Stress Detection of Office Employees
Using Sentiment Analysis

Aadarsh Ahuja [1], Ekta Kithani [2], Manav Motwani [3], Sahil Motwani [4], Sunita Sahu [5]

[1]1503/B,Mohan Pride, Wayle Nagar, Kalyan - 421301.

[1]aadarshahuja99@gmail.com

[2]17/A,4th Floor,Mahadev co-operative society, Bewas Chowk,Ulhasnagar-421001.

[2]ektakithani123@gmail.com

[3]Flat No G3,Poonam APT,Laxmi Nagar,Ulhasnagar - 421003.

[3]2017.manav.motwani@ves.ac.in

[4]605,Ajmera Heights-3, Yogidham, Kalyan(w) - 421301.

[4]2017.sahil.motwani@ves.ac.in

Hashu Advani memorial,Collectors colony,chembur- 400074

[5]sunita.sahu@ves.ac.in

Abstract: Due to the increasing competition in the industry, companies demand more work hours from employees, and employees take a lot of stress in completing their deadlines. Now with the existing deadline stress, they also face problems like family problems, low motivation, discrimination, politics, etc, which brings the extra negative stress that harms the productivity and mental peace of employees. To reduce workplace stress among the employees and increase productivity, there is a need for a system to identify the stress level so that remedial action can be taken beforehand[4,5]. In this paper, we have proposed a method to detect the seven emotions(Angry, Disgust, Happy, Sad, Fear, Surprise, Neutral) of employees at the workplace using facial expressions from the web camera of their computers, sentiment analysis on the monthly reviews provided by the employees using natural language processing to calculate the stress level, and stress level is also calculated using the answer provided by the employee to the question[2] "How was your day?" at the end of each day and generate a report for the Human Resources(HR) of the company who will analyze the stress level of the employees. HR can talk to them, counsel them, and Help them which will ultimately motivate employees to do quality work[5].

Keywords: Stress, Myers-Briggs test, Natural Language Processing, Face Emotion Recognition.

1   Background

All over the world, an estimated 264 million human beings suffer from depression, one among the leading causes of disability, with many of those people also affected by symptoms of tension[10]. A recent WHO-led study estimates that depression and anxiety disorders cost the world economy US$ 1 trillion every year in lost productivity. Unemployment may be a well-recognized risk factor for psychological state problems while returning to or getting work is protective[10]. A negative working environment may cause physical and psychological state problems, harmful use of gear or alcohol, absenteeism, and lost productivity[8]. Workplaces that promote psychological state and support people with mental disorders are more likely to cut back absenteeism, increase productivity, and like associated economic gains. From these sorts of various studies, we got the motivation to create some software to trace the psychological state of the workforce and solve the issues they're facing, therefore the economic losses are often reduced and quality of life is often increased.

In this day and age, stress has become an overall phenomenon[3]. Employees are working for longer hours, as the increased level of duties and responsibilities are given to them. Stress is characterized as a state of mental and emotional pressure or strain, induced by difficult or unfavorable circumstances in human resource management[12]. It is an outside force that governs the feelings and actions of a person. Stress affects the human body badly physically, feeling wise or mentally[11]. Nowadays it's the most common problem which results in significant health disease is Stress[1]. Stress can hit anybody at any degree of the business and late research shows that business-related pressure is far-reaching and isn't kept to a specific division or an occupation. Many of the reasons for the stress in the workplace are as follows:

Poor working conditions: It's the physical environment of the workplace, which involves high or low visibility, smoke, heat, inadequate ventilation system, and everything that can influence his / her mood and mental state[8].

Shift Work: When a shift of employees changes their body is accustomed to a particular time to be productive but because of the change in the shift their mind and body need a few days to get normal with the new shift timings. Employees get stressed in maintaining focus at work these days.

Long Working Hours: Some investigations have exhibited that long work hours add to mental pressure and work stress. Working at least 10 hours out of each day. At least 40 extra time hours of the month and at least 60 hours of the week would, in general, make upsetting sentiments. It has been considered that working more than 45 h for each week diminished the danger of mental pressure. The connection between working extended periods and work pressure requires more examination[8].

