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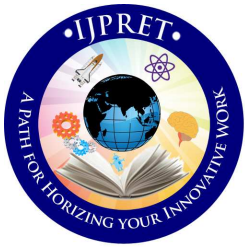

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A PATH FOR HORIZING YOUR INNOVATIVE WORK

DEVELOPMENT OF GESTURE RECOGNITION SYSTEM

ALISHA BEE SHAIKH, H.G.VIRANI

Department of electronics and telecommunication engineering, Goa college of engineering.

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Corresponding Author

Ms. Alisha bee Shaikh

Abstract

This paper presents method for hand gesture recognition based on neural networks. The paper deals with static hand gestures. The starting point of the project is the creation of a image database. This database will have all the hand gesture images that would be used for training and testing. The image database in this project contains photographs. These images are converted into grayscale first. A pattern recognition technique is used. The paper is based on a transformation of image data to form a feature vector which represents that particular gesture. It has a training phase and a test phase .In the training phase, the user shows few examples of hand gesture images. The computer stores the feature vector, for each gesture. In the test phase, the computer compares the feature vector for the present image with those in the training set, and picks the category of the nearest vector. The method is image-based and simple.

INTRODUCTION

Gestures

Gestures are defined as the motion of the body that is intended to communicate with other agents. For a successful communication, a sender and a receiver must have the same set of information for a particular gesture. As per the context of the project, gesture is defined as an expressive movement of hands which has a particular message, to be communicated precisely between a sender and a receiver. Hand gestures can be classified in two categories: static and dynamic. A static gesture is a particular hand configuration and pose, represented by a single image. A dynamic hand gesture is a moving gesture, represented by a sequence of images. This project focuses on the recognition of static images.

I. RELATED WORK

In the field of gesture recognition systems there are two commonly approaches .i.e. the data glove approaches and the vision based approaches. It can be used for human computer interaction (HCI) interpretation system. The commonly used approaches are mentioned below

a. Data Gloves Approaches: These methods employ mechanical or optical sensors attached to a glove that transforms finger flexions into electrical signals to determine the hand posture . Using this method the data is collected by one or more data glove instruments which have different measures for the joint angles of the hand and degree of freedom (DO) that contain data position and orientation of the hand used for tracking the hand . However, this method requires the glove to be worn and a wearisome device with a load of cables connected to the computer.

b. Vision Based Approaches: These techniques are based on how the person understands the Information about the environment. These methods are usually done by capturing the input image using camera . In order to create the database for gesture system, the gestures should be selected with theirrelevant meaning and each gesture may contain multi samples.

Vision Based hand gesture recognition approaches can be categories into:

appearance based approaches, and 3D model based approaches :a) Appearance Based Approaches: These approaches use features extracted from visual appearance of the input image model of the hand, comparing these modelled features with features extracted from input camera or video input.

b) 3D Model Based Approaches:3D Model based approaches depend on the kinematic DOFs of the hand. These methods try to infer some hand parameters like pose of palm, joint angles from the input image, and make 2D projection from 3D hand model.

The Sayre Glove was the first instrumented glove to be invented in 1977, based on an idea from Rich Sayre. It used flexible tubes with a light source at one end and a photocell at the other. Finger flexion was thus measured by the amount of light incident on the photocell. In 1983, Gary Grimes received a patent covering the use of a special electronic glove solely to interpret a manual alphabet for data entry, for his Digital Data Entry Glove. The glove has specifically positioned ex sensors capable of recognising an 80 character superset of the Single Hand Manual Alphabet for the Deaf. By far the most successful glove is the VPL Data Glove developed by Zimmerman. The Data Glove is based on patented optical fibre sensors along the backs of the fingers, two for each finger. Like the Sayre glove finger flexion bends the fibres, attenuating the light they transmit. This analog signal is sent to a processor which determines the joint angles based on calibrations for each user. While the Data Glove emphasised user comfort the Dextrous Hand Master was invented but had less comfort. Inspired by the success of theVPL Data Glove, the toy manufacturers Mattel, released the Power Glove in 1989.

Gesture recognition is the process by which gestures made by the user are made known to the system. For recognizing the gestures, there are several algorithms that are available. There are several approaches for gesture recognition. Artificial Neural networks are flexible in a changing environment.

