Propose a Model for Customer Purchase Decision in B2C Websites Using Adaptive Neuro-Fuzzy Inference System

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Abstract

If companies are to enjoy long-term success in the Internet marketplace, they must effectively manage the complex, multidimensional process of building online consumer trust. The online environment and the quality and usability of websites help the browser and consumer to be attracted and accessible to the information and the product and services available online. In this Paper a new model would be suggested based on neuro-fuzzy System which depicts some of the hidden relationships between the critical factors such as security, familiarity, and designing in a B2C commercial website on other hand, and the competitive factor to other competitors on other hand. Then, the impacts of these factors on purchasing decision of consumers in B2C commercial websites are extracted. We are going to find the impact of these factors on the decision-making process of people to buy through the B2C commercial websites, and we also will analyze how these factors influence the results of the B2C trading. The study also provides a device for sellers to improve their commercial websites. Two questionnaires were used in this study. The first questionnaire was developed for e-commerce experts, and the second one was designed for the customers of commercial websites. Also, Expert Choice is used to determine the priority of factors in the first questionnaire, and MATLAB and Excel are used for developing the Fuzzy rules. Finally, the Fuzzy logical kit was use to analyze the generated factors in the model.

Keywords: Anfis, Clustering, E-commerce, Trust, Rules.

1. INTRODUCTION

The lack of trust in different components of the most e-commerce applications is known as one of the main reasons which may lead to some e-commerce companies to fail [3, 4].

If companies are to enjoy long-term success in the online market place, they must effectively manage the complex, multidimensional process of building online consumer trust. Trust exists in many forms, across multiple domains, and at variety of levels [8].

Trust, according to Fukuyama, is the lubricant of trade and, this way, determines the wealth of nations. The relative paucity of regulations and customs on the internet makes consumer familiarity and trust especially important in the case of e-commerce [9]. Yet the lack of an interpersonal exchange and the one-time nature of the typical business transaction on the internet make the unique conditions on this kind of consumer trust, because trust relates to the other people and this nourished through interactions with them [10].

Trust is an interpersonal determinant of behavior that deals with beliefs about the integrity, benevolence, ability and predictability of other people [11]. However, in contrast of face-to-face commerce and other applications of trust in the literature, there are typically no interpersonal interactions in e-commerce directly or implied. Such interactions, or even cues relating to them, are notably missing from e-commerce website [12].

The detailed information on trust and the security system that is implemented by companies for secure transactions are important attributes in B2C e-commerce. According to Lightner the rewards of B2C e-commerce are realized partially through well-designed websites, since they act as the primary contact with customers. There are some factors for consumers trust in online buying when they plan to buy, and also there are more factors and matter of interactions when they are on the buying process in online and after one[13].

Website designers must consider factors, in a website allowing the emergence of confidence between an online seller and a customer. A website is the first factor that influences on the reliability of the seller into the mind of customer, and this strongly effect can affect on the initial trust of customers [5, 7].

Lightner states, B2C websites allow companies to present their unique advantages, as long as they provide the necessary services for customers. While there are many factors for determining the success or failure of an e-commerce website, the service level provided for customers may serve as an indication of user satisfaction in transaction with a website. The aim is to specify what factors in the online environment really we should take in our main consideration and how online customer services help to build trust step-by-step [13]. Singh says that it is also necessary for customers to have trust in electronic commerce infrastructure and environment [14].

Marsh and Mitch in their plan, entitled as the Call to arms, have challenged the website designers and asked them to think of this point that how they can easily make the trust possible between an online website and its customers in the early stages of their partnership. They claim that websites can be designed in a special fashion so that the trust not only becomes the indivisible part of the plan, but also it can be considered as a further thought.
Furthermore, the decision about online purchase must be available based on the accurate and correct information rather than focusing on the partial insight, general concepts and individual experiences [1, 2].