Work Underload: When employees are not given challenging work instead they are given routine and uninteresting work they get a lot of stress as they feel harassed [8].Suppose a Data scientist is given the work of replying to grievance mails.

Work Overload: It happens when an employee is given a lot of work to complete in less time. Due to the workplace stress, employee's productivity, efficiency decreases, the quality and quantity of the work also decreases which ultimately affects the outcome of the company, Hence It is necessary to identify the workplace stress and inform it to the Human Resources of the company so that remedial actions can be taken[13]. In this paper, we aim to propose a system for organizations to manage and reduce stress at work[8].

Our system is designed in such a way that the personality of the employee is detected by asking questions based on the Myers-Briggs test. Myers-Briggs - is a personality classification test. The four classifications are Introversion/Extraversion, Sensing/Intuition, Thinking/Feeling, and Judging/Perception. Every individual is said to have one favored quality from every classification, creating 16 one of a kind sorts. The system will detect the mood of the employee by detecting his/her face at regular intervals and accordingly generate the reports. Also, at the end of each day, the employees would be asked to provide their personal opinion on the work that they have done for that day. Apart from this, the employees will be asked to provide a monthly review of their work. In this review, Natural Language Processing techniques will be applied to determine whether the review is positive (Happy) or negative (Sad). Weekly reports of the mood of employees will be shown to the admin so that the admin can conduct stress management sessions for those employees who are suffering and take actions accordingly which will ultimately motivate employees to do quality work and increases the overall performance which is beneficial to the organization in many ways[9,14].

2   Methods
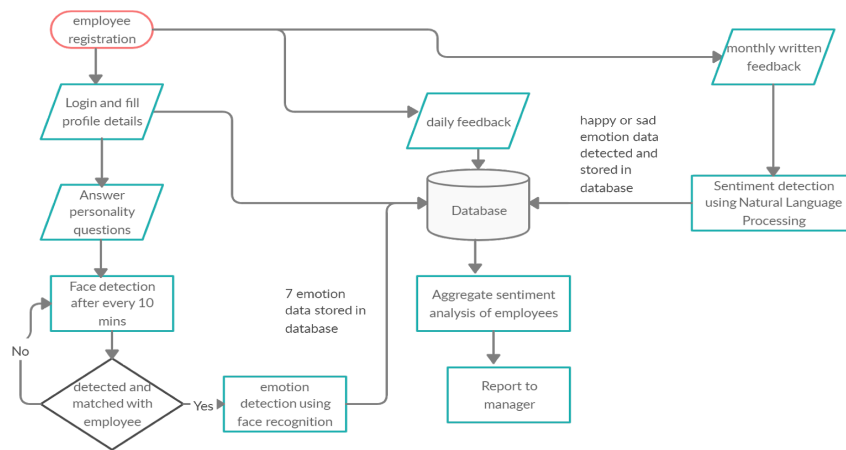
2.1   Approach Architecture

Fig 2.1.1. System Architecture

The above diagram shows the interaction of office employees with the system, the employee will first have to register at the web portal, where he/she will provide his/her details. Followed by this, the employee will undergo the Myers-Briggs personality determination test which will be in the form of four questions, each of them having two alternative options of which only one can be selected. Based on these answers, a code will be generated which will then be compared with the codes stored in the database. The corresponding matching code will describe the personality of an employee which will help the Human Resources of the company to assign appropriate work to that employee.

The Employee will then log in to the system. After this, pictures of the employee will be taken at regular intervals. These pictures will be provided as an input to the face identification and emotion recognition model. This model will first recognize the employee from the picture and then detect the emotion of the employee at that particular instant. Similarly, at regular intervals, the mood/ stress of an employee is detected and stored in the database. Daily answers to "How was your day?" will be taken from the employee which will help Human

Resources to analyze the mood of the employee. Apart from this, monthly feedback from the employee is taken, using Natural Language Processing the mood (Happy/Sad) of the employee is detected and stored in the database. In the end, Reports in the form of Charts will be generated and shown to the Human Resources to help him analyze the mood/stress level of the employee.

