REAL TIME STRESS DETECTION AND PROPOSED SOLUTION

By

NANCY PARETA 19205004

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ABSTRACT

REAL TIME STRESS DETECTION AND PROPOSED SOLUTIONS

Stress has become part and parcel in every individual's day to day lifestyle. From youngsters to sandwich generation, stress has become a major concern for the wellness economy of country India. In spite of, a lot of progress has been done in recognizing stress physiologically, there are still barriers in recognizing stress in real lifetime in cost effective way and providing hand to hand solutions. Human psychological stress and human emotion are very much interconnected. In computational psychology study, the relationship between stress and emotions is the key to understanding the human behavior. Research has been done for detecting facial emotions from images using deep learning but has not been explicitly taken up yet to find psychological stress. We have reviewed various stress recognition techniques and Proposed a hybrid system in which a convolutional neural network (CNN) is used to detect the stress levels of human being through face musculature detected from image .A CNN is trained to detect and recognize facial expressions and classify human faces into discrete emotion categories (Anger, Disgust, Neutral, Fear, Sad, Happy and Surprise). The Real time face stress detection model is image processing-based model which is having two parts: **Emotion Recognition and Stress level calculation.**

The Real time emotion recognition model will return the emotion predicted in real time. The model classifies face as stressed and not stressed. A model is trained on the fer2013 dataset (https://www.kaggle.com/deadskull7/fer2013) .The stress level is calculated with the help of eyebrows contraction and displacement from the mean position. The distance between the left and right eyebrow is being calculated and then the stress level is calculated using exponential function and normalized between 1 to 100.

Chatbot-Depression Therapy to provide real time therapeutic solutions to alleviate depression. Chatbot System is implemented using deep learning for detection and management of stress and depression and provide suggestions accordingly based on user's mental condition. Technologies: Keras, genism python libraries, anaconda environment, the dataset being used is obtained from Kaggle.

Keywords: Cognitive behavior therapy, Deep learning, Convolution Neural Network (CNN), Facial Expression Recognition.

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Chapter 1

PROBLEM STATEMENT

Ever-increasing academic pressure has created inclination in the stress level in students especially for those who are preparing for any competitive examinations. Due to the in- ability of an individual of expressing problems and taboo associated with mental health issues, a person intends to suppress these vulnerable emotions like stress and anxiety. As a result, the individual mechanism of dealing with stress reaches to a point of total collapse. This could be fatal for individuals going through stress as well as to the society. The levels of stress are very high in country India as compared to other developing and developed countries, this is due to the rational thinking of Indian society with respect of education, job, family, property, social media influences, etc. According to the survey conducted by Cigna TTK Health Insurance(https://economictimes.indiatimes.com/magazines/panache/89-per-cent-of-indias-population-suffering-from-stress-most-dont-feel-comfortable-talking-to-medical-professionals/articleshow/64926633.cms)The global average is 86% and in comparison, with its 89% of the population in India suffering from stress and there are 75% answerers find it uncomfortable to share their stressful thoughts to the medical professionals and this creates barriers in proposing the rightful solutions to the targeted stress engrossed audience

In India, the age groups between 14-30 are living the most stressful life because of educational and job pressure. There is hardly a day in the country when newspapers do not carry any headline about the suicide of these age group people. The longing of cracking tough competitive exams, excelling in higher degree education and job competition has changed the lifestyle of an individual bending towards stress encircled environment. Stress can lead to mental illness, irritation, health disorders, anxiety issues, depression, isolation from society, unhealthy lifestyle, silent heart attacks, and various other medical conditions.

PURPOSE OF STUDY

The work reported in this manuscript focuses on the automated identification of a set of facial parameters (mainly semi- or/and non-voluntary) to be used as quantitative descriptive indices in terms of their ability to discriminate between neutral and stress/anxiety state. In support of this objective, a thorough experimental procedure has been established in order to induce affective states (neutral, relaxed and stressed/anxious) through a variety of external and internal stressors designed to simulate a wide range of conditions. An emotion recognition analysis workflow used is presented in Fig. 1.

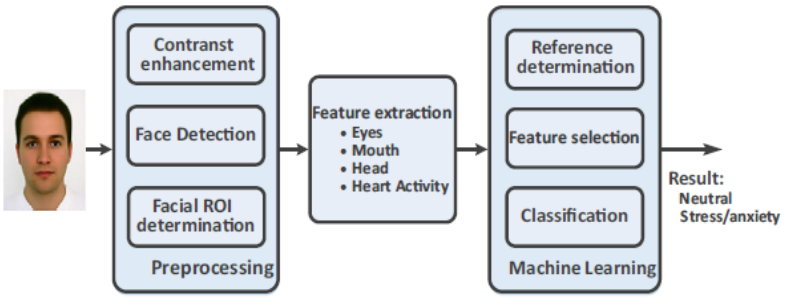


Fig. 1. Overview of the framework for the stress/anxiety detection through facial videos.

The advantages of the present study relate to the fact that (a) a variety of semi voluntary facial features are jointly used for the detection of anxiety and/or stress instead of the traditional facial expression analysis, (b) the experimental protocol consists of various phases/stressful stimuli covering different aspects of stress and anxiety, and (c) the facial features that are involved in stress/anxiety states for different stimuli are identified through machine learning and deep learning techniques.

STRESS PROTOTYPE

Stress can transpire due to any situation in life which is not up to human expectations or very high expectations. It can also occur because of peer pressure and facing struggles in life especially for students who are struggling for their careers. The Indian society has given so much significance to a job and educational qualifications that every individual is fighting and working hard to live up to the society anticipation. The stress can be divided into three models that are Emotional, Psychological, situational (based on some events of real life). Stress induces human intervention in terms of their Psychological health, Behavioral changes, emotional changes, Neurological changes. Stress affects heart rate, respiration process that is heaving breathing, a neurological process that is late responding or not doing any physical activity with full concentration, these all can be detected using sensors and can track the levels when the person is with a group of people or when alone.

There are various common symptoms of stress to the human body which therapist can detect by observing which include:

A. Physical

Headaches, sleep disturbances, nausea, tearfulness, muscular aches and pains, susceptibility to infections with an increase in cold/flu type illnesses, etc. When the stress reaches to an extreme level over a period of time it can lead to persistent high blood pressure, digestive disorders e.g.: stomach ulcers; there is also an increased risk of strokes and silent heart attacks.

B. Behavioral

Poor concentration, memory loss, irritability, intake of caffeine and drugs which is harmful for the human body, reduced work efficiency, an inability to achieve good grades and performing at work, feeling of spending time along and deep thinking.

C. Psychological

Depression, anxiety, lack of motivation, poor concentration and memory, low self-esteem, fear of failure, unusual behavior. This will help to track the physical activity of the person according to its environment that will be detected by sensors that will alarm the person about stress level and also to the counselling committee which are keeping track of the students in different educational institutions. The counselling committee further can give the good schedule chart to the stress accused student. The methods of stress coping mechanisms will include extra co-curricular activities, diet plans, hobbies, motivational therapy daily sessions, and home care advice. This will help in reducing suicide rates happening in prominent educational institutions which have now become a day to day news. The counselling committee can use models of ML such as Support Vector Machine that will help them to first classify the students that have acute stress levels. This procedure should carry every month so that the students stress reasons could be detected and then further rightful steps should be taken to abolish those reasons.

FIGURE 1: Stress Prototype

INTRODUCTION

In recent times, psychological stress has grown to be an extreme risk to public fitness. Immoderate pressure might also motive many mental and bodily health issues such as insomnia, cancer, depressions etc., or even suicide. Existing stress detection techniques are mainly face-to-face interviews, self-file mental questionnaires and physiological sensors. However, these methods are commonly exertions-ingesting, time-costing and hysteretic.

