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Detection of Stress in IT Employees using Machine Learning Technique

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***Abstract*- The objective of this paper is to apply machine learning and visual processing to identify overworked IT employees. Our technology is an improved version of older stress detection systems that did not include live detection or personal counseling. Stress detection methods that don't include real-time monitoring or individual counselling are being updated in this research. A survey is used to collect data on employees' mental stress levels in order to provide effective stress management solutions. In order to get the most out of your employees, this paper will look at stress management and how to create a healthy, spontaneous work environment.**

***Keywords*-** *Stress prediction, KNN classification, facial expressions.*

I. INTRODUCTION

To be competitive, the IT industry is continually launching new items and services. Furthermore, employees' stress levels have increased over the past year, according to this poll. The problem exists, despite the fact that many firms provide mental health benefits to their personnel. We'll start by looking at the stress levels of employees in the workplace. Images and machine learning will be used to examine stress patterns and pinpoint the most important factors that influence individual stress levels. According to the WHO, stress is a mental disease that affects one out of every four voters. Mental and social issues, a lack of openness in the job, a loss of faith in coworkers, and even death are just a few examples [12] [3]. Counseling is beneficial to people who are under a lot of stress. If we don't take precautions to control stress, societal and economic systems may be affected [10]. Preventative interventions can assist to lessen the harmful repercussions of stress.

These days, it aims at providing new technology and items to the economy in order to provide a fresh perspective. The strain levels in employees were found throughout this study, which raised the standard high [12].

Questionnaires are routinely used in the field of stress research to get insight into overall working experiences, but little is known about the immediate consequences of stressors at work [10]. There will be a hesitation on the side of people to declare whether or not they are worried. Traditional techniques of evaluating workplace stress levels included asking employees to fill out a survey [18]. To get the paperwork to the receiver, the sender had to put in a lot of time and effort [7]. Employers who use the Stress Detection System can better prepare their employees to deal with stressful events before they occur. While office workers are concentrated on their task, stress identification might sometimes imply distinguishing between a 'stressed' and a 'relaxed' condition [20]. Employees' headshots are taken, and survey questionnaires are given to them that are similarly standard in style and layout. Physical exertion is reduced, which saves both time and money [27]. This organizational strategy can assist relieve employee stress by using our painstakingly developed questionnaire.

The usage of stress monitoring software can improve both the well-being of society and the health of individuals. It is consequently necessary to develop scientific technologies that can analyses physiological data and automatically estimate stress levels in humans [21]. Obesity, heart attack, diabetes, asthma, and other health complications may arise as a result of stress. Hourly, a student in a different section of the country commits suicide.

According to a Lancet report in 2012, our country has seen a substantial number of suicide cases among young people aged fifteen to twenty-nine [2]. Stress detection has been shown in studies to enhance people's outlook on life, which could have a substantial social benefit. Companies in the information technology sector are currently altering the industry by introducing new technologies and products.

The three steps of image processing are as follows: Tools for importing images can be used to do this. During the process, images are reviewed and edited. A modified image or a report is the output of the image analysis. Machine learning is an artificial intelligence approach that allows a system to learn and evolve without being explicitly programmed (AI)[5]. The construction of computer programmers that can learn on their own is the subject of "machine learning," a branch of computer science [5].

The assessment of previous work on stress detection depended on digital signal processing, which took into account Galvanic skin reaction, blood volume, pupil dilation, and skin temperature [1]. Other studies on this topic use a number of physiological indicators and visual characteristics (eye closure, head movement) to quantify stress levels in persons who are focused on their work [21]. These measurements, on the other hand, are obtrusive and uncomfortable in real life application [5][11][17]. Stress is a factor in as many as 50 percent to 80 percent of all health problems, according to medical sources [1][24]. The core cause of cardiovascular disease is largely regarded to be stress. Stress plays a role in a number of the most frequent health problems in the United States. All of these issues, along with a plethora of others, are classified as psychosomatic (i.e., caused or amplified by mental causes such as stress) [8]. There are three areas where stress has a harmful impact.

Stress can manifest itself in a variety of ways, including feelings of guilt, embarrassment, worry, and even fury and impatience. Loneliness can manifest itself as fatigue, tension, concern, irritation, moodiness, and loneliness. As a result of stress, a person's behavior alters. When people are stressed, they are more likely to get into accidents, abuse drugs or alcohol, or engage in confrontational behavior. Anxiety and stress can decrease cognitive ability, cause impulsive behavior, limit memory, and even cause hypersensitivity to criticism [13]. In the early stages of depression, tension is common. Money, employment, and personal relationships are just some of the factors that might generate stress. Employees in the corporate world have a limited idea of what it's like to work in high-stress situations. Long-term stress is particularly common among those in the IT business.