Thus, the Human Resources of the company will have a complete overview of the stress levels of each employee and accordingly, he can take remedial action.

2.2 Algorithms used

The algorithms we used were support vector machine (SVM), LBPH, CNN out of which we got the highest accuracy for LBPH with 99% accuracy followed by the support vector machine with 79.3%, followed by Face Emotion Recognition 72% accuracy. All the accuracy results are illustrated in Fig 3.

Local Binary Pattern Histogram Algorithm

The Local Binary Pattern Histogram(LBPH) algorithm may be a simple solution to face recognition problems, it can recognize both the front face and side face[7]. However, the popularity rate of the LBPH algorithm under the conditions of illumination diversification, expression variation, and attitude deflection has decreased[15]. To unravel this problem, a modified LBPH algorithm supporting pixel neighborhood gray median(MLBPH) is proposed. the grey value of the pixel is modified by the average of its neighborhood sampling value, so the feature value is extracted by the sub-blocks and therefore the statistical histogram is established to create the MLBPH feature dictionary, which is employed to acknowledge the face identity compared with the test image.[15] Experiments are carried on the FERET standard face database and therefore the creation of recent face databases, and therefore the results show that the MLBPH algorithm is superior to the LBPH algorithm in recognition rate.

Natural Language Processing

It provides a powerful tool for analysis of text written in human-understandable languages. NLP helps in understanding and interpreting the human language. It is used to determine the emotion associated with the monthly review of each employee. The process begins with tokenization. This is followed by word-stemming which aims at reducing the inflectional forms of each word into a common base or root. Afterword stemming, term frequency, and inverse document frequency method are used for word vectorization. Finally, a linear Support Vector Machine model is used to predict the emotion associated with the review. The dataset used for NLP sentiment analysis is in the form of 40,000 tweets and was split into 80:20 ratio for training and testing respectively.

Face Emotion Recognition

Face Emotion Recognition (FER) bundles a Keras model, The model is a convolutional neural network with weights saved to the HDF5 file in the data folder relative to the module's path. It can be overridden by injecting it into the FER() constructor during instantiation with the emotion_model parameter. In this Project, it is used to determine the mood of the employee at a particular instant of time based on the facial expression of the employee. It returns seven classes of classification namely, happy, sad, surprise, anger, neutral, fear, and disgust[6].

Convolutional Neural Network(CNN)

CNN is a deep learning algorithm that is used to work with image data. The working of this algorithm is divided into 3 phases, namely, the input phase, the feature learning phase, and, the classification phase. The input corresponds to the image of the employee as a matrix. On this matrix, features are extracted through multiplication with the feature map matrix. This is the convolution step and is primarily used for edge detection in images. After this, pooling is done on the convolved matrix which reduces the number of features in case of a large image matrix. This resultant matrix is flattened into a vector and fed into a fully connected layer. The output class is then obtained by using an activation function on the flattened vector.

Support Vector Machine(SVM)

Support Vector Machine is a supervised machine learning algorithm that is primarily used for classification problems and is capable of working on regression as well as classification problems. It can work with both linear and nonlinear cases. The algorithm works by approximating a hyperplane between two classes. It then finds the points closest to the hyperplane. These points are called support vectors and the distance between the hyperplane is called margin. The focus then shifts on maximizing the margin. Thus, the line or hyperplane corresponding to maximum margin is considered to be the line of demarcation between the two classes.

The confusion matrix obtained from the results is:

	Predict	
Actual	0	1
0	1033	270
1	283	1008

Here, 0 indicates the happy mood of the employee and 1 indicates the sad mood of the employee.

2.3   Modules

In this, we will discuss various modules of the proposed system.

   Registration of Employee: The first step is the employee has to register on our website. After registration, the employee has to answer a few questions for the determination of their personality.

