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Workload Management System for IT Professionals through Stress Identification

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***Abstract* - A significant issue which is reported by most of the employees suffering from stress is, allocation of heavy workloads by their project managers without the acknowledgement of their stress condition. This study intends to investigate the connection between workload distribution and workplace stress levels and automate the work allocation based on stress metrics. To accomplish the need of identifying stress, a voice based chatbot to track emotions and a device developed to track the body parameters of the employee has been implemented. The speech data and body parameters collected while the employee is at work has been converted to a stress level in this study. And also, this project concerned with protecting the privacy of employee personal data collected by IoT sensors and chatbot. It aspires to improve data security, integrity, and accessibility by leveraging blockchain and advanced AI, addressing the critical importance of data privacy in today's world. Proposed method will automatically assign tasks for the employees based on stress metrics by using Machine Learning techniques. The anticipated findings of this study will have an impact on the IT workforce, particularly Project Managers and Developers. This project's contribution will allow Project Managers to assign work based on employees' actual stress levels. While getting less complaints from developers about hefty workloads.**

Keywords: Artificial Intelligence, Automation, Access Control, Emotion Recognition, IoT (Internet of things), Information Technology, Machine Learning, Natural Language Processing, Stress Identification.

I. INTRODUCTION

The information technology (IT) sector is growing rapidly in the modern era. Most people choose IT-related occupations like software engineering, data engineering, web development, devops engineering, etc. because of the high pay rates. However, a lot of workers claim that they experience stress at work. The many challenges that employees now confront have elevated the significance of mental health in the workplace. A few of the factors that might lead to mental health issues including worry, sorrow, and burnout are heavy workloads, long hours, job uncertainty, a lack of autonomy, and social isolation. Therefore, businesses must prioritize their employees' mental health and implement workable plans to lower hazards and provide support.

However there seems to be a lack of focus on the issue of stress among IT professionals. Stress has an impact on employee behavior potentially leading to effects such as decreased performance, increased absenteeism, higher turnover rates, accidents and errors substance abuse, compromised product quality and reduced productivity. It's important to note that stress can also be detrimental to work quality since a worker under stress is more prone to making mistakes.

Although numerous research studies have focused on job stress there has been limited research on stress related to IT related jobs. In this study we have investigated approaches to identify and understand stress using technologies, like IoT Machine Learning, Deep Learning, Computer Vision, and Natural Language Processing.

A chatbot application has been designed to meet the requirement of identifying stress. Chatbot communication is permitted between employees. As a result, each of their emotions are recognized and the output for stress level is observed.

The research explores monitoring stress levels using multi-modal approaches, including facial expressions, body temperature, heart rate, and blood oxygen levels. It aims to develop a reliable stress detection system using biometric sensors, image processing, and machine learning. The study aims to understand stress expression across various demographic groups and situational circumstances, impacting healthcare, business productivity, human-computer interaction, and psychological well-being. This research aims to enhance stress management techniques and improve overall quality of life, as stress-related ailments continue to challenge societies worldwide.

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In this approach, a task classifier is proposed in order to classify tasks utilizing supervised learning algorithms and methodologies. Then, job allocation will be based on employee complexity and stress levels, which will be one of the crucial requirements of the proposed system. A blockchain-driven data storage system with automated access-control administration connects employees with mental health providers based on stress levels, while safeguarding personal information. This innovative solution combines AI technology and blockchain security, emphasizing the importance of data privacy and accessibility in the workplace.

The remaining sections of the paper are organized into five parts: literature review, methodology, results &discussion, and a conclusion. These sections provide information on the chosen research approach the obtained results and their interpretation ultimately culminating in a conclusion.

II. LITERATURE REVIEW

Since it might be difficult for someone suffering from a mental illness to seek therapy or it may be too expensive for some, and others may not want to discuss their problems with a real person. Therefore, virtual mental health assistants will be preferred by many people. When it comes to virtual assistance applications that are implemented on behalf of emotion monitoring and stress identification, mostly there is research done and systems implemented for scholars, medical professionals or the general public.

In the study proposed by Sriman B et al.[1] it raises questions about you and your daily routine. In order to assess the level of stress individual texts will be examined by the system's NLP module in order to gain a thorough understanding of their views. Following the analysis, the virtual assistant will determine their level of stress. If they prove to be stressed, he or she will go through the psychological counseling process with the virtual assistant.

Amogh N. Parab et al.[2]have proposed the process of identifying intent from a voice response is known as speech emotion recognition. Humans use speech tones to convey a variety of emotions. As humans spend a significant amount of time interacting via speech mode in calls, podcasts, and so on, artificial intelligence can be utilized to extract critical purpose information from speech data.

