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Analyzing the Biosignal to Make Fatigue Measurement as a Parameter for Mood Detection

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***Abstract*— Fatigue is a state of impairment that can include physical and/or mental elements, associated with lower alertness and reduced performance. Fatigue can be defined as a state of impairment that can include physical and/or mental elements, associated with lower alertness and reduced performance. Fatigue can lead to incidents because employees/workers are not alert. Shortly when person with increase in fatigue level, then physical or mental activity becomes more difficult to perform. Sign of the fatigue include tiredness even after sleep, psychological disturbances, loss of energy & inability to concentrate. Basically fatigue is categorized in two part work related fatigue & non work related fatigue. Work related fatigue is similar for different individuals performing the same task. Whereas non-work related fatigue are considerably between individual and is best managed at an individual level. There are several causes of work-related fatigue such as aspect of the task being undertaken (e.g. greater workload within standard shift) two many consecutive night shifts, unplanned work, overtime, emergencies, breakdowns & call-outs, feature of working environment (e.g. noise or temperature extremes). So the fatigue becomes a problem and important issue in the process industry. When employees/workers are fatigued they are more likely to exercise poor judgment & slow reaction. This can increase risks on site because fatigued employees are less able to respond effectively to changing circumstances. So the aim of this paper is**

1. **Simulating the physiological changes due to exertion and exhaustion by analyzing the biosignals.**
2. **Mood Detection.**

***Keywords*— Fatigue level measurement, Mood detection, Biosignals- facial expression, stress, facial action codes.**

I. INTRODUCTION

There are different perspectives of modeling the mood as well as fatigue in any individual. The visual fatigue may be measured in either subjective or objective methods. Subjective evaluation methods are based on survey or interview to measure subject's visual fatigue. Although the subjective method can easily acquire user's states, the result can be affected by individual scoring (or answering) variation and the other kinds of human emotion which are similar to visual fatigue. On the other hand, the objective evaluation methods quantify the degree of human visual fatigue by analyzing biosignals or image. Fatigue is a state of extreme tiredness that is usually associated with physical and/or mental weaknesses that affect our daily tasks, It reduces the work accuracy, performance and time constraints ,whatever work a person can do within a seconds ,it may requires hours together to the person with high degree of fatigue. As fatigue categorized into two parts such as work related fatigue and non-work related fatigue, this paper deal with the measurement of work related fatigue [2]. As work related fatigue is similar for different individual dealing with the same task. There are several causes of fatigue mentioned below. Fatigue can signal to serious medical problem. Fatigue is a normal result of working, mental stress; fatigue is different from drowsiness, where a patient feels that sleep is required. Fatigue is a normal response to physical exertion or stress, but can also be a sign of a physical disorder. Faces are rich in information about individual identity, and also about mood and mental state, [1] it should be noted that these physiological signals may be easily intervened with the stimuli coming from other sensing organs. Also, even small movements may negatively affect reading of bio-signals.[6] Among the various emotional factor, facial expression is one of the most important and spontaneous element to recognize the human emotional status. A facial expression is the common part or most expressive part of human to display mood and fatigue. Facial expressions in spontaneous interactions are often characterized by the presences of significant head motion, temporal behaviors, and partial occlusions. So this paper described biosignals i.e. facial expression and consider the parameter on face to detect the fatigue and mood. [7]

A. *CAUSES OF FATIGUE AND DESCRIPTION OF THE SYSTEM*

1. The length of time spends at work & in work related duties.
2. Type & duration of a work task & environment in which it is performed.
3. Individual factor such as not enough sleep: less sleep can negatively affect your concentration and health.
4. Features of the work & workplace.
5. Features of an employee or workers life outside work.
6. Circadian system [2].

As fatigue becomes a problem and important issue in the process industry increases risk on site because fatigue employee are less able to respond effectively to changing circumstances. Fatigue can lead to incidents because employees or workers are not alert. As fatigue and mood totally the part of emotional cognition which directly affects the performance, work accuracy and time constraints and also deal with psychology of human being and it has been claimed as primary cause of many major incidents because of tiredness & lack of alertness. So the aim is to build the system which will alert the employee by

simulating the physiological changes due to exertion and exhaustion by analyzing the biosignals and next aim is Mood Detection.

B. *Mood Detection and Stress*

In general, emotion is a mental state or feeling that occurs spontaneously rather than a conscious effort and it is reflected by physiological changes in our human body. Psychologists and Neuroscientists have explained various theories of emotion. However the two most applied models are the discrete emotional model proposed by Ekman and the two dimensional valance arousal model proposed by Lang .The discrete emotional model claims the presence of some basic emotions universally among all cultures. Several psychologists have suggested different categories of emotions. But there has been a considerable agreement in the following six emotions – happiness, sadness, surprise, anger, disgust, and fear. The Dimensional model categorizes emotions based on the scales and can be characterized by their valance and arousal. Valance represents the pleasantness and ranges from negative to positive. Arousal indicates the activation level and ranges from low to high. Figure 1 shows the six basic emotions plotted on valance-arousal place. For example, sadness has negative valance and low arousal [4].