Moreover, a lot of trust models have been presented. Most of them are mentally active, effect as unclear and ambiguous confidence in e-commerce websites, and don't involve the experience and understanding of customers during performing online transactions [6].
Therefore, in summary, the following objectives are achievable:

- To identify trust factors between the customer and sale agents.
- To measure the effect of a factor on confidence in contrast to other factors by fuzzy logic.
- To identify factors or security components that considerably affects the customer confidentiality upon the online purchase.
- To help customers when shopping online.
- To help designers of e-commerce website to use important factors in designing commercial websites.
- To help online enterprises for finding the customer needs.
- To detect the level of transaction on a commercial website by the sale agency.

2. ADAPTIVE NEURO-FUZZY INFERENCE SYSTEM (ANFIS)

In 1993 Roger Jang, suggested Adaptive Neuro Fuzzy Inference system (ANFIS). ANFIS can serve as a basis for constructing a set of fuzzy 'if-then' rules with appropriate membership functions to generate the stipulated input-output pairs. Here, the membership functions are tuned to the input-output data and excellent results are possible.

Fundamentally, ANFIS is about taking an initial fuzzy inference (FIS) system and tuning it with a back propagation algorithm based on the collection of input-output data. The basic structure of a fuzzy inference system consists of three conceptual components: A rule base, which contains a selection of fuzzy rules; a database, which defines the membership functions used in the fuzzy rules; and a reasoning mechanism, which performs the inference procedure upon the rules and the given facts to derive a reasonable output or conclusion [15].

These intelligent systems combine knowledge, techniques and methodologies from various sources. They possess human-like expertise within a specific domain - adapt themselves and learn to do better in changing environments. In ANFIS, neural networks recognize patterns, and help adaptation to environments. Fuzzy inference systems incorporate human knowledge and perform interfacing and decision-making. ANFIS is tuned with a back propagation algorithm based on the collection of input–output data [15].

The adaptive network based fuzzy inference system (ANFIS) is a useful neural network approach for the solution of function approximation problems [17]. An ANFIS gives the mapping relation between the input and output data by using hybrid learning method to determine the optimal distribution of membership functions [19]. Both artificial neural network (ANN) and fuzzy logic (FL) are used in ANFIS architecture [18]. Such framework makes the ANFIS modeling more systematic and less reliant on expert knowledge [16]. Basically, five layers are used to construct this inference system. Each ANFIS layer consists of several nodes described by the node function. The inputs of present layers are obtained from the nodes in the previous layers. To illustrate the procedures of an ANFIS, for simplicity, it is assumed those two inputs (x, y) and one output (fi) are used in this system. The rule base of ANFIS contains fuzzy if-then rules of Sugeno type. For a first order two-rule Sugeno fuzzy inference system, the two rules may be stated as:

- Rule 1: If x is A1 and y is B1 then z is f1(x, y)
- Rule 2: If x is A2 and y is B2 then z is f2(x, y)

Where x and y are the inputs of ANFIS, A and B are the fuzzy sets fi (x, y) is a first order polynomial and represents the outputs of the first order Sugeno fuzzy inference system[17].The ANFIS architecture is shown in figure1. The circular nodes represent nodes that are fixed whereas the square nodes are nodes that have parameters to be learnt [17].

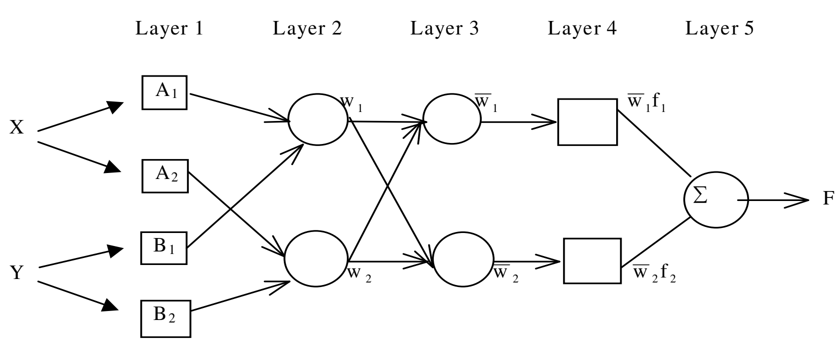


FIGURE 1: An ANFIS architecture for a two rule Sugeno system

A Two Rule Sugeno ANFIS has rules of the form:

$$\textit{If } x \textit{ is } A_1 \textit{ and } y \textit{ is } B_1 \quad \textit{THEN } f_1 = p_1 x + q_1 y + r_1$$
$$\textit{If } x \textit{ is } A_2 \textit{ and } y \textit{ is } B_2 \quad \textit{THEN } f_2 = p_2 x + q_2 y + r_2$$

For the training of the network, there is a forward pass and a backward pass. We now look at each layer in turn for the forward pass. The forward pass propagates the input vector through the network layer by layer. In the backward pass, the error is sent back through the network in a similar manner to back propagation [20].

