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Stress Detection And Remediation In IT Employees Using Machine Learning

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Abstract:

Stress disorders are a common issue among working IT professionals in the industry today. With changing lifestyle and work cultures, there is an increase in the risk of stress among the employees. Though many industries and corporations provide mental health related schemes and try to ease the workplace atmosphere, the issue is far from control. In this paper, we would like to apply machine learning techniques to analyze stress patterns in working adults and to narrow down the factors that strongly determine the stress levels. A questionnaire is one of the most used methods for detecting stress. This technique relies primarily on the individual's responses. In this technique we can leverage use of the word cloud. The dataset contains text messages or documents that are labeled as either stressed or non stressed. Automatically detecting stress can lower the likelihood of the stress problems and improve society's well being. Image capturing is automated so it collects photographs whenever a typical behavior occurs. With the help of facial emotion recognition we can analyze the stress. However we consider the stress detection as a "Problem Detection" but our goal is to furnish the "Solution for the Problem " as well. Proposed system is capable of detecting stress and providing remediation.

Keywords:

Stress management, Machine learning, Stress detection, Mental health, Socio-economic impact,World Health Organization (WHO), Automated image capturing, Behavioral indicators , Individualized therapy, Well-being, Problem detection, Subjective responses, Health issues.

Introduction:

In contemporary times, the IT industry stands at the forefront, setting new standards in the market through the introduction of innovative technologies and products. However, alongside these advancements, employee stress levels have emerged as a significant concern. Despite the availability of mental health benefits in many companies, the issue remains largely unaddressed. This study endeavors to delve deeper into this topic by examining stress patterns among workingemployees in various businesses.

Stress is widely acknowledged as a significant contributor to physical ailments, with cautious estimations

attributing 50-80% of all illnesses to stress. Medical literature often identifies stress as a leading cause of cardiovascular disease, with links to various other health conditions including diabetes, ulcers, asthma, migraine headaches, skin problems, epilepsy, and sexual dysfunction. Many of these disorders are deemed psychosomatic, meaning they are induced or exacerbated by mental factors such as stress.

The impacts of stress can manifest in various ways, encompassing subjective, behavioral, and cognitive dimensions. Subjective symptoms may include feelings of guilt, humiliation, anxiety, anger, and frustration, as well as physical sensations like fatigue, tenseness, nervousness, irritability, moodiness, or loneliness. Behavioral impacts may be observable through increased accidents, drug usage, and alcohol consumption. Additionally, cognitive effects of stress may lead to a decline in mental ability, impaired judgment, impulsive decisions, forgetfulness, and hypersensitivity to criticism.

A proactive approach to stress detection and management holds immense potential for timely intervention and tailored support. Stress prediction not only facilitates early detection and personalized intervention in healthcare settings but also has implications for optimizing work environments in occupational settings. Furthermore, it can inform public health initiatives and policy decisions, ultimately contributing to the improvement of well-being and resilience in individuals and communities alike.

Literature Survey:

1. Stress Detection with Machine Learning, Aman Kharwal, 20th December, 2021.
   The authors would like to apply machine learning techniques to analyze stress patterns in working adults and to narrow down the factors that strongly determine the stress levels. Towards this, data from the Kaggle stress was considered. Various Machine Learning techniques were applied to train our model after due data cleaning and preprocessing. Theaccuracy of the above models was obtained and studied comparatively. Model building isperformed by the Bernoulli Naive Bayes algorithm, which is one of the best algorithms for binary classification problems like if there is “Stress” or “No Stress” by taking help ofWord Cloud technique.

2. Machine Learning Unlocks Insights For Stress Detection, Kajal Kumari, 12 Jul, 2023. The authors aim to utilize machine learning methodologies to examine stress patterns among employed adults and identify the key factors influencing stress levels. To achieve this objective, data from the Kaggle stress dataset was utilized following thorough data cleaning and preprocessing. Several machine learning techniques were employed to train the model, and their respective accuracies were compared. Model construction was carried out using the natural language processing toolkit, recognized as one of the top algorithms for addressing binary classification problems such as distinguishing between "Stress" and "No Stress" states.

3. IT Professionals Stress Detection By Image Processing Using Deep Learning, A.PriyaDharshini , Mrs.P.Jasmine Lois Ebenazer , Mrs.S.CyciliyaPearlineChristy and Mrs.S.Cephas Department of Computer Applications, Sarah Tucker College, Thirunelveli-7. To classify stress, machine learning algorithms such as KNN classifiers are used. The employee's image is snapped by the camera, which serves as input, and image processing is used at the initial step for detection. Image processing is used to improve an image or extract relevant information from it by converting the image to digital form and executing operations on it. By taking an image from video frames as input, and producing an image or attributes related to the image as output. The threephases that make up image processing.

4. Stress Detection Using Facial Expression, Narayan Dev Gambhir ,Department of Computer Science & Information Technology, Meerut Institute Of Engineering & Technology. This project employs deep learning to detect and interpret facial expressions, aiding in understanding users' sentiments like stress or enjoyment. Applications range from customer service to healthcare, where it can discern emotions for tailored responses and pain detection in non-verbal patients. It's also beneficial for social media stress detection and enhancing virtual reality experiences with lifelike animated characters mimicking real expressions.

