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Live Analysis Using Emotion Recognition

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Abstract: **Recognizing, extracting and validating various emotions from facial expressions has become an important part of improving the overall human computer interaction. Facial expressions give important information about the emotions of a person. Automatic emotion recognition using facial detection is henceforth a major area of interest within various fields. This paper reviews the literature on different aspects, such as image processing, face detection and emotion recognition. Different comparative methods for automatically recognizing facial actions in successive images are discussed. Different theories of emotions and defining unique methods for studying a variety of images in databases as well as detecting different ways of extracting emotions are studied. The purpose of this survey is also to identify and extensively study the framework, components and papers related to image processing and emotion recognition. This also helps us to establish the significance of the general fields of image processing and emotion recognition and thus help identify where a new contribution pertaining to these fields could be made.**

Keywords: **Image processing, Computer vision, emotion recognition, face detection.**

I. INTRODUCTION

The process of converting a static image into a corresponding digitized format in order to perform some operations on it, thereby acquiring an enhanced version of the image or extract some useful information from it is called **Image Processing**. This technique is being applied in many fields in today's world and has a wide scope. These include image sharpening and restoration, medical diagnostics, remote sensing, transmission and encoding, pattern recognition, machine/robot vision, color and video processing to name a few.

Face Detection is the process of determining the presence of faces in a given image (usually in gray scale) and returning the location of the facial region and the content of each face, if present. This technique is typically used to allow computer systems to analyze the information contained in faces (e.g., identity, gender, expression, age, race and pose) and react accordingly, thereby improving human computer interaction.

Emotion Recognition is the process that follows face detection. It involves identifying human emotions through image processing. Effective improvements in human computer interaction can be brought about if an efficient system can be developed that can recognize these facial expressions and classify them into the basic universal emotions (Happiness, Sadness, Anger, Disgust, Surprise and Fear). The recognition of emotion from facial expression has been the focus of innumerable studies over the past decades.

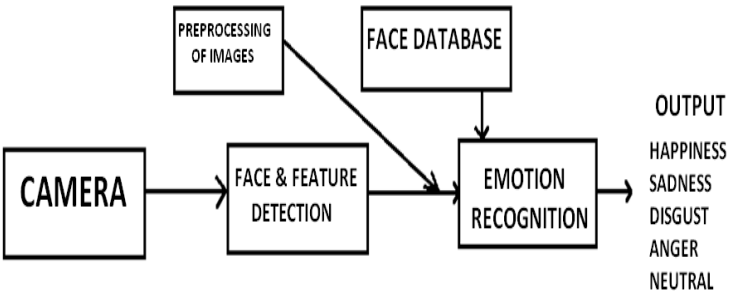

Fig. 1: Emotion classification process

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II. IMAGE PROCESSING

The complication with the annotation based system to index an image through natural human language can be overcome using CBIR (Content Based Image Retrieval). The concept of CBIR has been popularized and actualized in various projects based on image parameters like shape, texture and color. MAT-LAB is often used to combine the three in order to improve the retrieval efficiency. The modern search engines also take advantage of CBIR to index an image efficiently and accurately [1].

Humans are capable of producing hundreds of thousands of facial expressions that vary in intensity, complexity and meaning. Luigi Rosa's algorithm for facial expression recognition can classify the expressions from any given image into the following basic categories : happiness, sadness, surprise, anger, fear, disgust, neutral. The supervised Neural Network classifier is trained using the acquired feature vectors. [2]

CBIR is the mechanism of searching for a digital image from an image database. "Content based" means that the search analyzes the content of the image rather than metadata such as shape, color, texture, etc. The GPU is a highly powerful graphics engine which is used for high performance parallel computing. Images are automatically stored at index in feature database and indexes describe the content of the image. The extracted features are stored as feature vectors, which are then compared with respect to both the query image and the database in order to retrieve the required image. Features may be color, shape, contour, etc. [3]

