STRESS DETECTION IN IT PROFESSIONALS BY IMAGE PROCESSING USING MACHINE LEARNING

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Abstract

The main objective of our project is to detect stress among the IT professionals with the help of rich Machine learning and Image processing techniques. Our system is an enhanced version of the earlier stress detection systems that did not involve the live detection and the personal counselling but this system involves live detection and regular analysis of the employees and physical and mental stress levels in his/her by providing them appropriate solutions for stress management. Our system is mainly focused on managing stress and making the workplace healthy and normal for the employees and to get maximum output from them during working hours. The system works when the IT professionals will be in front of the camera then it will be able to detect the facial expression and perform in real time. A camera is used to capture the in front view of the worker as he/she types in front of the computer. Stress is a major concern affecting individuals mental and physical health, making early detection crucial for effective intervention. This project focuses on developing an stress detection system using image processing and deep learning techniques. The model analyzes facial expressions and physiological indicators to classify stress levels. Our team is building a dataset to train the model, ensuring validation and accuracy. The system aims to offer real-time stress assessment, which can be useful in workplaces, healthcare and personal wellness monitoring. Our method employs TensorFlow and python to provide advanced stress detection. functions with interface for practical applications.

1. INTRODUCTION

Stress management systems have an important role to observe the level of stress that disturbs our socio-economic mode. According to World Health Organization, Stress could be a psychological state drawback moving the lifetime of one in four voters. Human stress leads to mental as well as socio-fiscal problems, absence of transparency in work, poor operating relationship, depression & ultimately commitment of suicide in extreme cases. This requires counselling to be offered for the stressed individuals cope up against stress. Stress away is not possible but preventive measures helps to overcome the stress. Now, only medical and physiological consultants will check if one or one is under depressed state or not. one of the usual methodology to observe stress is based on form. This approach, completely relies on the responses provided by the individuals, people are going to be unstable to say whether they are stressed or not. Stress detection automatically reduces the possibility of health issues and improve the well-being of the society. This includes the way for the requirement of a scientific device, which utilizes physiological signals thus making detection of stress levels in individuals[1-32].

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Automatic stress detection reduces the likelihood of health issues and improve the well-being of the society. This includes the way for the necessity of a scientific device, which utilizes physiological signals thus automating the stress level detection in individuals.

IT industries today are setting a new peak in the market by transferring new technologies products in the market. in the course of this research, the degree of stress among employees also are observed to raise the bar high. Even though their square measure some institutions United Nations agency provide mental health related schemes for employees however the issue is far from administration. in this paper we tend to attempt to get to the depth of this drawback by attempting to observe the stress patterns within the operating worker within the corporations we could prefer to implement image process & ML strategies to study stress patterns and to narrow down the factors that significantly authenticate the stress levels. ML algorithms such as KNN classifiers square measure used to categorize stress. Image process is used at the starting phase for identification, the image of employee is captured by the input camera. In order to retrieve some useful information from its image process is used by converting image into digital form and playing some operations on that. By accepting input as an image from video frames and output also image or image-related characteristics. Image process mainly consists of the following 3 steps:

- Bringing in the image through image acquisition tools.
- Image analysis and manipulation.
- Output within which result's altered image or report that's supported image analysis.

2. PROBLEM STATEMENT

The problem statement in our system is Stress Detection. If the person going through stress that time mental condition is not well. Detection of emotional status of a person who is stressed is important for the safety of a person. In that scenario we use our system to detect person is stressed or not using Image Processing and Machine Learning.IT professionals undergo extremely stressful conditions under prolonged working hours, tight deadlines, and pressure of work, resulting in severe mental and physical well-being. There is a requirement for unobtrusive, computerized, and real-time measurement of stress levels through image processing and machine learning approaches based on facial expressions, exactly detecting levels of stress. Present approaches do not provide real-time detection as well, resulting in delayed intervention.

Stress is one of the most significant determinants of physical and mental well-being, which results in issues such as anxiety, depression, and low productivity. Early identification of stress enables people to manage it effectively and prevent possible complications of health. However, manual subjective approaches to estimating stress are time-consuming. This project involves developing stress detection system that monitors facial expressions and physiological signals to determine stress levels. The system will utilize image processing techniques and machine learning methods to categorize stress levels in a proper manner. Since the publicly available data may not align with the requirements of the project, a custom training dataset will be created to make the model more reliable and efficient.

