Online Auction System by Using Mobile Agents

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Abstract

Online auctions have become an effective approach in the buying and selling process, employed in the rapidly emerging Internet-based electronic commerce platforms. Through internet, the limitation of distance and region are broken for business behaviors. Especially the internet and WWW technologies broken the limitation of space and the mobile agent techniques can solve the problem of this limitation. In this paper, an online auction system by using mobile agents is proposed for user-desired products/services. Among many types of auctions, English auction and Reverse auction will be proposed.

1. Introduction

Electronic commerce is having a revolutionary effect on business. It is changing the way businesses interact with consumers, as well as the way they interact with each other. Electronic interactions are increasing the efficiency of purchasing, and are allowing increased reach across a global market [7].

Electronic commerce is to use electronic means for conducting business transactions. Its implementation harnesses networked resources to foster the exchange of business transactions in a more efficient and cost effective manner. The market of e-commerce is growing very rapidly thanks to the increasingly greater accessibility of Internet services [10].

In recent years, companies of all sizes ranging from international corporations to small companies are migrating towards an E-commerce marketplace [2].

Besides current web-based systems, agent-mediated e-commerce is now playing a more and more important role. Mobile agents refer to self-contained and identifiable computer programs that can move within the network and act on behalf of the user or another. The mobile agent paradigm has been proposed as a competitive counterpart to the client/server paradigm. Instead of exchanging messages known as request/response between the client and server, mobile agents can migrate to a remote host and execute, thus taking advantages of exploiting the resource near the data source and reducing network traffics caused by frequent remote communications. Mobile agents may be equipped with intelligence ranging from simple decision algorithms to sophisticated reasoning and learning [10].

Electronic marketplaces are places where buyers and sellers can come together, exchange information, negotiate and transact as in traditional marketplaces. The various forms of electronic marketplaces - auctions, product exchanges, online shopping markets, e-catalogs, etc. - are considered critical elements of electronic commerce. Online auctions mimic auctions in the physical world and differ according to many parameters like the role of the sellers or buyers and the sort of pricing or bargaining. Software agents participate in an auction on behalf of their owner, who can be a seller or a buyer [10].

Considering the roles of the agents, auctions are classified as seller auctions and buyer auctions. Seller auctions are the classical form of auctions. Bidders place offers on one or more items. On the other hand, buyer auctions, which are also known as reverse auctions, work the other way around. Sellers compete with each other to satisfy the buyer. Mobile agents will involve in this system on behalf of their owners, who can be a seller, buyer and auctioneer.

In this paper, section 2 discuss the related work in agent based auctions. Background information of agents and auction is discussed in section 3. Section 4 presents the overview of the proposed system. Implementation of the proposed system is discussed in section 5. The conclusion is presented in section 6.

2. Related Work

Ayse Morali evaluated analytically and experimentally different auction types and coordination models in an electronic marketplace. They studied and analyzed different types of auctions in terms of their potential to satisfy users, and in terms of their electronic complexity by three important metrics: the number of software agents, the number of messages exchanged between these agents, and the number of migrations performed by the agents. They concluded that dynamically choosing the number of agents and the coordination model can

improve quality of service in electronic commerce applications. Furthermore, in online auctions where there is a lot of interaction between software agents, migration of agents to virtual stores and local bidding is more fair and efficient than using remote interaction [5].

Elth Ogston and Stamatis Vassiliadis examined a peer-to-peer agent continuous double auction. They compared agents trading using peer-to- peer communications with agents using the same trading strategy in an auction that makes use of a centralized auctioneer to disseminate information. They found that the peer-to-peer auction is able to display price convergence behavior similar to that of the centralized auction. They told thaat the peer-to-peer system outperformed the simple central auction by at least 100 times in our simulations [6].

Minguha He, Nicholas R. Jennings and Adam Prugel-Bennett presented the design, implementation and evaluation of a novel bidding strategy for obtaining goods in multiple overlapping English auctions. The strategy uses fuzzy sets to express trade-offs between multi-attribute goods and exploits neuro-fuzzy techniques to predict the expected closing prices of the auctions and to adapt the agent's bidding strategy to reflect the type of environment in which it is situated. They showed through empirical evaluation against a number of methods proposed in the multiple auction literature, that their strategy performs effectively and robustly in a wide range of scenarios [4].