Layer 1:

The output of each node shown in equation 1:

$$\begin{aligned} O_{1,i} &= \mu_{A_i}(x) \qquad for\ i = 1,2 \\ O_{1,i} &= \mu_{B_{i-2}}(y) \qquad for\ i = 3,4 \end{aligned} \tag{1}$$

So, the $O_{1,i}(x)$ is essentially the membership grade for x and y.

The membership functions could be anything but for illustration purposes we will use the bell shaped function given by equation 2:

$$\mu_A(x) = \frac{1}{1 + \left| \frac{x - c_i}{a_i} \right|^{2b_i}} \tag{2}$$

Where a_i, b_i, c_i are parameters to be learnt. These are the premise parameters.

Layer 2:

Every node in this layer is fixed. This is where the t-norm is used to ‘AND’ the membership grades - for example the product shown in equation 3:

$$O_{2,i} = w_i = \mu_{A_i}(x)\mu_{B_i}(y), \quad i = 1,2 \tag{3}$$

Layer 3:

Layer 3 contains fixed nodes which calculate the ratio of the firing strengths of the rules shown in equation 4:

$$O_{3,i} = \overline{w_i} = \frac{w_i}{w_1 + w_2} \tag{4}$$

Layer 4:

The nodes in this layer are adaptive and perform the consequent of the rules shown in equation 5:

$$O_{4,i} = \overline{w_i} f_i = \overline{w_i}(p_i x + q_i y + r_i) \tag{5}$$

The parameters in this layer (p_i, q_i, r_i) are to be determined and are referred to as the consequent parameters

Layer 5

There is a single node here that computes the overall output shown in equation 6:

$$O_{5,i} = \sum_i \overline{w_i} f_i = \frac{\sum_i w_i f_i}{\sum_i w_i} \qquad (6)$$

This then is how, typically, the input vector is fed through the network layer by layer. We now consider how the ANFIS learns the premise and consequent parameters for the membership functions and the rules.

There are a number of possible approaches but we will discuss the hybrid learning algorithm proposed by Jang, Sun and Mizutani which uses a combination of Steepest Descent and Least Squares Estimation (LSE).

It can be shown that for the network described if the premise parameters are fixed the output is linear in the consequent parameters.

We split the total parameter set into three:

S = set of total parameters S_1 = set of premise (nonlinear) parameters S_2 = set of consequent (linear) parameters

So, ANFIS uses a two pass learning algorithm:

Forward Pass: Here S_1 is unmodified and S_2 is computed using a LSE algorithm.

Backward Pass:

Here S_2 is unmodified and S_1 is computed using a gradient descent algorithm such as backpropagation.

So, the hybrid learning algorithm uses a combination of steepest descent and least squares to adapt the parameters in the adaptive network [17].

The summary of the process is given below:

The Forward Pass:

1. Present the input vector.
2. Calculate the node outputs layer by layer.
3. Repeat for all data $\rightarrow A$ and y formed.
4. Identify parameters in S_2 using Least Squares Compute the error measure for each training pair.

Backward Pass:

1. Use steepest descent algorithm to update parameters in S_1 (back propagation).

2. For given fixed values of S_1 the parameters in S_2 found by this approach are guaranteed to be the global optimum point.

3. RESEARCH METHODOLOGY

The proposed model has been established based on this principle that each real level of transactions in B2C websites includes two factors as follows:

1. Trust (T) level in B2C web site.

2. Competitive (C) in b2c web site for purchasing purposes.

Therefore, we propose to investigate into the truthfulness of the equations 7:

$$\begin{aligned} T &= H(S, F, D) \\ L_{B2C} &= G(T, C) \end{aligned} \qquad (7)$$

The first part of equation 7 ($T = H(S, F, D)$) that has three inputs, S is as the level of security, F is as the level of familiarity and D is as the level of design and Level of trust obtains of these three parameters performance.

