

# E-Commerce Traffic Intelligent Agent

Tawfeq Z. Hasanain, Ibrahim Albidewi.

**Abstract**— The paper is a description of an e-commerce intelligent agent. Intelligent agents entail new varieties of software with substantial prospect for numerous Web-based applications. These applications have been successfully implemented in emails management, decision-support systems, and personal assistants. Business performance has been greatly changed by agents applying e-commerce, resulting in an innovative change. This has been showed in the form of business-to-business (B2B), business-to-customer (B2C), and customer-to-customer (C2C) relations.

**Index Terms**— e-commerce intelligent agent, electronic commerce, Electronic transactions

## I. INTRODUCTION

Innovation in business has resulted in electronic commerce (commonly referred to as e-commerce), which has revolutionized the business world. This has impacted greatly on business communication, thus powering the economy and opening up the global market. According to statistics dated early 2000, business-to-business (B2B) e-commerce was expected to reach 1.3\$ trillion by 2003, and further Internet usage grew by about 120% between 2002 and 2005. During the coming year, consumer spending online is expected to increase by 41%, reaching 72.1\$ billion [1].

Customer relationship management is critical in e-commerce and mutual trust is also a necessity in the growth of this trade. Use of software that automatically plays crucial role in the trade can enhance e-commerce. This may be achieved through the use of software agents, which are software applications that are independent but owned by some party [2].

Worldwide information systems are viewed as rich platforms for collaboration where intelligent automation enables firms to partner and do business. The modern “electronic economy” requires the researchers and industries involved to exploit new technological applications and information systems to act as an infrastructure for automated business if they are to survive competition [3].

Intelligent agents and e-commerce are the focus of this paper along with the interfacing technological applications used in purchase and sales. E-commerce systems are reviewed from the perspective of the buying process. Customer services provided through the Internet are the focus of this project.

## II. RELATED WORK

### A. A Real-Time Multi-Agent System Architecture for E-Commerce Applications

This is an architecture that gives instantaneous multi-agent systems. The instant agent services include real-time agent communication, agent scheduling, and real-time agent facilitation. These services are intended to allow the communication and execution of agent interaction instantly [4].

### B. Integrating Mobile and Intelligent Agents in Advanced e-Commerce

There are instances where mobile agents and intelligent agents enhance the efficiency of electronic trade. Current trends are leading to the development of mobile-facilitated e-commerce which compares prices, conducts auction bidding, and negotiates for contracts [3].

### C. Electronic Agents and the Law of Agency

Commercial laws require businesses to operate within a certain legal framework. These electronic agents must be designed to abide by the law of agency with subjectivity to law and its relationship to third parties [5].

### D. Intelligent Agents for World Wide Web Advertising Decisions

This involves marketing on the World Wide Web (www). It is founded on the instant nature of responses and processes from Internet applications. Thus applications providing information to potential customers over the Internet can achieve success for worldwide marketing decisions [6].

## III. BACKGROUND

### A. Intelligent Agents

There is no universal definition of the term “agent”, and varied definitions are made based on different approaches, expectations, or visions. A software agent is a software unit that performs continuous functions independently within an environment with other players. These agents are capable of performing actions intelligently and can respond to changes in the environment with limited or no supervision. The agent should “co-exist” with other agents in the environment and collaborate with them [7].

There are particular attributes that define an agent [7]–[10]:

- **Reactivity:** the ability to sense and respond appropriately
- **Autonomy:** acting towards a goal without instructions or operation
- **Collaborative behaviour:** the ability to cooperate with other players to achieve the ultimate goal
- **“Knowledge-level” communication ability:** the capability of communicating with other players in a language understandable by humans
- **Inferential capability:** the ability to infer knowledge from earlier functions and the procedures of operation
- **Temporal continuity**
- **Personality**
- **Adaptively**
- **Mobility.**

**Classification of Agents** [1]–[8], [11]–[15]:

a) **Deliberative** – from the deliberative thinking paradigm, which holds that the agent possesses symbolic reasoning models; they are able to engage, plan, and negotiate with other agents in order to achieve their goals.

b) **Reactive** – these agents are built on the model of responding according to the input provided, thus presenting the state of their environment.

