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Prediction of Personality Traits and Suitable Job through an Intelligent Interview Agent using Machine Learning

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Abstract: ***Interviews play a crucial role in an individual's career. They are often a means through which recruitments are finalized in various companies. To effectively understand the suitability of the candidate for a particular job, the interviewer not only assesses the conceptual knowledge of the candidate but also tries to identify if the personality traits of the prospect match with the job requirements. Facial expressions are crucial in human communication since they assist in understanding others better and are commonly used to assess personality. The automation ensures that the procedure for selecting candidates in an objective manner is not tainted by the interviewer's bias and personal experiences. The proposed Intelligent Interview Agent uses video input of the interviewee to predict the Big Five Personality traits as seen by skilled human resource experts. To achieve this, the system uses VGG16 Convolutional Neural Network (CNN) Model. The system also predicts the suitable job role for the candidate depending on the scores predicted for the Big Five personality traits, by employing a machine learning (ML) model. The system serves the purpose of both the recruiter and the candidate. The recruiter can analyse the candidate's personality traits and assign him/her the predicted suitable job. On the other hand, the candidate can get an idea of his/her personality traits and know which profession suits the best.***

Keywords: Facial expressions, Machine Learning, Convolution Neural Network, Big Five Personality Traits

I. INTRODUCTION

Choosing a suitable career is a crucial part of a student's professional life and recruiting an efficient employee for a position is important for the success of an organisation. During interviews, recruiters determine whether a candidate's skills and personality match the organisation's needs and culture. One cannot overlook personality when it comes to recruitment through an interview [12]. One of the most tried-and-true methods to evaluate personality is the Big Five Personality Traits. Recent developments have demonstrated that deep learning and machine learning algorithms are getting better at addressing complicated problems, which call for finding hidden patterns in the data. Convolutional Neural Networks (CNN) are widely utilised in the realm of personality detection and are the best tools for analysing personality traits based on facial expressions[15]. Using the same insights, techniques such as CNN are employed to predict the values of the Big Five Personality traits while Machine Learning algorithms are employed to predict the most suitable profession using the scores of the Personality traits as input. Video of the interviewee is taken as input to predict the Big Five Personality traits as perceived by experienced professionals. These personality traits are then used to predict the most suitable job for the candidate. This ensures better job satisfaction [11][13].The automation makes sure that personal experiences and an inclined perspective of the interviewer do not cast a shadow on the process of selecting candidates in an unbiased manner. The figure 1 depicts the Big Five Personality traits.



Figure 1: Big Five Personality Traits

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II. LITERATURE SURVEY

Interviews provide an opportunity for the interviewer to determine whether the candidate's talent and character are compatible with the firm's needs and culture. Technical abilities and personality attributes play a part in determining the outcome of an interview. Hough L. and Dilchert S. [12] have provided documented evidence about the usefulness of personality traits in employee selection for a particular job. Thus, one cannot overlook the personality traits when it comes to recruitment through an interview.

Facial expression analysis is a great technique for assessing personality traits, and the popular Big Five Personality trait evaluation method is one of the finest ways to assess personality [17]. A study done by Hong Bui [8] shows that, the Big Five personality traits have a strong correlation with job satisfaction. The interviewer might find it challenging to objectively evaluate the interviewee's Big Five Personality Traits as the interviewer's opinion and personality may have a huge impact on the choice or evaluation of the candidate. Thus, it is necessary to automate the process of assessing the personality to have a fair assessment for all the candidates. The most common methods for automating personality detection have been briefly described by Yash Mehta et al. [15]. Bounab et. al[7] predicted personality traits from the video transcripts taken as part of an interview. Joan-Isaac Biel et. al[5] focused on determining the personality traits of people featured in youtube vlogs while Bo et.al [6] tried the same for Facebook users.

