

A Comprehensive Review on Depression Detection using Computer Intelligence

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Abstract: The depression that has affected millions of patients and their families in the last decade has been one of the most common diseases of mind. However, almost all methods of medicating anxiety depend on series of questions evaluations and professional judgments of depressive symptoms, which are highly reliant on doctors' experience and time-consuming. The aim of our research is to create an objective and practical method for detecting depression in adolescents using facial characteristics. The majority of teenagers are wholly unaware that they have been depressed. Some teenagers hide their depression from others, whether they are even aware of it. An automated system is needed to select the teenagers who face depression. Various research projects aimed at identifying depression are explored in this article.

Keywords: Depression Detection, Facial Features, Facial Emotions

1. INTRODUCTION

Depression is a widespread mental issue that impacts over 350 million people globally [1]. Not just the patients but their families will have a bad effect. Depression is said to be the second most important cause of illness by 2020[2] by the World Health Organization. Depression leads to increased risk of drug abuse, financial problems and suicidal behavior. Current WHO forecasts indicate that depression will become the world's largest cause of disease by 2030[2]. In addition, depression is largely undiagnosed due to the boring lines of diagnostic criteria and under-reporting. The Diagnostic and Statistical Manual of Mental Disorders (DSM) guidelines are used to identify depression, which is then verified by a clinical examination. Patients are administered first-line antidepressants after being diagnosed [3].

The assessment strategies for diagnosing depression, on the other hand, almost entirely depend on patient-reported and clinical symptom severity judgments [3]. Current depression diagnosis approaches have significant drawbacks, including patient denial, low sensitivity, contextual biases, and inaccuracy [4]. Seeking a technique for identifying depression that is objective, precise, and realistic is indeed a task.

Nowadays, anxiety is most prevalent amongst teenagers and young adults who are just starting out in their careers.

Depression is a significant problem because it has a direct impact on a person's productivity. It has an effect on adolescent exam success as well as other field trips [4].

Depression affects employees' performance, as well as their ability to cope with the working pressure that leads to their overall performance being deteriorated and could ultimately lead them to discharge. Depression can lead to a slew of other issues in a person's life [5]. Others might judge them as cowards or sympathize with them. However, they are oblivious to the fact that they are going through a stage of mental illness in which the individual starts to view himself or herself as a coward and feels uncomfortable in the company of others. Many strategies for overcoming depression have been established over the years.

People et al.[3] proposed the treatment of depression through psychotherapy. Clarke et al. [4] created a program called Overcoming Depression on the Internet (ODIN) to help people overcome depression. Gilson et al.[5] have implemented cognitive therapy to help overcome depression. We have many good strategies to fix depression, as previously mentioned. Many of the great approaches and techniques, however, are useless if we don't understand about whom they should be implemented.

The main problem is determining who is depressed. The majority of depressed people find it difficult to accept that they are sad. It's not that they're hiding; there are always exceptions; it's just that they're unaware of their own frame of mind. Many people tend to mask their feelings while speaking with others, making it difficult to judge others simply by meeting them. When a person is alone, his or her true state of mind is revealed. As a consequence, we need a simple but effective technique for identifying a person's depression [6-11].

2. RELATED WORK

It's all about the thoughts of depression. Plutchik [2] identified the following eight basic forms of emotions:

1. The sensation of being afraid or insecure is known as fear. It is normally caused by a sense of danger or hazard. It has the ability to alter one's actions. It's an uncomfortable sensation.

