A Dialog Robot Based on WeChat

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Abstract. WeChat is one of the most popular instant messaging applications in the world. It has now become an important access to variety business systems for billions of users. The vast majority of companies want to provide their business services onto WeChat in order to gain advantage in fierce market competitions. However, as far as we know, today it is not easy to access WeChat with business service. In this paper, we propose a framework to integrate business services and WeChat. On the basis of this framework, companies or entrepreneurs can provide their business services on WeChat easily. Finally, we use a case study to demonstrate how our service can be used in helping tickets sells and statistical analysis.

Keywords: WeChat on Web · Dialog robot · SNSs

1 Introduction

In recent years, since the Internet has become more developed, many innovative information services have been created. Of which, Social Networking Services (SNSs) have been well-received by the public. Using the Internet to maintain interpersonal relationships through SNSs has become a part of modern life. SNSs has unique capability to build mobile social networks among people who has the same interests. As network information technology has increasingly advanced, there is a growing trend of people using electronic devices. With the rise of social network services (SNSs), people are using SNSs more frequently, SNSs have gradually replaced many traditional methods of contacting, such as sending emails, typing text messages, or chatting on the phone. There are lots of famous SNSs providers include WeChat [1], KakaoTalk [2], and WhatsApp [3] etc. Because of its capacity to connect people, more and more industry companies devoted a lot of manpower and resources to develop business service among Social Network Services.

However, as far as we know, it is not easy to let industry companies provide their business services for SNSs providers. Because it requires lots of efforts to satisfy the frequently updated APIs offered by SNSs providers. Like WeChat often updates their APIs to provide more comprehensive services.

WeChat is one of the most popular instant messaging applications in the world. It provides text, image, voice and video communication service for smart terminal users.

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Besides the basic functionality of sending message. They can also use multiple convenient services such as WeChat Moments and Official Accounts to share and publish information. Due to the free and abundant services, it not only changed the way people communicate, but also triggered a new media revolution, become the most popular new media communication tools. At the end of 2016, it has covered more than 90% smart phones and the monthly active users reached 889 million from over 200 countries [4].

In February 20, 2014, Tencent announced the launch of QQ browser for WeChat version, that is, WeChat on Web [5]. The purpose of WeChat on Web is to bring more convenient way for users to communicate. It gets through the WeChat mobile version and web version. After that, users can directly send, receive, and even transfer between the computer and mobile phone files in the web browser. It uses its own WeChat Web API to communicate with WeChat server, and it can achieve most of the functions on the WeChat mobile version. The detailed introductions of this API will be given in Sect. 3. Compared to the WeChat Public Platform [6], it has the following three advantages:

(1) It provides more basic functions, which can be extended easily.
(2) If developers who want to use WeChat public API to provide services, they should register a WeChat Official Account first. As we know, the registration process of WeChat Official Account is very cumbersome. It provides few functionalities if you pay more money to upgrade the account. It would be a laborious and costly thing for users who use our framework.
(3) As we use WeChat Web API, developers who use our framework can provide personalized services use any WeChat account (business account or personal account). It can also provide services in WeChat group, which is the Official Account can not do. Therefore, we use WeChat Web API instead of WeChat public API to achieve our framework.

However, we also need to face these challenges: (1) As WeChat do not provide official documentation for Web APIs and it may evolve over time, developing business services over WeChat requires lots of development efforts; (2) As our framework can provide unified API to the developers, it is difficult to abstract all kinds of variety WeChat messages into a standard interface; (3) As the core of our framework is dialogue robot, how to identify the topic and keywords in the conversation is the key to provide good service to users.

To address these three challenges, in this paper, we plan to develop a service-based framework for mobile dialog service using WeChat. Using this framework, developers will save lots of time in reading API specifications of WeChat Public Platform or coding system, since they can easily access their business services through our framework. This framework can also provide other services such as knowledge integration, dialogue analysis and statistic.

2 Related Work

Yitong et al. [7] proposes a framework to integrate WoT and WeChat platform. They designed and realized the system basing on WoT and WeChat public API. Xiang et al. [8] discussed the features of WeChat public platform, and then proposed a smart university campus information dissemination framework based on WeChat public platform. Maohong et al. [9] provided mobile learning resources based on WeChat public platform, and applies WeChat in mobile learning, improve the flexibility of learning, build more good autonomous learning and collaborative learning environment, and promote the learning effect.

