Intelligent Agent based Hotel Search & Booking System

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Abstract: M-commerce (mobile commerce) is the buying and selling of goods and services through wireless handheld devices such as cellular telephone and personal digital assistants PDA. M-commerce provides lot of services like Mobile ticketing, Mobile banking, Mobile location based services, Mobile auctions, Mobile purchasing and so on. This represents an incredible opportunity to enable mobile devices, as a universal device for mobile commerce applications. For such applications, we normally want to choose the best hotel in prime locations, with modern facilities, clean environment and affordable rates. This can be time consuming and sometimes costly when doing this on our own or using human agents. So based on this we here propose “Intelligent Agent Based Hotel Search and Booking System”. This system here would use an intelligent agent (instead of the human agent) to perform similar search and booking activities that can improve the speed of the search and reduce cost significantly. So in summary we propose developing an agent that will move from hotel to hotel from the mobile devices like Smart phones by collecting details on the list of available facilities, price, customer experience, transportation etc and forward-feeding them back to the user’s mobile phone. The implementation will be carried using JADE-LEAP agent development kit

Keywords: M-commerce, Agents, JADE, LEAP

1. Introduction

The hotel Industry is one of the largest and most profitable industries in most countries. It helps to boost the economy of both developed and developing countries alike and stands as one of the major supplier for tourism in these countries. People are always ‘shopping around’ when vacationing for the cheapest rates for hotels and arrange bookings in advance to guarantee their stay for the period of their vacations. Several sites and booking systems [1] have developed over the years to assist in the search and booking of hotels for individuals. However these systems generally require individuals to do the bulk of the search and booking. This is not only time consuming exercise, but can be frustrating and costly as well.

The advent of the World Wide Web or internet as we know changed the landscape of communication and the way we conduct business dramatically, allowing us to reach beyond boundaries once separated by miles of oceans. Information that once took days and in some cases weeks, can now be received in a matter of seconds. This technology has grown significantly over the years and has been interfaced with other technologies such as smart phones, PDAs and other forms of wired and wireless networking devices, propagating the ability to receive information and conduct business on the go at the finger tip. With this background in mind we propose an intelligent agent based hotel search and booking system that will undertake the bulk of the search and booking of hotels for various users. The system will provide users with the ability to enter some criteria for the search and then perform the search base on those criteria and book the most appropriate hotel base on the user’s confirmation. These would be carried out using JADE-LEAP on user's mobile device. The reminder of the paper is organized as follows. Section 2 discusses Agent based Systems. Section 3 talks about the intelligent agent based Hotel Search & booking system. Section 4 provides the details of the implementation of an agent based hotel search and booking system using JADE-LEAP combination. Section 5 is the concluding & future work.

2. Agent based Systems

Since the introduction of software agent technology more than a decade ago, there has been a lot of discussion surrounding a proper definition of the term agent. An autonomous agent [2] is a system situated within and a part of an environment that senses that environment and acts on it, over time, in pursuit of its own agenda and so as to effect what it senses in the future. The properties of an agent include being reactive, autonomous, goal oriented, temporally continuous, communicative, learning, mobile, flexible, and character. Agents were classified based on the subset of properties they possessed. The classification of agents this research is interested in is the mobile agent.

A mobile agent [2-9] is an autonomous program that can move from machine to machine in a heterogeneous network under its own control. The mobile agent can suspend its execution at any point, transport itself to a new machine, and resume execution on the new machine from the point at which it left off. On each machine, it interacts with service agents and other resources to accomplish its task, returning to its home site with a final result when that task is finished.

Mobile Agent Technology [2-9] is designed to work within a networked environment, as the mobile agent will migrate from machine to machine across the network to complete its tasks. In order for a mobile agent to migrate the following must exist, a common execution language, process persistence, communication mechanism between agent hosts, and security to protect agents and agent hosts.

Agent toolkits provide a platform for developing agent applications, or they may provide an environment in which
an agent developer may run, monitor, analyze, and test agent applications. A number of agent toolkits are available, e.g. IBM Aglets, Fargo, JADE etc., to name a few. For the purpose of our research the most suitable toolkit viz., the JADE (Java Agent Development) toolkit[10-11], has been utilized since the system developed has to run on mobile devices, which include mobile phones and personal digital assistants (PDAs). This being the case the J2ME [12] language using CDC will be used along with the LEAP (Light Extensible Agent Platform) add-on for JADE. Taking these into consideration we now explain the Intelligent Agent based Hotel search and booking system being developed by us.