The extant research reveals a rising interest in the complex interactions between physiological and emotional states, revealing the relationship between blood oxygen levels, heart rate, and facial expressions[3]. Studies on facial expressions have shown their importance as strong emotional markers, with subtle differences in muscle activity corresponding to certain emotional reactions [4]. This foundation explains how emotional experiences and physical manifestations are related.

The control of body temperature changes by the autonomic nervous system has been connected to emotional moods. During emotional reactions, stress-induced vasoconstriction and changed blood flow patterns have been seen, which cause changes in body temperature [5].

A crucial cardiovascular metric called heart rate responds delicately to emotional stimulation. According to research, the heart rate is sensitive to emotional states because it changes dynamically with stress-induced sympathetic activation and relaxation-induced parasympathetic activation[6].

Blood oxygen levels, a marker of respiratory and circulatory balance, have been linked to emotional states. An actual connection between emotional moods and physiological reactions may be seen when breathing patterns change in response to emotions[3].

Collectively, these investigations point to a bidirectional link between feelings and bodily reactions, highlighting the possibility for holistic approaches to comprehending emotional well-being and its physiological foundations. The gaps in our knowledge of these links highlight the necessity of thorough studies that take into account both emotional and physiological factors.

In order to successfully carry out this study, it is essential to gain the knowledge of machine learning and Natural Language processing to build a scoring system to classify the tasks based on task descriptions (text), and automation knowledge to automate the process of intelligent task allocation based on stress level. Some findings from the research papers are as follows.

In the study composed by Kamran Kowsari et al.[7]it shows that in general, the text classification method can be implemented at four different levels of scope: document level, paragraph level, sentence level, and sub-sentence level. Sentence level classification is used in this case. Feature extraction and preprocessing are performed before data is fed into a classifier model, which is evaluated by comparing predictions with original data.

The Naive Bayes method has numerous shortcomings as well. Naive Bayes Classifier (NBC) makes a substantial assumption on the data distribution's shape. NBC is similarly constrained by data scarcity, requiring a frequentist to estimate any conceivable value in feature space, a likelihood value[7].

According to Thorsten Joachims's research, the initial stage in text categorization is to convert documents, which are

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often strings of characters, into a representation suited for the learning algorithm and classification task. [7]. The research presents experimental results demonstrating that Support Vector Machines (SVMs) routinely perform well on text categorization challenges. Because of their capacity to generalize well within high dimensional feature spaces, SVMs reduce the requirement for feature selection, making text categorization easier to apply.[8]

The proposed project addresses a critical aspect of employee well-being by utilizing blockchain-based data storage and access control management to ensure the confidentiality, integrity and availability of sensitive personal data. Real-time data collected from AI chatbots, and stress detection systems aid in recognizing an employee's stress levels via emotional analysis, heart rate, oxygen rate, and temperature. The use of a private blockchain network (Hyperledger Fabric) ensures data integrity. This aligns with existing research in Electronic Health Record (EHR) data utilization [9], enabling health monitoring and tailored insurance policies. As data integration becomes more prevalent in society [10], security measures are crucial. The project draws inspiration from distributed ledger technology [11]. The Identity Mixer protocol, in particular, guarantees privacy-preserving features. By merging these concepts, the proposed solution provides an approach to safeguarding employee information while promoting support, for their wellbeing.

The solution uses real-time data from AI chatbots, hardware sensors, and past health records to establish an automatic interaction between healthcare providers and employees based on stress levels. The K-Nearest Neighbors (KNN) algorithm is used to classify patients based on their stress data and connect them with appropriate professionals such as psychiatrists, psychologists, licensed professional counselors, and counselors. This approach enhances scalability compared to decision tree techniques, as KNN can handle extensive training data that may not fit in memory [12]. KNN's pattern arrangement based on feature resemblance and majority vote classification aligns well with the project's goal [13]. Unlike typical models constructed from historical data, KNN uses the training dataset directly as the model. This advancement highlights the project's emphasis on real-time personalization and timeliness in gaining access to mental health professionals.

But none of the research or already implemented systems focused on IT professionals. Due to excessive workload, job stress is increasing for employees who are working in the IT industry. These days many IT companies grapple with the challenge of safeguarding the welfare of their employees.

III. METHODOLOGY

This research contains four main components. They are Virtual counselor for Stress Identification Based on Emotional Content Analysis, Monitoring Stress Levels through Body Parameters, Allocation of Tasks through Analysis of Task Complexity Using ML & NLP and Blockchain-Based Data Storage and Automates Access-control Management to Select Mental Specialist According to Stress Level of Employ.

