A Novel Technique for Facial Expression Using Feature Extraction

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Abstract-The purpose of this paper is to present the needs and applications of facial expression recognition. Expression detection is useful as a non-invasive method of detecting lying and predicting behavior. However, it may be difficult to detect these facial expressions for the untrained eye. In this paper, we implement facial expression recognition techniques using the main component analysis (PCA). The six basic, universally accepted sentiments that must be recognized are: anger, happiness, sadness, disgust, fear and surprise along with neutrality. Euclidean distance based matching Classifier is used. Between verbal and nonverbal form of communication Facial expression is a form of nonverbal communication but plays a central role. It expresses a human perspective or fills its mental state. This paper provides an introduction to facial emotion recognition and application, a comparative study of popular face recognition techniques and phases of the automatic face recognition system.

Keywords : - Facial Expression, PCA, Euclidean Distance, MATLAB-2013.

1. Introduction

Humans are emotional creatures. Our emotional state shows how to act from the most basic processes to complex procedures and difficult decisions [1,2]. Their lives are guided in many ways by our emotions, so knowing more about emotions allows us to learn more about human behavior in general. It's clear that understanding the emotional state of people can be useful for a range of applications from developing a better understanding of human psychology, to investigating behavior for improved user experiences, to developing productive advertising campaigns, and beyond Emotions are a very important aspect of human life. Basic research on the emotions of recent decades has resulted in many discoveries that have led to important applications in the real world. This thesis describe two of these discoveries: the universal facial expressions of emotion and the existence of subtle expressions because of their importance and novelty in psychology. Here discuss how have taken those discoveries to create programs that teach people how to read facial expressions of emotion, as well as recent research that has validated those training programs and documented their efficacy.

1.2 Two Important Scientific Discoveries

It can be said that the most important contribution of the basic science in our understanding of emotion is the universal expressions of the emotional face. Darwin (1872) was the first to suggest that they were universal; his thoughts on emotions were the focus of his theory of evolution, suggesting that emotions and their expressions were biologically innate and adaptive, and that similarities could be seen evolutionarily. However, the first investigations that assessed Darwin's ideas were inconclusive. The dominant view in psychology was that facial expressions were culture-specific, as well as every culture. He had his own language, and had his own language in facial expressions. Darwin's assertions were revived by Tomkins (1962, 1963), who suggested that emotion was the basis of human motivation and that the seat of emotion was in his face. Tomkins conducted the first study to show that facial expressions were reliably associated with some emotional states. Later, Tomkins recruited Paul Ekman and Carole Isard to carry out what is now known as "world studies" and the basic cultures documented that the emotional expressions themselves were automatically produced by members of completely different cultures in response to films that evoked feelings. Since the original world study, more than 30 studies have examined the terms of the facial expression by repeating the universal recognition of emotion on the face (revised in Matsumoto, 2001). In addition, the meta-analysis of 168 data sets that examined emotional and facial expressions and other nonverbal stimuli indicated a recognition of global emotion well above the levels of probability. More than 75 studies have shown that the same facial expressions occur when emotions are spontaneously generated. These findings are impressive given that they have been produced by different researchers around the world in different laboratories using different methodologies with participants from many different cultures but all converging on the same set of results. Therefore, there is strong evidence of the universal facial expressions of seven emotions: anger, contempt, disgust, fear, joy, sadness and surprise (see figure 1).

Fig. 1. The Seven Basic Emotions and their Universal Expressions.

Other bodies of evidence provide support for the biological and genetic sources of facial expressions of emotion. For example, when emotions are spontaneously aroused even congenitally blind individuals produce the same facial expressions as sighted individuals do. The behaviors of blind individuals are more in line with their peers than with strangers. Some facial expressions of emotional provocative stimuli are more compatible between single-pair pairs of twins. Kindler et al., 2008). The same facial muscles exist in adult humans in newborns and are fully functional at birth. The same facial muscles used by humans to indicate emotions are also present

in chimpanzees and facial expressions considered universal among humans have been observed in nonhuman primates.

Micro expressions

The second important discovery indicates that there are subtle expressions. When individual feelings occur and there is no reason to modify them or hide them, expressions usually last from 0.5 to 4 seconds and include the entire face (Ekman, 2003). This call these macro expressions; they occur when we are alone or with family and close friends. Macro expressions are relatively easy to see if you know what to look for. However, the exact expressions are expressions that are activated and deactivated in a fraction of a second, sometimes as fast as 1/30 of a second. They're so fast that if you blink, you'll miss them. Small expressions are most likely signs of hidden emotions. (They can also be signs of emotional states that are processed quickly but are not hidden). Speak so quickly that most people cannot see or recognize them in real time. The idea of nanoparticles has its roots in Darwin's hypothesis of inhibition (1872), which suggests that uncontrolled behavior can occur involuntarily even if the individual tries to control their expressions. Research on the neural foundations of emotional expressions indicates how this happens. There are two neurotransmitter-mediated pathways, both of which originate in a different area of the brain. The hierarchical channel leads the voluntary facial actions and arises in the cortical motility band, while the extracellular channel drives the involuntary emotional expressions and arises in areas under the cerebral cortex. When individuals are in intense emotional states, but need to control their expressions, they activate both systems, involved in the nervous "tug of war" on facial control, allowing the rapid and transient escape of small expressions.

