Personality Prediction from Social Networks: a Review of Works

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Abstract

Today, the potential of social networks for all types of communication is difficult to overestimate. For business communication in virtual communities, it is important to take into account the socio-psychological features of the participants in the communication process. This actualized various aspects of network identity, virtual personality behavior, and online persona. This study offers a review of the scientific literature on personality prediction based on the analysis of different content generated in social networks. First, we analyzed the literature that used methods for analyzing text and photos from social networks using different approaches. The analysis emphasized that in the modern digital age, psychological aspects of communication in social networks and methods of identifying the personality of social network users based on their social activity and the practice of using language and images are very much in demand and relevant. We have proposed a comparison table of existing personality prediction methods based on relevant parameters. In addition, based on the analysis, a program of future research in the field of intellectual analysis of content for the purpose of personality prediction in social networks was determined.

Keywords 1

Social networks, Facebook, LinkedIn, Twitter, message, personality, personality prediction, review of works, intelligent monitoring, machine learning.

1. Introduction

Prediction of personality is scientific question that science tried to solve many years ago, nowadays as well, because it is the person who acts in a unique way as the subject of activity and communication, they are the builder and transformer of the social and material world, the creator of spiritual and material values.

The problem of personality prediction has become especially relevant in the conditions of the unprecedented dynamism of social processes, the scientific and technical revolution, and the mega-popularity of social networks. Social networks Facebook, YouTube, Instagram, WhatsApp, Twitter, which have the largest number of active users, have become a prominent platform for the exchange of information of various kinds. On the other hand, it is consolidated data from social networks that is the most valuable information for analyzing human actions and predicting personality.

The use of social networks provides scientists with the opportunity to optimize the search prediction of an individual to determine the possible state of a person in the future. Such a forecast is based on the conditional continuation into the future of the development trends of the subject in the past and present, abstracting from the proposed solutions, actions on the basis of which it is possible to radically change the trends, sometimes to cause self-fulfillment or self-destruction of the forecast. Information search results.

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2. Information search results.

2.1. Review of studies on the definition and prediction of personality, its psychological characteristics from social media content

It is believed that our personality is formed, stable and difficult to change. A number of well-known scientists, including H. Jung and A. Augustinaviciute [1, p. 30], held the opinion that the psychological type of a person is unchanged throughout life. Moreover, according to Jung, attempts to change a person's psychological type inevitably lead to mental disorders of the individual. [1, 2].

A number of authors pay attention to the language stability of an individual, when the intention and behavior of an each person individually or communities of people are aimed at consistent, unwavering use of a certain language or language means in daily communication. In this context, the practice of personality modeling based on five main traits ("Big Five" ("OCEAN") has become widespread. Such a personality model represents:

Openness — the openness of experience. Appreciation of art, emotions, adventure, unusual ideas, curiosity, and diversity of experience

Conscientiousness — conscientiousness. Tendency to be organized and reliable, to demonstrate self-discipline, to act obediently, to strive for achievement, and to prefer planned rather than spontaneous behavior.

Extraversion — extraversion. Energy, positive emotions, sociability and ability to activate in the company of others and talkativeness. Extroverted people tend to be more dominant in social settings, unlike introverted people, who can act shyer and reserved in this environment.

Agreeableness — benevolence. Tendency to be sympathetic and cooperative. It is also an indicator of a trusting and altruistic nature, as well as whether a person is generally well-mannered or not.

Neuroticism — neuroticism. Tendency to be prone to psychological stress. A tendency to easily feel unpleasant emotions such as anger, anxiety, depression, and vulnerability.

The practical application of the model ("OCEAN") is proposed in works [3-5].

Today, the mega-popularity of social media and online social networks has led to numerous studies on the problem of online identity, online persona, and identity recognition. In the work of scientists Tommy Tandera, Derwin Suhartono, RiniWongso, Yen Lina Prasetio [6], a prediction system that can automatically predict the user's personality based on his actions on Facebook is proposed. The authors used a personality model representing five main traits: Openness Conscientiousness Extraversion Agreeableness Neuroticism. The data set used in this study is the sample data for the myPersonality project, and the second data set consists of 150 manually collected customers. Facebook API Graph is used in the data collection process. Custom branding is then done manually by entering users' email addresses into Apply Magic Sauce.