Mei et al. [10] propose a framework for providing mobile dialog services using WeChat. They provided a framework with which industry companies can easily provide their IT services using WeChat. This framework can serve as the bridge between users and various information and business functionalities. Their previous study [11] introduced a framework on the social messaging integration in PaaS. They introduced how to provide mobile dialog service in details, which can not only be deployed on PaaS, but also on other standalone VMs.

The above services or frameworks are all based on WeChat public platform. Considering we use WeChat web API instead of WeChat public API, developers can configure their business services use their own WeChat account, rather than spending lots of time in reading API specifications of WeChat Public Platform, design, coding, and debugging or registering the WeChat Official Account. As we all know, the registration process of WeChat Official Account is very cumbersome.

2.1 Technical Architecture

Figure 1 shows the technical architecture of our framework. Our framework includes four major parts: (1) Web platform (2) WeChat on Web (3) Rest [12] API and (4) Our engine for WeChat Integration.

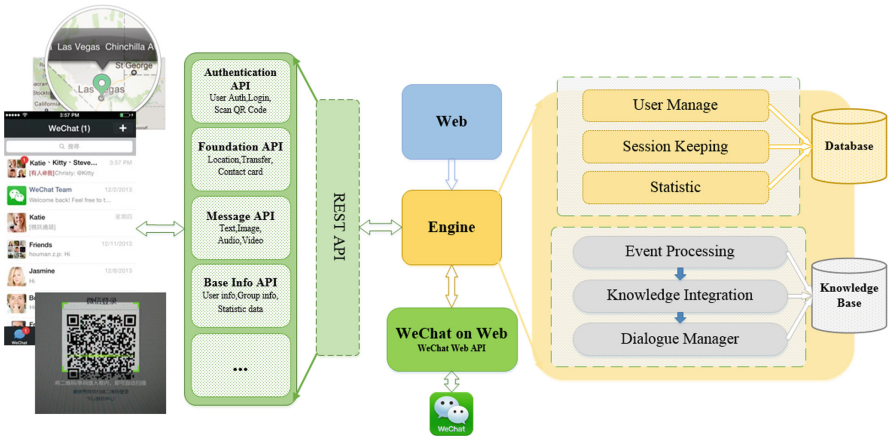

Fig. 1. System architecture for mobile dialog service framework using WeChat.

Web platform provides a simple configuration interface of dialog robot and a variety of statistical graph for the users who are not have the ability to develop the application but still want to provide dialog robot server using their own WeChat account.

The WeChat on Web layer are provided by WeChat Web API, the detailed introductions of WeChat Web API are already given in next section.

The role of Rest API layer is to abstract the business logic into a few main interfaces to the developers or company, it majorly consisted of following four parts: the authentication API, the foundation API, the message API and the base info API as well. These four parts are separated independently in order to make it easy for developers to use it but worked interconnected. The authentication API is used to check the user's legitimacy. It can get the login QR code of WeChat on Web and give interface to check if the QR code is scanned or if the user is logged in. The purpose of the message API is to provide users a message handler process used to receive and send the message from or to the WeChat, which is the fundamental function of instant messaging. Meanwhile, foundation API provide basic functions of WeChat like send location, contact card and transfer with friends. It waits for the event and send the key value to the developer as a response. The forth part is base info part, base info API is for establishing, querying and deleting user or group info.

The engine is the main part of our system, the role of the engine includes the following aspects:

(1) User/Robot manage. In our framework, any WeChat account can be used as a user, but also as a robot. A user can manage multiple robots; a robot can only be supervised by a user. Users can manage each robot in our web platform. All information of users and robots is managed by this module.
(2) Session keeping. As we provide dialog robot using WeChat, each robot need to keep connecting with WeChat use WeChat Web API. In this module we use the Actor model. The actor model in computer science is a mathematical model of concurrent computation which treats actors as the universal primitives of concurrent computation. In response to a message that it receives, an actor can: make local decisions, create more actors, send more messages, and determine how to respond to the next message received. The Actor model can be used as a framework for modeling, understanding, and reasoning about a wide range of concurrent systems. In our framework, each robot is supervised by an Actor. Each Actor has its own context, it manages and maintains all the information of the session, if a robot is disconnected with WeChat, it will send an event to inform the robot's supervisor immediately.
(3) Statistic. The responsibility of the statistic module is to analyze all the conversational data statistically and to present the statistical results to the Web platform for the user's query.
4) Dialogue engine. The dialog engine consists of three parts: Event Processing, Dialogue Manager and Knowledge Integration. In this framework, all messages associated with WeChat are abstracted as events. Events consists of type and content. Event Processing is to abstract the message and do the appropriate treatment according to the different types of events. For example, text messages

