Predicting Stock Exchange Behaviour using Decision Tree and Type Effect Weight (TEW) Algorithm

Aizaz Imtiaz Awan, Zeeshan Bhatti

Institute of Information and Communication Technology, University of Sindh, Jamshoro

aizazawan55@gmail.com, zeeshan.bhatti@usindh.edu.pk

Abstract— **In this paper, various factors are investigated that effect the behavior of Stock exchange share process. The aim is to identify and analyze the effects of factors that are driven through various environmental and political situations in the country which drive the rise and fall of share prizes. Based on the results of these analysis an algorithm is derived using Artificial Intelligence (AI) with Expert System and Rule-Based System, to predict the behavior of stock prices. The system uses decision tree algorithm along with a novel Type, Effect and Weight (TEW) Algorithm, to intelligently predict the pattern of stock prizes. The system predicts the behavior of stock exchange market, forecasting the market rate to either increase or will it decrease using AI (Expert Tasks). The purpose of this work is to facilitate user of stock exchange and save money of investors.**

Keywords-Artificial Intelligence. AI Prediction, Stock Behaviour

I. INTRODUCTION

Artificial Intelligence system are beginning to dominate the real world with their human like problem solving abilities. The use of AI system has integrated into our daily tasks. The use of AI to forecast and predict behaviors of real world principles is gaining much popularity [1].

The success of every country is dependent on its economy and stock exchange plays a vital role in country economy. This popularity and integration of AI in various fields, has led us to use AI to prediction stock exchange behavior and determine in advance when the stock prices will go up or it will go down. There are several factors that affect the stock market, however in this research work only those factors are considered which effect are witnessed very commonly in Pakistan and have substantial history of effecting the stock prize behavior, as discussed in Section III.

Our System is designed based on AI (Expert System) which follows a decision tree algorithm to predict stock exchange behavior. The algorithm is designed to take various factors which have deep effect on stock exchange behavior. The algorithm considers various environmental and political factors as an input, it processes these factors and show the prediction of stock prices. The algorithm process factors automatically because it based on AI (Expert System) using our custom Type, Effect and Weight (TEW) algorithm. This algorithm takes factor from stock market database and then apply AI technique on these factors to predicts the behavior of stock exchange.

Objectives of making this Expert System is to facilitate investors of Stock market, to save their money by safeguarding their investment and consequently help our economy. Investors without having some critical knowledge about stock market invest their amount in stock market and then loss huge amount in stock. If our market falls down then it has bad effect on economy, therefore, through this system we facilitate the investor and economy of our country.

II. FORECASTING

A. Methods of Forecasting

There are two methods of forecasting as discuss below:
- Qualitative Forecasting
- Quantitative Forecasting

1) Qualitative Forecasting:

If there is no data available or if the available data is not relevant to forecasting, the qualitative forecasting method must be used.

2) Quantitative Forecasting:

It is applying when two conditions are satisfied.

• Numerical information about the past is available.
• It is responsible to assume that some aspects of the Past patterns will continue into the future.

Generally, two method are used for data collection to address the problem of quantitative forecasting. The first method id Time series data which uses data collected at a regular interval, whereas the second approach involves cross-sectional data which is collected at a single point in time.

B. Forecasting Accuracy

Accuracy means the quality being correct, true or close to the true value, and forecasting is making

prediction for future. The forecasting accuracy means accuracy in prediction or forecasting means how accurate forecast found

We have two types of forecasting accuracy:

• Long-term Forecast Accuracy

will get low because there will be huge amount of change occur in data because of long time period.

2) Short-term Forecasting Accuracy:

In this type the accuracy will get high because the short amount of change occurs in data because of short time period.

The short-term forecasting accuracy is more reliable as compared to long-term forecasting accuracy.

III. FACTORS INFLUENCING STOCK BEHAVIOR

In stock exchange market, the behaviors of its price rates are under constant influence by various external factors. These external factors can have devastating effect on stock market.

A. Bonds

Bonds are one of the most common investment, however many investors, they remain a mystery. A bond is simply a loan given to company or government by an investor, issuing bond a company or government borrow money from investors then return an interest on money they have loaned. If interest on bonds will rise up, then investors move to buy bonds as compared to invest their money on risky market called Stock market. They fell save to invest in bonds rather than in stock market, so if bonds interest rate moves up the market will move down and vice versa. Bond prices are inversely proportional to interest rate, when interest rate goes up bond prices fall down and vice versa.

