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Lie Detection Using Facial Micro- Expresions (September 2020)

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ABSTRACT

In many fields, such as airport management, criminal inquiries, counterterrorism, etc., identifying lies is key. We can't go to the people in this area requesting for a practical lie detection test as it takes a hard task which takes a lot of time. An evergreen and changing topic has been Lie detection. The most common and effective approach to date has been polygraph techniques. The biggest downside of the polygraph is that it is difficult to obtain successful outcomes without establishing physical interaction with the person under investigation. This physical touch will usually trigger additional attention in the subject. One way of identifying lies is to recognize facial micro- expressions, which are small, spontaneous expressions seen on the face of individuals as they attempt to hide or repress emotions. So, our goal is to use facial micro- expressions to build and improve a lie detection system. The system's primary goal is to target the slight changes that occur in the face when someone is tricky and deceptive.

Keywords :- Lie detection, micro expressions, Emotions, Expressions

I. INTRODUCTION

Lying is an act of disrespect and would have cost a lot in any aspect of life, whether in personal or professional life. So the evaluation of a verbal statement with the purpose of exposing a potential deliberate deception. Lie identification is commonly referred to as a polygraph. A polygraph is a mechanism that tests different factors, such as breathing, blood pressure, heartbeat and sweat, which are used as hints in the calculation of lies. The downside of the polygraph is that it causes false positives when the person under examination is nervous or emotionally excited. Lie Identification is of the utmost importance, particularly in areas such as security, crime, interpersonal relationships, and may result in highly disastrous outcomes if undetected. Manual estimation of lie detection is hard work, time consuming, and unreliable. So here we are going to use facial features to present a lie detector.

Emotions play a very influential and purposeful role in daily life. Emotions show the exact emotions of an individual at any given moment. Emotions play a crucial role in the process of identifying lies, are more accurate as emotions are common and do not change with caste, community, creed, faith and the region. At every given moment, the feeling felt by a human can only be normal, effected by the environment. Thus, in contrast to manual labor, the odds of identifying specific details are high.

The 80 muscular facial contractions of a person and their variations give birth to thousands of gestures. Seven fundamental emotions, such as rage, disgust, terror, satisfaction, surprise, sorrow and contempt, are grouped into a single class of expressions. Contempt is an emotion that has been added to the list of common emotions lately. As of now, six basic emotions (with neutral expression) are restricted to the analysis in hand, leaving behind distrust.

Present day lie detectors, such as polygraph examination, are very powerful thermal cameras that measure minute shifts in the face temperature of the person. This paper explores an accessible, cost- effective and minimally - intrusive model.

II. RELATED WORK

We give a short background of micro-expressions and a review of similar studies in the field of psychology. We also provide for a study of preceding studies on actuated micro-expressions. For a more detailed overview of the relevant studies on facial expressions, we direct the reader to Zeng et al. survey [19]. In the study of facial gestures, the primary objective has been on identifying six specific emotions and having facial action unit marking using FACS. Few efforts within computer vision exist to examine more complicated facial expressions. In social psychology, nevertheless, micro-expressions as a dynamic mode of facial expression have been extensively researched by Guttmann [8] and Ekman [4]. Ekman initially noticed the presence of facial micro-expressions when he looked at a recording of a mental patient attempting to mask a plot to commit suicide. By studying the video in slow motion, Ekman found a very brief gesture of deep anguish, which was eventually replaced by a grin. Since these gestures are very quick, they are undoubtedly overlooked through natural monitoring. Micro-expressions were later first-hand found in social studies [17] and preparation programmers for studying to observe them were developed [4]. Studies of micro- expressions in psychology clearly indicate that people are inherently poor to understand micro-expressions. Frank et al.[5] carried out a micro expression identification trial for real-life videos and discovered that U.S. undergraduates and coast guards had a precision of 32 per cent and 25 per cent without experience, and 40 per cent and 47 per cent without experience, respectively (with a chance of 20 per cent), with very poor perfect amounts of observation. Many facial expression experiments till date use a research body composed of people acting on facial expressions. They have been shown to vary greatly from the normal facial gestures that exist in daily life [1]. As anticipated, the emphasis is now turning towards the use of induced and inherent data for research [10]. These details are more complex to work with, as they require greater entitlement to communication and thus less authority over monitoring environments. Few computer vision research on the identification of facial micro-expressions have implemented acted data, but none of the research have made their results publicly accessible. Polikovsky et al. [13] obtained figures from 10 university students who conducted micro- expressions and implemented gradient orientation histogram descriptors. Likewise, Shreve et al. [14, 15] recorded 100 active facial micro-expressions from an undisclosed number of volunteers and used tension patterns for classification of the features. Example recordings with micro-expressions have been revealed and asked to imitate them. Micro-expressions, however, are spontaneous by psychological study [4] and cannot be extracted by behaving. Not unexpectedly, Shreve et al. [14] recorded chance validity (50 per cent) while trying to test their classifier on 24 random micro-expressions in the Canal-9 political debate corpus. While the weak outcome could be partially accredited to head man oeuvre and voice, it is obvious that a new approach and a greater unconstrained facial micro-expression compilation are required to obtain fair functional precision. In our article, we introduce both a considerably greater corpus of random facial micro-expressions and a process that triumphs in categorization. More diverging similar efforts incorporates Michael et al.[11], who suggested a system for automatic detection of deceit using body gestures. While the authors scantily discuss micro-expressions, no review of their frequency in the training data is mentioned. Numerous effective facial expression detection techniques till date have included the use of spatial-temporal local texture descriptors. An example of such a texture descriptor mentioned as LBPTOP, which freshly provided state-of-the-art findings in facial expression scrutiny [10,20].

