Real Time Fuzzy Personalized Web Stock Information Agent

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Abstract

The real time fuzzy personalized stock information agent is designed based on fuzzy logic, intelligent agent, personalization, Jakarta-Tomcat-3.2.1 (Web sever) and Microsoft SQL Server 7.0 (database). In addition, a variety of languages, including Java, JSP (Java Sever Page), HTML, Java Servlet, XML, XSL (Extensible Stylesheet Language) are also used. The smart agent enables the users to create their own portfolios that contain the real time watch list of personalized stocks. The application refreshes each stock data in real time by accessing the appropriate database available on the Internet. This application enables the user to get accurate, real time information of a pre-selected list of favorite stocks. Using fuzzy reasoning, the Web stock agent is capable of ranking the "top 10 stocks" based on their real time stock information.

1. INTRODUCTION

In the Webster dictionary [17], an agent is defined as "generally, a person or thing that acts or is capable of acting, or, in this comparison, one who or that which acts, or is empowered to act, for another." Generally in the scope of data mining, agent stands for some software that can perform some kind of automated actions. There are several variations of the definition of agents. Here is one from IBM: "Intelligent agents are software entities that carry out some set of operations on behalf of a user or another program with some degree of independence or autonomy and in so doing, employ some knowledge or representation of the user's goals or desires". Agents are very useful for people in daily life, such as travel agents, and insurance agents. It is well known fact that tracking changes of thousands of daily stocks is very difficult job for humans to perform. On the other hand automating the process by an intelligent stock agent running on a computer can perform this task and help human stock traders or a stock agent a lot in terms of time saving, reliability, efficiency and convenience [11]. In large, intelligent agent technology and soft computing techniques are useful for smart Web applications under uncertainty conditions [5][10][11].

Personalized agents have merits including trust (the agent will do what the user wants, personalization (the agent can either learn or be explicitly taught what to do for each individual user), and autonomy (the agent is allowed to take at least some actions on the user's behalf, without permission or perhaps even notification).

By including uncertainties, fuzzy reasoning can yield satisfactory results comparable to human reasoning. For data mining applications [1][6], fuzzy reasoning is easy to understand and implement with the help of some popular complex techniques used in data mining systems [9]. In addition, fuzzy reasoning uses fuzzy rule base for input classification and processing which enforces the precision and reliability of the output. Fuzzy systems generally enhance users confidence and trust on the results.

In this paper we present a real time personalized fuzzy stock information agent based on the above-mentioned technologies.

The presented application is web-based and given the name; "VirtualStreet.com". VirtualStreet.com is created on Jakarta-Tomcat-3.2.1, Microsoft SQL Server 7.0, Java, JSP, HTML, Java Servlet, XML, and XSL. The smart stock agent enables users to select a list of stocks, and generate a list of top 10 stocks based on fuzzy logic.

The rest of the paper is organized as follows. The fuzzy logic system is introduced in Section 2. Section 3 covers a system implementation including system assumption, architecture, database, user interface and application functionality. Section 4 includes system demonstration. Section 5 gives conclusions.

2. FUZZY SYSTEM

To give users reliable and correct stock information and guide them in a useful way, we need to build a powerful algorithm that accommodates all situations. It is difficult to solve every factor in precise percent among the whole factors. However people can decide which one is more important than others. So we can be imprecise rather than precise. Fuzzy logic with fuzzifier and defuzzifier is one way. It can solve the problem using approximate information to generate decisions. Fuzzy logic is a superset of conventional (Boolean) logic that has been extended to handle the concept of partially true-partially false values between "compelete truth" and "complete false".

A fuzzy rule system is a collection of membership functions and rules that are used to reason about data. The goal is to get the numerical process using fuzzy rule systems. Generally, The rules in a fuzzy rule system are similar to the following form:

If x is low and y is very low then z is very low,

where x and y are input variables, z is an output variable. x and y are defined as a low membership function. Very low is membership function that is defined on output variable z.

A fuzzy reasoning system with fuzzifier and defuzzifier, includes four processes: fuzzification, inference, composition and defuzzification [2][4][8].

1. Fuzzification

In this process, the membership functions defined on the input variables are applied to their actual values, to determine the degree of truth for each rule premise.

2. Inference

In this process, the value of each rule is computed, and applied to one conclusion of each rule.

3. Composition

In this process, all of the fuzzy subsets are combined into a single fuzzy subset for each output variable.

4. Defuzzification

In this process, the fuzzy value is converted into a value. The main methods of defuzzification include CENTROID and MAXIMUM methods. In CENTROID method, the crisp value of the output valuable is calculated by finding the variable value of the center of gravity of the membership function for the fuzzy value, while in MAXIMUM method one of the variable values at which the fuzzy subset has its maximum truth values chosen as the crisp value for the output variable. The advantage is that we do not need to specify a precise border between the ranges and each input value has a membership value.

