with a real-time dataset obtained from the high-resolution cameras. Input from the high-resolution cameras is compared to the training set given to the system and the desired action is given as output.In this paper, we use the concept of edge detection where it can be done by using two major methods that are by MATLAB and by PYTHON. Here in this paper, we are programing with python since it is an open-source platform. Open cv, NumPy, pandas are the various packages used for image processing. We utilize the gaussian technique to decrease the commotion present in the picture and it obscures the foundation and it even improves the quality of the image. We use the Canny Edge detector for the detection of the hand gesture of a paralytic person where he/she is bedridden and can only move their hands. Hence, by this method, we can help them in their day-to-day activities. This algorithm is even more helpful because it detects the object even in a moving background.

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II. LITERATURE SURVEY:

Bhushan Bhose et al [1] describes a Neural network using simple pixel counting analysis. This recognizes the number of fingers in front of the web camera and does counting analysis. The hand signal acknowledgment framework has advanced enormously in an ongoing couple of years. This is a direct result of its capacity to cooperate with machine productively and made simpler for the confined to bed patient to utilize. The literature review conveys many methods used by the authors such as simple pixel counting analysis, back propagation learning, artificial neural network, MATLAB with GUI, python and all other methods for this purpose.

D. Gawande et al [2] presented neural network-based hand gesture recognition. Here, the Neural network is been classified by backpropagation learning algorithm and edge detection. The neural system is based on the order by utilizing back engendering learning calculation. American sign language is recognized. Edge detection is used. It can be used in only high-level computation and not in a low-level computation model.

Tasnuva Ahmed [3] he had introduced a continuous hand motion acknowledgment framework. This framework comprises three phases: picture obtaining, include extraction, and acknowledgment. The program is developed in Matlab for a neural network to recognize the number of fingers in front of a web camera. Web camera gives images of lower quality. A simple pixel counting analysis algorithm is used. Run time errors are more due to Matlab so we are switching to python.

A Study on Different Hand Gesture Recognition Techniques was finished by Anju SR [4]. In any case, it depended close by division, continuous signal acknowledgment, neural system shape fitting, and finger earth mover's separation. This method presents a continuous hand motion acknowledgment framework. This framework comprises three phases: picture obtaining, include extraction, and acknowledgment. The proposed methodology applies a PC vision procedure that is adaptable, sound act continuously execution. The presentation of the framework tried on genuine information. The downside is that it can't

work in any lighting condition and grow the framework to perceive the hand following.Ashwin Yadav et al [5] developed a Gesture Recognition Via Neural Network that will speed up the automation of applications and this method will immensely overcome the problem of communication for disabled people. This method gives an investigation on four distinct strategies close by motion acknowledgment dependent available division, ongoing motion acknowledgment, neural system shape fitting, and finger earth mover's separation. The primary strategy to hand motion acknowledgment was tried on 70 examples of green shading glove and skin shading. Mix-ups happen because of false highlight extraction and bogus estimation of hand incline Time required for acknowledgment on a 3Ghz CPU is 1.5s. Rafiqul Zamar Khan, Cijo Paul et al [6, 7], they have proposed Hand Gesture Recognition using Neural Network, HMM, fuzzy c-means clustering, and Seed fill algorithm is used. Gesture Recognition Via Neural Network. The system if developed will greatly overcome the problem of communication for disabled people. It can speed up the automation of applications in a certain place of work. Will act as an automation tool. It overcomes the labor of nurses and caretakers of disabled people. Designing the framework architecture for the system. It can be a challenging part to make a framework dynamic. It cannot help people with hand impairment. The void in the education system can be found. The framework is to make a characteristic association among humans and PC where the perceived signals can be utilized for controlling a robot or passing on important information. Recognition strategies incorporate from Neural Network, HMM, fluffy c-implies grouping, other than utilizing direction histogram for highlights portrayal. Fluffy c-implies bunching calculation connected in has a few burdens; the wrong object extraction issue raised if the articles are bigger than the hand. The exhibition of acknowledgment calculation diminishes when the separation more noteworthy than 1.5 meters between the client and the camera. Other than that, its variety of lighting condition changes and undesirable articles may cover with the hand signal.

