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## An Agent-based Model for Agriculture E-commerce System

<sup>1</sup>O. Folorunso, <sup>2</sup>Sushil K. Sharma, <sup>3</sup>H.O.D Longe and <sup>1</sup>K. Lasaki

<sup>1</sup>Department of Mathematical Sciences, University of Agriculture, Abeokuta, Nigeria

<sup>2</sup>Department of Information Systems and Operations Management, Ball State University, USA

<sup>3</sup>Department of Computer Sciences, University of Lagos, Lagos, Nigeria

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**Abstract:** Internet access and agent technology promises to revolutionize the landscape of agricultural business. Already E-commerce is clearly beginning to have a major impact in the agricultural sector. The way people go about purchasing agricultural products is of great concern. Sometimes buyers have to travel far distances to get agricultural products and getting the right quality is not guaranteed. Also, various market prices cannot be compared because buyers do not have all the time and resources to visit every agricultural farm. Hence, the need for an electronic means of trading called Agriculture Electronic Commerce (Agric-EC), which would help farmers and other buyers, make their appropriate business transactions online. To achieve this, a prototype Agric-EC site would be developed using web service technologies as the communication infrastructure between the buyers and the farms server using an Agent sheet simulator. This paper focuses on how mobile agents, a new technology can be incorporated into an Agriculture E-commerce system to aid buying and selling in the agricultural sector and more importantly, how prices can be retrieved from Agricultural electronic commerce sites in cases where the buying agent recommends the best price.

**Key words:** E-commerce, software agents, agriculture, internet, agent sheet

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### INTRODUCTION

The internet has brought about unprecedented change in the society, spanning the entire globe and crossing all boundaries. The Internet has redefined the methods of communication, education, health and commerce etc. Agricultural E-commerce enables good trading possibilities by supporting different business models such as multi-suppliers, e-sales and several types of auctions. Today's E-commerce lacks fully automated business processes and still requires a significant manual effort by users.

The way people go about purchasing agricultural products is of great concern. Sometimes they have to travel far distances to obtain these products and unfortunate, sometimes the products may not be in stock. Also the quality of the products is not guaranteed, especially the perishables. In case of any problems, the buyer cannot complain to the sellers or producer of the product. Also various market prices cannot be compared because buyers do not have the time and resources to be visiting all agric farms. This problem can be solved if there was an electronic means of trading using a multi-agent system's approach.

An agent is an entity that is designed to undertake autonomous action on behalf of a user in pursuit of his desired goal<sup>[1]</sup>. This implies that agents are intelligent and autonomous objects that are capable of behaving like a human being. Therefore agent technology is a suitable means for expanding agricultural business activities and saving cost.

Agents possess some form of basic intelligence to allow decision-making or have a structured response to a given set of circumstances. These behavior patterns are acquired from or given to the agent by the user, this enables the agent to be capable of flexible actions. Allowing it to exhibit good oriented and opportunistic behavior to meet its objective. Agents exist in an environment and can also respond to changes therein. Complex tasks can be broken down into smaller components that can each be the responsibility of an agent. They concentrate on their individual components, find optimal solution and combine their efforts by inter-agent communication.

Agriculture E-commerce: blurs the physical existence of agro-allied stores, the integrity of products are ensured, no paper money involved in the process, distance doesn't exist and so on. However, for effective E-commerce site

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**Corresponding Author:** Dr. Sushil K. Sharma, Associate Professor, Department of Information Systems and Operations Management, Millar College of Business, Ball State University, Muncie IN 47306, USA  
Tel: 765-285-5315 Fax: 765-285-5308

buyers, experience must surpass the store experience, such as price comparison (buyers want a fair price)<sup>[2]</sup>. Detailed product information is one of the most important aspects dealing with E-commerce sites. The need to incorporate an agent system into agriculture E-commerce needs to be promptly addressed. The agent system can be made responsible for autonomously aiding purchases for prospective buyers.

This study therefore builds a framework for integrating a mobile agent system and an Agricultural Electronic commerce site(s) together by incorporating a mobile agent system into the Agricultural E-commerce site.

