A Survey on Mood Condition Detection and Fatigue Measurement Methodology

Suwarna A. Hajare
Computer Science & Engineering Department
G. H. Raisoni College of Engineering
Nagpur, India

Prof. Chhaya S. Dule
Computer Science & Engineering Department
G. H. Raisoni College of Engineering
Nagpur, India

ABSTRACT
In this paper we present different perspectives of modeling the mood as well as fatigue in any individual. Mood detection and fatigue detection totally based on lot of parameter like facial expression , tone of voice that is speech synthesis, posture, gesture etc. This paper highlights the most expressive way of humans to display emotions and fatigue that is through facial expressions. First methodology describes both basic as well as non basic emotions and second methodology calculates fatigue level of eye.

General Terms
Pattern recognition, Face recognition.

Keywords:
Mood detection, fatigue detection, Facial expressions, Eye movements.

1. INTRODUCTION
Humans are able to convey their emotional state by facial expressions The emotional intelligence is the ability to manage and use your emotions in positive and constructive ways. When it comes to satisfaction and success at work, emotional intelligence matters just as much as intellectual ability. It is harder and difficult to manage work accuracy than ever to cope with stress in the workplace. Regardless of occupation, seniority, or salary level, we're spending more and more of our work days feeling frazzled and out of control, instead of alert and relaxed. Emotional intelligence is about communicating with others in ways that draw people to you, overcome differences, repair wounded feelings, and defuse tension and stress. It includes lot of parameter such as nonverbal cues or signals, moment-to-moment emotions influence, while some stress is a normal part of the workplace, excessive stress can interfere with the productivity and reduce your physical and emotional health. Finding ways to manage workplace stress is not about making huge changes to every aspect of your work life or rethinking career ambitions. Rather, stress management requires focus on the one thing that's always within your control. Facial expressions are also used as paralinguistic cues to regulate our conversation.

So to show mood and stress of a person various methodologies are available. As there is lot of key factor such as tone of voice, posture, gesture etc. This paper describes most expressive way humans display emotions is through facial expressions. So Facial expressions are the primary source of information for mood and fatigue detection. As virtual environments may be used for a plethora of pedagogical purposes such as virtual schools Worldwide, more effective methods for Human Computer Interface are being developed which rely on higher level image analysis techniques which has its wide applications in automatic interactive tutoring, multimedia and virtual environments. For the computer to interact with humans, it needs to have the ability to understand the emotional state of the person. The fatigue directly affect human performance in term of accuracy and reaction time and it has been claimed as primary cause of many major accidents so fatigue measurement also be a basic part. For resolving the absence of mutual sympathy in interactions between humans and machines is one of the most important issues in human-computer interaction, many researches about the emotional communication between the human and the machine have been reported. In this paper lot of perspectives of modeling the mood as well as fatigue in any individual it may be the student, learner, employee of software industry or other organization where work based on facial expression any either it may be student or employee of software industry or industrialist.

2. METHODOLOGY
2.1 Wrinkles on the forehead
First approach deal with detection of mood of the student, Facial expressions are identified from the wrinkles of the forehead[2],which gives the appearance of worry. Basic key action units in the face to expose expression is forehead is based on facial expressions it deal with two basic emotional expression states comprehensible, incomprehensible. As facial Expression plays a vital role in the identification of Emotions and comprehension level of this methodology. In this method first one of the most dominant and reliable features of the face that is forehead. Forehead wrinkles are forehead rows, the lines that run horizontally across the entire forehead. But many people also develop deep vertical wrinkles between the eyebrows called glabellas lines .These forehead wrinkles can make people always angry or unhappy.

Forehead block of the image with normal expression given with variable B_1 and for the forehead block with wrinkles have as $\mathbf{B_2}$.Formula for calculation of wrinkle density area is given as [2]

$$\mathbf{D_A = W_A/P_A}$$

Where WA is the number of wrinkle pixels in area A
$\mathbf{P_A}$ is the number of pixels in A.
$\mathbf{D_A}$ value for $\mathbf{B_1}$ and $\mathbf{B_2}$.
Forehead is defined as the part of the face above the eyebrows containing pixels in the face image, after wrinkle extraction, emotion is defined by using some rules where

wrinkle density on forehead get calculated and rules decides comprehensible and incomprehensible state. And Rules are given as

1. $\mathbf{D_A}$ value of $\mathbf{B_1}$ is 0 and $\mathbf{D_A}$ value of $\mathbf{B_2}$ is greater than 0.
2. $\mathbf{D_A}$ value of $\mathbf{B_1}$ is greater than 0 and $\mathbf{D_A}$ value of $\mathbf{B_2}$ is greater than $\mathbf{D_A}$ value of $\mathbf{B_1}$.
3. $\mathbf{D_A}$ value of $\mathbf{B_1}$ is equal to $\mathbf{D_A}$ value of $\mathbf{B_2}$ then the student is said to be in **comprehensible** state.
4. $\mathbf{D_A}$ value of $\mathbf{B_2}$ greater than $\mathbf{D_A}$ value of $\mathbf{B_1}$ then the student is said to be in **incomprehensible** state.