The existence of subtle expressions after nearly a century of Darwin was verified by Haggard and Ishaqas (1966) during the screening of slow-motion therapy sessions. Later Ekman & Friesen (1974) demonstrated that micro expressions occurred in their frame by frame analysis of interviews with depressed inpatients. Most recently Porter & ten Brinke (2008) demonstrated that micro expressions occurred when individuals attempted to be deceitful about their emotional expressions.

1.3 Types of facial expression

Human facial expressions are one of the most important nonverbal ways in which we communicate. Through 43 different muscles, our faces are able to produce more than 10,000 expressions, many of which return to our primitive roots. Even our smile, some researchers say, has evolved from the way monkeys show their teeth to negotiate social status or to establish dominance. Although each has its unique way of presenting feelings, there are some selected expressions that still appear, regardless of the person's age, race, language or religion. Here are seven basic wired feelings in our brains and show on our faces. Here is a summary of those seven global sentiments, how they look and why we are biologically aware of their expression in this way:

Anger- The face of anger works well because every movement in the face makes the person appear physically stronger, according to the researchers. This face allows the threat to know that we are serious. It is one of our strongest feelings and shows the expression of the human face. This face serves as a warning, either simply to intimidate or to show that the conflict has begun.

Fig. 1. Facial movements: Eyebrows pulled down, upper eyelids pulled up, lower eyelids pulled up, margins of lips rolled in, and lips may be tightened.

Fear- Fear every movement of a face based on fear prepares us to fight or flight response. This facial expression takes advantage of the way our bodies work. By expanding our eyes, our vision is opened, allowing more light to pass and allowing us to see the threats that surround us. The same can be said about our oxygen pathways. Opening the gills increases our intake of oxygen and helps us prepare for flight or fighting.

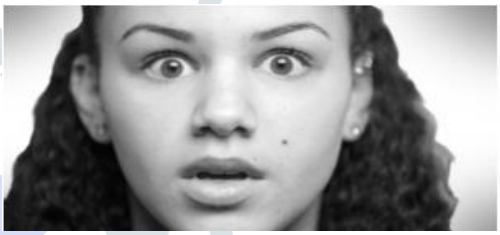

Fig. 2. Facial movements (Eyebrows pulled up and together, upper eyelids pulled up, mouth stretched)

Disgust The disgust face doesn't just show our distaste, it also works to protect us. Wrinkling the nose closes the nasal passage protecting it from dangerous fumes and squinting our eyes shields them from damage.

Fig. 3. Facial movements: Eyebrows pulled down, nose wrinkled, upper lip pulled up, lips loose.

Happiness - Happiness Despite friendly connotations, researchers believe that our smiles may be a more sinister origin. Many prisms show their teeth to confirm their dominance and prevent their place in their social structure. Some researchers believe that this nonverbal mark is what eventually turned into a smile.

Fig. 4. Facial movements: The muscles around the narrow eyes, "crow feet" wrinkled around the eyes, raised the cheeks, lips lifted diagonally

Sadness- Hard to fake, according to researchers. One of the signs of grief-ups are the raising of the forehead, which is very few people can do when ordering.

Fig. 5. Facial movements: Inner corners of eyebrows raised, eyelids loose, lip corners pulled down.

Surprise- While the expression of surprise can only last for a second or two, the facial movements, especially the high eyebrows, allow us to observe our surroundings, change our attention to another event, perhaps threaten it, and react more quickly. Whether it is a good or bad surprise, the facial reaction is the same.

Fig. 6. Facial movements: Entire eyebrow pulled up, eyelids pulled up, mouth hangs open, pupils dilated.

Contempt Although feelings of contempt can interfere with anger and distrust, the facial expression is unique. This is the only expression that appears on only one side of the face and may vary in severity. At its strongest point, the eyebrow can drop while the lower eyelid and lip angle rise on the same side. In most of its secret forms, the lip angle can only rise briefly.

Fig. 7. Facial movements: Eyes neutral with the lip corner pulled up and back on one side.

1.4 The Communication Process

Communication includes verbal, verbal, non-verbal, or implied forms to ensure that our message is heard. When we communicate non-verbally with others, we often use facial expressions, which are subtle references to the broader communication process. A simple smile may indicate a letter, while a frown may indicate resentment or disgust. Understanding facial expressions is an important part of communication.