Majumder, S. Poria, A. Gelbukh, and E. Cambria [7] proposed a new technique for document modeling based on CNN feature extractor. The researchers used James Pennebaker and Laura King's stream-of-consciousness dataset. A sentence-essay filter transformation was used to obtain a sentence model in the form of n-gram feature vectors. Also, for classification purposes, this study uses a neural network fully coupled with one hidden layer.

These researchers also work in the field of multimodal sentiment analysis. They developed a novel feature-combining strategy that works in a hierarchical fashion, first combining two-by-two modalities before combining all three modalities. The implementation of the method proposed by the researchers is publicly available in the form of open code [8].

D. Xue [9] developed a method of machine learning label distribution (LDL), with which it is possible to recognize the symbols of microblogs. The researcher processed 994 profiles and microblogs of active Sina Weibo customers, and obtained 113 characteristics. All characteristics were divided into three categories: profile-based static characteristics, profile-based dynamic characteristics, and content-based microblog characteristics.

In the work of researchers N. Alsadhan and D. Skillicorn [10], a new method of personality prediction based on short text processing was developed and applied. The data set used consists of four elements. Three elements are marked by "OCEAN" personality traits and one with Myers Briggs

personality types. Python is used to obtain grids of archival words by selecting the 1000 most regular words in each corpus and requiring each word to occur multiple times.

In his work, M. Tadesse [11] used a set of information about the myPersonality project to investigate the existence of social network structures and linguistic characteristics related to personal relationships. The study also analyzed and compared four machine learning models and made a correlation between each set of features and character traits.

C. Li, J. Wan, and B. Wang [12] extracted and analyzed social information from the Chinese microblogging service Weibo. The purpose of the study was to predict personality traits by exploiting user textual information. The work of these scholars used correlation analysis and principal component research to select usage information, and therefore used multiple correlation models, a gray prediction model, and therefore a multitask model to predict and analyze the results.

In a scientific study, A. Laleh and R. Shahram [13] suggested a model that, on the basis of processed activities of Facebook network users in the format of preferences, is able to predict the assessment of their Big Five personality traits. In the study, the LASSO algorithm was used to select the best characteristics of Facebook users and predict the Big Five model.

In a scientific study, Farnadi [14] proposed a deep learning strategy that extracts and uses data in different ways. The hybrid user profiling framework used, which provides a joint representation of all modalities, integrates three sources of feature-level information.

Author Y. Wang [15] investigated the relationship between language characteristics and psychological characteristics of Social Media users. The new language tool was designed to extract three categories of features, namely n-gram packets, POS tags, and word vectors. While evaluating these characteristics, the use of language for different symbols was observed.

Author Gjurkovic [16] ran a large-scale data set labeled with MBTI types, obtained and analyzed a rich collection of characteristics from this data set, and trained and evaluated comparative models for personality prediction. Three different classifiers were used, support vector machine (SVM), 2-regular logistic regression (LR), and three-layer multilayer perceptron.

Scientists in [17] presented a study of different dimensionality reduction methods for extracting hidden features from the text content of tweets for predicting the personality traits of Twitter users. In particular, the researchers tested: PCA, LDA, and NMF and proved that the latent characteristics of the LDA technique are very complete, as it gives the best results in predicting three personality traits and gives acceptable results in the other two traits.

In the study of the group of authors [18], an automatic method of identifying a person based on Twitter is proposed. Researchers use such a machine learning algorithm as SGD, two ensemble learning algorithms, and other techniques.

