

## Automated Personality Prediction of Social Media Users: A Decade Review

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**Abstract:** We live in a world where social media has taken over almost every possible field and has blended into our daily lives. People like to express their interests, thoughts, and views on these social networking sites. This information reveals many psychological aspects of their behaviour that can be used to predict their personality. Personality prediction is a very comprehensive and varied field of study. Over the years, there has been an ample amount of research done in this field. In this paper, we have tried to review the work carried out for personality prediction of social media users in the past decade using the information extracted from their digital footprints. Further, we have also discussed different machine and deep algorithms, datasets, personality measures, and applications of automatic personality detection. To understand the area better, we have done a case study where we used Convolutional Neural Networks model with word embeddings to predict the personality of 50 bloggers using the data accumulated from their blog posts around various topics such as beauty, fashion, travel, food, etc. We concluded that personality of Bloggers in the real world observed in their online columns, validating the hypothesis that the nature of online interactions does not greatly differ from that of real-world interactions.

**Keywords:** Social Media, Personality, Psychological, deep learning, machine learning, CNN, Word Embeddings

### 1. Introduction

Every individual has his own lifestyle, likes, dislikes, perspective, pattern of behaviour, views, etc. which makes them unique. These unique traits sum up and influence the personality of an individual. Our personality has a great influence on how we act in our day-to-day lives, our thinking, interests, and temperament. The study of psychological aspects of personality can help understand how some people are different and yet similar to each other in various ways. It is observed that the personality of an individual is highly correlated with their real-life behavior. It significantly affects the way people interact on social media platforms. Detection or prediction of personality of an individual has become an important feat in recent times. There are various ways through which we can detect the personality type of an individual. To measure the personality of an individual, various personality tests, assessments, and inventories have been developed by psychologists. These tests are extensively used in a variety of settings. These assessment tests are also helpful in professional environments to better understand the good and bad qualities of the subjects, sometimes these tests can help in diagnosing if there are any personality disorders.

The MBTI or the Myers-Briggs Type Indicator is an assessment test of personality types that was developed by Katherine Briggs and Isabel Myers, the mother-daughter duo. The Five-Factor Model or the Big Five model is another such model that is widely used for the assessment of an individual's personality. In this paper, we have tried to explore the works of different researchers from the past decade where they have used digital footprints of social media users to predict the personality of users. When people create their profiles on any social media platform, users tend to reveal a lot of information through the description, pictures, number of connections. These social networking platforms allow users to express their feelings and thoughts through their status, tweets, and daily post. This information can be used to interpret the personality of these users by extracting features from the information that they share openly on these sites. This can be achieved by data mining and employing various deep and machine learning algorithms. This paper provides an overview of various algorithms, computational techniques, and data sets that have been used in the personality prediction and assessment of social media users.

#### Personality Theories and Measures

For years researchers have been studying the psychology of personality and how it influences a person. There are several theories that have emerged from this extensive research. Some psychologists say that each individual has a unique trait that can't be found in any other while some argue that these attributes can draw similar meaning in

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**Table.1.** Personality Models

Personality Models	DISC	MBTI	OCEAN/BIG 5
Traits	<ul style="list-style-type: none"><li>• Dominance</li><li>• Influence</li><li>• Steadiness</li><li>• Conscientiousness</li></ul>	<ul style="list-style-type: none"><li>• Introversion vs Extraversion</li><li>• Sensing vs Intuition</li><li>• Thinking vs Feeling</li><li>• Judging vs Perceiving</li></ul>	<ul style="list-style-type: none"><li>• Openness</li><li>• Conscientiousness</li><li>• Extraversion</li><li>• Agreeableness</li><li>• Neuroticism</li></ul>

different individuals psychologically. Freud's theory suggests that an individual's personality during adulthood is influenced by our childhood. Freud suggested a system where he structured personality into the id, ego, and superego (McLeod, 1970). Viewing personality in traits or attributes is another approach to better describe the personality of a person. According to this theory, attributes differ between distinct individuals but remain constant over time and situations. These attributes are measured in quantitative variables and the score depicts the amount of trait an individual owns. Based on these theories and various personality assessments, different models have emerged over time most popular being MBTI (Myers & McCaulley, 1985) and the Big Five Model (Judge et al., 1999). MBTI is an assessment test is based on Carl Jung's work where the behaviour of humans and their personality is classified into 16 different groups. The Big Five Model is a framework and is based on the trait theory, it is the most popular way of personality assessment nowadays and there are various scholarly articles on this Model. It measures personality based on five traits or categories namely openness, conscientiousness, extroversion, agreeableness, and neuroticism. Table 1 shows the types of Personality models and respective traits in each model.

## 2. Related Works

Throughout the years, various methods and strategies have been applied to predict personality from the digital data. These techniques have been discussed in the remaining part of the paper.

