Study on Different Human Emotions Using Back Propagation Method

Subhashree Behera,
Sophitorium Group of Institutions/Jatni/Khurda, Odisha/India
Pranati Mishra,
Sophitorium Group of Institutions/Jatni/Khurda, Odisha/India
Amit Tripathy,
Sophitorium Group of Institutions/Jatni/Khurda, Odisha/India
Himansu Mohan Padhy
Sophitorium Group of Institutions/Jatni/Khurda, Odisha/India

Abstract

With fast evolving technology, Cognitive Science plays a vital role in our day-to-day life. Cognitive science is summed up as the study of mind based on scientific methods. It is all about the sum of all interdisciplinary like philosophy, psychology, linguistics, artificial intelligence, robotics, and neuroscience. In this paper, I focused on the facial expressions or emotions of human being as it has an important role in interpersonal relations. Without verb communication, one can imagine the mood of a person by expressions. In this method, we use back propagation neural network for implementation. It is an information processing system that has been developed as a generalization of the mathematical model of human recognition.

Introduction

Science has made great strides in our understanding of the external observable world called as "outer space" .Physics revealed the motion of the planets, chemistry discovered the fundamental elements of matter, biology has told us how to understand and treat disease. But during much of this time, there were still many unanswered questions about something perhaps even more important to us. That something is the human mind. What makes mind so difficult to study, it is not something we can easily observe, measure, or manipulate. In addition, the mind is the most complex entity in the known universe. Unlike the science that came before, which was focused on the world of external, observable phenomena, or "outer space," this new endeavor turns its full attention now to the discovery of our fascinating mental world, or "inner space."The study of inner space is termed as "cognitive Science ". Cognitive science is study of mind through which we can judge the emotions of human being. Human beings are capable of producing millions of facial expression as human can interact not only using verbal languages but also non-verbal languages such as gestures & facial expressions or emotions. Face expressions refers to the changes in face with respect to their inner sense ,intentions & facial feature(nose ,eyes, mouth).Face recognition involves the comparison of an image with a database of stored faces or given data base of a face to produce the original identity of the input image. There are so many methods which exploit different concepts to determine facial emotions of human being .However developing a system with various human ability has been difficult & complex task nowadays .Because it is very difficult to imitate artificial system of human brain. .

Human brain is the most intellectual & complex system in the world. It consists of the most important thing called processing element, the neurons. A neural network is a powerful tool used to perform pattern recognition and other intelligent tasks inspired by the working of a human brain. It is a learning mechanism. The pattern recognition refers to the process of distinguishing the patterns into a set of predefined data based on observations of the network. It is used in the area of biometrics, medical diagnosis, face detection, image processing, system security etc .There are numerous methods used for pattern recognition depending upon the type of pattern. It includes statistical approach, structural approach, hybrid approach, template matching and the last but not the least neural network approach. In the first, the statistical approach, a pattern is formed of fixed length in a dimensional space. Here the pattern formed using the probability distribution function. In the second, the structural approach – a pattern is formed as the collection of sub patterns and the interconnections among the sub patterns are defined here. In the third, the hybrid approach is the combination of above two kinds used at appropriate stage in pattern recognition. The last approach is the most important and flexible method with many advantages compared to other approaches. i.e, the neural network approach based on the concept of neurons and the interconnections among the neurons. It is basically based on human perception. There are various algorithms

based on this approach: Feed forward network, Self Organizing Map(SOM) , Radial basis function network and Back Propagation network used for different pattern identification & classification. In the recent years, tremendous improvement has been done in the areas of face recognition with the help of many techniques.Fig.1shows the block diagram of face recognition technique:

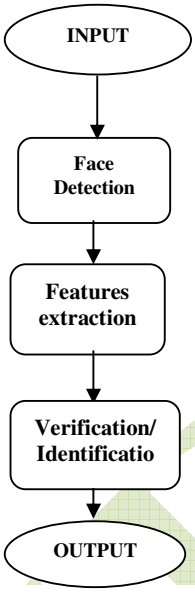

Fig.1.Face Recognition Technique

In this paper, I introduce a robot which can perceive human gestures/emotion/feelings. Human beings have different emotions such as happy, sad, angry, joy, disgust, fear, surprise, serious, thinking etc .suppose if a person is laughing, then the robot will laugh. or if a person is angry ,then the robot will show the anger by some symbol as predefined in the concept .For this ,I adopt the neural network approach as it has better performance and high efficiency as compared to different approaches. The work of face recognition is to find the exact identity of an unknown image against a database of face models .For the implementation, back propagation neural network is used .Back propagation method is an information processing system developed from the mathematical model of human recognition. This paper consists different section. Section I gives the introduction of the paper ,section II involves literature survey, section III involves methodology, section IV gives the idea about neural network ,section V about back propagation method then section VI about the comparison about different methods of neural network ,Section VII about the experimental results ,Section VIII about the conclusion and section IX gives about the reference of different paper.

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Literature survey

There are number of research done in the field of face recognition which led to a remarkable shape in the present days. Here literature review consists of recent development on advancement in Facial recognition dealing with facial emotions and expressions. A learning machine by using neural network [19] introduces two key issues related with the neural networks. The first issue was that the single-layer neural networks were not suitable for processing the exclusive-or circuit. The second significant issue was that the computers were not sophisticated enough to effectively handle the long processing time complexity required by large neural networks. Neural network research slowed until computers achieved greater processing power. Also key in later advances was the back propagation algorithm which effectively solved the exclusive-or problem. Use of Artificial Neural Network in Pattern Recognition [1] ,there are various methods used to recognize patterns however Artificial Neural Networks forms the most commonly used method to perform pattern recognition task. The basic design of a recognition system was explained based on certain issues: the definition of pattern classes, sensing environment, pattern representation, feature extraction and selection, classifier design and learning, selection of training and test samples, and performance evaluation. The images are decomposed and then Neural Networks are used Human

Face Recognition. Singular value decomposition as images and back propagation is used as its classifier [4]. "Recognition of ECG Patterns Using Artificial Neural Network"[12] stated that the artificial neural network work in two phases: one is the training phase and the other is the test phase. In the training phase, the connection weights are automatically adjusted to map the input to the corresponding out-put whereas in the test phase, the already trained network is testing against a sample of patterns. Three different neural network models are employed to recognize the ECG Patterns. These include the Self -Organizing Map Network, Back Propagation Algorithm, and Learning Vector Quantization. "Neural Network Information Technologies of Pattern Recognition"[17] concluded that the main problems in many pat-tern applications are the abundance of features and the difficulty of coping with concurrent variations in position ,orientation and scale. This clearly indicates the need for more intelligent, invariant feature extraction and feature selection mechanisms. A computational model[8] is developed known as threshold logic for neural networks based on thematic and algorithms. This model consists of two distinct approaches for neural networks. One approach focused on biological processes in the brain and the other focused on the application of neural networks to artificial intelligence.A survey on face detection techniques [16] identified two broad categories that separate the various approaches, appropriately named feature-based and image-based approaches. They divide the group of feature-based systems into three subcategories: low level analysis feature analysis and active shape models. Image based approaches are divided into three sections: Linear subspace methods, neural networks and statistical approaches.

Methodology

Recently, a lot of research effort has been extended towards improving human computer interaction so that computers can also have the intelligence to perceive the emotional state of a human and react accordingly.Iimage processing is done through image enhancement, image restoration, image compression.