3. Background Theory

3.1. Agent

An agent is software that becomes an extension of the user, performing tasks on the user's behalf. Agent technique is one of the important technologies developed to support the Internet applications. Even if the users are off-line, the agents are still active in the world of computer network and play the roles that their users assigned. There are various types of agents -intelligent agents, information agents, mobile agents, personal assistant agents and so on [3].

3.2. Mobile Agent

A mobile agent is a program, which represents a user in a computer network. It is capable of migrating autonomously from node to node, to perform some computation on behalf of the user. Its tasks are determined by the agent application, and can range from online shopping to real-time device control to distributed scientific computing [9].

3.3. Auction Agent

The Auction Agents can bid for and sell items in an online auction on behalf of their owners. Each mobile agent carries along with it information about its owners bidding range, time within which the item is to be procured, bidding pattern, and other relevant attributes [8].

3.4. Auction

Auctions are common in markets where the goods sold are valuable (like art) or when their prices can't be easily determined. The process of an auction aims to find a fair price for the goods by identifying buyers who need them the most. Such auctions are called forward auctions. In forward auctions buyers compete with each other by placing bids for the goods to be sold. In reverse auctions, sellers compete with each other to satisfy the buyer [1].

3.5. Types of Auction

Depending on the pricing and bargaining schemas, auctions are categorized into iterative auctions and sealed-bid auctions. English auctions and Dutch auctions belong to the first group, where the price, ascends iteratively. First-price-sealed-bid auctions and Vickrey auctions are the major examples of auctions in the second group.

3.6. English Auction

This is the most frequently used and common method and is known also as the open-outcry auction or the ascending-price auction. The auctioneer begins here with the lowest acceptable price, which is not secret, and proceeds to solicit successively higher bids from the buyer agents, and ends with a timeout. The item is sold to the highest bidder agent at the price of her last bid. In an English auction, the buyer agents may bid several times or react to the bids of others arbitrarily. The information flow of English auctions can be seen in the sequence diagram in Figure 3.1. English auctions favor sellers in terms of profit, particularly on demand-driven scenarios.

One variation of the English auction is the open-exit auction. Here the prices rise continuously,and bidders must publicly announce that they are dropping out when the price is too high. Once a bidder has dropped out, she may not reenter. In another variation, an auctioneer calls out each asking price and bidders lift a paddle in the online version, send an accept message, to indicate a willingness to pay thatamount. Then the auctioneer calls out another price, etc.

Yankee auctions are another type of English auction, where multiple items of the same kind are negotiated in one auction. The items are allocated

afterthe auction is finished, depending on different criteria like desired amount of items and maximum budget of the agent [5].

3.7. Reverse Auction

In reverse auctions, the successful bidder is determined by the lowest price submitted to the auctioneer at the conclusion of the auction. While potential suppliers are underbidding each other, the buyer does not do anything but only observes the negotiation. Reverse auctions have the following flow:
- The buyer submits a list of items to the auctioneer.
- The auctioneer invites sellers to participate, with a specified start and closing time.
- All bidder's identities are kept confidential during the auction.
- Bidders submit prices that are ranked and disseminated to all bidders as new bids are made.
- An extension of the auction closing time may be triggered for a pre-determined period of time if one of the top bid rankings changes.
- The auction closes once no new bids are placed and the original or extended closing time expires.
- All bidders are immediately notified of the final bid rankings, and the auctioneer notifies the buyer of the bidding results.

Reverse auctions favor buyers in terms of budget, particularly on supply-driven scenarios [5].
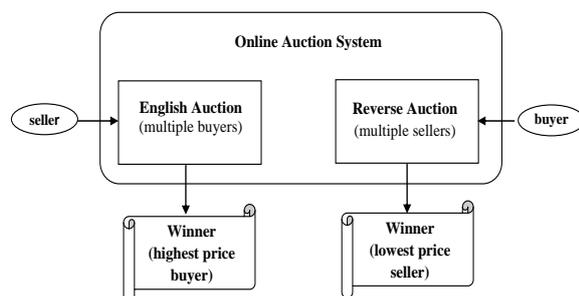
4. Proposed System Overview

Figure 1 Proposed System Overview

The overview of the system is shown in Figure 1. In this system, two types of auction will be developed by using three types of agents (seller agent, buyer agent and auctioneer agent). First is English Auction (Open-cry Auction). In this auction, seller creates an auction by sending a seller agent to the auctioneer agent. The auctioneer agent tells the auction information to buyer agents. Buyers agents compete for a limited time. Then, the auctioneer agent selects the winner (the buyer who gives the highest price). Second is the Reverse Auction. In this auction, buyer creates an auction by sending a buyer agent to the auctioneer agent. The auctioneer agent invites sellers via seller agents. Seller agents compete with one another to satisfy the buyer. Finally, the auctioneer agent selects the winner (the seller who will sell products/services with lowest price).