Author Lei Zhang [19] proposed a new situation-based interaction learning model. In this technique, the obtained situation is characterized by the DIAMONDS lexicon and the calculated interaction. Author Hassanein [20] combined several images of users' texts with several semantic indicators in Facebook status updates to predict the personality of their users. The author, Ahmad [21], analyzed tweets using the DISC system (dominance, influence, relevance, stability). They grouped together more than 1 million tweets and analyzed them for the sentiment.

In the study [22], topical issues of formalization and definition of specific roles of users of social networks are considered. The authors proposed a special system of user activity indicators. Activity indicators were taken as a basis for distinguishing special groups of users, such as opinion leaders, opponents, and trolls. For each group of users, special marks were developed in the form of mathematical expressions using the main proposed values. Another group of signs was based on linguistic influence techniques that are purposefully used in online communication.

In another work of these authors, a group of individual identification data, its network identification, and groups of state security characteristics were considered. Two components are included in the model to describe network characteristics : user activity log and social portrait. Characteristics that describe the level of user interaction with other users and communities are considered [23].

The work [24] presents the results of research into the processes of using information technologies of multi-level intelligent monitoring for the classification of text messages on the Internet in social networks. Two classes of text messages (class of intruders and non-intruders) were formed from the content of the Facebook network selected by experts. The authors investigated the processes of decomposition of text messages of social networks, adaptive formation of dictionaries of signs, use of

an agent approach to the construction of a classifier, and its use for the recognition of intruders. In this work, hypotheses regarding the existence of participants in Ukrainian-speaking social communities who have a common style of presentation of messages are experimentally confirmed.

A separate direction of scientific research is the sociometric analysis of the content of groups and communities in social networks with the aim of predicting effective team activity. The article by Ion Georgiou, Ronald Concer, Andrej Mrvar describes the methodology for analyzing the compatibility and diversity of different, interrelated, structural configurations of groups that are oriented towards achieving a certain goal based on sociometric principles and methodological and measurement standards [25].

The study [26] proposed an algorithm that uses the community structure of a social network and forms a team by choosing a leader together with neighbors within the community. A community-based team building strategy called TFC leads to a scalable approach that builds teams in a reasonable amount of time across very large networks. Experimentation is conducted on a well-known DBLP dataset, where the task is treated as writing a research paper and the title words are treated as skills. The problem of forming a team boils down to finding possible authors for this work who possess the necessary skills and have the lowest communication costs.

The paper [27] presents an analysis of the advantages of the Agent SocialMetric web tool, which is based on the sequential analysis of social networks with intelligent dialogue agents. Researchers Jiamou Liu, Ziheng Wei in their work proposed a game model of cohesion, which is not only based on a social network, but also reflects people's social needs [28]. This model is presented as a type of joint activities in which all participants can gain popularity through the strategic formation of groups.

Based on the analysis of the Twitter social network, Martin Grandjean highlighted the structure of relationships and identified users with a special position. His work also shows that language groups are key factors for the justification of clustering in the network [29].

The study [30] examines the definition of the psychological type of a person through social networks with the help of social analysis. Methods of visual and verbal determination of a person's sociotype are used. Practical examples of this method are given. They clearly demonstrate that knowledge of certain features of the body or the style of human speech with great probability helps to predict how they can behave in certain situations.

In [31], the authors recommend using Jung's basis as criteria for selecting personnel for vacant positions. With the help of four pairs of dichotomous signs, the psyche of a person is determined with high probability and, on this basis, their ability to be involved in the performance of a certain type of work is assessed. For this, the authors suggest using the following methods of analysis: visual, verbal, and, if possible, testing. The study also describes an algorithm for using these methods to form teams, assess their cohesion, and determine the optimal leader. As a source of information for such analysis, it is suggested to use photos and text messages from social networks Facebook and LinkedIn.

2.1.1. Setting the Task.

The purpose of the work is :

- make an overview of studies that investigate various aspects of the problem of personality prediction from various content in social networks;
- determine directions of future research in the field of intellectual content analysis for the purpose of predicting personality in social networks.

