Emotional Artificial intelligence impact on facial expression- A phenomenon

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Facial expression plays a vital role in any communication, most of our communications are non-verbal and carries a variety of emotions. Recognition of emotions by machines is quite challenging and researchers are working to implant this emotional intelligence i.e. making the machines capable of reading, imitating, interpreting, and responding to human facial expressions and emotions. This area of Emotional Artificial Intelligence (E-AI) is also known as Affective computing [1], which relates to the field of computer based Facial Expression Recognition (FER). Here, computers are used for the detection and recognition of face in any image or video, which is further processed for the extraction of facial expression, which is further categorised into various categories of prototypic facial expressions like fear, happy, sad etc. In the era of robotics and computer vision, several companies and organizations are working towards the area of Emotional Artificial intelligence, to drive their business outcomes Viz. Disney is planning to use facial recognition to find the emotional responses of the audience [2] in Toy Story 5, an upcoming movie by Disney; further Animoji is a new feature introduced in Apple iPhone X, where you can get a computer simulated emoji to mimic your facial expressions [3]. The work performed in this article relates to the understanding the concept of Emotional Artificial intelligence, and how the same can be applied to recognize the facial emotion in real time video streams. The importance of the work relates to real time identification and analysis of facial expressions.

Keywords : AI | Deep learning

Introduction:

Gesture executed by the facial muscles leads to facial expression, which reflects the emotional state of any observer, thus reflects the internal feeling of any person. Expressions and emotions go hand in hand, i.e. special combinations of face muscular actions reflect a particular emotion. Many a times, it is very hard, and maybe even impossible, to avoid it's fitting facial expression [4] for certain emotions. Say, somebody is trying to ignore annoying offensive comment of his/her boss, by maintaining a neutral expression, which might be showing a brief expression of anger. This phenomenon of a brief expression i.e. an involuntary facial expression is known as 'micro-expression'. Micro-expressions involves the seven universal emotions i.e. *happiness, sadness, anger, surprise, contempt, fear and disgust*. Nonetheless, one's real feelings, whether S/he wants it or not, can be revealed by capturing Micro-expression. Due to the variations in the illumination, pose and occlusion, Face Expression Recognition techniques have always been a very challenging task in real life applications [5]. Several models are proposed for recognizing the facial expressions viz. Facial Action Coding System (FACS) [6] was developed by Ekman and Friesen developed in 1978, which is a special system for objectively measuring facial movement; later, Swedish anatomist named Hjortsjö [7] developed a FACS based system, which became the standard for identifying any movement of the face. Further, computer based facial measurements [8], were studied by Ekman and Sejnowski. We followed the basic emotion theory by "Paul Ekman and ArmindoFreitas-Magalhaes"[9] and trained the system by using Haar Cascade classifier for classification and feature extraction,

Conceptual Model

Facial Action Coding System (FACS) is a universal standard for systematic categorization and indexing of the physical expression and emotions. The Action Units (AUs) are the basic values of FACS. Fundamentally AUs are the actions of individual muscles or groups of muscles, AUs

are grouped in to several categories and they are identified by a number involving various codes viz. main codes, codes for head movement, codes for eye movement, codes for visibility, and gross behaviour codes. It is not simple to detect the emotions from facial expressions, automatically. The interpretation of the facial expressions is highly context driven. To simplify this automatic affective inference mechanism, Ekman and Friesen in 1978 developed special system for objectively measuring facial movement; the Facial Action Coding System (FACS) [6]. Later, Swedish anatomist named Hjortsjö [7] developed a FACS based system, which became the standard for identifying any movement of the face. Further, computer based facial measurements [8], were studied by Ekman and Sejnowski.

Facial Action Coding System (FACS), involves the Action Units (AUs) as the basic values of FACS. Fundamentally AUs are the actions of individual muscles or groups of muscles, AUs are grouped in to several categories and they are identified by a number involving various codes viz. main codes, codes for head movement, codes for eye movement, codes for visibility, and gross behaviour codes. The intensities of AUs are annotated in five categories, by appending letters A□E to the AUs (A for minimal intensity-trace, B for slight intensity, C for marked, D for severe, E for maximum intensity). For example, AU1A signifies the weakest trace of AU1 and AU1E is the maximum intensity possible of AU1 for the individual person.

