Robust Face Recognition Using Artificial Neural Network

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***Abstract*—Face recognition is done naturally by humans. However, developing a computer algorithm to do the same thing is difficult. Assume for the moment we start with images, and we want to distinguish between images of different people. One class of methods presupposes the existence of certain features in the image, i.e. eyes, nose, mouth, hair, and an algorithm is devised to find and characterize these features. FACE recognition is an important research problem spanning numerous fields and disciplines. This because face recognition, in additional to having numerous practical applications such as bankcard identification, access control, Mug shots searching, security monitoring, and surveillance system, is a fundamental human behavior that is essential for effective communications and interactions among people.**

***Keywords*- Face recognition, Artificial Neural Network, the back propagation algorithm.**

I. INTRODUCTION

Humans have been using physical characteristics such as face, voice, gait, etc. to recognize each other for thousands of years. With new advances in technology, biometrics has become an emerging technology for recognizing individuals using their biological traits. Our face recognition technology uses faces as unique verification information. We offer facial recognition system that works in a wide range of operating environment from individual home environment to most common public places. Face recognition, in particular has received a considerable attention in recent years both from the industry and the research community.

Almost in any face recognition application, a face detection stage is needed. Although face detection poses also a very challenging problem, many techniques have been proposed with enough success to consider face detection a very mature field of research. However, although it is clear that face detection is far from being solved, it will not be considered in this position paper. Face recognition can be divided into two basic applications: identification and verification. In the identification problem, the face to be recognized is unknown and is matched against faces of a data base containing known individuals. In the verification problem the system confirms or rejects the claimed identity of the input face.

II. FACE RECOGNITION FROM IMAGE SEQUENCES

A typical video-based face recognition system automatically detects face regions, extracts features from the video, and recognizes facial identity if a face is present. In surveillance, information security, and access control applications, face recognition and identification from a video sequence is an important problem. Face recognition based on video is preferable over using still images, since as demonstrated in Bruce et al. [1998] and Knight and Johnston [1997], motion helps in recognition of (familiar) faces when the images are negated, inverted or threshold. It was also demonstrated that humans can recognize animated faces better than randomly rearranged images from the same set. Though recognition of faces from video sequence is a direct extension of still-image-based recognition, in our opinion, *true* video based face recognition techniques that coherently use both spatial and temporal information started only a few years ago and still need further investigation.

Significant challenges for video-based recognition still exist; we list several of them here:-

(1) ***The quality of video is low*****.** Usually, video acquisition occurs outdoors (or indoors but with bad conditions for video capture) and the subjects are not cooperative; hence there may be large illumination and pose variations in the face images. In addition, partial occlusion and disguise are possible.
(2) ***Face images are small.*** Again, due to the acquisition conditions, the face image sizes are smaller (sometimes much smaller) than the assumed sizes in most still-image-based face recognition systems. For example, the valid face region can be as small as 15 × 15 pixels, 13 whereas the face image sizes used in feature-based still image based systems can be as large as 128 ×128. Small-size images not only make the recognition task more difficult, but also affect the accuracy of face segmentation, as well as the accurate detection of the fiducially points/landmarks that are often needed in recognition methods.

(3) ***The characteristics of faces/human body parts*****.** During the past 8 years, research on human action/behavior recognition from video has been very active and fruitful. Generic description of human behavior not particular to an individual is an interesting and useful concept. One of the main reasons for the feasibility of generic descriptions of human behavior is that the interclass variations of human bodies, and in particular faces, is much smaller than the difference between the objects inside and outside the class. For the same reason, recognition of individuals within the class is difficult. For example, detecting and localizing faces is typically much easier than recognizing a specific face.

III. FACE RECOGNITION PROCESS

There are four steps in face recognition process:- for the face recognition we have need some steps apply like acquiring a sample, extracting feature, compression template, declare a match etc.
1. Acquiring a sample: In a complete, full implemented biometric system, a sensor takes an observation. The sensor might be a camera and the observation is a snapshot picture. In our system, a sensor will be ignored, and a 2D face picture “observation” will supplied manually.
2. Extracting Features: For this step, the relevant data is extracted from the predefined captured sample. This is can be done by the use of software where many algorithms are available. The outcome of this step is a biometric template which is a reduced set of data that represents the unique features of the enrolled user's face.
3. Comparison Templates: This depends on the application at hand. For identification purposes, this step will be a comparison between a given picture for the subject and all the biometric templates stored on a database. For verification, the biometric template of the claimed identity will be retrieved (either from a database or a storage medium presented by the subject) and this will be compared to a given picture.
4. Declaring a Match: The face recognition system will return a candidate match list of potential matches. In this case, the intervention of a human operator will be required in order to select the best fit from the candidate list.

IV. STEPS OF FACE RECOGNITION

In identification problems, the input to the system is an unknown face, and the system reports back the determined identity from a database of known individuals, whereas in verification problems, the system needs to confirm or reject the claimed identity of the input face. Face perception is an important part of the capability of human perception system and is a routine task for humans, while building a similar computer system is still an on-going research area.