Once the personality traits are determined, it is then necessary to check if the candidate's personality is suitable for a particular profession. The applicability of the Big Five Personality qualities to the job requirements has been addressed by Michael P. Wilmot and Deniz S. Ones [16]. Aamir et al. [1] mapped the hard and soft skills required by various software engineers and then linked them to the Big Five Personality traits for determining a specific relation between personality traits and the probable job. Hung-Yue Suen et. Al [17] worked on developing an interview agent to predict the Big Five Personality traits, by taking facial images as inputs. Both Abhimanyu Sherawat et.al [2] and Aslı Gül et. al [4], went a step ahead to consider audio and body posture as components to predict personality traits apart from distinctively choosing text and body posture of the candidate respectively. Though most of the studies focused on predicting personality traits of candidates, one can observe that attempts to predict a suitable job based on the personality of the candidate has not been addressed adequately. Both De Jong N et. al [11] and Kern et. al [13] have stressed that the personality traits are closely related to suitable jobs and contribute to job satisfaction. The elaborate survey thus highlights the necessity for an automated system that predicts the personality of the candidate and also a suitable job for the user based on the personality.

III. PROPOSED SYSTEM

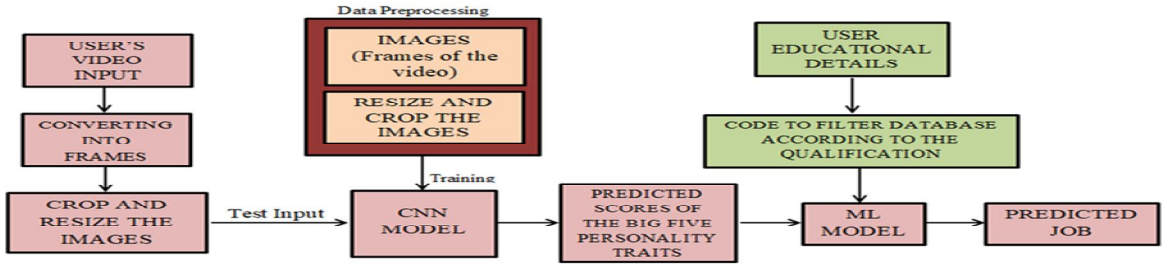


Figure 2: Architecture

In the proposed system, the user's video is taken as input and the predicted scores of the Big Five Personality traits along with the suitable job are displayed as the output. Figure 2 explains the proposed system's architecture.

A. Dataset

The dataset used for training the CNN model consists of 145 videos and the testing dataset comprises 54 videos. The labeled values of the Big Five Personality traits for each video are included in a csv file. The dataset, comprising 496 records, employed for the prediction of probable profession consists of seven columns, namely, Extraversion, Agreeableness, Openness, Conscientiousness, Neuroticism, qualification and profession. Each record in the dataset consists of the labeled scores of the personality traits, profession and qualification of a particular person. Chartered Accountancy, Bachelor of Technology in Computer Science, Bachelor of Technology in Mechanical, Bachelor's Degree in Human Resource Management, Masters in Business Administration and Bachelor of Architecture are the qualifications considered in the dataset.

The Intelligent Interview agent system consists of four different phases, namely Prediction of scores of the Big Five Personality traits, Determination of a subset of professions compatible with the Qualification of user, Building ML models and Prediction of a suitable job on the basis of the scores obtained for the Big Five Personality traits and the qualification of the user.

B. Prediction of Scores of the Big Five Personality Traits

The candidate's personality traits are predicted by VGG16, a Convolutional Neural Network model. The user's video input is used to predict the scores for the Big Five Personality traits. The VGG16 model is trained using a dataset consisting of 145 videos and the labelled scores of the personality traits. Frames are extracted from each video in the dataset. Four images, randomly chosen, are resized, cropped accordingly and stacked together.

A tensor of shape (4,128,128,3) i.e. 4 video frames of 128 pixel height x 128 pixel width consisting of 3 RGB colours, is the video representation considered per sample.

A generator is created which iterates over the visual representations to produce a tuple of the form (x0,y) where x0 is the video representation and y is a vector representing the ground truth labels. The video representations of all videos and the corresponding vectors of ground truth labels are stacked together as two separate lists. These lists are used as the training data to the VGG16 model, which consist of various consistently arranged convolution and max-pooling layers. The video input of a user undergoes similar data preprocessing to predict the scores of the user's personality traits using the VGG16 model.

C. Determination of a Subset of Professions Compatible with the Qualification of user

The user is prompted to select his/her qualification from a drop down box. Based on the user's qualifications, records with professions related to the user's qualification are determined from the dataset and only those records are considered while predicting a suitable profession for the user based on the scores of Big Five Personality traits through ML models. This module is crucial so as to avoid predicting jobs not related to the user's domain knowledge.

