e-Wedding Based on Multi-agent System

Kobkul Kularbphettong, Gareth Clayton, and Phayung Meesad

Abstract. Multi-agent system is continuously utilized in e-Business that want to improve responsiveness and efficiency of systems. In this paper, we propose multi-agent-system and various techniques that are Web service, ontology, and data mining techniques. The multi agent system, which constitutes the backbone of the framework, connects these pieces together and makes them perform properly. JADE is the MAS platform implemented this project. JADE is quite easy to learn and use. Moreover, it supports many agent approaches such as agent communication, protocol, behavior and ontology. This framework has been experimented and evaluated in the realization of a simple, but realistic, prototype of an e-Wedding system. The results, though still preliminary, are quite encouraging.

Keywords: multi-agent system, Web services, ontology, data mining techniques, JADE, e-Wedding.

1 Introduction

Nowadays, the explosion of Internet and the grown-up of e-Commerce have rapidly changed the traditional business operation. Electronic Commerce, commonly known as e-commerce or eCommerce is the development and deployment technology of the commercial transactions electronically so as to meet the ever-growing demands of the modern life. Based on web-based business, the wedding business is one of the important businesses that it be huge and still rapidly expanding. Booming of wedding business has also propelled the enhance of hotels, wedding studios, car hiring companies, flower shops, music, travel agencies, and even media businesses. Due to overwhelming information widely spread on internet and real world environments, it is very time consuming for couple to search appropriate information. Moreover, almost successful e-Commerce systems are still handled by humans to make the important decisions. Therefore, with vastly developed advance mechanisms, in this paper we propose the framework of e-Wedding business applied various approaches like multi-agent, web services, ontology, and data mining techniques.

The remainder of this paper is organized as follows. Section 2 discusses about related literatures and research works. Section 3 presents the methodologies used in this work. Section 4 implements the purposed model with a multi-agent

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framework. This prototype demonstrates the whole idea of adapt multi-agent in e-Wedding. Finally, we conclude the paper with future research issues in section 5.

2 Related Works

A literature search shows that most of the related researches have been deployed multi-agent to develop e-Commerce in various techniques by following this:

According to [1], they showed a prototype of the system using the JADE platform in the context of travel industry. Furthermore, other research works show that agent technologies are deployed as a significant tool for developing e-Commerce applications [2]-[7]. Hence, multi-agent technology, a promising approach, trends to handle internet transaction for customers.

Moreover, other researchers propose an agent-based framework representing in various ways.[8]-[11],[14] For instance, A.Negri, A. Poggi, M. Tomaiuolo, P. Turci [12] integrated the agent technology with other key emerging technologies like semantic Web, Web service, rule engine and workflow technologies and KODAMA [13] is another system based on a multi-agent system and leveraged the Semantic Web services.

From previous literature works, it appears that there are many research studies exploiting various techniques blended with multi-agent technology. Therefore, in order to success on e-Commerce, agent should have abilities to perform as a behalf of user to handle with business tasks such as planning, reasoning and learning. Data mining techniques is the important way to make a reason for agent under uncertainty and with incomplete information situations.

3 The Methodologies

3.1 Multi-agent Systems

Agent is the software program that enables to autonomous action in some environment so as to meet its design objectives. According to N. R. Jennings and M. Wooldridge [15], the essential characters of each agent are following: reactive, pro-active, autonomous, object-oriented and social ability. Each agent can play as a behalf of the user and execute the particular task. However, in open and dynamic environment like internet, a multi-agent system is one of the important means to help reduce cost, increase efficiency, reduce errors and achieve optimal deal.

There are two issues related to the design of MAS: Agent Communication Language and agent development platform. The former concerns with the message interchange between different agent such as KQML, and FIPA ACL. The latter is related with the platform development to provide an effective framework, such as IBM Aglets, ObjectSpace Voyager and etc, for the dispatching, communications, and management of multiple agents in the open and dynamic environment. For

this proposed project, JADE (Java Agent Development Framework) will be deployed as the prototype development tool.