III. METHODOLOGY

The proposed system is a lie detector using facial-micro-expression. It is quite difficult to catch micro-expressions by human eye while interrogating suspects. But using high tech camera and machine learning applications like face recognition system and iris

movement system makes our work quiet easy. For this problem we have come up with a solution which is quiet easy and logical we have tried to neglect the use of graphs and complicated algorithms. First a high tech camera is used to detect the hotspots next we will find the coordinates of the hotspots and assign counters to those coordinates and keep some value for the counters when there is any kind of movement in those hotspots we decrease the counter by one, and another variable is introduced by allocating some value to it and then the sum of all the coordinates is calculated if the sum is less than the variable the most probably the suspect is lying.

• FACE RECOGNATION

A facial recognition device is a technology capable of recognizing or verifying a person using a digital image or a video image from a video source. There are several ways in which facial recognition systems operate, but they typically work by matching selected facial features from a given image with faces in a database.[23]
The Face Recognition technology is used for security purposes. The Face Recognition Device should be able to recognize a face in a picture automatically. This involves extracting the features and then remembering it, regardless of lighting, voice, illumination, ageing, transformation (translate, rotate and scale image) and posture, which is a difficult task.

A variety of considerations need to be taken into consideration in order to create a useful and usable facial recognition system.[23]
1. The average speed of the device from detection to detection should be appropriate.
2. The accuracy of this should be high

Face Recognition Methods

In the early 1970s, facial recognition was viewed as a 2D pattern recognition problem. Distances between important points were used to distinguish recognized faces, e.g. to measure distance between eyes or other important points, or to measure various angles of facial components. However, it is important for the face recognition systems to be fully automatic. Face recognition is such a daunting but fascinating topic that it has attracted researchers of diverse backgrounds: psychology, pattern recognition, neural networks, computer vision, and computer graphics. The following methods are used to face recognition.

1. Holistic Matching Methods
2. Feature-based (structural) Methods
3. Hybrid Methods

1.Holistic Matching Methods: In a holistic approach, the entire face area is taken into account as input data to the face catching process. One of the best examples of holistic approaches are Eigen faces (the most commonly used approach for facial recognition), Principal Component Analysis, Linear Discriminant Analysis and Independent Component Analysis, etc.[24]

I. 2.Feature-based (structural) Methods: Feature points such as eyes , nose and mouth are first extracted in this process and local statistics (geometric and/or appearance) are fed into a structural classifier. A major challenge for feature extraction methods is the "restore" feature, which is when the device attempts to recover features that are invisible due to broad variations, e.g. the Pose header when we match a front image with a profile image.[24]

Hybrid Methods: Hybrid facial recognition systems use a mix of both holistic and feature extraction approaches. In general, 3D images are used in hybrid approaches. The representation of a person's face is captured in 3D, allowing the device to observe the curves of the eye sockets, for example, or the shapes of the chin or forehead. Even a face in the profile will serve because the machine uses depth and a measuring axis, giving it enough details to create a complete face. The 3D method typically proceeds as follows: detection, position, measurement, representation and matching. Detection-Capture of a face either by scanning a photograph or by photographing a person's face in real time. Position-Determination of the position, size and angle of the head. Measurement- Assigning measurements to each curve of the face to create a prototype with a particular emphasis on the outside of the eye, the inside of the eye and the position of the nose.[24]

• LIES, EXPRESSIONS AND EMOTIONS

To recognize the language of the body and micro-expression. We first need to establish the baseline on how someone behaves when lying before going on to this initiative. Some of the approaches are from watching the body language, the sound of the voice of a person has an incredible impact when a person is untruthful that he sometimes becomes upset and his sound becomes strong. There are also ways to identify whether someone is untruthful [27]