The second part of equation 7 ($L_{B2C} = G(T, C)$) that has two inputs, T is as the level of trust, and D is as the level of design and Level of B2C obtains of these two parameters performance. Figure 2 shows the structure of trust model.

4. DATA COLLECTION AND ANALYSIS

This study used a web-based survey because of its advantages such as convenience; viable, effective way to access difficult-to-reach respondents [7]. The selected population in this study was included in two groups. The first group was included ten experts in the field of e-commerce and the Second group was included 150 numbers of E-Commerce and IT students. The first group completed the first questionnaire and after obtaining results from the first questionnaire and the second group completed the second. After collecting answer of first questionnaire and finding factors with higher priority, the second questionnaire was designed .it involves 4 major groups, too the method of scoring was chosen based on the likert scale of 5 degrees and 18 given questions in questionnaire were scored like 5 selections and in order of intensity of factor in each group from 0 to 4, like (0) very low (1) low (2) moderate (3) high (4) very high. In this questionnaire 16 questions are relative to 4 major groups, and 2 questions have been observed relative to the trust level and b2c level of website. Determining the credit of questionnaire has been done by counting kronbach's Alpha which has credit coefficient in accordance with table 1.

kronbach's alpha coefficient for each website		
Irshop.ir	**Tobuy.ir**	**Parsim.com**
0.85	0.83	0.83

TABLE 1: The counted credit coefficient of second questionnaire

The inserted credit coefficient in table 1 shows the acceptance of second questionnaire credit. After that customers referred to special website for experimental buying, it was asked the respondents to analyze 3 websites as parsim.com, tobuy.ir, irshop.ir.