JADE (Java Agent Development Framework) is a software environment fully implemented in JAVA language aiming at the development of multi-agent systems that comply with FIPA specifications [20]. The goal of JADE is to simplify development while ensuring standard compliance through a comprehensive set of system services and agents. Each running instance of the JADE runtime environment is called a container as it can contain several agents. The set of active containers is called a platform. A single special container must always be active in a platform and all other containers register with it as soon as they start.

3.2 Web Services

The W3C Web Services Architecture Working Group defines a Web service as:

"*A software application identified by an URI, whose interfaces and bindings are capable of being defined, described and discovered as XML artifacts. A Web service supports direct interactions with other software agents using XML-based messages exchanged via Internet-based protocols.*"[17].

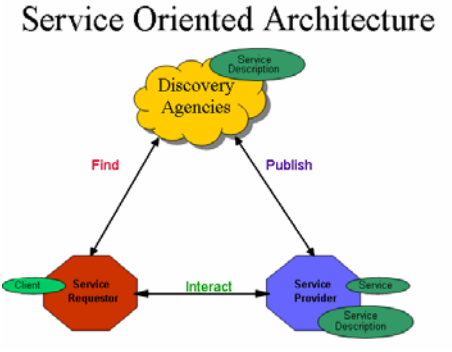

Fig. 1 The Web Service Architecture [18]

As Figure 1 represents the Web Service Architecture is included 3 components: Discovery agencies, service requesters and service providers. The Web service technology, allows uniform access via Web standards to software components residing on various platforms and written in different programming languages. As a result, software components providing a variety of functionalities (ranging from currency conversion to flight booking) are now accessible via the Web. Indeed, Web service technology has introduced a new abstraction layer over and a radically new architecture for software. From a business perspective, Web services often correspond to business services and thus the compositionality paradigm that underlies the Web service technology allows composing existing business services into new and more complex services.

3.3 Ontology

Ontology is an important composition in the communication language. Ontology is an agreement about a shared conceptualization, which includes frameworks for modeling domain knowledge and agreements about the representation of particular domain theories, often captured in some form of a semantic web formally. Its aim is representing the shareable conceptual model in formalized specification [8].

There are two kinds of ontology in the communication model, kqml-ontology and negotiation-ontology. Kqml ontology has been defined formally. We can find the OWL version from The DARPA Agent Markup Language web. Negotiation ontology is based on the idea that there are some general concepts that are present in any negotiation, and builds on finding commonalities across different negotiation protocols [9].

3.4 Data Mining Techniques

Data mining has matured as a field of basic and applied research in computer science in general and e-Commerce in particular [19]. The success of DM is

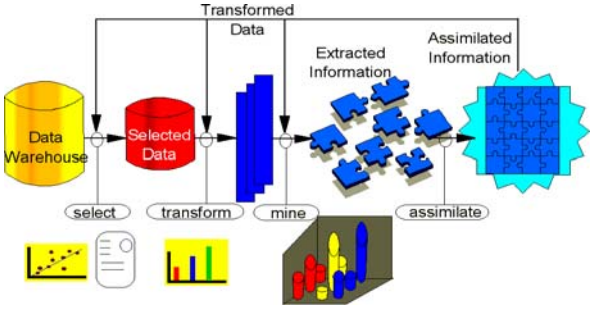

Fig. 2 The Data Mining process [21]

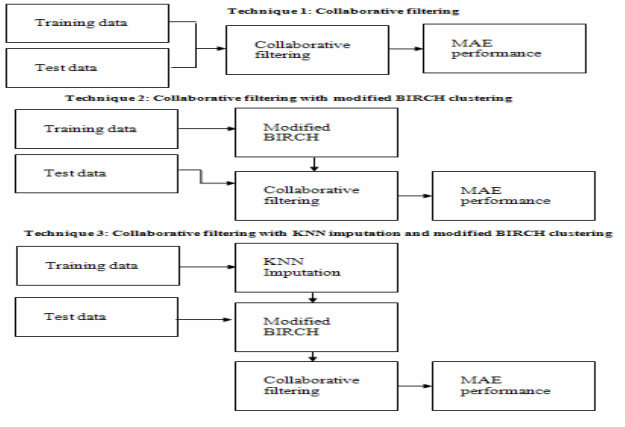

Fig. 3 The flowchart of data mining in the e-Wedding system

driven to a very large extent by the following factors: availability of data with rich descriptions, availability of a large volume of data, reliability of the data available, ease of quantification of the return on investment (ROI) in DM and ease of interfacing with legacy systems [20]. In Figure 2 explained the data mining process, from this project, we used Collaborative filtering, Collaborative filtering with modified BIRCH clustering, Collaborative filtering with KNN imputation and modified BIRCH clustering techniques as showed in figure 3.

