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Continuous Student Improvement Using Machine Learning Techniques

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Abstract: ***Student Improvement model aims in identifying student behavior traits and patterns using multiple psychometric tests followed by suggesting ways to improve areas of their interest along with overall psychological balance by continuous testing at constant intervals of time. To identify the subject's strengths, weaknesses, and behavioral interests, assessments are carried out on the principle of psychological assessments which assess the students by making them imagine their reactions in various psychological situations. We use different classification methods to predict psychological factors and the efficiency is measured by performance factors like recall, precision, and F1 score. It is mainly based on 3 Psychometric tests that are Big Five Personality, Benziger Thinking style assessment, and KOLB learning preferences. These tests have a huge role to play in the fields of career guidance and employability. Our model evaluates an individual's personality traits and learning styles and provides a descriptive analysis which helps in identifying students' overall improvement.***
Index Terms: Psychometric tests, BTSA, KOLB, Big Five Personality, Machine Learning

I. INTRODUCTION

Every individual is different from one another in terms of their psychological structure (thinking, behavior, and personal preferences). Psychometric assessments are tests that measure a person's traits, behavior, intelligence, abilities, and aptitude. The tests are widely used in the process of career guidance and placements/employment to match the person's capabilities and check if he/she is suitable for the defined role. Psychometric tests have proven their accuracy in improving one's performance and impact on human life over a long tenure of observation through which one can possess various aspects of development such as learning speed and accuracy, student performance, and career growth. Multiple personality tests can also help organizations to figure out the right candidate for a given position. They are meticulously designed in a way to measure a person's personality and factors like cognitive ability, IQ, EQ, and tendency to react to particular pre-defined situations. Psychometric tests solve real-life problems of students' psychological behavior by suggesting them various methods to improve in all dimensions.
We have used three major psychometric tests to create a model for Continuous student improvement.

A. Benziger Thinking Style Assessment

Benziger developed a model which states that our brain has 4 specialized areas and each is responsible for various functions which differ from each other and imply their strengths, behavior and thinking styles individually. It is used to measure the individuals' preferences in their way of thinking.

1) *MODE 1: BASEL LEFT:* Refers to traits representing order and habits/ daily routines.
2) *MODE 2: BASEL RIGHT:* Refers to traits representing spiritual experiences and feelings.
3) *MODE 3: FRONTAL RIGHT:* Refers to traits representing imagination, expressiveness.
4) *MODE 4: FRONTAL LEFT:* Refers to traits representing logic, mathematics, and structural analysis.[15]

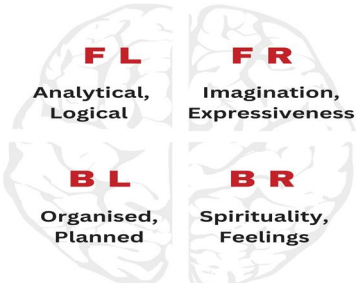

Fig. 1. BTSA

B. KOLB Learning Styles Assessment

KOLB learning styles model describes different learning styles a student may prefer while approaching a task (watch/do) and emotional approach towards an experience(think/feel). Learning styles show how an individual processes information with the aim of learning and applying it. [16] The dominant learning styles are generated from the combinations of learning modes preferred by an individual.

1) *Converger (AC/AE)*: Solve problems using practical solutions and like to experiment with new ideas.
2) *Diverger (CE/RO)*: Prefer to watch and observe things from different perspectives.
3) *Assimilator (AC/RO)*: Prefer reading, lectures and explore analytical models. Good at understanding wide ranging information and organizing it.
4) *Accomodator (CE/AE)*: Prefers hands-on experience and relies more on intuition than logic.