Communication means that two or more people exchange verbal and nonverbal signals to reach a point of common understanding. The communication process involves both a **sender**, who is sending a message, and a receiver, who is hearing and/or seeing the message.

This process can be complicated by many factors, such as parts that try to communicate while speaking in different languages. In addition, we send and receive messages on personal screens, such as experience, faith, values, cultural background, gender, and education, which can make mutual understanding difficult. These screens often lead us to make assumptions about the message being delivered. This can also make assumptions by observing, analyzing and assigning meaning to facial expressions to others.

2. Mathematical Model

A generalized block diagram of the entire system is shown in Figure 9.

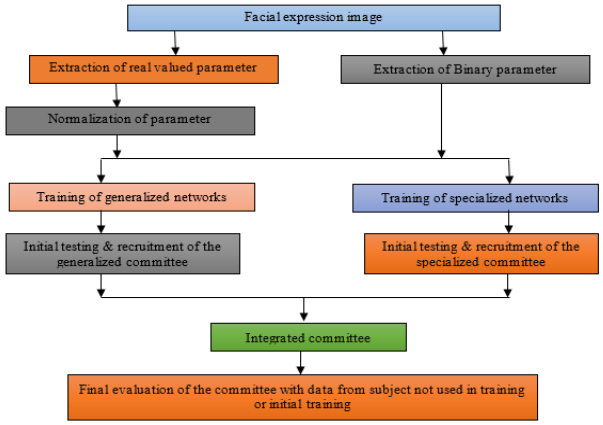

Fig. 9. Facial expression image

2.1 A step by step explanation of Principal Component Analysis

The purpose of this post is to provide a complete and simplified explanation of Principal Component Analysis, and especially to answer how it works step by step, so that everyone can understand it and make use of it, without necessarily having a

strong mathematical background. PCA is actually a widely covered method on the web, and there are some great articles about it, but only few of them go straight to the point and explain how it works without diving too much into the technicalities and the 'why' of things. That's the reason why they decided to make my own post to present it in a simplified way. Before getting to the explanation, this post provides logical explanations of what PCA is doing in each step and simplifies the mathematical concepts behind it, as standardization, covariance, eigenvectors and eigenvalues without focusing on how to compute them.

Facial Expression Recognition System

This section describes the structure of the facial expression recognition system. It includes pre-treatment, analysis of key components and classification of expressions using Euclidean work. Figure 10. Represents the block diagram of the facial expression recognition system.

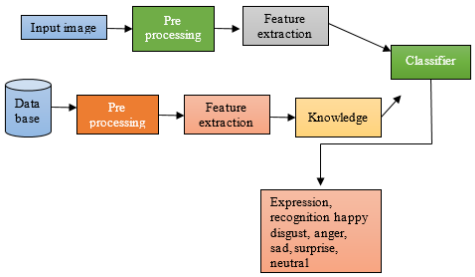

Fig. 10. Block diagram of Facial Expression Recognition System

This thesis use to classify facial expression. There are two sets of images. One is used for training purposes and the other is used for testing. Images are categorized into different types of expression: such as happy, disgusting, angry, sad, surprise and neutral. After cropping, expression images retain only the main areas of the face. But these images also contain redundant information. For this reason, a way to cut blocks of key features has been adopted to deal with expression images.

2.2 Algorithm: An algorithm for classifying facial expression.

Step I: A low-dimensional mouth space is created using train images. This is done by conducting PCA for a set of training images and taking key components.

Step II: Test images are also displayed in the mouth space; the main components are used to represent test images.

Step III: Euclidean distances are calculated between the test image and all train images and the minimum value is selected to detect the train image very close to the test image. Using the in this equation.

$$\mathbf{D=}\sqrt{(\boldsymbol{x1}-\boldsymbol{x2})\mathbf{2}\ +(\boldsymbol{y1}-\boldsymbol{y2})\mathbf{2}}$$

Where x = (x1, x2) and y = (y1, y2)

Step IV: To find the expression, Euclidean distance is calculated from the average of neutral images. The far distance is about neutral expression. As a result, stronger mouth expression can be identified as shown in Figure 11.