### Detailed Overview

Personality prediction is a very comprehensive and varied field of study. In the past decade, there has been a significant amount of work done on automated personality detection and assessment of social media users. Earlier works on personality prediction from social media data mostly used machine learning techniques. (Golbeck et al., 2011) proposed a method in which the personality of users could be predicted through the data collected from their Facebook profiles. For this study, two machine learning algorithms, M5'Rules, and Gaussian Processes were employed. The results showed that the performance and correlations produced by M5'Rules were stronger as compared to those in Gaussian Process where it showed no correlations. Though their study was effective, they did not focus on the network density between the users, which would have contributed immensely to the research in the area of personality prediction.

In the same year, (Golbeck et al., 2011) again proposed a model to predict the personality using the data users share on the most popular microblogging site, Twitter. To collect data for this research, a personality test for 50 Twitter users was conducted and data was collected from their Twitter profiles of the same users using the Twitter API. LIWC (linguistic Inquiry and word count) tool was used for feature extraction and statistics on 81 features of text were produced. In this study, sentiment analysis of tweets was also performed and two regression algorithms, ZeroR and Gaussian Processes were employed. The results showed that the techniques used in this model can be used to predict the personality of Twitter users from their tweets but the model can show better results on a larger dataset.

(Quercia et al., 2011) presented a study to analyse the personality of different types of Twitter users (popular users, influencers, etc.) and the relationship between these users based on how they interact on online platforms. Regression analysis with 10-fold cross validation technique was performed and the root mean square error was calculated which turns out to be 0.88 which was considerably low. This study observed that there are numerous noteworthy similarities in addition to differences among different Twitter users. The stability of personality traits is the most argued topic among psychologists and researchers.

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(Cobb-Clark et al., 2011) presented a study, results of which indicate that the personality remains stable among working adults but not constant. Various other numeric prediction techniques, LinR, REPTree, and DTable were introduced in the model proposed by (Wald et al., 2012). The data was collected by surveying 537 Facebook users. Out of three numeric prediction techniques, Dtable model showed better performance.

Personality prediction from online data eventually became important in a professional environment. (Shen et al., 2013) presented a study to predict the personality of users from email messages. Since emails consist of private data, the author developed email extraction tools. This study used bag-of-words features, part-of-speech tagging, and Naïve Bayes classifier. Their study was the first attempt at predicting the personality of an email writer.

(Bai et al., 2013) proposed two modeling approaches, incremental regression and multitask regression that was used for personality prediction of 444 Sina Weibo users. The data was collected by conducting a survey that includes a personality inventory test and data from the same users' profiles. The results show a moderate correlation among the 5 traits and the average mean absolute error of the multitasking regression model turned out to be 13.8. (Lima and Castro, 2014) proposed a model to predict personality through the digital footprints of a social media user. In this approach, the model was trained using three machine learning algorithms: Naïve Bayes, SVM, and a Multilayer Perceptron Neural Network. This paper introduces a system called PERSOMA, a personality prediction system for social media data analysis. This system is a multi-label classifier, based on the fact that each personality dimension in the Big Five Model is divided into one binary classifier. The proposed system extracts the meta-attributes from the tweets posted by users. Lastly, the classification algorithm is used to accurately predict personalities through the tweets. The performance was evaluated by applying it on 41 groups of tweets which were created by combining tweets from three different literature sources: Obama-McCain Debate, Sanders, and SemEval2013. These datasets were separated by manual clustering. Results showed that the most difficult trait to predict was openness while the other four traits showed high accuracy and the average accuracy of the system was found to be 83.

Another interesting way of collecting data was introduced by (Wan et al., 2014). They proposed a model to analyse the content of a Chinese social networking site Weibo. Data was collected by crawling the statuses of 131 Sina Weibo users, after which they conducted a personality test based on the Five-factor model with the same users. The extracted content was then analysed by LIWC dictionary which produced 5 classes from 71 distinct features of text. In this model two machine learning algorithms, Logistic Regression and Naïve Bayes were used. Naïve Bayes showed better results on precision while both algorithms had similar results on recall. (Najib & Nawab, 2015) proposed a system to identify age, gender, and personality traits through the tweets of a user. For the research, the PAN-2015 dataset was used which is grouped corpus in which the tweets are classified by author and age of author, language, gender, and corresponding personality traits. This study emphasized the importance of content-based features which can be used to differentiate among texts written by people belonging to distinctive profiles. Four machine learning classifiers: J48, Random Forest, SVM, and Naïve Bayes were used for training the model. The results showed that the system did not perform that well on the testing data as it did on the training data.