2.1.2. Review of the various methods used to predict personality from social media content

A forecast is a scientifically based conclusion about the future state of an object. A state is a set of properties of an object. This means that a forecast is a scientifically based conclusion about how the properties of an object will change in the future.

The condition of the object can change significantly under the influence of internal and external factors. Today, one such external factor is the social media environment.

Analysis of the content created by the user of social networks is the primary source for identifying a person's character. Researchers have intensified their research on predicting a user's personality based on his activity in social networks. Based on the analyzed content from social networks, scientists have proposed various methods and approaches for personality prediction.

The results of a review of works that investigate various aspects of the problem of personality prediction from various content in social networks are presented in Table 1.

Table 1

Review of works that investigate various aspects of the problem of personality prediction from various content in social networks

Author	Summary	Dataset	Method
Tommy Tandera(2017)	Constructed a scheme to predict Facebook users personality through deep learning architectures	myPersonality with a big five. The profiles of 150 Facebook users were studied. Information was collected manually	Both open and closed dictionaries are used for machine learning of models, in particular for their deep learning. the study used MLP, LSTM, GRU, CNN+1D and LSTM with CNN 1D deep learning architectures
Navonil Majumder (2017)	On the basis of the text from social networks, the author's personality type is determined. Pre-processing and filtering of input data, selection of features and classification are carried out. Two types of features are used: a fixed number stylistic features at the document level and word-by-word semantic features that are present combined into a variable-length input text representation.	myPersonality with Big five model	Method for determining the presence or absence of Big Five traits. A new document modeling technique is proposed. The first layers of the network process each sentence of the text separately; then the sentences are combined into a document vector. The method includes the following steps: • Pre-processing: sentence splitting, data cleaning and unification. • Extraction of functions at the document level. • Filtering. • Extraction of functions at the word level. • Classification using deep CNN. Its initial layers process the text hierarchically.
Di Xue (2017)	Proposed a deep learning primarily	myPersonality with Big five model	A method for recognizing the identity

	based approach for personality recognition from text posts.		of the Big Five microblogs in a Chinese language environment is proposed with a new machine learning paradigm called label distribution learning (LDL). One hundred and thirteen features are extracted from the profiles and microblogs of 994 active Sina Weibo users. Eight LDL algorithms and nine non-trivial conventional machine learning algorithms are applied to train Big Five personality trait prediction models. Experimental results show that two of the proposed LDL approaches outperform the others in predictive ability, and the most predictive one also achieves relatively higher performance among all algorithms.
N. Alsadhan (2017)	A way to predict personality from small amounts of text was implemented	Four types of corpora, three of which are marked with Big Five traits of personality, and one marked with MBTI.	The methodology is based on the use of the Python program, which was used to obtain word matrices of the document. The sampling was based on the following approaches: the 1,000 most common words in each corpus were selected; at least 40 repetitions of each word were required.
Chaowei Li (2017)	Focused on the characteristics of the social network and user behaviour, and established three comparative analysis prediction models.	Weibo users, social data and questionnaire with Big five model	Correlation analysis and principal Component analysis to select useful information and then to predict and analyze the results using the multiple

			regression model, the gray prediction model and the multitasking model.
Laleh (2017)	The LASSO algorithm is used to choose the finest characteristics and to predict big five personality characteristics for facebook users.	myPersonality with Big five model	R is used for implementation After standardizing the data, model receives XT rain, YT rain to train the model. To find the optimized value of the hyper-parameter in LASSO model, the cross validation method has been used.
Matej Gjurkovic (2018)	Extracted a number of language and user activity characteristics and conducted a preliminary MBTI dimension analysis.	MBTI9k with MBTI type	A feature of the technique is the use of three different classifiers: SVM, 2-regularized logistic regression (LR) and three-layer.
Andriy Peleshchyshyn (2018)	Modeling of information influence in the social environment of the Internet is presented, namely the interest of current topics for users based on the analysis of user activity and their reaction to publications. The activity of users as respondents was studied and important factors of the analysis of reactions to publications were determined, on the basis of which a mathematical model was built to determine regularities and predict the impact on opinion in the social environment of the Internet.	Facebook users status Manual datasets data	Two components are included in the model to describe network characteristics from the point of view of state security: user activity log and social portrait. The atomic components of the model are reduced to measurement values and data that are suitable for direct storage in a relational database. A typical data model is provided in entity-relationship diagram format.