This project is based on neural networks for gesture [1]recognition. Many methods for hand gesture recognition using visual analysis have been proposed for hand gesture recognition. For hand detection, many approaches use colour or motion information. There is a method developed for hand gesture recognition system based on the shape analysis of the static gesture . Another method is proposed by E.Stergiopoulou[2] and N. Papamarkos which says that detection of the hand region can be achieved through colour segmentation.

There are different methods of dealing with gesture recognition as shownSubtraction Method:

This method involves a simple subtraction between two images, pixel per pixel to compare them.

Gradient Method:[3]

This method involves detecting edges in an image and counting the bright pixels that comprise them for each row or column and then making a comparison.

Principal Component Analysis:

The goal is to compute and study the Eigen vectors of the different pictures and then to express each image with its principal components (Eigenvectors).

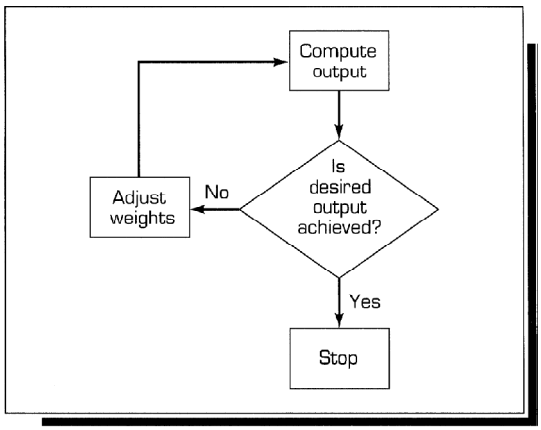
Rotation Invariant:

This method involves two steps basically. First, achieving gray scale and secondly, achieving rotation invariance of an image. Rotation Invariant method is widely used for textureclassification and recognition. Researchers have also suggested this method for texture classification using Local Binary Patterns.

III ARTIFICIAL NEURAL NETWORKS

Neural networks are composed of simple elements operating in parallel. These elements are inspired by biological nervous systems. As in nature, the network function is determined largely by the connections between elements. We can train a neural network to perform a particular function by adjusting the values of the connections (weights) between elements. Commonly neural networks are adjusted, or trained, so that a particular input leads to a specific target output. Such a situation is shown in figure(1) below. There, the network is

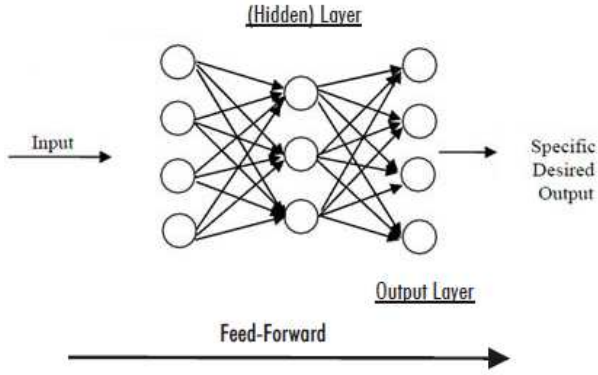
adjusted, based on a comparison of the output and the target, until the network output matches the target.



Figure(1): Neural Net block diagram

Supervised and Unsupervised learning

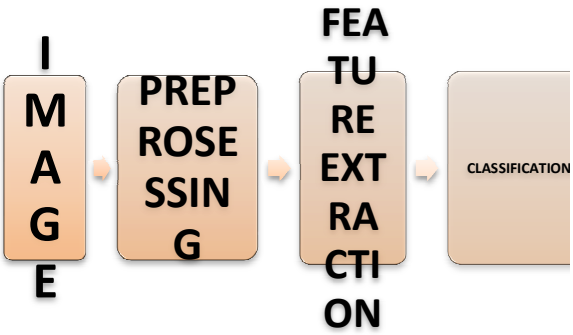
Supervised learning is based on the system trying to predict outcomes for known examples and is a commonly used training method. It compares its predictions to the target answer and "learns" from its mistakes. The data start as inputs to the input layer neurons. The neurons pass the inputs along to the next nodes. As inputs are passed along, the weighting, or connection, is applied and when the inputs reach the next node, the weightings are summed and either intensified or weakened. This continues until the data reach the output layer where the model predicts an outcome. If the predicted output is equal to the actual output, no change is made to the weights in the system. But, if the predicted output is higher or lower than the actual outcome in the data, the error is propagated back through the system and the weights are adjusted accordingly .This feeding errors backwards through the network is called "back-propagation." This method is called the Feed forward method.