The knowledge of psychological stress and human emotions is well related but has not been explicitly taken up for research yet. They're always dealt in researches as two specific fields of study to look at. In this research, we present a quantitative indicator for stress from the human facial emotions which we term as facial expressions. Facial musculature is substantially varied amongst humans and to set up an ordinary or generalized technique to assess facially found stress could be not possible if we have been to use most effective the muscle movement data. So, we express the muscle movement data to an intermediate form before we develop a model to evaluate facially observed stress. According to the Facial Action Coding System developed by Ekman and Friesen seven basic emotions anger, disgust, neutral, fear, happy, sad and surprise are innate and universal to humans. These emotions can be used as an intermediate form to evaluate our stress indicator.

We used the Kaggle FER2013 dataset for the training and testing of our model. Our model was divided in two phases: the emotion detection phase and the stress detection phase.

In psychiatry and medical science there are plenty of solutions like consultation or medication to cope with stress specifically that originate from the workplace. But all these methods will only be effective when there is a way to indicatively predict the stress level of a person without making the subject aware of it. So, a stress monitoring system needs to be developed that will indicate the stress levels without asking the subject, answers to questions, biological samples or sport electrodes all the time as this would help not to intervene in a person's work schedule. This kind of system is not intended as a replacement for the scientific medical procedures to identify stress levels completely and accurately but it would act as an aid to determine when such procedures need to be initiated. This is highly desirable as bio-medical or psychiatric procedures cannot be performed continuously and hence needs some indicators for considering assessment and treatment.

In this dissertation we intend to propose and implement a more accurate method to identify emotions from facial muscle movement using Convolutional Neural Network and use these identified emotions to evaluate facially observable stress levels by finding the best emotion stress relational model from stress survey data and chatbot behavior therapy to provide hand to hand solutions.

Chapter 2

MODELS OF STRESS DETECTION

MODEL 1: Stress detection model Image Emotion Classification

Human psychological stress and human emotion are very much interconnected. In computational psychology study, the relationship between stress and emotions is the key to understanding the human behavior. A CNN is trained to detect and recognize facial expressions and classify human faces into discrete emotion categories (Anger, Disgust, Neutral, Fear, Sad, Happy and Surprise). Further logarithmic regression is applied to evaluate stress as a function of the deciphered emotions. We performed experiments on Facial Expression Recognition (FER2013) dataset to evaluate our architecture. Our method achieved the result, 67.76% accuracy, for 5-layer CNN and 65 iterations.

DATASET: - We have used FER2013 dataset from the Kaggle Facial Expression Recognition Challenge to train our model. The dataset consists of 35,887 grayscale images, each image of 48-by-48 pixel labelled with one of the 7 emotion categories: Angry, Disgust, Fear, Happy, Sad, Surprise and Neutral. We used 80% of the dataset for training and remaining 20% for testing.

PROPOSED METHODOLOGY

Our model comprises of two main steps: Facial emotion recognition and stress detection from the deciphered emotions. We used Convolutional Neural Network (CNN) to find the probabilities that facial expression represents a particular emotion from all emotions.

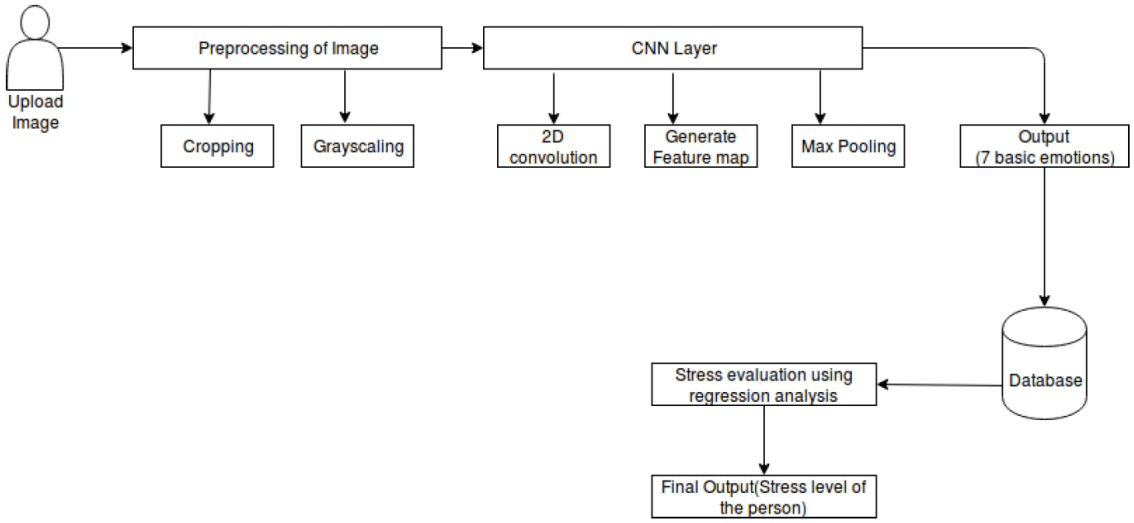


Figure: 2. Architectural diagram of our model

STEP 1

As a part of emotion recognition, in input layer, we did pre-process on the acquired image pre-processing included activities like cropping and gray scaling of the images to obtain the images that have a normalized size or intensity. Then this pre-processed image was fed into NumPy array. The NumPy array was then passed to convolutional layer which consisted of 3 convolution layers and the set of filters to generate the feature maps. We included the combination of depth-wise separable convolutions and residual modules in place of fully connected layers. The model was trained using the ADAM optimizer. We used Global Average Pooling to completely remove any fully connected layers. This was achieved by having in the last convolutional layer the same number of feature maps as number of classes, and applying a SoftMax activation function to each reduced feature map. Finally, in the output layer, the SoftMax function presented the output as a probability for each emotion class.

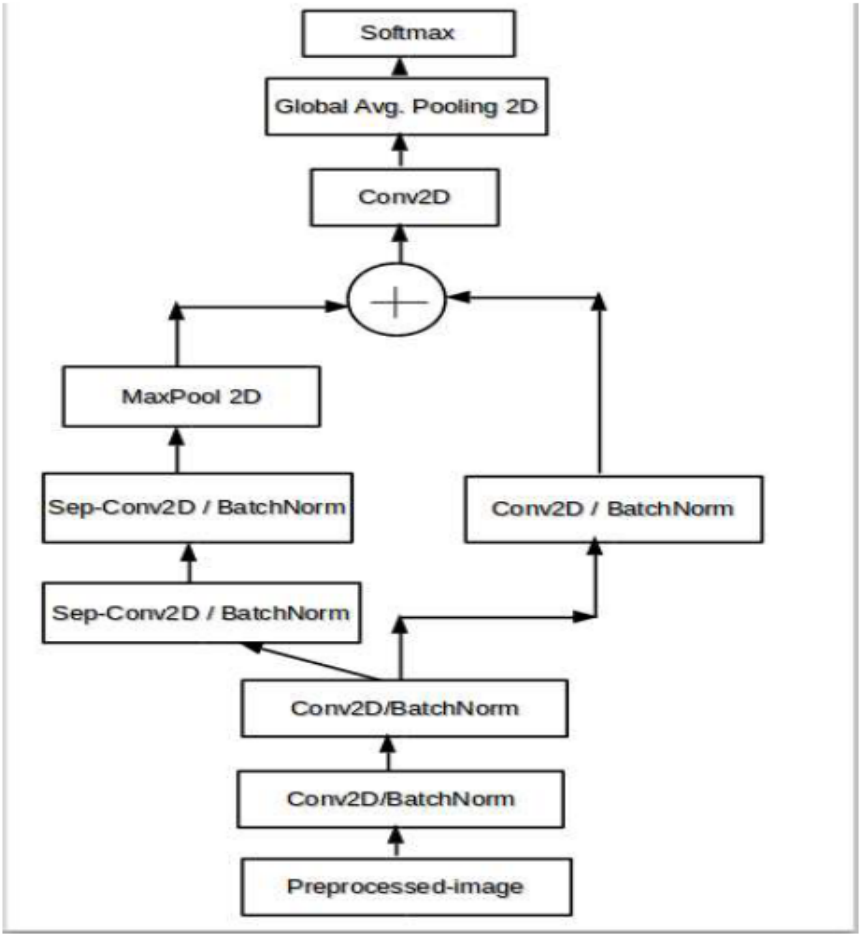


Figure: 3. CNN Implementation

STEP 2

After we have deciphered emotion information from the facial expression, we evaluated the stress levels.