2.2 AAM and DBN model

It shows temporal relationships among various Action Units available on the face. It uses novel method for mood condition detection. In this approach combining active appearance model with Facial Action Coding System as active appearance model which generates statistical appearance models and takes texture variations and keep track of landmark point which stored in shape vector as a mathematical representation. In this method before applying Principal Component Analysis (PCA) an Eigen-analysis of the dispersions of shape and texture shapes get aligned by translating, rotating and scaling to minimize the sum of squared distances between the landmark points. Both FACS and AAM techniques used in combination and also use of both model that is measurement model and state model which calculates emotion state vector at time *t* , recognition error vector at time *t* , process noise vector at time *t* ,emotion recognition vector at time *t*.

The landmark points representation as in shape vectors is given as

$X = [x1, y1,..., xn, yn]^T$

The next important aspect used for classification of facial expression is *Bayesian Networks.* Bayesian network approach based on temporal evolution of facial AUs. Bayesian network represent the probabilistic relationships between different mood categories and fatigue monitoring parameter. Model divides the facial expression into three layers namely, recognition layer, AU layer, visual cue layer. Recognition layer contain basic five mood condition as normal, happy, sad, angry, surprise. Action unit denoted the intensity of action which scale to the particular range and lastly visual cue layer include the parameter like eyebrow, eyelid, eye, wrinkle, lips, lip-corners, mouth. This model used temporal link of DBN by considering temporal evolution of Mood

2.3 Algebraic representation of emotions [1]

It represent basic 8 dimensions of emotions which act as a primary emotions, This multidimensional model provides to represent infinity of emotion using different combinations of basic emotions. Model is three dimensional follows the approach of RGB color model for the formation of numbers of emotions. Emotion dimensions arranged as four pairs of opposites such as Joy-Sadness, Fear-Anger, Surprise-Anticipation and Disgust-Trust. It consists of vertical dimensions use to represents intensity or level of arousal, and the circle represents degrees of similarity among the emotions. Plutchik defined rules for building complex emotions out of basic ones [1] which support dyads and triads which takes adjacent emotions from the model .A tertiary emotion is generated from a mix of emotions that are two steps apart on the wheel (Surprise + Anger = Outrage). A basic emotion is described by a vector, which contains a single non-zero coefficient This model use mathematical approach for getting more accurate result in term of multidimensional vector, and the value of emotions get calculated.

Evaluation of fatigue takes only eye movement parameter as eye is one of the basic units mostly responsible for showing fatigue level. Eye blink frequency, color of the eye, sleep rested and sleep derivate view of eye shows the increase level of fatigue.

2.4 Subject-dependent and Subject-independent [5]

The database used in this work is the GEMEP-FERA database with video-recordings, training data set and test data-set and five discrete, mutually-exclusive emotion categories are: Anger, Fear, Joy, Relief, and Sadness. Different classifier used for classification of mood and since it uses totally hierarchical approach first person specific and person independent classifiers were trained, it was identified whether the subject appearing in the given test video also appears in the training set .It it contain and match with one it was So Based upon the decision, person specific or person independent classifier was used. Both the manual and automated person ID and verification were experimented with . It turns out that both give similar performance for expression recognition. In person specific classification, the present or absent decision was done using manual or automated method .Based on training data and person Id training data set get selected and for Person Independent classification ,when data is not in a training set then we resort to the person independent results, in both approaches multi-class SVM classifier is used.

2.5 Visual fatigue measurement system

This method used a new objective visual fatigue measurement system by using a high resolution camera and an infrared illuminator. As fatigue evaluation method use both approaches subjective approach and objective approach. As subjective approach use observer views so there may be less accuracy so used objective approach based on eye movement such as pupil region, pupil size, pupil accommodation speed, blink frequency, and eye closed duration means pupil detection methodology [4] which model under different stages such as

1. Image Sub-sampling
2. Eye Detection
3. Cropping Eye Region
4. Circular edge detection
5. Local thresholding
6. Component Labeling
7. Morphological operation
8. Calculating Eye information

In circular edge detection method used core pupil centre detection which highlights intensity positions
I (X, Y). To detect blink, two states such as eye open and close should be determined. To determine two states, pupil size is used as a metric, the threshold value of pupil size for deciding eye state is defined by considering the camera focal length and the smallest anatomical pupil size.