It is not possible to decide what feelings are read from facial expressions, according to Paul Ekman.[28] According to Paul Ekman it is not enough to determine what emotions are read from facial expressions.it is also crucial to discover whether the interpretation of the observation are correct or not.. Facial gestures and thoughts are universal, and experiments and research have said that facial expressions can be interpreted correctly.[28] Basically, there are seven facial micro expressions of surprise, pleasure, disgust, sorrow, terror, and rage, and all these feelings display any change in expression, some of which are easy to observe while others are minute.[31]

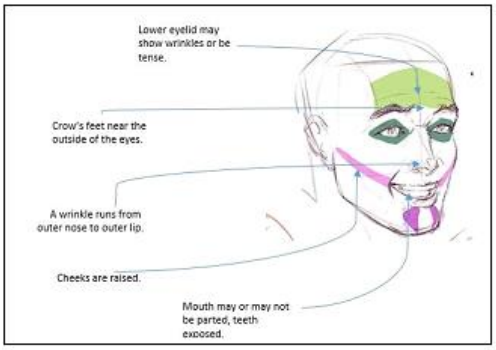

Figure 1: Happiness Micro-expression

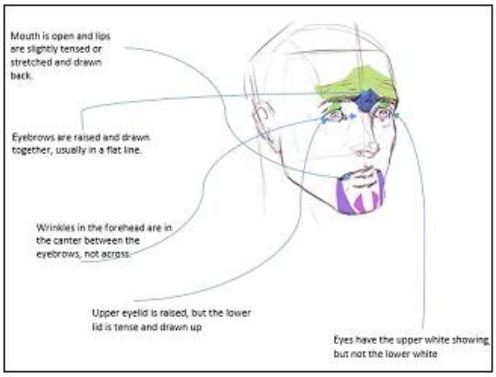

Figure 2: Fear Micro-expression

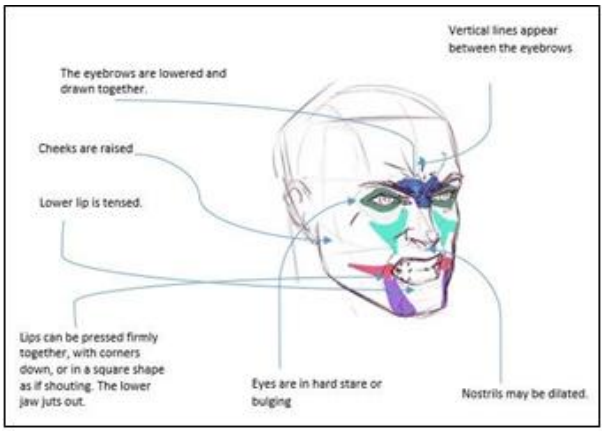

Figure 3: Anger Micro-expression

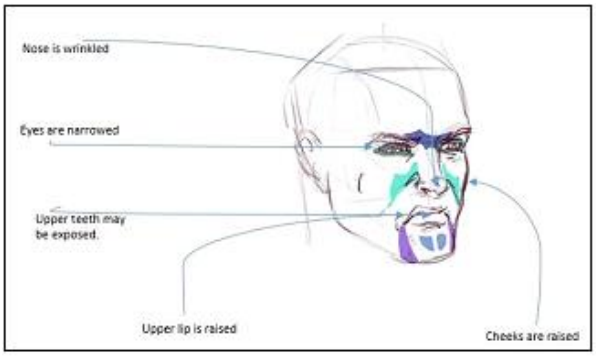

Figure 4: Disgust Micro-expression

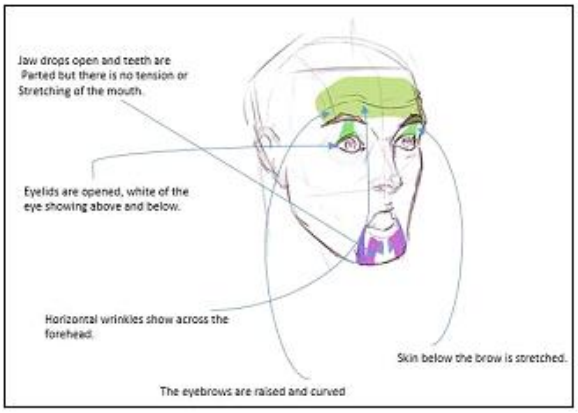

Figure 5: Surprise Micro-expression

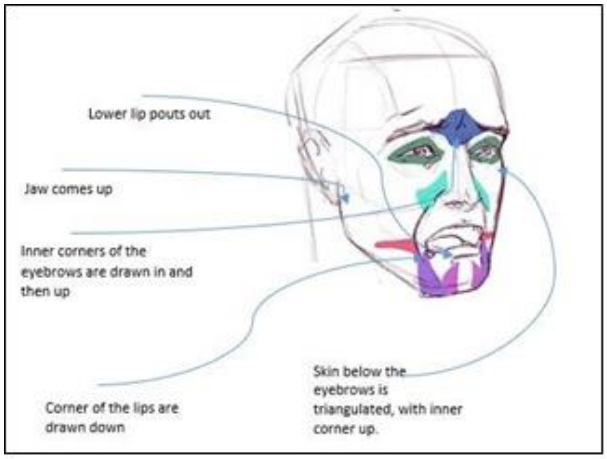

Figure 6: Sadness Micro-expression

The Equivocator's Face

• No matter the person, there are seven fundamental feelings that are hard-wired: pleasure, sorrow, disgust, terror, disappointment, rage and contempt. Any of these feelings is reported in very different patterns that are almost impossible to falsify. For only one-fifteenth of a second, micro-expressions of these feelings can leak out. They are a struggle to spot, but it is extremely beneficial to learn to spot these flickering feelings. [30]

Figure 6: Sadness Micro-expression

Based on the form of questions posed when interrogating a suspect, behaviour indicates improvement. The facial expression of a human says a lot about a person's current behavioural condition.[28] There are several ways to identify when the offender is being untruthful movements such as sudden frustration, people also appear to get agitated when lying or the same question is frequently asked, There is a rapid shift in the body language of the defendant when interrogating, twitch of hands and blinking of eyes is often detected, but there are kinds of movements that can be readily detected, but there are certain kinds of micro-facial changes and motions that cannot be noticed when interrogating. There have been too