5. Stress Detection Using Machine Learning and Image Processing Mahesh Kanthale, PCET's Nutan Maharashtra Institute Of Engineering And Technology, Institute Of Technology In Talegaon Dabhade, Pune, Maharashtra, India. The rise of social media platforms has provided a rich dataset for identifying common traits among depressed individuals, facilitating the use of machine learning algorithms for detection. Accurate classification of depression levels is crucial for determining appropriate interventions, particularly for individuals with suicidal thoughts. Machine learning, integrated into medical practice, offers enhanced diagnostic capabilities, improving precision and efficiency in mental health assessments. The Artificial Intelligence Mental Evaluation (AiME) framework combines human-computer interaction and deep learning to predict depression levels with satisfactory accuracy. Its user-friendly interface enables mental health professionals to swiftly identify symptoms and intervene preventatively. AiME's integration may mitigate challenges in interpreting subtle biomarkers of depression, offering a more objective assessment. This seminar serves to elucidate the efficacy of machine learning in depression analysis, highlighting its potential to revolutionize mental health diagnostics and intervention strategies.

6. Hybrid Algorithm Based on Content and Collaborative Filtering in Recommendation System Optimization and Simulation, Lianhuan Li. This paper examines recommendation technologies such as content filtering and user collaborative filtering, proposing a hybrid algorithm that combines both approaches. By leveraging content filtering's advantages and performing similarity matching for all items, even those not yet evaluated by users, early-level issues are avoided. Additionally, the method utilizes collaborative filtering's strengths, reducing matrix sparsity and enhancing accuracy with dense user rating data. Through integration, system performance is greatly enhanced. The proposed hybrid algorithm builds a user feature rating matrix by combining user ratings with item features, addressing data sparsity issues. It effectively tackles the "cold start" problem for new projects by predicting user interests based on project and user characteristics, enhancing recommendation quality and addressing speed bottleneck issues in data sparsity, cold start, and online recommendation.

Methodology:

1. Stress detection from personal responses , opinions.
2. Stress detection using image processing.
3. Stress remediation solutions.

1. **Stress detection from personal responses & opinions:Machine Learning Techniques Used:**

1.A. : Exploratory Data Analysis(EDA)

Exploratory Data Analysis (EDA) is a crucial step in understanding and analyzing a dataset. It involves

visually exploring and summarizing the main characteristics, patterns, and relationships within the data. The Matplotlib and Seaborn libraries create a count plot for the "stress" dataset. It visualizes the count of stress instances across different subreddits, with the stress labels differentiated by different colors.

```
plt.figure(figsize=(20,12)) plt.title('Subreddit wise stress count')plt.xlabel('Subreddit')
sns.countplot(data=stress,x='subreddit',hue='label',palette='gist_heat') plt.show()
```

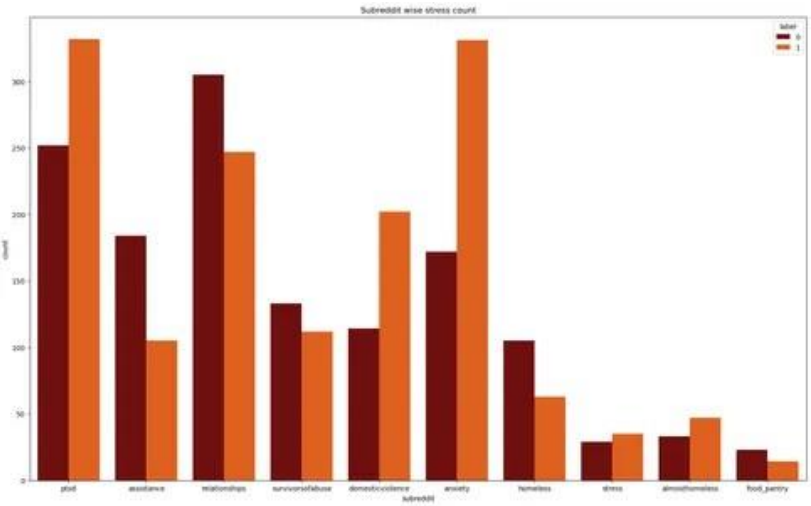


Figure.1: Stress Levels

1.B. : Text Preprocessing

Text preprocessing refers to the process of converting raw text data into a more clean and structured format that is suitable for analysis or modeling tasks. It specially involves a Series of steps to remove noise, normalize text, and extract relevant features. Here I added all libraries related to this text processing.

1.C. : Text Cleaning

- Removing special characters: Remove punctuation, symbols, or non-alphanumeric characters that do not contribute to the meaning of the text.Removing numbers: Remove numerical digits if they are not relevant to the analysis.
- Lowercasing: Convert all text to lowercase to ensure consistency in text matching and analysis.
- Removing stop words: Remove common words that do not carry much information, such as "a", "the", "is", etc.

1.D. : Tokenization

Splitting text into words or tokens: Split the text into individual words or tokens to prepare for further analysis. Researchers can achieve this by employing whitespace or more advanced tokenization techniques, such as utilizing libraries like NLTK or spaCy.

1.E. : Normalization

- Lemmatization: Reduce words to their base or dictionary form (lemmas). Forexample, converting "running" and "ran" to "run".
- Stemming: Reduce words to their base form by removing prefixes or suffixes. Forexample, converting "running" and "ran" to "run".
- Removing diacritics: Remove accents or other diacritical marks from characters.