Hand Gestures Detection and Recognition Building System for Stroke Patients utilizing Supervised Neural Networks done by Azmi Shawkat Abdulbaki et al[8]. The possibility of the calculation is perusing hand signals (HS) by high goals camera and handled by the PC after managed neural systems connected The library has been created remembering adaptability and in this manner gives application engineers a wide scope of options. Seed fill calculation is used. This library has been created utilizing the MATLAB (R2013a) environment. More entangled signals can be added to the library, for example, perceiving the finger type, (for example, pointer or thumb). Data isn't ensured as it is an open domain. Hand Gestures Detection and Recognition Building System for Stroke Patients utilizing Supervised Neural Networks. The proposed model is worked by utilizing administered neural systems (SNN). The possibility of this calculation is perusing hand signals (HS) by high goals camera and handled by the PC after regulated neural systems applied. Then the framework relies upon hand movements. This strategy can't be controlled remotely. This procedure can be made a remote method, particularly faraway patients.

Neha V. Tavari [9] distributed the Implementation of Neural Network-based Hand Gesture Recognition System where a counterfeit neural system based arrangement with blunder backpropagation calculation is utilized for perceiving various signs and interpret them into content and voice design.. A counterfeit neural system based grouping with blunder backpropagation calculation is utilized for perceiving various signs and interpret them into content and voice format. Developing such a framework interpreting communication via gestures to content/voice arrangement will demonstrate exceptionally helpful for physically weakened individuals of India. Input innovations appear to cause a noteworthy bottleneck in playing out a portion of the assignments, under-using the accessible assets and limiting the expressiveness of utilization use.Hand Gesture Recognition System Using Camera was displayed by Viraj Shinde et al [10] where the paper centers around utilizing pointing conduct for a characteristic interface. It centers on utilizing pointing conduct for a characteristic interface, Hand motion acknowledgment based human-machine interface. This method exhibits some low-intricacy calculations and motions to lessen the motion acknowledgment multifaceted nature and be progressively appropriate for controlling ongoing PC systems. Web cameras are utilized which does not work in low light.SQL is utilized which sets aside a great deal of effort to identify.

III. OBJECT DETECTION:

It is the technique in image processing which deals with detecting objects of different classes (buildings, cars, human face, etc.) in videos and digital images.

A. Removal of noise:

Advanced pictures are inclined to different kinds of clamor and commotion must be evacuated for appropriate picture acknowledgment. There are a few calculations that can be utilized for diminishing commotion in the pictures. The Gaussian channel is utilized to diminish the commotion and smoothen the picture. Gaussian channel decreases the difference and obscures the picture that is it diminishes the clamor in the picture. Gaussian obscuring of a picture resembles convolving the picture with Gaussian capacity. Convolving by the circle is increasingly precise to imitate the bokeh impact which makes the undertaking of edge identification more straightforward and simpler. Consider a be the good ways from starting point to the flat pivot, b be the good ways from birthplace to the vertical hub and s be the standard deviation of the Gaussian appropriation. Then, the Gaussian function in two-dimension is given by:

$$g(a,b) = \frac{1}{2\pi s^2} * e^{(-a^2 + b^2)/2s^2}$$

For one-dimension is given by:

$$g(a) = \frac{1}{\sqrt{2\pi s^2}} * e^{(-a^2)/2s^2}$$

B.Non-maximum suppression:

The next major work is to find out the largest edge, this is done by using non-maximum suppression which makes the edge thin. Since the edge must be marked only once in the image there must be only one response to the edge. This algorithm helps to suppress all the edges except the largest one, which indicates the sharpest change in the intensity value. The intensity

gradient can be found using operators such as Roberts, Prewitt, and Sobel. These operators give the first derivative of horizontal and vertical directions which can be used to compute the intensity gradient of a pixel. In the wake of computing the force slope, non-most extreme concealment calculation is connected to the picture which finds the biggest edge in the picture.

