INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Lie Detection Using Facial Expressions

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Abstract:

Finding lies is important in many places, such as airport security, police investigations, anti-terrorism, etc. The only way to find out is to identify the face short speeches, which are short, unrelated expressions displayed on people's faces when they try to hide or suppress emotions. Manual measurement of micro-expressions by hard work is time-consuming and inaccurate. Small facial expressions, body language as well Speech analysis is a powerful tool for Lie detection. Facial micro-expressions are an impossible participatory response that is impossible to lie. Liars experience pressure that manifests itself as body language indicators and oral indicators. Small facial expressions are found and known based on Paul Ekman's research using Key Analysis. This paper proposes a non-invasive and economically friendly method to detect lies from people seen as a threat to society.

Keywords: Machine Learning; Lie detection; facial micro-expression

Introduction:

Lie detection is an evaluation of a verbal announcement based on possible intentional deceit. Lie detection can also refer to a cognitive procedure of detecting deception by evaluating message content in addition to non-verbal cues. It additionally might also seek advice from questioning techniques used along with technology that documents physiological features to check truth and falsehood in reaction. The latter is typically utilized by regulation enforcement in America, but rarely in different international locations due to the fact it's far primarily based on pseudoscience.

There are multiple technologies in existence for this purpose. The most common, highly-used and one of the oldest methods is the polygraph. A comprehensive study through the National Academy of Sciences of Existing Studies concluded that "there was little basis for the expectation that polygraph tests could be extremely accurate."

In this society, the detection of lies has a positive impact on public services, especially those that require education - e.g., education or health care and security, it is a necessary skill for many professions such as teachers, doctors, or law enforcement officials. They are generally trained to recognize lies but have also demonstrated that their ability to distinguish between the truth and the lie is often inaccurate. A study reported that experienced professionals like police have an average of 65% accuracy when asked to detect a lie and it does not depend on the direct expression of behavior known to be associated with lying, but rather the subjective experience of the individual.

Common methods of detection include the use of a number of devices such as polygraphs, sweating and measuring breathing rate, heart rate, and blood pressure monitoring. The most commonly used method, the polygraph, achieves high accuracy in detecting lies from 81 to 91% (Gaggioli, 2018). However, they are aggressive and require an experienced interviewer to conduct questions and interpret the results. Moreover, such methods are not always reliable, as it has been shown that trained people can be very effective in cheating the system (such as polygraph Honts et al., 1994).

Micro-Expressions: Facial Micro-expressions are involuntary facial expressions that occur for a very short period. These involuntary emotional signals can be used to decode the true feelings of a person. These Expressions are as natural as breathing.

Micro-expressions are most often completely missed and are very hard to interpret. They can occur as fast as 1/15 to 1/25 of a second. They show hidden feelings without the subject's knowledge.

There is no way to prevent them from happening. The ability to detect these involuntary expressions is essential to emotional intelligence and detection of deception. Micro-expressions cannot be faked and happen in a split of a second. These facial expressions have been proven to be an important factor for hostile intent and risk detection[1].

Use of Deception Detection: The main purpose of deception detectors in security testing is to identify individuals who present significant threats to national security. To put this in the language of diagnostic testing, the goal is to reduce to a minimum the number of false-negative cases.

Literature Review:

Albert Mehrabian, the author of silent messages, says that only 7% of communication is verbal and 93% is nonverbal (55% being body language,38% tone of voice). Paul Ekman[2], a leading psychologist, proposed the theory of universality of facial expressions which states that facial expressions are unlearned behaviors that develop independently from cultured expressions. Studies show that like-minded blind people make the same expressions even though they have never seen other people's faces. According to the groundbreaking research done by Haggard, Isaacs, and Paul Ekman[2], a microexpression is a sudden involuntary facial expression that flashes on human faces, that occurs as fast as 1/15 to 1/25 th of a second. They often display a veiled emotion and are the result of suppression. Contrary to normal facial expressions it is difficult to hide microexpression and hence they are a good tool for lie detection.

According to the Black Book Of Lie Detection by Martin Soorjoo [3] body language gives away the emotions we experience and liars experience stress which manifests itself through body cues. According to Carl Williams and Kenneth Stevens psychological stress affects speech. This can be measured using a Voice Stress Analyzer[4]. According to a 2002 study conducted by the University of Massachusetts, 60% of adults can't have a ten-minute conversation without lying at least once. Many[5] Different types of day lie detectors have been developed using a variety of techniques. A polygraph detects lies based on several physiological indices such as blood pressure, pulse, respiration, and skin conductivity during an interrogation. However, according to the book The Lie behind the lie detector by George W Maschke and Gino J. Scalabrini, several countermeasures are available to cheat a polygraph test[3].

Existing Lie-detection Models:

A) Polygraph Test:

A polygraph, popularly name as a lie detector test, is a device or procedure that measures and records several physiological indicators such as blood pressure, pulse, respiration, and skin conductivity while a person is asked and answers a series of questions.[6] The belief underpinning the use of the polygraph is that ambiguous answers will produce physiological responses that can be differentiated from those associated with non-ambiguous answers. There are, however, no specific physiological reactions associated with lying, making it hard to identify factors that separate those who are lying from those who are telling the truth. Polygraph examiners also prefer to use their before scoring method, as opposed to computerized techniques, as they may more easily defend their evaluations.