1.F.: Machine Learning Model Building

Machine learning model building is the process of creating a mathematical representation or model that can learn patterns and make predictions or decisions from data. It involves training a model using a labeled dataset and then using that model to make predictions on new, unseen data.Selecting or creating relevant features from the available data. Feature engineering aims to extract meaningful information from the raw data that can help the model learn patterns effectively.

1.G. : Model Evaluation

Model evaluation is a crucial step in machine learning to assess the performance and effectiveness of a trained model. It involves measuring how well the multiple models generalizes to unseen data and whether it meets the desired objectives. Evaluate the trained model's performance on the testing data. Calculate evaluation metrics such as accuracy, precision, recall, and F1-score to assess the model's effectiveness in stress detection. Model evaluation provides insights into the model's strengths, weaknesses, andits suitability for the intended task.

1.H. : Model Performance Comparison

This is a crucial step in machine learning to identify the best-performing model for a given task. When comparing models, it is important to have a clear objective in mind. Whether it is maximizing accuracy, optimizing for speed, or prioritizing interpretability, the evaluation metrics and techniques should align with the specific objective. Consistency is key in model performance comparison. Using consistent evaluation metrics across all models ensures a fair and meaningful comparison. It is also important to split the data into training, validation, and test sets consistently across all models. By ensuring that the models evaluate on the same data subsets, researchers enable a fair comparison of their performance. Considering these above factors, researchers can conduct a comprehensive and fair model performance comparison, which will lead to informed decisions regarding model selection for the specific problem at hand.

```
# Creating tabular format for better comparisontbl=pd.DataFrame()
tbl['Model']=pd.Series(['Logistic Regreesion','Multinomial NB', 'Decision Tree','KNN','Random
        Forest','Adaptive Boosting'])
tbl['Accuracy']=pd.Series([acc_lr_tf,acc_nb_tf,acc_dt_tf,acc_knn_tf,acc_rf_tf,acc_ab_tf])
tbl['F1_Score']=pd.Series([f1_lr_tf,f1_nb_tf,f1_dt_tf,f1_knn_tf,f1_rf_tf,f1_ab_tf])
tbl.set_index('Model')
# Best model on the basis of F1 Score tbl.sort_values('F1_Score',ascending=False)
```

	Model	Accuracy	F1_Score
0	Logistic Regreesion	0.733568	0.733494
4	Random Forest	0.714789	0.712023
1	Multinomial NB	0.706573	0.688416
3	KNN	0.683099	0.680416
5	Adaptive Boosting	0.637324	0.637836
2	Decision Tree	0.607981	0.608361

Figure.2: Model Comparisons

2. Stress detection using image processing:

The CNN model in the project is built on the LeNet Architecture and extracts a collection of facial motions and classifies facial emotions. and the Kaggle facial expression (FER2013) dataset, which has seven different human facial expression classes namely: happy, disgust, surprise, sad, afraid, rage, and neutral. Convolution Neural Network is used to create a human facial expression recognition system . The project's CNN model isbased on the LeNet Architecture [17][18]

In this project firstly we designed our own convocation neural network and after that dataset is used to train our neural network model.Machine learning allows computers to function without being explicitly programmed. Computers are taught skills such as computer vision, language processing, pattern recognition, and so on. We leverage face emotion detection skills in this project by programming it to identify particular user emotions through picture or live video processing. After execution of code for training purposes , input data is then divided into a couple of directories. The first directory will have all of the photos, while the second will hold all of the information on the various sorts of emotions [19][20][21]. The Image Processing methodology used to acquire an improved image and extract useful information. It is a very effective way for turning a photograph into digital form and then performing various operations on it. This is a signal processing method in which the input is a 2D image with values ranging from 0 to 255 signifying the corresponding pixel value Preprocessing is a key phase that includes numerous strategies such as scaled and cropped pictures to save training time, and pixel variations to boost image diversity and eliminate over-fitting. Training of the model comprises many CNN filter layers and also Max Pooling layers, as well as pre-processing stages. The images undergoes pre-processing here, and after being filtered and pooled via multiple rounds, the model becomes trained. The model is trained to identify different expressions in the frontal face .Face is a non rigid object and it is difficult to extract its features. Model is trained in such a way which calculates different features of the nose, lips, and eyes of different persons. From the live feed or previously stored data, pictures were captured in OpenCV. The photos are then transformed to grayscale 48x48 images. The grayscale image is then compared to the trained model . To detect the user's faces, this module uses the HaarCascade classifier.Many EMOTIONS THAT MAY BE DETECTED FROM a Picture [22][23]. Angry , Disgusted , Fearful ,neutral , Happy ,Sad,Surprised.

CNN: Convolutional neural networks are made up of a number of layers which include an input layer, several hidden layers and output layer, of artificial neurons to learn complex and difficult patterns [24][25][26]. CNN is used for analyzing visual imagery. It has a specialized method called convolution based on mathematical operation which involves the combination of two functions. Third function is produced by the two functions. A typical neural network has numerous layers. Every layer consists of neurons that are connected with neurons in the layer before it, and every neuron contains its own weight. The two layers namely convolutional and pooling layers are two types of layers present in CNN. However, similar with other neural networks, A ReLU stands for rectified linear unit layer, and will also be present. as well as a completely linked layer.The ReLU layer functions as a function of activation. guaranteeing adequate nonlinearity as data goes across each tier in the network.. The Pooling layer is in charge of reducing the overall measurement of the Convolved Pattern. The computer power needed for processing the data is lowered when the size is reduced. Pooling is classified into two types: average pooling and maximal pooling. Convolutional neural networks operate differently because they deal with spatial data. Instead of being coupled to every neuron in the previous layer, Neurons present in this layer are exclusively coupled to nearby neurons and possess the same weight. The filtering mechanism that happens in this type of network is known as convolutional DATASET The dataset used in this project is taken from kaggle named FER-2013. This data set having the 48 into 48 picture element grayscale frontal facial images of the human faces and it contains the different seven categories of emotions like anger or rage, disgust, afraid or fear, happy, surprise, sad, and neutral so in this data set we have around

28709 grayscale photos for the trainingphase and in the test phase we have around 3589 images.