(Arroju et al., 2015) proposed two multilingual predictive models using the PAN-2015 data set, the former was used to identify the age and gender of authors, and the latter was used for predicting personality traits. LIWC features were used for predicting personality in this study since the PAN-2015 corpus is composed of multilingual texts from tweets and there are multiple languages available in LIWC dictionaries. The results recorded the best performance for predicting personality traits, age, and gender of the Italian users with the accuracy of 71% while for Dutch users, it gave the worst performance. Another study on personality trait detection, where languages other than English were used was seen in the works of (Peng et al., 2015). They proposed a model to classify the personality traits of 222 Facebook users with Chinese as the main text language. For segmentation of Chinese text, Jieba, which is a segmentation tool for the Chinese language, was used and Support Vector Machine was implied as the learning algorithm for the model. Overall results showed that text segmentation helps in improving the performance of the model in terms of precision and recall.

(Skowron et al., 2016) presented a study, where they integrated text, image, and meta-features of the user profile from Twitter and Instagram. To extract linguistic features, an integrated approach of natural language processing and classifiers were used. While extracting features from images, various annotations such as Pleasure-Arousal-Dominance and brightness were used for emotion detection. Random Forest Regression was used to train the model. This research showed that multi-modal analysis of the data generated from social platforms is possible.

A comparative analysis (Farnadi et al., 2016) showed a variety of other means by which data can be collected from different social media sites such as Facebook, Twitter, and YouTube. (Ngatirin et al., 2016) proposed a study in which the performance of various classifiers such as Naïve Bayes, Functions, Rules, Trees, and Meta in personality prediction of students were compared. A survey was conducted among undergraduate students and to extract the information of the students Twitter Rest API was used. 10-fold cross validation was applied for every classifier and the results show that the OneR algorithm with Rules classifier showed the best accuracy. (Ong et al.,

2017) presented a model to predict the personality of Twitter users based on the information shared on their profile. A total of 359 instances of Twitter users who use Bahasa as their main language was collected. These instances were trained on two algorithms: Support vector Machine and XGBoost. The results showed that XGBoost yields better accuracy of 97.9962% than the Support Vector machine's 76.231%.

**Table .1.** Summary of Earlier Works

Author	Dataset Description	Personality Measure	Technique
Golbeck et al. (2011)	163 Facebook users	BIG 5	M5'Rules, Gaussian Processes
Golbeck et al. (2011)	50 Twitter users	BIG 5	ZeroR and Gaussian Processes
Quercia et al. (2011)	335 Twitter users	BIG 5	Regression analysis
Wald et al. (2012)	537 Facebook users	BIG 5	Linear Regression, REPTree, DTable
Bai et al. (2013)	444 Sina Weibo users	BIG 5	Incremental regression. Multitask regression
Lima et al. (2014)	41 group of tweets	BIG 5	Naïve Bayes, SVM , Neural network
Wan et al. (2014)	131 Sina Weibo users	BIG 5	Logistic regression Naïve Bayes
Najib, Fahad, et al. (2015)	PAN-2015	BIG 5	J48, Random Forest, SVM
Peng et al. (2015)	222 Facebook users		SVM
Arroju et al.(2015)	PAN-2015	BiG 5	Stochastic gradient descent learner
Golbeck et al. (2016)	myPersonality Dataset	BIG 5	Receptivity API with LIWC
Majumder et al. (2017)	Essays	BIG 5	CNN
Ahmad et al. (2017)	1 million tweets	Disc Assessment	
Ong et al. (2017)	Twitter 359 Twitter users	BIG 5	SVM, XBoost
Xue et al. (2018)	myPersonality dataset	BIG 5	AttRCNN, CNN
Balakrishnan et al. (2019)	Cyberbullying dataset	BIG 5, Dark Triad Model	Random Forest
Guilio et al. (2018)	myPersonality data set	BIG 5	SVM with word embedding
Jeremy et al. (2019)	508 Indonesian Twitter users	BIG 5	K-NN, J48, Random Forest, SVM, Naïve Bayes
Hall et al. (2020)	myPersonality dataset	BIG 5	LASSO and Random Forest Models
Kazameini et al. (2020)	Gold standard dataset	BIG 5	Bagged SVM over word embeddings
Zhao et al. (2020)	250 Facebook Users	BIG 5	CNN-LSTM
Kamal et al. (2021)	myPersonality ,Essays	BIG 5	CNN and Pre-trained language models

Other than the Big five Model and MBTI, various other models are used for personality assessment. (Ahmad et al., 2017) proposed a study in which the personality of a Twitter user can be predicted through the data present on their profile using DISC assessment. The DISC assessment is a simple test that is based on four key traits: Dominance (D), Influence (I), Stability (S), and Compatibility (C). People with D personality types tend to be confident and punctual. People with the I personality type tend to be more open, influencing, and persuasive. People with the S personality type tend to be dependable, cooperative, and sincere. People with C personality type tends to be competent, expert, and accurate.