A) Voice Based Chatbot Application for Stress Identification

This research component focuses on Identifying stress of target employees. To approach that outcome, a chatbot application has been implemented, which can talk and build a conversation with an employee to identify stress level through emotion analysis.

First built a deep-learning model for sentiment analysis using Python. The model was trained on an emotional speech audio dataset that contains 1440 files. (60 trials per actor x 24 actors = 1440) and it is able to classify different emotional states such as calm, happy, sad, angry, fearful, surprise, and disgust. Preprocess the dataset, which contains labeled audio files for emotion recognition, as a first step. Then, for the selected dataset sample, perform a feature extraction based on features such as Zero Crossing Rate, MFCC, Spectral Centroid, Spectral Rolloff, and Chroma frequencies.

Initially, the Convolutional Neural Network (CNN) Model, Multilayer Perceptron (MLP) Model, and Long Short-Term Memory Networks (LSTM) Model have been prepared and check the accuracy based on the previously extracted feature extraction file. Out of them the CNN model produces the best performance metrics therefore we've selected the CNN model for use emotion identification. Below figure (Fig. 1) shows the training and testing accuracy obtained while training the CNN model.

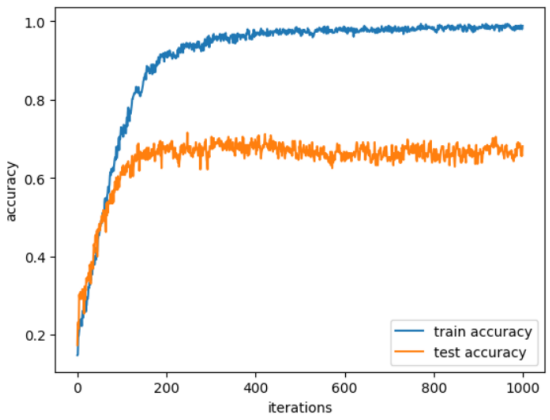

Figure 1: Speech Emotion Recognition Graph

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B) Monitoring Stress Levels through Body Parameters

The methodology used in this study includes data preprocessing, feature selection, train-test separation, and model training. The aim is to build an emotion recognition model utilizing IoT sensors. It is intended to successfully categorize emotions based on facial expressions by utilizing sensor data and visual inputs.

Raw data from sensors like the MLX90614 contactless temperature sensor, the MAX30102 oximeter heart rate sensor, the Node MCU ESP-32S WiFi Bluetooth dual model IoT Dev Board, and the DHT11 Temperature and Relative Humidity Sensor Module are first processed. To guarantee consistency, numerical readings like heart rate and temperature are standardized within the range of 1.8-3.3V. Concurrently, grayscale images from a 48x48-dimensional dataset are scaled and normalized to meet the input specifications of the selected algorithm.

The dataset of 35,685 categorized facial expression instances is divided into training and testing subsets for the purpose of evaluating the model. To ensure that emotions are fairly represented in both categories, the conventional split ratio of 80-20 is used for training and testing. Training three different algorithms—K-Nearest Neighbors (KNN), Convolutional Neural Network (CNN), and Recurrent Neural Network (RNN)—is the key to the process. CNN and RNN handle the resized facial expression photos while KNN process the sensor data that has been standardized. The architecture of CNN is particularly well-suited for image-centric tasks because it can capture spatial cues through convolutional layers.

Using important performance indicators including F1 score, precision, recall, and accuracy, the models are assessed after training. These metrics provide information on how well the model can classify emotions across a range of facial expressions. These analyses show that the CNN algorithm is the most promising one, having the best F1 score as well as the highest precision, recall, and accuracy. This demonstrates how well CNN captures the subtle aspects of facial emotion. (Table I)

Table I: Statistic Table

Model Name	Accuracy	Precision	Recall	F1 Score
CNN	0.8768	0.8621	0.8521	0.8231
KNN	0.8321	0.8123	0.8022	0.8012
RNN	0.8222	0.7922	0.7954	0.7893

C) Allocation of Tasks through Analysis of Task Complexity Using ML & NLP

In building this system, the need for a task classifier to classify task descriptions into various levels of complexity was critical. Using ML and NLP techniques, a task complexity classifier is to be built. The task descriptions provided by the project managers will be used as text inputs to successfully categorize the tasks based on textual phrases.