Recent developments in feature extraction and classification techniques have enabled the task of Sound Event Recognition (SER) that can achieve human-like sound recognition performance in unstructured environments. SER interprets the sound event as a two-dimensional spectrogram image, with the two corresponding axes as time and frequency. This makes it possible for humans to visually recognize the different sound events in a spectrogram. The motive of SER is to devise a system that can achieve performances comparable with those of humans on a variety of hearing tasks. If machines could hear as humans do, then it would be a simple task for them to distinguish between various sounds, such as music and background noises, to sense which direction the sounds are coming from, and to evaluate which sounds are noteworthy and which are simply distorted and unwanted noise. [4]

III. FACE DETECTION

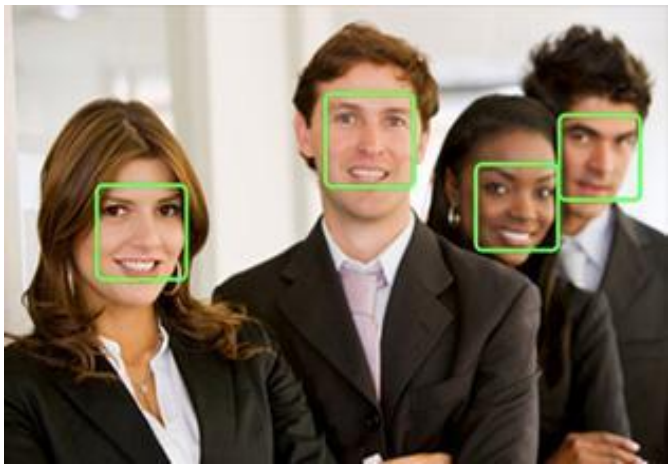

Fig. 2: Identifying the facial region

An emotional state of the object can be derived and classified into happy, sad, angry and neutral. The motion of the facial features like eyes, eyebrows and lips can be used to determine one's facial expression. The previously used off-line processing techniques facial detection algorithms can be enhanced to enable a real time implementation. This can be implemented to obtain a real-time emotional analysis.[5]

A static image can be used to extract a state of emotion through the facial features. The regions of eye and mouth are can be analyzed to classify into six universal basic facial emotions i.e. Anger, Disgust, Fear, Happy and Sad. A confusion matrix for all six emotions recognized in an image is produced and a contrast between them can hence be obtained. This ideology enables us to implement a facial detection and emotion recognition algorithms.[6]

Knowledge Based, Template Matching, Feature Invariant Based, Appearance based and Part based methods are just some of the many face detection techniques available. These methods may be used in a number of applications, a major one being face recognition. Gestures of the body are read through an input sensing device, such as a web cam. The device then communicates with a computer that uses these gestures are input. These gestures are then interpreted using an appropriate algorithm such as statistical analysis or artificial intelligence techniques. The major aim of gesture recognition is to allow a system to acquire and interpret the basic human gestures so as to convey appropriate information. [7]

Given a single arbitrary image, identifying all the regions within the image which contain a face, is the primary goal of face detection. Face detection also aims at detecting facial regions, regardless of its three-dimensional position, orientation, and lighting conditions, and return the image location and extent of each face. Such a problem is challenging because faces are imprecise and vary in fields like size, shape, color and texture..Numerous techniques have been developed to detect faces in a single image. The first step of any system designed to detect and process faces is to detect the locations where facial properties are present. However, detecting facial regions from a single image is a challenging task as there is significant degree of change in scale, location,orientation(up-right, rotated) and posture (frontal, profile).Facial expression, occlusion, and the intensity of light also change the way faces appear in images. [8]

A system is developed to examine different face detection and recognition methods, provide accurate solutions for image based face detection and recognition and also improve the response rate as an initial step for video surveillance. A solution is proposed on the basis of tests performed on various face rich databases with respect to subjects, pose, emotions, race and light. [9]