(Cagatay et al., 2017) proposed a new dimension in the field of personality prediction through social media i.e., cross-cultural personality prediction. For this study, two models were built based on features of users belonging to South Korea and Turkey. To train the model, regression algorithms were used, and to increase the performance of the model deep learning algorithms were also employed. The purpose of this study was to investigate any noteworthy differences or similarities between people belonging to two different countries, in this case, Turkey and South Korea, due to cultural and languages differences. (Azucar et al., 2018) emphasized the importance of different types of information available online and its influence on the accuracy of a model. A series of the meta-analysis was performed to determine the impact of the virtual footprints on the accuracy of the model. The results showed an improvement in accuracy.

(Hinds & Joinson, 2019) presented a study in which they addressed a few questions on personality assessment tests that were both human and computer-based. With the growing demand for personality assessment in a number of fields, automation of these assessments has become an important task. Through online media, behavioural patterns of an individual combined with some other additional information can give us a better insight into the person's personality traits. Inevitably, these automated assessments will be considered better in predicting the personality of a user.

(Bleidorn & Hopwood, 2018) proposed a model where they embedded a validation framework with the machine

learning algorithms. This construct validation framework was used to determine the validity of the test results and this approach claimed that test development and theory development were correlated. Thus, incorporating the construct validation approach in the prediction systems could make machine learning a powerful tool in the area of personality prediction. A single trait of any personality model can be broken down into several other attributes or factors, this is known as item level representation of personality or personality nuances.

(Hall & Matz, 2020) proposed a method to predict the personality nuances before the trait to explore the possibilities of improving the predictive performance of the model. This was done by comparing the accuracy of two models: in the first model, the personality trait score is predicted directly and in the second model, the personality nuances are predicted. The results indicated that the second model has been shown to improve the predictive performance of the system. In the past decade, there has been an ample amount of study where digital footprints extracted from social media platforms were used to predict the personality of a user.

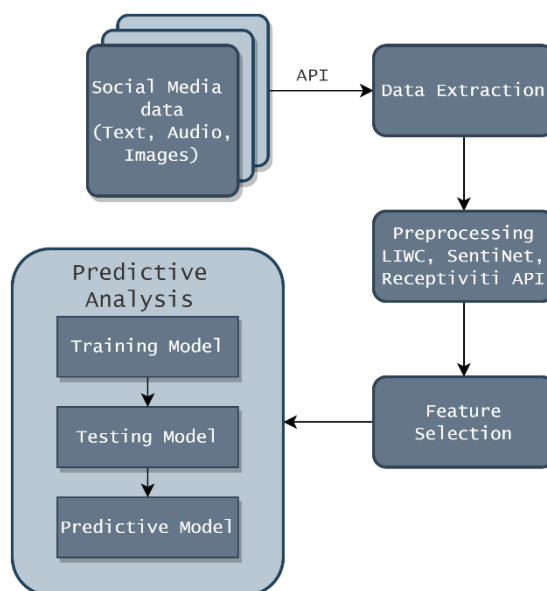
(Stahl et al., 2020) presented a study to predict the personality of a smartphone user from the behavioural patterns collected from smartphones. Since smartphones have sensors, they can be used to collect relevant data on the user’s behaviour (social behaviour, music consumption, app usage, phone activity, etc.). This model showed an accuracy similar to the accuracy of models where data is collected from digital footprints.

(El-Demerdash et al., 2021) proposed a deep learning model using three pre-trained language models (ELMo, ULMFit, BERT) to predict personality. In this paper, two fusion strategies, data level fusion and classifier level fusion, were implemented for better classification and prediction accuracy. Dataset used in this paper is the combination of two datasets, myPersonality, and Essays. The results showed that the accuracy can be improved by fine-tuning the pre-trained models on fused data rather than on each dataset individually. Table 2 shows a summary of earlier works done in the field of automated personality prediction of social media users.

### 3. Methods and Technology

The methodology used in the above works can be summed up into three tasks: data collection, data preprocessing, model building. A general personality prediction framework is shown in figure 1.

**Figure.1** General Framework of Personality Prediction



(Dandannavvar et al., 2018) observed that most of the works on personality prediction have similar methodologies with different variations depending on the way data is collected or different algorithms used in the models. Data collection for the personality prediction model is done by conducting surveys that include a set of questions for determining the personality traits and extracting information from social media platforms of the same users, already existing datasets such as PAN-2015 and myPersonality dataset are considered great for training the model.