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3. LITERATURE SURVEY

We have studied various papers related to the Stress Detection in IT professionals using Machine Learning as follows:

1)Detection of Stress Using Image Processing and Machine Learning Techniques

AUTHORS: Nisha Raichur, Nidhi Lonakadi, Priyanka Mural

Stress is a part of life it is an unpleasant state of emotional arousal that individuals undergo in circumstances such as working for extended periods of time in front of computer. Computers are a way of life, most life is spent in the computers and therefore we are thus more disturbed by the fluctuations that they subject us to. One cannot simply avoid all his/her work on computers but one can at least regulate his/her usage when getting alarmed about him getting stressed at some point of time. Keeping a check on the emotional state of an individual who is spending more time working in front of the computer is vital for the well-being of an individual. In this work we are recording real-time non-intrusive videos, which sense the emotional status of an individual by analyzing the face expression. We identify a single emotion in every video frame and the determination on the level of stress is done in successive hours of the video recorded.

2)Machine Learning Techniques for Stress Prediction in Working Employees

AUTHORS : U. S. Reddy, A. V. Thota and A. Dharun

Stress disorders have become a prevalent problem among working IT professionals in the current industry. Due to changing lifestyles and work cultures, there is a growing risk of stress among employees. Although many industries and corporates offer mental health-related schemes and attempt to relax the workplace environment, the problem is hardly under control. In this paper, we would like to use machine learning methods to study stress patterns among working professionals and to shortlist the factors that significantly influence the stress levels. For this purpose, responses of working professionals from the tech-industry for the OSMI mental health survey 2017 were used. Different Machine Learning methods were used to train our model after proper data cleaning and preprocessing. The above models' accuracy was acquired and compared. The highest accuracy was achieved by Boosting among the models used. Decision Trees were used to determine key features that affect stress, which include gender, family history and the provision of health benefits at work. Based on these findings, companies can now refine their strategy to minimize stress and design a much more comfortable work environment for employees.

3)Classification of acute stress using linear and non-linear heart rate variability

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analysis derived from sternal ECG

AUTHORS : Tanev, G., Saadi, D.B., Hoppe, K., Sorensen, H.B

Detection of chronic stress is a critical element in the prediction and prevention of cardiovascular disease. This research is a pilot study aimed at creating a means of detecting short-term psychophysiological change using heart rate variability (HRV) features. The aim of this pilot study is to delineate and to provide insight into a series of features that can be utilized to identify psychophysiological changes which take place under chronic stress. This research elicited four kinds of arousal by pictures, noises, intellectual tasks and relaxation, and classified them in terms of linear and non-linear HRV features from electrocardiograms (ECG) recorded by the wireless wearable ePatch® recorder. The maximum recognition rates obtained for the neutral phase (90%), the acute stress phase (80%) and the baseline phase (80%) were by sample entropy, detrended fluctuation analysis and normalized high frequency features. Standardization of non-linear HRV features for each subject was seen to be a significant contributor for enhancing the classification results

4. EXISTING SYSTEM

In the current scenario, stress detection is typically conducted through manual assessments, wearable devices, or artificial intelligence-based techniques. Some of the common existing systems are outlined below:

1. Classical Psychological Tests:

Stress is measured by self-rated questionnaires like Perceived Stress Scale (PSS), Depression Anxiety Stress Scale (DASS), etc.

These methods are subjective and will not always be correct**.**

2. Wearable Stress Detecting Devices:

Smartwatches and fitness bands (Apple Watch, Fitbit, Garmin) track heart rate variability (HRV), skin temperature, and other biological signals to estimate stress.Good but only employing expensive hardware and having to wear them continuously.

3. Pre-Trained Model-Based Stress Detection:

Some existing systems use pre-trained deep learning models to analyze facial expressions, speech tone, or biological signals for stress detection. All of them are relying on public datasets that may not be sufficient to generalize for everyone.

Drawbacks of the Existing System

- Physiological signs utilized for analysis are usually compartmentalized by a Non-stationary time performance.
- The attributes derived through extraction provides the stress index of the physiological signals clearly. The ECG signal is directly assessed utilizing widely used peak j48 algorithm.

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5. PROPOSED SYSTEM

The suggested System ML algorithms such as CNN classifiers are utilized to classify stress. Image Processing is utilized at the detection stage initially, the image of the employee is provided by the browser serving as an input. Stress detection system based on facial expression analysis. The system operates when the IT professional will be seated in front of the camera then it will be capable of detecting the facial expression and operate in real-time. A camera is utilized to record the near front view of the employee while he is sitting in front of the computer. Captured video is split into parts of equal length and set of similar size of image frames are extracted from each part correspondingly and are analyzed in order to obtain an improved image or to derive some useful information from it image processing is utilized through converting image into digital form and performing some operations on it. Through taking input as an image and output can be image or characteristics related to that images. The emotion are displayed on the rounder box. The stress level indicating by Angry, Disgusted, Fearful, Sad.

Algorithm:

Convolutional Neural Network (CNN).