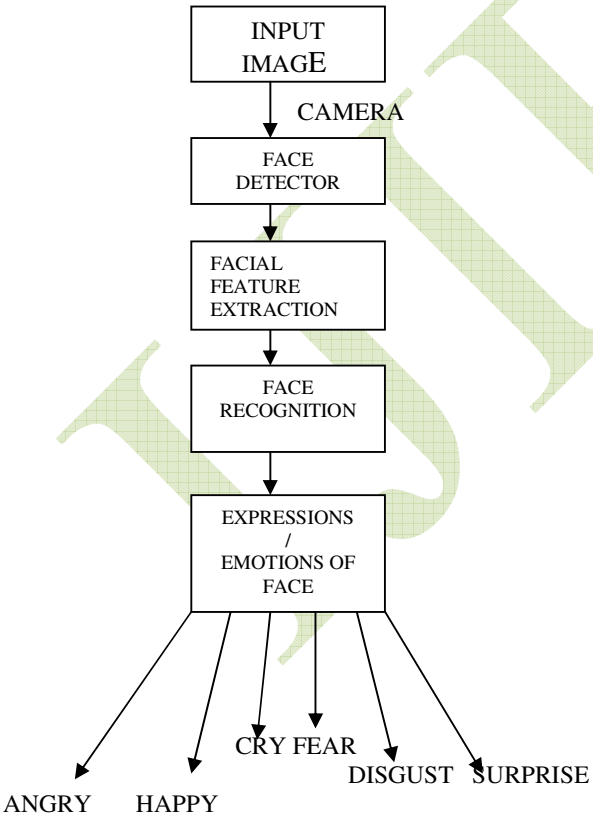


Fig.2. Block diagram of facial expression recognition technique

But the entire Face recognition process can be decomposed into two parts:
1. Finding a face from an image known as face registration or localization.
2. Recognizing or identification or verification of that face.
Finding a face in an image is based lighting and background conditions. And whether the image is color or monochrome and whether the images are still or video. For face verification involves testing the quality of match of an image against the original. In the case of face recognition the problem is to find best match for an unknown image against a database of face models or to determine whether it does not match any of them.

The structure of the neural network

The Neural Network is the most powerful and computational structure inspired by the study of processing of human brain .Each neuron is independent. The neural network approach for pattern recognition is based on the type of the learning mechanism applied to generate the output from the network. The learning method is classified as supervised leaning in which the desired response is known to the system and another one unsupervised learning in which output is produced based on priori assumptions and observations, the desired response is not known. We used a feed forward back propagation neural network with adaptable learning rate. The NN have 3 layer; an input layer, a hidden layer , and output layer (1 neuron). The activation function used is the tan sigmoid function, for both the hidden and the output layer. These layers comprises of the neurons which are connected to form the entire network. Weights are assigned on the connections which marks the signal strength. The weight values are computed based on the input signal and the error function back propagated to the input layer. The hidden layer is to update the weights on the connections based on the input signal and error signal.

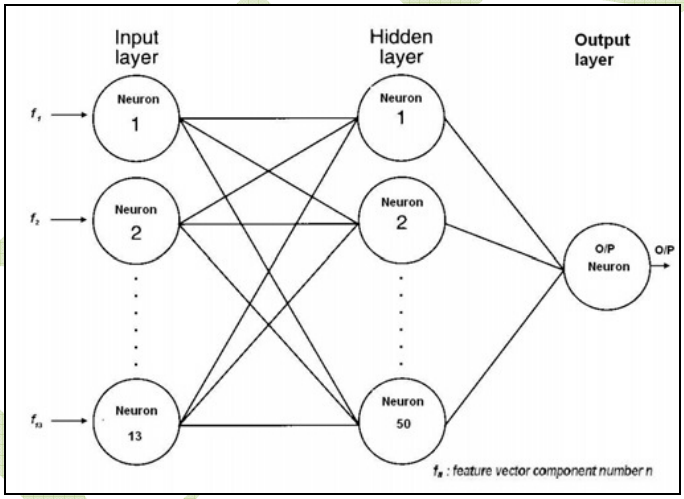


Figure 3: The neural network structure

Back propagation algorithm

The essential idea of back propagation is to combine non-linear multi-layers and calculates the error derivatives of the weight of the image given as input. This back propagation method is used to determine the error derivatives.
Back propagation process involves 3 steps generally:
1. Feed forward of the input training pattern.
2. Back propagation of the associated error
3. Weight adjustment.
The algorithm operates in two phases: Initially, the training phase wherein the training data samples are provided at the input layer in order to train the network with predefined set of data classes. During the testing phase, the input layer is provided with the test data for prediction of the applied patterns. The advantage of this algorithm that it is simple to use and well suited to provide a solution to all the complex patterns. And the implementation of this algorithm is faster and efficient depending upon the amount of input-output data available in the layers .