4 The Proposed Architecture of e-Wedding

Today the wedding business is increasingly becoming growth. With its boom, it is effect to other business like Hotel, wedding studio, car hiring companies, flower shops, music, travel agencies, and even media businesses. Due to the explosion of internet, couples use the wedding portal sites as a medium to search needed information. However, it takes time consuming because of the flood with information available on internet. Couples must take time to looking for wedding packages and related services, depended on information of wedding business agencies. Further, couples make their decision based on comparing various wedding packages. The wedding package is composed of hotel wedding package, wedding studio package, music, floral decoration, card & gift agencies and etc.

The proposed e-Wedding framework is a multi-agent system designed to couple with optimum wedding packages for the couples relying on their preferences and our system is divided to be two parts. First, it concerns about a recommendation system to couples to find appropriated wedding packages and the final takes responsibility to bargain with wedding business agencies in order to get the optimal solution. From figure 1 representing the purposed architecture of the e-Wedding system, this framework concerns about four main aspects: multi-agent system, Web services, ontology and data mining techniques.

In the multi-agent system, each agent is autonomous to be able to make decisions and act proactively. Agents can communicate, exchange knowledge, collaborate or negotiate with each other, to efficiently achieve the common goal. They receive and process users' requirements, make use of user's preference, perform as a mediator of services business. They select and contact with appropriate wedding business agencies like hotels, wedding studio, and so on through Web services and give couples the optimal result. Web services define, provide related services, and interact with negotiator agents and ontology is the meaningful data which can be directly accessed by agents or people through Web.

Each agent is identified to response a specific task. An interface agent is designed for assistant couples and acts as a behalf of couple when using e-Wedding. A couple fills their preference with an interface agent and passes though a preparation agent. Moreover, the interface agent observes a couple, adapts preference based on couple's requirement, and returns the result to a couple. A preparation agent responds to calculate couples' budget, searches appropriated wedding business and passes though a manager agent. A manager agent is response for communication with a negotiator agent to send user information, to receive wedding packages, to look for and estimate suitable wedding packages

based on user's profile and preference. Furthermore, it takes responsibility for contact with interface agents to purpose wedding packages suitable with their user. A negotiation agent carries out user's information and connects to web services so as to get information about wedding packages. Moreover it persuades its offer to wedding suppliers, evaluates value by compare information with each other and sends to a manager agent in order to evaluate the optimal solution and return the solution to an interface agent. And data mining agents in this system are separated to be three parts: First, a preprocessing Agent, It prepares data for mining to perform the necessary data cleansing, transforming, and preparing data depended on specific data mining techniques. Second, mining agents implement specific data mining algorithms. In this paper as Figure 2, we used Collaborative filtering, Collaborative filtering with modified BIRCH clustering, Collaborative filtering with KNN imputation and modified BIRCH clustering techniques in part of recommendation to search appropriated packaged for couples. Final, auction agent gets the results from mining agents, evaluates the optimum solution and pass to knowledge of system.

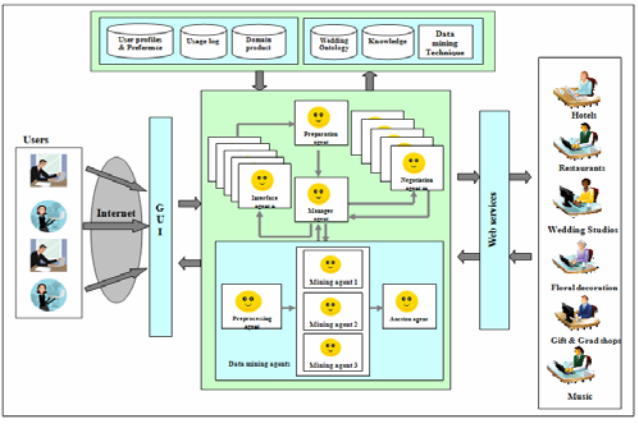

Fig. 4 The purposed architecture of the e-Wedding system

5 Implementation

Our research purpose is to develop a new framework and mechanisms of e-Wedding based on a multi-agent system. In order to demonstrate the effectiveness of our framework and mechanisms, we develop and test a prototype of the e-Wedding.

