

# 스마트 폰 사용에 따른 사용자의 태도 예측

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## Predicting User Attitude Based On Smartphone Usage

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### Abstract

Recently, predicting personality with the help of smartphone usage is become very interesting and attention grabbing topic in the field of research. At present there are some approaches towards detecting a user's personality which uses the smartphones usage data, such as call detail records (CDRs), the usage of short message services (SMSs) and the usage of social networking services application. In this paper, we focus on the predicting user attitude based on MBTI theory by using their smartphone usage data. We used Naïve Bayes and SVM classifier for classifying user personalities by extracting some features from smartphone usage data. From analysis it is observed that, SVM classifier works well as compared to Naïve Bayes.

### 1. Introduction

The increased usage of smartphone has increased the need of user behavior study for providing good services based on their personality. Knowing the users' personality can be a strategic advantage for the design of adaptive and personalized user interfaces [4]. In recent years, the field of Human-computer interaction (HCI) has emphasized the importance of identifying the users' personality traits and preferences in order to build adaptive and personalized systems with an improved user experience [6]. MBTI is frequently used in the areas of pedagogy, career counseling, team building, group dynamics, professional development etc. [5].

Existing research work in the direction of user's personality detection is based on smartphone usage data, such as information extracted from call detail records (CDRs) [1], the usage of short message services (SMSs) and the usage of web, music, video, maps, proximity information derived from bluetooth etc., [2]; GPS log data is used for clustering user locations with the possibility of detecting user's personality preferences [11]. This paper presents predicting user attitude based on MBTI theory i.e. predicting a user is extravert or introvert by using smartphone usage of a user.

In this paper, we focus on predicting user attitude based on their smartphone usage. We gathered about 31 user's smartphone usage data which contains call logs, SMS logs, messenger logs and GPS log data; and also the personality type of a user based on MBTI theory [1]. By using the available dataset, we extracted some features such as call data, SMS data. We developed some assumptions based on MBTI theory. We used two classifiers viz. Naïve Bayes and Support Vector Machine (SVM) to classify smartphone usage data based on user attitude E and I. SVM gives better

classification results than Naïve Bayes, when we use single feature classifying introverts and extraverts; and Naïve Bayes works better when we use all features for classifying introverts and extraverts.

The paper is organized as follows. Section 2 describes methodology which explains dataset used for classification, user personality based on MBTI theory and hypothesis we used to classify the user personality. Section 3 describes the features we extracted from smartphone usage data for classification in detail. Section 4 describes Classification techniques we used to classify the user personalities. Results of evaluation study are described in section 5. Finally, discussion and conclusion is provided in last section.

### 2. Methodology

#### A. Dataset

To predict user attitude based on smartphone usage, we gathered a dataset for a month from 2013 October to 2013 November. Android application is designed and implemented on the smartphone of each participated user to collect user behavior data based on their usage of smartphone. We collected 31 users' smartphone usage data such as call logs (incoming and outgoing call log), SMS logs (SMS received and SMS sent log). And also we collected MBTI-based personality type data of each user. During our experimentation, we mainly focused on I and E attributes of MBTI-based user personality, which describes attitude of a user.

Note that with the proposed approach, call logs and SMS logs are used to predict user attitude by using smartphone usage. Therefore, the data cannot be used in any way to reveal the users' identity or to obtain personal information.

**B. User Personality**

Knowing the users' personality can be a strategic advantage for the design of adaptive and personalized user interfaces. The 16 distinctive personality types are generated by using the four pairs of preferences or dichotomies viz. 1. Extraversion (E) - Introversion (I), 2. Sensing (S) - iNtuition (N), 3. Thinking (T) - Feeling (F), and 4. Judgment (J) - Perception (P) based on the Myers-Briggs Type Indicator (MBTI).

Extraversion (E) - Introversion (I): The extraversion-introversion dichotomy is used as a way to describe how people respond and interact with the world around them. Extraverts are "outward-turning" and tend to be action-oriented, enjoy more frequent social interaction, and feel energized after spending time with other people. Introverts are "inward-turning" and tend to be thought-oriented, enjoy deep and meaningful social interactions, and feel recharged after spending time alone.

**C. Hypothesis**

Based on MBTI theory (explained in User Personality section), we developed some assumption with MBTI user personality (extraversion and introversion) and the smartphone usage data.

Assumption 1: Extraverts get energized after communicating with outside world of people but introverts feel recharged after spending time alone. By considering this assumption, we used incoming and outgoing call duration to check user's talkative nature with outside world.

Assumption 2: Extraverts like to share more information as compared with introverts. With this assumption we used SMS logs.

**3. Features**

With the available dataset we decided to extract some features to classify user personality.

**A. Call logs**

Call log contains number of incoming and number of outgoing call, as well as the duration of call information. Call duration in case of extraverts is greater than introverts; it shows that extraverts are more talkative as compared to introverts.

**B. SMS logs**

SMS log contains number of SMS received and sent as well as the length of SMS. SMS sent by extraverts has greater length than to SMS sent by introverts. It shows that extraverts are interested in sharing more information as compare to introverts.

**4. Classifier**

To predict user attitude by using smartphone usage data, we applied two well-known classifiers, Naïve Bayes Classifier and SVM classifier.