D. Building Machine Learning Models to Predict Suitable Profession

On the basis of the scores predicted for the Big Five Personality traits and the qualification of the user, Machine Learning classification algorithms are employed to predict a suitable profession for the user. The Decision Tree Classifier Algorithm, SVM Algorithm, Stochastic Gradient Descent Algorithm, Ada Boosting Classifier, Linear Regression, Naive Bayesian Algorithm are the Machine Learning algorithms employed. Accuracies are determined for each of the models. For each of the six qualifications, six models using the six Machine Learning algorithms are built and a comparative study is done for the average accuracies obtained.

E. Prediction of Suitable Professions

On conducting a comparative study, it is observed that the Decision Tree classification algorithm yields better accuracy on an average for all the qualifications. Thus, it is employed to predict the suitable job on the basis of the user's qualification and scores obtained for the Big Five Personality traits.

IV. RESULTS

The application aims to serve the purpose of both the interviewer and the candidate, preparing for an interview. The interviewer can obtain insights about the interviewee's personality and determine a profession that would be ideal for the candidate considering both the qualifications and personality. The candidate preparing for an interview can use the application to examine his/her personality and find out the professions in line with his/her personality and qualifications.

As the application starts, the user is redirected to a webpage with two options to choose: student or employer. If the option selected by the user is 'student', then the user is redirected to a webpage containing sample questions which are to be answered in a stipulated time frame.

The responses of the user are recorded and later uploaded after filling the user's details in the 'student' form. If the chosen option of the user is 'employer', then the user is redirected to the employer's form where the interviewer will be able to upload the video of the interviewee. The results page consists of the predicted scores of the personality traits and a suitable job.

The Intelligent Interview Agent, built to predict scores for the Big Five Personality traits of the user from the video input and subsequently predict a suitable job as per the scores predicted and the user's qualifications, is found to satisfy all the functional and non-functional requirements by addressing the limitations observed in the existing systems.

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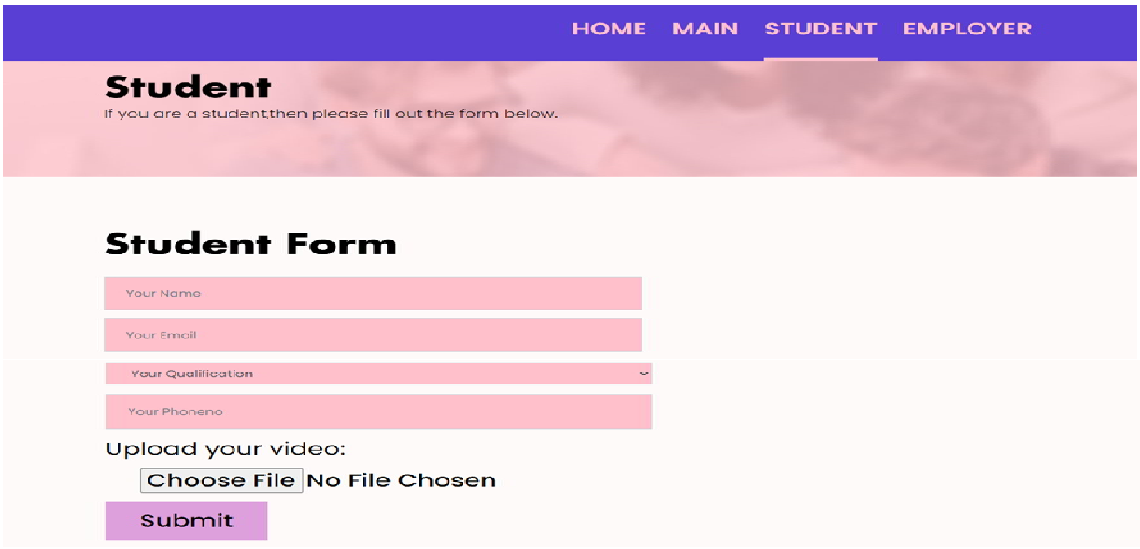