Most of the digital footprints extracted from social media are in the form of raw and unstructured text. To use this information, pre-processing of raw text is a crucial step that approximately takes about 70% of the time. LIWC is a software tool that is used to perform analysis on words using its built-in dictionary of words. (Golbeck et al.,

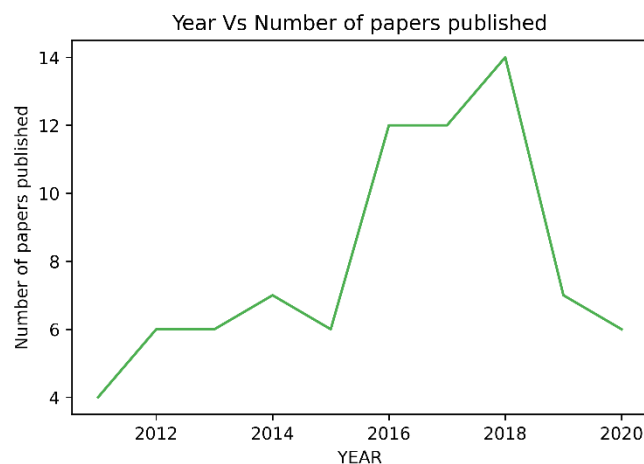
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2016) made use of Receptiviti API over LIWC. Receptiviti API comes with insights into the overall personality traits and social connections of an individual. Text mining makes excessive use of n-grams which are basically a unit of words that lie within a given window. (Jeremy et al., 2019) created n-gram from preprocessed tweets, these word n-grams were then used with Twitter metadata to see how the different frequencies have affected the result of model.

There are a number of machine learning algorithms that have been used in the prediction of personality from online data. (Stachl et al., 2020) gave an insight into classification problems and regression problems. In order to boost the performance of the machine learning models, using classification instead of regression is preferred. This favored treatment emerges from various works done in the past where classification methods seem more intuitive and showed better performance. (Ong et al., 2017) built a model on two algorithms, SVM and XGBoost. XGBoost is an algorithm that is used to boost the performance of machine learning algorithms by implementing them under the Gradient Boost Framework. Support vector machine is a fast classification algorithm that performs fairly well for limited data. (Kazameini et al., 2020) uses bagged SVM over BERT word embeddings. A bagged SVM classifier means that instead of using just one classifier for the prediction model, more than one SVM classifier were used, in this case, 10 SVM classifiers were implemented to increase the performance of the system. Word embeddings can be understood as vector representations of words in which words that have a similar meaning or appear to be similar in some ways are closely placed in vector space. These can be used to comprehend the relationship between words in different settings. (Arnoux et al., 2017) presented a model that integrated word embedding features using Google GloVe with Gaussian Process regression. (Carducci et al., 2018) used tokens to derive the vector space representation and showed how word embedding could be used to test pre-trained models. (An et al., 2018) experimented word embeddings with LSTM by incorporating 300-dimensional GloVe embeddings into the LSTM layer in a deep learning model. (Zhao et al., 2021) proposed a method that is based on CNN-LSTM to analyse the model and its potential to perform sentiment analysis. CNN was used to extract local features and LSTM to extract global features, this way only the most relevant features were extracted which improved the accuracy of the model.

Deep learning algorithms are inspired by the brain's framework and how it works. These algorithms are also implied in personality prediction. (Majumder, 2017) used CNN for classification in the proposed model for document modeling where fixed-length word2vec word embedding were used as an input. (Xue et al., 2018) designed attRCNN which is a variant of RCNN. The RCNN model is modified by incorporating an attention mechanism and batch normalization technique. The results show that features vectors extracted from the proposed model turned out to be most accurate. (Zhu, 2020) presented a model in which a deep neural network based on deep learning was used to construct a classification system. Using deep learning models can provide depth in the network density of social media users which can result in more optimized models. The most commonly used deep learning algorithm in personality prediction is convolutional neural networks. The approach to convolutional neural networks is to apply a filter or feature detector that creates a feature map that highlights relevant features of the input. Figure 2 shows the number of the papers published on personality prediction each year. We found out that a approximately 80 papers were published on personality prediction using social media data in the last decade.

**Figure. 2** Number of Papers Published in the last decade



## 4. Experimental Study

After going through the extensively detailed literature and understanding the different CNN architectures proposed and implemented by different researchers, we have performed an experimental study where we attempted to predict the personality traits of 50 Indian bloggers using Convolutional Neural Networks(CNN) with word embeddings. Personality traits of around 50 bloggers have been predicted by analysing the text in the data collected from their blogs. We developed web crawlers with Scrapy in Python which is a powerful framework for extracting, processing, and storing web data to crawl data of bloggers. For this study, we used the BIG 5 model to predict personality traits namely, Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. The advantage of cross-learning is that training examples from different social media platforms can be combined to increase the accuracy on test data (Farnadi et al., 2014). Such models could also be applied to environments where training data representative for the deployment domain is not available.