Naïve Bayes Classifier: Naive Bayes models are effective classification tools that are easy to interpret. Naive Bayes is particularly appropriate when the dimensionality of the independent space (i.e., number of input features) is high.

Support Vector Machine (SVM): SVMs are based on maximum margin linear discriminants, and are similar to probabilistic approaches, but do not consider the

dependencies among attributes (features).

**5. Results**

Based on the assumptions explained above in hypothesis section, we used smartphone usage data to extract some features to predict user attitude. Recall and precision is used to get good features for classification. Table I shows the percentage of precision and recall for extravert (E) and introvert (I) by using Naïve Bayes and SVM classifiers in detail. We used features Call logs and SMS logs for classification of extraverts and introverts. When we use Call log and SMS log feature separately SVM can classify extravert and introverts better than Naïve Bayes; but when we use all features together then Naïve Bayes can classify extraverts and introverts better than SVM.

**Table I: Detail analysis of extracted features**

	Type	Naïve Bayes		SVM	
		Precision	Recall	Precision	Recall
Call log	E	78	78	83	100
	I	69	69	100	70
SMS log	E	61	94	86	100
	I	67	15	100	75
All features	E	84	89	71	90
	I	83	77	75	45

**Figure 1: Frequency and Length of SMS Received**

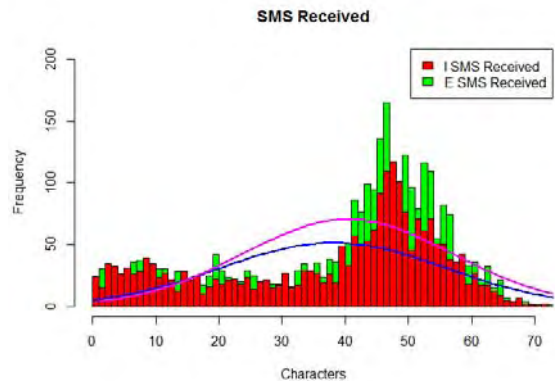
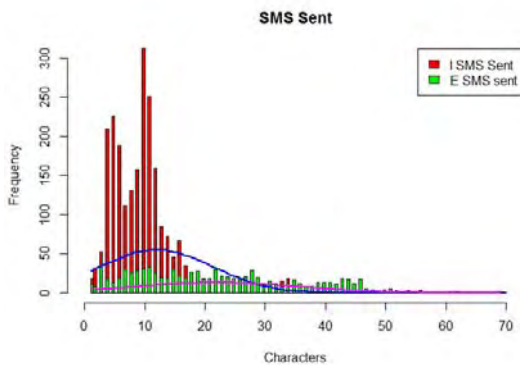


Figure 1 shows the frequency of SMS Vs the length of SMS received by extraverts and introverts. From analysis we observed that, with this feature we may not able to classify the extraverts and introverts very well. So we can say that this feature is not good for classifying E and I.

Figure 2 shows the frequency of SMS Vs the length of SMS sent by extraverts and introverts. We assumed that extraverts like to share more data, so we consider that length of SMS can be feature to classify extraverts and introverts. Distribution curve with blue and magenta color indicates average length of SMS sent by introverts and extraverts respectively. Figure 2 shows that the length of SMS is short but the frequency of SMS sent is higher in introverts than extraverts. In contrast to assumption 2, introverts share data,

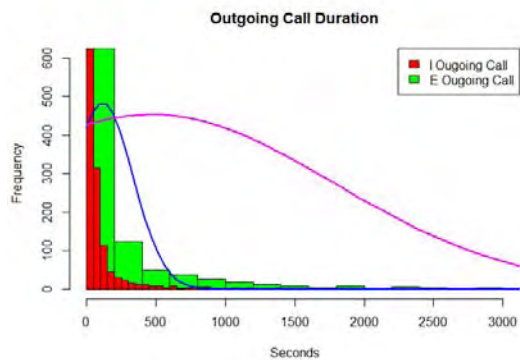
more frequently than extraverts even though amount of sharing data is short in introverts as compared with extraverts.

**Figure 2: Frequency and Length of SMS Sent**



In figure 3 we use frequency and duration of outgoing call in extraverts and introverts as a feature; and the blue color distribution curve shows average outgoing call duration for introverts and the magenta color distribution curve shows average outgoing call duration for extraverts. From figure 3 it is observed that if the duration of call is small then possibly the user is classified as introverts, and if the duration of increased probability of classifying the user as extraverts is increased. From this result we can say that our assumption 1 to classify the user personality with smartphone usage data works well with given data; i.e. extraverts are talkative in nature.

**Figure 3: Frequency and Duration of Outgoing call**



## 6. Conclusion

To predict user attitude based on smartphone usage, we applied two well-known classifiers Naïve Bayes Classifier and SVM classifier for predicting user's attitude. We developed some assumptions for classifying extraverts and introverts by extracting features from smartphone usage data. Precision and recall is used to get good feature for classification. Based on the features extracted from smartphone usage data, we classified extraverts and introverts. From analysis we observed that by using SVM gives better classification results than Naïve Bayes, when we use single feature classifying introverts and extraverts; and Naïve Bayes works better when we use all features for classifying introverts and extraverts.

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