**Exhibition of primary attributes:**

a) **Autonomy** – an efficient agent is able to operate without human instructions, this is manifested through pro-action, which is the ability to take an action [3].

b) **Cooperation** – in an environment, the agent may not operate alone but requires cooperation, which may involve a lot of communication.

c) **Learning** – agents should increase performance over time since they should learn as they interact with other agents in the environment.

• **Hybrid properties** – merging of two or more agents in a single agent

• **Secondary attributes** – these are the characteristics that give a more solid definition to an agent and they include versatility, trustworthiness, and emotional qualities, among others.

Based on the primary attributes and the characteristics, four types of agents can be defined: collaborative, collaborative learning, interface, and smart, as shown in Figure1 [7], [16].

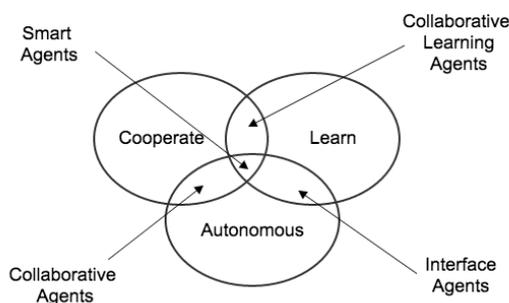


Figure 1: Typology based on Nwana’s prim

Nwana [16] and Jennings and Wooldridge [17] developed a more common classification of agents which comprises eight categories:

• **Collaborative agents:** Lack of interference from humans and cooperation with other agents to perform the programmed tasks within the confines of the environmental. Other than providing the service they may also negotiate for mutual agreement with other agents [17].

• **Interface agents:** Emphasis is on autonomy and learning. They support and provide proactive assistance. The agent monitors the actions of the user on the interface and provides suggestions on better ways to complete the task in future. The agent may also adapt to the user’s preferences and habits [17].

• **Mobile agents:** The agent is able to rove across the networks, interacting with numerous hosts and settling on the performance of the tasks for the owners.

• **Information/Internet agents:** These agents manage and manipulate information inputs. Information overload on the World Wide Web has necessitated this management.

• **Reactive agents:** They interact with other agents in basic ways; the response is not specified in advance but the action of the user or the player determines the action taken by the agent [12].

• **Hybrid agents:** They bear the features of reactive agents and deliberative agents and are thus robust and easily adaptable.

• **Smart agents:** They are intelligent agents that combine the features of all the other types, thereby achieving the best capabilities.

**B. E-commerce**

E-commerce entails business conducted via communication networks. It may take the form of B2B, business-to-customer (B2C), or customer-to-customer (C2C) commerce. According to recent statistics, B2B is booming while adoption of B2C e-commerce has been slow. To effectively enhance e-commerce, three factors should be considered: the provision of electronic information, electronic relationships, and electronic transactions [18].

• **Electronic information**

The Internet contains a lot of information. To achieve efficiency in e-commerce, the information shared must be optimized and translated into appropriate formats which are easily accessible and easy to manage.

• **Electronic relationships**

Innovation and value addition must be available on the online portal site as well as information and interaction. Thus a community that is devoted to customer interests should be created. This may be achieved by customer profiling or buying-behaviour analysis.

• **Electronic transactions**

Before the contractual agreement to make payments electronically, a firm should have the capacity to handle and manage electronic transactions. Barriers to Internet security and uncertainty should be eliminated.

The best employed applications of e-commerce are customer based and are based on activities revolving around the purchase and sale of goods and services such as banking and stock exchange. Internet security has limited most electronic transactions. There are numerous advantages attached to this trade as the enterprise is visible throughout the global market. However this also increases competition, thus lowering prices and profits [19].

E-commerce thus employs telecommunication channels and information technology. Thus it may be defined as any trade that generates cash flow through the Internet. The interface uses interrelationships to capture all logistics involved. In many ways, e-commerce is simply a new way of doing business. However, it also presents some very new business paradigms with the following features [14]:

1. services are becoming more important than products;
2. mass production is being supplanted by demand-driven production, which in turn requires electronically integrated supply chain systems;
3. customized bundling of services supported by sophisticated user profiles;
4. differential pricing and fine market segmentation;
5. services and products can be both commoditized and personalized; and
6. *dynamic brokering achieved through intelligent agents.*