### Dataset

To train the model we used the myPersonality dataset which consists of approximately 10,000 statuses labeled with the Big 5 personality traits from 250 Facebook users. The trained model was then used to predict the personality traits of 50 bloggers from categories such as food, travel, beauty, etc. Personality traits values of these 50 bloggers were also collected using a questionnaire, created by the Open-source Psychometrics Project<sup>1</sup>. The questionnaire consisted of 50 questions, 10 questions for each trait rated on a five-point scale ranging from 1 to 5, where 1 is for Disagree and 5 for Agree. Figure 3 shows the sample questions from the questionnaire. Further, we tried to correlate predicted values with questionnaire values to study whether bloggers blogging their real-selves in the:

	Disagree		Neutral		Agree
I am the life of the party.	0	0	0	0	0
I feel little concern for others.	0	0	0	0	0
I am always prepared.	0	0	0	0	0
I get stressed out easily.	0	0	0	0	0
I have a rich vocabulary.	0	0	0	0	0
I don't talk a lot.	0	0	0	0	0
I am interested in people.	0	0	0	0	0
I leave my belongings around.	0	0	0	0	0
I am relaxed most of the time.	0	0	0	0	0
I have difficulty understanding abstract ideas.	0	0	0	0	0
I feel comfortable around people.	0	0	0	0	0
I insult people.	0	0	0	0	0
I pay attention to details.	0	0	0	0	0
I worry about things.	0	0	0	0	0
I have a vivid imagination.	0	0	0	0	0
I sympathize with others' feelings.	0	0	0	0	0
I make a mess of things.	0	0	0	0	0
I seldom feel blue.	0	0	0	0	0
I am not interested in other people's problems.	0	0	0	0	0
I get chores done right away.	0	0	0	0	0

### Methodology

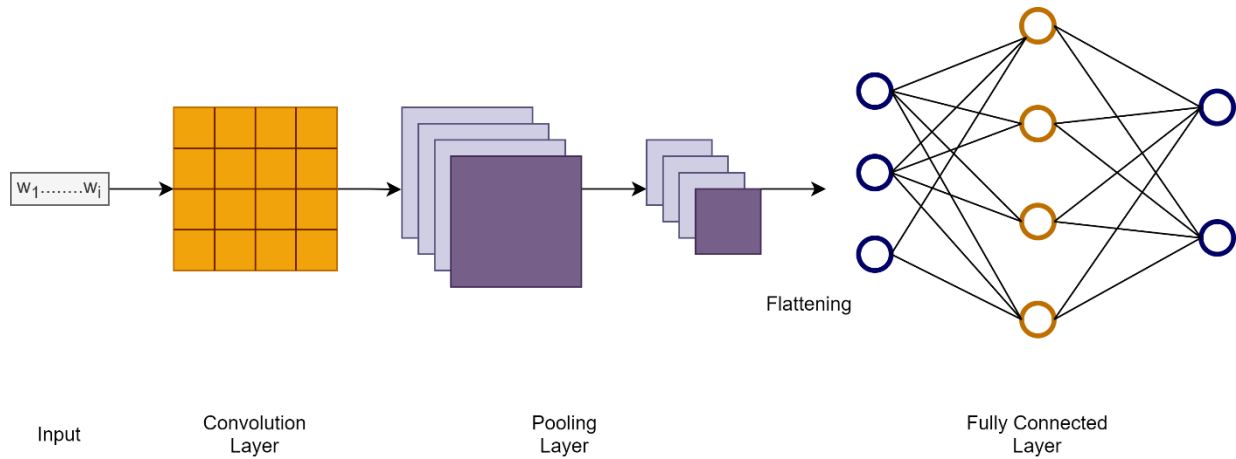
To predict the traits from the textual data of bloggers, the model is trained on the myPersonality dataset using Convolutional Neural Networks. We divided the data set into training set ( $S_{train}$ ) and testing set ( $S_{train}$ ). Input to the CNN is set of word vectors  $W$  trained from Google News<sup>2</sup>. These vectors are embedded in the embedding layer in the form of a matrix  $C$ . For each trait, we have trained five different CNNs. During Convolution process, we apply filters to the input to create a feature map that summarizes the presence of detected features. Hyperparameters used for CNN model fitting is listed in Table. 2

<sup>1</sup> <https://openpsychometrics.org/tests/IPIP-BFFM/>

<sup>2</sup> [GoogleNews-vectors-negative300.bin.gz](#)

Then, max pool function was applied to the output of convolutional layer. It calculates the maximum value for each patch of the feature map. Finally, Softmax function is applied to calculate the probability of a personality trait  $t_i$  exhibited by the text  $s$ . Algorithm used in the proposed research is given below.

**Figure.4.** Working of CNN model



### Algorithm

Initialize Hyperparameters

Split the data set  $S_{train}$  (.85) and  $S_{test}$  (.15)

Obtain a set of word vectors  $W \in \mathbb{R}^{v \times e}$  using pre-trained Google News.

For each  $s$  in  $S_{train}$

Construct word embedding matrix  $C \in \mathbb{R}^{v \times p \times e}$

For each patch filter ( $m$ )=2,3 and 5

Generate eigen values  $c_i = (w_i \times m \times v + b)$  by convolution process

Select the most representative feature  $c(s)$  using MaxPool function

Apply output activation function SoftMax to find the probability of a personality trait  $t_i$  exhibited by the text  $s$ .

$$p(t_i | \hat{\theta}) = \frac{\exp(\beta_i^s \hat{\theta})}{\sum_{j=1}^r \exp(\beta_j^s \hat{\theta})}$$

For each  $s$  in  $S_{test}$

Classify each sample using trained model to test its accuracy.