Some of the factors needed for evaluating stocks are stock ask/bid prices, earning/share, price/earning, price day range, and so on. The earning/share value and price/earning ratio are very important parameters that make the trader decide which stock to buy, sell or hold.

3. FUZZY PERSONALIZED STOCK AGENT

Fuzzy logic implementation becomes very complex when the number of inputs increases. Thus, to avoid system complexity and overhead while provide enough precision in output, a minimum number of inputs should be carefully selected. "earning/share" and "P/E Ratio" are chosen as inputs in the present system implementation among the so many values that can be fetched from Internet. The output of the fuzzy logic method is in the form of a list of predicted stock value. The method is processing information based on 25 rules that takes the above mentioned factors into account.

The application suite resides on a workstation with single Intel Pentium III 800MHz CPU running at 133MHz front bus speed and 256 MB memory running at 133MHz. The operating system is Windows 2000 Professional, and web browser is IE 5.0. A dial up connection to the Internet is chosen to fetch stock information from Yahoo! server at http://quote.yahoo.com. The trading data of each stock is fetched from Internet every five minutes.

According to database design[3], the following three database schemas (tables) are created using VirtualStreet which is the name given to this application, as shown in Tables 1, 2 and 3. Table.1 shows key words account and password which are primary keys used for subscription to this application.

Graphical User Interface (GUI) is implemented in the application to provide user an easy, convenient and user-friendly way to access and navigate the application

When the application accepts user name and password of a particular user, a three-frame page will appear, providing services such as "My Account" information, "Reference Links" and "Logout". The services provided in the "My Account" section include portfolio management tools (create, display, edit, delete), and a list of "Top 10

stocks", obtained using method of fuzzy logic. "Reference Links" provide some useful links for related web sites, including links to stock glossary, stock forums.

Table 1 Table member

Account	Password

Table 2 Table porfolio

Mname	Pname	Sname

Table 3 Table ssymbl

Sname	Pask	Pbid	Pchange	Erng	Dhigh	Dlow	Yhigh	Ylow	Ltrade	drange
Popen	Pclose	Pertatio	Vlmn	Svalue	Ncom					

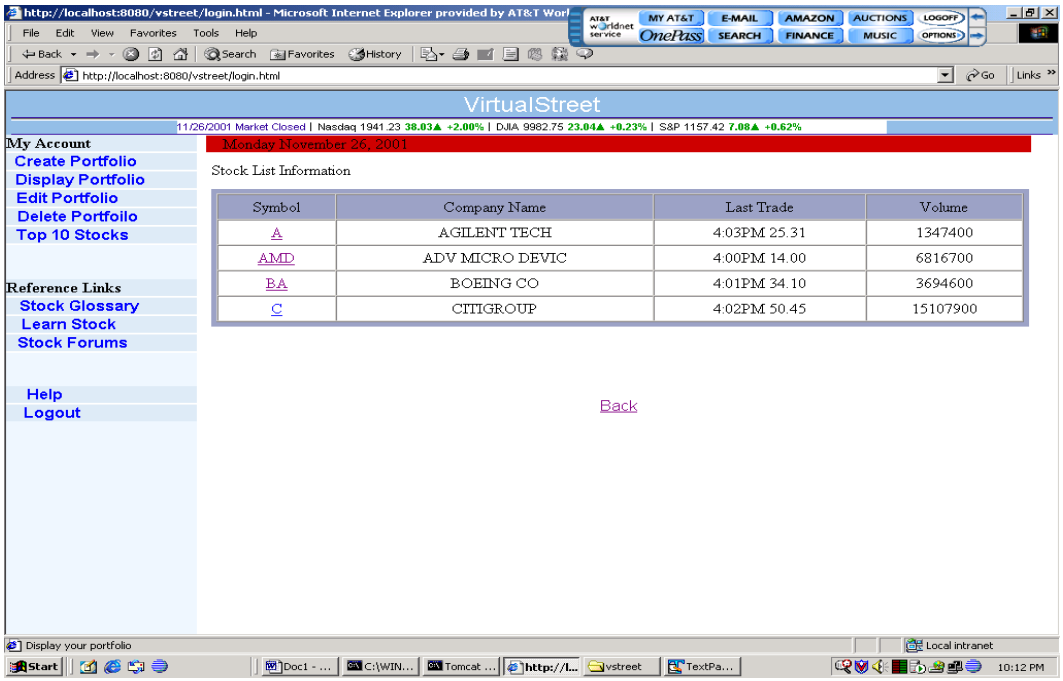

Figure 1 "Display Portfolio" page

Only one portfolio can be created at a time, and the user can create and keep as many portfolios as he/she wants. To create a portfolio, the user first needs to choose a name for it, and then check the checkboxes left to the stock ticker symbols to include these stocks into the watch list in the named portfolio. The number of stocks that can be included in a portfolio can be between 1 and 25. The portfolio is created after the user clicks "Finished" button, and a confirmation message will be displayed on the screen.

