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Realtime Face Emotion Recognition And Worker Stress Analysis

Naveen Sundar Kumar P[1], Aleefa Rizwana P[2], Veera Indrasena Reddy S[3], Bharath C[4], Amareswar Reddy S[5]

Assistant Professor, Computer Science and Engineering, Rajeev Gandhi Memorial College of Engineering and Technology, Nandyal, India[1]

Computer Science and Engineering, Rajeev Gandhi Memorial College of Engineering and Technology, Nandyal, India[2-5]

Abstract: The Information Technology (IT) professionals often face high-stress levels due to the demanding nature of their work. Chronic stress results in cancer, cardiovascular disease, depression, and diabetes. Developing robust methods for the rapid and accurate detection of human stress is of paramount importance. This research aims at developing a stress detection and management system specifically tailored for IT employees. Machine Learning algorithms and Deep Learning techniques like Convolutional Neural Networks are used for face emotion detection. Image Processing is used at the initial stage for detection. The existing methods for real time face emotion recognition and worker stress analysis has a draw-back that there is no live detection. Additionally, the existing system lacks a contextual data component to account for external factors influencing stress. The proposed system includes the real time live cam detection of Face emotion recognition and Worker Stress analysis and periodic analysis of employees and detecting mental stress levels through seamless integration of deep learning models for emotion detection. It provides a comprehensive understanding of employee well-being. The ultimate goal of our research is to identify emotion levels in employees, providing a foundation for stress management and thus enhance employee well-being and ultimately improving individual overall quality of life by enabling early stress detection.

Keywords: Image Processing; Convolutional Neural Networks; Stress

I. INTRODUCTION

Facial expressions play a crucial role in human communication, conveying emotions such as joy, sadness, and anger. Studies indicate that nonverbal components, including facial expressions, carry about two-thirds of interpersonal communication, while verbal components convey only about one-third. This underscores the importance of understanding facial emotions in deciphering others' intentions. In this fast-evolving world, people started to use electronic gadgets, which made their work faster. This usage of computer-related gadgets day and night increases screen time. Due to overuse, people might experience migraines, eye strain, pain in the wrists (carpal tunnel syndrome), stress, and physical fatigue. Screen time is the total time spent per day viewing screens such as a mobile phone, TV, computer, tablet, or any hand-held or visual device. Just like the balanced food that we consume, screens need to be properly chosen and used in the right quantity and at the right time. Constant exposure to digital devices can be harmful to our eyes. Digital eye strain, sometimes called Computer Vision Syndrome (CVS), is one of the most commonly reported symptoms of too much screen time.

For example, one study suggested that over 60% of people were affected by it. Studies have shown that too many gadgets may negatively affect a child's brain's functioning and may even cause attention deficits, cognitive delays, impaired learning, increased impulsivity, and decreased self-regulation. Technology has the whole world in its grip, and we cannot avoid the use of technology in this era. Multiple technology gadgets are being used by almost every person everywhere, and it has changed the environment of every workplace. Employees can easily access, as well as be accessed by technology like the internet, mobile phones, emails, and messages can be checked at any time and any place. Therefore, technology has become an "organizational actor" that increases employees' availability for organizations. This organizational actor negatively affects organizations. Information and communication technology at the workplace is designed to help workers and enhance their work productivity, as well as increase collaboration among workers. But research has proven that employees who are using electronic devices for performing their daily tasks are becoming frustrated by the extensive use of electronic gadgets in the workplace.