The eyes and mouth have high importance to emotion detection; therefore, to successfully recognize an emotion, the observations mostly rely on the eye and mouth regions. Furthermore, the actions of eyes and mouth allowed grouping the expressions in a continuous space, ranging from sadness and fear (reliance on the eyes) to disgust and happiness (mouth). Combining these observations with facial AUs increase knowledge about the areas involved in displaying each emotion.For example, “happy” denoted by AU6 + AU12, comprises AU6 (Cheek Raiser) and AU12 (Lip Corner Puller), whereas ‘sad’ (AI1 + AU4 + AU15) comprises AU1 (Inner Brow Raiser), AU4 (Brow Lowerer) and AU15 (Lip Corner Depressor).

The computer algorithm for facial coding extracts the main features of the face (mouth, eyebrows, etc.) and analyses the movement, shape and texture composition of these regions to identify facial action units (AUs). Therefore, it is possible to track tiny movements of facial muscles in individuals’ face and translate them into universal facial expressions like happiness, surprise, sadness, anger and others.

We followed the basic emotion theory by “Paul Ekman and ArmindoFreitas-Magalhaes” [9] and trained the system by using Haar Cascade classifier for classification and feature extraction, The process of detection of facial expression recognition in real time video streams is presented in Fig.1

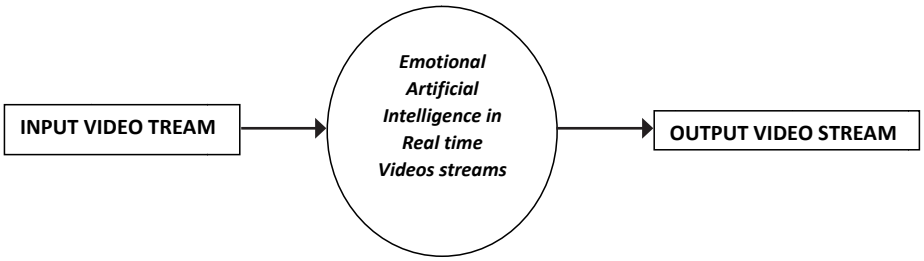

Fig. 1 – Block Diagram – *Emotional Artificial Intelligence in Real time Videos streams*

The process of detection of emotions of the faces identified in the real time video streams comprises of three modules shown in fig. 2:

- Frame wise video stream processing system
- Emotion specification system
- Emotion prediction system

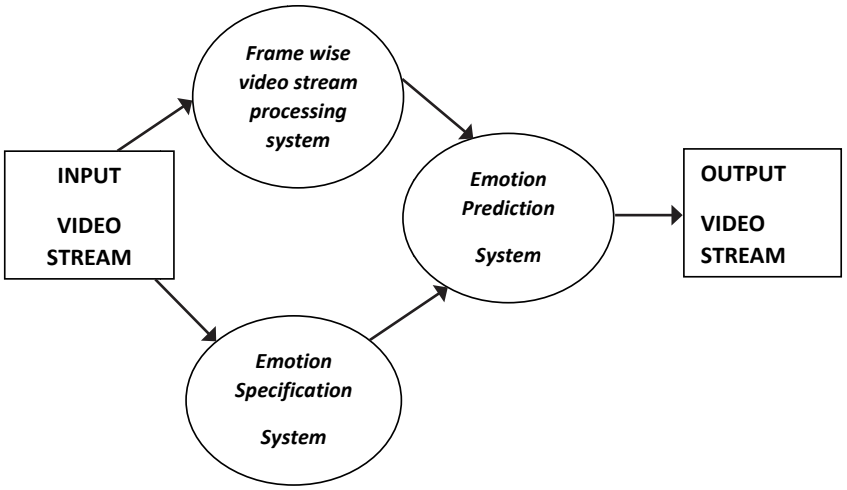

Fig. 2 : Emotional Artificial Intelligence in Real time Videos streams- Modular Decomposition

Following are the details of the working of each system mentioned above.