will be send to Knowledge Integration for semantic analysis. The role of Dialogue Manage is to maintain the context of the session. Because a robot may serve multiple clients at the same time. In addition, the same sentence in different contexts will be expressed as different semantics. So, in our framework, we use a simple state machine model and keyword matching to handle this situation. We use state to represent different context, the same text in different states will be treated differently. In the same context, what the servers need to do is matching the keywords which are configured by users or developers and feedback information. For example, if the user send "I want to buy a train ticket from Beijing to Shanghai tomorrow", the words "train ticket", "Beijing", "Shanghai" and "tomorrow" would be matched, and the system would get the ticket information from Beijing to Shanghai tomorrow and send back a detail train list to the user. That is what Knowledge Integration do. Its purpose is to find the most approximate response. Its will first find candidates response from database. If there are multiple candidates present. It will choose the highest priority result according to the different semantics. If no candidate response exists, it will send the message to the Turing robot (Third part knowledge base) to find the most appropriate answer.

2.2 WeChat Web API

WeChat have its own customized protocol for Web. Its protocol and data structure have some different between WeChat on iPhone [13] or Android [14, 15]. Figure 2 shows the flow chat of WeChat on Web. Each of the above boxes is an interface, each interface communicates with each other through data, and all of these APIs form the whole WeChat Web framework. It works like this:

(a) The client first gets an UUID from WeChat server, UUID can be understood as a token, it is used for generate QR code.
(b) Then the client sends the UUID to server and get the QR code as response.
(c) The client initiates a request to the server repeatedly to query whether the user has already scanned the code.
(d) If the user scans the QR code, server will return a series of verify message, it includes user identity, session message and token.
(e) The client can use these verify message to fetch detail information of users from server, this information includes user basic information, friend contact and group contact etc.
(f) The client informs the server that the message has been received and establishes a long connection with the server, and then all messages that interact with the server are sent on this link.
(g) If there are new message received, the server will inform the client immediately. This message can be a new friend invitation, a contact card from friend or a red packet from group. Each message has its own specific format. It mainly includes the sender of the message, the recipient of the message, the message type and the content.
(h) Meanwhile, the client can also send various types of messages proactively to the server by its message API.

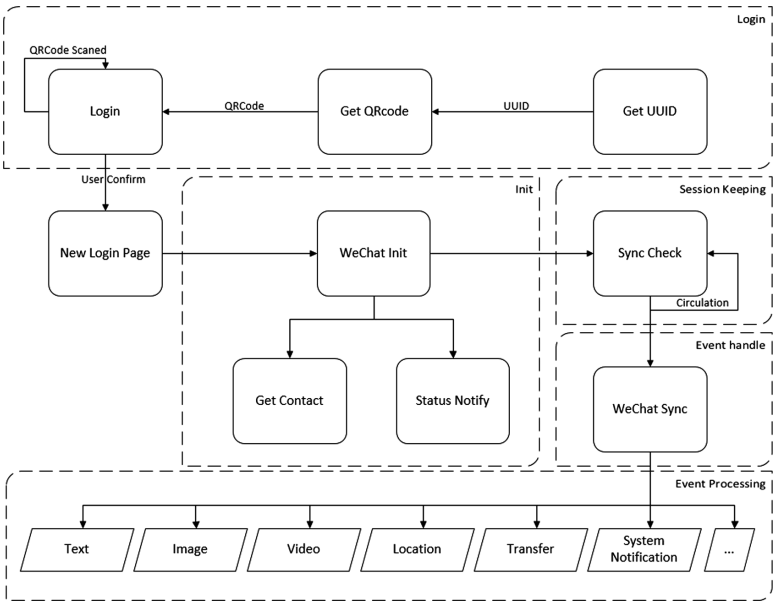

Fig. 2. Flow chart of WeChat on Web.

With this interface, our framework can be achieved with all aspects of WeChat interaction. It can support, including messaging, friend management, group management, personal information settings and all the features of the WeChat on Web, which is the basic of providing dialog robot for WeChat.

2.3 Text Classification

In order to allow robots to provide more humane services, we must first understand the user's input. The most common practice is to analyze the text entered by the user. This process can be divided into two parts, one is the text segmentation, the other is the clustering of text. As we all know, word is the minimum meaningful unit of languages. However, unlike English and other western languages, there is no natural delimiter between Chinese words and even no uniform smallest semantic units.