#### C. Intelligent Agents in E-commerce

The application of artificial intelligence (AI) in e-commerce plays a vital role in information sharing and deliberations. An intelligent agent in this trade operates under the support of AI. The computer systems involved in transactions have artificial knowledge of buyers, negotiators, and marketing professionals [20]. The buyer model applied in e-commerce has been explained by several theorists. However, all the theories show six important stages of the buying process, where intelligent agents apply the shopping experience [15]:

- Identification: At this level the customers are made aware of the need, which is not met by providing them with information on the product.
- Brokering: This takes two forms:
  - a. Product brokering: These are agents systems that lower consumers' search costs when deciding which products best meet their needs.
  - b. Merchant brokering: This stage provides customers with specific merchant alternatives to assist them in determining where to buy from.
- Negotiation: At this stage the customer and the agent agree on price and other transactional terms and conditions. This application helps to eliminate barriers experienced in real world negotiation.
- Payment and delivery: After negotiation is successful, the client is given the available payment and delivery options and decides which course to take.
- Product service and evaluation: At this stage the customer is provided with a service and the opportunity to evaluate his satisfaction and experience of the buying process.

These buying process stages identify intelligent agents as vital inputs in e-commerce. They are suitable for providing information, negotiating, and coordinating real-time relations. Current levels of technology can be exploited to build a digital economy. However competitive pressure will be experienced.

Intelligent agents and e-commerce are the focus of this paper and the interfacing technological applications used in purchase and sales. E-commerce systems are reviewed from the perspective of the buying process. Customer services provided through the Internet are the focus of this project.

#### IV. MODELLING AND DESIGN OF THE SYSTEM

The primary objective of this project is to enable both customers and sellers to get a fair deal in the transaction.

##### A. Requirement Analysis

- Evaluation based on many criteria, not just price.
- The buyer is not bound to ultimately select the choices offered to him. He has the flexibility of making selections according to his will. He can bid on multiple offers, which will increase his chance of finding the most suitable offer.
- Sophisticated tools to aid the seller to measure the benefits to the seller and not just the obvious revenue.
- The auction situation is such that the buyer bids on a limited number of goods during a limited number of bidding periods. The interest in goods changes over the long haul, impacting the amount of approaching offers. The seller's objective is to exploit these popular vacillations to expand his revenue.
- The buyers and sellers should be represented as agents in a common marketplace as shown in Figure 2.

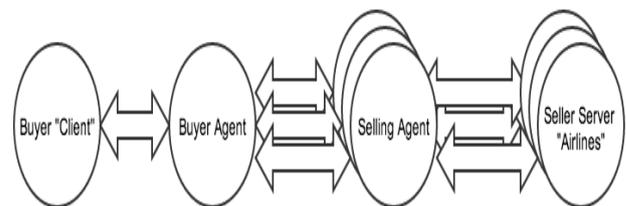


Figure 2: Representation of Buyers and Sellers

##### B. Use Case Diagrams:

The identified use cases are described below, as shown in Figures 3 & 4 .

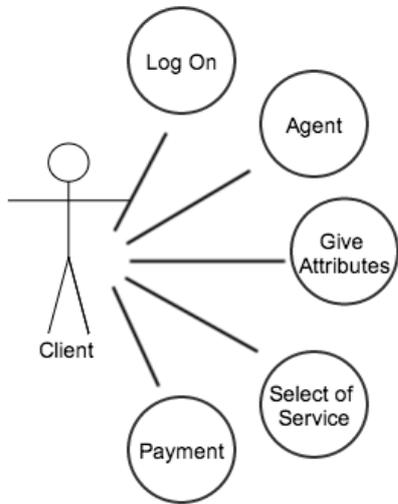


Figure 3: Buyer Interface

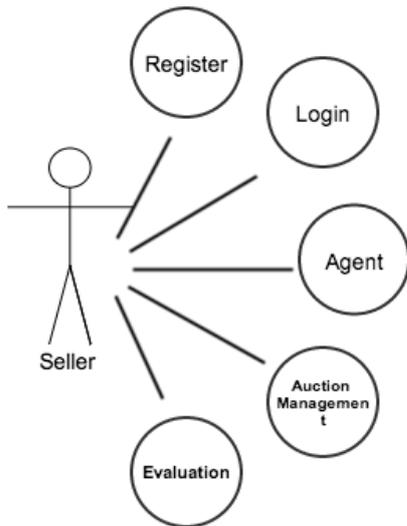


Figure 4: Seller Interface

There is many steps in the system, as shown in Figure 5:

- The client logs onto the system.
- The client fills in the attributes for the choice of trip.
- The client receives the set of schedules of trips and opts to bid for one or more of the trips.
- After receiving the notification of a successful bid, the client books the tickets by paying online.