B. Emergency Rule

Emergency rule has negative impact on stock market because emergency is apply by army person when emergency applied the national assembly has broken and policies, rules, and regulations of government for stock market was not applying any more so, investors do not get required amount of profit, stock market moves downward so emergency rule have negative impact on stock market.

Example 1: General Musharraf Emergency Declaration
In 1999 then-Chief of Army General Pervez Musharraf, imposed coup and dethrone the democratic government [3][4].

• Short-term forecast Accuracy

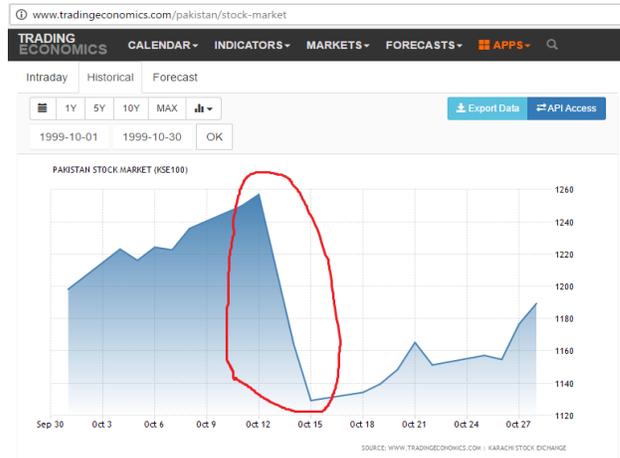*1) Long-term Forecast Accuracy:*
In this type the accuracy

Figure 1: Diagram of Stock Market Behavior [Source: tradingeconomics.com]

The coup had a devastating effect on stock market and it totally crashed as shown in Figure 1. The Figure 1 clearly shows that on the day of Declaration of Marshalla (coup) the Karachi Stock Exchange falls dramatically. It clearly shows that this factor has a negative impact on KSE.

C. General Election of Pakistan

When general election of Pakistan held the new Government is selected and the policies, rules and regulations regarding stock market is updated. It has positive impact on stock market because every selected government wants the stock market getting increase so the stock market moves upward.

We Observe that KSE-100 before and after the 11 May 2013, and the record tell us that the market went up mean the affect is positive as shown in Figure 2 and Figure 3.

Figure 2: KSE index values on 08 May-2013 [Source: ksedailymarketsummary.com]
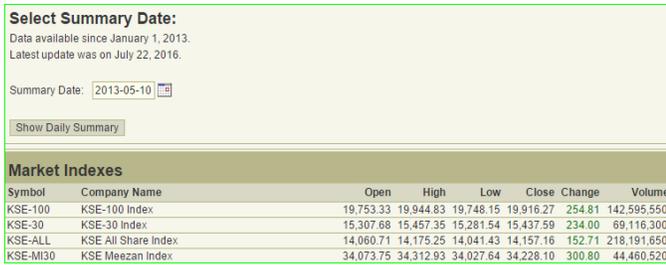
Figure 3: KSE Index value on 10th May 2013

This data collected before Election date on 11-May-2013 the Election was held on 12-May-2013 the market was closed when the market will open it has positive effect as shown in Figure 4 and Figure 5.
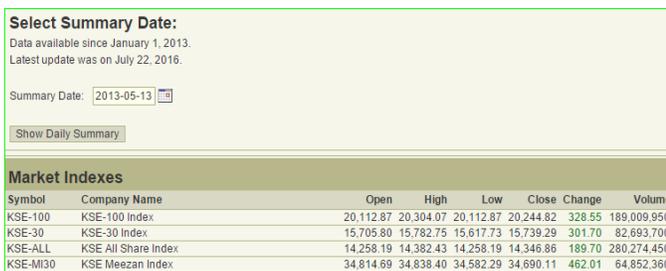

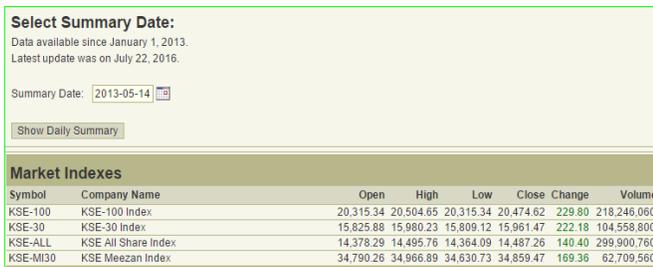Figure: 4: KSE on 13th May 2013 [Source: ksedailymarketsummary.com]

Figure 5: KSE on 14th May 2013 [Source: ksedailymarketsummary.com]

D. Incident concerning Political Leader

This event has very much importance because any major incidence happened with any top most personality of Pakistan like: Benazir Bhutto's Murder.