Serhii Holub (2020)	The information technology of multi-level intelligent monitoring was used to classify text messages. The processes of decomposition of text messages of social networks, adaptive formation of dictionaries of signs, use of an agent approach to the construction of a classifier and its use for recognition of certain groups of persons are studied.	Intelligent Monitoring System (IMS) Facebook data text messages of up to one hundred characters, selected by an expert	Classification technology text messages in social networks
Oleksandr Morushko (2020)	On the basis of Jung's "coordinate system", four pairs of dichotomous signs were used to determine the human psyche. The following methods of analysis were used: visual, verbal. The algorithm for using these methods for forming teams, assessing their cohesion and determining the optimal leader is described.	Jung's basis Facebook end linkedIn data text messages photo content, selected by an expert	The sociological analysis method used in the works consists in determining the psychological type using visual signs obtained from the photo content of social network users, or using word-markers of text messages that allow diagnosing Jung's dichotomous signs.

2.1.3. Future directions of research

The application in the practice of Internet communications of knowledge about the laws and mechanisms of the functioning of the human psyche in different time periods, the use in online marketing and online management of the achievements of psychological science and modern methods of processing Internet content in combination with a personally oriented position and humanistic orientation of methods and technologies, able to meet the needs of the individual and allow him to maximize his potential.

The sources of information about the future behavior of an individual, which are the basis of forecasting, should be the following components:

- evaluation based on experience, analogies of ways of development of the projected object;
- extrapolation of known trends;

- a model of the state of the object in the future, based on taking into account the changes (desired or expected) of those indicators, the prospects for the development of which are sufficiently known.

Forecasting methods provide scientifically based forecasts of the future, namely:

- expert evaluations;
- extrapolation;
- modeling;
- use of analogies.

In recent years, the problem of identifying a person using content in online social networks has attracted great interest [32, 33, 34], but systematic research is just beginning. At the same time, the greatest attention is paid to the problems related to the identification of an individual using the text written by the user in social networks. In particular, most studies distinguish different types of features extracted from textual data used in social media posts. Among the linguistic features, the following are distinguished: LIWC - Linguistic query and number of words, speech acts, published tags, feelings [35]. Non-linguistic features for text identification are distinguished as follows: structural, behavioral, temporal [35].

The relevance of studies that use consolidated data and various types of content generated in various social networks to analyze user behavior is growing.

In our opinion, the promising directions of future research in the field of intellectual analysis of content for the purpose of predicting personality in social networks may be:

- study of the process of classifying the authors of messages with their psychological states;
- detection of a person's psychological state based on his cognitive reflections of text messages in social networks;
- prediction of personality as a consequence of the application of governing influences;
- forecast of the individual's condition based on the results of complex intellectual monitoring of this individual.

3. Conclusions

The purpose of this article was to present an overview of scientific research in which the task of identifying an individual in social networks is set, based on the analysis of user-written text and other content, and to identify future directions for scientific interdisciplinary research on personality prediction. As a result of our research, we have analyzed the various methods or techniques used to predict personality. We reviewed the various studies conducted on social network profiles for the purpose of automatic and expert identification of a person.We elaborated on the dataset and methodology used for each study.

Thus, in the post-industrial, post-modern, and digital era, which is formed in the context of three technological directions - high-hum (high humanitarian), high-tech (high technical), and high-sensory (high sensory-technological), the psychological component of the individual in general and its behavior in the virtual environment is of increasing interest to researchers. Professional interdisciplinary research on personality prediction based on the analysis of various content generated in social networks becomes the basis for the development of effective techniques that meet the needs of strategic areas of online marketing and online management.

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