

## SARCASM AND PERSONALITY TRAITS DETECTION: A REVIEW AND PROPOSED COLLABORATIVE ALGORITHM

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**ABSTRACT:** Personality, as defined in the Encyclopedia of Psychology, refers to the individual differences in the patterns of thinking, feeling and behaving. Recently, studies focused towards the automatic detection of personality traits have increased due to the enormous increase in the use of social media. The Big Five Model is the most widely used psychological model to assess the personality traits which categorizes the personality under five main dimensions. Automatic sarcasm detection is another popular area of research among the researchers due to the same aforementioned reason. This paper is the assemblage of the past work done for automatic detection of sarcasm from texts on social media and recent developments made towards the determination of personality traits from text. It provides an incremental learning approach for sarcasm detection and mapping with personality traits and the results obtained. The paper aims to provide future directions for research for analyzing the personality traits of people who use sarcasm in their texts.

**Keywords:** Big Five Model, Personality Traits detection, Sarcasm detection algorithm, Social Media.

### INTRODUCTION

Social media analytics has become one of the most popular research areas which are basically related to analyze the text written by the online users to determine their emotions, sentiments, religious and political orientations and many more. This has become possible due to the fact that social media has now become a major part of everyone's life. Facebook and Twitter have played an important role in connecting the people online and also provided a platform to share and express views on a global level. Due to the availability of internet and a global platform the outreach of all information is vast and quick. There has been a constant rise in the number of users and data posted online daily.

Detection of personality traits of people through texts has also been one of the popular research areas. Automatic personality detection though has recently been explored with the emergence of social media.

There are a number of psychological models to depict the personality traits of a person like the MBTI Model, NEO-PI Five Factor Model, TIPI Model and Big Five Model. Among all these models, the Big Five Model has been the most accepted and widely used model for researches. The Big Five Model was proposed by Goldberg in 1981. According to this model, the personality traits of a person can be broadly classified under five dimensions. These are Extroversion (EXT), Agreeableness(AGR), Conscientiousness(CON), Openness(OPN) and Neuroticism(NEU). Extroversion is characterized by factors like sociability, expressiveness, assertiveness, and excitability. With the presence or absence of these attributes, a person is said to be extrovert or introvert. Agreeableness is the presence of attributes like trust, empathy, affection and kindness. Agreeable people are prosocial, are friendly and have a helping nature. Conscientiousness dimension is defined by will, thoughtfulness, good impulse control, organized attitude and goal-directed actions. Openness is related to intellect, imagination and insight. Neuroticism trait is the presence of attributes like sadness and emotional instability. People with low neuroticism tend to be more emotionally stable.

Sarcasm detection and analysis has also been among the recent research areas in the text analysis. Among all the texts and data available online, 11% of the data is said to be sarcastic in nature. This has attracted the interest of the researchers to propose various sarcasm detection techniques. Detection of sarcasm is a difficult task as the user actually wants to convey the exact opposite of what he speaks. So, it becomes even more difficult when the detection has to be done on texts, as the emotions and sentiments of the writer are difficult to analyse sarcasm in written form. Twitter has been the main dataset used for the sarcasm detection research due to the fact that the size of the tweets is limited and a lot number of sarcastic people use twitter to depict sarcasm. Various sarcasm detection techniques have been developed in past two decades which detect sarcasm up to certain accuracy and precision. But still no such technique has been developed which can be generalized for all the sarcastic data online.

## 1. RELATED WORK

In the age of internet, people communicate with their friends and families over social media. The texts written by people reflect their personality traits which have been greatly researched upon[16]. Recent developments have been made to gain more psychological insights with the increase in the availability of large datasets over social media like Facebook and Twitter and the increased storage and computational power.

### 1.1 Personality Detection

A number of personality models have been developed for psychological studies like the Big Five Model and MBTI model[2] in which the Big Five Model is most widely used model for psychological as well as computational studies. The Big Five Model broadly classifies the personality of people under five categories which are termed as the personality traits. These are: Extroversion (EXT), Neuroticism (NEU), Agreeableness (AGR), Conscientiousness (CON) and Openness (OPN).

In the age of internet, people communicate with their friends and families over social media. The texts written by people reflect their personality traits which have been greatly researched upon.