On 31st of December 2007 The KSE was opened again after 3 days of closing, The Karachi Stock Exchange KSE-100 index to 13,335 from 14,772. The 10% fall wrote off 400 billion rupees (US$6.4 billion) in market capitalization a huge dropdown was occurred. This event has negative impact on stock market the market moves downward when that kind of event will happen, this can be evidently seen in stock rates shown in Figure 6-8.
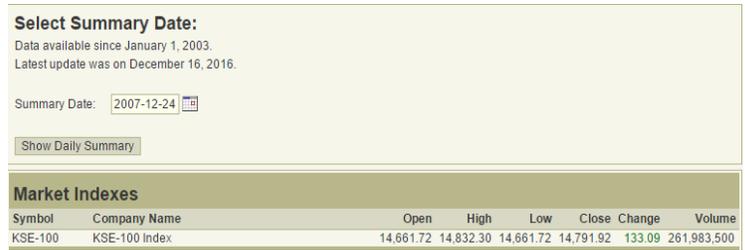

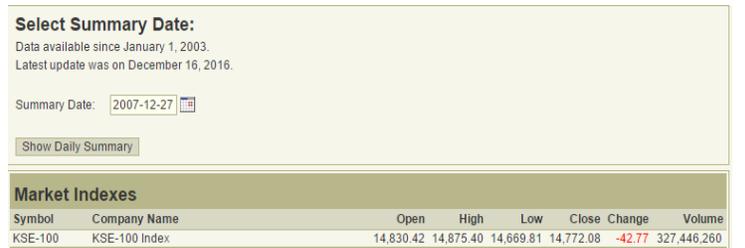Figure 6: KSE index on 24th December 2007
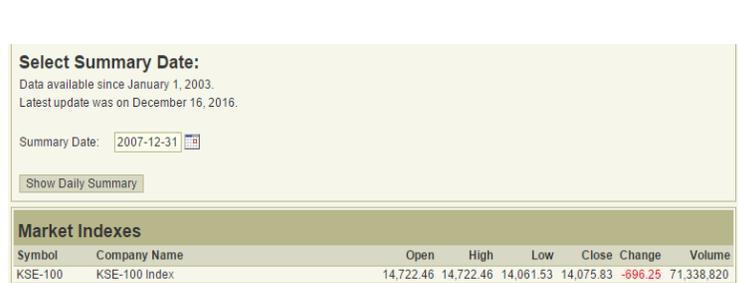

Figure 7: KSE index on 27th December 2007

Figure 8: KSE index on 31st December 2007

This is the one example and we have lot more like this like Shuja Khanzada Governor of Punjab was killed the market was fall.

E. Change of Prime Minister or Political Leader

The major change on government and of Political leaders also has negative effect on stock market, the market falls down when that kind of event occurs like:
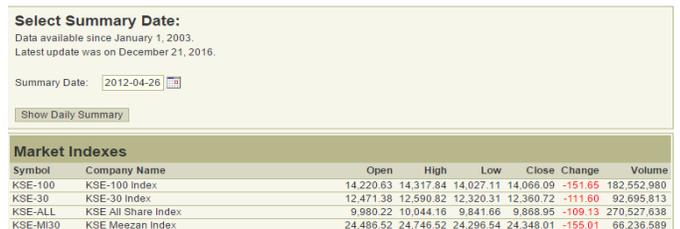Resignation of PM Gyllani had affected negatively stock market.

Figure 9: KSE index on 26th April 2012

The above example shows clearly that this factor has negative affect on Stock market.

F. Protests and Ralleys

In our country politician has introduce the protest culture on road or (Dharna). When political party protest on road mean all the roads are blocked which will be stop on economy, and investors are not going to market or theirs firms all the business will stop that's why Protest on road has negative affect on Stock market.