4.1. Agents in System

There are three types of agents used in this system:
(1) Seller Agent
(2) Auctioneer Agent and
(3) Buyer Agent
The roles of each agent are as follows:
- Seller/Buyer agent is responsible for (1) initiating auctions or (2) automatically placing bids on behalf of a user.
- An auctioneer agent is created for each new auction to handle its auction related activities such as posting bids.
- While an auction is running, an agent representing a user (seller/buyer agent) can put bids on auctioned items.
- The corresponding auctioneer agent is responsible for updating bidding activities for all involved agents.
- At the end of an auction, the auctioneer agent notifies the winner of the auction.

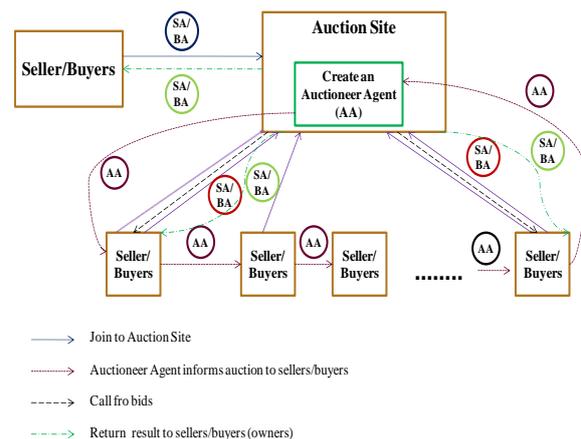The agent architecture used in this system is shown in Figure 2.

Figure 2 Agent Architecture

Firstly, a seller agent or buyer agent begins an aucion. When the auction site receives detail information from seller/ buyer agent, an auctioneer agent (AA) is created. The AA visits and informs the auction's information to all registered sellers/buyers. Then, the AA goes back to the auction site and waits for the joining information of sellers/buyers. After receiving joining information, AA checks whether the joining sellers/buyers (bidders) are valid. If the

number of valid bidders is greater than 2, the AA calls for bids from valid bidders. As for bidders, he is allowed to compete in the auction if he receives call for bids from AA. Then, the valid bidders sends seller/buyer agents to the auction site. And the respective agents compete the auction at the auction site. Finally, the agents come back to their owner carrying the result of the auction.
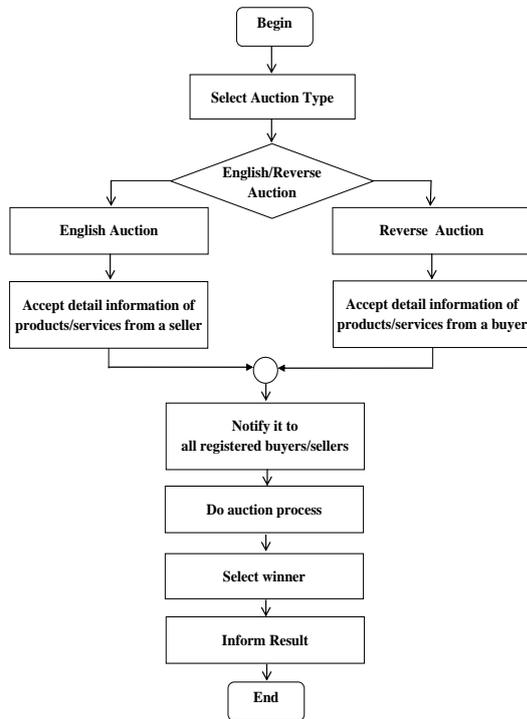
5. Implementation

Figure 3 Proposed System Overview

The system flow diagram of the proposed system is shown in Figure 3. Firstly, users must choose the auction type to interact with the system. If the user select "English Auction", the system will accept detail information of products/services from the seller and do forward auction process. If the selected type is "Reverse Auction", the system will accept detail information of product/services from the buyer and do the reverse auction process.