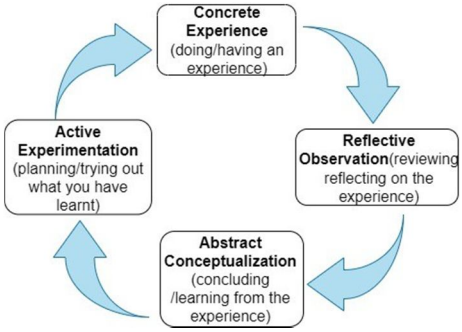

Fig. 2. KOLB

C. Big Five Factor Model

Also known as the Five Factor model, it is widely usedto assess an individual's personality traits. Big five-factor assessment classifies your personality based on 5 different parameters: Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (OCEAN).

1) *Factor 1: Extroversion:* Individuals who score high on Factor I are outgoing and social.
2) *Factor 2: Neuroticism:* Individuals who score high are more emotionally stable and confident.
3) *Factor 3: Agreeableness:* Individuals who score high arefriendly and optimistic.
4) *Factor 4: Conscientiousness:* Individuals who score highare responsible and organized.
5) *Factor 5: Openness to Experience:* Individuals who score high tend to be intellectually curious and have deep imaginations.[17]

The main objective is to make each student undergoingour test to be aware of their strengths, weaknesses, and the departments where they can excel the most. This shall not only make them focused on working for a particular goal but also instill confidence in themselves.

Fig. 3. Five Factor Model

II. RELATED WORKS

Every individual can be differentiated in terms of their own personality. Throughout the year numerous amounts of research have been conducted on psychometric factors affecting a student's educational performance.

In 2011, university students' data was collected from their third-semester course. A questionnaire was used to collect data to describe the relationship between the behavior of students and their final academic performance. The student's final grade was predicted using the SSVM algorithm. Average testing accuracy of the lowest at 61% was achieved for the prediction of "good" performance and the highest at 93.7%for the prediction of "poor" performance [5].

In 2014, 6 classification algorithms were used to predict the student's academic performance. Younger students were observed to have good predictive accuracy and older students' results were less accurate. The resulting accuracy gained for SVM was 73.3% and 60% accuracy were obtained for logistic regression [2].

In 2015 a thinking style assessment was conducted amongst 552 third-year undergraduate engineering students to identify the relationship between brain dominance and academic results. The survey was conducted with a questionnaire using the open-source software MOODLE. It was observed that students achieved better results if their thinking style matches their learning styles and increased brain dominance leads to better academic grades [10].

An automatic personality classification system was proposed by V.Mamatha which uses different data mining techniques to classify the personality of different users. The personality of the user was predicted using the questionnaire of the Big five personality model. The different models used obtained an accuracy of 96% for the decision tree, 91% for SVM, and 78% for logistic regression. Scores were analyzed and calculated based on precision, recall, and F1 score [6].

In 2021, Thahira M and Mubeena A K proposed an approach to predict a person's personality using social media networks by using the OCEAN model. My personality data set was used which consists of status updates, social network features, and comments and articles. The highest accuracy of 58% was obtained for openness-to-experience using the SVM classifier. The deep learning model was observed to have the highest accuracy amongst other machine learning classifiers [7].

A famous stream-of-consciousness essays data set collected by James Pennebaker and Lauren King was used for personality detection. Features extraction was performed using Google's word2vec embedding and Mairese featuresand a binary classifier was used to classify the personality traits. The proposed model was created using deep CNN and the holdout method was used for the evaluation of the model. The model achieved better results as compared to the k-fold cross-validation technique [8].

In the 2021 IEEE paper Twitter data from users' Twitter profiles and myPersonality data set from Facebook was collected for the assessment by Noureen Aslam, Khalid Masood Khan, Afrozad Nadeem, Sundus Munir, and Javairya Nadeem. The big five-factor model is used for prediction. The efficiency of the proposed technique was measured using Precision, Recall, and F1-Score. The prediction model was created using multi-target regression with TF-IDF vectorizer and deep sequential neural network model. They haveachieved 94% accuracy from their training data and 78% for the testing data in predicting the connection between a person's personality and their tweets [1].