Sensor technologies, such as smartphones and wearables with physiological and movement sensors, have been the focus of recent research [22][25].

Fig. 1

Above Fig. 1 shows the model of stress which can be caused by the change in sleep patterns, physical activity, increase in number of working hours, change in Heart Rate.

II. LITERATURE SURVEY

1) Detecting stress and anxiety via facial clues

Authors: G. Giannakakis, et al.

Using video-recorded face clues, this literature review establishes a model for detecting and identifying stress/anxiety emotional states. Through some kind of range of external and internal stresses, a complete experimental method was designed to induce systematic diversity in emotional states (neutral, relaxed, and stressed/anxious). In order to evaluate emotion expression more clearly and accurately, the paper concentrated mostly on non-voluntary and semi-voluntary facial cues. Sight related activities, oral activity, gesture recognition characteristics, and heart rate were also examined [4].

2) Image Processing and Machine Learning Techniques used for Stress Detection

Authors: Nisha Raichur, et al.

A real-time non-intrusive video is produced in this paper, which detects by analyzing a person's facial expression, can determine their emotional state. Each video frame contains an individual feeling, and the stress level is determined in the hours after the video capture[18]. A mechanism is applied that enables us both to train a system and analyze feature prediction differences. The paper findings

suggest that the developed technique works effectively with a generic model of all ages[5].

3) Techniques for Predicting Stress in Working Employees Using Machine Learning

Authors: U. S. Reddy, et al.

Machine Learning techniques were utilized to train the model that had constructed after preprocessed the data. It was measured and compared to the models shown above in order to determine how well they were manufactured [26]. Out of all the models boosting proved to be the most accurate in our experiments. According to the Decision Trees, factors such as gender, family history, and the availability of health benefits at work are all factors that contribute to stress. Many companies now know more about how to make their workplaces less stressful for their employees by implementing innovative technological solutions [6].

4) Analysis of Stress Detection among Employees using Machine Learning Techniques

Authors: B. K. Kiranashree, et al.

This research focuses on using Artificial Neural Network (ANN) classifiers to detect stress levels in employees. Employees' mental state is assessed by questions that use the Perceived Stress Scale, which also includes their health and wellbeing by measuring cardiac fluctuation and blood pressure. Because an ANN classifier can learn a large amount of data, we believe it will produce a rather more accurate solution [19] [15].

5) Recognition of mood at work by smartphones and wearable sensors

Authors: Zenonos, et al.

Sensor technologies, such as smartphones and wearables with physiological and movement sensors, have been the focus of recent research in this area [9]. We investigate the practicality of employing such devices for mood identification in the workplace in this research [14]. Every two hours, a new mood detection framework that can recognize five intensity levels for eight different types of emotions is proposed. In a small-scale user research, wearable sensing data in an office is collected to evaluate our technology environment. Our experiments have yielded promising results, allowing us to accurately distinguish different types of moods [14][16]. The use of sensors that measure physical properties can be costly and time-talking [7].

6) *Machine Learning Paradigms for Recognizing Human Mental Stress*

Authors: Mrs. Megha V Gupta, et al.

Detection of human mental stress utilizing Machine Learning frameworks and methodologies such as Electroencephalogram (EEG), Speech Signal, and audio-visual data. For stress detection using EEG, the Database for Emotion Analysis using Physiological Signals (DEAP) dataset will be used. Using Speech Signal and audio-visual data, RAVDESS (Ryerson Audio-Visual Data of Emotional Voice and Song) will also be designed to recognize Stress [18].

7) Stress and Relaxation Magnitudes for Tweets Detection

Authors: Reshmi Gopalakrishna Pillai, et al.

In this exploration work, a WSD arrangement as a preprocessing stage to a current vocabulary based pressure/unwinding strategy. A dataset involving 1000 tweets with questionable influence words was gathered and commented on with high interannotator understanding. Joining a WSD was found to fundamentally work on the presentation of TensiStrength regarding Pearson's connection and definite match rate, for both pressure and unwinding. TensiStrength with WSD outflanks AI strategies also. Given the moderately little size of the test set, this must be additionally concentrated on utilizing greater datasets explained with pressure and unwinding qualities [7].

8) *Detecting Stress using Social Interactions*

Authors: Huijie Lin, et al.

In this paper, a construction for perceiving clients' psychological tension states from clients' step by step web-based diversion data, using tweets' substance as well as clients' social coordinated efforts. Using authentic virtual diversion data as the reason, we focused on the connection between's client' mental tension states and their social association approaches to acting.We developed a crossbreed model that combines the part diagram model (FGM) with a convolutional frontal cortex affiliation to completely exploit both substance and social joint exertion data from customers' tweets (CNN) [8].

