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Automatic Personality Recognition in Online Interviews using Deep Learning Techniques

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ABSTRACT: With the rise of artificial intelligence (AI), the automatic analysis of video interviews to identify individual personality traits has become a hot topic of research. This has applications in personality computing, human-computer interaction, and psychological testing, among other things. Advances in computer vision and pattern recognition based on deep learning (DL) techniques have led to the development of convolutional neural network (CNN) models that can recognise human nonverbal cues and attribute their personality traits with the help of a camera. These models can do this because they use DL techniques. Video interviews (AVIs) were processed in this study, and an AI engine called TensorFlow used to do automatic personality recognition (APR) based on features from the AVIs as well as the true personality scores from the facial expressions and questionnaires of 120 real job applicants. In tests, our AI-based interview agent can correctly identify the "big five" traits of an interviewee with an accuracy between 90.9 percent and 97.4 percent, which is good enough for us. Our experiment also shows that even though the machine learning was done without a lot of data, the semi supervised DL approach did very well at recognising people's personalities even though they didn't have to do a lot of manual annotation and labelling. If job applicants manipulate their self-reported personality assessments to achieve socially desirable results, an AI-based interview agent can be used in place of them.

KEYWORDS: Big five, convolutional neural network (CNN), personality computing, TensorFlow.

I. INTRODUCTION

Researchers in industrial and organisational psychology (I/O) have shown that personality is a universal predictor that may be utilised in the hiring process for occupations. There are some businesses that do background checks on job candidates by asking them to complete questionnaires about their personality traits. The problem is that job candidates may embellish their personality features in order to get more employment opportunities. Nonverbal indicators, such as facial expressions and body language, may be difficult to fake in an interview, therefore some companies use them to gauge the personalities of job candidates. A live job interview may be required to get a job, but not everyone has the means or time to do so due to the expense and time restrictions. It is possible to interview many job candidates at the same time using an AVI (one-way asynchronous video interview). Employers may access the audio and video recordings at a later time using this technique. Human raters find it difficult to accurately assess an applicant's personality attributes while using AVI. If you're looking for an accurate assessment of a job candidate's personality, you can't only look at their recorded videos. In I/O psychology and computer science, AI may be better than humans in predicting or recognising an applicant's personality during the screening process. That's because using AI approaches on audio-visual datasets may reach more accurate and dependable prediction power than human raters.

EXISTING SYSTEMS AND DRAWBACKS

Existing methods of behaviour, bodily fluid testing, and physiological parameter assessment. Multiple-choice questions are given to the participants in order to collect their responses. There will be a separate score for each response.
People's scores will be tallied up at the end of the questionnaire so that they may be judged on how they behave. They will be judged on this score. Cortical, a stress hormone, may be detected in persons via the use of either saliva or blood testing.

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Long-term stress monitoring is not possible with any of these approaches. A person's health may be assessed by monitoring and analysing physiological indicators.

A. Behaviour Recognition using Bio signals

Because bio signals indicate the body's most sensitive alterations and enable researchers to check for changes in the body that aren't reflected by the face or body language, they were employed in the early phases of stress detection research. Biomarkers of stress, such as the ECG, EDA, ESR, Respiration, Galvanic Skin Response, and HRV, were examined in these research. These biosignals were also examined for signs of stress. Even more well recognised classifiers like the Support Vector Machine, Linear Discriminant Analysis and Adaboost were used by several of these researchers.

B. Behaviour Recognition using Thermal Image

Increased blood flow and a rise in warmth in the face occur when you're anxious. To test whether this change may be noticed in your thermal picture, a lot of study has been done Looking at thermal pictures or looking at factors like the amount of blinks and skin temperature and blood flow using thermal imaging were used in these research to identify stress.

C. Behaviour Recognition using General Image

Anxious people display a variety of facial expressions, and researchers are also working on ways to identify whether someone is stressed by glancing at a photograph of a typical person. It wasn't only the eyes, nose, and mouth that could tell you whether someone was worried; people also looked at the size of their eyes and the movement of their mouths to see if they were stressed.

PROBLEM STATEMENT

To design and develop a real time project to provide a platform for both the Employee and Recruiter to fulfill the job requirement.
The Student/Employee answers to the list of questions (MCQ's) based on analyzing the questions . While answering the questions , the machine recognizes the emotion from which the personality behavior of the person is identified by using Artificial intelligence.
From the personality predictions received the machine can decide whether that particular employee/student is fit for the job or not.