1. Frame wise video stream processing system:

This module relates to the capturing of real time video from the webcam, and process each frame of the captured video, the processing involves

a. Resizing of frame as per requirements

b. Transforming the captured image to Gray scale from RGB

c. Detection of face in the transformed image by using haar cascade classifier.

d. Determine pixel wise information of the detected face.

2. Emotion Specification System:

This modules relates to specify emotions/initialize the array Emotions according to the basic emotion theory by "Paul Ekman and ArmindoFreitas-Magalhaes" as emotions = (angry, disgust, fear, happy, sad, surprise, neutral). The work performed in this module of emotion specification involves following steps:

a. Specification of the Emotion model

b. Loading of specified model and initialization of model training weights

c. Specification of emotion classification array "emotions" according to the basic emotion theory by "Paul Ekman and ArmindoFreitas-Magalhaes" as emotions = (angry, disgust, fear, happy, sad, surprise, neutral).

Emotion Prediction System:

This module relates to the pixel wise analysis of face detected in the frame identified in module 1 (Frame wise video stream processing system) for face detection, each pixel value of the detected face is subjected to predict the emotions, based on the models specified in the module 2 (Emotion Specification System) for the emotion specification. The final outcome of emotion for each pixel of face is then determined as one of the emotions specified in array emotions = (angry, disgust, fear, happy, sad, surprise, neutral).

The work performed in this module of emotion prediction involves following steps:

a. Use pixel wise information of the detected face.

b. Apply the models of emotion specification module and determine the closest emotion value for each pixel of the detected face.

c. Determine the maximum index for the predicted values

d. Map the maximum index with the emotions array and determine the emotion.

Finally the predicted emotion is embedded in to the Frame of the captured real time video stream

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Dr. Sudhansh Sharma is a student of multiple disciplines viz. Computer Science, Physics, & Operation Research. His academic credentials involve following PhD (Physics),M.Sc.(Physics), M.Tech. (Computer Science), MBA(Operation Research). He has got one and a half dozen of Publications in various National and International Journals/Conferences. He is the Technical Reviewer of various Journals and Conferences of National and International repute. He tried to express his understanding of interrelation between Base sciences and Computer science through his Book "Modeling Of Novel MOSFET Devices – Basics, Concepts, Methods " published by Lambert Academic Publishing(Germany), and Contributed to an edited Book titled "E-Commerce and Online Banking", as an editor, published by Manakin Press, India. He has delivered invited talks in various Workshops, Refresher and Orientation programmes. His experience includes both, industrial and Academic Domains. He has been associated with various Industries and academic institutions. Currently he is serving as Assistant Professor in the School Of Computers and Information Sciences – IGNOU.

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Annexure I

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Reviewers Comment

Reviewer Comment 1: As per this Article, Artificial intelligence is a branch of computer science that aims to create intelligent machines. It has become an essential part of the technology industry.

Reviewer Comment 2: In current scenario we have many leading face recognition software's EXP:-: Amazon Recognition, Face Detection by Lambda Labs, Microsoft Face API, Google Cloud Vision and IBM Watson Visual Recognition, among others.

Reviewer Comment 3: Amazon has also Discover the face recognition. It offers "Rekognition" - a facial recognition tool that has been used to spot criminals. According to NCRB, the Automated Facial Recognition System (AFRS) to be implemented that would help in automatic identification and verification of persons from digital images.

Editorial Excerpt

This Article has 2% plagiarism, Which is accepted as per the standards of publication for the magazine. The above article analyze the Artificial Intelligence in current scenario. It is an area of computer science that emphasizes the creation of intelligent machines that work and reacts like humans. As per Article it properly Analysis The Speech recognition, Learning, Planning ,Problem solving. As per the editorial board and reviewers' suggestions had been incorporated in the article and the manuscript had been earmarked and finalised to be Published under "**Argument Based Credentials** (ABC)" Category.

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