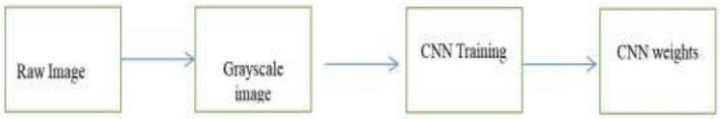


Fig. 3. Training phase

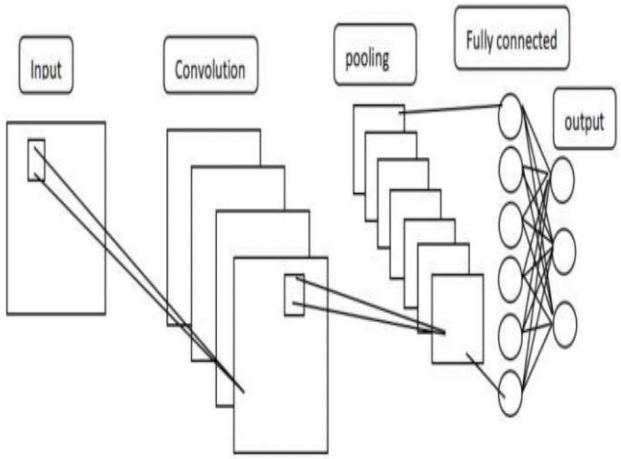


Fig. 4 Architecture of CNN

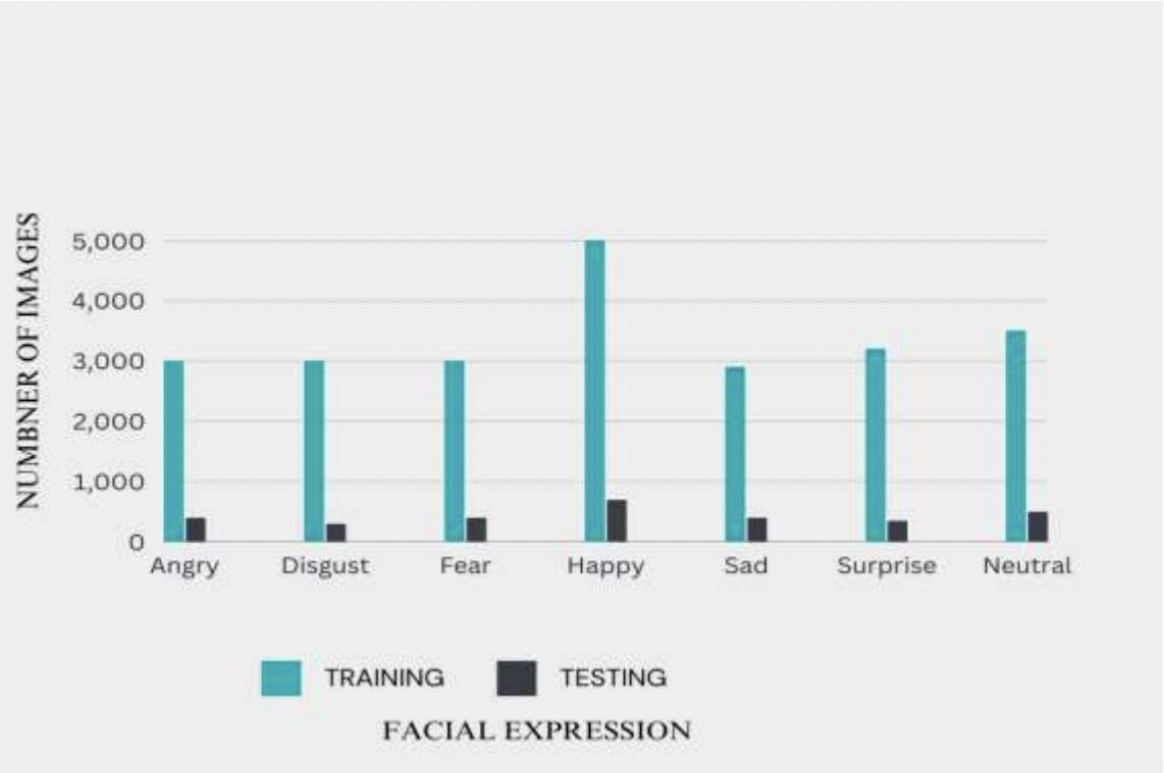


Fig. 5. Training and testing data validation

In this study, we effectively display a person's diverse emotions by his shifting facial expressions and can determine the tension on his face from his expressions. We can use our classifier to live videos or streams. First create a virtual environment and it possesses its own dependencies. To recognise frontal faces in a video frame, a haar cascade classifier is utilised. This model may be utilised for existing videos or that have a livefeed from a web camera. Below are some live feed results of our model [27].