C. Double thresholding:

After the non-maximum suppression there persist some edge pixels that are due to color variation or noise. This can be removed by applying a double threshold. Thresholding distinguishes the object from the background. It is important to remove these edges with a weak gradient and retain the one with a high gradient. This should be possible by choosing low and high edge esteems. The edge pixel slope esteem that is more prominent than the edge worth is set apart as solid edge pixels and the rest as powerless edge pixels.

Otsu's method is used for double thresholding in this paper. This method separates the pixels into foreground and background based on the intensity. The threshold in this method is obtained by minimizing the intraclass intensity or by maximizing inter-class intensity.

D. Edge detection:

This is trailed by the edge recognition which is finished utilizing the Canny edge identification calculation. It is one of the most carefully characterized techniques that gives a dependable location. It is a multistage calculation used to identify a wide scope of edges in each picture. It is considered as one of the most ideal calculations utilized for edge location.

E. Image Recognition:

We have utilized Convolution Neural Network which is a class under the profound neural system. A convolution neural system comprises of an info layer, a yield layer, and some various concealed layers. The shrouded convolution layers by and large comprise of the arrangement of convolutional layers that convolve with some increase or another speck item.

IV. HAND GESTURE DETECTION

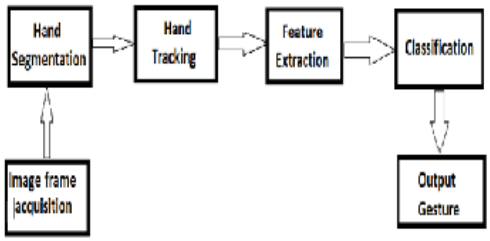

Fig 1: hand gesture detection

In our analyses, the hand motion pictures are caught by high goals advanced camera. The yield of this camera is an RGB picture. In any case, in our present framework, we are not utilizing the shading data, the principal method for pre-preparing is desaturation procedure to change over the picture into a dim scale picture. In the second method for pre-handling, the dim scale picture is prepared to utilize an edge indicator by the idea of watchful edge recognition. Firstly, the image is extracted from the video (continuous images). The image is then enhanced using the gaussian filter. The Gaussian filter removes the noise and blurs the edges in the image. This is then trailed by the non - greatest concealment, which is utilized to locate the longest edge in the picture. The longest edge is discovered utilizing the force inclination of every pixel.The pixel having a high-intensity gradient (i.e. more than the threshold) is considered as the strong pixel and the rest as the weak pixel. By doing so we can find the longest edge of the image.Shrewd edge discovery calculation is utilized to recognize the edges of the item. Watchful edge identification is considered as probably the most grounded calculation and known for its exactness. This algorithm gives more accurate results. The image after edge detection is then compared by the system with the input set to give the appropriate action as a result. The result will be the action which the paralytic person wants to perform.Below are the input gestures that we are going to use in our research

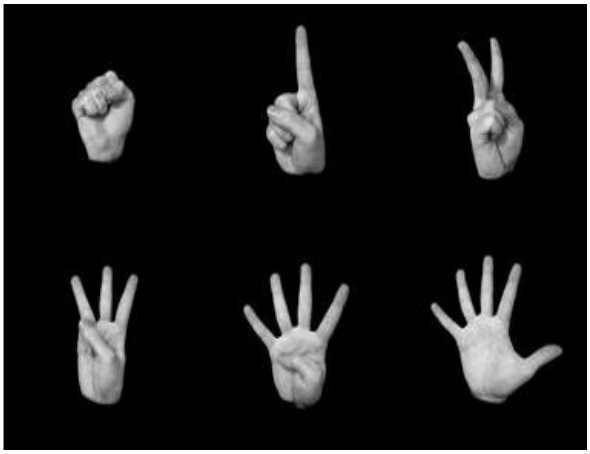

Fig 2: Hand Gestures

V. ALGORITHM:

Algorithm of the Canny edge detector is as follows:

Canny edge detection should fulfill the following three criterion's:

1. The error rate should below that is the edge present in the image should not be missed and the edge that is not present should not be included.
2. There should be good localization of the pixels which is the separation between the edge pixels found by the framework and the genuine one ought to be least.
3. There should be a single response from each pixel that is a pixel that must not have more than one response to the intensity.