5.1. Procedures of Agents

A seller agent is responsible for initiating auctions (for English Auction) or automatically placing bids on behalf of a user according to user defined bidding strategies (for Reverse Auction). Users must configure a seller agent by providing auction related information, such as the type of items they are interested in, maximum value for that item, and bidding strategies for how to put bids during an

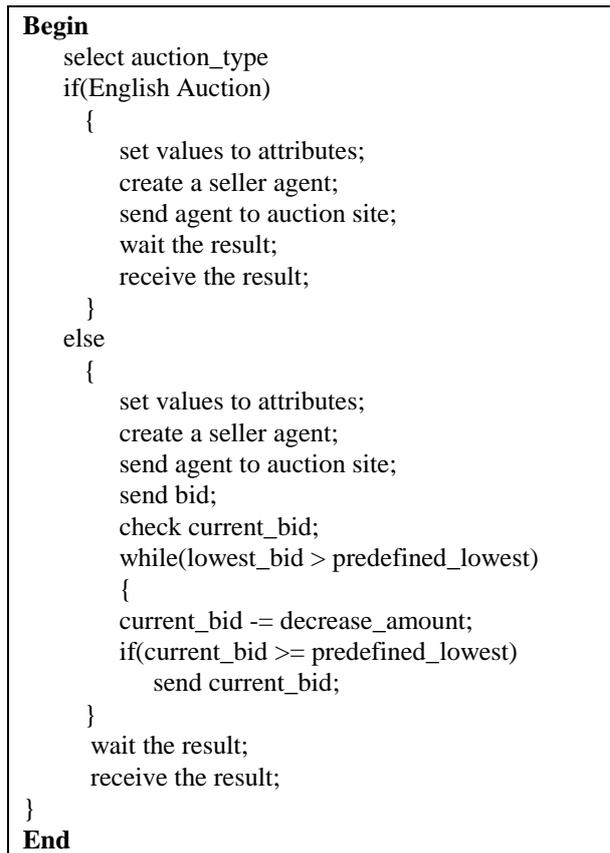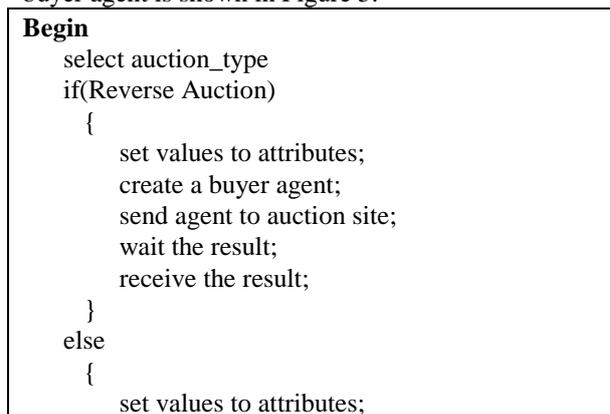auction. The datail algorithm for the seller agent is shown in Figure 4 .

```
Begin
    select auction_type
    if(English Auction)
      {
          set values to attributes;
          create a seller agent;
          send agent to auction site;
          wait the result;
          receive the result;
      }
    else
      {
          set values to attributes;
          create a seller agent;
          send agent to auction site;
          send bid;
          check current_bid;
          while(lowest_bid > predefined_lowest)
          {
          current_bid -= decrease_amount;
          if(current_bid >= predefined_lowest)
              send current_bid;
          }
        wait the result;
        receive the result;
    }
End
```

Figure 4 Algorithm for Seller Agent

Users must configure a buyer agent by providing auction related information, such as the type of items they are interested in, maximum value for that item, and bidding strategies for how to put bids during an auction. A configured buyer agent will run autonomously, and make decisions on behalf of the user during the bidding process. When an auction event begins, buyer agents migrate themselves to the auction node, where the auction takes place. After completion of the auction, buyer migrate themseles back to their home nodes. The detail algorithm for buyer agent is shown in Figure 5.

```
Begin
    select auction_type
    if(Reverse Auction)
      {
          set values to attributes;
          create a buyer agent;
          send agent to auction site;
          wait the result;
          receive the result;
      }
    else
      {
          set values to attributes;
```

```
        create a buyer agent;
        send agent to auction site;
        send bid;
        check current_bid;
        while(highest_bid < predefined_highest)
        {
         current_bid += increase_amount;
         if(current_bid <= predefined_highest)
            send current_bid;
        }
        wait the result;

        receive the result;
    }
End
```