3. Stress remediation solutions:

Prediction table	Anger	Disgust	Fear	Happy	Sad	Surprise	Neutral
Anger	0.41612	0.020769	0.108774	0.068099	0.108729	0.048339	0.13193
Disgust	0.04618	0.92238	0	0	0	0	0
Fear	0.16236	0.00924	0.393142	0.054571	0.122122	0.107844	0.173548
Happy	0.11865	0.006703	0.090508	0.678665	0.080498	0.043549	0.155164
Sad	0.17135	0.008063	0.150811	0.067099	0.378353	0.043739	0.194234
Surprise	0.04686	0.005042	0.095785	0.035938	0.026949	0.615265	0.048574
Neutral	0.14054	0.005042	0.11422	0.089062	0.137814	0.052364	0.496136

Fig. 6. Matrix for facial expression recognition

Recommender systems, also known as recommendation systems, are machine learning algorithms that use data to recommend items or content to users based on their preferences, past behavior, or their combination. These systems can recommend various items, such as movies, books, music, products, etc. Different approaches to building recommender systems include collaborative filtering, content-based filtering, demographic-based filtering, utility-based filtering, knowledge-based filtering, and hybrid approaches. The ultimate goal of recommender systems is to help users find items they will likely enjoy and increase user engagement with the application or platform.

Making recommendations involves two main stages:

- Candidate generation—creating a subset of products the user might be interested in.
- Scoring—reducing and sorting a candidate list.

Large enterprises such as Google, Instagram, Spotify, Amazon, Reddit, and Netflix frequently employ them to boost engagement with their platform and users. By collecting user data, Amazon utilizes recommendations to propose products to diverse users. For instance, Spotify suggests songs similar to the ones you've often played or liked to keep you using their service to stream music.

A cutting-edge video recommendation system harnessing the power of machine learning serves as a pivotal tool in addressing employee well-being. The system is meticulously designed to detect signs of stress among employees by analyzing their behavioral patterns and interactions with video content. Upon detecting stress indicators, the system promptly initiates a data gathering process to ascertain the employee's hobbies and interests. Leveraging this information, relevant keywords are extracted and fed into the YouTube API, which intelligently retrieves videos tailored to the individual's preferences. These curated recommendations serve as a therapeutic outlet, offering a diverse array of content designed to alleviate stress and promote relaxation. By seamlessly integrating data-driven insights with personalized recommendations, this innovative system not only mitigates employee stress but fosters a culture of well-being within the organization.

To achieve the objectives outlined, a hybrid recommendation system would be a suitable choice. A hybrid recommendation system combines multiple recommendation techniques to provide more accurate and diverse recommendations. In this case, a hybrid system could integrate content-based filtering and collaborative filtering methods.

1. **Content-Based Filtering**: This approach recommends items (videos in this case) based on the characteristics of the items themselves and the user's preferences. By analyzing the content of the videos and extracting relevant features such as keywords, genres, or themes, the system can match them with the user's interests and hobbies. This method would be used to generate initial recommendations based on the employee's hobbies.
2. **Collaborative Filtering**: Collaborative filtering recommends items based on the preferences of users with similar tastes. In this context, it could analyze the viewing behavior of other users who share similar hobby interests with the stressed employee. By identifying patterns in their viewing history and preferences, the system can suggest videos that are likely to appeal to the stressed employee.

Integrating both approaches would provide a more comprehensive and personalized recommendation experience for the employee. Additionally, the system could continuously learn from user feedback and behavior to improve the accuracy of recommendations over time. By leveraging a hybrid recommendation system, the organization can effectively address employee stress while enhancing user satisfaction and engagement with the platform. The model architecture involves learning embeddings for videos in a vocabulary and feeding them into a neural network, akin to a continuous bag of word language models. These embeddings convert sparse video IDs into dense vectors representing a user's watch history, with averaging performing the best among various methods. The network consists of dense layers with ReLU activation, learning embeddingsalongside other parameters through gradient descent.

YouTube's recommendation system employs two neural networks for candidate generation and ranking. The candidate generation network selects a subset of videos from a large corpus based on user activity, using collaborative filtering for personalization. The ranking network assigns scores to videos using various characteristics, presenting the highest-scoring ones to users. This two-stage approach balances personalization with scalability.

Cosine similarity:
measures the similarity between vectors in a multidimensional space, commonly used in text analysis and document similarity assessment.

$$similarity(x,y) = cos() = x \cdot y / ||x|| * ||y||$$

Output: Research opportunities exist to improve recommender systems by addressing challenges like latency, cold-start, and sparsity. Design principles include demographic filtering, contextual recommendation based on user information, and maintaining separate recommendation lists for short-term and long-term preferences. Filtering out obsolete items and recommending newer onescan enhance system effectiveness.