Qiu, Lin, Ramsay, Yang[20] performed their research to detect personality traits of 142 participants using their tweets. They also worked to identify valid linguistic cues which can be associated with people of certain personality traits.

Schwartz et al.[21] worked the language used in social media to gain psychological insights of the personality of the users. Facebook status of 75000 users was extracted as dataset and further research. The main features taken into consideration were gender and age of the users.

Lima, Nunes de Castro[10] proposed a personality prediction system for social media data analytics which used a multi-label classifier for personality prediction. The proposed system classified each element of the personality into a binary classifier which is the presence or absence of that element in that personality trait. The tweets updated online by the users were used as the dataset and personality prediction was done solely using the tweets and not the profile information of the users.

Liu and Zhu[12] proposed a deep learning algorithm to perform an unsupervised extraction LRFV to detect personality traits of people over social media. They worked on the Sina microblog for their research.

Majumder et al.[13] developed a novel modeling technique based on CNN feature extractor for automatic personality detection over Twitter. The highlight of their work was the feature extraction at word level, sentence level and document level separately.

Lin, Mao and Zeng in the same year[11] proposed a personality based refinement for sentiment classification of online users. They developed a rule based approach to predict the personality traits of the users. By this approach, the personality based refinement for sentiment classification could capture better features for classification.

### 1.2 Sarcasm detection

The task of detecting sarcasm from text is not an easy one. It involves both the grammar and the sentiment involved in it.

#### a. Techniques and Approaches for Sarcasm detection.

Various techniques to detect sarcasm in text have been developed in different researches. These techniques can be broadly classified under:

#### 1.3 Rule Based Approach.

The rule-based approach applies a set of rules that collectively represent knowledge captured by the system. It follows the if-else conditions to implement the techniques. Rule based approaches are Dictionary based or Corpus based.

Maynard and Greenwood[14] proposed an approach for analysing the impact of sarcasm on sentiment analysis. Their work focuses on Hashtags in Twitter to determine the effect of sarcasm scope on the polarity of tweets. They developed a hashtag tokenizer for GATE to detect the sentiment and sarcasm within hashtags. Their work not only identifies whether a tweet is sarcastic or not, but also considers the range of the sarcasm modifier on the polarity of the sentiment expressed.

Khatti et al.[9] proposed a novel method for sarcasm detection. They used the historical tweets of the author as well that would provide an additional context for sarcasm detection. Their approach used two components: a contrast based predictor to identify if

there was a sentiment contrast in the tweet and a historical tweet based predictor to identify the sentiments of the author towards the target in the past. Hiai and Shimada[6] proposed a rule based approach for detection sarcasm on product reviews to improve the accuracy of sentiment analysis. They proposed a three stage approach in which firstly the input text is classified into 8 classes. The second stage is based on boosting rules about the sentences in which the sentences which contain certain words or phrases are termed as sarcastic and the final stage is about rejecting the sentences which contain the words or phrases for rejection.

**1.4 Supervised Learning Based Approach.**

Supervised learning based is another approach for detecting sarcasm. It is a machine learning based approach in which a function is generated which maps the inputs to desired outputs called "labels". New data can be put under these labels.

Rajadesingan, Zafarani and Liu[18] introduced an effective behavioral modeling technique for sarcasm detection on Twitter. They studied the psychology behind sarcasm, identified its different forms and demonstrated how these forms are manifested on Twitter. They focused mainly on the historical information collected from past tweets to detect sarcasm. This approach was efficient for the data which contained historical information but was not effective if no previous tweets were found or for real time streaming data.

Hern, Far Ias, Patti, Rosso[4] proposed a novel approach emotIDM which was an extension of the model developed by Hernandez Farias et al. in 2015 for irony detection which focuses on the affective information from the tweets apart from the sentiment related features. They evaluated this approach and the result proved that affective features can prove useful for detection of irony on social media. The affective features captured three main values which were activation, imagery and pleasantness.