III. PROPOSED APPROACH

Stress is classified using supervised machine learning algorithms such as KNN classifiers in the proposed system. The detection of stress is accomplished through image processing. The worker's picture is given by the program as information, and Image Processing is utilized for discovery at the underlying stage. By translating an image to digital form and performing operations on it, image processing can improve or extract relevant information from it. In previous papers, various machine learning algorithms are used like SVM, linear regression, logistic regression, etc.., but didn't use KNN for the experiment which is similar to our approach. Not only accuracy but we also found Classification Error, Sensitivity, specificity, false positive rate error, precision. Our system is an updated version of prior stress detection systems that did not include live analysis or individual counseling, but it now incorporates live monitoring and frequent employee analysis, as well as identifying physically and emotionally stress levels. Because there is no continuous taking of photographs, it takes less time and produces more effective outcomes when compared with the results achieved by continuously capturing images of a person.

By taking a picture as inputs and returning a photograph or characteristics associated with those images as output. We use a bounded box to show the employee's feeling, and also the emotions are shown at the top of the bounded box. Angry, Disgusted, Fearful, Sad, and Neutral are all stress indicators.

Fig. 2. Indication of stressed emotions states.

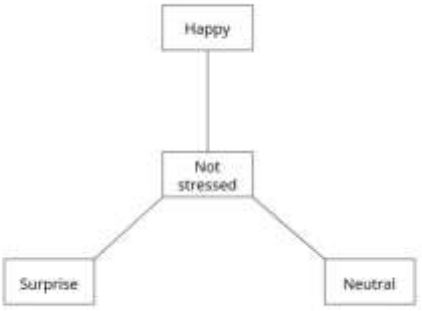

Fig. 3. Indication of not stressed emotions states.

A. Advantages of this Approach

- An image that has been edited or a report based on image analysis as a result of the output.
- The Stress Detection System helps workers in managing difficulties that add to stress by giving proactive stress management solutions.
- Over periodic times, we will take photographs of employees and then distribute traditional survey forms to them.
- We can also use live cam to detect the stress of the employee, which shows the stress characteristic of a person.

Algorithm: K-Nearest Neighbor (KNN)

Dataset:

To complete the task in accordance with predictions or judgments, an explicit mathematical model is developed using "training data". Image mining can be used to find hidden information in images, link previously unrelated data, and uncover new patterns in the data being mined.

Dataset contains a grid representation of an existing dataset with distinctive characteristics. Feature selection is the method involved with diminishing the quantity of information factors while fostering a prescient model. It's the process of selecting appropriate characteristics for your classification algorithm that depends on the sort of issue you're attempting to answer automatically. However, Property Extraction produces a completely redesigned dataset with only mathematical input parameters as an outcome of Principal Component Analysis feature selection, which transforms to six principal components: Condition (No stress, Time pressure, Interruption), Stress, Physical Demand, Performance, and Frustration.

Angry:

Disgusted:

Fearful:

Happy:

Neutral:

Sad:

Surprised:

IV. ALGORITHM

The following is a general description of how the proposed systemalgorithm works:

Step 1: Begin
Step 2: Employee Login.
Step 3: Determine whether or not the IT employee is currently employed.
Step 4: If you haven't already, sign up.
Step 5: Return to the previous step.
Step 6: If the answer is yes, the employee will log in.
Step 7: Upload the Image.
Step 8: If the uploaded image is not in JPG file format then a message ”THIS IS NOT A JPG FILE” is displayed.
Step 9: If uploaded image file format is valid then image is detected.
Step 10: User Live Cam Detection.
Step 11: KNN Algorithm Results are obtained Along with classification error, sensitivity, specificity, recall, precision,
Step 12: End.

A. Implementation of KNN

- Machine learning is basically divided into 3 categories: Supervised learning, Unsupervised learning, reinforcement learning. We chose KNN algorithm among all the machine learning algorithms as it saves every piece of data and utilizes it to classify new data.
- In this, no assumptions are made about the data.
- It saves the dataset during training and then performs an action on dataset.
- The K Nearest Neighbors' basic premise is that the data points with the shortest feature space distance from our new data point are called nearest neighbors.
- K is the sum of all such data points we consider during the implementation of our classification algorithm.
- We iterate the KNN method with various K values until we find one that greatly minimizes the number of errors while preserving the algorithm's capacity to make right predictions when given data it hasn't seen before.
- In this it finds the minimum distance between the new data and the data points in the feature space. In this paper, the value of K is 5 and the distance is found by using the most popular distance metric called Euclidean distance.
- The distance can alternatively be calculated using Hamming, Manhattan, or Minkowski distances, depending on the needs.
- The distance is calculated between the new datapoint and the existing data points and takes the 5 nearest points to the data point.
- The new datapoint will go into the category which has maximum nearest neighbors.