### AGRICULTURE E-COMMERCE

Agriculture E-commerce is a situation whereby buying and selling of agriculture products and services are carried out electronically with the use of computer systems linked together over inter network protocols and standards. The various parties involved in the electronic business dealings agree to conform to the norms, rules and regulation guiding the industry<sup>[3]</sup>.

A typical scenario in commercial transactions in most countries today, would include business dealings through physical contact. This method has been in use for some time and its relevance is not in doubt. The use of computer systems has brought about improvement and efficiency over the previous manual operations such as payroll processing, stock inventory analysis and control and scientific processes<sup>[2]</sup>. In the same vein, the Agric E-commerce is going to change the way agricultural products are purchased.

Agricultural E-commerce is any method of using electronic communications and computer technology to conduct agricultural business, so that trading partners can share a wide range of communiqué and data. Agricultural E-commerce transforms the way agricultural products are sold and the way farms interact with each other and customers through communication channels. In order words, this technology is a subject of the larger world of both Information Technology and Agriculture.

Furthermore Agricultural E-commerce enables good trading possibilities by supporting different business models as multi-supplier, e-sales and several types of auctions.

Agricultural E-commerce converts the way people buy agricultural goods and services in the physical world to buying and selling in the virtual world. Agricultural

E-commerce blurs the distinction between the physical world and the virtual world, as electronic presence of people, places and products become a common place. Eventually the movement of people, paper and products within an agricultural farm are replaced with IT Internet representations. Both small and large farms are opened to the same resources so the size of the farming plant does not matter.

### AGRICULTURE E-COMMERCE MODELS

According to Folorunso *et al.*<sup>[3]</sup> the agriculture e-commerce models includes:

**Farm to Farm (F2F):** This model was designed for farms to collaborate or sell goods and services to each other. That is, the supplier is a farm and the customer is another farm. The F2F is a bit complex, although it may not appear so. Under this model the agents do not negotiate for the products to buy, instead the two farms agree on a set of terms and continue to follow those terms in each transaction.

**Farm to Customer (F2C):** This model allows farms to sell goods and services to customer or an individual via the Internet. The agents are responsible for price comparison.

**Customer to Customer (C2C):** The supplier and buyer are individuals.

### AGRICULTURE E-COMMERCE SITE DESIGN

The Agric EC site will have a homepage as described in Fig. 1, which interfaces the user with the application. All other pages on the site are linked to the homepage.

- An “About us” page will be supplied to provide the user with some valuable information about the website.
- An “Event” page will contain current events by trading partners.
- A “Catalog” page, which has information about the products in stock
- The “Mobile Agent System” page, which allows connections between hosts
- For interested buyers, “The Payment” page and feedback page where the users can purchase goods and leave their personal feedback.

Figure 1 shows the web page design:

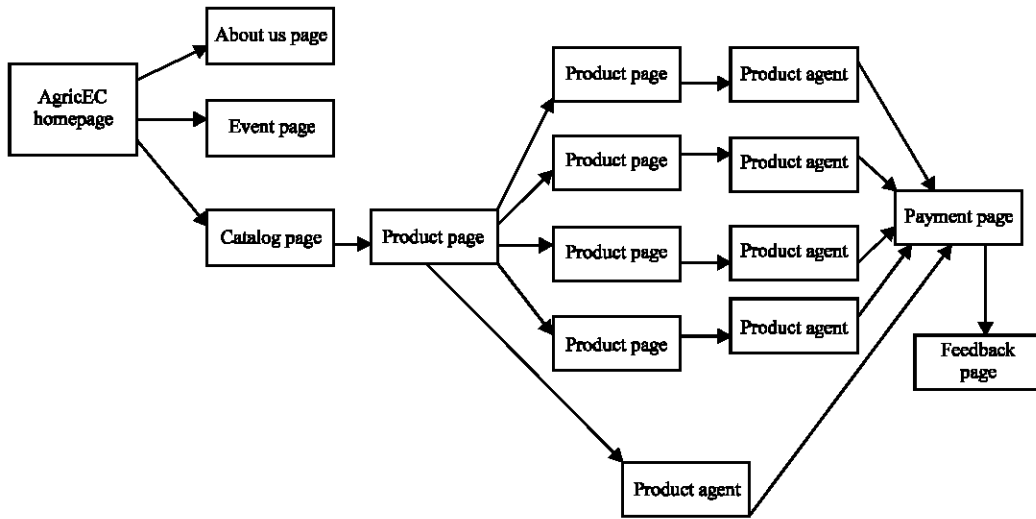


Fig. 1: Agric E-commerce site design

**BENEFITS OF IMPLEMENTING AGRICULTURAL E-COMMERCE**

- Agricultural E-commerce is a method for reducing administrative cost and cycle time, re-organizing farm processes and improving relationships between both business partners and customers.
- Agricultural E-commerce techniques allow small farms to have access to the same markets as larger farms. That is, small farms can have instant access to international markets.
- Small farms can grow very quickly and even take on larger farms. They are able to provide personalized services to individuals who visit the site more easily than larger farms.
- An effective agric-E-commerce solution can extend business by increasing opportunities with customers, suppliers and other farms.
- With the use of Agric-E-commerce techniques and technology, they are likely to attract additional customers because of a higher level of customer service. And this will lead to better customer relations and increase the number of customers.

**SOFTWARE AGENT**

The research on the software agent was started in the area of Artificial intelligence in the 1970s, which is the basis for all types of agents. The first mobile agent system was Telescript, developed by General Magic in 1996. In the last years, research and development of mobile agent have become fast growing areas of research. The goal of

most projects concluded so far was to prove the possibility to implement mobile code, which is the basis of a mobile agent done in a different programming language<sup>[4]</sup>. Past projects also showed that it is worth using mobile agent technology for particular application domains. Some of the mobile agent systems developed in the last years are aglets by IBM, voyager by object spaces and Grasshopper by IKV<sup>[5]</sup>. Since the research work is on prototype development, we considered an agent sheet for the experiment.

**AGENT SHEET**

Agent sheet is an agent-based simulation-authoring tool that lets users create their own interactive simulations<sup>[6]</sup>. Agent sheet is an environment that combines the agents, spread sheets and java authoring techniques in one single medium.

**AGENT BASED SIMULATION**

The agent sheet programming language called Visual Agent Talk (VAT) is a rule-based language that features Conditions, Actions and Rules. These are objects that can be explored:

**Condition:** Conditions are used to test the circumstances agents are in.

**Actions:** Actions are operations performed by agents. Actions allow agents to do things such as moving in work sheets etc.

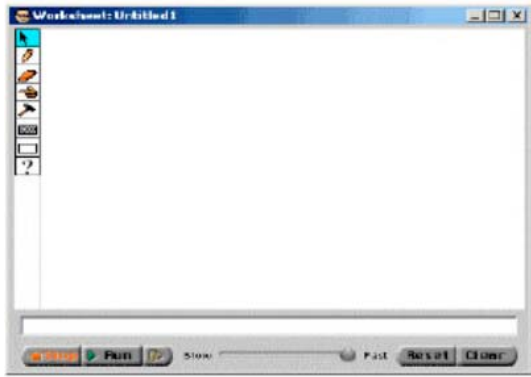


Fig. 2: An agent worksheet

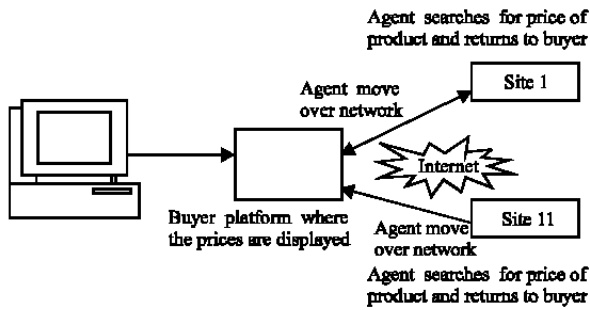


Fig. 3: Agent based Agric E-commerce design

**Rules:** Lists of rules are grouped into methods. The user decides how to define different methods for agents. By filling those methods with a list of rules, which in turn are assembled from a list of conditions and actions.

The simulation platform displayed in Fig. 2 provides a simple way to implement different agent behaviors and observe their dynamical interactions. This platform consist of the following main components:

**Agent sheet main window:** A window with main controls of the simulation.

**Worksheet:** Agent sheet worksheet come equipped with a toolbar along the left side of the window, set of buttons and a message area right above the buttons.