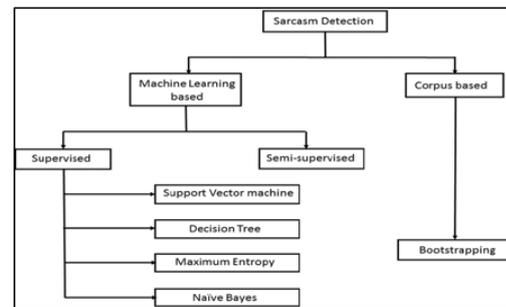
**1.5 Semi-Supervised Learning Based Approach.**

In semi-supervised approach, the training dataset is comparatively smaller and large dataset is used for testing.

Davidov, Tsur and Rappoport[5] proposed a semi supervised approach for sarcasm detection on Twitter as well as Amazon product reviews. Their algorithm utilizes two modules: one for identifying the sarcastic

patterns which is a semi supervised pattern acquisition module that works as a feature for the classifier. The second module is for classification which classifies the sentence into a sarcastic class.

Riloff et al.[19] devised an iterative bootstrapping algorithm which detects sarcasm which arises from positive/ negative contrast. The algorithm learns from phrases which depict positive sentiments and negative situations. The presumption taken for this approach is that in sarcasm, positive sentiments occur simultaneously with negative situations. They used a single seed word "love" and a set of sarcastic tweets as training set to automatically detect positive sentiments and negative situations. However, not all the tweets follow this convention which make this approach less efficient.



**Fig. 1.** Proposed Sarcasm Detection Technique Proposed research model

Figure 2 shows the proposed research model of mapping sarcasm detection with personality traits. This mapping is achieved by selecting / extracting various social media texts over the specific period of time, for either specific case study of an individual or generalized system design including masses.

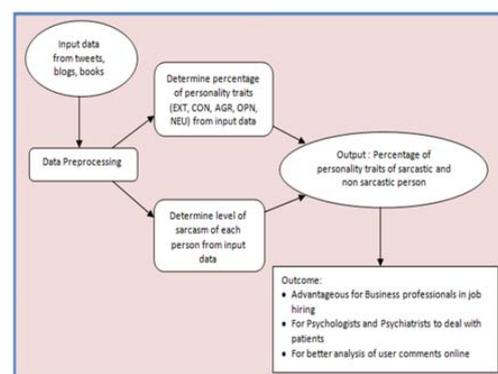


Fig. 2. Proposed Model for Sarcasm Detection Mathematical Model for Proposed System

Let the A be the proposed system represented as a 6-tuple such as  $A = \{S, L, C, u, p, p'\}$  Where,

- S = Author/Writer/Speaker,
- L = Listener,
- C = Context, u = Statements,
- p = Literal Proposition, and
- p' = Intended Proposition.

For example, teacher said to student, "That's how practical assignments should be done!" [11] and student knows that they have barely completed the assignment, they would understand the sarcasm. In context of the 6-tuple above, the properties of this sarcasm would be:

- S: Teacher
- L: Student
- C: The student has not completed his/her assignment.
- u: "That's how assignments should be done!"
- p: The student has done a good job at the assignment.
- p': The student has done a bad job at the assignment.

**1.6 Algorithm Designed for Proposed System**

In this section of paper, the detailed steps of algorithm designed for this proposed system is discussed, showing complete concepts of input, processes and output.

**Input:** First start by choosing a topic, then gather tweets with that keyword and perform sarcasm analysis on those tweets. Personality traits data is ready with classification details.

**Output:** An overall impression of whether people view the topic positively or not and its personality traits.

**Method:**

- Step 1:** Gather Tweets containing input phrases
- Step 2:** Clear out the retweets so that don't have duplicate data throwing off the scores
- Step 3:** Twitter conveniently includes "RT" at the beginning of each tweet, so we find tweets with that string and remove them from data set.
- Step 4:** Input data is scanned for positive and negative words from library called as "Bag of Words" (BoW) and TF-IDF text mining algorithms. "Incremental Learning" about extraction of keywords.