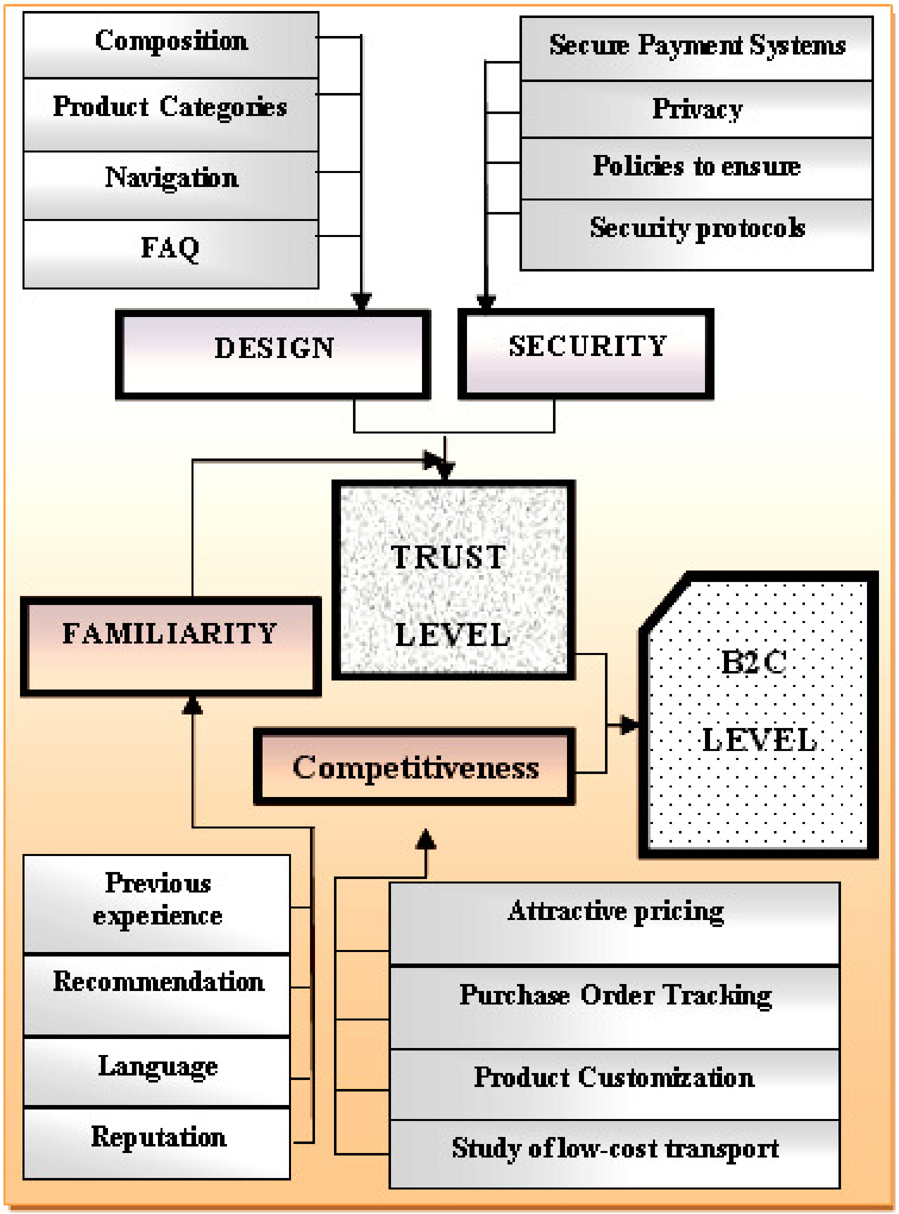


FIGURE 2: The structure of trust model.

During this process, they should answer some questions in security groups, familiarity groups, design groups, competitiveness groups, and trust and b2c level.

Finally respondents should determine the trust level competitiveness and b2c level of website after analyzing website and answering the questions.

The order of answering the questions is that first of all the respondents should analyze the website and answer the questions in security groups, familiarity, design and then they were asked to count the trust level and after that the it was weighted respondents were asked to evaluate the selective website for b2c dealings based on their expectation level of trust and competitiveness.

Counting the Level of Security

To count the level of security one sheet was created in EXCEL (security sheet) and linguistic values questionnaire were changed to numerical values. Actually it was related numerical value to each linguistic value (0, 1, 2, 3 and 4) in order to count the level of security the counted level of security is made by adding these values for each factor whose maximum for four factors is number 16.Also, its percent for level of security was counted that has been in table 2, and in general second equation has been used for level of security .the decided levels of design factor and familiarity are like table 2 too.

$$AccumulatedSecurityLevel = \sum_{i=1}^{4} x_i \qquad (8)$$

$$PercentageOfMaximum = (AccumulatedSecurityLevel)\big/16)*100 \qquad (9)$$

domain of values percent	Linguistic value
0-33	low
34-66	moderate
66-100	high

TABLE 2: linguistic and numeric values for security level

Some Pseudo code for counting the level of factors was written with vba programming in excel software. The sample Pseudo code for counting the level of security is shown in following:

```
Sub Security_Ind_Prot_Auth ()
Dim i as Integer
Dim col As Integer
Dim x as String
Worksheets ("security").Activate
   For col = 2 To 6 Step 2
      For i = 4 To 153 Step 1
      Cells (i, col).Select
         ActiveCell.Value = Trim ((ActiveCell.Value))
            If StrComp (ActiveCell.Value, "very low",
vbTextCompare) = 0 Then
            ActiveCell.Offset (0, 1).Value = 0
         End If
         If StrComp (ActiveCell.Value, "low", vbTextCompare) = 0 Then
            ActiveCell.Offset (0, 1).Value = 1
         End If
         If StrComp (ActiveCell.Value, "moderate", vbTextCompare) = 0
Then
            ActiveCell.Offset (0, 1).Value = 2
         End If
         If StrComp (ActiveCell.Value, "high", vbTextCompare) = 0 Then
            ActiveCell.Offset (0, 1).Value = 3
         End If
         If StrComp (ActiveCell.Value, "very high", vbTextCompare) = 0
Then
            ActiveCell.Offset (0, 1).Value = 4
         End If
      Next i
   Next col
End Sub
```

The Prioritize Factors Resulted From AHP Method

The priority of counted factors in security groups, design, familiarity, and competitiveness has been noted in figure 2.