This is the data of PTI Protest in Islamabad. 0n 14th of august 2014 there was holiday and the market were close, and 16th and 17th Saturday and Sunday market were also close, so on 18th of august 2014 there was an impact of (Dharna) on Stock market.

When PTI called for cancelation of Dharna:
They call cancelation of (Dharna) held on 17th December 2014 at night time and KSE closing timing is 4.00 pm. So on that date the market was closed, on next day 18th December 2014 the KSE shows upward direction.

G. Terrorism

It is big/huge factor which effect completely on stock market because something happens wrong like bomb blast, target killing, attack on any big personality then the fear of terrorism spread in public, peoples will give priority to stay at homes rather than will go to market because of terrorism fear.

If investors, sellers, buyers would not go to market then obviously the trade will not perform in market so, market will go down the foreigner investors will take out their money from stock exchange market and market will go down, because we have 37% of shares in stock market from foreigners.

The terrorism affects deeply on stock exchange market like recently murder of popular "Qawal Mr Amjad Sabri" in Karachi on 23rd-june-2016 and it has negative affect on Karachi stock exchange. The Karachi stock exchange (KSE) goes down next day of terrorism attack. Attack on Amjad Sabri was on 23rd at 4:00pm and market was closed on that day at 3:30pm so, market had closed before half hour of murder attack, the closing time of market 3:30pm, that's why it has no effect on that date and next day the market was fall almost -848 kse-100 indexes.

If such type terror took place in Karachi then the impact has more affect because Headquarter of stock exchange is at Karachi and if attack is in some other places, it has considerable less effect on Karachi stock exchange. This shows that if there is a terrorist attack, the market will fall otherwise the market will remain stable.

Another example is a terror event of APS attack on 16th December 2014.

IV. DESIGN AND DEVELOPMENT

A. System Design

The system is designed with minimum user interaction, and centered towards automation of prediction results. The system automatically fetches data from various online sources to determine the predefined factors and the current stock market trends. The System design is illustrated in Figure 10.
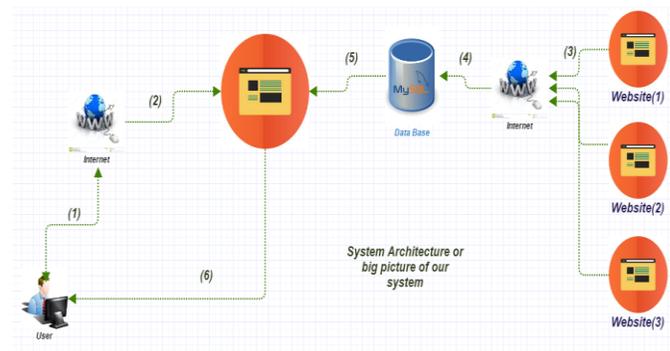

Figure 10: System architecture

The architecture shown in Figure 10, illustrates the structural solution and technical process of the system.

The web application that we have developed works on three tiers architecture.

- Presentation Tier

The most-top level of the application is focus on user interface. The main function of the interface is to translate tasks and results to something the user can understand [5][6]. All input that websites gives, and all results that user gets are presented at this tier.

- Logic Tier

This layer coordinates the application, processes queries, makes logical decisions and evaluations, and performs AI Expert algorithm tasks [6][7].

- Data Tier

this tier information stored and retrieved from database. The information passed back to logic tier for processing and then eventually back to user on the presentation tier [6] [7].
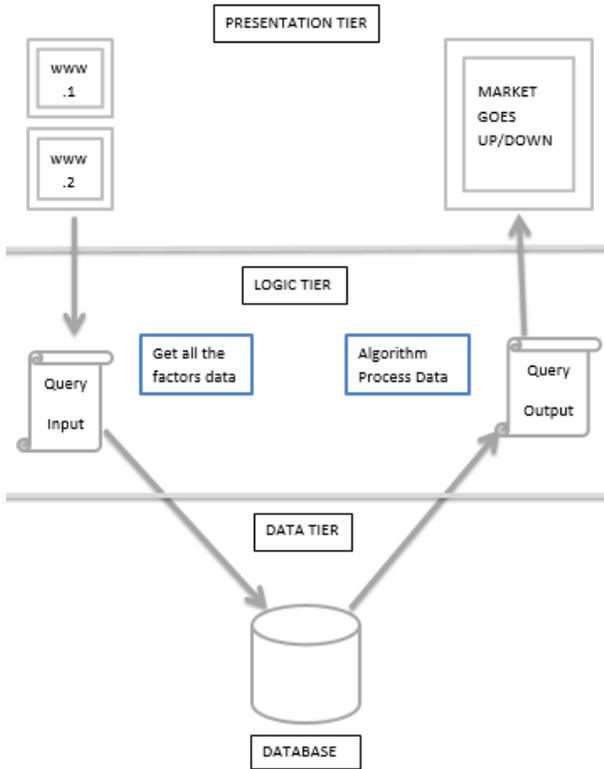
Figure 11: AI Based Prediction of Stock Market Behavior System Architecture