Figure 5 Algorithm for Buyer Agent

The auctioneer agent begins auction protocol by sending a product offer to seller/buyer agents. If the predefined time to start the auction is on hands, and only one seller/buyer agent is registered with the auction, the auctioneer has to inform the shopper that the auction has been cancelled due to the lack of participants. If there are enough bidders and when the predefined time has come, the auction begins and seller/buyer agents can start bidding. When a new bid is sent by a seller/buyer agent, the auctioneer checks it and if it is appropriate, a message informing acceptance of the bid is sent back. Also, every other participant is informed about the new bid. This continues until no one can be found to outbid the current standing bid. Then, the auctioneer agent waits a while and announces that the auction has finished and the participant, who made the final bid, is the winner and is obligated to pay the bid amount. The detail algorithm for auctioneer agent is shown in Figure 6.

```
Begin
  set values to min_bidder;
  check auction_type;
  if(English Auction)
  {
     get detail info from seller agent;
     create auctioneer agent;
     notify to all buyers;
     if(no_of bidders >= min_bidder)
     {
      start auction;
      while(time_unexpired)
      {
        accept bids;
        update highest_price;
        notify highest_price to all bidders;
      }
      for (each bid_price)
      {  if(bid_price == highest_price)
           winner++;
```

```
      }
      if(winner>1) choose the first bidder;
      notify the name of winner to all buyer agents;
     }//end if
   }//end English Auction
else
  {
     get detail info from buyer agent;
     create auctioneer agent;
     notify to all sellers;
     wait for bidders;
     if(no_of bidders >= min_bidder)
          start auction;
     while(time_unexpired)
     {
       accept bids;
       update lowest_price;
       notify lowest_price to all bidders;
     }
     for (each bid_price)
     {  if(bid_price == lowest_price)
          winner++;
     }
     if(winner>1) choose the first bidder;
     notify the name of winner to all buyer agents;
    }//end if
  }//end Reverse Auction
```

Figure 6 Algorithm for Auctioneer Agent

An example auction process is shown in Figure 7. This figure shows the situation when a seller agent arrives for competing.
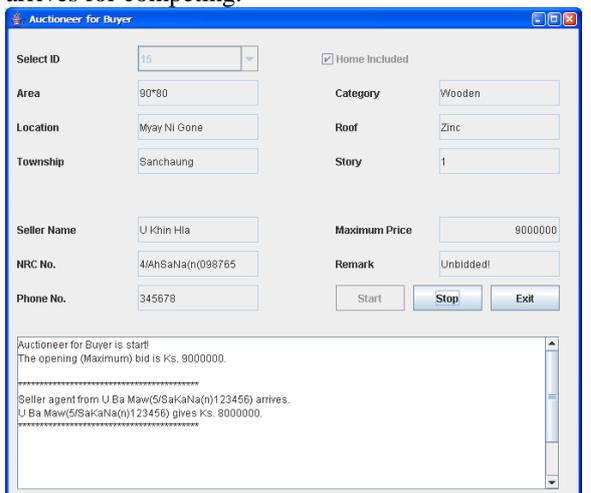

Figure 7 Example auction process

After the completion of auction process, the system will produce the result of winner as shwon in Figure 8. This message is carried by all buyer agents to their owners.
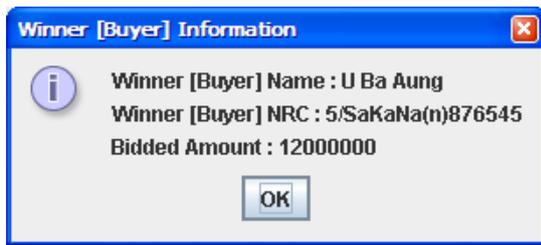
Figure 8 **Winner Message**

6. Conclusion

Electronic commerce is a domain where agent technologies are well suited. Software agents help automates a variety of tasks including those involved in buying and selling products over the Internet. This system will be developed as an online auction system using English auction and reversed auction mechanism for user-desired products/services. It will be implemented using mobile agents. It will be very useful for businessmen and customers, and saves time and money as the participants of auctions do not need to be together at the same time and same place.

7. References

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