OBJECTIVES

- As a result, a key objective of this project is to develop a system that accurately and efficiently analyses a potential employee's personality and conduct during an interview.
- They don't have to spend as much time and energy as they would if they used paper and pen.
- When a person is in front of the computer, the system will automatically make up a questionnaire. It will be able to figure out the person's personality based on how they answer the questions, and this is how it works.
- There will be a lot of automatic feedback, and it will be stored in storage devices.
- We must provide a photo that is clear and undistorted in order for the face detection to perform properly. In order to identify faces and facial traits, we employed an algorithm.
- Real-time data analysis and graphs of data.

II. LITERATURE SURVEY

Personality characteristics may be identified via the use of artificial intelligence (AI) in video interviews, according to Hung-Yue Suen et al. [1]. This has applications in the fields of personality computing, human-computer interface, and psychological evaluation, according to the researchers. [1] Convolutional neural network (CNN) models that are able to analyse human nonverbal signals and assign personality qualities using a camera have been developed utilising deep learning techniques. Candidates may mislead current self-reported personality assessment approaches to acquire socially acceptable results, but AI-based interview agents may enhance or replace these methods.

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It has been recommended that a novel approach for the selection of elicitation teams for user-centric requirements frameworks by M. Aqeel Iqbal et al. [2]. Big-five personality evaluation is used to choose the best requirements elicitation teams for these frameworks in the described approach. For the current team selection procedure, the most important big-five personality qualities for requirements engineering teams are derived from industry data advertised for the induction of requirement analysts. The big-five personality characteristics predicted by the proposed methodology have been compared to those predicted by other methods. The suggested approach has been shown to significantly enhance the outcomes produced to better assist requirements engineering.

According to Dina Al-Hammadi et al. [3], a study on the Big Five dimensions (OCEAN: extraversion, agreeableness, conscientiousness, neuroticism and openness) is drawing the attention of academics. The future of human-computer and robot-interaction applications that use personality identification looks bright. When listening to someone talk, a wealth of information is conveyed that may be used to identify the speaker. Nonverbal aspects of human speech, however, are the focus of our investigation. We pay attention to how people communicate, not what they discuss. Our primary goal in this study is to test the effectiveness of four distinct machine learning approaches, and we publish our findings in this respect. The Speaker Personality Corpus from the Interspeech 2012 challenge is what we're working with. Our first step is to identify the root causes of the system's poor performance: data imbalance, dimensionality, and judges' agreement. Each problem is addressed and a solution is provided to help the system run more efficiently. Finally, we compare our findings to the baseline and find that our categorization results are superior than the baseline's.

Personality prediction study was developed by Brijesh Kumar Singh and his colleagues [4]. This research aims to detect the personalities of persons based on their actions and behaviours in various settings. A person's ideas, emotions, and actions may be captured by a variety of personality qualities. Personality qualities may be both good and detrimental. The OCEAN (Openness, Consciousness, Extraversion, Agreeableness, and Neuroticism) model is used to measure personality qualities based on the Big Five Model. In the prior research, a number of studies were conducted. Various methods and algorithms have been used to make generalisations about people's personalities. The GSC algorithm has been used by some to predict personality based on handwriting. Using CNN characteristics, facial expressions have been employed in several research. Social networking sites have not been extensively studied in terms of personality prediction by analysing an individual's response to various postings, their comments, and their posts, among other things Emotional traits and their combinations were used in one research to predict personality. Apart from that, the single models we've looked at so far have just a few drawbacks. They function well with a small dataset, but their accuracy steadily decreases as the dataset grows. If you're looking to automate the process, a multimodal agent can better distinguish between verbal and non-verbal personality characteristics.

In their study, Dzhumana Mansour et al. [5] presented a study on the influence of personality qualities like neuroticism, extraversion, and psychoticism on work satisfaction in order to underline the importance that personality types have in employee job satisfaction. Big five personality characteristics and work happiness are among the factors. According to this study, the following five characteristics do not have a significant impact on job satisfaction. The aforementioned elements have a significant bearing on work contentment. Analysis of correlations between characteristics including neuroticism, extraversion, psychosis and work satisfaction was conducted out using this method. Purposive sampling was used to gather the majority of the study's data. Personal questionnaires filled out by sixty aviation sector personnel were used to gather, process, and analyse data based on the sort of work they were engaged in. There are two surveys here. The EPQ-R and the Job Satisfaction Survey were used to investigate the influence of personality factors on overall levels of job satisfaction. In the future, the findings of this research may help to boost employee productivity and raise awareness of the favourable effects of extraversion on work satisfaction.