Many standard machine learning techniques have been applied to automated text classification problems, and kNearest Neighbor algorithm (kNN) and Support Vector Machine (SVM) have been reported as the top performing methods for English text classification [16, 17]. However, the studies on Chinese text classification are less sufficient compared with English and Chinese text has its own characteristic. As there is no natural delimiter between Chinese words, this means that the Chinese segmentation is necessary before any other preprocessing.

Luo et al. [18] give an efficient and effective approach to improve the performance of Chinese text classification. They study on Chinese text classification using character-based approach (N-gram) and word-based approach and propose the use of uni-gram, bi-gram and word features of length greater than or equal to three. They also

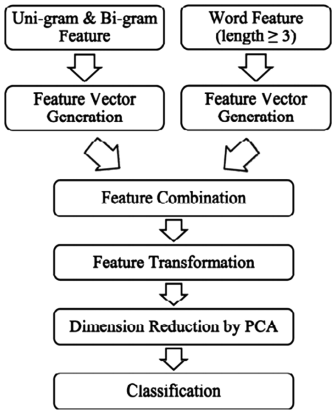

Fig. 3. Steps for Chinese text classification [17].

investigate a serial approach based on feature transformation and dimension reduction techniques to improve the performance. Figure 3 shows their steps for Chinese text classification based on the proposed approach.

After a lot of testing, we use proposed approach of *1 + 2-gram* feature set of *RBF* kernel with the weight coefficient α is assigned a value of 10. In our system, most of the dialogue are short dialogue, like "What's the weather today?". In this case, the algorithm offered by Luo and their team have shown a very good performance in the context of Chinese and English, which can fully meet the needs of robot dialogue analysis in our system.

2.4 Keywords Matching

In our system, it is necessary to determine whether a keyword appears in the text of the conversation. To determine whether a word appears in the text, the commonly method take the pattern string to match the text string word by word, in which case the time complexity is $O(P * T)$ (P represent the length of pattern string, T represent the length of text string), the improved algorithm represented by KMP algorithm, the time complexity is $O(P + T)$, which has a highly matching efficiency. However, in our system, it is often necessary to take multiple pattern strings to match, in which case the time to match a text becomes $O(L * (P + T))$ (L represent the number of pattern string). And usually L is greater than 100. At this case the matching speed is far less than our expectations.

Based on our business scenario (the vast majority of the text is short dialogue), we come up with a method using text string to match the pattern string. First, the pattern string is pre-processed with the form of the K-V stored in the Hashset table. We know that the time complexity of finding an element in a HASHSET is $O(1)$, so the total time complexity reduced to $O(K * 1)$ (K represent the number of segments divided by text string, and the time complexity of searching for a string in a pattern string is constant). And K is less than 10 in most cases. So the speed of matching in this way is very fast, which greatly enhance the efficiency of our robot's text analysis.

3 Case Study

In this section, we present a case study on how our framework can be used by organizing a ticket system. In this case study, we use a train ticket booking for illustration. We demonstrate the capabilities from the following 4 aspects.

(1) Ticket bookings. The robot can provide buying guidance for the users (Fig. 4). And users can simply pay the ticket by red packet. All the operations are user-friendly.
(2) Ticket inquiries. Based on the rest APIs provided by the ticket company, robot can provide real-time ticket query.
(3) Ticket reminder. Before the plane or train departs, the robot will inform the user of preparing in advance by proactively pushing the message.
(4) Statistics. According to the robot's dialogue message, this information can be analyzed from different dimension, such as finding the most active period of users, analyzing the most common topic for users (Fig. 5), and doing some business-related statistics (e.g. Finding out ten highest sales days in one year (Fig. 6)). Meanwhile, these statistics will display on the Web page for developers to view in the form of charts or figure.