For example, recognition of face images acquired in an outdoor environment with changes in illumination and/or pose remains a largely unsolved problem. In other words, current systems are still far away from the capability of the human perception system.

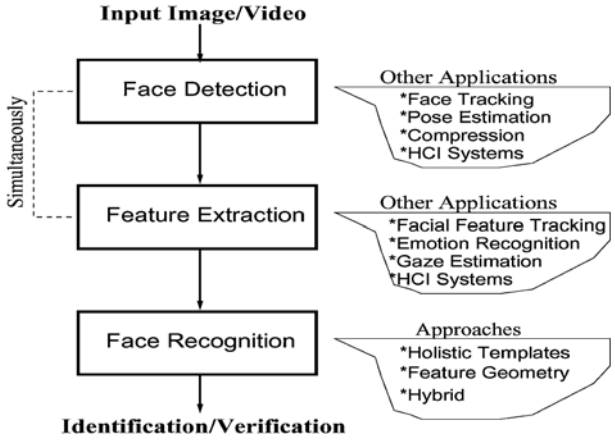
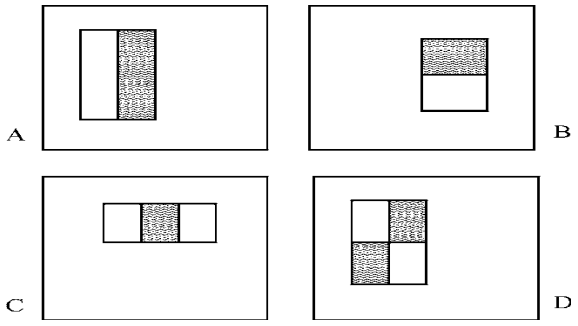


Figure 1: Three steps of face recognition

As illustrated in Figure 1, the problem of automatic face recognition involves three key steps/subtasks: (1) detection and rough normalization of faces, (2) feature extraction and accurate normalization of faces, (3) identification and/or verification. Sometimes, different subtasks are not totally separated. For example, the facial features (eyes, nose, mouth) used for face recognition are often used in face detection. Face detection and feature extraction can be achieved simultaneously, as indicated in Figure 1.

Figure 2. Example rectangle features shown relative to the enclosing detection window. The sum of the pixels which lie within the white rectangles are subtracted from the sum of pixels in the grey rectangles. Two-rectangle features are shown in (A) and (B). Figure (C) shows a three-rectangle feature, and (D) a four-rectangle feature. Face detection is concerned with finding whether or not there are any faces in a given image (usually in gray scale) and, if present, return the image location and content of each face.



This is the first step of any fully automatic system that analyzes the information contained in faces (e.g., identity, gender, expression, age, race and pose).

V. ALGORITHM USED FOR FACE RECOGNITION

Algorithms measure key points of the face (nose, eyes, mouth, jaw, etc), head angle, skin tone, lighting, and create a template based on these measurements. The file is then compared to other files (still photos or video captures) that are enrolled into the software's database, searching for a match based on the "Similarity Rating" percentage. The closer the characteristics match, the higher the similarity rating. The software can also identify individuals over time for various facial expressions.

Face Recognition software allows a user to create their own biometric face identification security for Windows.

The software uses a neural network **Back Propagation Algorithm** combined with more Artificial Intelligence tool added for imaging optimization.

VI. THE BACKPROPAGATION ALGORITHM

The BP learning process works in small iterative steps: one of the example cases is applied to the network, and the network produces some output based on the current state of it's synaptic weights (initially, the output will be random).

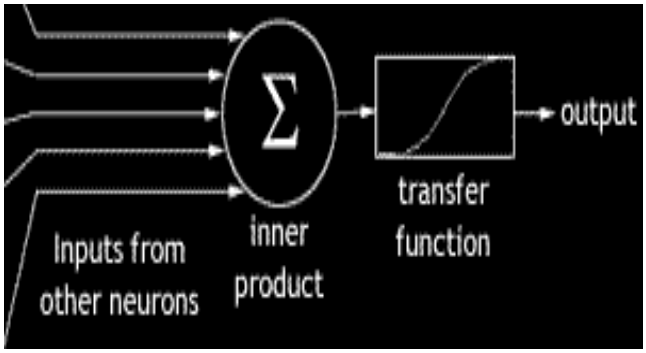


Figure 3: Backpropogation Algorithm

This output is compared to the known-good output, and a mean-squared error signal is calculated. The error value is then propagated backwards through the network, and small changes are made to the weights in each layer. The weight changes are calculated to reduce the error signal for the case in question. The whole process is repeated for each of the example cases, then back to the first case again, and so on.

1. A successful face recognition methodology depends heavily on the particular choice of the features used by the pattern classifier .The Back-Propagation is the best known and widely used learning algorithm in training multilayer perceptions.

2. Back propagation is a multi-layer feed forward, supervised learning network based on gradient descent learning rule. This BPNN provides a computationally efficient method for changing the weights in feed forward network.