The user can view the stock list information by clicking "Display Portfolio" on the left menu frame to bring up a new page, and choosing the portfolio name in the scroll menu on this page. Figure 1 shows stock information, including symbol, company name, time of last trade, price, and trade volume, in the selected portfolio.

The application provides the user with very flexible editing and modifying portfolio tools.

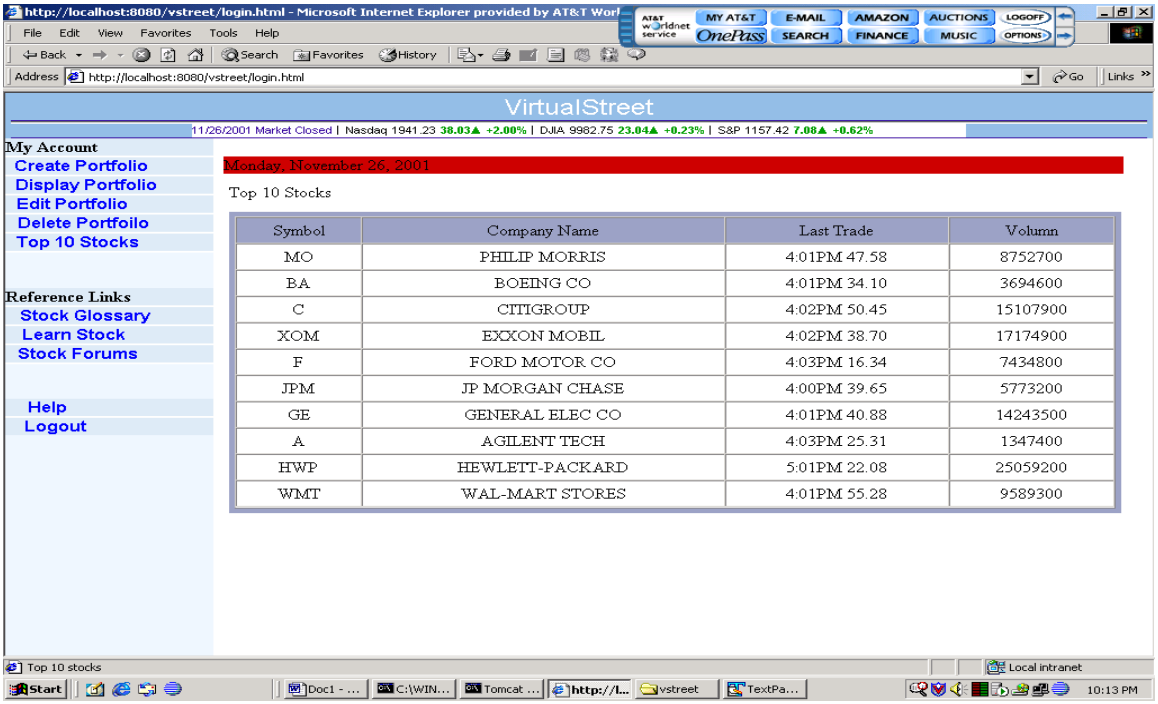

Figure 2 "Top 10 Stocks" page

Figure 2 shows the top 10 stocks determined by the fuzzy logic algorithm implemented in VirtualStreet, when the user clicks "Top 10 Stocks" on the left menu frame. The information in the list includes ticker symbol, company name, last trade time, price, and trade volume. The more attractive stock is listed first.

Currently, VirtualStreet does not provide inherent education service to users, instead, it provides three links to other websites containing financial information.

4. SYSTEM DEMONSTRATION

In today's fast-paced life style, people are faced with tons of data and information that must be processed and stored. Decision-making cannot fully rely only on human brain any more. Human cannot perform research and analysis on the existing thousands of stocks based on the values such as earnings, P/E ratios, .. etc. When an investor wants to trade stocks, he/she often pays attention to some specific stocks that are profitable. In fact, sometime he/she thinks a particular stock is a good one, but it may not be best choice. Fuzzy logic method, implemented in the Personalized Real Time Stock Agent – VirtaulStreet, can aid in decision-making and get the precise result in real time for dynamically-changing information.