In the part of user, user can get to our web page, register to be a member and fill in he/she preferences that are included engagement date, engagement place, wedding date, wedding place, expected guest in engagement day and expected guest in wedding day and their estimated budget. After users key in their preference, agents will prepare data, calculate their preferences, connect with Web Service to find suppliers that propose their product to company, contact with

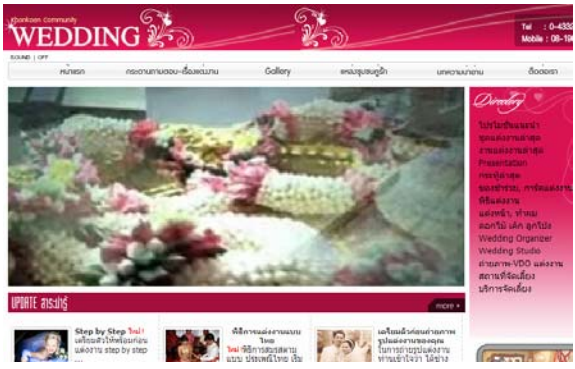

Fig. 5 The prototype of e-Wedding system

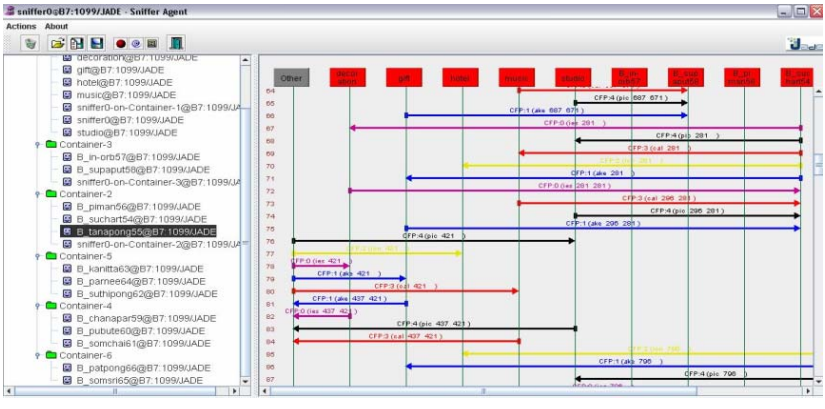

Fig. 6 The operation of JADE

supplier agent to find available products, find optimized packages that suitable with user preferences, purpose optimized packages to customers, and etc. In the part of find optimized packages, we used mean square error sense.

$$y = p_{1 \times m} x_{m \times 1} \quad (1)$$

y = estimated budget of customer
p = real price that we get from our suppliers
x = expected profit

$mse \rightarrow y = px$ and $|y - \hat{y}|^2 \rightarrow 0$

$\min_{\hat{x}} |y - \hat{y}|^2$, so that

$$\min_{x} |y - p\hat{x}|^2 = \min_{x} (y^2 - 2yp\hat{x} + (p\hat{x})^2) = \min_{x} \{-2yp\hat{x} + x^T p^T px\} \quad (2)$$

And Figure 4 showed the result of communication among other agent in e-Wedding System by using JADE.

6 Conclusion and Future Works

In this paper we presented our preliminary ideas of building e-Wedding system based on a multi agent system and various techniques. Our system consists of four main aspects: multi-agent system, Web service, ontology and data mining techniques. In the part of MAS, we have implemented this prototype by using JADE platform. JADE is quite easy to learn and use. Moreover, it supports many agent approaches such as agent communication, protocol, behavior and ontology. As for the future work, we need to explore more reasonable technologies and methods to enhance e-Wedding system and also need to evaluate our system from the users' point of view.

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