Working of Model:

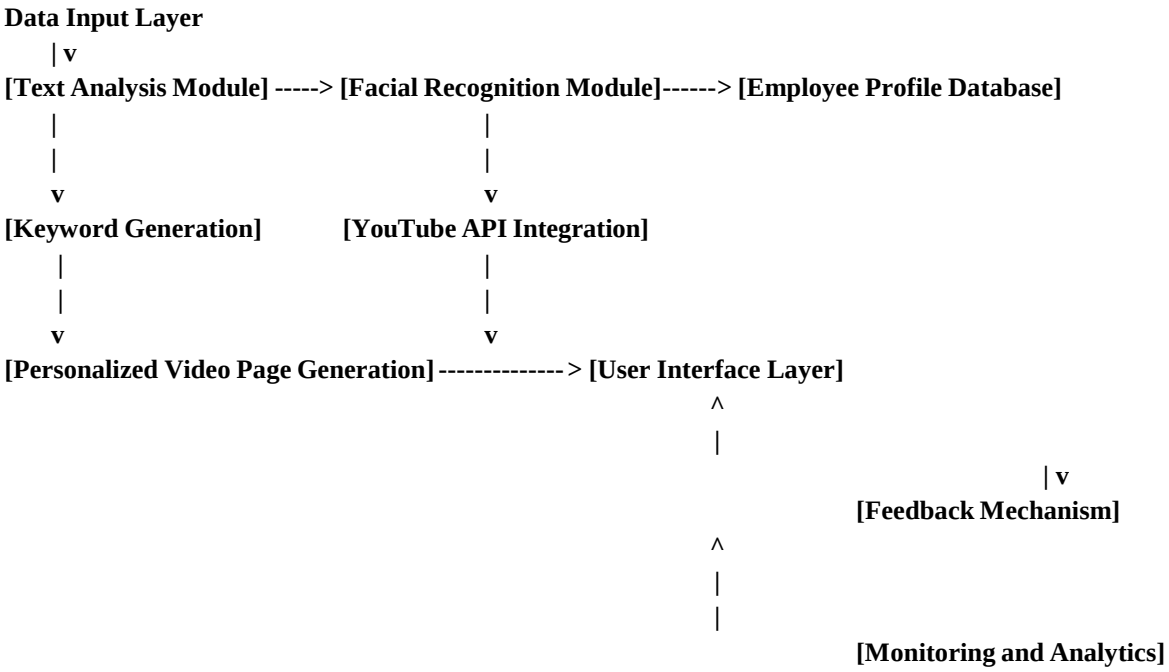
The model operates through a multi-step process to detect and alleviate stress in employees. Firstly, it employs text analysis techniques, such as generating a word cloud, to discern stress-indicative language from comments or messages shared by the employee. Concurrently, facial recognition technology is utilized to analyze the employee's facial expressions for signs of stress. If stress is identified through either of these methods, the model proceeds to the next step.

It retrieves the employee's hobbies or interests from their profile or designated database. These hobbies serve as valuable indicators of what content may be engaging and enjoyable for the individual. Leveraging this information, the model generates relevant keywords derived from theemployee's hobbies.

These keywords are then employed to suggest suitable YouTube videos aimed at stress relief and relaxation. The model curates a personalized video page featuring content aligned with the employee's interests and designed to promote relaxation and well-being.

Finally, the employee is directed to this customized video page, where they can access a selection of videos tailored to their preferences. By providing personalized recommendations based on both textual cues and facial expressions, the model offers a comprehensive approach to addressing stress in the workplace, promoting employee well-being and productivity.

Architecture of System:



ACKNOWLEDGMENT:

I extend my heartfelt gratitude to all those who contributed to this project's success. Special thanks to the team members for their dedication and hard work. I am grateful for the support and guidance provided by our mentor Dr. A.A. Khatri, Department of Artificial Intelligence and Data Science and advisors throughout this endeavor. Additionally, I appreciate the participants whose feedback and input were invaluable in refining our model. Lastly, I acknowledge the support of our college for fostering an environment conducive to innovation and collaboration.

RESULTS:

```
y
         subreddit post_id sentence_range  ... social_num_comments  syntax_fk_grade  sentiment
0             ptsd  8601tu      (15, 20)  ...                   1         3.253573  -0.002742
1       assistance  8lbrx9        (0, 5)  ...                   2         8.828316   0.292857
2             ptsd  9ch1zh      (15, 20)  ...                   0         7.841667   0.011894
3    relationships  7rorpp       [5, 10]  ...                   5         4.104027   0.141671
4  survivorsofabuse  9p2gbc        [0, 5]  ...                   1         7.910952  -0.204167

[5 rows x 116 columns]
```

```
subreddit                0
post_id                  0
sentence_range           0
text                     0
id                       0
                        ..
lex_dal_avg_pleasantness 0
social_upvote_ratio      0
social_num_comments      0
syntax_fk_grade          0
sentiment                0
```

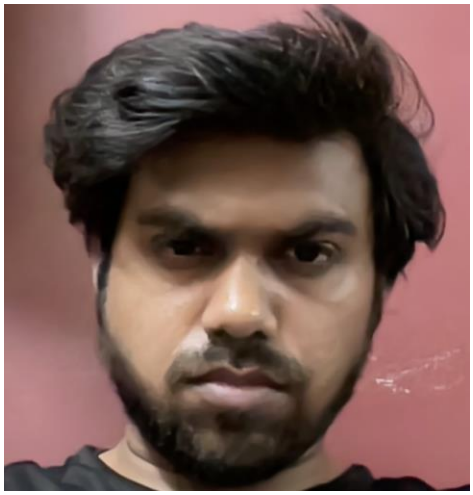
```
                                                text      label
0  said felt way sugget go rest trigger ahead you...     Stress
1  hey rassist sure right place post goe  im curr...  No Stress
2  mom hit newspap shock would know dont like pla...     Stress
3  met new boyfriend amaz kind sweet good student...     Stress
4  octob domest violenc awar month domest violenc...     Stress
```

```
Enter a Text: People need to take care of their mental health
['No Stress']
```

```
Enter a Text: Sometime I feel like I need some help
['Stress']
```