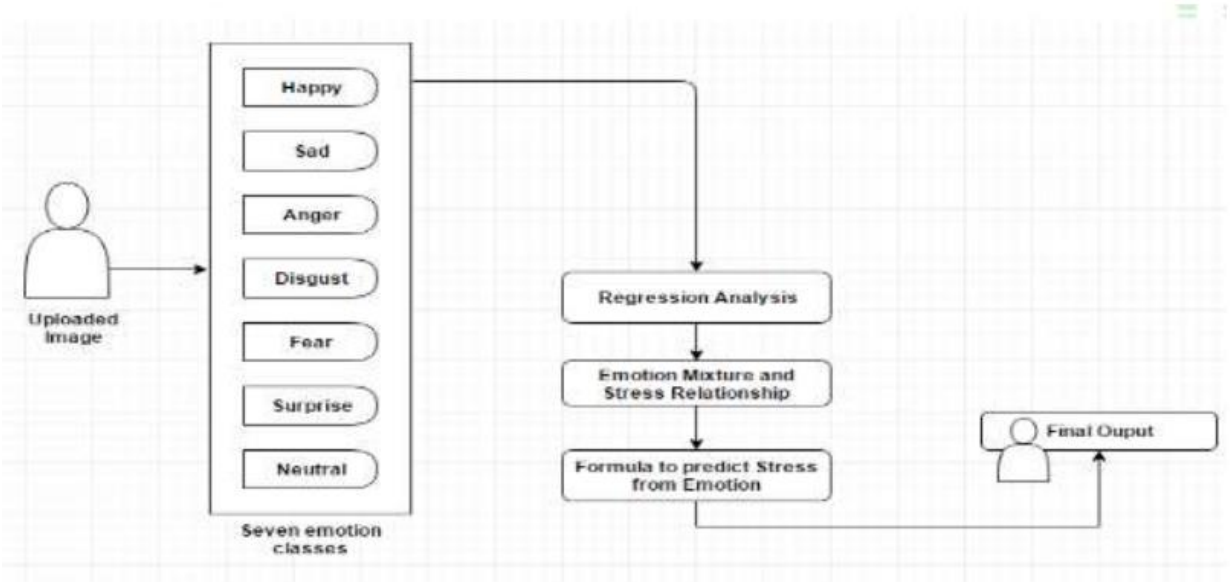
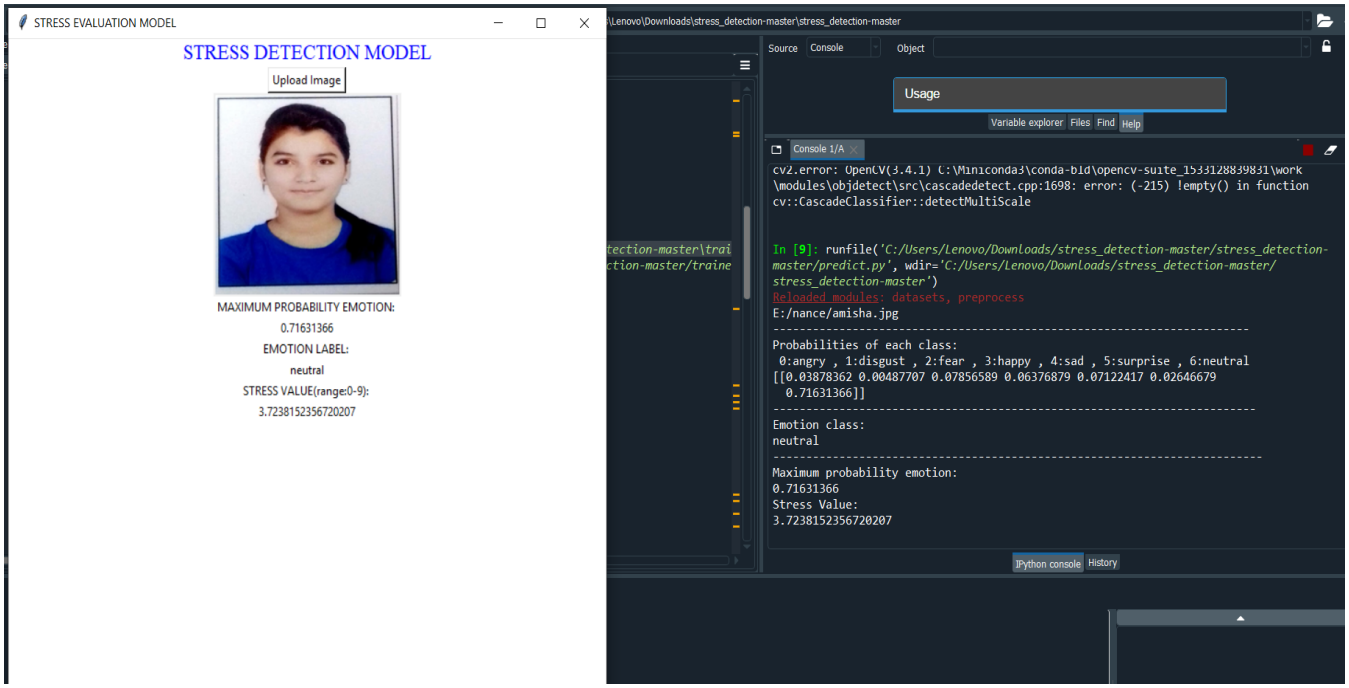


Fig 4: Stress Evaluation Architecture

RESULTS

Results of the emotion classification task and stress level detection can be observed in below images. The corresponding image and its detected emotion label and probability and stress probability is shown in these figures.



STRESS EVALUATION MODEL

STRESS DETECTION MODEL

Upload Image

MAXIMUM PROBABILITY EMOTION:

0.71631366

EMOTION LABEL:

neutral

STRESS VALUE(range:0-9):

3.7238152356720207

STRESS EVALUATION MODEL

STRESS DETECTION MODEL

Upload Image

MAXIMUM PROBABILITY EMOTION:

0.39278305

EMOTION LABEL:

sad

STRESS VALUE(range:0-9):

5.161172309384272

```
D:/severe-depression-56af379d3df78cf772c1aa84.jpg
--------------------------------------------------------------------------
Probabilities of each class:
 0:angry , 1:disgust , 2:fear , 3:happy , 4:sad , 5:surprise , 6:neutral
[[0.32100216 0.01642106 0.08577225 0.10751624 0.39278305 0.00120669
  0.07529843]]
--------------------------------------------------------------------------
Emotion class:
sad
--------------------------------------------------------------------------
Maximum probability emotion:
0.39278305
Stress Value:
5.161172309384272
```

MODEL 2: Real time face stress detection model

1.1 Physical, mental and cognitive effects of stress/anxiety

Stress and anxiety have impact both on physical and mental health. They are also implicated in the onset and progression of immunological, cardiovascular, circulatory or neurodegenerative diseases. Evidence from both animal experiments and human studies suggests that stress may attenuate the immune response and increase the risk for certain types of cancer .