   Face Verification and Emotion Analysis: After completion of step one a picture of the employee will be taken for face verification, Now when an employee will start their computer a picture will be taken 4 times a day, the first face of the employee will be verified and then the picture will be sent to an API call for emotion analysis. After that, the emotions of that employee and timestamp will be stored in the database.
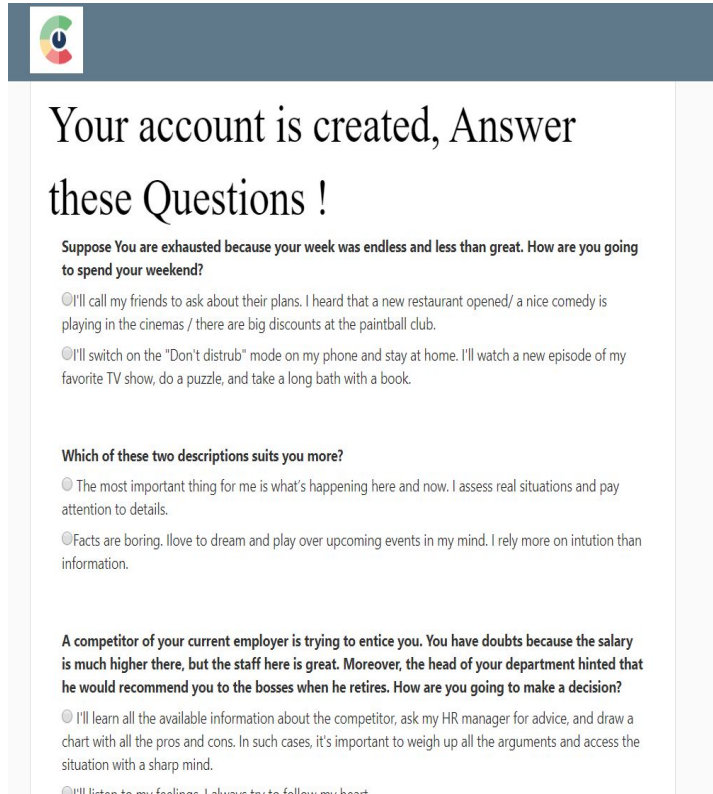
   Daily Feedback: At the end of the day when employees will shutdown their computer there will be a popup with two buttons GREEN and RED. GREEN indicates Good day whereas RED indicates Bad day, Employees will select one option that value will be stored in the database of that employee.

   Monthly Feedback: At the end of each month written monthly feedback of the employee will be taken and by using Natural Language Processing we will classify the positive and negative feedback and it will be stored in the database of that employee.

   Aggregate Sentiment Analysis of Employes: Reports in the form of Charts will be generated and shown to the Human Resources to help him analyze the mood/stress level of the employee. Thus, the Human Resources of the company will have a complete overview of the stress levels of each employee and accordingly, he/she can take remedial action.

3 Results

The main purpose of the proposed system is to analyze the Stress level in people working in software industries and facing many problems (Physical and Health) during their hectic working time or in their life. This section will cover various user interfaces of the proposed web-based system. First, when an employee joins, he/she will register his/herself using the registration page.

Fig 3 .1. Myers-Briggs Questions

Fig 3.1 shows the Myers-Briggs test questions which are asked after registration to detect the personality of the employee.

id	angry	disgust	fear	happy	neutral	sad	surprise	created at
28	0.05	0	0.04	0.13	0.75	0.03	0	29:47.2
33	0.12	0	0	0.5	0	0.1	0.28	29:47.2
34	0	0	0	0.82	0	0	0.18	2020-04-22
35	0.1	0.2	0.2	0.01	0.25	0	0.24	01-05-2020