Getting the right information about certain stock at the right time can be very profitable to even inexperienced investor. Using smart agents, the investor can choose among a list of the top 10 stocks. Smart agent based on fuzzy logic has the following advantages:

1. It guarantees a precise classification of the input data by adding a degree of uncertainty (each vale is classified with a particular percentage, fuzzy membership probability).
2. Results of the data processing using fuzzy logic are precise and accurate, since output values are also computed with the consideration of degree of uncertainty.
3. Fuzzy logic method is easier to implement than other sophisticated techniques (e.g. neural networks and k-nearest nearest neighbor method) when used for mining large data sets.
4. The algorithm produces results much faster comparing with other algorithms (tree based classifiers and ensemble learning).

5. Also fuzzy logic algorithm uses fewer number of local variables to obtain the results, which is a big advantage for the systems with low memory.

Although there are many websites that offer stock information, most require the user to an exhaustive search . The task of finding stock information becomes time-consuming when the search involves several stocks, and the user has to enter their symbols manually. Virtual Street trading system enables the user to choose several commands to perform on or more action on a particular portfolio. It takes only a few seconds for him/her to get all the quotes on all the stocks at the same time. The system fetches stock data from its Internet source every few minutes. This will keep the stock information up to date. Figure 3 shows a comparison of data retrieval using (VirtualStreet) and Yahoo! finance. The graph clearly shows the superiority of Virtual Street over Yahoo! Finance.

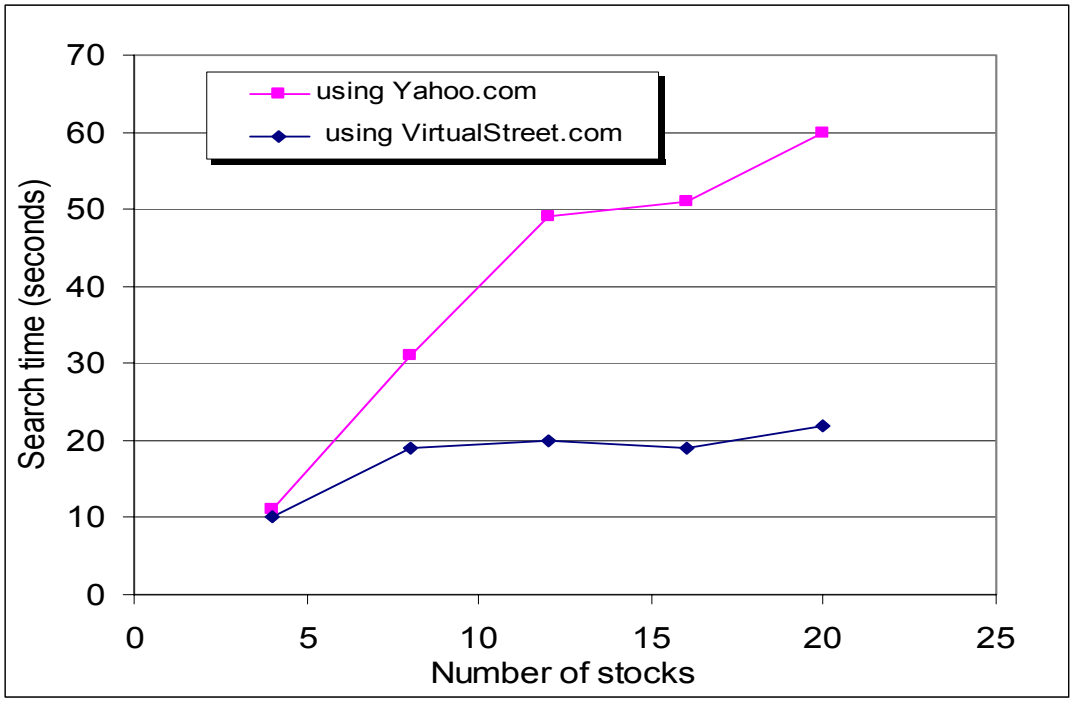

Figure 3 Comparison of time spent on searching a set of stocks using the designed VirtualStreet and yahoo.com

This system is made public and is free for everyone. The system can be easily installed in any personal computer.

5. CONCLUSION

The Personalized Real Time Stock Information Agent – VirtualStreet is created. The user can create his/her own portfolios that contain the watch list of stocks. In addition, the user can modify and delete those portfolios. The GUI and functions are easy to use. The Agent can refresh the stock data in a real time manner by accessing the database on the Internet so that the user can get accurate, real time information of the stocks. Using fuzzy logic, the Agent can create list of top 10 stocks based on output values calculated from stock information. Since output values are calculated with the consideration of degree of uncertainty, results of the data process are precise and reliable. It saves time for user to search for stock information, and good stocks from thousands of stocks.

The personalized agent gives the user advantages, including trust (the agent will do what the user wants, personalization (the agent can be either learn or be explicitly taught what to do for each individual user), and autonomy (the agent is allowed to take at least some actions on the user's behalf, without permission or perhaps even notification).

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