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Devices and tools that are designed to decrease the burden on human cognition are inadequate; in fact, they have truly added overload on human cognition. Electronic gadgets have become a vital part of our everyday life. Even a school going boy can operate a mobile. This screen addiction is from child to senior citizen. This overload leads to stress, burnout, and loss of productivity. In a world that values hyper-productivity, it is becoming more and more difficult for people to find a work-life balance. Workers are risking their health by continuing to work on mobile devices after leaving the office. The Chartered Society of Physiotherapy conducted an online survey of 2,010 office workers, whereupon they found that close to two-thirds (64%) of those who responded admitted to continuing their work outside of the company's normal office hours. More specifically, the report stated that people were ending their work day with two hours and 18 minutes of extra screen-time at home every day of the week. Additional data showed that the two most common reasons on why workers needed to spend extra hours performing work-related duties came from having too much work at the office, and the need to find a way to ease the pressure of having to perform at work.

Here we'll start by looking at the stress levels of employees in the workplace. Initially we created a model for emotion recognition of a person. That model can classify images into 7 emotions like happy, sad, anger, disgust, surprise, fear and neutral. Then our proposed system includes real-time face emotion detection as well as the stress levels. This will help manager or an individual to concentrate on his work-health balance. Counseling is beneficial to people who are under a lot of stress. If we don't take precautions to control stress, it may affect our society also. Preventative interventions should be taken.

A long-ago Questionnaires are routinely used in the field of stress research to get insight into overall working experiences, but it is time taking process and no continuous result is available. There will be a hesitation on the side of people to declare whether or not they are worried. Traditional techniques of evaluating workplace stress levels included asking employees to fill out a survey. Alot of time and effort should be invested. Employers who use this Stress Detection System can better prepare their employees to deal with stressful events before they occur. This system is able to detect between stress and non-stress condition.

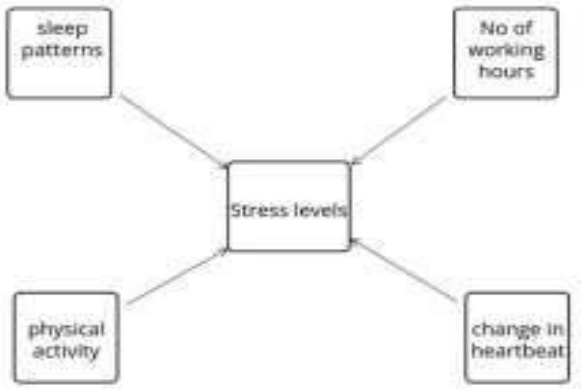

Fig. 1 shows the model of stress which can be caused

by the change in sleep patterns, physical activity, increase in number of working hours, change in Heart Rate. This is a specific condition, phenomenon or a point where technology users feel the physical and mental burden to use a technology during their everyday life." Organizations should establish laws for timings after work hours and disconnection from the internet at home to reduce technology overload. The usage of stress monitoring software can improve both the well-being of society and the health of individuals. More improved results will be shown when we integrate this stress detection system in webcam by default in every electronic gadget in the workplace by including privacy concerns.

II. LITERATURE SURVEY

1) Detecting stress and anxiety via facial clues

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

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2) Image Processing and Machine Learning Techniques used for Stress Detection
Authors: Nisha Raichur, et al.
A real-time non-intrusive video is produced in this paper, which detects by analyzing a person's facial expression, can determine their emotional state. Each video frame contains an individual feeling, and the stress level is determined in the hours after the video capture. A mechanism is applied that enables us both to train a system and analyze feature prediction differences. The paper findings suggest that the developed technique works effectively with a generic model of all ages.

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

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

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

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

6) *Machine Learning Paradigms for Recognizing Human Mental Stress*
Authors: Mrs. Megha V Gupta, et al.
Detection of human mental stress utilizing Machine Learning frameworks and methodologies such as Electroencephalogram (EEG), Speech Signal, and audio-visual data. For stress detection using EEG, the Database for Emotion Analysis using Physiological Signals (DEAP) dataset will be used. Using Speech Signal and audio-visual data, RAVDESS (Ryerson Audio-Visual Data of Emotional Voice and Song) will also be designed to recognize Stress.