Fig 3.2. Mood stored in the database

Fig 3.2 shows the mood of the employee stored in quantitative terms in the database using face recognition and face detection.
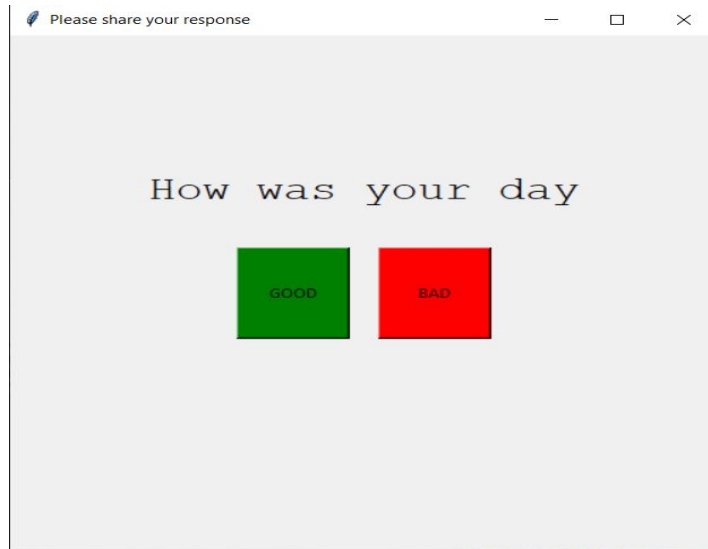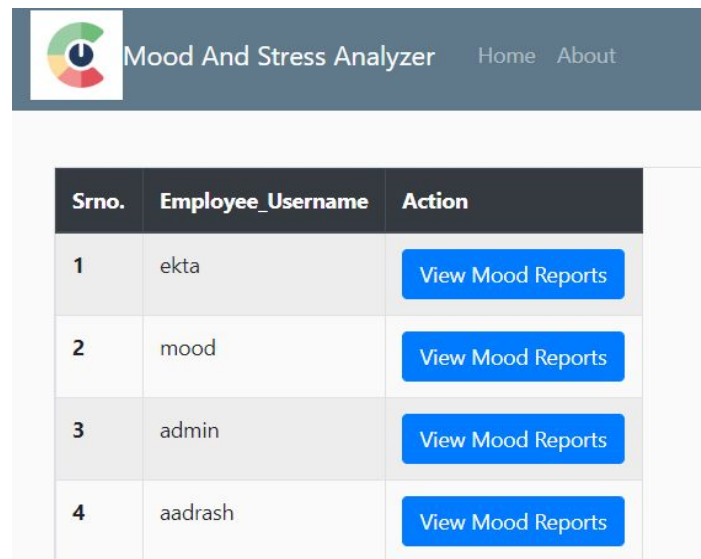
Fig 3.3. Daily Feedback of Employee

Fig 3.3 shows the snippet of the application which asks "How was Your Day" at the end of everyday.this will give employees their view about the day.

Fig 3.4 monthly *feedback from the employees*

Fig 3.4 shows the UI for taking monthly feedback/reviews from the employee. Here the employee will write the review and we will run our natural language processing module to find the sentiments of the employee.

Fig 3.5. Dashboard to display an Employee's Mood

Fig 3.5 shows the dashboard for the administrator in which the status of all the employees is displayed, Human Resources can see the mood/stress of each employee.
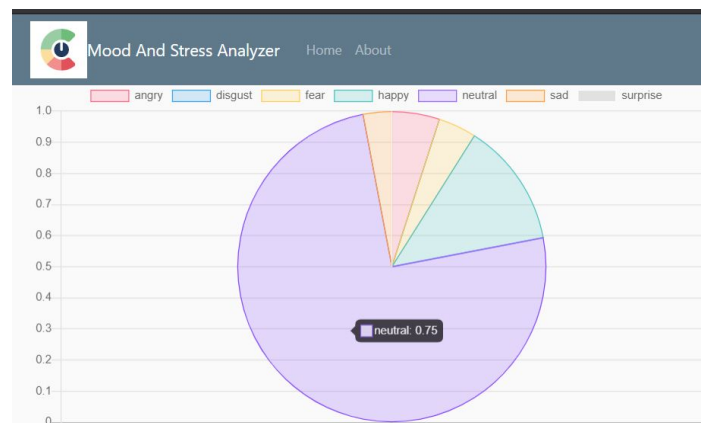

Fig 3.6 Mood of an Employee

Fig 3.6 shows the reports in the form of pie charts which will be shown to the Human Resources of the company.