Increased skeletal, smooth and cardiac muscle tension, gastric and bowel disturbances are additional typical signs of stress and anxiety, which are linked to some of their most common symptoms and disorders, namely headache, hypertension, exaggeration of lower back and neck pain, and functional gastrointestinal dis- orders (such as irritable bowel syndrome) . These signs are frequently accompanied by restlessness, irritability, and fatigue. From a psychological perspective, prolonged stress and anxiety is often identified as a precipitating factor for depression and panic disorders and may further interfere with the person's functional capacity through impaired cognition (e.g., memory, attention and decision making).

Stress can be detected through bio signals that quantify physiological measures. Stress and anxiety affect significantly upper cognitive functions and their effects can be observed through EEG recordings . Mainly, stress is identified through arousal related EEG features such as asymmetry beta/alpha ratio or increased existence of beta rhythm. Stress regulates active sweat glands increasing the skin conductance during stress conditions. Thus, stress can be detected with the use of Galvanic Skin response (GSR) which has been adopted as a reliable psychophysical measure . Breathing patterns are also correlated with emotional status and can be used for stress and anxiety detection . Studies report that respiration rate increases significantly under stressful situations . Additionally, EMG is a bio signal measuring muscle action potential, where trapezius muscle behavior is considered to be correlated with stress . Finally, speech features are affected in stress conditions , the voice fundamental frequency being the most investigated in this research field.

1.2 *Effects of anxiety/stress on the human face*

An issue of great interest is the correspondence between information reflected in and conveyed by the human face and the person's concurrent emotional experience. Darwin argued that facial expressions are universal, i.e. most emotions are expressed in the same way on the human face regardless of race or culture . There are several recent studies reporting findings that facial signs and expressions can provide insights into the analysis and classification of stress. The main manifestations of anxiety on the human face involve the eyes (gaze distribution, blinking rate, pupil size variation), the mouth (mouth activity, lip deformations), the cheeks, as well as the behavior of the head as a whole (head movements, head velocity). Additional facial signs related to anxiety may include a strained face, facial pallor and eyelid twitching . In reviewing the relevant literature, facial features of potential value as signs of anxiety and stress states were identified (as listed in Table 1) and are briefly described in this section.

Table 1
Categorization of facial features types connected with stress and anxiety.

Head	Eyes	Mouth	Gaze	Pupil
Head movement	Blink rate	Mouth shape	Saccadic eye movements	Pupil size variation
Skin colour	Eyelid response	Lip deformation	Gaze spatial distribution	Pupil ratio variation
Heart rate (facial PPG)	Eye aperture	Lip corner puller/depressor	Gaze direction	
	Eyebrow movements	Lip pressor		

There have been reports that head movements can be used as a stress indicator, although their precise association has not yet been established. It has been reported that head movements during stressful conditions are more frequent , more rapid and there is greater overall head motion . In head nods and shakes were employed among other features in order to dis- criminate complex emotional situations. Regarding the eye region, features like the blink rate, eye aperture, eyelid response, gaze distribution and variation in pupil size have been studied. Blinking can be voluntary but also as a reflex to external or internal stimuli and The blinking rate typically increases with emotional arousal, including stress and anxiety levels , The blinking rate is affected by various other states, such as lying , and disorders such as depression, Parkinson's disease and schizophrenia . It is also affected by environmental conditions such as humidity, temperature and lighting . The percentage of eyelid closure induced by a light stimulus (increase in brightness) was significantly higher in a group of anxious persons when compared to the corresponding response of non-anxious individuals.

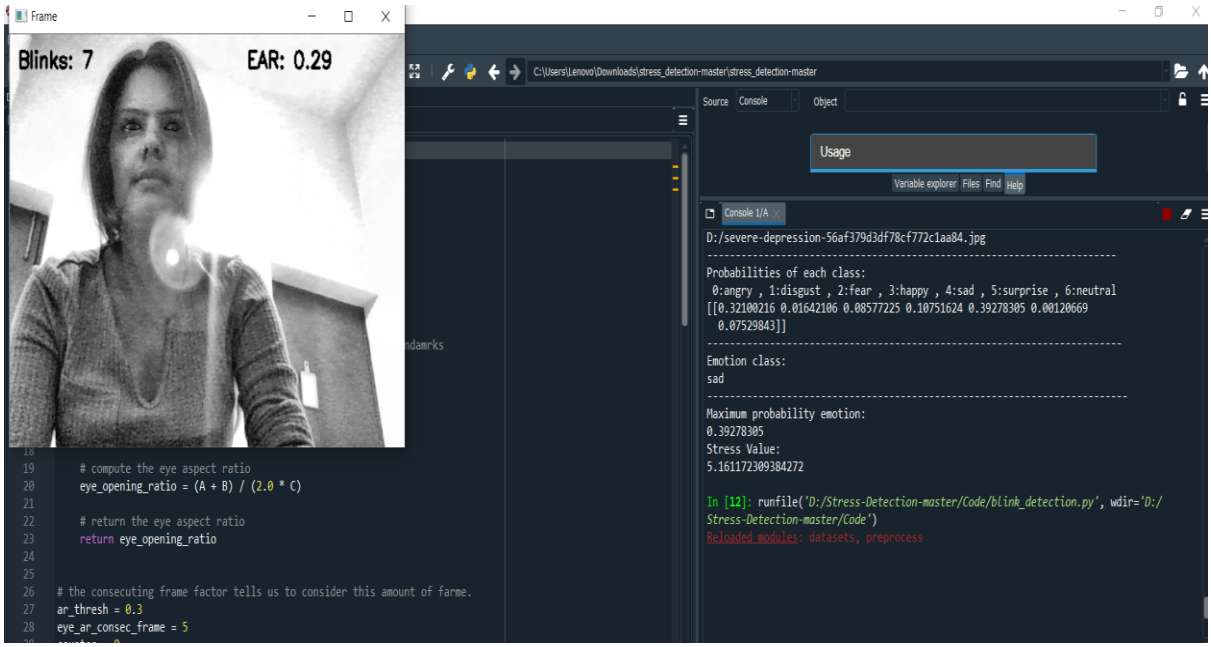
Similarly, gaze direction, gaze congruence and the size of the gaze-cuing effect are influenced by the level of anxiety or stress. Persons with higher trait anxiety demonstrate greater gaze instability under both volitional and stimulus-driven fixations . Moreover, high levels of anxiety were found to disrupt saccadic control in the ant saccade task . Anxious people tend to be more attentive and to make more saccades toward images of fearful and angry faces than others . Various studies have documented an association between pupil diameter and emotional, sexual or cognitive arousal. In addition, pupil dilation can be employed as an index of higher anxiety levels . Pupillary response to negatively valanced images also tends to be higher among persons reporting higher overall levels of stress . Pupil size may also increase in response to positive, as well as negative arousing sounds as compared to emotionally neutral ones .

There is also sufficient evidence in the research literature that mouth-related features, particularly lip movement, are affected by stress/anxiety conditions. Asymmetric lip deformations have been highlighted as a characteristic of high stress levels. In addition, it was found that the frequency of mouth openings was inversely proportional to stress level, as indexed by higher cognitive workload.