Surprised

Happy



Sad

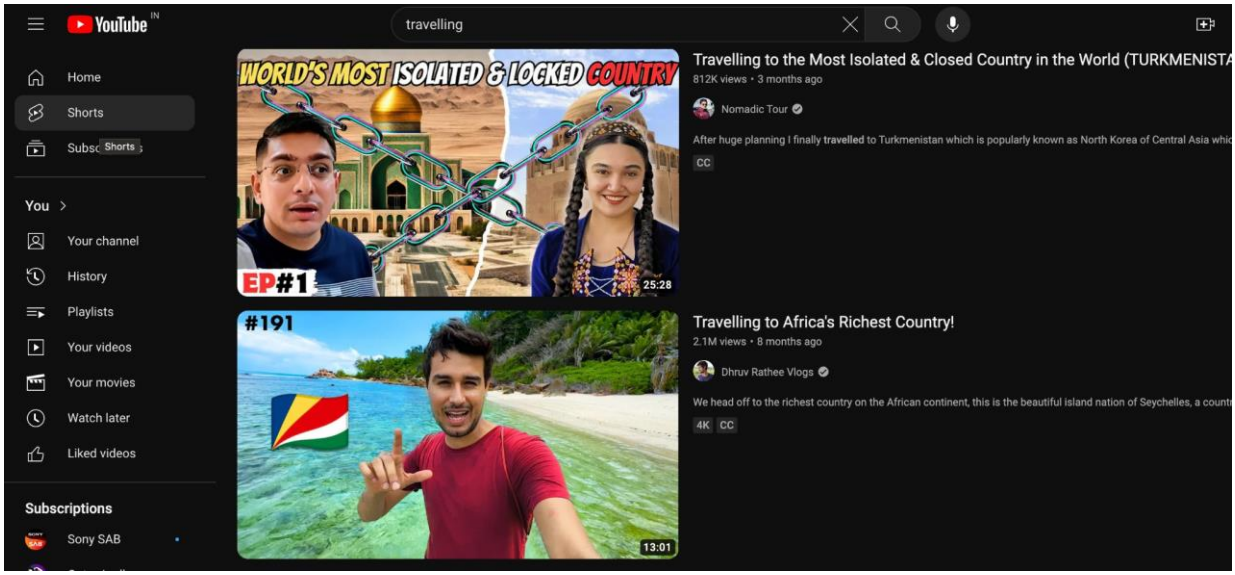
Normal

```
employee_data = {
    'Employee_ID': [1, 2, 3],
    'Hobbies': ['cooking, hiking', 'gaming, reading', 'painting, gardening'],
    'Preferred_Videos': ['cooking tutorials, hiking trails', 'gaming walkthroughs, book reviews', 'painting tutorials, gardening tips']
(variable) employee_df: DataFrame
        return employee_df.iloc[employee_indices]['Preferred_Videos']

    # Example usage
    employee_id = 1
    recommended_videos = recommend_videos(employee_id)
    print("Recommended videos for Employee {}: ")
    print(recommended_videos)

PROBLEMS 3  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

apurvpatil@Apurvs-MacBook-Pro ~ % {
  "EmployeeId": "1",
  "Response" : "Sometimes I feel like I need some help"
       "[Stress]"$    Fetching Hobbies:       1. Cooking      2. Travelling   redirecting youtube API:}
```



CONCLUSION:

The application of machine learning techniques in predicting stress levels provides personalized insights for mental well-being. By analyzing a variety of factors such as numerical measurements (blood pressure, heart- rate) and categorical characteristics (eg,gender, occupation), machine learning models can learn patterns and make predictions onan individual stress level. With the ability to accurately detect and monitor stress levels, machine learning contributes to the development of proactive strategies and interventionsto manage and enhance mental well-being.

We explored the insights from using machine learning in stress prediction and itspotential to revolutionize our approach to addressing this critical issue.

- Accurate Predictions: Machine learning algorithms analyze vast amounts of historical data to accurately predict stress occurrences, providing valuable insights and forecasts.
- Early Detection: Machine learning can detect warning signs early on, allowing for proactive measures and timely support in vulnerable areas.
- Enhanced Planning and Resource Allocation: Machine learning enables forecasting of stree hotspots and intensities, optimizing the allocation of resources such as emergency services and medical facilities.
- Improved Public Safety: Timely alerts and warnings issued through machine learning predictions empower individuals to take necessary precautions, reducingthe impact of stree and enhancing public safety.

In conclusion, this stress prediction analysis provides valuable insights into stress levels and their prediction using machine learning. Use the findings to develop tools and interventions for stress management, promoting overall well-being and improved quality of life.

FUTURE SCOPE OF WORK:

1. Integrate the stress detection model with webcams and surveillance cameras.
2. Implement systems with other public places or private spaces with cameras.
3. Conduct surveys in particular residential areas for better reach.
4. Load end user hobbies and extra curricular activities for improved suggestions.