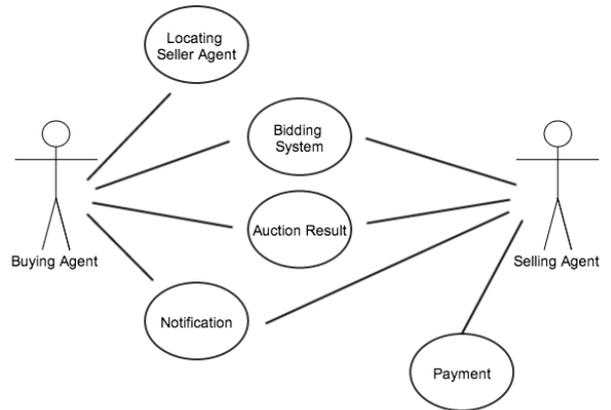


Figure 5: Interaction between buying agent and selling agent

**C. Analysis Model: Use Case Sequence Diagrams**

**• Buyer Sequence Diagram and Buying Agent Sequence Diagram**

Figure 6 shows the relationship between the client and buying agents. In this diagram the client must log into the system by using his username, and then he will receive a form from the buying agent to be fill in himself, to check availability of his forms, and he can respond by selecting the flight as his choice; also Figure 7 shows the operations between the buying agent and the selling agent. The buying agent will send the attribute to the selling agent. After that, the selling agent will respond with a list of available flights. Finally, the buying agent will send back the selection.

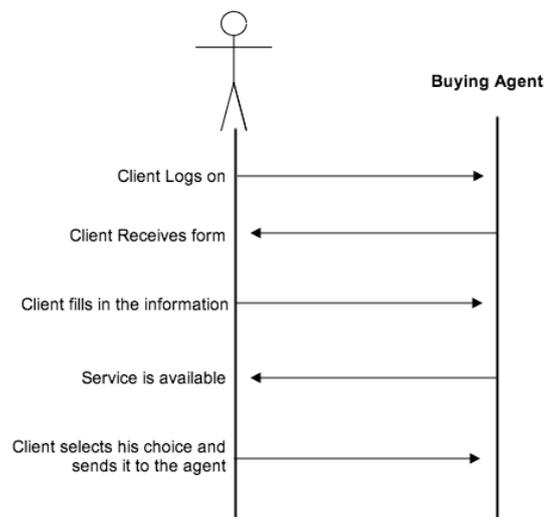


Figure 6: Buyer Sequences

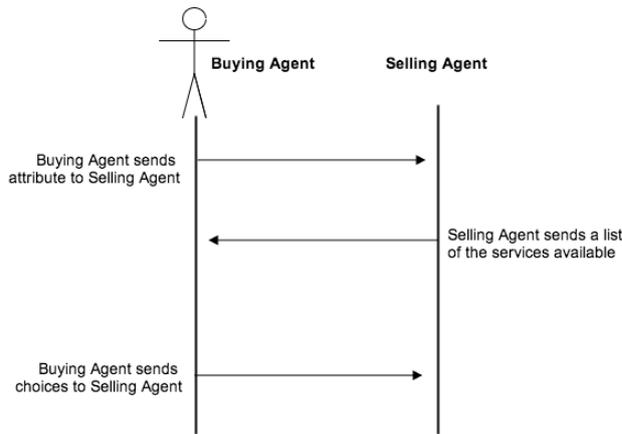


Figure 7: Buying Agent Sequence

• **Selling Agent Sequence Diagram**

The attributes (date, time, number, class, ..., etc.) of the flight will be sent by the selling agent through the server to be checked on the database. It will respond with the available flight information depending on the client's request. After that, all information about the client and bids placed by him will be sent to the seller's server, which will store all the operations in a database and compute the bids, as shown in Figure 8.