2. Rage is a strong useless trait that triggers a harsh reaction in the face of vulnerability, danger, or injury [6]. It's usually followed by an urge to do anything aggressive in response.
3. Despair, grief, disappointment, and sorrow are all feelings associated with sadness. It causes a person to act in a way that makes them feel awful and makes them want to weep.
4. Joy is a positive emotion characterized by satisfaction and enjoyment. It allows a person to appreciate the present moment and look for the positive in anything and everything. It encourages a person's good behavior.
5. Disgust is a regretful and disapproving feeling brought on by something negative or offensive. It's normally accompanied by a burst of anger.
6. When something unexpected happens, surprise is a sensation of astonishment. It allows the child were unable accept what he or she sees.
7. The feeling of reliability, truth, or faith in someone is known as trust.
8. Anticipation is the sensation of looking forward to something that is about to occur in a good way. Other emotions include approval, anger, and ecstasy. Both of these emotions, however, are a mixture of two or more of the foregoing feelings. Computer Vision has become a hot subject in the field of machine learning, and it's a major topic.

Significant work has been done in the literature in this field to detect a state of the mental disorder based on the emotions of the individual which is shown in table I.

Table I: Summary of Research Works in field of Depression Detection

Author	Technique Used	Description	Conclusion
Lu-Shih et al. [6] (2009)	Gaussian mixture models (GMM)	Speech content-based depression detection Features used are Mel frequency cepstral coefficients (MFCC), short time energy (Energy), zero crossing rate (ZCR) and Teager energy operator (TEO)	Accuracy=59.55%
Cohn [7] (2009)	Active Appearance Modeling (AAM) and Pitch Extraction	Used an approach based on the facial action and vocal prosody to detect depression in an individual. Facial expressions are a great reflector of the mood of the person.	Accuracy=79%
Lu-Shih et al. [8] (2011)	Teager energy operator (TEO)	Acoustic correlates of depression	Accuracy=80.5%
Wang et al. [10] (2013)	Vocabulary rules to calculate the depression inclination	Sentiment analysis in microblog social network	Accuracy=80%
Xinyu Wang et al. [11] (2013)	Calculate the probability of a user being depressed	Sentiment analysis in microblog	Accuracy=95%
Alghowinem et al. [13] (2013)	Active Appearance Models Gaussian Mixture Models Support Vector Machines	landmark distances in the eyes and eyebrows Duration of blinks significantly longer in depressed subjects	Accuracy=70% Accuracy=75%
Vonikakis et al. [16] (2016)	Geometric features Partial Least Squares regression	Group happiness assessment, to derive distances between specific landmarks, the presence or absence of which is commonly related to happiness.	RMSE = 0.8316
Sharma [17] (2018)	Deep Learning	Facial Expression Recognition in static as well dynamic condition	Discussed the advantages of deep learning in depression detection
Shen et al. [20] (2018)	Deep Neural Network model with Feature Adaptive Transformation & Combination strategy	Social media harvesting	Accuracy=77%

3. DATASET

The dataset employed for testing in different approaches was introduced in the 3rd and 4th AVEC [19], being the only freely available dataset, annotated for depression, which includes video recordings of participants; DAIC has also been made partly available, but without video recordings.

The AVEC dataset includes volunteer participants, recorded by a webcam, during performance of several tasks [11]. In the present work a subset of the dataset was used, in the sense that only two tasks were considered, namely

- i. FreeForm task, where participants answered questions
- ii. NorthWind task, where participants read aloud a passage

Depression annotation however is provided only for 200 of the recordings, as test set labels were withheld for the challenge needs.

4. PROPOSED MODEL

The proposed system will be designed with the potential of serving as a decision support system based on facial features from video frames to determine the level of depression.