3 Intelligent Agent based Hotel Search & Booking system

At present most individuals when searching to book a hotel for vacation, business or leisure employ one of the following strategies: search the internet, check the yellow pages of the directory, employ a travel/booking agent or browse through vacation magazines. They gather information on various hotels which usually include cost, location, type of facilities, rating from recognized bodies, etc and then compare and contrast their findings before selecting and booking the hotel of their choice. The usual challenge is to find the best hotel in a prime location, with modern facilities, clean environment and affordable prices within the shortest possible time which maintains the hotel website. Based on these we proposed intelligent agent based mobile tour planner [7] in mobile device in LEAP which would query the hotel agent developed in JADE. The hotel website holds information such as price, star rating, and facilities and so on. The hotel search agent possesses the intelligence to search the hotels below the price range, within the price range and above the price range by 10% in the same or different location. But the drawback in the system is that the hotel agent does not produce results of ranking of the hotel and also search possesses no intelligence for searching hotels with approximate or best match of amenities. Also the agent possesses no intelligence to search hotels with exact matching of amenities for any price. So based on this we here possess intelligent agent based hotel search and booking system an improved system.

The proposed system will seek to overcome these challenges in the search and booking process by the use of software based intelligent agents. This agent here would move from one hotel to another collecting and contrasting information about the hotel search like the type of hotel, Location, Star rating, price, amenities and so on. The search agent that resides on the mobile device will be launched and pass request to the appropriate hotel and makes booking with the hotel. Once booking gets confirmed, the Hospital Agent sends the confirmation to user’s mobile phone. The Hotel booking agent has been developed in LEAP on the user’s mobile device.

b. The Algorithm

Based on the architecture explained above, we will now present the algorithm used in our development.

- Users enter search criteria on GUI from mobile device and submit request.
- The search agent that resides on the mobile device will be launched and pass request to Database Agent (DA) with the search criteria like Star rating, location, parish, price, amenities provided etc.
- The DA will now match the search criteria and return the list of hotels to the user’s mobile phone as follows:
  - If a hotel is available for lower price range with exact or closest matching of amenities in the same or different location or parish
  - If a hotel is available for the price range specified with exact or closest matching of amenities in the same or different location or parish
  - If a hotel is not available within the price range, it finds a hotel above the maximum price by say 10,
To interact with the system the user is provided with a graphical user interface (GUI). This interface is used to enter the details for locating a hotel. The details entered are used to query the Central Database Agent, that responds with a list of facilities matching the user details. This information is then presented to the user in a format so that the user may select a facility to initiate an booking. Another user interface is used to accept the details for setting the booking with the Hotel Agent (HA) of the hotel. This information is submitted and the HA checks for existing bookings. The user is notified of the booking request outcome and whatever needs to be done next. The Hospital Agent (HA) represents the Hotel, and has the necessary intelligence to pursue the interests of the facility. The HA knows all the details of the facility and uses this knowledge in negotiating with the Booking Agent. It also provides the Central Database Agent with these details when requested. The Central Database Agent (CDBA) is the regulator agent within the system; it has details on all Hotel Agents in the system. This information is used to match against the user details when search for a Hotel is made. The CDBA is not under the control of the Hotel Facilities, therefore it maintains unbiased information on each facility, and also maintains feedback from each user that has used the facility. This information is used for presenting the user with a ranking/rating of the various facilities based on properties such as customer service, price, environment etc. All the agents discussed above communicate using messages; the messages passed between the agents are FIPA ACL Messages. All the agents in the system are implemented to conform to the FIPA Agent Standards. The conformance of the agents to these standards ensures and guarantees agent interoperability. The fact that this system has more than one agent working together to solve the general problem of searching and booking, means the system is a multi-agent system.

4. Implementation using JADE-LEAP

The implementation of Intelligent agent based hotel search and booking system for validation has been done using JADE-LEAP toolkit[10-11]. The Graphical user interface for the mobile phone has been developed using Java 2 Micro edition (J2ME) [12]. This enables the user to provide his specifications for the agent to shop around. Before we discuss the results, we now give some details about J2ME. Java 2 Micro Edition (J2ME) is Sun’s version of Java aimed at machines with limited hardware resources such as PDAs, cell phones, and other consumer electronic and embedded devices. J2ME is aimed at machines with as little as 128KB of RAM and with processors a lot less powerful than those used on typical desktops and server machines. J2ME actually consists of a set of profiles. Each profile is defined for a particular type of device – cell phones, PDAs, microwave ovens, etc. - and consists of a minimum set of class libraries required for the particular type of device and a specification of a Java virtual machine required to support the device. The virtual machine specified in any profile is not necessarily the same as the virtual machine used in Java 2 Standard Edition (J2SE) and Java 2 Enterprise Edition (J2EE). It may be seen that the profile that we have used to develop a Palm OS device application is a subset of the Java Virtual Machine. Sun systems have released the following profiles: (i) The Foundation Profile - A profile for next generation consumer electronic devices and (ii) The Mobile Information Device Profile (MIDP) - A profile for mobile information devices, such as cellular phones and two-way pagers, and PDAs.

For our research purpose, we created five (5) hotels. The list of five hotels created in the JADE environment is shown in Fig.1.

![Five Hotels in JADE Environment](image)

Fig.1 Five Hotels in JADE Environment

Fig.2 shows the user entering the details/requirements of given below to perform the hotel search.