Refining and Relative to Rule of the Level of Trust and B2C and Creating Member Functions.

For refining and finding the rules of fuzzy model, it has been the clustering technique, and the kind of clustering has been chosen the fuzzy C-means (FCM) clustering in MATLAB software.

Equation 10 is as a major function in clustering k-means.

$$J_m(U,V) = \sum_{j=1}^{n}\sum_{i=1}^{c} u_{ij}^{m}\left\|X_j - V_i\right\|^2, \quad 1 \le m < \infty \tag{10}$$

Where m is any real number greater than 1, uij is the degree of membership of Xj in the cluster i, Xj is the jth of d-dimensional measured data, Vi is the d-dimension center of the cluster, and ||*|| is any norm expressed the similarity between any measured data and the center.

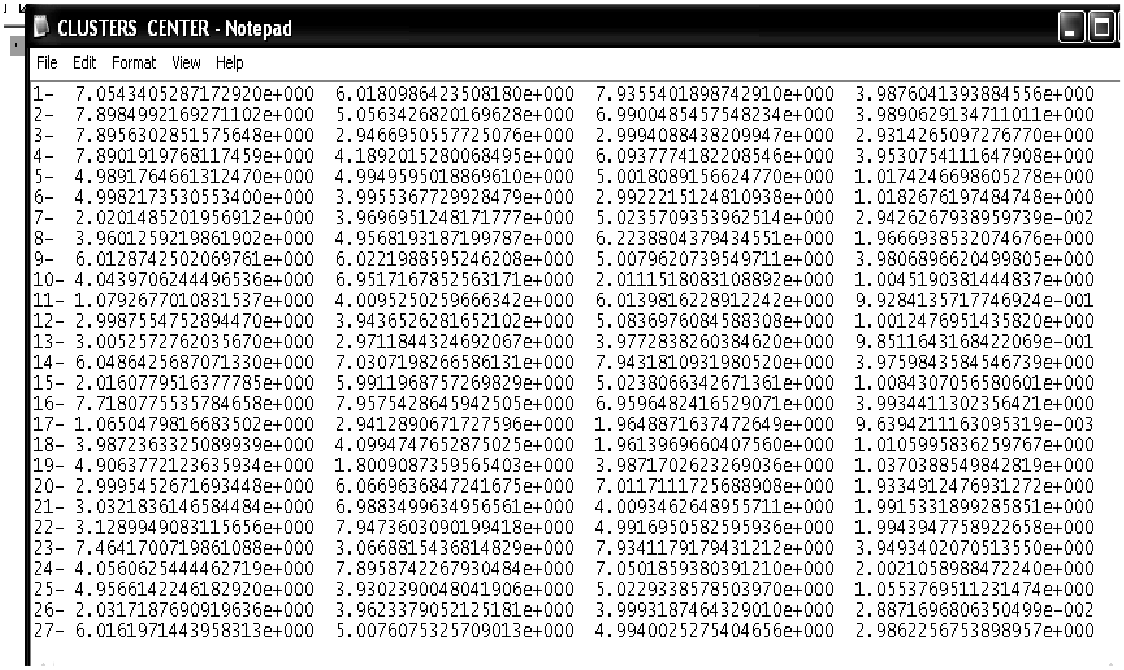
Fuzzy partition is carried out through an iterative optimization of Equation 8 with the update of membership uij and the cluster centers Vi by Equation 11 and 12:

$$u_{ij} = \frac{1}{\sum_{k=1}^{c}\left(\frac{d_{ij}}{d_{ik}}\right)^{\frac{2}{m-1}}} \tag{11}$$

$$V_i = \frac{\sum_{j=1}^{n} u_{ij}^{m} X_j}{\sum_{j=1}^{n} u_{ij}^{m}} \tag{12}$$

The criteria in this iteration will stop when $\max_{ij}\left[\left|u_{ij} - \bar{u}_{ij}\right|\right] < \varepsilon$, where ε is a termination criterion between 0 and 1 [21].All clustering activities were done in MATLAB software.