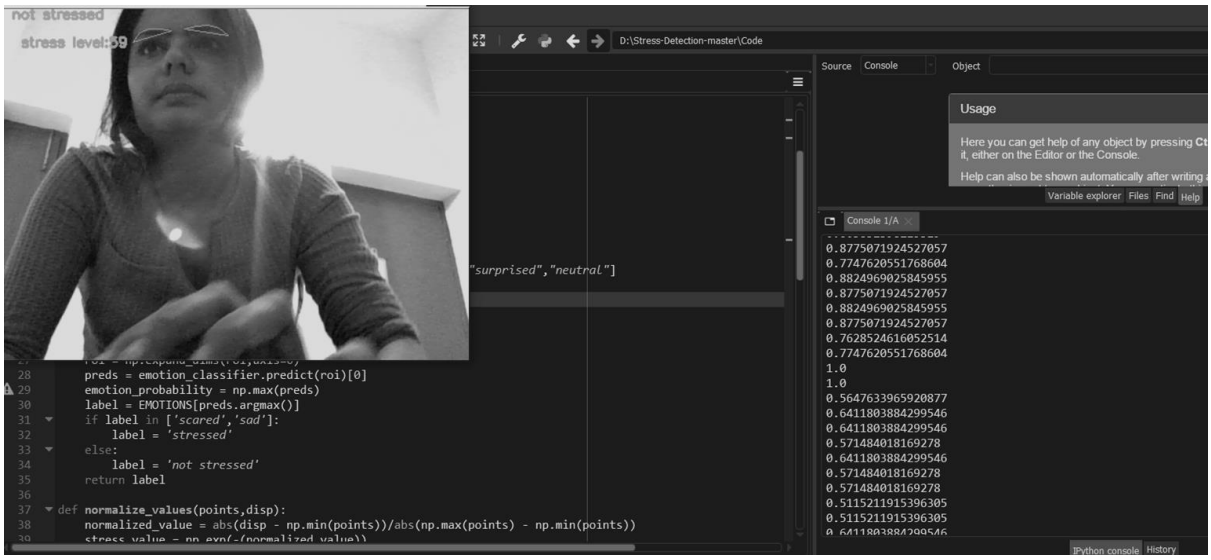
A technique designed to detect facial blushing has been reported and applied to video recording data concluding that blushing is closely linked to anger-provoking situations and pallor to feelings of fear or embarrassment. The heart rate has also an effect on the human face, as facial skin hue varies in accordance to concurrent changes in blood volume transferred from the heart. There is the general notion in the literature that the heart rate increases during conditions of stress or anxiety and that heart rate variability parameters differentiates stress and neutral states . Finally, there are approaches that aim to detect stress through facial actions coding.

RESULTS

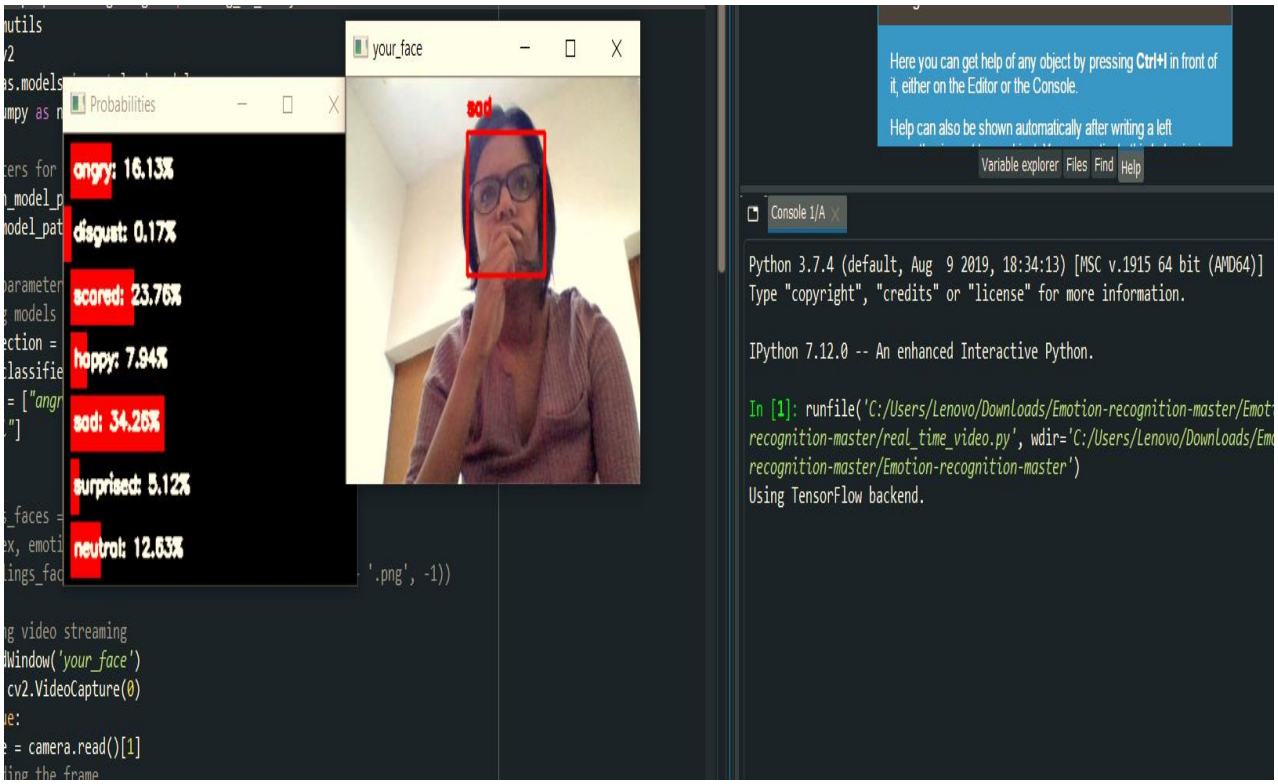
EYE BLINKING



EYEBROW MOVEMENT



FACIAL EMOTION DETECTION (REAL TIME VIDEO ANALYSIS)



CHAPTER 3

RELATED WORK

LITERATURE REVIEW

STRESS ANALYSIS

The research motive is to target the young generation of India for the classification of stress levels and proposing hand to hand effective solutions by analysing stress levels using EDA sensors which can detect skin activity which include changes in emotional ,cognitive ,attentive states and ECG signals which can detect electrical activity of skin along with heart rate. ECG can detect abnormal heart rates and the real-time results will be displayed on smartwatch and mobile phone application which will show heart rate levels which will beep or send an alert if it will detect something abnormal.

It is necessary to develop and sustain an analysis system for the evaluation of mental health and the development of an individual. A lot of factors contribute to stress. It could be geographical, psychological, related to post-traumatic incidents or sometimes development issues in a child. Complex and unpleasant emotions are hard to express. Predicting the mental state of an individual through words and actions can be a challenging task. For this facial expression can be an effective tool for interpreting emotions. By carefully and consistently observing linguistic and emotional behavior, we can measure the emotions and predict the mental state of an individual. Unpleasant emotions lead to more displacement in facial expression then pleasant emotions. Through sentimental analysis, the mental state of an individual can be detected by observing facial expressions. Stress can cause a negative impact on day to day life of a person. It affects the overall well-being of an individual Human body responds when it is in immense stress.