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

8) Stress and Relaxation Magnitudes for Tweets Detection
Authors: Reshmi Gopalakrishna Pillai, et al.
In this exploration work, a WSD arrangement as a preprocessing stage to a current vocabulary-based pressure/unwinding strategy. A dataset involving 1000 tweets with questionable influence words was gathered and commented on with high inter-nation understanding. Joining a WSD was found to fundamentally work on the presentation of TensiStrength regarding Pearson's connection and definite match rate, for both pressure and unwinding. TensiStrength with WSD outflanks AI strategies also. Given the moderately little size of the test set, this must be additionally concentrated on utilizing greater datasets explained with pressure and unwinding qualities.

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III. PROPOSED APPROACH

Stress is classified using supervised machine learning algorithms such as KNN classifiers in the proposed system. The detection of stress is accomplished through image processing. The worker's picture is extracted from the video capturing through webcam. This picture given by the program as information, and Image Processing is utilized for discovery at initial stage. By translating an image to digital form and performing cleaning operations on it, relevant information can be extracted from it. In previous research papers, various machine learning algorithms are used like linear regression, logistic regression, etc., but didn't use KNN for the experiment which is similar to our approach. Not only accuracy but we worked on various metrics. Existing systems took images as input and classified the emotions into 7 different classes. In our system ,live analysis and individual counseling is included. incorporates live monitoring and frequent employee. There is no requirement of taking frequent photographs of the subject, it takes less time and produces more effective outcomes when compared with the results achieved by continuously capturing images of a person. As employees may work 24*7,this system able to provide continuous monitoring and well defined outcomes time to time dynamically. With the help of contour plotting in Image Processing libraries, a bounded box is drawn to identify face in the video. The emotion is displayed on top of the bounded box.

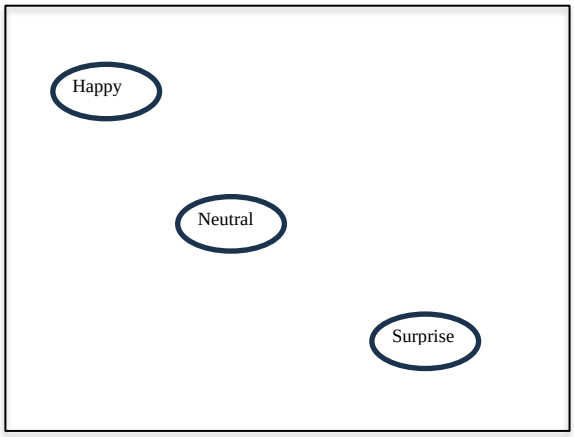

Fig. 2. Indication of stressed emotion states.

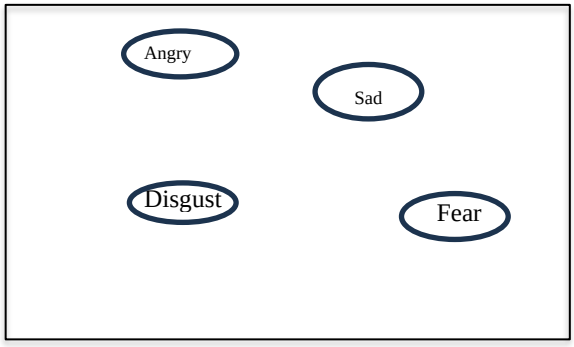

Fig. 3. Indication of stressed emotion states.

Dataset:

Here Dataset is collection of images that are used in order to train our model. A model in image processing is used in training and testing phase. Then we can use the model for predictions. Image mining can be used to find hidden information in images, link previously unrelated data, and uncover new patterns in the data being mined.

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

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Advantages of this Approach

- An image that has been edited or a report based on image analysis as a result of the output.
- Continuous monitoring and prediction can be achieved using live cam.
- The Stress Detection System helps workers in managing difficulties that add to stress by giving proactive stress management solutions.
- Over periodic times, we will take photographs of employees and then distribute traditional survey forms to them.