**Gallery:** A gallery is a window that houses the entire agent created in a simulation.

**Condition palette:** Condition commands are blue and are permanently housed in the conditions palette. They are always dragged into the IF side of a rule. An implicit and exists between all conditions in a rule. This means that all the conditions of a rule must be true in order for the actions of that rule to be executed.

**Action palette:** Action commands are red and are permanently housed in the actions palette. They are always placed in the THEN side of a rule. An implicit and also exists between all actions in a rule. This means that all the actions in a rule will be executed if the rule's conditions are true.

**Agent-based model for agriculture E-commerce:** As described in Fig. 3 a mobile agent system is built for each product and the two Agric-EC sites are the points where the product prices will be retrieved. The mobile agent system for a particular product moves into the first Agric-EC site and retrieves the price of that product from the price-listing page, which is not visible to the user, then displays the price of the product. The same mobile agent system moves into the second Agric-EC site and retrieves the price of the same product from the price-listing page and displays it. The mobile agent system then compares the two prices and displays the cheaper of the two prices. It then suggests to the buyer the site to buy from, which is the cheaper or the two. It should be noted, that the total cost before comparison is the unit cost of the shortest route to transport the agricultural material and the actual price of products per Agric. E-commerce site.

$$\begin{aligned} \text{Total cost} &= \text{Price per site} \\ &+ \text{cost of minimum route of transportation} \\ T_c &= P_{\text{per/site}} + \text{MRT} \end{aligned}$$

These are embedded in the conditions (buying and selling conditions), actions and rules (matchmaking between demand and supply) respectively.

### ISSUES AND PROBLEMS

The mobile agent developed for a particular product moves to the first Agric-EC site retrieves the price of that product and displays it to the buyer. The same mobile agent moves to the second Agric-EC site retrieves the price and displays it to the buyer. The mobile agents then compare the two prices and display the cheaper price, also suggesting to the buyer where to purchase the goods. This can be illustrated thus:

- A buyer gets to the Agro allied store X on the Internet, views the catalog to see the products in stock, clicks a product like a Cashew Nut and clicks the buy now button, the mobile agent system web page is loaded.

- On clicking the RUN button the mobile agent displays the price of Cashew nuts in the Agro allied store X and the price of Cashews at Agro allied store Y and displays the site with the cheaper price and suggests where to buy the Cashew nut. The buyer can now order based on this suggestion without having to physically go to the Agro allied stores. The buyer can give feedback information if he/she so wishes.

Different sectors are deploying E-commerce systems to expand markets, enhance customer satisfaction and loyalty and develop new revenue to help ensure that an E-commerce solution provides the intended return on investment applications. The server and the enterprise network infrastructure must work seamlessly. Three primary issues must be considered in the planning, design and implementation process. They are: availability, quality of services and security.

#### **AVAILABILITY**

Performance of the agricultural E-commerce solution depends first and foremost on continuous application availability. Locating servers in a secure, central location, also Ethernet network connections can help maximize availability application and database servers.

Access is the most important aspect of availability. Customers must be able to access the agricultural E-commerce website, application and data available for 24 h daily. This means that adequate bandwidth must be provided.

#### **QUALITY OF SERVICE**

Another important aspect is quality of service, which enables bandwidth management, so high priority or delay sensitive operations receive preference across the network. The network hardware should support quality service features. When implemented, they can deliver optimum application performance.

#### **SECURITY**

When conducting business over the Internet, customers and corporate information must be protected at all times. Firewall security policy-based authentications etc., are essential to protect sensitive resources such as payment processing.

#### **CONCLUSIONS**

Agent based Agric-EC is a new system that promises to change the way farms and individuals purchase agricultural products by delegating tasks involved in buying and selling to intelligent mobile agents. Also this system promises to connect buyers and sellers in a ways that ensure the integrity and visibility of valuable products to consumers, while trading partners can share a wide range of communiqué and data. In this study, price comparison was the major focus. An effective E-commerce site, buyers experience must surpass the store experience such as price comparison (buyers want a fair price) and detailed product information<sup>[2,7]</sup>. When implemented, the integrity, effectiveness and efficiency of trading in the agricultural industry is ensured. It stands a better chance of generating higher revenue for the government than E-commerce.

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