Generally moods shift when person tired, and tiredness increases when increased in fatigue level and fatigue makes our brain lose its ability for control and balance, which increases the stress level. Stress represents the major precipitating factor in mood disorders. For estimating mood, facial expression is recognized as positive or negative effects on mood. Positive mood will appear when person with less stress i.e. low fatigue level and negative mood appear in the case of heavy stress means high fatigue level [9].

As in this figure shows the intensity of head brows, when the person is in positive mood condition it shows low or negligible intensity expression whereas in negative mood condition head brow motion is highly intense.

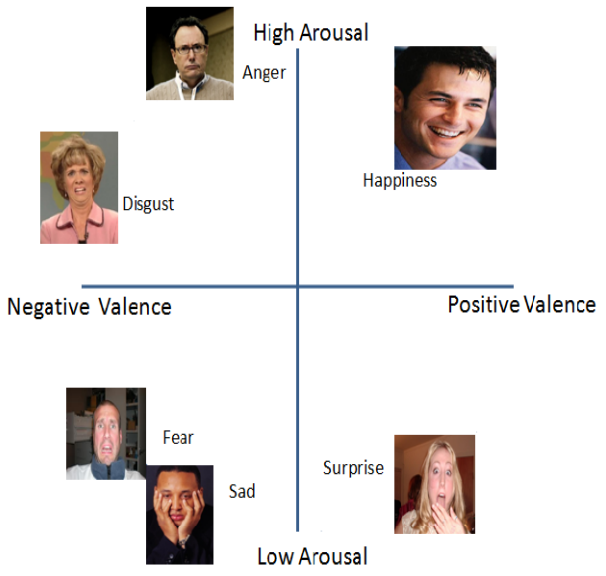

Fig.1 Basic Emotions on the Valance Arousal Dimensional Model [4]

II. FLOW OF THE PROJECT

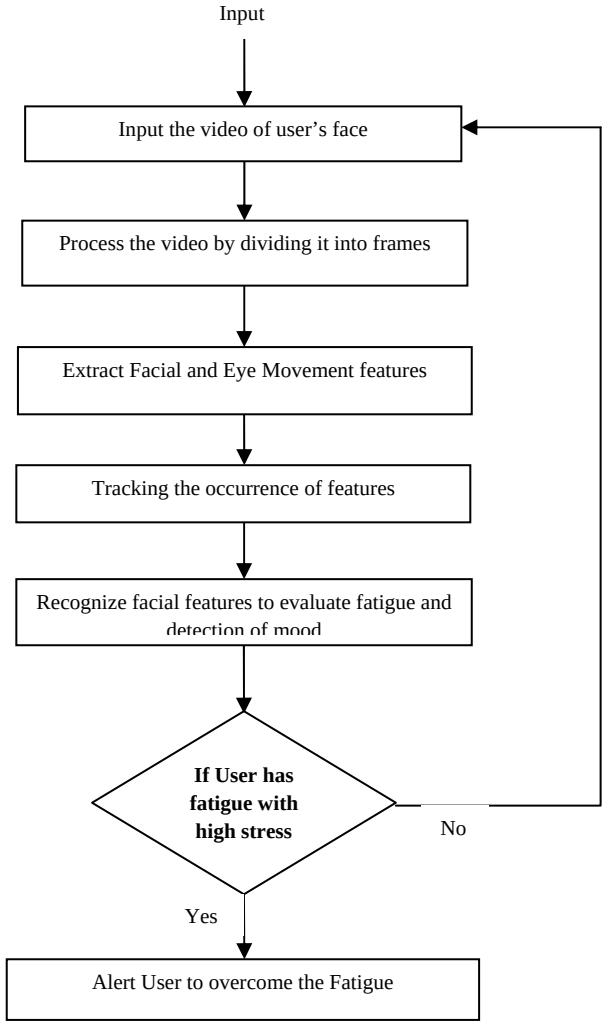

Fig. 2 Flow chart of fatigue measurement and mood detection model

Many studies have shown that measuring fatigue in any situation is a complex process and no easy method is available. Up to now, several types of fatigue measures have been typically used, based on hardware devices and have varying level of utility. The typical ones are physiological, behavioral, visual, and subjective performance measures.

Fatigue monitoring scheme based on three parameters.

1) Blink frequency rate.
2) Eye movement activity.
3) Head brows motion.

III. Fatigue Level Calculation and Mood Detection along with Results

A. *Video Creation*

Create the video by using the video capturing software.