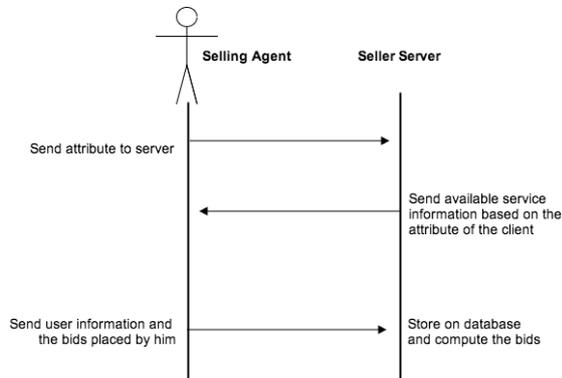


Figure 8: Selling Agent Sequence

The previous analysis diagrams show that the bid is sent to the buying agent by the user. It is the responsibility of the buying agent to find all the potential selling agents present in the marketplace. The buying agent then sends the bid to all the selling agents and similarly accepts the auction results from various selling agents..

*D. Interaction Diagram*

The interaction diagram shows the communication between the objects inside the system.

Figure 9 shows the implementation of an interaction diagram for the general phase in the design model.

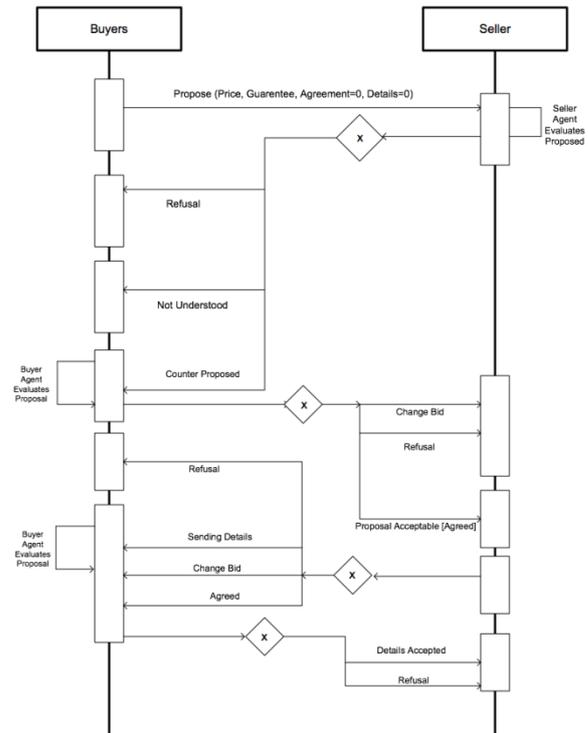


Figure 9: Interactions that may occur between the buying and selling agents in the reservation system

V. IMPLEMENTATION

In Figure 10 below, we can see the default interface for most airline sites on the Internet. The buyer should enter his desired criteria, and then the agent should display the best matches for these criteria.

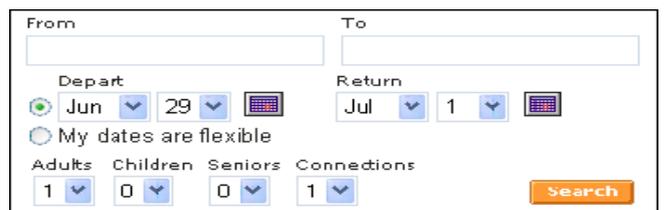


Figure 10: The familiar method of flight booking

In our proposed system, an algorithm has been used to optimize the interface by introducing the "priority" concept. Every category has been affected by this idea, whether it is the flight classification, flight destination, flight timing, number of passengers, selection of airlines, or booking class. The application of this concept, though, varies from category to category, ranging between high priority, medium priority, low priority, and no priority (this is illustrated in Figure 11).

Needless to say, the system has become more efficient due to this alteration; it therefore accepts all passenger requirements and gives the best results in any online search. Because of this developing tool, flight booking is becoming more and more convenient for the passenger.

We may reach a time in the near future when the customer will choose a suitable flight without thinking twice. All he would need to do is to head to any place where Internet access is available, which would likely be his home or office, and search the Internet. In a moment, a wide variety of choices will appear before the user in a list for him to make a selection. It is then a matter of booking the flight, paying the money, and confirming the reservation – all without having to leave his home or waste precious time in travel agencies. In short, the intelligent agent has enhanced the level of search results and has benefited customers greatly in various ways.