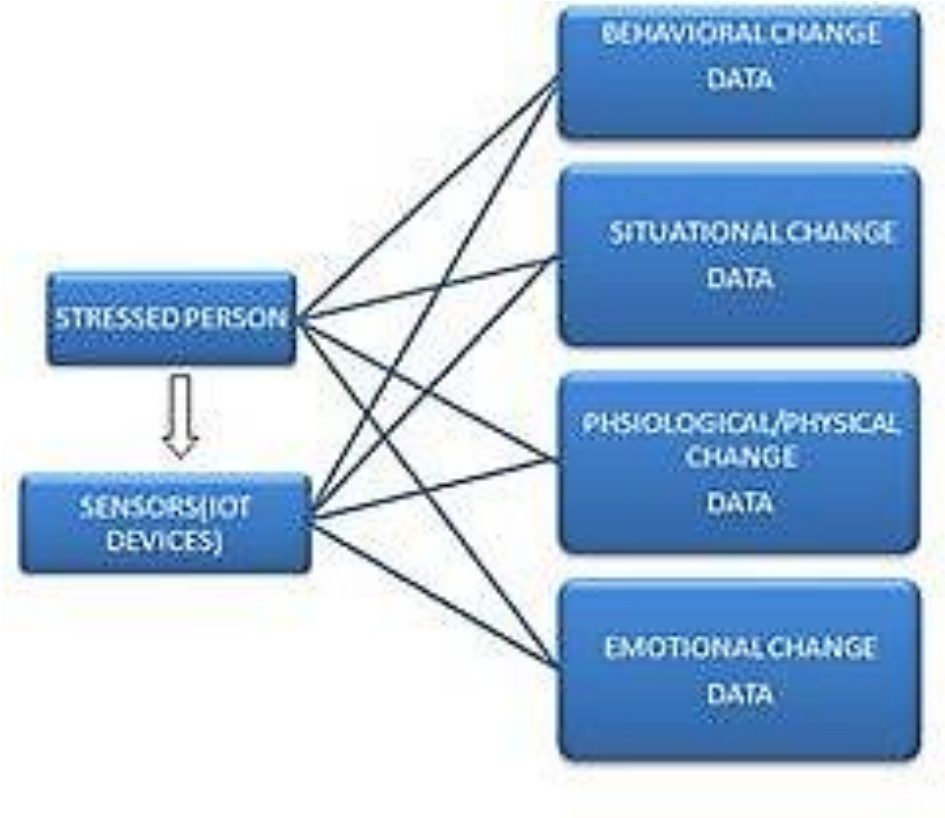


FIGURE 5: Sensors Prototype

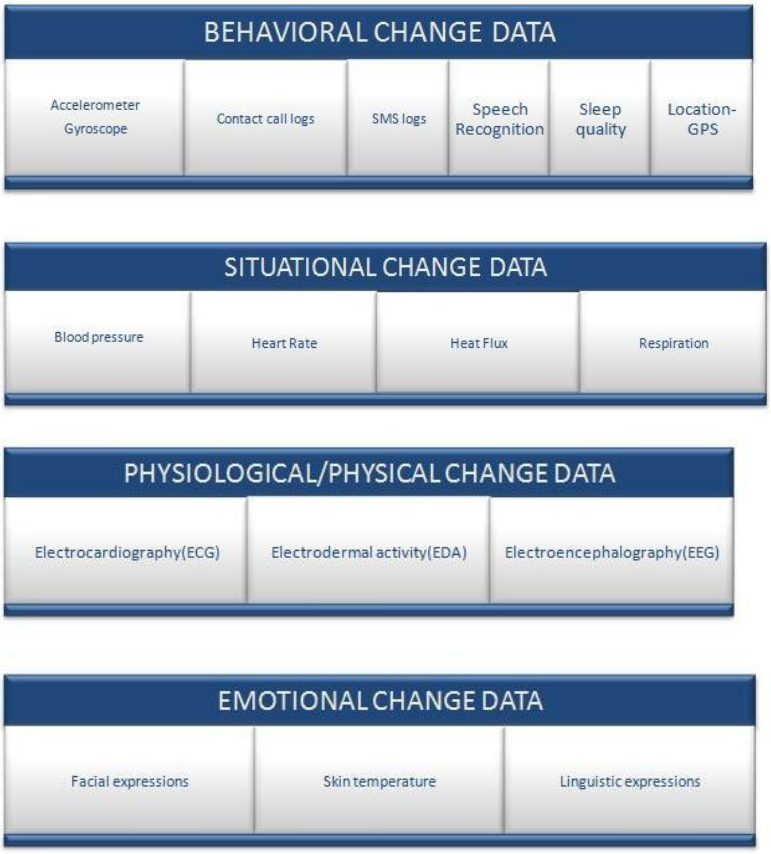


FIGURE 6: Sensors collected data Model

In, a virtual instrument is created which predicts the mental or psychological state by evaluating the skin resistance of the body. In stress, the sweat glands activity increases, especially in the palms and soles of feet. The measure of the change in the conductance of skin due to any physiological or psychological reasons is called Galvin Skin Response (GSR). Any change in the stress or emotional state of an individual affects the conductivity of the skin. This conductance can be measured using electrodes and accuracy in it reflects the mental state of an individual. The stress decreases the resistivity of the skin, thereby making the skin more conductive. This virtual instrument has the ability to calculate skin conductivity when a small constant current is applied on the fingertips. On applying Ohm's Law (A Complete Virtual Instrument for Measuring and Analyzing Human Stress in Real-Time, we can calculate the conductance. This instrument can be used for predicting stress patterns in an individual.

Fig. 6 Self-Rating Scale Evaluation

Another approach used for human assistance for monitoring mental health is through autonomous self-assessed robots. It decreases the level of human intervention in diagnosing and assisting a human going through stress. It is an approach in which the author tends to dynamize an autonomous program or device to conduct itself more constructively and intelligently that resembles human perception and insight. In this, the robots are designed to perceive the human intellect and behavior. All this process takes place under the supervision of the therapist who can over-rule the decision taken by the robot and can give better guidance and solution to the person under observation. In this, the robot is personalized in such a manner that it can adapt in the given environment and also engross the behavior of the subject to create a comfortable and welcoming atmosphere.

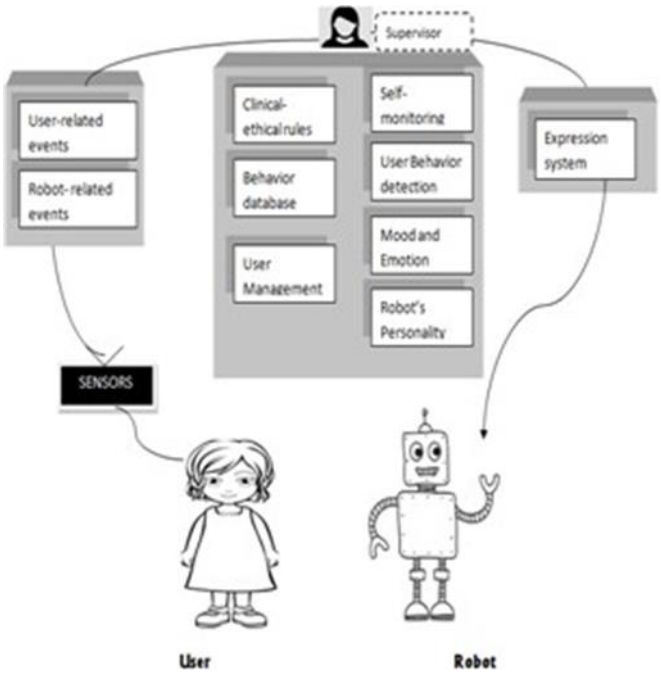


Fig. 7. Robot User Interface

This approach has a limitation in which constant supervision of therapist is needed. The robot behavior has to be managed and controlled by professionals which deviates them from the goal of assisting a stressed person. It may lead to missing important details in the ongoing therapeutical reactions.