III. METHODOLOGY

In this project, personality traits, thinking patterns, and learning preferences of an individual were predicted by using different classification techniques. The accuracy of different classifiers was compared and the algorithm with the best accuracy is applied to the final model. A website is createdfor individuals to take different psychometric tests and a personalized report is generated for every individual.

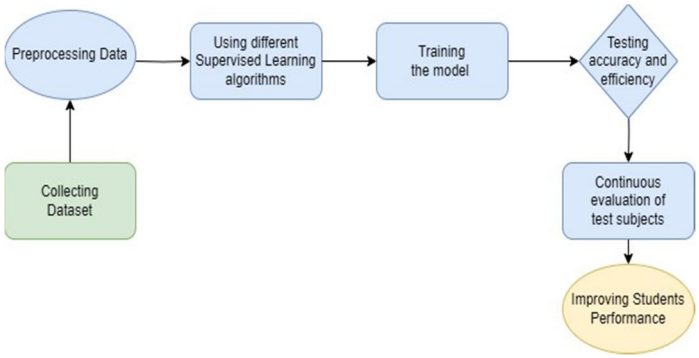

Fig. 4. Block Diagram

A. Data Collection

The dataset was collected from different students by issuing forms. A separate questionnaire was provided for all 3 psychometric tests. Scores were calculated as per the criteria.

Participants were informed that their responses would be recorded and used for research at the beginning of the testand asked to confirm their consent at the end of the test.

For the five-factor model, the personality test was con- structed with the" Big-Five Factor Markers" from the IPIP. https://ipip.ori.org/newBigFive5broadKey.htm Each item is rated on a five-point scale from disagree to neutral to agree.

For BTSA a separate question set was provided for all4 modes of the brain.

A predefined questionnaire was used created by Katherine Benziger.For the KOLB assessment, 34 sets of questions were given to be divided into four learning style scales.

B. Data Pre-processing

The data collected was saved in Excel spreadsheets. Pre- processing included cleaning the dataset removing null and missing values, changing the data types, making the data consistent, and deleting unnecessary columns.

C. Feature Selection

Feature selection algorithms Chi-Squared is used to select the independent variables which are in correlation with the target variable. The lowest score columns can be removed fromthe dataset.

D. Classification Method

Different classification algorithms were applied for the evaluation of the model's performance.

1) *Decision Tree:* It is a type of supervised machine learning used to create a training model to predict the class or value of the target variable by learning different rules extractedfrom the training data. It is widely used for predicting classes in a particular data set. The data set is split into different features using the cost function and forms a hierarchical tree- like structure.
2) *Naive Bayes:* It is one of the easiest and most effective classification algorithms based on the Bayes Theorem thatcan make quick real-time predictions. Predictions are made based on the probability of a variable and are also known as probability classifiers. Since it takes linear time rather thanthe costly iterative approximation used by many other typesof algorithms, it can easily scale to larger data sets [7].
3) *Random Forest:* It is a popularly used supervised ma- chine learning algorithm used for both classification and regression problems. It is a combination of multiple decision trees used to arrive at a singular decision. It provides higher accuracy as compared to a decision tree and can handle big data with multiple features.
4) *Logistic Regression:* Logistic regression is a probabilistic classifier used to predict the probability of a particular event occurring. A particular logic function is used for this method of classification. It is a statistical analysis methodused to predict the dependent variable by understanding the relationship between different independent variables.
5) *Neural Network:* Neural networks are a type of machine learning algorithm that mimics the way the human brain processes different things from its surroundings and makes decisions based on that information. It is a system of artificial neurons that can detect all possible interactions even in complex nonlinear relationships between dependent and independent variables. It is a technique that is widely usedfor complex predictions giving the best accurate results.

IV. RESULTS AND ANALYSIS

We have used machine learning algorithms like the random forest, decision tree classifier, Bayes classifier, logistic regression, and neural network. The algorithms are compared depending on the accuracy and different performance factor like precision, recall, and F1 factor for every trait.

In the case of the Big five Personality model, thereare 5 personality traits to predict personality, openness-to-experience(O), extraversion(E), agreeableness(A), conscientiousness(C) and neuroticism(N).