V. THE EXPERT SYSTEM

Expert systems are one of the most important applications of AI. It introduced by researchers from Stanford University [1][2]. Expert Systems are the computer applications help us to solve complex problem in particular domain. These computer applications help humanity at the level of extra ordinary human intelligence and expertise. This computer application works same as a domain expert that is why we call this an Expert System [8].
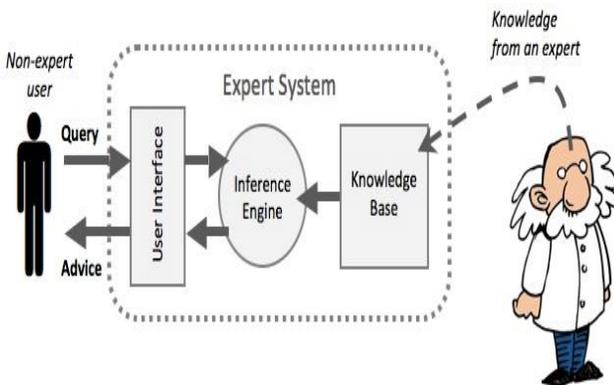

Figure 12: Expert System model
(source: http://blog.castac.org/wp-content/uploads/2014/02/expertsystem.png)

The use case of the expert system is shown in Figure 12. Our Expert system has only 1 Actor which is a user:

• USER

A user will be Investor, Purchaser, Seller, Broker, or any user in the world. The user will be able to see prediction of our Expert system and also able to give a factor to Expert system and check its effect to Karachi Stock Exchange (KSE).

A. The Expert System Scenario

The process of checking predicts on our web application is done through Check Prediction system, User could see prediction on our web application easily.
• The system takes data from external website to DB.
• Expert System (ES) algorithm takes data from DB and process.
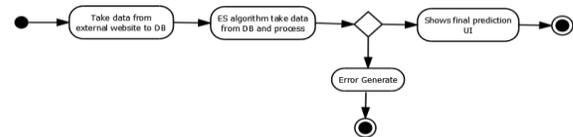• The system shows final prediction to user or if error occurs it shows error message.

Figure 13: Checl Prediction activity diagram

B. Check Factor

The process of given factor, weightage and affect as an input to our expert system then user gets response from our expert system.
• The user gives data through textbox, real time data.
• The algorithm then takes data from textboxes and process it.
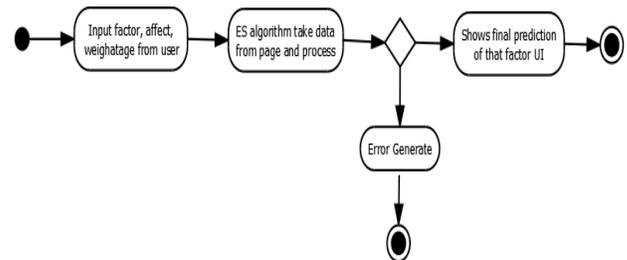• The system shows final prediction to user or if error occurs it shows error message

Figure 13: Check Factor activity diagram

C. Check KSE Stock Prices & Check News

The checking process KSE Stock prices to our Web application, it will help user to look up on market condition.