3. A typical back propagation network with Multi-layer, feed-forward supervised learning is as shown in the figure. Here learning process in Back propagation requires pairs of input and target vectors. The output vector ‘o‘ is compared with target vector ’t’
.
4. A Generalized Network**.** Stimulation is applied to the inputs of the first layer, and signals propagate through the middle (hidden) layer's) to the output layer. Each link between neurons has a unique weighting value**.**

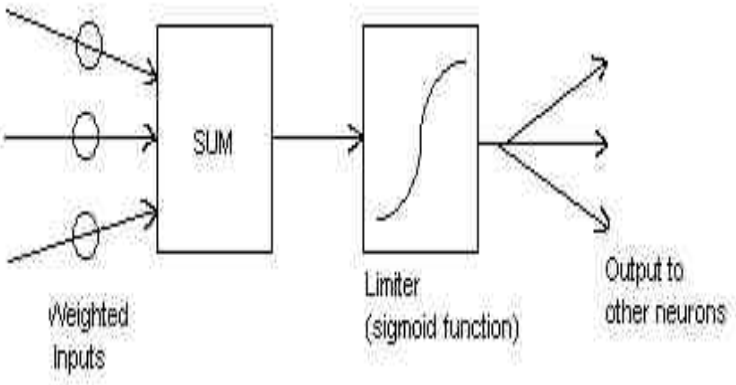


Figure 4: structure of a neuron

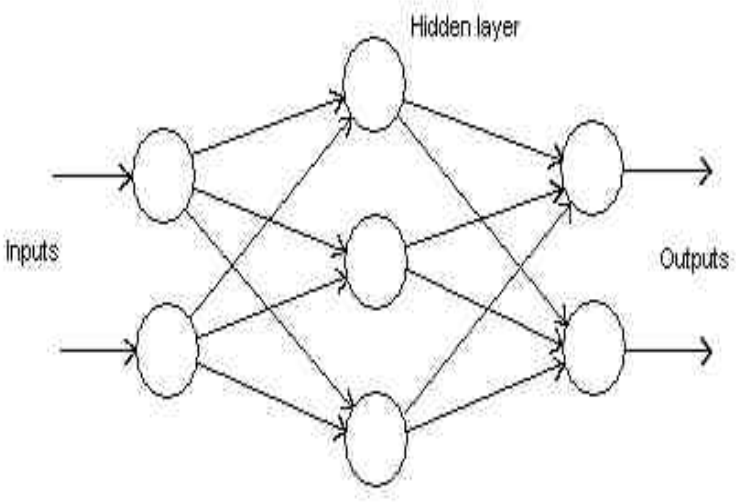


Figure 5: structure of neuron (input and output)

Figure 4&5: The Structure of a Neuron. Inputs from one or more previous neurons are individually weighted, then summed. The result is non-linearly scaled between 0 and +1, and the output value is passed on to the neurons in the next layer.

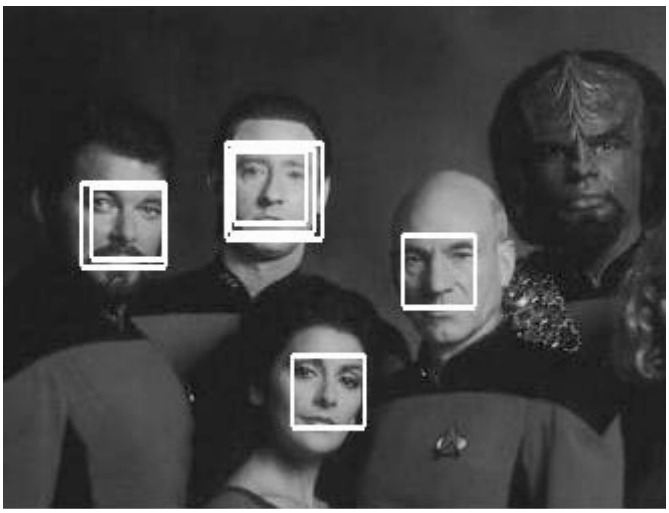


Figure 6: Recognised Faces

VII. CONCLUSION

The computer based face recognition industry has made much useful advancement in the past decade, however, the need for higher accuracy system remains. Through the determination and commitment of industry, government evolutions, and organized standards bodies, growth and progress will continue, raising the bar for face recognition system. Computer based face recognition system is very useful for the police, industries, and for government for various security regions.

This project gives a more accuracy than other traditional way of recognize the face and less time consuming. It has numerous applications in areas like surveillance and security control systems, content based image retrieval, video conferencing and intelligent human computer interfaces.

Face recognition has been and will continue to be a very challenging and difficult problem. In spite of the great work done in the last 30 years, we can be sure that the face recognition research community will have work to do during, at least, the next 30 years to completely *solve* the problem. Strong and coordinated effort between the computer visions, signal processing and psychophysics and neurosciences communities are needed.

VIII. REFERENCES

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