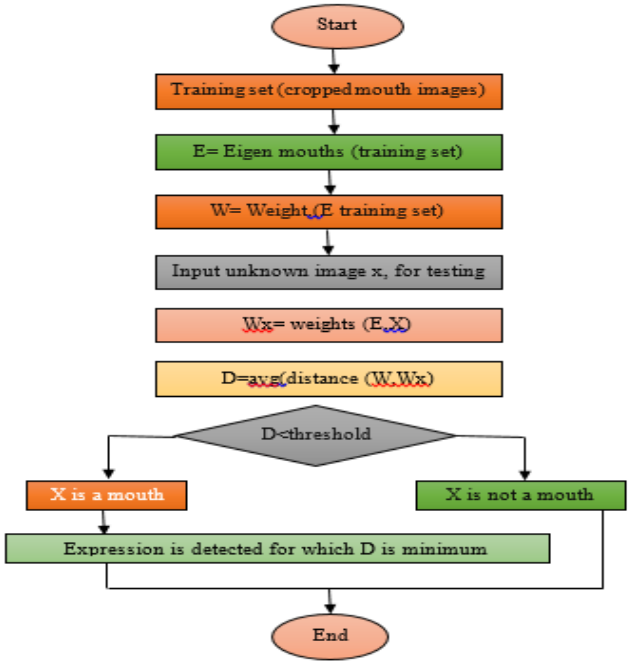

Fig. 11. Flow chart for facial expression using PCA

3. Result and Discussion

Facial expressions provide important behavior. Measurement of the study of emotions, cognitive processes and Social interaction, thus, automatic facial expression. Recognition systems can provide a less intrusive way to stop the emotional activity of the person you care about. With Provides low cost and arithmetic images. Devices, automatic face recognition systems now have Ability to be useful in various everyday applications. Environments as in identifying persons suspected of Airports, railway stations and other places with a greater threat of terrorist attacks. The recognition of emotions depends on the distance between several points of characteristics. In this step, a comparison between the test image and neutral image distances is performed as well as the best match possible for the test image from the train folder. It also classifies or recognizes emotions at other calculated distances. Final results are shown.

Data set

Dataset of training images contains 50 images for training.

Fig. 12. Training dataset

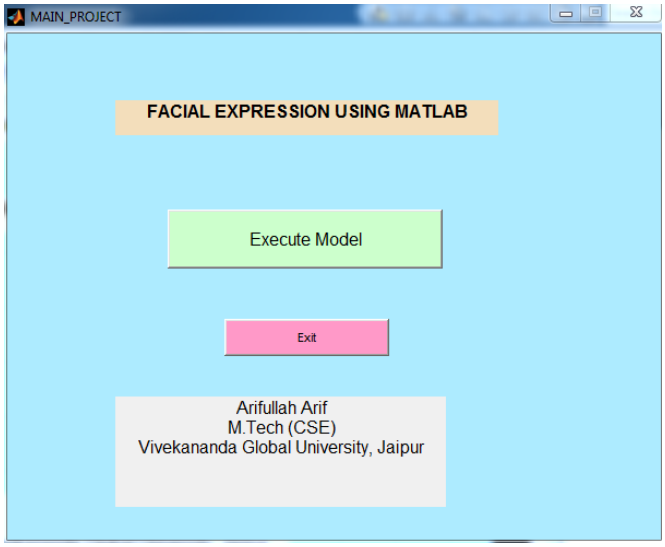

Fig. 13. Main GUI of facial expression Model

After click execution model button, following message shown on command window of MATLAB, Enter train, label File and train name Command window. After loading training and testing images, the output of facial expression of testing images, we fetch in text file name FACIAL_EXP_OP.txt,

4. Conclusion and Future Work

Because facial expressions of emotion are part of our evolutionary history and are a biologically innate ability, we all have the ability to read them. It is an ability that gets better on the job in our everyday lives. This is especially true for macro expressions. But most people are not very good at recognizing micro or subtle expressions. The facial expression recognition system presented in this research work contributes a resilient face recognition model based on the mapping of behavioral characteristics with the physiological biometric characteristics. The physiological characteristics of the human face with relevance to various expressions such as happiness, sadness, fear, anger, surprise and disgust are associated with geometrical structures which restored as base matching template for the recognition system. The behavioral aspect of this system relates the attitude behind different expressions as property base. The property bases are alienated as exposed and hidden category in genetic algorithmic genes. The gene training set evaluates the expressional uniqueness of individual faces and provide a resilient expressional recognition model in the field of biometric security. The design of a novel asymmetric cryptosystem based on biometrics having features like hierarchical group security eliminates the use of passwords and smart cards as opposed to earlier cryptosystems. It requires a special hardware support like all other biometrics system.

This research work promises a new direction of research in the field of asymmetric biometric cryptosystems which is highly desirable in order to get rid of passwords and smart cards completely. Experimental analysis and study show that the hierarchical security structures are effective in geometric shape identification for physiological traits. The general experimental evaluation of the face expressional system guarantees better face recognition rates. Having examined techniques to cope with expression variation, in future it may be investigated in more depth about the face classification problem and optimal fusion of color and depth information. Further study can be laid down in the direction of allele of gene matching to the geometric factors of the facial expressions. The genetic property evolution framework for facial expressional system can be studied to suit the requirement of different security models such as criminal detection, governmental confidential security breaches etc.

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