The algorithm is described as follows:

1. To find the horizontal and vertical gradient of each pixel of the image.

Input: a- distance of horizontal axis from the origin.

b- a distance of vertical axis from the origin.

s- standard deviation of Gaussian distribution.

G(a)- intensity gradient along the horizontal axis.

G(b)- intensity gradient along the vertical axis.

Then, the Gaussian function in one-dimension is given by:

G(a)=(1/sqrt(2*3.14*s^2))*e^(a^2/2s^2)

G(b)= (1/sqrt(2*3.14*s^2))*e^(b^2/2s^2)

2. For each pixel intensity and direction is found out.

Using the above values total intensity gradient is found out using the formula:

$$G = sqrt(G(a)^2 + G(b)^2)$$

The direction is given by:

An = Xtan2(G(b), G(a))

3. In the non-maximum suppression, all the non-maxima are made to 0.

If (pixel = non-maxima):
Pixel=0;
Else:
Pixel=1;

4. High and low thresholds are measured.

High_threshold = max(G)
Low_threshold = min (G)

5. The edges with high threshold are called strong edges and the ones with the threshold value in between low and high are considered weak edges. The weak edges connected to the strong edges are also considered as strong edges.

If (G >=High _threshold):
Pixel=edge;
Else:
Pixel! =edge;

VI. RESULT:

The output for the given input is as follows:

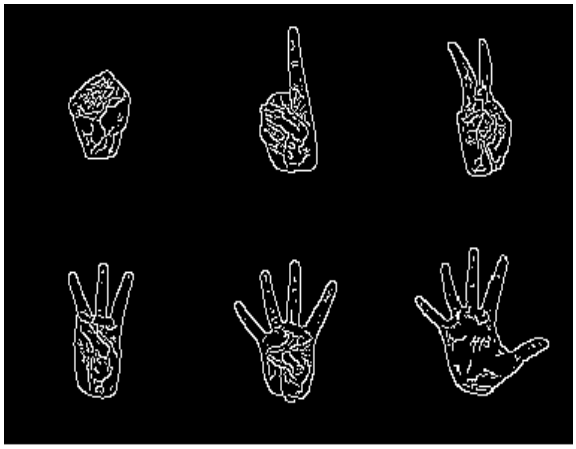

Fig 3: Output gestures

We have taken six gestures as a sample input to train the system and tested them with a test set. To develop the real-time hand gesture recognition system, we have used python which is an open-source programming language and has high performance in computation. We have used 9000 images of greyscale to train the system and is tested using 1800 images. The accuracy of this algorithm is found to be 99.8%.

VII. CONCLUSION:

In this paper, we center around the idea of hand signal acknowledgment. Our examination delineates that the framework utilizing just desaturation as a pre-preparing step gives the most noteworthy presentation. Edge recognition is utilized to make the framework too touchy to even consider shifting close by position in info pictures.A neural network is one of the most efficient ways to reduce the rate of errors. The main idea of this research is to implement a system that will aid in the interaction between machines and humans using hand gestures as the control commands.In the future, the hand signal acknowledgment calculation will be improved. We will consolidate the skin shading identification into the system, and we can even join various sorts of hand acknowledgment. We will likewise attempt to actualize the framework with a technique to control a robot. In the future, this examination can be changed into some other condition.

Table1: Comparison between the accuracy of the algorithms

S No.	Neural network type	Accuracy
1	**Convolutional neural network**	**98.8%**
2	Error back propagation	98.52%
3	Supervised neural network	90%
4	Feed forward back propagation	91.66%
5	Scale space feature detection	93.8%
6	Elastic graph matching technique	86.2%

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