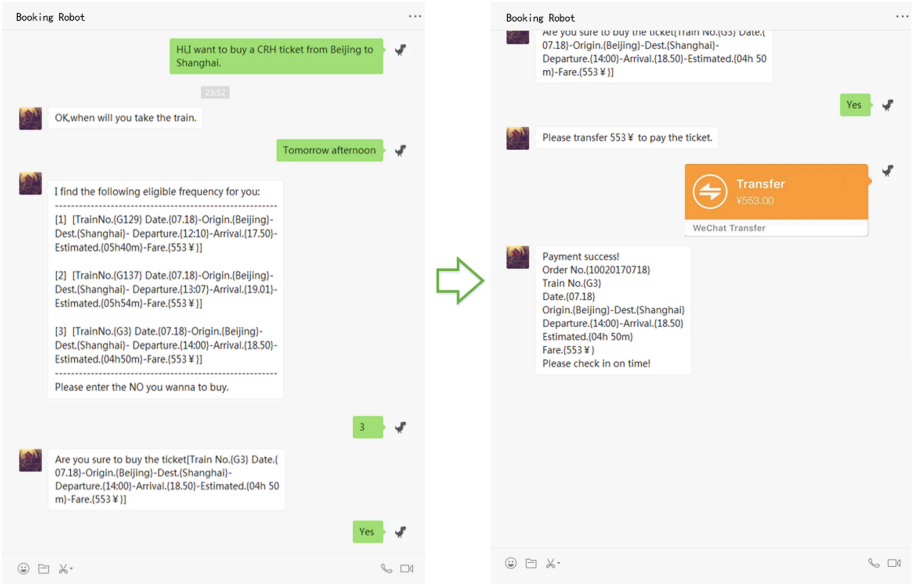

Fig. 4. Payment guidance.

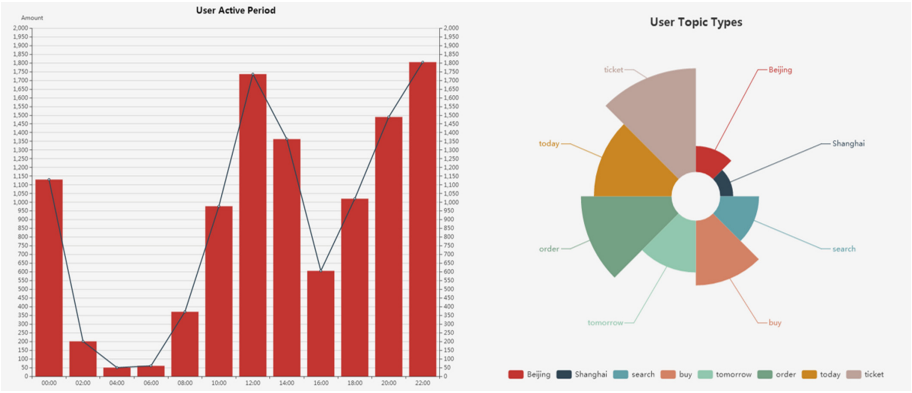

Fig. 5. Statistic data of user.

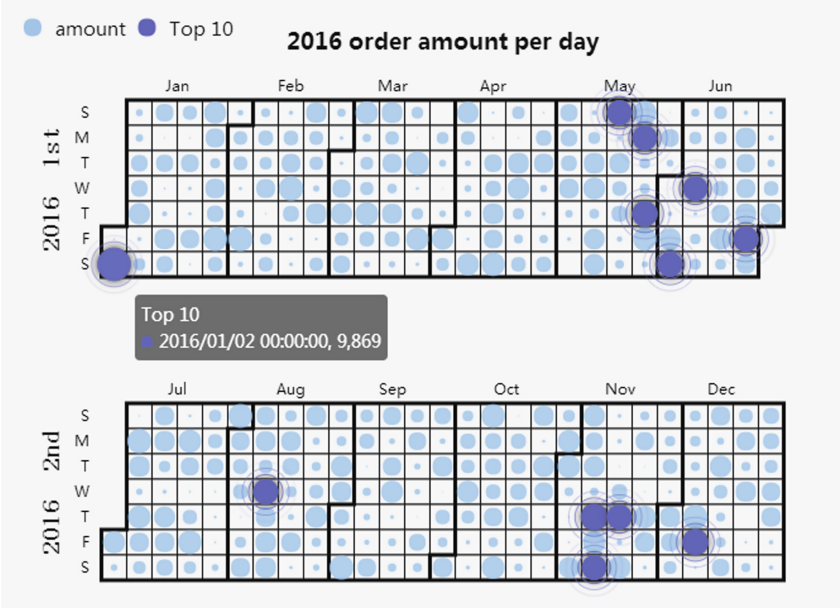

Fig. 6. Top 10 order quantity in 2016.

4 Conclusion

Providing business applications based on WeChat has gradually become popular in recent years. Many industry companies have provided their service on WeChat in order to gain an advantage in the fierce market competition. But as far as we know, to most of developers, it is not easy to build such a dialog robot based on WeChat because WeChat is updated occasionally and it need to spend lots of efforts combining dialog

robot with WeChat server. In this paper, we proposed a framework for providing dialog robot based on WeChat. We explained how our framework work and use a study case to display how to use our framework to provide service. We hope it can help developers reduce the development efforts. But in this version, our robot can only deal with the text message and the position message, maybe the voice and the other information is represented automatically [19, 20] and will be added in the future.

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