2.6 Template matching method

In this methodology extraction of eye spacing takes place with the help of improved adaboost algorithm. Eye spacing means distance between the upper and lower an eyelid. eye

spacing , the eye spacing is the important parameter to calculate the degree of weariness;. Distance means the levels of learners' fatigue. Distance [6] get calculated by this formula

Dis=C-D+A-B/2

Where,

A-Vertical coordinates of the midpoint of the right upper eyelid.

B-Vertical coordinates of the midpoint of the right lower eyelid.

C-Vertical coordinates of the midpoint of the left upper eyelid.

D-Vertical coordinates of the midpoint of the left lower eyelid.

When fatigue level increase means, the eye spacing (dis) becomes smaller even if closes eyes. Then the eye spacing is zero. Through the changes of the eye spacing, take appropriate fatigue detection strategies.

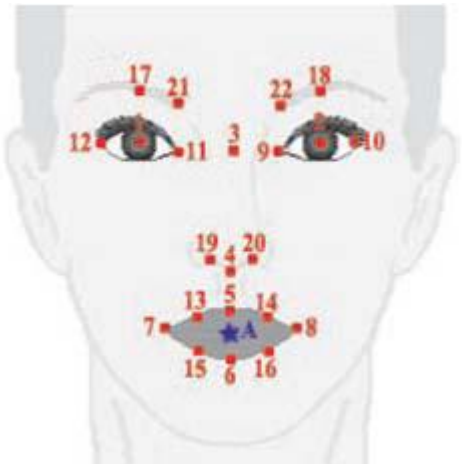
2.7 Dynamic System

It combines three approaches based on

1. Facial action units and head orientation
2. Hidden Markov Models
3. Multi level Dynamic Bayesian Network

Facial action units and head orientation identified from 22 feature points and Gabor filters. second classify sequences of actions into head and shoulder gestures. Last is used to model the unfolding emotional state based on probabilities of different gestures. Actions unit denoted ad AU1, AU2, AU3, AU4…..

This methodology consists of sensitive AI systems which contain some non-verbal cues which will detect fatigue level .so that specific information get extracted in this dynamic model to infer the fatigue detection.



.

Fig.1. The 22 feature points tracked by the NevenVision face tracker [7]

3. APPLICATIONS

- Health monitoring
- Human Computer Interactions
- Intelligent tutoring System
- Robotics
- Psychological Constraints

4. CONCLUSION

Face area is an important parameter to calculate average degree of fatigue level and also reflects the mood of a person to know ones interest. Fatigue measurement strategy proves that eye in term of eye distance or eye spacing and blink frequency become necessary parameters for expression analysis. And multidimensional models best suited for detecting once mood .As this both techniques get combine resultant model become continuous and detect any complex emotion and level of fatigue

5. REFERENCES

[1] Imen Tayari Meftah, Nhan Le Thanh and Chokri Ben Amar, "Towards an Algebraic Modeling of Emotional States", Fifth International Conference on Internet and Web Applications and Services 2010.

[2] Dr. M. Mohamed Sathik, G.Sofia, "Identification of Student Comprehension Using Forehead Wrinkles", International Conference on Computer, Communication and Electrical Technology – ICCCET 2011, 18th & 19th March, 2011.

[3] Kwang-Eun Ko, Kwee-Bo Sim, "Development of a Facial Emotion Recognition Method based on combining AAM with DBN", International Conference on Cyberworlds 2010.

[4] Jinman Kim, Eui Chul Lee" A New Objective Visual Fatigue Measurement System by Using a Remote Infrared Camera", Eighth International Joint Conference on Computer Science and Software Engineering (JCSSE) 2011

[5] Usman Tariq, Kai-Hsiang Lin," Emotion Recognition from an Ensemble of Features".

[6] Yin Liu, Wansen Wang, Dian Liu, Shuai Liu, "The Study of Learners' Emotional Features in The Elearning System", Second International Conference on Networks Security, Wireless Communications and Trusted Computing 2010.

[7] Tadas Baltruˇsaitis, Daniel McDuff, Ntombikayise Banda, Marwa Mahmoud, Rana el Kaliouby, Peter Robinson and Rosalind Picard, "Real-time inference of mental states from facial expressions and upper body gestures", in IEEE International Conf. Automatic Face and Gesture Recognition2011.

[8] Usman Tariq, Kai-Hsiang Lin, Zhen Li, Xi Zhou, Zhaowen Wang, Vuong Le, Thomas S. Huang, Xutao Lv and Tony X. Han "A Bayesian Approach to Recognise Facial Expressions using Vector Flows", International Conference on Computer Systems and Technologies - CompSysTech'09