Angry:

Disgust:

Fear:

Happy:

Neutral:

Surprise:

Sad:

Fig.4. Images of 7 different emotion in the dataset

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IV. ALGORITHM

Machine learning is basically divided into 3 categories:

- Supervised learning,
- Unsupervised learning,
- reinforcement learning.

Convolutional Neural Networks (CNNs) and k-Nearest Neighbors (KNN) for most used for face emotion recognition. Convolutional Neural Networks (CNNs) are a type of deep learning neural network architecture.

The algorithmic steps that are used in image processing are as follows:

- Preprocessing: Extract features from each face image. These features can include facial landmarks, color histograms, or deep learning.

- Split Data: Split the dataset into training and testing sets. The training set will be used to train the KNN classifier, and the testing set will be used to evaluate its performance.

- Training: Initialize the algorithm with a chosen value of k (the number of nearest neighbors).Train the model on the training data by fitting it with the feature vectors and their corresponding emotion labels.

- Feature Extraction: In CNNs, each layer learns to extract hierarchical features from the input image. Lower layers detect simple features like edges and textures, while higher layers detect more complex patterns relevant to emotion recognition, such as facial landmarks and expressions.

- Classification: The output of the CNN is fed into a classification layer, which predicts the probability distribution over different emotion categories (e.g., happy, sad, angry). This is typically achieved using a SoftMax activation function

- Prediction: The trained model can be used to predict the results. Haar cascade classifier is used to detect face in the image or an video stream.

- Evaluation:

Compare the predicted emotion labels with the ground truth labels from the testing set.

- We iterate the KNN method with various K values until we find one that greatly minimizes the number of errors while preserving the algorithm's capacity to make right predictions when given data it hasn't seen before.

- Tuning Parameters:

Optionally, you can tune the hyperparameters of the KNN algorithm, such as the value of k, using techniques like cross-validation to improve performance.

- Deployment:

Once satisfied with the performance, deploy the trained model to detect face emotions in new, unseen images. specifically designed for processing grid-like data, such as images and videos.

V. RESULTS

To check the efficiency of the system we tried to run the code. The code is implemented in Visual Studio Code. Firstly User has to register with the required details user name, login ID, password, mobile, email etc., with all the required details user has to register. If all the details are correct then the message will be displayed as “you have been successfully registered”. We have included constraints on email,[password for increased privacy.

If you enter email or mobile number which is already existed the it will display message as “email or mobile already existed”. Password must contain one number, one upper case and lowercase letters and should contain 8 characters or more. If any of the field is missed then it will display a message as “please fill out this field”. If all these details are entered, then only user registration can be successful.

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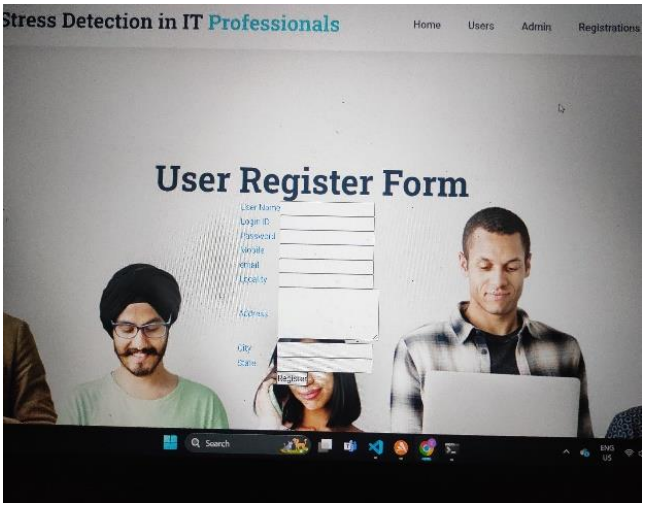

Fig. 5. User Registration form

Authenticated user only can access with corresponding username and password. User Registration is required to know whether the employee is currently employed to that IT Company or not. If the person is introvert or some kind of person who is having inferiority complex is not interested in exposing his/her stress to others and also not comfortable in sharing their personal details like images, username, password, etc.

