Rule Based Approach for Stock Selection: An Expert System

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Abstract—Artificial Intelligence (AI) is one of most emerging field in the research field and has given boost to the most growing technology known as Expert System (ES). An ES is a computer based program that is built to solve the problems in specialized domain. There are various expert systems in diversified areas like medical, engineering, agriculture, science etc. have been developed over the last five decades. Stock market is also one of the most important growing areas which shows the country's economic growth and also shows the need of expert system. This paper mainly highlights the need of expert system in stock market as well as rule based expert system approach for particular stock selection.

Keywords—Artificial Intelligence, Expert System, Stock Market, Rule Based, Forward Reasoning.

I. INTRODUCTION

From the beginning it has been always challenging task to profitable share selection for stock users because stock market requires the too much knowledge about economy. However it is not surprising that lots of work has to be done on accurately predicting the stock market trends. Over the last six decades various methods have been proposed for stock price prediction but no method or combination of methods have been succeeded to beat the volatility of the market [1]. In traditional stock market prediction system investors or brokers analyze the stock market behavior i.e. if they got the profit on individual share so it signal buy share otherwise sold the share if they got the loss. Now traditional approach is replaced by expert system approach which will work intelligently and efficiently for stock market and will guide us to know time to time market conditions [2].

A. Architecture of Rule Based Expert System
An expert system is a computer program that attempts to mimic human capability by the system capability to learn, to advice, to teach and performed intelligent tasks [3]. A rule based expert system is an expert system where knowledge is encoded by series of rules. The major components of rule based expert system are [4]:

- *Knowledge Base: - it contains the useful domain* knowledge for problem solving.
- *Database:* -it includes a set of facts used to match against the IF (condition) parts of rules stored in the knowledge base.
- *Inference Engine: -* The reasoning mechanism where expert system reached out a certain decision and solve a problem.
- *Explanation Facility:* -A component that is responsible for answering the users "why" or "how" questions.

- *User Interface: -* The user interface provides the communication between user and expert system.
- *External Interface: -* It provides an useful external environment (i.e. programs or files) so that expert system can easily work with it.
- *Developer Interface: -* It usually includes knowledge base editors, debugging aids (i.e. list of rules fired during the program execution and also tells the expert system in advance where and when to stop it) and input-output facility.

In these days stock price prediction is an important issue. To making the right prediction useful knowledge is stored in knowledge base and knowledge is collected from various sources like stock websites, newspaper, financial institutes, books, magazines, TV channels etc. After collecting the knowledge the organization and representation of this one is also important concern. For this various encoding schemes and knowledge representation techniques used. In this study important stock knowledge and their casual relationship is represented by rule based approach which is very powerful and effective approach for stock market prediction [5]. The inference engine is an important component of system which is used to solve the stock related problem or describe the reasoning process how to reach a particular goal. Sometimes also provide explanation or justification to the user i.e. why a specific piece of information is used in the system and how this information would be helpful to carried out a goal. The Figure 1 shows the architecture of rule based expert system.

II. LITERATURE REVIEW

This section presents a brief review that is proposed by significant researchers in the field.Apte et al. (1989) [7] have proposed an expert system for business development. Their expert system successfully predicted all the events of the business. It would be very helpful to draw conclusions based on events and might be look forward or backward. Their system also has a capability to change data over time. Boer and Livnat (1990) [8] have proposed an expert system for financial applications. Their expert systems are most widely used to train managers, financial experts and other industrial analysts. The knowledge based to be used in such a system very effective and updated time to time. So it would be able to solve user's queries.Smith and McDuffie (1996) [9] has used various quantative ratios like profitability, total profit, long term and short term debt etc. for knowing the market conditions, business reputation and organizations position.
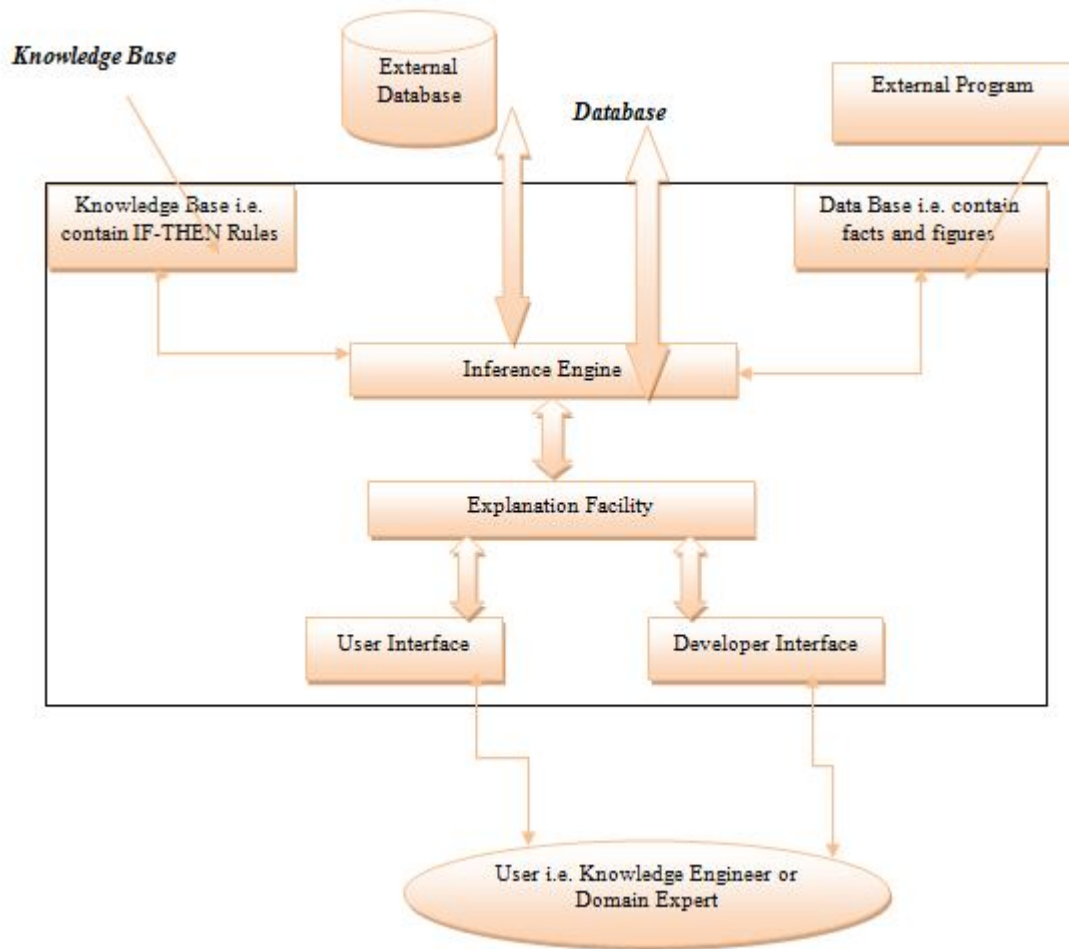
Fig. 1. Architecture of Rule Based Expert System [5]