REFERENCES:

1. OSMI Mental Health in Tech Survey Dataset, 2017 from Kaggle.
2. Stress Detection with Machine Learning, Aman Kharwal, December 20, 2021.
3. Emotion_recognition using CNN MOAAZ HAMMAD , 2022.
4. Machine Learning Unlocks Insights For Stress Detection , Kajal Kumari , 12 Jul 2023.
5. Machine Learning Techniques for Stress Prediction in Working Employees , ADITYA VIVEK THOTA , B.Tech., ECE,National Institute of Technology, Trichy.
6. Machine Learning Approaches to Automatic Stress Detection: A Review , Sami Elzeiny College of Science and Engineering Hamad Bin Khalifa University Doha, Qatar.
7. Stress Detection with Machine Learning and Deep Learning using Multimodal Physiological Data ,Pramod Bobade , Department of Computer Science and Engineering National Institute of Technology, Karnataka Surathkal, India.
8. Hybrid Algorithm Based on Content and Collaborative Filtering in Recommendation System Optimization and Simulation ,Lianhuan Li , Zheng Zhang , and Shaoda Zhang**,** School of International Education, Nanyang Medical College, Nanyang, Henan 473000, China.
9. HUMAN STRESS DETECTION USING DEEP LEARNING, A. Phani Sridhar , Aditya Engineering College, CSE, Surampalem.
10. Video Recommender System using textual data: Its Application on LMS and Serendipity Evaluation , Natthanun Chantanurak, Proadpran Punyabukkana, Atiwong Suchato Department of Computer Engineering Faculty of Engineering, Chulalongkorn University Phayathai Road, Pathumwan Bangkok, Thailand.
11. Stress detection methods in Social networks: A Comparative study , P.Iswarya, D.Maheswari, R.Rajeswari, Assistant Professor, Dept. of. CT, Dr.N.G.P Arts and Science College, Coimbatore, TamilNadu.
12. STRESS DETECTION USING MACHINE LEARNING , Prof. Rohini Hanchate1, Harshal Narute2, Siddharam Shavage3, Karan Tiwari4 , 1Prof. Rohini hanchate, Dept. of Computer Engineering, NMIET, Maharashtra, India.
13. Youtube Recommendation System **,** Anirudh Kamat , Ashish Sharma , Jyoti Mudkanna, 14-06-2022.
14. YouTube Video Recommendation System using Machine Learning , (https://pythongeeks.org/youtube-video-recommendation/).
15. STRESS DETECTION USING MACHINE LEARNING AND IMAGE PROCESSING, Mahesh Kanthale, Akshata Shendkar, Payal Kadadhekar, Siddheshwari Rao,Prof. Dheeraj Patil, PCET's Nutan Maharashtra Institute Of Engineering And Technology, Institute Of Technology In Talegaon Dabhade, Pune, Maharashtra, India.

16. STRESS DETECTION USING FACIAL EXPRESSION, Narayan Dev Gambhir ,Department of Computer Science & Information Technology, Meerut Institute OfEngineering & Technology.

17. Faiz, Mohammad, et al. "IMPROVED HOMOMORPHIC ENCRYPTION FOR SECURITY IN CLOUD USING PARTICLE SWARM OPTIMIZATION." Journal of Pharmaceutical Negative Results (2022): 4761-4771. [18] Narayan, Vipul, A. K. Daniel, and Pooja Chaturvedi. "E-FEERP: Enhanced Fuzzy based Energy Efficient Routing Protocol for Wireless Sensor Network." Wireless Personal Communications (2023): 1- 28.

18. Narayan, Vipul, A. K. Daniel, and Pooja Chaturvedi. "E-FEERP: Enhanced Fuzzy based Energy Efficient Routing Protocol for Wireless Sensor Network." Wireless Personal Communications (2023): 1- 28.

19. Tyagi, Lalit Kumar, et al. "Energy Efficient Routing Protocol Using Next Cluster Head Selection Process In Two-Level Hierarchy For Wireless Sensor Network." Journal of Pharmaceutical Negative Results (2023): 665-676.

20. Paricherla, Mutyalaiah, et al. "Towards Development of Machine Learning Framework for Enhancing Security in Internet of Things." Security and Communication Networks 2022 (2022).

21. Sawhney, Rahul, et al. "A comparative assessment of artificial intelligence models used for early prediction and evaluation of chronic kidney disease." Decision Analytics Journal 6 (2023): 100169.

22. Srivastava, Swapnita, et al. "An Ensemble Learning Approach For Chronic Kidney Disease Classification." Journal of Pharmaceutical Negative Results (2022): 2401-2409.

23. Mall, Pawan Kumar, et al. "FuzzyNet-Based Modelling Smart Traffic System in Smart Cities Using Deep Learning Models." Handbook of Research on Data-Driven Mathematical Modeling in Smart Cities. IGI Global, 2023. 76-95.

24. Mall, Pawan Kumar, et al. "Early Warning Signs Of Parkinson's Disease Prediction Using Machine Learning Technique." Journal of Pharmaceutical Negative Results (2022):4784-4792.

25. Pramanik, Sabyasachi, et al. "A novel approach using steganography and cryptography in business intelligence." Integration Challenges for Analytics, Business Intelligence, and Data Mining. IGI Global, 2021. 192-217.

26. Narayan, Vipul, et al. "Deep Learning Approaches for Human Gait Recognition: A Review." 2023 International Conference on Artificial Intelligence and Smart Communication (AISC). IEEE, 2023.

27. Shashank, Awasthi, et al. "Stability analysis of SITR model and non linear dynamics in wireless sensor network." Indian Journal of Science and Technology 9.28 (2016)