The process to see the Business, National and International News. This helps user to look up the economy and overall environment condition which helps user to sustain in the market.
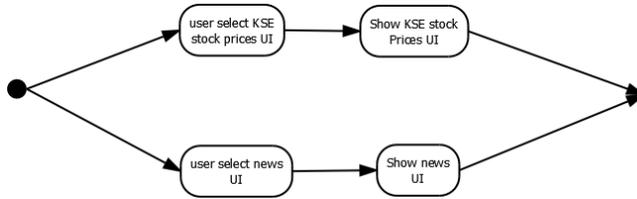
Figure 14: Check KSE stock proces and Check News

D. Expert System Processing

In this process expert system take data from database through using queries and apply the algorithm then it shows the final prediction.
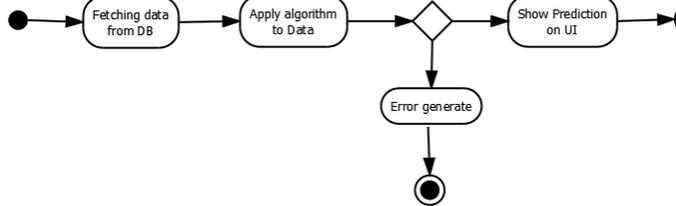

Figure 15: Expert Ssytem Processing

E. Database Insert/Fetch Data

In this process the database takes data from external websites and expert system fetch that data from database

F. The ER Model of Expert System

1) Factors

This table stores the data about Factors that is coming from external website. The table has factor_id as a primary key and that primary key is a foreign key for prediction table. The table also has factor_name attribute. Table is missing add table.

2) Factor_effect

This table stores the data about Factors effect. The table has factor_effect_id as a primary key and also that primary key is a foreign key for prediction table. The table also has factor_effect_name attribute.

3) Factors_type

This table stores the data about Factors type. The table has factor_type_id as a primary key and also that primary key is a foreign key for prediction table. The table also has factor_type_name attribute.

4) Factors_weight

This table stores the data about Factors weight. The table has factor_weight_id as a primary key and also that primary key is a foreign key for prediction table. The table also has factor_weight_no and factor-id attributes.

5) Prediction

This Prediction table uses factor_id, factor_type_id, factor_effect__id, factor_weight_id, attributes as a foreign key from other tables. There is a one to many relationships in prediction_table with factor_effect and factor_type table, and one to one relationship in prediction_table with factors_table and factor_weight
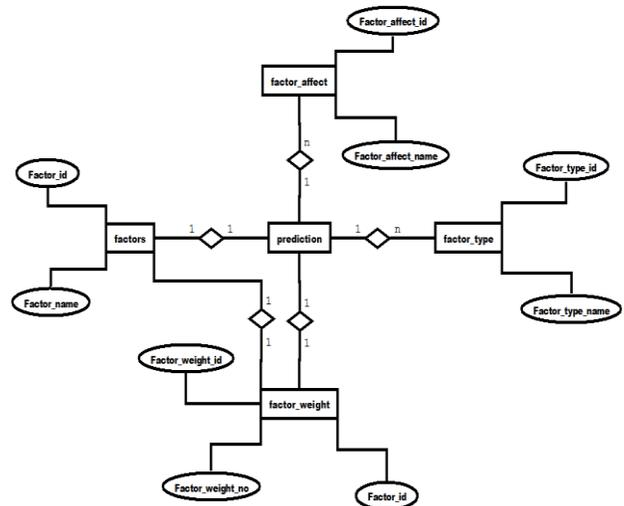