The creation of a generic 3D system can be used to improve the performances of the currently existing face recognition systems. The 3D model is used to synthesize the led prototype image from a given image acquired under various lighting and viewing conditions. Computational simplicity and robustness of the system which are essential for many real life application, can be achieved by this approach. [10]

IV. EMOTION RECOGNITION

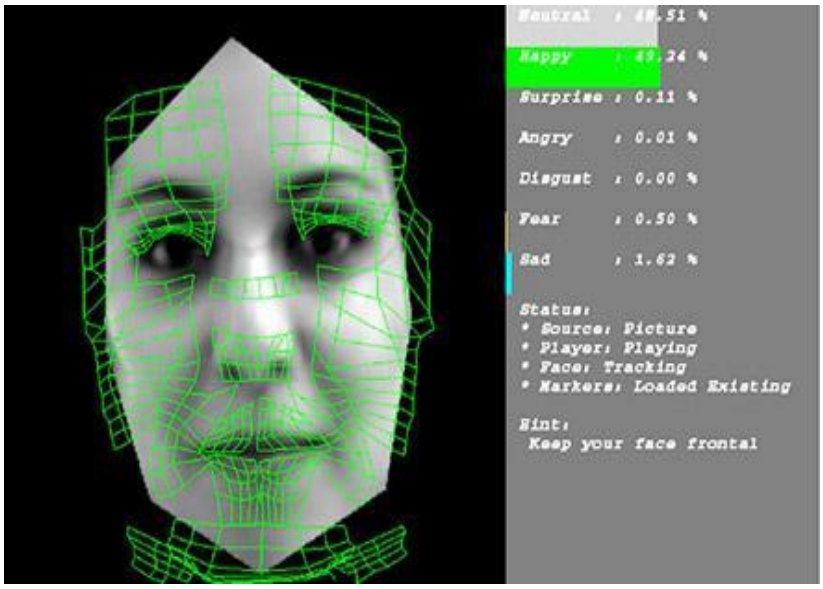

Fig. 3: Classification of emotions in frontal facial image

The facial features in a static image are used to recognize an emotional state of the object. In the face detection process this algorithm takes advantage of skin texture and color detection to identify the facial region from a complicated background. We will often find a scenario to implement the technology in a complicated, not so well contrasted image. This skin detection algorithm is used to obtain more consistent and reliable results. [11]

An algorithm is used to identify the person's emotional state through facial expression such as angry, disgust, happy where the people are differentiated on the basis of their age, thus providing more clarity in recognizing expressions. Other feature selection tools are used; these classifiers can help improve the detailing of our project. [12]

A facial recognition systems framework can be created, and the process comprises of the training phase followed by testing. Features are extracted from sample images and the feature classifier is obtained after training the respective classifications in the training phase. Meanwhile, in the testing phase, human faces are initially detected from the facial images followed by feature extraction and finally feature classification. This represents a unique approach towards facial recognition, where two different processes are successfully used to detect emotions. [13]

Two experiments concerning trait EI. In study 1, ten high and ten low traits EI individuals are selected to participate in a computer-based experiment which involves recognizing morphed emotional expressions. The results were in favor of the hypothesis that the people having higher values of partial trait EI scores would be more prone to the mood induction procedures than the people having lower value of partial trait EI scores.[14]

An accurate and high speed emotion detection system is proposed by the color and feature based detections which are adopted to find skin color fast and candidate blocks will be selected carefully. Lighting compensation has been used to improve the performance of color-based scheme. Hence, a speedy and detailed emotion detection system is created in order to detect edges of the images and calculate the distances between various features based on these edges. [15]

Facial feature points are first tracked using a constrained local model tracker. The resulting facial shapes are aggregated and are used to select key frames from which appearance features are obtained. However, registration of facial regions can be achieved by using a face detector rather than using the tracked facial point locations. Finally, emotions can be successfully detected. The final result is the emotion avatar image, a single image that exhibits all the expressions and facial motion present in the input video.[16]