Advantages of proposed system:

- Output where outcome is altered image or report that is image analysis based.
- Stress Detection System enables employees with coping up with their issues leading to stress by preventative stress management solutions.
- We will capture the photos of the employee according to the normal intervals and then the tradition survey questionnaires will be distributed among the employees.
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6.WORKING PROCESS

stress detection system is systematic in its approach from data collection, preprocessing, model training, and stress classification. Below is the step-by-step explanation:

1. Data Collection (Collecting Own Data):

Since we can't use pre-trained sets, we need to collect and label our own data:

- Facial Images/Videos – Capture images of individuals in stressed and non-stressed conditions.
- Physiological Data (if needed) – Record heart rate, skin conductance, or voice tone (if there are sensors).
- Annotation – Manually annotate data as "stressed" or "non-stressed" for training.

2. Data Preprocessing:

Once the data is available in the dataset, the data must be cleaned and processed:

- Face Detection & Cropping – Crop faces from an image using OpenCV or Mediapipe.

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- Normalization – Resize images to a specific size (e.g., 224x224 pixels) for homogenous input.
- Augmentation – Use techniques like rotation, flip, and brightness adjustment to change the dataset.

3. Training & Model Selection:

our project will utilize machine learning or deep learning algorithms to label stress levels:

- Model Type: CNN (Convolutional Neural Network) for image-based stress detection.
- Feature Extraction: Extract features like furrowed brows, eye widening, and lip tension.
- Training the Model: Train the model using TensorFlow or keras. Split the data into training
- (80%) and test (20%).

4. Stress Classification & Prediction:

After being trained, the model can identify stress levels in real time:

- Input Image → Passes through the trained model.
- Prediction → Model returns stress level (e.g., "High Stress," "Low Stress," "No Stress").
- Visualization → Show results on a GUI with confidence scores.

5. Deployment & User Interaction:

In order to make the project accessible, deploy it in an accessible manner:

- GUI Creation (Optional) – Implement with Tk inter or web-based UI (Flask/Django).
- Webcam Integration – Record actual facial expressions.
- Real-time Alerts – Provide the user with feedback on their stress level.

Summary: It captures and pre-processes face images, and trains a CNN model to forecast stress levels. Post-training, it forecasts stress levels in real-time and displays output via a GUI with webcam support. The system can be supplemented with physiological information like heart rate for enhanced accuracy.

7.ADVANTAGES

1. Early Stress Detection:

- Detects the level of stress early in order to enable early intervention.
- Prevents chronic health ailments such as depression, anxiety, and cardiovascular diseases.

2. Automated & Objective Analysis:

- Removes human bias and gives consistent stress level measurements.
- Ensures accuracy by reducing situational and emotional bias when measuring stress.

3. Real-Time Monitoring:

- Uses a webcam to analyze stress levels instantly without delays.

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- Facilitates continuous monitoring and provides real-time feedback for stress management.

4. Custom Dataset for Increased Accuracy:

- Increases model stability by training from actual, self-gathered data.
- Ensuresthe system is flexible to accommodate various populations and weather conditions.

5. User-Friendly Interface:

- An intuitive-to-use GUI allows for comfortable use, ensuring it is user-friendly for everybody**.**
- Reduces the learning curve, thereby being suitable for both technical and non-technical users**.**

6. No Expensive Wearables Needed:

- Only compatible with a camera, without the financial burden of smartwatches or biometric sensors.
- Makes stress detection easy and available for more people.

7. Scalable & Flexible:

- Can be extended to handle various inputs like heart rate, voice or EEG signals.

8. Positive for Mental Health Awareness:

- Raises awareness of stress levels and encourages self-care.

9. Helpful in Wide-Ranging Industries:

- Can be used in the workplace, schools, healthcare, and health and wellness apps.
- Style modification and stress management. Improves productivity, psychological health, and performance in various settings.

8. LIMITATIONS

1. Depends on Facial Expressions:

- The system is based purely on facial expressions, which do not always represent stress levels and can result in misclassification.
- People manifest stress in different ways, and some of them do not show facial manifestations of stress.

2. Lack of Integration of Physiological Data:

- The system does not consider biometric indicators like heart rate or cortisol, which are great indicators of stress.
- Internal tension that is not manifested on the face cannot be measured, lowering overall accuracy.

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3. Difficulty in Distinguishing Similar Emotions:

- The model can be confused between stress and feelings such as anger, fatigue, or intense focus and provide false positives.
- Emotional expressions differ in cultures, and it is therefore difficult to design a cross-cultural stress detection system.

4. Impact of Externally Provided Facts on Accuracy:

- Poor lighting, image quality, and camera angle can hinder the system from recognizing facial features to some extent.
- Obstructions like glasses, face masks, or facial hair may obstruct stress analysis.