Given a document collection D, a word w, and an individual document  $d \in D$ , we calculate:

$$w_d = f_{w,d} * \log \frac{|D|}{f_{w,d}}$$

- Where,  $f_{w,d}$  equals the number of times w appears in d, |D| is the size of the corpus, and  $f_{w,D}$  equals the number of documents in which w appears in D.
- BoW details:
- Given a corpus of K documents, comprising a dictionary of M words, to find relations of words post-clustering phase.
- The word frequency in the text can be computed by using following formula:

$$tf_{i,j} = \frac{n_{i,j}}{\sum_k n_{k,j}}$$

$$tfidf_{i,j} = tf_{i,j} * idf_i$$

Where,  $tf_{i,j}$  :Frequency of Wordi in BoW

- Step 5:** Apply the Sarcasm detection technique (describe in the above section) on tweeter data
- Step 6:** if the sentiment expressed by a user tweet does not agree with rest of the tweet, the tweet is predicted as sarcastic or if a negative phrase occurs in a positive sentence, then the sentence is predicted as sarcastic else the tweet is not sarcastic
- Step 7:** This final result returns a number in the range [0-2] representing, in order, negative, neutral, and positive sarcastic.
- Step 8:** Based on the quality of sarcasm, map the details with classification suggested for the personality traits, for using Naïve Bays (NB) Algorithm. Naive Bayes Classifier model works with the BOWs feature extraction irrespective of the position of the word in the document (tweeter dataset). It calculates the posterior probability of a class, based on the distribution of the words in the document. By using Bayes Theorem, predict the probability that a given feature set belongs to a particular label or not

$$P\left(\frac{\text{label}}{\text{features}}\right) = \frac{P(\text{label}) * P\left(\frac{\text{features}}{\text{label}}\right)}{P(\text{features})}$$

Where, P(label) is the previous probability of a label or a random feature set the label. P(features|label) is



Iterations	1	2	3
Number of Tweets	960	1120	1200
Minimum Similarity Index	0.02	0.035	0.02
Maximum Similarity Index	5.426	5.671	5.93
Standard Deviation	1.03	1.05	1.04
Number of Clusters Formed	3	2	3
Instances in cluster 1	132	150	165
Instances in Cluster 2	85	100	111
Instances in Cluster 3	100	95	134
Size of Bag-of- Words	35	38	40

### 3. RESULTS SHOWING MAPPING OF % SARCASM WITH PERSONALITY TRAITS

In this section, mapping of the personality traits with the sarcasm is showing with the help of the social data collected from different persons (such as twitter as well as Facebook) and the type of personality traits discussed in the section 1 are as follow:

**Phase 1:** According to the tweet collected from different persons for personality detection, If Person A is 60 % sarcastic based on 1200 tweets, and hence he is Conscientiousness Personality. Person B is 23 % sarcastic based on 1200 tweets, and hence he is Openness Personality and person C is 89 % sarcastic based on 1200 tweets, and hence he is Neuroticism Personality.

**Phase 2:** After some time again collected the tweets from the same persons now person A is 80 % sarcastic based on 1200 tweets, and hence he is Neuroticism Personality. Person B is 23 % sarcastic based on 1200 tweets, and hence he is Openness Personality and person C is 50 % sarcastic based on 1200 tweets, and hence he is Extroversion.

Applying the Naive Bayes Classifier for personality detection,

**Phase N:** If person A is 95 % sarcastic based on 1200 tweets, and hence he is Neuroticism Personality. Person B is 23 % sarcastic based on 1200 tweets, and hence he is Openness Personality and person C is 25% sarcastic based on 1200 tweets, and hence he is Agreeable. Conclude that, person B having the same sarcastic throughout his life span, hence his personality is same as its pervious but in case of person A sarcasm has increases as age increases finally his personality changed to the Neuroticism.

### 4. CONCLUSION

The proposed work will help to gain some psychological insights into the personality traits of people from a different perspective. The research will prove beneficial in following areas:

**Education:** Provide assistance to teachers in schools to deal with students who are sarcastic in nature.

**Psychology:** Support further researches for psychologists and psychiatrists to deal with the people of certain personality traits

**Business:** Assist in the hiring of job associates who have a certain personality type and are suitable for a certain profile.

**Social Media Analysis:** Helps in analysing the personality of people efficiently who post sarcastic comments while buying products online.

The future work on this research can be extended to classify the personality traits of sarcastic people based on the age group and gender of the users. A Comparative study can also be done to determine how personality traits of sarcastic people differ from those the non-sarcastic people. The dataset can be increased by considering the online blogs and books written by the authors as well.

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