Figure 3: Webpage for the user to fill the details and upload video



Figure 4: Output displayed on the application interface

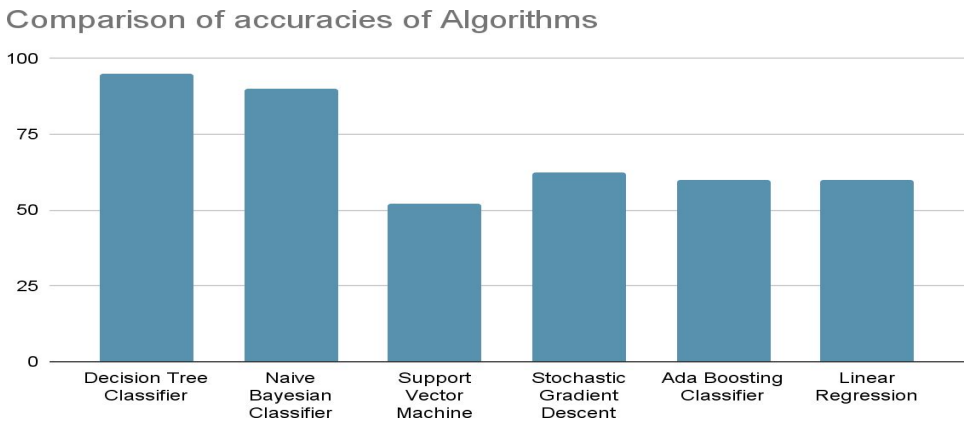


Figure 5: Comparison of accuracies of the machine learning models.

Figure 3 depicts the webpage for the user to enter the details and upload the video. Figure 4 is the output displayed about the predicted scores and job. The performance of the CNN model built to predict the scores for Big Five Personality traits from the video is calculated using the formula for mean absolute error (MAE). The MAE obtained for the CNN model built and used as part of the Intelligent Interview Agent is found to be 0.19. The accuracy obtained for machine learning models built to predict suitable job is calculated using the confusion matrix. Considerable work has been done to improve the effectiveness of the system for predicting the job by building models using various machine learning algorithms and then using the one with the maximum accuracy to make predictions as part of the Intelligent Interview Agent. The accuracies obtained for various models are shown in Figure 5. The model built using the Decision Tree Classifier is found to produce better and accurate results to predict suitable jobs for the user depending on the scores obtained for Big Five personality traits.

The final output obtained consists of the scores of the Big Five personality traits predicted by the CNN model and the suitable job predicted by the machine learning model depending on the scores obtained for Big Five personality traits. The scores obtained for Big Five personality traits are on a scale of 0-1 which denotes the degree of dominance of the particular trait in the candidate. The scores obtained for the personality traits are categorized into low or high depending on the numerical value as shown in Table 1.

Table 1: Categorization of values of the Big Five personality traits

Predicted traits	Score(0-1)
Openness	(0-0.4)- Low Openness (0.5-1.0)- High Openness
Conscientiousness	(0-0.4)- Low Conscientiousness (0.5-1.0)- High Conscientiousness
Extraversion	(0-0.4)- Low Extraversion (0.5-1.0)- High Extraversion
Agreeableness	(0-0.4)- Low Agreeableness (0.5-1.0)- High Agreeableness
Neuroticism	(0-0.4)- Low Neuroticism (0.5-1.0)- High Neuroticism

Table 2: Output obtained for a test case along with the predicted personality values for Five Big Personality traits.

Input	Output	Inference
 Testvideo1.mpg Qualifications: B.Arch	Predicted profession- Project Architect Predicted personality traits: Extraversion: 0.25 Agreeableness:0.36 Conscientiousness: 0.38 Neuroticism: 0.40 Openness: 0.54	Candidate with less extraversion and high openness

The results of the test run conducted on the system are shown in Table 2. The suitable profession is then predicted as 'Project Architect' based on educational qualifications and the personality scores of the candidate.