Figure(2):feed forward neural network architecture

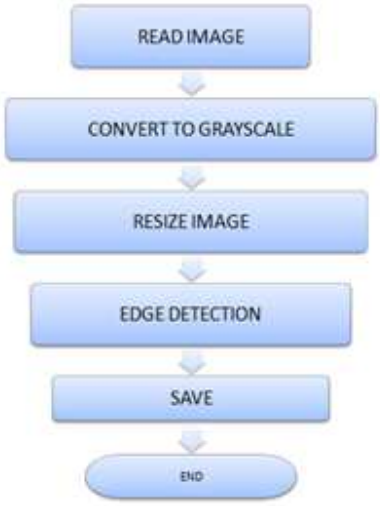
The approach shown in the paper is based on supervised learning feed forward architecture.

IV **BLOCK DIAGRAM**



Figure(2):block diagram

The block diagram of the gesture recognition system is shown in the figure 2.The input is a image of the gesture. This image is then preprocessed.Here the image is converted to greyscale and filtered. The image is then sent for feature extraction, where a feature vector i.e. the gradient orientation patterns of the image is taken. Next is the classification for which we make use of the neural networks. The classification is such that the feature vector of the image will be compared with the feature vectors of the images in the database. As per the match of the feature vector that particular image is recognized. The flowchart showing the pre-processing steps and obtaining the feature extraction of the images.



Figure(3):flowchart showing feature extraction of hand gesture images.

V Method 1:

Procedure:

Step 1:The starting point of the project is the creation of a image database with all the images that would be used for training and testing. Photographs will be used in the database. They are converted to greyscale.

Step2:Resize all the images.

Step3:Next thing to do is to find the edges. This is done to count the number of bright pixels(the change in the intensity)

Step 4:Then taking the angle at which there is maximum rate of change of gradient. This will give the gradient orientation(i.e.change in the intensity[4])

Step 5:Then rearrange the image matrix into columns.

Step 6:Convert the column matrix with the radian values to degrees. This is how the feature is extracted. The features are saved.

Step 7:Next is the training stage.

Step 8:Finally testing is done.

As per the approach I have used eight hand gestures for the training with a few samples of the gestures each making 59 gestures in total for training and testing.The database therefore contains 59 images resembling 8 different.gestures.so there would be 8 classes one to classify each image. Once an input image is given this image will be pre-processed, feature would be extracted, and that featured is matched with the various features in the database and the corresponding class is classified. I have taken the feature vectors of all the images and used for the training purpose. This is done by the neural network toolbox in matlabnprtool [5]. The feature vector is basically the matrix having the gradients. The neural networks provide Pattern recognition is a powerful technique for harnessing the information in the data and generalizing about it. The system is developed through learning rather than programming [6]

185
364
427
181
1079
156
323
222
1769
0
228
402
762
413
2716
376
1162
699
312

Figure (4): Feature extraction of hand gestures resembling class 5 to represent number 5.

VI METHOD 2:

This method is also simple. It involves the use of the feature vector i.e. the counting of the white and black pixels from the binary images. It gives how many columns from the image matrix contain a specific range of white pixels. There is another feature involved i.e. obtaining the mean from a grayscale image .Once the feature extraction is done for all the images, these

features are taken for training by neural networks toolbox in matlab.

Procedure:

Step 1: image database, Photographs will be converted to grayscale.

Step2: Resize all the images.

Step3: calculate the mean of the image matrix

Step4: Consider the mean from values in specific range from the matrix. This is the first feature to be used in the feature extraction matrix.

Step5: Convert the grayscale image to binary.

Step6: Pre-processing the image, edge detection

Step 7: Dilate the image.

Step 8: Now count the number of one's in each column.

Step9: Now the feature vector is how many columns in this matrix have white pixels in specific range of values. The feature extracted matrix contains the mean values and the white pixel count as well for further classification.

Step 10: Next is the training stage.

Step 11: Finally testing is done.

Conclusion:

Neural network using feed forward neural networks is presented in this paper for hand gesture recognition. The method 1 mentioned in the paper shows 62% proper classification of gestures. It is also observed that initially when few samples were used the classifications are improper but when the number of samples is increased the performance is better. The method 2 mentioned in the paper gives 70%proper classification for a total of 65 gesture images.

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