We have obtained a thorough dataset for this study from a business that includes a wide variety of data. The project details in the dataset, which include project titles and related work descriptions, give an overall picture of the tasks carried out within the business. The inherent complexity of each assignment as assigned and noted by the company's personnel has also been carefully taken into account. In order to gain a deeper understanding of the variables influencing task intricacies within the company's operational landscape, it is possible to explore and analyze the complex relationships between project names, task descriptions, and their respective complexities using this comprehensive collection of data.

We selected a collection of features from the textual data found in the task descriptions in the dataset in order to successfully train our machine learning model. The goal in selecting these aspects was to identify and capture the text's most prominent and distinguishing qualities. We wanted to convert the free-form text into a structured manner that the model could understand by extracting and engineering these properties. As a result of this procedure, the model was able to identify distinct qualities found in the textual data and make accurate predictions in addition to being able to recognize patterns and correlations within the job descriptions.

To forecast complexity levels, we trained SVM and Naive Bayes models with task descriptions as features. Iterative training was used to predict task complexity using unique textual patterns. To improve model performance, strict hyperparameter adjustment was used. Following a thorough examination of performance indicators, SVM emerged as the best option, displaying greater predicted accuracy for task complexity levels. (Table II)

Table II. Statistic Table

Model Name	Accuracy	Precision	Recall	F1 Score
Naïve Bayes	0.7000	0.7142	0.4166	0.5263
SVM	0.8333	0.8123	0.8022	0.8012

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D) Blockchain-Based Data Storage and Automated Access-control Management to Select Mental Specialist According to Stress Level of Employee

The suggested project methodology includes a multifaceted strategy that integrates AI, stress detection methodologies, blockchain, and an automated access-control mechanism to assure employee data security and efficient mental health specialist selection.

1) Data Collection and Processing

Real-time data gathering from AI chatbots and IOT systems will be used to capture a variety of information, including emotional reactions, heart rate, oxygen levels, and temperature.

2) Blockchain Integration

The processed data will be securely stored on Hyperledger Fabric-enabled private blockchain nodes. The tamper-proof nature of blockchain will protect the data's integrity and confidentiality. The stress-related information of each employee will be cryptographically linked, producing a chain of records that cannot be changed without sufficient authorization.

3) Automated Access-Control and Specialist Matching

The K-Nearest Neighbors Algorithm will categorize employees based on stress levels and prior health data in order to link them with relevant mental health professionals. This automated procedure will reduce bias and human mistakes. Access to these documents will be restricted via an automated method, ensuring that only authorized people have access to sensitive information.

4) Specialist Recommendation

The system will propose a variety of mental health professionals, including psychiatrists, psychologists, and counselors, based on the algorithm's classification. The advice will be based on the employee's stress profile, historical data, and specialized experience, increasing the likelihood of a successful therapeutic fit.

5) Privacy and Security Measures

To safeguard employee identities, strict data anonymization procedures will be used. Encryption and cryptographic hashing will also be used to ensure safe data transmission and storage. To safeguard employees' privacy and rights, the system will adhere to appropriate data protection standards such as General Data Protection Regulation (GDPR).

The suggested technique combines AI, blockchain, and automated access control to develop a safe, efficient, and privacy-protecting system for employee stress assessment and mental health specialist referral. Comprehensive strategy addresses data security and workplace mental health care requirements.

IV. RESULT AND DISCUSSION

A) Voice Based Chatbot Application for Stress Identification

In this research component, the main input is voice responses that's directly taken from the IT professionals in a workplace. Then this voice will be going through a speech recognition algorithm to detect and identify several emotions that they are expressing real-time. After that it will recognize and show each emotion and its intensity level separately.

After that, identifying stress is the most important part that needs to be done. To achieve that goal different emotional state, map into stress levels as follows. If the emotions are positive like calm, happy, and surprise generally lower stress is produced. And also, if the emotions are negative like sad, angry, fearful, and disgust stress level tends to increase. Subsequently, this insightful correlation between emotions and stress is used by task and mental specialist allocation systems.

B) Monitoring Stress Levels through Body Parameters

The relationships between facial expressions, body temperature, heart rate, and blood oxygen levels has been uncovered in this study, creating a unified picture of emotional and physiological states.

As effective nonverbal communicators, facial expressions can reflect a variety of emotions, from joy to anguish. These expressions, which have their origins in brain and muscular processes, serve as portals into our inner selves, fusing the spheres of emotion and physiology.

The metabolic and neurological systems that control body temperature allow it to reflect emotional changes. There is a clear connection between our emotions and our physical responses, as stress-induced vasoconstriction can cause a reduction in body temperature while intense emotional states can cause an increase.