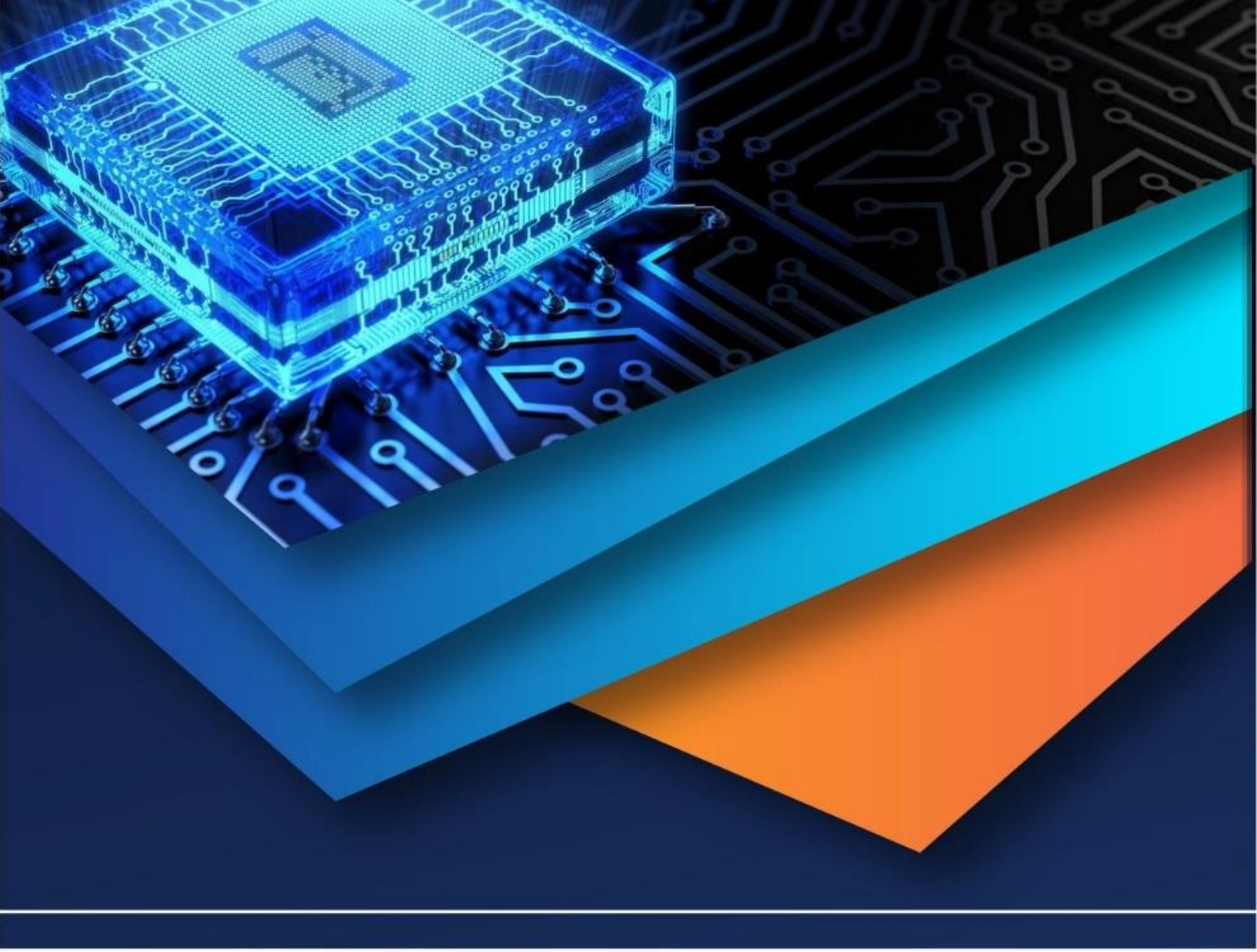
V. CONCLUSIONS AND FUTURE WORK

An Intelligent interview agent is developed to predict the scores of Big Five Personality traits and thereby those values are used along with the qualification of the candidate for predicting a suitable profession for the candidate. This system is useful to both the candidate and the interviewer. The interviewer can get an idea of the candidate's Big Five personality traits, which helps to evaluate if the candidate is suitable for the role, while the candidate can analyze his/her degree of dominance in the Big Five Personality traits and choose a profession which is most suitable for his/her personality. Therefore, it serves the purpose of both the interviewee and the interviewer. The CNN algorithm is used for the prediction of Big Five Personality traits. The Decision Tree Classification algorithm is employed to predict suitable jobs depending on the scores obtained for Big Five Personality traits, after comparison of various machine learning algorithms to ensure that the best model is used in the system to provide accurate results. Currently, professions related to six different qualifications are only considered for predicting a suitable job for the user. The number of qualifications and the number of professions considered for each qualification can be increased and can also be customised depending on the organisational requirements.

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