Finally their system showed that better decision making before investment.Fazel and Hajigol (2008) [10] have proposed Type-2 Fuzzy Rule Expert System Model for portfolio selection. The proposed model used indirect approach fuzzy modeling. They also proposed clustering approach for automatic rules extraction. The input variables risk, return, dividend etc. are selected for research study and model is tested on Tehran Stock Exchange (TSE). The proposed model had succeeded to particular portfolio selection for stock users and most promising results are generated in real time trading environments.Alizadeh et al. (2009) [11] have proposed expert neuro fuzzy model for forecasting exchange rates. The proposed model takes 28 input variables for both USA/JPY currencies. The model performance compared with other models like Sugeno-Yasukava model, multiple regression models, and feed-forward neural network model. The comparison demonstrated that proposed model had great performances In terms of minimize error rate, robustness and flexibility.Paulo E. Merloti (2010) [12] has proposed fuzzy expert system for stock trading advisor. His expert system was used to show how many stocks to buy or sell based on input values like price and MAD indicator. He also put various research questions i.e. what would be effects of increasing the number of variables etc. for validating proposed system.Hadavandi et al. (2010) [13] have proposed Genetic

Fuzzy Expert system model for stock market forecasting. The proposed model has ability of rule base extraction and data base tuning to predict next day's price and also some useful pattern with rule based approach. They applied the method on IBM stock and compared the results with previous methods. The experimental results shows that proposed method had better prediction accuracy for short term prediction.Abdalla (2010) [14] has proposed various artificial intelligence approaches for analyze the modern financial time series. They also used various tools for analyzing the stock market variability. Finally they concluded that artificial intelligence approaches with combination of technical analysis could lead to significant performance.Hamid and Vida (2012) [15] have proposed hybrid intelligent system for gas price forecasting. The proposed model developed with GMDH neural network-genetic algorithm and rule based expert system. Their model extracts the useful rules and better accuracy with GMDH neural network model. This study inspired by rule based expert system applications in stock market field.

III. PROPOSED METHODOLOGY

Stock market stores large amount of data. So it would be very effective to represent knowledge in terms of set of rules (IF-THEN) rather than declarative form or some in a static way. It

would also help to reach at certain conclusions that are derived under given conditions or in diversified situations. A rule based system comprise of [4] [12]:
(1) Rule base(set of IF-THEN rules)
(2) Collective facts.
(3) Inference mechanism which decides which rule is to be applied based on the set of available facts and also shows the action against the selective rule.

There are two kinds of approaches used in rule based system forward chaining and backward chaining but in this study forward chaining approach is proposed. Forward chaining is the data-driven reasoning. The reasoning process starts from the initial facts or known data and proceeds forward with that data. Each time only top most rules are executed when fired and the rule adds a new fact in the database. The most important thing the rule can be executed only once. The match –fire procedure stops when no further rules can be fired [5] [6]. The working procedure of forward chaining approach is as follows:

(1) In first step suppose database contain some initial facts like A, B, C, D and E and knowledge base contain only five rules:

Rule 1: $Y \& D \rightarrow Z$

Rule 2: $X \& B \& E \rightarrow Y$

Rule 3: $A \rightarrow X$

Rule 4: $C \rightarrow L$

Rule 5: $L \& M \rightarrow N$

(2) In the second step only two rules i.e. rule 3 and rule 4 matched with the initial facts.