By using the Naive Bayes classifier, the highest F1 score is obtained for Conscientiousness (0.85) and Neuroticism (0.84) factor. Among all the algorithms neural network model obtained the highest trainingaccuracy of 98% and testing accuracy of 88%.

TABLE I
COMPARISON OF ALGORITHMS FOR BIG FIVE MODEL

Algorithm	Accuracy
Logistic Regression	0.98
Decision Tree	0.74
Random Forest	0.79
Naive Bayes	0.81
Neural Network	0.88

For the KOLB learning styles assessment, the highest per- centage of 64% was observed for diverger, 22% for accommodator, 19% for assimilator, and only 0.5% for converger.In the case of thinking styles, most people were observedto have a dominant basel right or dominant basel left as their dominant thinking preference. About 0.08% showcaseda whole brain pattern and 0.04% had a triple brain thinking style. A relationship was observed between the different think-ing styles and learning styles. Basel left thinking was most correlated with the abstract conceptualization type of learning and similarly, Basel right thinking had the highest correlation with the concrete experience type of learning.

Considering the accuracy of all algorithms we created the model which predicted accurate results and deployed a websitethat would allow individuals to take any tests of their choice. The questionnaire is showcased in a form format and ac- cording to the individuals' preferred answers their personality factors, thinking mode, and listening styles are displayed with descriptive analysis. The results are generated in report formatand can be further used for self-analysis and improvement on different aspects of their personality.

TABLE II
COMPARISON OF ALGORITHMS FOR THINKING AND LEARNING STYLES

Algorithm	Accuracy	
	KOLB	BTSA
Decision Tree	0.81	0.91
Random Forest	0.75	0.89
Logistic Regression	0.91	0.80
Naive Bayes	0.60	0.64

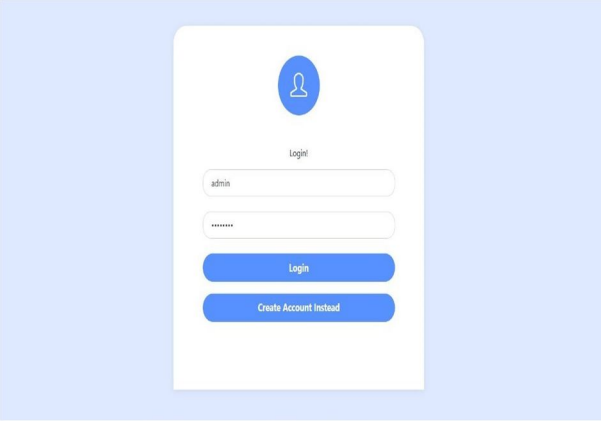

Fig. 5. Login Page.

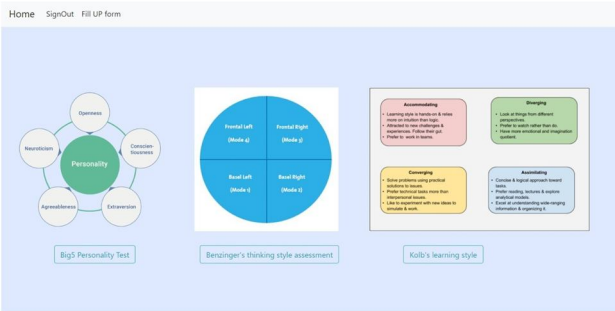

Fig. 6. Personality Tests Website.

V. CONCLUSIONS

We discovered a connection between psychometric parameters such as learning style, thinking style, ability, self-behavior which can be analyzed using machine learning, and suggestions to improve traits that can be automated, thus one can continuously self-analyze using the designed tests and work on self-psychological improvement using the suggestions given by different machine learning techniques. It is possible to enhance the self-awareness of a student in academic and behavioral terms using automated systems fed with data and results and by following the recommendations the chances of success in the chosen path can increase. This project is our attempt to achieve continuous student improvement using an automated system to minimize efforts and maximize overall behavioral results.