B) Voice stress analysis:

Voice stress analysis (also called voice risk analysis) uses computers to compare pitch, frequency, intensity, and micro tremors. In this way, voice analysis "detects minute variations in the voice thought to signal to lie." It can even be used covertly over the phone and has been used by banking and insurance companies as well as the government of the United Kingdom. Customers are assessed for truth in certain situations by banks and insurance companies where computers are used to record responses. The software then compares control questions to relevant questions assessed for lying. However, its reliability has been debated by peer-reviewed journals.[7] "When a person lies, an involuntary interference of the nerves causes the vocal cords to produce a distorted sound wave, namely a frequency level which is different from the one produced by the same person when telling the truth."[8]

C) Eye-tracking:

John Kircher, Doug Hacker, Anne Cook, Dan Woltz, and David Raskin have developed eye-tracking technology at the University of Utah that they consider a polygraph alternative. This is not an emotional reaction like the polygraph and other methods but rather a cognitive reaction. This technology measures pupil dilation, response time, reading and rereading time, and errors. Data is recorded while subjects answer true or false questions on a computer.[9]
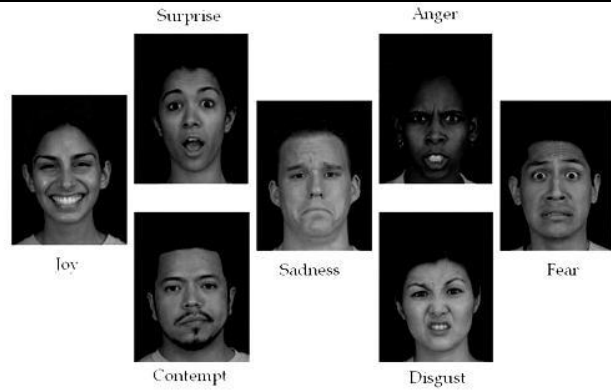
Proposed Model:

Facial Micro expression Detection:

Facial Micro expression Detection:
According to the research on facial micro-expression by Dr. Paul Ekman fear, happiness, anger, disgust, repression, and sadness have been recognized as facial micro-expressions.
Since facial micro-expressions occur as fast as 1/15 to 1/25th of a second it is vital to use a high-speed camera that captures at least up to 30 frames per second. The video is broken down into small pieces of frames. Facial Micro Expressions are detected using the traditional Principal Component Analysis technique.
The speech input collected is then converted to text by a speech-to-text converter and is forwarded for speech analysis. Results of the speech analyzer and facial micro-expression detector are then checked for consistency.

Fig. 2
basic assumptions of Ekman's facial action coding system

Proper positioning of the hardware setup is the first stage in the method used to detect facial micro-expressions and therefore, deduce that the interviewed individual is lying or saying the truth. In preparing the subject for the interview, his/her face should always be in front of the camera in order to detect all the possible muscle changes. Some restrictions should be applied prior to the shooting which can avoid mispredictions if the subject moves his/her head while being recorded.
The recorded interview is broken into single frames which are then fed to the model as an input. The face is detected, studied, and enhanced. The input is then inspected and compared with the features of facial micro-expressions as per the FAAC system.

System Design:

Fear	Anger	Happiness	Surprise
Raised Eyebrows are drawn together, Wrinkles in the center, Lips Retracted	Flaring Nostrils, Furrowed Brow, Mouth Compressed	The skin under eyes wrinkled, corner of lips are drawn back and up	A raised eyebrow, horizontal wrinkles around the forehead

Fig. 1
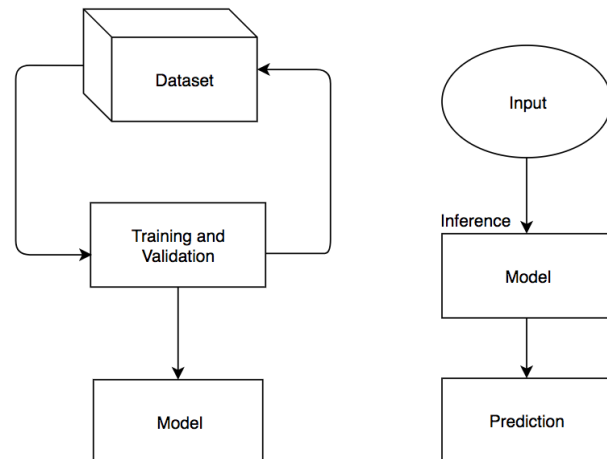*Features of different micro-expressions*
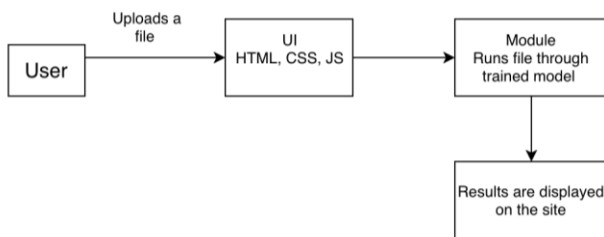

Fig. 3
Architectural Design

Fig. 4
Component Diagram

Conclusion:

In this paper, we discussed a lie detection model which is asymptomatic and economically friendly with no high investment in either hardware or manpower. The purpose of this system is to analyze real facial motion to derive the spatial and temporal patterns exhibited by the human face while attempting to lie. The system analyzes the facial expressions by observing significant diction of the subject's face over a sequence of frames extracted from a video. By examining the parameters over a wide range of frames, a parametric representation of the face which could be useful for static analysis of facial expression in other fields of studies was extracted. This motion is then combined with a physical model by which geometric-based dynamic and effective templates are applied to the facial structure. In psychology, human emotion is also an important topic of research. It is believed that the developed system can be useful in many fields where psychological interpretation is needed such as in, airport and homeland security, police interrogations, clinical and employment tests.

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