The article by Maria Koutsombogera et al. [6] provides a summary of the studies conducted in the MULTISIMO corpus to discover personality characteristics in participants' speech. Audio and linguistic elements from participants' speech and transcripts were employed in experiments, together with both self- and observer personality ratings. To our surprise, these findings show that personality characteristics may be accurately predicted using a wide range of methods, not only language content alone. the majority of qualities can be predicted using acoustic cues alone or when paired with linguistic information; findings also reveal that there is no one optimum model or feature set for predicting traits across personality reports, since multiple models work best for various traits.

[7] Marco Moreno-Armendáriz et colleagues employed deep neural networks to construct a model that predicts perceived personality characteristics. Based on a portrait image and the Five-Factor model, the Big Five model may be used to assess a person's personality traits. First Impressions and ChaLearn videos were used to create a new corpus of 30,935 faces and their associated personality attributes to test this strategy's effectiveness. Openness (O),

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conscientiousness (C), extraversion (E), agreement (A), and neuroticism (N) are examples of personality qualities that may be detected automatically using Convolutional Neural Networks (CNNs) (N). Using feature encoding and transfer learning, we are able to increase the number of untagged portraits in the image database from 45,000 to 200 million, yielding an accuracy level that is comparable to current industry standards (though not directly comparable), and an overall classifier accuracy level of 65.86 percent when considering the five factors (O=61.48 percent, C=69.56 percent, E=73.23 percent, A=60.68 percent, N=64.35 percent.) For four of the Big Five model's five components, the model outperformed and outperformed humans on average and with better precision (mean accuracy of 56.66 percent). In addition, there are other advantages to this paradigm over the present technology: First, since it is non-invasive and widely available, a forecast may be produced using just one image (e.g. selfies) Using a single model, a picture's characteristics are extracted and categorised automatically.

Yigang Ding et al [8] may be used to mine personality traits. People's personality characteristics may be affected by their online experiences, which in turn affect their online behaviour, especially when it comes to education. Traditional personality studies, on the other hand, rely on self-reporting and are subjective, rigid, and time-consuming in their design. Data mining and cluster analysis on the Sina microblog social network were carried out using the Gaussian Mixture Model approach. Using data gleaned from the study and comparison of online user text features and behavioural characteristics, a 14-cluster model of personality traits was constructed and integrated into the Big Five-Factor Model. For online personality trait mining, this approach provides new ideas and is applicable to many application settings since it is accurate, unbiased and excellently scalable.

People's usage of different mobile apps might be influenced by their personality, according to a research by Farid Huseynov et al. [9]. The Big Five personality traits taxonomy was used in this study to measure personality. The Big Five personality traits were assessed using the Mini-International Personality Item Pool assessment. App use data was acquired directly from the devices' built in app usage trackers instead of relying on participant self-reports. Instead than focusing on a single app category, the study participants' actual behaviour was analysed across 10 different app categories. Mobile app usage is significantly influenced by personality traits, according to this study. People who are more open to new experiences are more likely to utilise mobile picture and video editing apps, according to this research. There is a correlation between persons who are more emotionally stable and those who are more careful when it comes to using e-business software. The usage and availability of health and lifestyle mobile apps, as well as Internet search and browsing apps, were demonstrated to be negatively linked with agreeableness. Study findings may be utilised by app developers and marketers in an attempt at attracting more users to their apps.

Morteza Nagahi et al. [10]'s research on the academic performance of engineering students continues to attract attention in the literature. Despite this, few studies have examined the relationship between students' systems thinking (ST) skills, the Five-Factor Model (FFM) personality traits, the proactive personality scale, academic, demographic, and family background factors, and the potential impact on academic performance of these variables. Additional data was collected via the use of a demographic survey as well. To gather data from engineering students, Qualtrics was employed in a web-based study. Students' ST and FFM skillsets and personalities, as well as demographics and family history, were shown to be predictive of academic achievement by two unsupervised learning algorithms. Algorithms developed for this study showed promise in classifying engineering students according to their key competencies and personality factors.

Lingyu Zhang and colleagues [11] studied participants' body language during group meetings to understand more about how individuals interact and their responsibilities in a team. In this study, the frequency with which a person swings his or her arms or establishes eye contact while he or she is the centre of attention is examined, as are the other people's visual traits (such as facial expressions, body movements, and hand placements). Our user surveys revealed a connection between the "Big Five" personality traits (Openness/Conscientiousness/Extraversion/Agreeableness/Neuroticism) and team assessments of the conversation's leader and dominant contributor. We demonstrate that our algorithms are state-of-the-art in terms of Big-Five personality trait prediction, which might be used in systems that automatically understand group meetings and debates.