Create a dataset of 50 bloggers.

Predict the personality traits of Bloggers users using Trained CNN model.

**Table .2. Model Hyperparameters**

Parameter	value
Vocabulary( $v$ )	17636
Maximum sentence length	108
Embedded vector ( $e$ )	300
The convolution kernel size	2,3,5
Hidden activation	ReLU
Dropout	0.5
Learning rate	$10^{-4}$
Batch size	128
Number of epochs	10
Loss function	Categorical Cross-entropy
Optimizer	Adams
No. of Epochs	10

## 5. Results

The results showed that our model achieved the accuracy of 63.84% after evaluating it on five-fold cross validation by randomly splitting the data into 8:2 each time, by training the train set five times, testing the test set five times, and taking the average accuracy as the final result. We also compared our results with previous baseline

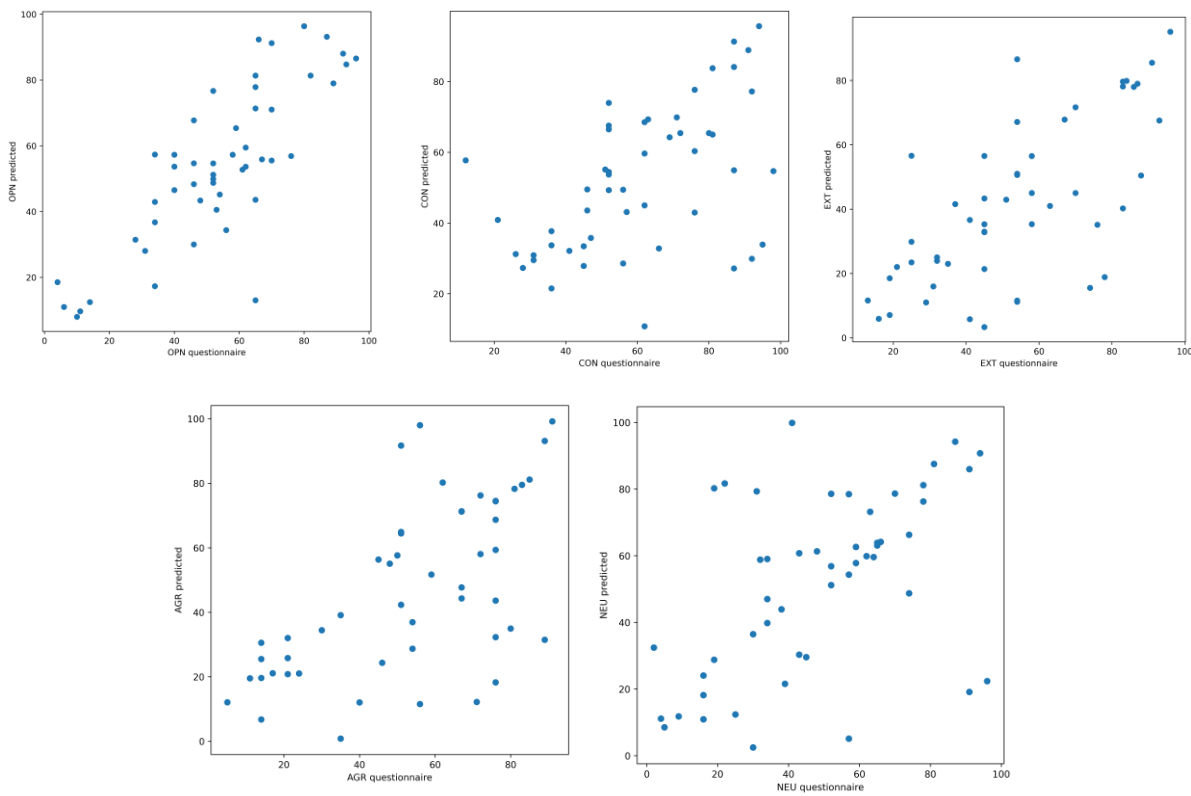


models (Tandera et al., 2017) as shown in Table 3. The finding of our experiments show that our model performed better than existing machine and deep learning models in terms of accuracy.