many experiments and numerous approaches to record these micro-facial movements have been attempted. There are, however, several facial hotspots that are likely to serve as indications, according to Kelly J. Todd, Managing Director of Forensic Strategic Solutions. Liars are like tight rope walkers whose aim, when threading their web, is to remain upright [27].

The Maximizer's Face
• Changes in eye contact
• Tight lips
• Changes in blink rate

The Minimizer's Face
• Facial blocking
• Hiding in their hair

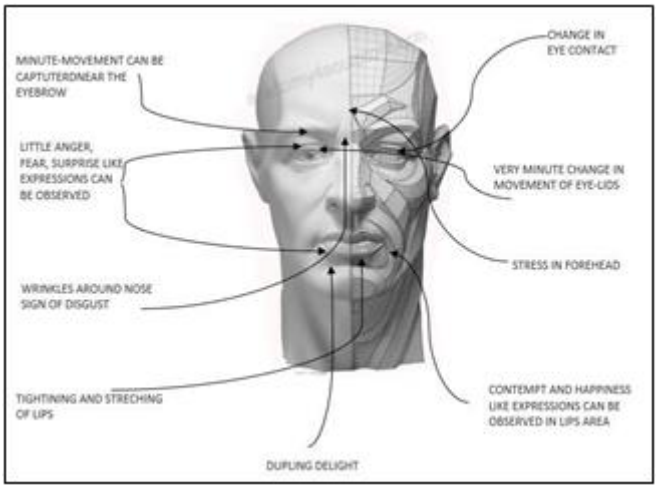

Figure 7: different hot-spots while lying

IV. RESULTS

The frequency of micro expressions can be lower than other cues and it is quite difficult to read these expression so our model can be used to catch hold of such liars. At the end of this experiment we will be able to detect easily if the suspect is lying or being untruthful by simply detecting the micro-expressions. The technique of reading micro expressions is an art and is being studied from the time of Darwin. Now in this fast growing up world it is time that we use better techniques and methods to catch hold of such culprits. Expressions and body language are connected to the subconscious mind and to completely trick facial expression is very difficult and using high tech super speed cameras give us an extra edge against such criminal culprits.

V. CONCLUSION

Human emotion is an important subject of research in psychology on the basis of facial micro expressions. It is believed that in many places where psychological understanding is needed, such as police interrogations, airport and border checkpoints, jobs, and clinical testing, the developed method may be useful. For regular review, the Real Time Lie Detector seems very beneficial. It can be used to classify perpetrators, but cannot be used as evidence of a deception that is foolproof.

This research is not an explicit detector of lies, but it extracts micro expressions, which in turn helps to detect lies for both individuals and investigators. Micro expressions show the subject / people's real intentions. Witnessing, examining and recognizing these micro expressions will therefore intensify the process of identifying a lie, but it is a repetitive and hard job for an average individual to understand such impulsive expressions.

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