A characteristic of cardiovascular health, heart rate reflects emotional arousal. Heart rate increases with sympathetic activation during emotional stress while heart rate decreases with parasympathetic effect. Further capturing the complex interplay between these opposing systems is heart rate variability.

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Emotions affect blood oxygen levels, which are indications of respiratory and circulatory health. The relationship between the physiological and emotional domains is highlighted by the possibility that altered breathing patterns during emotional experiences can cause changes in blood oxygen saturation.

The multi-dimensional canvas of human experiences, including facial expressions, body temperature, heart rate, and blood oxygen levels, is crucial for psychology and healthcare. Understanding the connections between mood and physiology can aid diagnosis and treatment, and advances in human-computer interaction. This intersection of emotions and physiology offers a deeper understanding of human nature and potential applications for communication and well-being.

C) Allocation of Tasks through Analysis of Task Complexity Using ML & NLP

The identification of patterns in word usage within task descriptions has proven to be useful in estimating task complexity. Detailed investigation revealed that tasks with sophisticated procedures, technical jargon, and domain-specific language tended to have higher complexity ratings. In contrast, tasks involving simple directions were associated with lower degrees of complexity. These patterns illustrate the underlying relationship between verbal expression and the cognitive demands provided by tasks. Using these observed connections, our models capitalized on the subtle linguistic cues inherent in the task descriptions, allowing accurate prediction of complexity levels.

Finally, our findings show that linguistic patterns within task descriptions play an important role in identifying task complexity levels. We have laid the groundwork for accurate and automated difficulty evaluation by exploiting these patterns. Based on this, we anticipate a practical application in which the determined complexity of tasks based on their descriptions can be used as a key input for a comprehensive employee-task assignment strategy. We present a novel method for automatically assigning work to employees depending on their stress levels. Less challenging tasks could be assigned to individuals experiencing higher levels of stress, enabling better job distribution and stress management. Tasks of greater complexity, on the other hand, may be assigned to staff with lower stress levels, maximizing total output. This forward-thinking integration of complexity evaluation and employee allocation highlights the potential synergy between NLP-driven complexity evaluation and people management, paving the way for a more efficient and employee-centric workflow.

D) Blockchain-Based Data Storage and Automated Access-control Management to Select Mental Specialist According to Stress Level of Employee

The suggested system's deployment produced encouraging results in terms of data safety and effective mental health professional selection. The gathering of real-time data from AI chatbots and stress identification algorithms generated a large dataset for stress evaluation. Through personalized conversations, the integrated AI chatbot successfully assessed stress levels, improving the precision of the stress indicators. Based on Hyperledger Fabric, the private blockchain efficiently preserved data integrity and guaranteed safe storage of stress-related information.

The K-Nearest Neighbors Algorithm effectively classified employees based on their stress levels, utilizing past health information to provide individualized mental health professional suggestions. The automatic access-control technique guaranteed that sensitive data was only accessed by authorized individuals, boosting privacy and security.

V. CONCLUSION

IT project managers sometimes assign hefty workloads without considering their employees' mental stress levels. This might result in exhaustion, worry, and sadness among employees. Job stress is a widespread issue, and people who are stressed are hesitant to discuss their problems with a real person. We solve the issues in identifying stress levels in this system by proposing the use of a voice chatbot and an IOT device. The information gathered from this will be evaluated to determine whether the employee is under stress. The tasks obtained from the classifier, automatically assigned considering the stress levels will help the developers to engage in their work more productively than before.

While the proposed system can make positive changes to mitigate stress of working individuals, it is essential to acknowledge its limitations. The knowledge from health professionals was obtained in the process of converting the emotions to stress levels. A main limitation was the availability of many stress scales. It was hard to choose a more precise scale to map emotions in to stress levels. The developed prototype in this study can be altered according to any stress scale in the future.

The target audience aimed by this study was IT professionals, but the sample we collected for the analysis in this study includes the domain of Software Engineers and the tasks assigned for them by the Project managers. This system can be further expanded to other domains within the IT industry for effective workload distribution among employees, while considering their mental status. Implementing

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Hyperledger Fabric for maintaining employee health information means that health data is safe, transparent, and immutable. Its distributed ledger technology ensures data security, accessibility, and anonymity, enabling future monitoring and analysis of individual well-being to be seamless.

This solution can help to establish a positive and less stressful job setting for IT professionals by adopting these steps. This will benefit not just the employees, but also the companies, because people who are stressed are less productive as well as more inclined to leave their jobs. Overall, a task allocation system based on stress has the potential to be a significant tool for managers trying to enhance the overall well-being and efficiency of their software engineering teams.

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