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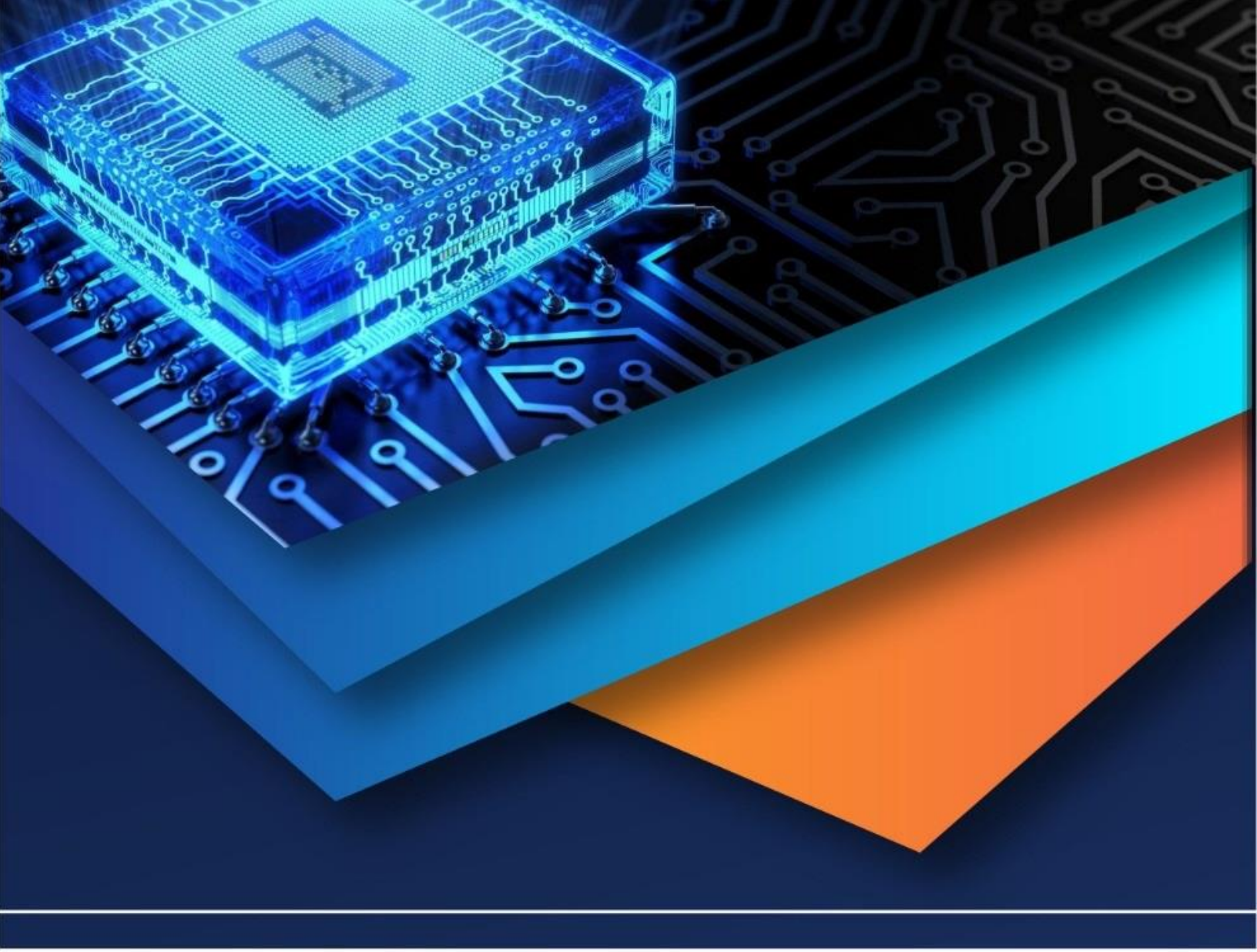

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