Comparison of different types of neural network

In radial basis function network, the network has a static Gaussian response as nonlinearity presents for the hidden layer processing element. The Gaussian function responds only to a small region of the input space where the Gaussian is centered. Here a suitable center is found for the Gaussian function. The main advantages of this method are quicker, sensitive method and faster but the disadvantage is it needs larger input units. Radial basis function is basically a non-linear function of a neuron. For nonlinear function, the activation function is saturating linear activation function, hyperbolic Tangent sigmoid activation function. Basically radial basis function depends on hyperbolic tangent sigmoid activation.

Hyperbolic tangent sigmoid activation function

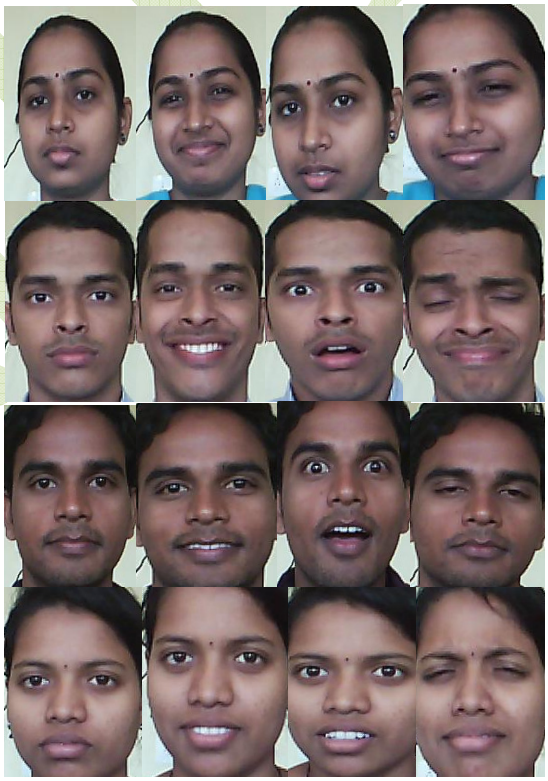
This function takes the input any value between plus and minus infinity and the output value into the range – 1 to 1.The tensing activation function is commonly used in multilayer neural networks that are trained by the back propagation algorithm since this function is differentiable.

In self organizing map (SOM),it is a type of artificial neural network based on unsupervised learning to produce a low dimensional representation of input space of the training samples called map .It is mainly used for visualizing low dimensional views of high dimensional data. The advantage of this method is easy to understand, simple, work very well but very expensive.

The experimental results

We have evaluated our algorithm on various color images containing the human face. The simulations were performed using the Image Processing Toolbox of Matlab 13.Here four different emotions were taken for the recognition of human emotions – normal, happy, sad, socking. The pixel of the images here taken is 60 * 100. These are some of the results taken as comparing to the standardized values of the face.

SL.NO	Standard Value	Result
1.	< 900	Normal
2.	> 20000	Cry
3.	900-20000	Laugh
4.	Other	Sock



The performance can be tried to improve by also changing the nature of the input to the neural network, for example, the facial feature contour coordinates of the subject exhibiting the emotion and that of the subject's neutral state.

Conclusion

In this paper, face recognition system is based on neural network. This method has high efficiency, high performance and high accuracy for complex pattern. Here I introduced a facial expression system using neural network and a speech recognition system by comparing different methods of neural networks. Here I studied different emotions of human being like happy, angry, sad, surprised etc.

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