B. *Database Creation*

Create database file which contained the field such as *'head_starts', 'eye_starts', 'nose_starts','face_starts', 'face_ends', 'blink_min', 'blink_max', 'head_max', 'eye_ball'* and save this values. When we input the video it will check entered parameter with already store parameter and display the massage "Found matching entry".

C. READING OF FRAMES

Read that specified video in Matlab by making use of Matlab commands and also create object for reading video files by making use of *mmreader* with the read method to read video data from a multimedia file into the MATLAB workspace. Read in all video frames by dividing the input frames to get the appropriate number of frames and then read and process each frame starting from first till last frame and then create structure from the captured video frames.

D. IMAGE SEGMENTATION

Receive image of User's Face from captured video by making use of the concept image segmentation. Before the image segmentation simple image pre-processing has been done such as separating object out of its background which can be useful in the initial image processing stage. There are many different possibilities of image regions segmentation [8] and we shall study the use of the region searching methods for pre-processing the images. It is an important step towards pattern detection and recognition. Segmentation is often considered to be the first step in image analysis, the purpose is to subdivide an image into meaningful non-overlapping regions, which would be used for further analysis. Basically the goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. All the image segmentation methods assume that, the intensity values are different in different regions, and within each region, which represents the corresponding object in a scene, the intensity values are similar. Image thresholding classifies pixels into two different categories first is those to which some property measured from the image falls below a threshold, and second those at which the property equals or exceeds a threshold. The threshold value is held constant throughout the image. Determine a single threshold value by treating each pixel independently of its neighbourhood.

This step includes selection of appropriate video input file from specified location. Follow the two phases.

a) Face Localization.

b) Eye Location.

Fig. 3 Image segmentation.

E. IMAGE PROCESSING

This approach analyzes the images captured by the camera to detect physical changes of person, such as number of blinks, eye movements, and head brows motion using Matlab software [8]. The separation of two objects or frames difference means removal of their common part is during processes done on the frames.

F. CALCULATION OF RESULT BASED ON THREE PARAMETER

1) *Blink Detection:* Calculation of number of blinks for given input number of frames. Monitoring model make use of image processing technique to measure the *difference_percentage.* It takes the difference of old and current frame and also find out the threshold value by analyzing the video running number of times for different frame transferred.

Result For first 1000 frame out of total 2334 frame of complete video.

Enter number of frames (max 2334):1000

Following are the values of *difference_Percentage* when Blink Detected

0.49
Blink Detected
0.47
0.44
Blink Detected
0.45
0.48
Blink Detected
0.45
Blink Detected
0.45s
Blink Detected
0.48
0.46
Blink Detected
0.46
0.50
Blink Detected
0.44
0.46
Blink Detected
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0.45
Blink Detected
0.49

0.45
Blink Detected
0.49
0.44
Blink Detected
0.48
0.50
Blink Detected
0.46
0.45
Blink Detected
0.48

By running the video for number of frames, threshold values decided between the range.
diff_percentage > 0.44 && diff_percentage <= 0.5.

2) *Eye Movement Detection :* Calculation of the eye movement activity for given input number of frames is done by calculating the distance Percentage .In the same way as in step 6 threshold value of distance percentage calculated and given as
percentage >= 0.11.

3) *Head Brows motion Detection:* For calculating head brows motion intensity for given input number of frames done, first by taking the frame difference and then find out the head difference percentage, again search the threshold value by analyzing the video for different frame transfer rate. The execution result shows difference percentage range as

diff_percentage_head > 0.65 && diff_percentage_head < 0.75

If intensity of head brow is high then mood of a person is of type annoyance that it shows negative mood. For low intensity, mood is of type interest which shows positive mood.

G. CALCULATION OF FATIGUE

It based on occurrence of parameter mentioned in the steps 1, 2 and 3.For calculation of fatigue level some observation has been made.
It follows the following steps

1) Take the five of observations of each person by manually observing the individual persons.
2) Calculation of mean value from observed values.
3) Taking the average of all mean value and find out one specified value for all three parameter such as blink rate, eye movement activity, and head brows motion.

Combined Result shows occurrence of each and every parameter as

High Fatigue Detected
Blinks: 21, Head Movements: 5, Eye-ball Activity: 6

If high fatigue detected then alerts the user otherwise person is in the state of doing the work accurately.

IV. CONTRIBUTION OF THIS WORK

Several theories work from different authors that try to explain the relationship between learning and specific emotion or mood but no relationship found between fatigue and mood. So this indication criteria shown in this paper. It also described the implemented model which is totally different from traditional approaches, two independent model named attention model and mood detection model investigated through literature survey get combined into one and it also work together so fatigue measurement become the parameter to show mood condition of a person. Also searching the biological base for correlating stress, fatigue and mood. Experimental results show that these methods have achieved good results of image segmentation blink rate detection, head brow motions and eye movement.

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