V. EXPERIMENTS AND ANALYSIS

To check the efficiency of the stability, we gathered information and executed quantitative experimental investigation.

Firstly User has to register with the required details user name, login ID, password, mobile, email, Locality, Address, city, state. with all the required details user has to register. If all the details are correct then the message will be displayed as "you have been successfully registered". Password must contain one number, one upper case and lowercase letters and should contain 8 characters or more. If you enter email or mobile number which is already existed the it will display message as "email or mobile already existed". If any of the field is missed then it will display a message as "please fill out this field". If all these details are entered, then only user registration can be successful.

Fig. 4. User Registration form

User Registration is required to know whether the employee is currently employed to that IT Company or not and for the security and privacy purpose as well. If the person is introvert or some kind of person who is having inferiority complex is not interested in exposing his/her stress to others and also not comfortable in sharing their personal details like images, username, password, etc.

Fig. 5. Admin login form

Admin has to login by "admin" as both user name and password. After admin successful login he can activate the successfully registered user.

Fig. 6. Admin users page

User can login with registered Login ID and password. He can successfully login only if admin activates that user. If admin doesnot activate that user then he cannot login and the message will be displayed as "your account not yet activated".

Fig. 7. User login Form

If the user is successfully login then a page will be opened which contains Home, Image, Live Cam, KNN, Logout pages.

Fig. 8. User Image Page

If user clicks on the Image page, then the user can upload the image and can see the results. User can also see already uploaded images and its results as well. As this stores previous uploaded images, this can help for the future medical references by which psychiatrist can be able to help the person. Not

only single face but this approach can also detect the multiple faces as well.

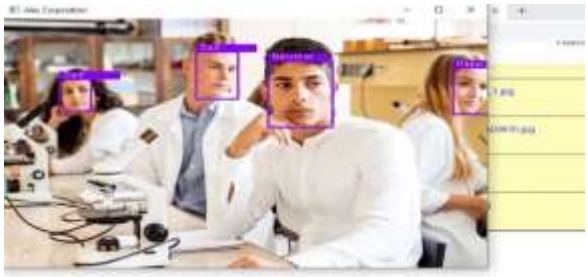

Fig. 9. Uploaded Image Facial emotions

If user clicks on the live cam then camera turns on and monitors the face of a person who is in front of the camera and displays the result. It also monitors multiple faces as well.

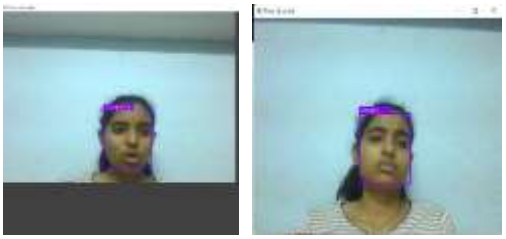

Fig. 10. Using Live Cam Result

After uploading the image or when using the Live Cam the result will be displayed on the top of the bounding box.

If user clicks on KNN page then user can see the Accuracy which is obtained using KNN algorithm. Along with accuracy user can also see Classification Error, Sensitivity, specificity, False positive rate error, precision.

Classification error implies how regularly is the classifier right? Sensitivity implies when the actual value is positive, how frequently is the prediction right? Specificity implies when the actual value is negative, how regularly the prediction is the right? False positive rate implies when the actual value is negative, how regularly the prediction is the wrong? Precision implies when a positive value is anticipated, how regularly is the prediction right?

Fig. 11. KNN Algorithm Result

By clicking on logout page user returns to the home page.

VI. CONCLUSION

The Stress Detection System is designed to assess employee stress by reviewing photographs submitted by verified users, making the framework is reliable. After the successful registration and login, user uploads the image and also uses the live cam. After uploading the image, we will get the output of the stress level on the top of bounded box as angry, sad, happy, disgusting, and neutral.

We develop this model by using Machine Learning Algorithm like KNN classifier. We use KNN classifier and predict the accuracy of the model. Along with the accuracy we also predict classification error, sensitivity, specificity, false positive rate error, and precision. We can supply successful solutions for stress management, keeping the working conditions sound and unconstrained for representatives, and capitalizing on them all through work hours, thusly.

VII. FUTURE SCOPE

To identify stress, the proposed method combines image processing and deep learning. To extract features, images were gathered and analyzed. Along with the Live Cam, the video facility can also be benefitting to the future work with various algorithms. The algorithm processing outputs were used to train the model and test it with the test dataset. Despite the fact that the acquired results are preliminary due to the small number of persons involved or technical information, the key added value of this paper is acquired by permitting end - user to correctly recognize ongoing stress in order to decrease future health risk factor. A broader population study will be part of our future effort.

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