Figure 16: ER diagram of Expert System

VI. TEW (TYPE, EFFECT, WEIGHT) ALGORITHM

For making an Expert System a unique Type, Effect and Weight (TEW) algorithm was designed. There are many AI algorithms which are suitable or specially design for an Expert system but in our case the algorithms we studied are not working properly for our conditions, so we design our own algorithm and the TEW algorithm workflow is shown below in Figure 17.
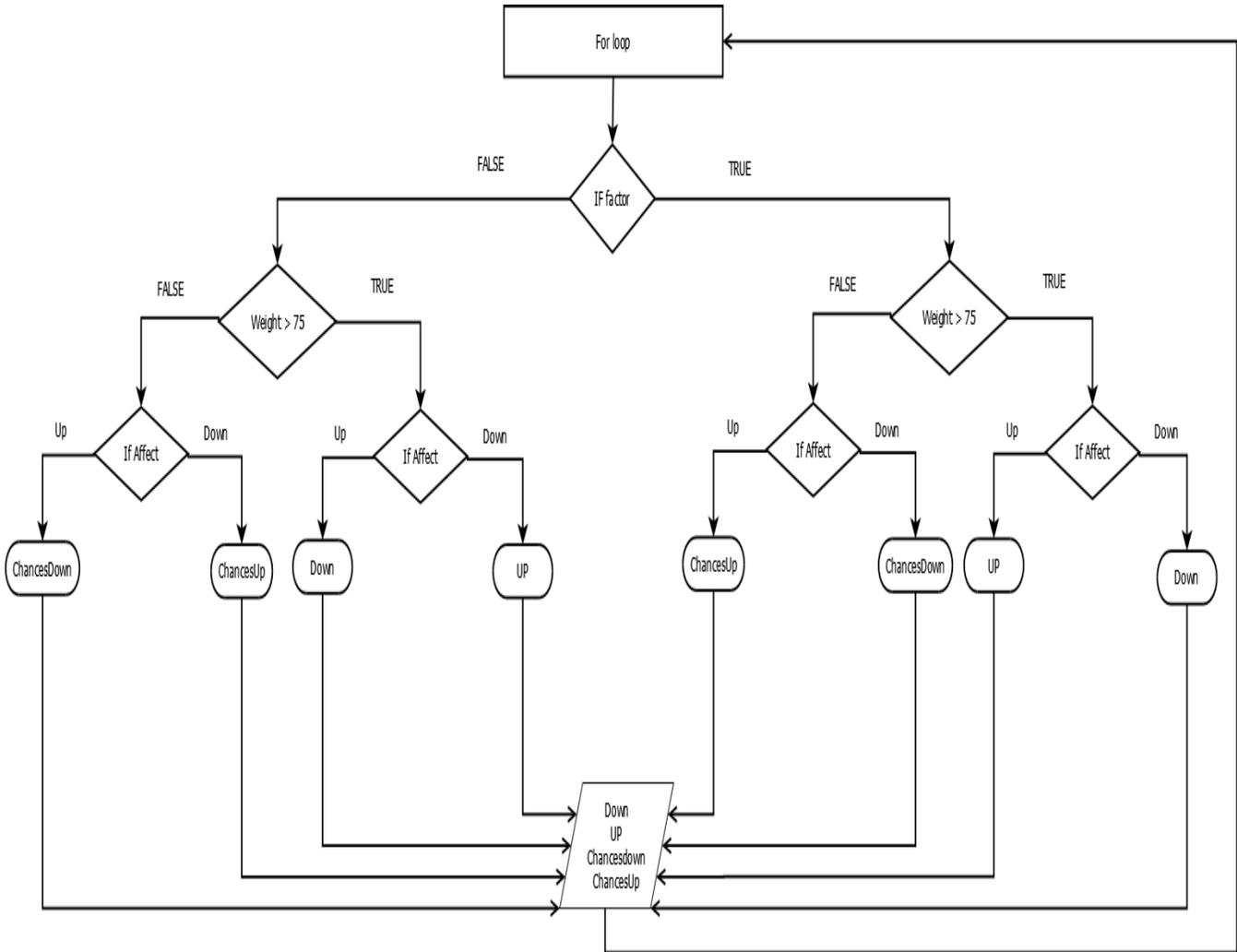
Figure 17: TEW Algorithm Decision Tree

The TEW algorithm specially designed for very sensitive expert system. It designed for stock market behavior. Our research shows that if only one factor which has down effect and weightage is greater   than 80%, if the only factor will be true then the market damn care of other factors and fall down.

In This scenario, our TEW algorithm work if any one factor weightage >80% with negative effect and the type is true then TEW predict that market will fall down, and if it is false then this algorithm moves to other condition to check if the factor effect positive and weightage > 80% true then it will predict the market will moves up.