Most of the stress-related programs can be handled efficiently by tracking behavior and human activities. Most of the chronic diseases can be prevented by behavior modification. Everyone must be aware of their own well-being and should take responsibility for creating a healthy life that is free from any psychological and chronic disease. IoT devices such as mobile phones are handy and approachable device which can help an individual to maintain a record of Behavioral activities and can detect Behavioral pattern which further gives a preliminary source contributing to stress. Wellness Diary provides complete behavioural-related and physiological graphical representation of stress level, sleep patterns, weight and blood pressure based upon the entries filled by the user. Many other online applications are available on mobile phones like Sanvello,

Youper, Virtual Hope board which are open source and freely available. It can assist an individual in real-time and is available round the clock. The chat bots available in these applications provide support for a person dealing with stress. Moreover, these apps promote meditations and other possible solutions for health management. The only shortcomings associated with mobile phone application is that they do not provide and personalized care and attention. One has to motivate themselves to use these applications under stressed conditions. Due to user negligence and irregularity user may blackout of the entire process and thereby putting all the efforts of creating a self-assisted application in veins. Behavior change is a time-consuming process. It makes take some time for a system like this to show any long-term results.

Internet-based Cognitive behavior therapy is a new approach towards dealing with many psychological and sociological problems like stress, anxiety or depression. An individual can remotely be assisted through iCBT. This approach can be carried forward in two ways. In one scenario, therapist-intervention in the entire iCBT process is visible. The entire therapy is through iCBT under the supervision of the therapist and the user actively participates in the process and user-therapist interaction takes place through e-mails. The other scenario is one in which iCBT act as an autonomous body where a therapist is not involved. Even though both the approaches under normal circumstances have an equivalent effect, the only difference observed in the case of autonomous iCBT is that the number of dropouts was more as there was no human involvement in it. The individual lacks motivation as human interaction was missing in the entire process. The need of therapist in iCBT is ambiguous because the approach for identifying the role is quantitatively based in which minutes dedicated to each user is monitored rather than noticing the therapist interaction and behavior.

B. Measurement of stress

Virtual reality is the simulation of the real environment through computerized audio and video graphics. It acts as an interface between a user and computer which further can be used for creating a real-world scenario and finding the response of an individual with respect to a situation. Stress is unavoidable due to hectic schedule and fast-changing lifestyle, but we can find a mechanism through which we can effectively manage stress. It is difficult to detect the human psychological state on the surface. Through electroencephalogram (EEG) the electrical activity of the brain can be monitored. In with the help of Virtual Reality relaxation scenes and EEG technology, the subject's brain activity was evaluated and factors like level of arousal, valence level, dominance and change in relaxation state keep into consideration. Carefully selected music and images are presented in front of the subject and one's response is noted effectively through a self-reporting measuring scale.

A personality of an individual is influenced by many external and internal factors. Through Regression Analysis, stress factor can be evaluated keeping into consideration of various study variables such as student's CGPA, performance in class as well as psychological influences such as personality trait. The dependent variable in this case is stress variable. The research has discovered many valuable factors which help us in efficacious detection of stress. Based upon gender, the female observer suffered from more emotional stress whereas male observer had difficulty in coping studies and family relationship. The research also threw light upon the impact of negative and positive personality on stress level. A person with negative personality is more likely to burnout as compared to a person with positive personality. Adolescence has also played a significant role in influencing the personality of an individual. The academic pressure and desire for higher grades in adolescence has deeply affected the personality of an individual and the effect is significantly visible when the individual goes for higher studies.

Few participants are observed in this research and analysed under psychological, stress, demographic and personality factor. In order to analyse the role of demographic factor, four main aspects are chosen. (gender, department, CGPA and working sector). A Chi-square analysis is performed on the above chosen factors in order to conclude that which factors primarily affects the stress level. Chi-square test is a statistic test in which expected value is measured with respect to observed values. Here we determine the degree of freedom of a variable in data set. Degree of freedom are those logically independent variables which are free to change without affecting the dataset.

S. No.	Factors	χ^2 Value	Sig.	Decision
1.	Gender	1.080	0.299*	Accept
2.	Department	7.467	0.113*	Accept
3.	CGPA	39.613	0.000	Reject
4.	Sector	1.016	0.000	Reject

Table 2: Chi-square analysis for demographic factors

From the above Chi-square analysis two out of four factors are more likely to influence the stress level. CGPA and Sector has higher impact on stress and gender and department has comparatively less impact on stress factor. It is important to develop effective measures to manage the stress level in students dealing with academic pressure. The management should take active part in improving the mental health issues of students.

There have been several facial expression and emotion recognition approaches evolved in the ultimate decade and lots of development has been made on this research region recently. Previously, researchers propose a simple solution for facial expression recognition on Extended Cohn-Kanade (CK+) dataset, that uses a combination of standard methods, like Convolutional Network and specific image pre-processing steps with 97.81% of accuracy, and takes less time to train than state-of-the-art methods. But it was seen that the accuracy of some expressions, like fear and sad, was less than 80%, Previously 5-layer CNN and deeper CNN was applied on Kaggle FER dataset to achieve an accuracy of 48%. Also some researchers presented the model with 4 convolutional layers and 2 fully connected layers on Kaggle FER2013 dataset and also comparison between shallow and deep models where the deep network enabled us to increase the validation accuracy by 18.46%. Also, a cascade network with 6 CNN including 3 CNNs for face vs. non-face binary classification and 3 CNNs for bounding box calibration, which is formulated as multi-class classification of discretized displacement pattern is proposed on the FDDB dataset with an accuracy of 85.1%.

DATASET

We have used FER2013 dataset from the Kaggle Facial Expression Recognition Challenge to train our model. The dataset consists of 35,887 grayscale images, each image of 48-by-48 pixel labelled with one the 7 emotion categories: Angry, Disgust, Fear, Happy, Sad, Surprise and Neutral. We used 80% of the dataset for training and remaining 20% for testing. **Fig 9: A sample of images from FER2013 dataset with their corresponding emotions**

Chapter 4

Findings and Discussion

We are aware that our current implementation of the stress detection model may have the following limitations. If anyone tries to give fake expressions or if there is beard or glasses are used in the image, our model may give wrong output. Also, as the training done on the images is less, the expressions like fear, sad or disgust may not be correctly identified. The stress results also depend only on the one survey which may sometimes give incorrect stress probability.
Chat-Bot Depression Therapy is based on the tweets, further it can be optimized into real time analysis of tweets and suggesting stress management solutions to the humans. Also, it can be accumulated with wearable watch which have galvanic skin response sensor and heart rate sensor

If the readings of these sensors reach to stress level automatically Chat-Bot is fired in smartphone or on watch that will talk to the person and suggest them the rightful solutions in real time.

This study investigates the use of task elicited facial signs as indices of anxiety/stress in relation to neutral and relaxed states. Although there is much literature discussing recognition and analysis of the six basic emotions, i.e. anger, disgust, fear, happiness sadness and surprise, considerably less research has focussed on stress and anxiety detection from facial videos. This can be justified partially by the fact that these states are considered as complex emotions that are linked to basic emotions (e.g. fear) making them more difficult to be interpreted in the human face. The sensitivity of specific measures of facial activity to situational stress/anxiety states was assessed in a step-wise manner, which entailed univariate analyses contrasting emotion elicitation tasks to their respective neutral reference conditions, followed by multivariate classification schemes. The ultimate goal of these analyses was to identify sets of facial features, representing involuntary or semi-voluntary facial activity that can reliably discriminate emotional from neutral states through unsupervised procedures. The facial cues finally used in this study involved eye related features (blinks, eye aperture), mouth activity features (VTI, ENR, median, variance, skewness, kurtosis and Shannon entropy), head movement amplitude, head velocity and heart rate estimation derived from variations in facial skin colour. All these features provide a contactless approach of stress detection not interfering with human body in relation to other related studies employing semi-invasive measurements like ECG, EEG, galvanic skin response (GSR) and skin temperature.