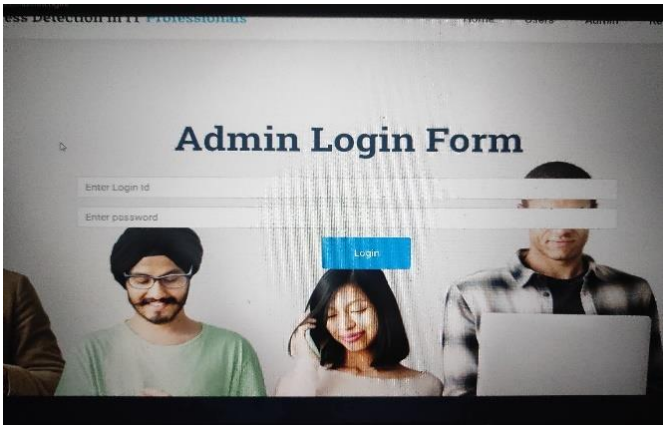

Fig. 6. Admin login form

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

Fig. 7. List of registered users

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Authenticated User can login with the help of login page using registered ID and password.

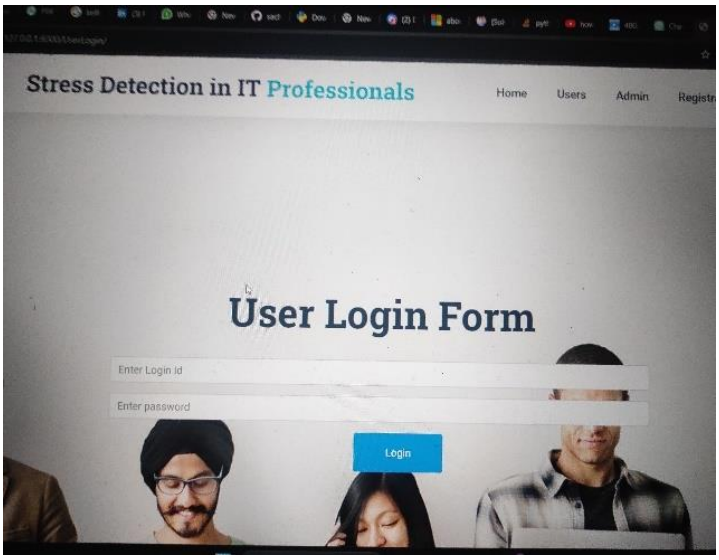

Fig. 8. User login Form

If the user is successfully login then a page will be opened which contains a navbar that includes Home tab, Image tab, Live Cam, Logout tabs etc., this system also support emotion detection for static images also. For this click on image tab and upload image. If user clicks on the Image page, then the user can upload the image and can see the results . User can also see already uploaded images and its results as well. As this stores previous uploaded images, this can help for the future medical references by which psychiatrist can be able to help the person. Not only single face but this approach can also detect the multiple faces as well For user live monitoring, we need click on live cam tab then it automatically turns on the inbuilt webcam in respective laptop or desktop. A bounded box with emotion marked on top is visible and this is dynamic way of stress detection.