If all factors having weightage >80% is false, then algorithm look for chances up and chances down condition. If the factor has weight < 40% and its effect is negative, then condition will move to chances down to store over there and vice versa. The algorithm compares chances down and chances up, any one which will be greater than other that will be the prediction but 60% prediction at the end.
If these both conditions of chances up and chances down has equal amount of occurrence, then it predict the chances of 50-50
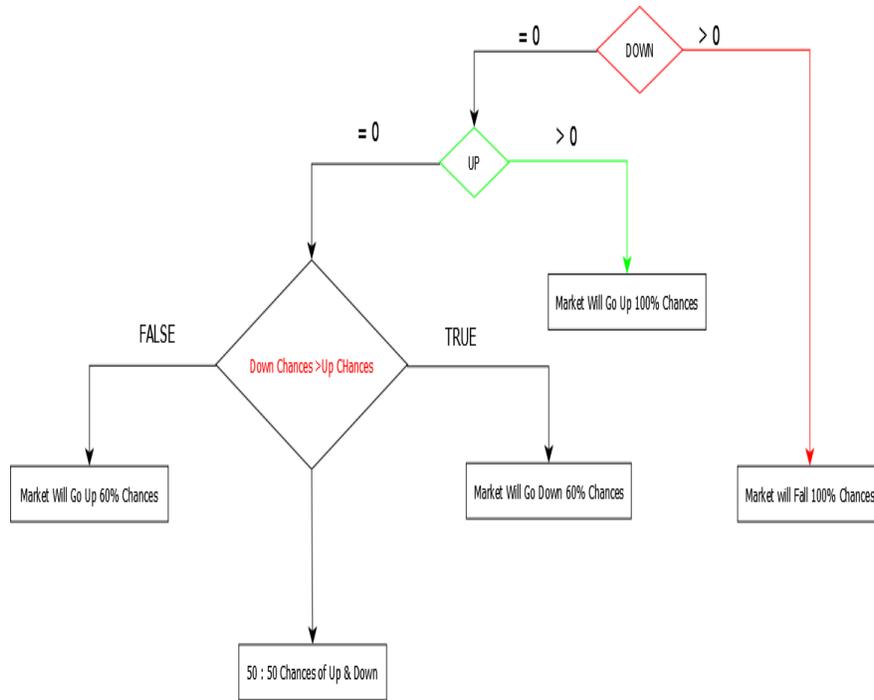
Figure 18: Stock behaviour prediction logic

VII. Conclusion and Future Work

This expert system was planned and develop for saving huge number of investors and predict the market behavior, market some time goes up and sometime down the investors lose their investments So, this system designed and develop to save their investments also this system will help investors in making decision making investment by predicting the future behavior of marketing. it will tell the investors that what will the market behavior tomorrow.

This system is working an algorithm which calculates the weightage, effective factors which affect the marketing value and market behavior then it shows that the prediction market position will go up or down. This web application will also useful for other people which are the part of market, they can see the worldwide business news on this web application. There is the news about KSE-100 top gainers and top losers every person can see this news, and prediction our system by just accessing this web application from anywhere.

This expert system designed to predict the overall market behavior, this expert system will not predict about the single company stock price because we did a huge research on KSE-100 index, 1 we did regression analysis, market capitalization, interest rate effect, foreign currency exchange rate effect, etc At the end, we make a conclusion that the daily bases overall prediction of KSE-100 is impossible. in future the research, we will begin from single company stock prediction that what will be the single company stock price tomorrow and customize TEW algorithm for that and predict the single company stock price, or in future this web app will be change into android app.

VIII. Acknowledgment

IX. References

[1] Nilsson, N. J. (2014). Principles of artificial intelligence. Morgan Kaufmann.

[2] Michalski, R. S., Carbonell, J. G., & Mitchell, T. M. (Eds.). (2013). Machine learning: An artificial intelligence approach. Springer Science & Business Media.

[3] Waycross Journal-Herald, (2000), "Pakistan Judges Refuse Oath Demanded by Pakistan's Rulers". 31 January 2000. Retrieved 7 May 2011.

[4] Wikipedia,(2017) "1999 Pakistani coup d'état", From Wikipedia, the free encyclopedia , Accessed On: August 2017, URL: https://en.wikipedia.org/wiki/1999_Pakistani_coup_d'état

[5] Anand, R., Ahmad, S., Jaiswal, S., & MK, S. G. (2018). Web Application for Secured Two Factor Authentication.

[6] Liu, X., Heo, J., & Sha, L. (2005, September). Modeling 3-tiered web applications. In Modeling, Analysis, and Simulation of Computer and Telecommunication Systems, 2005. 13th IEEE International Symposium on (pp. 307-310). IEEE.

[7] Manuel, P. D., & AlGhamdi, J. (2003). A data-centric design for n-tier architecture. Information Sciences, 150(3-4), 195-206.

[8] Khan, R.S., Zardari, A. A., Bhatti, Z., (2017) Artificial Intelligence based Smart Doctor using Decision Tree Algorithm. Journal of Information & Communication Technology - JICT Vol. 11(2)