(3) Rule 3 $A \rightarrow X$ is fired first. The IF part of this rule matches fact in the database, its THEN part is executed. Finally new fact X is added to the database.

(4) Rule 4 $C \rightarrow L$ is fired and new fact L is also placed in the database.

(5) In the second cycle Rule 2 is fired because facts B, E and X are already in the database. So Y is added in the database and this will in turn to execute Rule 1 i.e. $Y \& D \rightarrow Z$. Finally it will place new fact Z in the database.

(6) Now match-fire procedure stops because Rule 5 $L \& M \rightarrow N$ does not match with all the facts available in the database and thus Rule 5 cannot be fired. The Figure 2 shows the inference procedure for forward chaining approach.
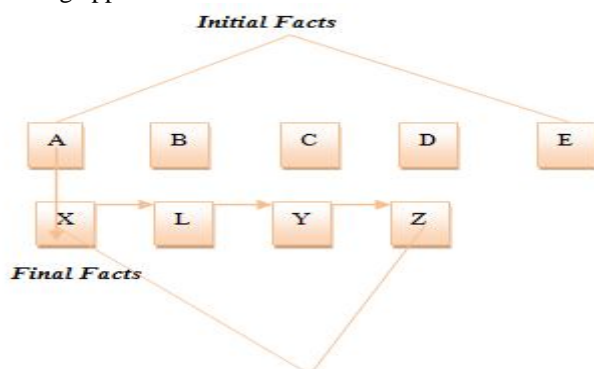

Fig. 2. An Inference Procedure for Forward Chain Approach

IV. APPLICATION OF RULE BASED APPROACH FOR STOCK SELECTION

Stock market contain so much variability in nature i.e. no one can accurately predict its nature. Stock market collects large amount of data throughout the year. The data is stored at one place or we can store in knowledge base. The organization and representation of knowledge is challenging task for stock price prediction. In this study we employed the database of TCS Company from Bombay Stock Exchange of India (BSE) site [20]. The rule base approach is employed and how it would be useful toward the stock price prediction issue. The Table 1 shows the sample of stock dataset.

Table 1. Sample of Stock Dataset

Month.	Open	High	Low	Close	Volume	Inflation Rate
Jan-12	3533.4	3555.83	3474.64	3479.07	93496100	1.70
Feb-12	3502.63	3512.32	3473.02	3500.35	88055500	2.00
March-12	3563.02	3629.34	3563.02	3619.93	135547500	7.80
April-12	3608.73	3613.76	3575.92	3580.26	135547500	6.64
Aug-12	3676.66	3745.51	3676.66	3720.46	290158800	3.81
Sept.-12	3760.03	3796.65	3759.45	3784.5	186331800	3.92
Oct.-12	3797.7	3819.37	3760.08	3766	220084800	6.93

In this study six variables like open price, high price, low price, close price, volume and inflation rate are employed which is shown by Table 1[20]. Now stock Knowledge base contain various types of rules based on this decision making is performed. Stock market generates huge amount of rule but we have considered only few important rules. The following rules show the stock knowledgebase:

Rule 1: IF open price of share rises from the previous month then invest money for particular month.
Rule 2: IF open price of share falls from previous month then do not invest money for particular month.
Rule 3: IF open price and low price rise and at the same time high price of share also rising then invest money for particular share.
Rule 4: IF open piece and low price rise and at the same time close price also rising then investing money for particular month may be harmful.
Rule 5: IF volume and open price of share increase then share prices also increase i.e. sell share and earn profit.
Rule 6: IF open price and close price rising and at the same time low price also rising then buy company's share at low price.
Rule 7: IF volume and close price falls down then do not invest money.
*Rule8:*IF inflation rate increases then economical growth of the country also increases i.e. share market performs outstanding.

Rule 9: IF inflation rate decreases then share price also decreases that shows the recession period of country.

Rule 10: IF close price of share is rising and check also open price and high price also rising with the same ratio then sell share and earn money.

Suppose the stock users/investors see the market conditions and ask the questions from proposed system "what would be decision regarding if open price and low price rising?" so it would be matched with Rule 4 then system will ask to the user check close price also rising. The user will check it and if say yes then system will suggest do not invest money it may be harmful i.e. shows the certain losses. In the same manner if user ask a question with system "what would be the impact of increasing inflation rate?' so it would be matched with Rule 8 and system will respond to the user it shows the economical boom i.e. investing money must be fruitful. This study shows that how expert system solve problem intelligently and how it behave on users queries.

V.   CONCLUSION

In this study rule based approach is presented for stock price prediction which is well defined for representing uncertain knowledge. The basic problem with approach is that sometimes a large amount of rule is generated so that's representation and handle in the knowledgebase is very complicated. In the future these drawbacks would be eliminated by using some constraints in the rule based system and expert system knowledge would be encoded by using some programming language like visual prolog. The expert system database also extended with some new features.

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