Emotion detection can be done using two classifiers, Naive Baye's classifier and the TAN classifier. On experimenting over a set of emotions, the usability and user-friendliness is significantly improved for the existing facial tracker, extending it with automatic face positioning, emotion classifiers and visualization in case of Naive Baye's classifier but inconsistent results are obtained using TAN classifier due to lack of training data and implementation issues.[17]

Human-computer intelligent interaction (HCII) enables a computer to interact with humans, with the basic requirement that it possess the communication skills of humans. One among these incorporated skills is the capability to understand the state of human emotions, by recording their facial expressions. The main focus is on automatic facial expression recognition from live video input using the concepts of dynamic programming and Hidden Markov Model (HMM). This method uses all of the temporal information displayed in the video. The basic idea behind using all of this temporal information is that any emotion being displayed has a different temporal pattern.[18]

The speech signal is the fastest and most natural modes of communication between humans, and thus serves as one of the most efficient methods of interaction between humans and machines. In speech emotion recognition, the emotions from the speech of the male or female source are acquired. Various classifiers are used to record basic emotions such as happiness, sadness, anger, surprise, disgust, etc. The database for this system comprises of the speech samples. The basic features extracted from these samples are the energy, pitch and other frequency coefficients.[19]

Computers are emotionally challenged in that they do not recognize human emotions or possess emotions of their own. However emotions form the basis for humans' individual identity and thus mechanisms need to be devised that would allow human-computer interaction. One method for recognizing emotions through facial expression displayed in a video sequence is by using a Cauchy Naïve Bayes Classifier that classifies each frame of the video to a facial expression based on some predefined group of features measured for that time frame. The first step is to develop a model for facial muscle motion corresponding to different expressions. The best known such model is called the Facial Action Coding System (FACS) that is used to code the expressions on faces as a sequence of facial movements known as action units (AUs) that are related to the movement of eyes, eyebrows and mouth, which in turn relate to the six basic universal facial expressions.[20]

Choosing a useful feature extraction method and classification scheme must be critical in order to recognize expressions of the face accurately. One such method is a novel fuzzy method for facial expression recognition on static images of the face, which is based on extraction of mathematical data from some specific facial regions and feeding them to a fuzzy rule-based system.Triangular membership functions are used by Fuzzification operations for both input and output. The distinct feature of such a system is its simplicity and high accuracy.[21]

Facial expression makes up for almost 55 percent of the effect of a communicated message and is hence a major modality in human communication which has resulted in a number of automatic methods to recognize facial expressions in images or video. One such method is based on the machine learning system of Support Vector Machines (SVM) that uses an automatic face(feature) tracker to perform localization of faces and extraction of facial features. The facial feature displacements in the video stream are used as input to a Support Vector Machine classifier. These displacements are subsequently used to train the SVM to recognize previously unseen expressions.[22]

Multiple features of an object like Facial expressions, speech and Multi-modal information can be used to derive an emotional state of the object. The audio-visual information of an object is extracted and analyzed to recognize emotions like happiness, anger, sadness and neutral state.[23]

The use of facial emotion recognition (FER) to identify and classify emotions for people with autism who find it hard to express their emotions.[24]

A number of typical algorithms can be presented, bifurcated into schemes based on appearance and schemes which are model-based. Various linear subspace analysis schemes and manifold analysis approaches for face recognition are described. Other approaches like Active Appearance Model, Graph matching and 3D Morphable Model methods are introduced for extracting faces using image analysis.[25]

V. CONCLUSION

Automatic emotion recognition from facial detection is increasingly used nowadays because it improves human-machine interaction. To improve the emotion recognition process, combinations of the given methods can be derived. Also by extracting more effective features from facial images, accuracy of the emotion recognition system can be enhanced. As a consequence, emotions, which were largely overlooked earlier to develop intelligent machines, are increasingly becoming an area of important research.

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