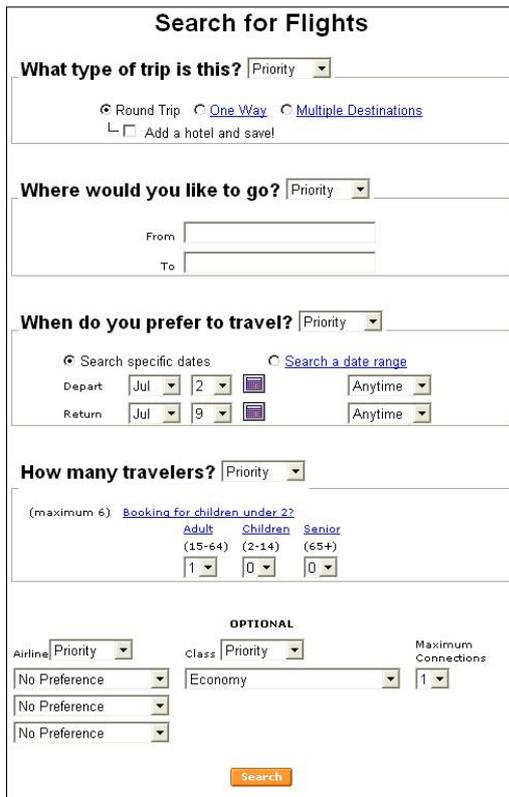


Figure 11: Suggested Alteration of the System

## VI. ALGORITHMS AND BID EVALUATION STRATEGY USED

### A. Distance Function

The distance function is used to calculate a match for the user depending upon the user's preferences. The preferences(attributes) which the user specifies are not hard and fast. Instead they are flexible and the user can specify his choice in one of three categories: (i) not flexible, (ii) somewhat flexible, and (iii) very flexible. The function used to evaluate the distance is shown below [13]:

$$\text{dist} = \sum_i \text{weight}_i \left( \frac{|\text{ideal}_i - \text{actual}_i|}{\text{range}_i} \right)$$

Based on the flexibility rating, the weight and range for each 'i', are calculated:

an ideal value: is the value entered by the buyer for the parameter 'i'

an actual value: is the value of the parameter for the located available bus service.

### B. Reserve Pricing Strategy

The service provider tries to maximize revenue by adjusting the daily reserve price to ensure that all the seats are sold by the end of the auction. The algorithm is as follows [13]:

- (s) is the total number of seats sold
- (d) is the number of days that have passed
- (t) is the total number of seats
- (a) is the total number of days in the auction
- if  $s < (d) * (t / a)$ , => decrease reserve price by (% off-target/2)
- if  $s > (d) * (t / a)$ , => increase the reserve price by (% off-target/2)
- if  $s = (d) * (t / a)$ , => no change.

### C. Seat-Releasing Strategy

The main aim of the service provider here is to forecast as accurately as possible the demand for the next day and to release the seats accordingly to increase the revenue. The previous history is taken into account for this matter. The algorithm is as follows [13]:

- $\text{delta} = (\text{value of yesterday's bid}) - (\text{value of the day-before-yesterday's bid}) / (\text{value of yesterday's bid})$
- if  $\text{delta} > 0$ , => then increase the number of seats released by delta
- if  $\text{delta} < 0$ , => then decrease the number of seats released by delta

Except :

- if  $\text{day} \leq 2$ , => then release one seat
- if  $\text{day} \geq (\text{second-to-last day})$ , => then release all the remaining seats.

### D. Market variables

There are some market variables which need to be updated and kept: the average number of bids, average bid price, number of seats released per day, and reserve price. These are used to calculate statistics and also to forecast demand patterns.

### E. Determination of the Winning Bid

The auction functions as a sealed bid, discriminatory auction. At the end of each day the service provider accepts the bids which are above the reserved price, up to the number of released seats.

## VII. CONCLUSION

E-commerce introduces extra automation, federation, and dynamism, which pose new challenges to trade-management systems. This paper presented some of the requirements of e-commerce systems and the intelligent agent. These requirements were derived from various existing airline flight standards and from our own experience of travel-management solutions. The paper also compares the properties of some e-commerce travel airlines.

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