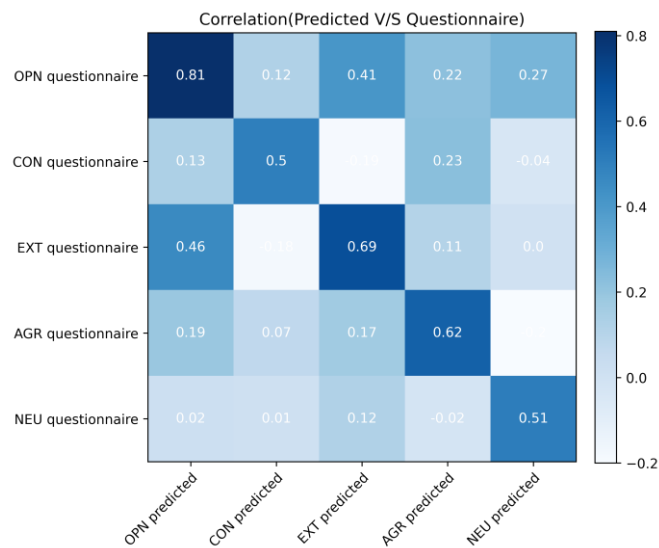
**Table.3.** Comparison of our approach with other baseline models

Technique	OPN	CON	EXT	AGR	NEU	Average
Naïve Bayes	70.00	59.00	68.00	56.40	54.00	61.76
Support Vector Machine	70.40	56.00	61.60	56.80	60.40	61.04
LSTM	68.00	52.00	58.00	56.52	58.62	58.63
CNN	79.31	50.00	60.94	67.39	61.54	63.84

**Figure.5.** Scatter plot depicting relationship between Predicted values(x) and Questionnaire values(y) for 50 Bloggers for all five traits.



**Figure.6.** Pearson Correlation Matrix



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## Correlation Analysis

The relationship between the predicted values from the model and the questionnaire has been observed using scatter plots as shown in Figure 5 for all five traits in BIG 5 Model. The Scatter plots shows raw data for 50 Bloggers (Predicted values(x) vs questionnaire values(y)) for trait Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. On a scatter plots, the closer the points lie to a straight line, the stronger the linear relationship between two variables x and y. Since most of data points line on straight line, they depict a significant correlation between predicted values(x) and questionnaire values(y) for all five traits. Pearson Correlation coefficient(r) is used to calculate the strength of relationship.

$$r = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2 \sum_{i=1}^n (y_i - \bar{y})^2}}$$

where  $\bar{x}$  is the mean of the x values, and  $\bar{y}$  is the mean of the y values. Since the value of r lies between +1 and -1 for all five traits and the correlation co-efficient is significantly different from 0 and more towards +1. We concluded that personality of Bloggers in the real world reflected in their online posts, reinforcing the premise that the nature of online interactions does not significantly differ from that of real-world interactions.

Figure 6 shows the Pearson correlation Matrix for predicted values and the values obtained from the questionnaire.

## 5. Applications

Applications of personality assessment can be understood by acknowledging the importance of personality in today's world. One of the most important factors for hiring a person is the personality of that individual. Therefore, in most professional sectors, conducting personality assessment has become the most important component.

Detecting Cyberbullying by identifying the behavioural pattern of online users is an important application. Social media is a vast platform which allows users to express their thoughts and feelings. Cyberbullying is a byproduct of this freedom of expression on online platforms where people post malicious content and send offensive messages to inflict harm on others. (Balakrishnan et al., 2019) proposed a study for cyberbullying detection on Twitter based on the big five traits of personality and the dark triad model. Results showed that some of the Big Five traits namely extraversion, agreeableness, and neuroticism, and a dark triad trait, psychopathy helped detect the cyberbullies.

There are a lot more possibilities where an automated personality assessment system can be used. (Mehta et al., 2019) in their paper highlighted a few such applications such as enhanced personal assistants where already existing assistants like Alexa, Cortana, etc., could be programmed such that they reveal the personality traits of the users. Specialized health care and counseling system which could be extremely helpful in giving better counseling to an individual based on the personality trait they exhibit.

The most common application of such systems is in the employment industry. Automated tests can be created which used to recognize traits from the applications submitted. (Suen et al., 2019) proposed a TensorFlow-Based Automatic Personality Recognition system that can recognize the five traits of the OCEAN model with an accuracy between 90% and 97.4%. Such systems can be employed in the recruitment processes.

Career counseling is an area that can highly benefit from such systems. There are a vast number of career options available for an individual to choose from and sometimes it can be hard to find the right fit. Such automated personality detection systems can help highlight the traits and qualities possessed by an individual.

## 6. Conclusion

Personality prediction is a very comprehensive and varied field of study and there are numerous applications of automated personality detection as discussed above, so it has become a very important and trending field of research. People are so intrigued with social media that they do not feel shy to put their whole lives online. Interacting through Social Networking Sites has become new normal. Initially, personality was assessed by filling different surveys and questionnaires but from the last decade, integration of social media data into models for personality prediction has proven to be quite beneficial. The main objective of this work is to review, study and assess the work carried out for personality prediction of social media users. It has been further observed that deep learning algorithms have shown better prediction results than machine learning techniques as they have more computational power and can handle larger data more efficiently. They are many Personality assessment measures

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but most of the current datasets that are used to train the model are based on the Big-5 factor model also known as the OCEAN model. In the future, we would like to see more and improved multimodal algorithms for personality prediction

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