Huansheng Ning et al. [12] provides an overview of these systems, which will propose persons with similar characteristics as buddies. This kind of FRS works well when the common factor shared by the two people is a physical or social characteristic like race or gender. The opposite is true when it comes to personality types. Not all personality types are compatible with one other, even if they have the same traits. Our FRS is thus built on the big-five personality characteristics model and hybrid filtering, in which the buddy recommendation process is based on personality traits and users' harmony rating. On the basis of this, a personality-based social network site called PersoNet has been built

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using the suggested FRS. PersoNet outperforms collaborative filtering (CF)-based FRS in terms of accuracy and recall, according to user ratings.

It was recommended that researchers explore the relationship between personality characteristics and face qualities by Mingliang Xue and colleagues [13]. An attempt is made to confirm the link between facial features and personality characteristics using a computerised facial image-based personality traits categorization. An initial database of face photos and personality factors is created, and facial attributes are generated using facial landmarks that have been automatically recognised. Classifiers are trained on the retrieved face features for personality traits categorization in a second step. The suggested approach is then used to classify personality characteristics into one or two factors. Personality qualities conscientiousness and neuroticism have been shown to be strongly linked with the retrieved face features. It is shown that psychological qualities with a greater heritability are more closely linked to internal face features, as revealed by the two-factor categorization.

Perceptions of personality are influenced by a variety of factors, including cultural, social, contextual, gender, and outward appearance, according to Ricardo Dar'o Perez Principi et al. [14]. Automatic personality perception techniques are not meant to anticipate the target's genuine character, but rather the personality that external observers would attribute the target in a given situation. Consequently, they have to deal with the inherent human bias in the training dataset. On the other hand, bias analysis in personal computer systems is almost unexplored. In this study, the influence of facial expressions, attractiveness, age, gender, and ethnicity on perceived personality is studied. For regression purposes, we offer a multimodal deep neural network that combines both raw audio and visual inputs, as well as the predictions of attribute-specific model predictions. We also look at spatial-temporal aggregation approaches and the effect of different time intervals on first impressions.. ChaLearn First Impressions dataset conversational clips were used in our study. Regressing apparent personality using the Big-Five paradigm is achieved using our method. As a result of this, we investigate the impact of each bias on our network's final predictions in great depth.

It was proposed by Fania Mokhayeri and her colleagues [15] to look into Deep learning models for still-to-video face recognition. Only one face from a person's personal reference collection is used to compare unrestrained film faces against. For face-to-face matching, the use of deep Siamese networks has recently been used. It's necessary to collect a big number of images in these networks since there's no prior information about the target domain. Many real-world surveillance applications can't use this approach since it's unfeasible. Block-sparsity face matching is used by SiamSRC, while the reference gallery is complemented with a limited number of domain-specific facial images in this page. Unlabeled faces are searched for and then grouped using row sparsity on the target domain films before they are utilised in deployment. It is possible to construct a collection of synthetic faces for each reference by employing an off-the-shelf 3D face model and rendering characteristics (such as location, size, and lighting) that have been discovered in the capture condition space. In order to match query photographs with similarity, the SiamSRC employs sparse representation-based categorization with a block structure. For still-to-video FR, the SiamSRC network surpassed prior systems with a single sample per participant and just a little increase in computer complexity, according to researchers.

According to Brijesh Kumar Singh et al., personality prediction involves recognising the personalities of persons by studying their activities and behaviours in various settings. A person's ideas, emotions, and actions may be captured by a variety of personality qualities. Personality qualities may be both good and detrimental. The OCEAN (Openness, Consciousness, Extraversion, Agreeableness, and Neuroticism) model is used to measure personality qualities based on the Big Five Model. In the prior research, a number of studies were conducted. Various methods and algorithms have been used to make generalisations about people's personalities. The GSC algorithm has been used by some to predict personality based on handwriting. Using CNN characteristics, facial expressions have been employed in several research. Social networking sites have not been extensively studied in terms of personality prediction by analysing an individual's response to various postings, their comments, and their posts, among other things Emotional traits and their combinations were used in one research to predict personality. Apart from that, the single models we've looked at so far have just a few drawbacks. They function well with a small dataset, but their accuracy steadily decreases as the dataset grows. Using both verbal and nonverbal cues, an intelligent multimodal agent may detect personality characteristics more accurately than if just using one modality.

