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Non-Functional Requirements Analysis Based on Application Reviews in the Android App Market

Yongming Yao, Tongda College, Nanjing University of Posts and Telecommunications, China*
Weiyi Jiang, Tongda College, Nanjing University of Posts and Telecommunications, China
Yulin Wang, Tongda College, Nanjing University of Posts and Telecommunications, China
Peng Song, Tongda College, Nanjing University of Posts and Telecommunications, China
Bin Wang, Tongda College, Nanjing University of Posts and Telecommunications, China

ABSTRACT

There are more than 3 million mobile apps in the Android market. The development process of every mobile application is rigorous, and many types of research on application quality requirements are derived, which are highly related to the development of applications. Research shows that user reviews of mobile applications are an unused large database that can provide feedback on user needs. In this article, user comments are automatically classified into non-functional requirements (NFRs) and other types. This paper proposes a loop matching classification technique (loop matching classification). The three classification techniques of LMC, BOW, and TF-IDF were used to classify user comments, and the accuracy, recall rate, and F-measure of the results of the three classification techniques were compared. It was found that the precision value of the LMC classification technique was 74.2%, the recall was 82.5%, and the F-measure was 78.1%.

KEYWORDS

Mobile Applications, Non-Functional Requirements, User Comment Categories

INTRODUCTION

Software requirement analysis plays an important role in software development. Requirements engineering mainly describes the functional requirements and non-functional requirements of the system in language as complete and correct as possible.

Mobile apps are computer software applications designed to run on smartphones, tablets, and other mobile devices. Mobile App Store, also known as mobile app Store, is a mobile app platform service that provides free or paid mobile app browsing and downloading services. In recent years, with the popularization of intelligent terminals, people's demand for mobile application software is increasing, and the competition in the mobile application industry is increasingly fierce. By the end of August 2020, 3.51 million apps have been detected in China's domestic market. Mobile Internet is one of the areas with the biggest market potential and the most attractive development prospects, so mobile apps are increasingly valued. Ng YY et al.(2014) conducted consistency comparison and difference comparison among 20 popular Android app stores in China and 25 apps in Google Play, divided the apps into different security levels, and finally ranked the trustworthiness of 21 app stores

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through a simple calculation. Faced with the increasingly fierce market competition, developers need to make a careful plan for the iterative development of App. The mobile App Store adopts the user-driven quality evaluation mechanism, which makes those apps that cannot meet users' needs easily be replaced and eliminated by other apps. Therefore, apps need to respond to users' needs through version update to obtain high user evaluation. The user reviews provided by the mobile app Store contain valuable user demand resources, but the agile development model of rapid iteration and continuous delivery leaves developers insufficient time to extract user requirements from the huge number of user reviews of varying quality. Pagano et al. (2013) found that user participation and feedback are critical to the development of mobile apps, and text feedback published by users in the mobile App Store has a significant impact on the number of downloads of the App. Based on manual analysis, it is concluded and summarized to define 17 and 13 requirements types of users respectively. Pagano also further applies the frequent itemset mining algorithm to mine 20 common demand patterns of users. Iacob et al. (2013) spent two years developing and upgrading MARA, a tool that collects and analyzes user reviews. As a kind of resource that has not been fully developed, user reviews contain a lot of valuable information, which can help developers obtain users' requirements more quickly and accurately. Using user comments to mine valuable information and improve and perfect the application is one of the ways to retain existing users and attract new users. In the face of a large number of user comments, it is time-consuming and impractical to manually screen out valuable non-functional requirement comments, and the informal sentence structure of non-functional requirement comments makes it complicated to identify valuable information. Therefore, how to extract valuable information from user comments efficiently is one of the focuses of current research.

At present, non-functional requirement analysis is mainly based on Chinese language comment mode, Chinese feature selection method, and different classification machine learning algorithms. Hu et al. (2019) mined the seed of comment and defined the comment pattern by dividing software into three types: meeting requirements, having problems, and not meeting expectations. Jia et al. (2019) expanded the generic description vocabulary of non-functional requirements and selected the most efficient group by using the collocation of different classification models to focus on recall rate and accuracy rate. Since most of the paper on the extraction of non-functional requirements for comments are aimed at the English environment, there is a big gap between Chinese and English, such as language habits and traditional culture. At present, the main problem in the mining of non-functional requirements for Chinese text comments lies in the low accuracy of machine recognition of non-functional requirements and the excessive reliance on manual recognition, which leads to project failure and high cost of rework.

Based on the non-functional requirement analysis of Chinese comments in the Android app market, this paper proposes the loop matching classification technique (LMC), which focuses on how to automatically extract and analyze the non-functional requirements in user comments efficiently. The main research contents of this paper are as follows:

1. By combining the ISO25010 standard with the classification techniques (BOW, TF-IDF, and LMC), we selected the technology best suited for processing large amounts of user comment data.
2. The loop matching classification technology proposed in this paper (hereinafter referred to as LMC) can efficiently and automatically extract non-functional requirements in user comments.

The organizational structure of this paper is as follows: Section 2 gives an overview of domestic and foreign non-functional requirements engineering; Section 3 introduces relevant models; Section 4 briefly describes the experiment, reviews several important processes in the experiment, and explains in detail how to select the data set; Section 5 analyzes the experimental results and concludes. Section 6 summarizes and forecasts the future work.