- Parish
- Location
- Star rating
- Category
- Price markup
- Other facilities like bar, transportation etc
- Rating period- 3, 6 moths , 1 year

The user is able to select a parish from a drop down list and location which is dependent on the country selected. The parish and location option is another drop down list displaying the cities in the selected country. The user is able to select the star rating, price, hotel type etc from the drop down menu. Price mark up option allows the user to specify the maximum price he can afford. The price option allows a user to specify a price range for the facilities offered. The price option ranges from as low as $100 to $10000, and the option of any price, which is from $0 to the highest listed price. The Rating Period option allows the user to specify a range to be used for considering customer feedback information. Past customers are allowed to submit a rating of a hotel service such as customer service, Environment, facilities, Infrastructure and pricing. This information is then used to rate a facility based on rating periods such as three months, six months or one year.
The user specifies the criteria like the parish and location as Kingston, price range of $100-149 with a star rating of 4, price markup of 10%, other facilities like meals, transportation etc included and rating period of 3 months. The hotel search agent here possess the intelligence to search hotels for price range of 100 to 149 with the search criteria mentioned and display it onto the user’s mobile phone as shown in Fig.3. The agent here possess the intelligence to retrieve hotel with a price of $56.00 which fits in the price range of 100-149 with the rating by user’s in previous 3 months and current rating too and showing closest match facilities with one facility named baby sitter unavailable in fig.3.

Let us consider another scenario for the same search criteria mentioned above. The search agent finds no hotels in the location and parish Kingston. The agent now possess intelligence to retrieve hotels with a price of $70.00 which fits in price range of 100-149 in another parish named Trelawny in North coast location instead of Kingston with closest match of facilities. That is no hotels for the price range specified available in Kingston. This is shown in Fig.4.

Consider another scenario with the same search criteria mentioned above to search hotels with the price range of $50-110 in location and parish Kingston. The agent here finds no hotels in the price range specified in the location and parish Kingston for the facilities asked. The agent possess intelligence to markup the price by adding extra 10% to find hotels in the location and parish Kingston with the facilities asked for with closest match of facilities say baby sitter unavailable which is shown in fig.5.

Consider another scenario with the same search criteria mentioned above to search hotels with the price range of $50-120 in location and parish Kingston. The agent here finds no hotels in the price range specified in the location and parish Kingston for the facilities asked even after adding extra 10% too. The agent possess intelligence to find hotels in another location and parish within the price range of $100 to 120 or by adding extra 10% with the facilities asked for closest match of facilities. The agent here finds no hotels for price range specified but finds hotel with a price of $130 by adding extra 10% to retrieve hotels with closest match amenities say laundry unavailable which is shown in fig.6.
Consider another scenario with the same search criteria mentioned above for matching all the facilities requested in location Kingston. The agent here possess intelligence to retrieve hotels for any price in the location Kingston with all facilities matched with a price of $300.00 as shown in Fig.7.

Now that the search agent has retrieved the hotels, the next thing is to book the hotel. The booking agent is initiated which prompts the user for details like ID which is like TRN or so which is unique, name, age, e-mail, expected arrival and departure dates, number of persons, number of rooms, booking date as shown in Fig.8. Once the details enter the booking agent is started as shown in Fig.9 which contacts the respective hotel agent. Once booking is successful the confirmation is sent to user’s mobile phone. If necessary the booking made can be cancelled too which is shown in Fig.10.
Fig.11 Booking Agent- Unsuccessful confirmation

Also feedback about the hotel can be submitted for the user’s mobile phone onto central database. The feedback of a hotel is ranked on categories like Customer service, Environment, facilities, infrastructure, pricing on a scale of 1 to 4. This information is useful in selecting the hotel. A sample feedback screen is shown in Fig.12. Once feedback submitted confirmation received on user’s mobile phone as shown in Fig.13

Fig.12 Feedback Form

Fig.13 Feedback Submitted

5. Conclusion & Future Work

For such hotel search and booking application targeted on tourism industry, we normally employ a human agent to get the details for choosing the appropriate hotel. But in such a mobile environment we can employ intelligent agent which can replicate the job of the human being. Also, quite recently intelligent agents have gained considerable attention in the area of computer science which is from literature. With all these in mind we have attempted an Intelligent Agent Based hotel search and booking system that searches the hotels by getting necessary details, much like a human agent. The hotel search example attempted here is mainly concentrated towards mobile phones. In this case, the Agent gathers the information about the hotel and compares them with the user preferences. The Agent here possesses adequate intelligence to search and select a hotel based on what the user needs. Also based on the hotel selected the booking is been made. The results of our research have been shown as screenshots. The system can also be extended to include search using GPS information to search not in the main location and parish but also inner locations & parishes by using GPS and Google map. Also booking should include the financial information like credit card and so to be given wirelessly to hold the booking made which includes security in mobile payment too.

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