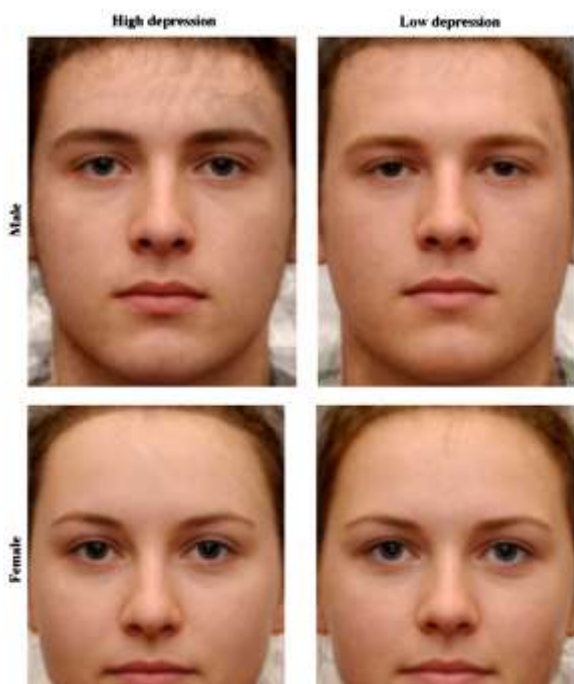


Figure 1: Depression Detection from Face

Following features will be extracted and analysed to determine the level of depression as:

A. Face Features

The 2-D facial landmarks are considered for face feature extraction. Different features extracted from face are in the form of head features, distance and blink rate.



Figure 2: Facial Landmarks

Head Features: The Head pose features provided by the organizers were not used as they did not depict temporal information, i.e. features did not convey the change with respect to time. Hence Head Motion was judged by horizontal and vertical motion of certain facial points, i.e., points 2, 4, 14, and 16 [Fig. 2] [20].

Participating in body expressions, such as blinking, smiling, and other facial expressions, their activity is popular as head-motion. The change in place of each of the above facial points was determined between each consecutive frame. This transition was calculated both horizontally and vertically, as well as in terms of net magnitude. The mean, median, and mode of displacement in horizontal, vertical, and magnitude of displacement, as well as velocity in horizontal, vertical, and magnitude of velocity, were then measured.

Distance: Combined head movement and face expressions can give considerable information about a person's behavior. The information they provide may convey information about the person's actual status, and thus correlations can be found between them. The features extracted in the facial areas, namely eyes, mouth, eyebrows and head, were implemented.

Blink Rate: The cab with the 2D facial characteristics can be calculated. First, the area of the points around the eye will be taken (points 37-42, left eye). The area of the polygon produced by these points is calculated for the whole number of frames. This way the VS frame data is obtained from the eye of the data. The minimum random surface area of 1000 frames is taken for the close-eye area. If the eye-point area of less than 90 percent of the eye-open area is considered a shadow. This calculates the number of blinks over the whole number of frames. By dividing the number of bubbles by the corresponding session duration, the blink frequency was calculated.

The detection of depression by pictures alone depends mainly on a clear and proper definition of the face. The face of a depressed face differs slightly from that of sadness. The features of a depressed face expression are similar to those of a sad expression, such as upward slanted eyebrows, but there is no big frown included. A sad face may also have lowered eyes that look down to demonstrate a hilarious, dejected mood [18,19].

5. INDICATORS OF DEPRESSION

Ideally, depression detection machine learning tools should have the same stream of information that a clinician uses to make a diagnosis. As a result, the features used by these classifiers should reflect each mode of communication: face and gesture, voice and expression, and language.

A. Visual Indicators

Depression analysis visual indicators including body movements, gestures, subtle expressions and periodic muscle movements have been extensively explored.

B. Speech Indicators

Recent research has shown the promise in using speech as a diagnostic and monitoring aid for depression. The speech production system of a human is very complex and as a result slight cognitive or physiological changes can produce acoustic changes in speech. This idea has driven the research on using speech as an objective marker for depression. Depressed speech has consistently been associated with a wide range of prosodic, source, formant and spectral indicators.

6. CONCLUSION

Depression is a severe psychiatric condition, and the current diagnostic procedure still requires a medically qualified physician or psychologist, who may use a scale and close observation of conversation, depending on the doctor's expertise. And it is difficult to diagnose and treat depression by non-psychiatrists. Capturing videos, including the eyes and faces, extracting and recognizing the captured videos can help patients or community physicians to detect, diagnose, or improve diagnosing depression at an early stage. In future research this is expected to be achieved.

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