According to Hugo Jair Escalante et al. [17], Decision support systems must be able to be explained and interpreted. Despite their significance, scholars have only just begun to investigate these elements. An introduction to explainability and interpretability in the context of apparent personality recognition is presented in this article To our knowledge, this is the first time this has been attempted in this way. In this post, we outline a challenge we organised on the topic of explaining first impressions analysis based on video. This issue requires a thorough examination of all of the newly

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presented data, assessment process, and solutions, and we've done just that. Bias is something we look at in great depth. Finally, based on our findings, we sketch out potential directions for further research in this area.

According to a research done by JIA XU et al. [18], appearance may have a substantial influence on the development of personality. Face morphology and social signals may reveal a lot about a person's personality and actions, according to substantial evidence. Self-reports of one's own personality traits and physical characteristics are the subject of our investigation. Based on the "Big Five" personality qualities, static face photographs may predict the personality attributes of college students. A dataset of 13,347 data pairs, containing photographs of faces and attributes associated with personality, was constructed in order to begin. There are 1,335 pairs of Big Five personality traits to test and validate after training a deep neural network with 10,667 samples from the dataset. Training a succession of deep neural networks on a big, labelled dataset helped us predict Big Five personality trait scores. This innovative work focuses on deep learning. Looking for distinct personality features in the publically available data may also help us establish the network's sophisticated nature as well. Researchers found that they could reliably deduce almost 70% of a person's personality traits just by looking at a picture of them. Neuroticism and extroversion had the greatest recognition and prediction accuracy for five-character tag classification, with a prediction accuracy of more than 90%. Deep learning neural networks surpass manual characteristics when it comes to predicting personality traits. Neural networks trained on large-scale labelled datasets may be used to predict many personality traits from static face photos, according to the findings. College students from various academic backgrounds have varied personality qualities, as seen in the third point. Other facial image elements may be studied to see whether they have any influence on other personality traits in the future.

Research on apparent personality and emotion analysis are crucial to emotional computing, according to Le Zhang, Songyou Peng et al [19]. Existing works address the issue on their own. Aims of this study are to determine if such high-level affect qualities and their interrelation may be learnt from face photos in the wild together. As a result, we've developed PersEmoN, a network that is both trainable and deep. Two separate convolutional networks, one for emotion and one for apparent personality, form the basis of the system's architecture. Both networks use a multi-task learning architecture and share a bottom feature extraction module. Networks of emotions and personalities each have an own annotated dataset. In addition, a loss function that resembles an adversarial adversary is used to improve representation coherence across diverse datasets. Based on this, we also investigate the link between emotion and apparent personality. PersEmoN's efficacy has been shown via extensive testing.

A study on this topic was recommended by Ghanapriya Singh et al. [20]. Mobile and wearable device users' motion activities are unique to them, and integrating individualised motion samples may help increase the accuracy of motion activity context recognition. However, it is impossible to get a sample of the user's motion activity that is unique to them. Mobile and wearable device users' motion activities may be classified more accurately using a semi-supervised technique that begins with a broad classifier and then customises it based on the user's unique motion patterns. Information theory criteria are used to choose tailored data samples from a target user's personal data set, which is a unique approach. Because each user has a particular gait personality, this is important in enhancing the detection accuracy of motion activity, because the motion activity data patterns accessible in a generalised database are utilised to train a generalised classifier. A generalised classifier's average accuracy for 11 target users is 93.11 percent, but when the device is utilised in in-hand mode, that accuracy rises to 96.50 percent. A customised classifier outperforms a generic classifier in terms of accuracy, especially for people with lower accuracy scores when compared to the generalised classifier.

III. CONCLUSION

An AVI using a TensorFlow-based semi-supervised DL model was created in this study to properly determine an interviewee's genuine personality based on just 120 real samples of job candidates. Our APR method outperformed prior nonverbal communication laboratory research, which had accuracy ranges between 61% and 75%, with a precision rate of over 90% [6]. Use of this AVI's APR may enhance or replace self-reported personality evaluation techniques that can be biassed by job candidates because of their social desire to be picked for work. This is consistent with previous research that indicated that deep neural networks trained on multimodal variables (image frames and audio) may outperform unimodal features in predicting the Big Five qualities. In the future, we may use a combination of visual and prosodic elements to better understand how interviewees express themselves. Furthermore, this research only recruited professionals from a certain field, which may restrict the applicability of these findings to a wider audience. In future studies, it is essential to incorporate a more varied group of participants.

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