5. Large computational demands:

- Real-time stress detection is highly resource-intensive, and low-end phones do not have this.
- Executing deep learning applications on big data is time consuming and requires hardware.

6. Privacy and Ethical Issues:

- Capturing facial information is a privacy issue for user consent and data security.
- Storage or transmission of this kind of sensitive personal information can cause abuse or ethical concerns.

7. Limited Generalizability Across Multiple Populations:

- The model may not perform equally well for other races, gender, or ages due to dataset bias. One trained on one set of individuals might not be correct for another unless retrained.

8. Challenges in Real-World Deployment:

- Real-world stress detection (e.g. in offices, public areas) can be challenging due to distractions and more than one face in the line of sight.
- Continuous monitoring might be burdensome or provoke resistance from the users, making effective adoption impractical.

9. FUTURE WORK

The horizon for the stress detection system is vast, with ample scope for improvement and real-world applications. One of the major improvements would be adding physiological data such as heart rate, blood pressure, and voice analysis to improve accuracy over facial expressions. Machine learning and deep learning algorithms can be improved to differentiate better between stress and other related emotions such as anger or fatigue. Adding more data to cover different

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age groups, ethnicities, and cultural expressions will enhance the system's generalizability and reliability. The system can also be integrated into wearable devices or smartphones, allowing users to monitor their stress levels in real-time. The system can be extended to workplaces, hospitals, and schools to facilitate effective stress management. Another promising area is combining stress detection with recommendations, where the system would suggest relaxation techniques, meditation, or lifestyle modifications based on stress levels. Improved privacy controls and secure data processing will be essential for ethical deployment, building user confidence. As IoT technologies advance, this project has the potential to make a significant contribution to mental health monitoring, productivity gain, and overall well-being management, making stress detection more practical and effective in everyday life.

10. CONCLUSION

Detecting stress among IT professionals based on image processing and machine learning offers a stealthy, real-time assessment of mental well-being. The process can utilize face expressions and physiology signals for monitoring stress levels and assist organizations to take proactive approaches towards enhancing workplace health and output. Existing systems have encouraging performances but variability of facial expressions, real-time execution, and maintaining privacy are concerns that require a deeper study. Future developments through multimodal fusion of data, adaptive frameworks, and deployment in the workplace can improve efficiency and usability. Deployment of a system such as this in business organizations can ensure healthier workplaces, less burnout, and enhanced overall efficiency. The capability to monitor facial expressions and physiological patterns allows for early stress identification, enabling timely intervention. By using this technology, organizations can establish a more productive and healthier work environment by addressing stress-related issues before they become severe. Moreover, automated stress monitoring systems can also help in minimizing burnout, improving mental health care, and enhancing work-life balance. With future developments, solutions for detecting stress can be easily incorporated into corporate wellness programs, advocating for an employee-centered and sustainable workspace.

11. OUTPUT SCREENS

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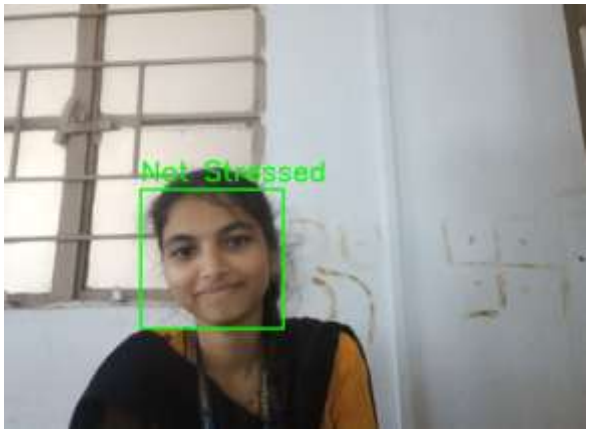

12. SYSTEM REQUIREMENTS

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1. Hardware Specifications

- **Processor:**Intel Core i5 or better (or AMD equivalent) for optimal model training and run.
- **RAM:**8GB minimum (16GB for deep learning tasks).
- **Storage:**A minimum of 20GB free space (for storing datasets and model files)
- GPU (Optional but Recommended).
- **Webcam:**Needed for real-time stress detection.

2. Software Requirements:

- **Operating System:**Windows 10/11, macOS, or Linux (Ubuntu for development recommended).
- **Programming Language:**Python version 3.7 or higher.
- **Deep Learning Frameworks:**TensorFlow or Keras for model building and deployment.
- **Libraries & Dependencies:**OpenCV (image processing), NumPy, Pandas, Matplotlib, Scikit-learn.
- **IDE (Integrated Development Environment):** Jupyter Notebook, PyCharm, or VS Code.

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