In addition, this approach incorporates information from a broad set of features derived from different face regions providing a holistic view of the problem under investigation. The sensitivity of these features was tested across different experimental phases employing a wide variety of stress/anxiety eliciting conditions. It was deduced that certain features are sensitive to stress/anxiety states across a wide range of eliciting conditions, whereas others display a more restricted, task-specific performance. It can be concluded that eye blink rate increases during specific stress and anxiety conditions. In addition, head movement amplitude and velocity is also related to stress, in the form of small rapid movements. Regarding mouth activity, the median and temporal variability (VTI) of the maximum magnitude increased while watching a stressful video whereas Shannon entropy appears to decrease. Finally, increased heart rate was observed during stress and anxiety states, where the most apparent differences were noted in the social exposure phase (self-describing speech, text reading) and mental task (Stroop colour-word test). The feature selection procedure led to identifying specific features as being more robust in discriminating between stress/anxiety and a neutral emotional mode.

Chapter 5

IMPLICATIONS AND LIMITATIONS

Stress has become stigma for our society. Social status, Social media, every second increasing information, work and job pressure ,time pressure have become the main reasons for increased stress levels in the Indian society .While, some people feel shy about sharing personal problems and about their hectic life schedule openly to the medical professionals, this leads to the stage of acute stress which in future can cause serious health issues. Stress has now become a problem in modern and revolutionized world.

Nonetheless, while slightly increased stress levels may be functional for productivity, prolonged and severe stress can be at the source of several physical disorders like headache, sleep or digestive disorders, unhealthy behaviors such as smoking and bad eating habits, as well as of psychological and relational problems. Stress not only leads to behavioural, psychological, emotional changes of an individual, it affects the society of a country financially also which are estimated by the World Health Organization, in terms of absenteeism and low productivity. Our review is to compare various techniques to recognize stress levels, diagnosis of stress and different techniques for early measurement of stress level. This will give wider view for the stress recognition and helping educational institutions to adopt the reliable idea for real time stress Recognition and real time solutions that are provided by cognitive based therapy using autonomous Robot.

The development of a reliable stress recognition system is an essential step and this can be done only by reviewing all the modern techniques available around us to build an autonomous stress recognition system. The limitation of stress recognition lies in making the system to detect and provide solutions in real time to the stress engrossed individual so that the individual will not fall in negative side effect after knowing about the stress levels. Fully autonomous Robotic therapy is still not reliable as it lacks personalization and emotion quotient. Moreover, it has its own behavioral constraints and ethical limitations.

Chapter 6

CONCLUSION AND FUTURE WORK

Main objective of our project is to detect stress and fire a chatbot that comforts the user. For this our project is divided into two modules. First module consists of detecting stress using sensors or capturing face data; the second module consists of a chatbot that requires user input and gives meaningful replies.

In this project, various techniques of stress detection and proposed solutions for stress dealing has been discussed. The first module is further divided into:

- Capturing face data to predict stress scores.

  This project presented a novel solution, for stress detection from facial emotion recognition using CNN. As shown in the results, in comparison with the other methods that use the same facial expression database, our method uses CNN that works better for images, and presents a simpler solution.

- Real time video analysis for counting number of blinks and detecting emotions to which predefined classes it belongs to.

  The motive for this part is to analyze how accurate the predictions are solely based on captured face data. Try to be clear with your emotion, Fakeness cannot be detected. The model is moderately accurate because the data could not be arranged within stipulated time.

Improvement Strategy:

The model can be improved by including other facial features inputs as well. The feature includes:

Lip movement

Head positioning

Eye blinking

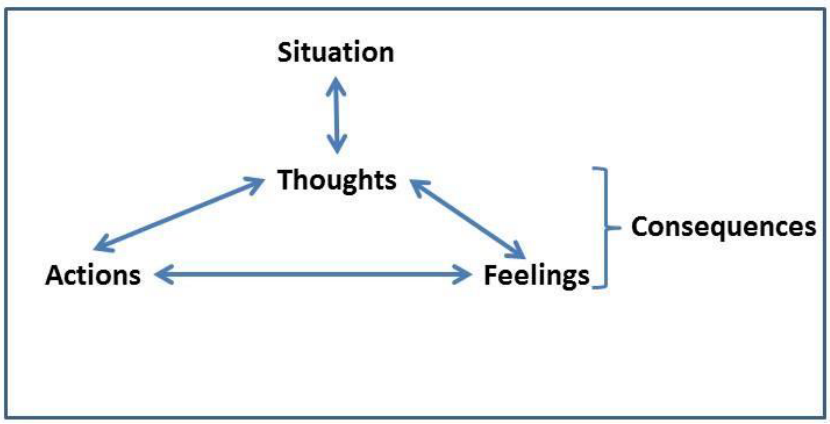
Gaze movement

The following features can be detected and a cumulative function can be defined to give out the total stress value.

PROPOSED SOLUTION

Chat-Bot Depression Therapy

Cognitive Behavioral Therapy (CBT) is an approach which mainly relies on three factors: thoughts, feelings, and behaviors. These three factors are interconnected and are mainly responsible for the consequences of an individual's actions, as shown in Fig



It is a psychotherapeutic approach addressing problems such as maladaptive behaviors, psychological disorders, stress etc. How people think (cognitive) and what they do (behavior) are the two aspects which can be changed by using different approaches like talking, motivating, skills training, relaxing etc. This is the major idea of using CBT, which helps the patients to change their behavior according to their medical and psychological condition for their own good. It analyses the patient's thoughts, feelings and actions in particular situations, then analyses the consequences and based on this analysis, the therapy, which includes different aspects like motivation, education, training etc. can be used to change the patients. behavior. By analyzing the CBT data and by providing effective support to the people, their self-efficacy can be improved, which in turn can help them to achieve the desired objectives

For module 1:

- We are hoping to find GSR (Galvanic Skin Response) sensor in order to predict more accurately.
- Heart rate sensor and GSR sensor will be used as a wearable device.

For module 2:

- Camera of the android phone will be used to capture face data which will be helpful for module 1.
- We will try to integrate the learnt model on an android app.

Stress and immune function

Modern medicine has come to appreciate the closely linked relationship of mind and body. A wide variety of maladies, including stomach upset, hives, and even heart disease, are linked to the effects of emotional stress. Despite the challenges, scientists are actively studying the relationship between stress and immune function. For one thing, stress is difficult to define. What may appear to be a stressful situation for one person is not for another. When people are exposed to situations they regard as stressful, it is difficult for them to measure how much stress they feel, and difficult for the scientist to know if a person's subjective impression of the amount of stress is accurate. The scientist can only measure things that may reflect stress, such as the number of times the heart beats each minute, but such measures also may reflect other factors.

Most scientists studying the relationship of stress and immune function, however, do not study a sudden, short-lived stressor; rather, they try to study more constant and frequent stressors known as chronic stress, such as that caused by relationships with family, friends, and co-workers, or sustained challenges to perform well at one's work. Some scientists are investigating whether ongoing stress takes a toll on the immune system.

But it is hard to perform what scientists call "controlled experiments" in human beings. In a controlled experiment, the scientist can change one and only one factor, such as the amount of a particular chemical, and then measure the effect of that change on some other measurable phenomenon, such as the amount of antibodies produced by a particular type of immune system cell when it is exposed to the chemical. In a living animal, and especially in a human being, that kind of control is just not possible, since there are so many other things happening to the animal or person at the time that measurements are being taken. Despite these inevitable difficulties in measuring the relationship of stress to immunity, scientists are making progress.

As future work, we want to test this approach in others databases, and perform a cross database validation. Also, the accuracy of our model can be increased by using GPU or cloud for training. Further, we want to extend our research to real-time stress monitoring of personnel inorganizations.

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