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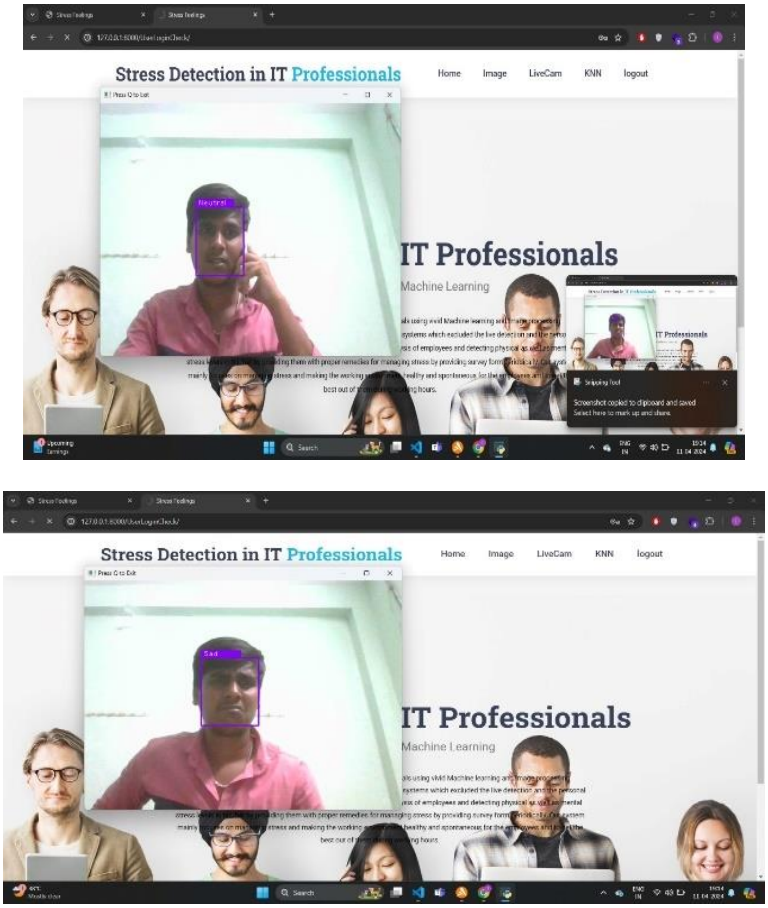

Fig.10. Stress Detection with Live Cam

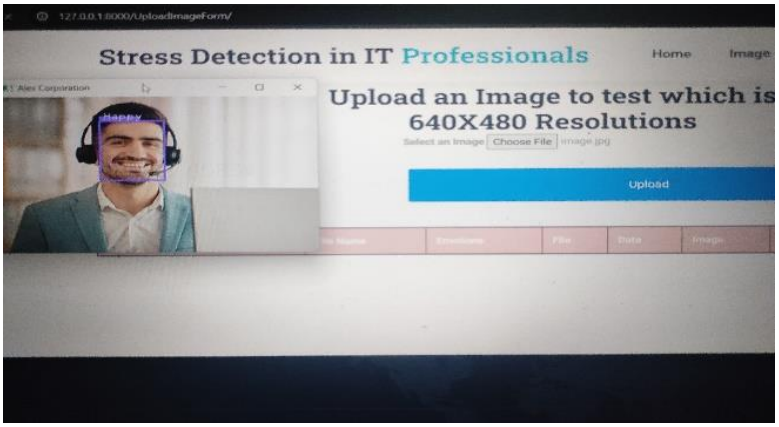

Fig. 10. Detection of Facial emotions in static image

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

VI. CONCLUSION

The system overcome the limitations of the traditional Paper method of questionnaire. By leveraging the power of deep learning, this project makes a significant step in real world applications. The Stress Detection System is designed to assess employee stress by reviewing photographs submitted by verified users, making the framework is reliable. The output of the stress level seen on the top of bounded box as angry, sad, happy, disgusting, and neutral.

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We develop the model ,trained and tested it. We successfully identified 7 emotions and stress levels through web cam. The study of facial emotion recognition may contribute a better feedback to the society and also interaction between Human Robot Interface (HRI) in a near future.

VII. FUTURE SCOPE

Image processing and deep learning are used to classify the emotions and identify stress levels. To extract features, images were gathered and analyzed from video stream. The FER2013 dataset is used to train the model and test it with the test dataset As the future work integrate the software as the feature in the inbuilt webcam with attention to privacy concerns. Also one can work with broader population to increase scope of system.

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