Table 3.1shows the accuracy obtained from different algorithms.

Model	Accuracy
Face Recognition using LBPH algorithm	99%
SVM for monthly review analysis	79.3%
Face emotion recognition using CNN	72%

Table 3.1. Average Classification Accuracy

4 Conclusion

The study examines the stress faced by employees in both the government and public sectors. The daily interaction with the co-Workers and fragmented demands of this profession often leads to pressure and challenges which may lead to stress. Stress in employees can be detected by observing patterns in emotional data and can be resolved by the Human Resource department of the company. The accuracy of emotion detection is 72% for face input, 79.08% for monthly review input in form of text, 99% for identification of employees from face input and we are applying solutions which are simple, not medical solutions, so where our algorithm fails, it doesn't have a negative impact. In conclusion, the results of the current study suggest that we can use face recognition to detect stress in employees.

5   Competing Interests

The authors declare that they have no competing interests.

6   Availability of data and materials

The dataset for Emotion detection from the monthly review was collected from :

https://data.world/crowdflower/sentiment-analysis-in-text

The above mentioned dataset is used for sentiment analysis, The dataset is in the form of 40,000 tweets and was split into 80:20 ratio for training and testing respectively.

7   References

1. Jeon, S. W., & Kim, Y. K. (2018). Application of assessment tools to examine mental health in workplaces: job stress and depression. *Psychiatry investigation*, *15*(6), 553.

2. Al-Shargie, F., Tang, T. B., Badruddin, N., & Kiguchi, M. (2018). Towards multilevel mental stress assessment using SVM with ECOC: an EEG approach. *Medical & biological engineering & computing*, *56*(1), 125-136.

3. Subhani, A. R., Mumtaz, W., Saad, M. N. B. M., Kamel, N., & Malik, A. S. (2017). Machine learning framework for the detection of mental stress at multiple levels. *IEEE Access*, *5*, 13545-13556.

4. Smets, E., Casale, P., Großekathöfer, U., Lamichhane, B., De Raedt, W., Bogaerts, K., ... & Van Hoof, C. (2015, September). Comparison of machine learning techniques for psychophysiological stress detection. In *International Symposium on Pervasive Computing Paradigms for Mental Health* (pp. 13-22). Springer, Cham.
.
5. Mantri, S. P., Kale, M. V. C., & Patel, M. A. A. (2019). Stress Management and Work Life``Balance: An Effective Approach For Success With Special Reference To Woman Employees From IT Industries. *RESEARCH JOURNEY*, 59.

6. Face Emotion Recognition, Justin Shenk github link :
https://github.com/justinshenk/fer

7. Face Recognition, Adam Geitgey github link :
https://github.com/ageitgey/face_recognition

8. OSH Answers Fact Sheets , Canadian Centre for Occupational Health and Safety (CCOHS)
https://www.ccohs.ca/oshanswers/psychosocial/stress.html

9. How to measure workplace stress
By Jennifer Paterson
https://employeebenefits.co.uk/issues/health-and-wellbeing-2013/how-to-measure-workplace-stress/

10.   Mental   health   in   the   workplace   by   WHO
https://www.who.int/mental_health/in_the_workplace/en/

11. The impact of employee level and work stress on mental health and GP service use: an analysis of a sample of Australian government employees by BMC Public Health.
https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-4-41

12. Health and well-being , Employee Benefits , Jennifer Paterson on 28th October 2013 .
https://employeebenefits.co.uk/issues/health-and-wellbeing-2013/how-to-measure-workplace-stress/

13.How One Company Is Using AI To Address Mental Health by Lucy Sherriff
https://www.forbes.com/sites/lucysherriff/2019/03/25/how-one-company-is-using-ai-to-address-mental-health/

14. Abid, R., Saleem, N., Khalid, H. A., Ahmad, F., Rizwan, M., Manzoor, J., & Junaid, K. (2019). Stress Detection of the Employees Working in Software Houses using Fuzzy Inference. Stress, 10(1).

15. XueMei Zhao, ChengBing Wei. A real-time face recognition system based on the improved LBPH algorithm