For example 27 centers of clusters for counting the level of trust is shown in figure 3 .after obtain the centers of clusters and save into DAT files, the centers of cluster were loaded into ANFIS. In fact this data is used as training data in ANFIS model.


CLUSTERS CENTER - Notepad

File Edit Format View Help

1-	7.0543405287172920e+000	6.0180986423508180e+000	7.9355401898742910e+000	3.9876041393884556e+000
2-	7.8984992169271102e+000	5.0563426820169628e+000	6.9900485457548234e+000	3.9890629134711011e+000
3-	7.8956302851575648e+000	2.9466950557725076e+000	2.9994088438209947e+000	2.9314265097276770e+000
4-	7.8901919768117459e+000	4.1892015280068495e+000	6.0937774182208546e+000	3.9530754111647908e+000
5-	4.9891764661312470e+000	4.9949595018869610e+000	5.0018089156624770e+000	1.0174246698605278e+000
6-	4.9982173530553400e+000	3.9955367729928479e+000	2.9922215124810938e+000	1.0182676197484748e+000
7-	2.0201485201956912e+000	3.9696951248171777e+000	5.0235709353962514e+000	2.9426267938959739e-002
8-	3.9601259219861902e+000	4.9568193187199787e+000	6.2238804379434551e+000	1.9666938532074676e+000
9-	6.0128742502069761e+000	6.0221988595246208e+000	5.0079620739549711e+000	3.9806896620499805e+000
10-	4.0439706244496536e+000	6.9517167852563171e+000	2.0111518083108892e+000	1.0045190381444837e+000
11-	1.0792677010831537e+000	4.0095250259666342e+000	6.0139816228912242e+000	9.9284135717746924e-001
12-	2.9987554752894470e+000	3.9436526281652102e+000	5.0836976084588308e+000	1.0012476951435820e+000
13-	3.0052572762035670e+000	2.9711844324692067e+000	3.9772838260384620e+000	9.8511643168422069e-001
14-	6.0486425687071330e+000	7.0307198266586131e+000	7.9431810931980520e+000	3.9759843584546739e+000
15-	2.0160779516377785e+000	5.9911968757269829e+000	5.0238066342671361e+000	1.0084307056580601e+000
16-	7.7180775535784658e+000	7.9575428645942505e+000	6.9596482416529071e+000	3.9934411302356421e+000
17-	1.0650479816683502e+000	2.9412890671727596e+000	1.9648871637472649e+000	9.6394211163095319e-003
18-	3.9872363325089939e+000	4.0994747652875025e+000	1.9613969660407560e+000	1.0105995836259767e+000
19-	4.9063772123635934e+000	1.8009087359565403e+000	3.9871702623269036e+000	1.0370388549842819e+000
20-	2.9995452671693448e+000	6.0669636847241675e+000	7.0117111725688908e+000	1.9334912476931272e+000
21-	3.0321836146584484e+000	6.9883499634956561e+000	4.0093462648955711e+000	1.9915331899285851e+000
22-	3.1289949083115656e+000	7.9473603090199418e+000	4.9916950582595936e+000	1.9943947758922658e+000
23-	7.4641700719861088e+000	3.0668815436814829e+000	7.9341179179431212e+000	3.9493402070513550e+000
24-	4.0560625444462719e+000	7.8958742267930484e+000	7.0501859380391210e+000	2.0021058988472240e+000
25-	4.9566142246182920e+000	3.9302390048041906e+000	5.0229338578503970e+000	1.0553769511231474e+000
26-	2.0317187690919636e+000	3.9623379052125181e+000	3.9993187464329010e+000	2.8871696806350499e-002
27-	6.0161971443958313e+000	5.0076075325709013e+000	4.9940025275404656e+000	2.9862256753898957e+000

FIGURE 3: 27 centers of clusters for counting the level of security

Expert ANFIS System

The ANFIS system based on Expert knowledge contains 27 rules, 3 inputs and one single output for trust level. The structure of expert ANFIS is shown in figure 4.The fuzzy logic toolbox using the MATLAB software is employed to create the ANFIS model. In fuzzy logic tool box, relevant fis for trust model is created. In this model type of fis is selected Sugeno type.

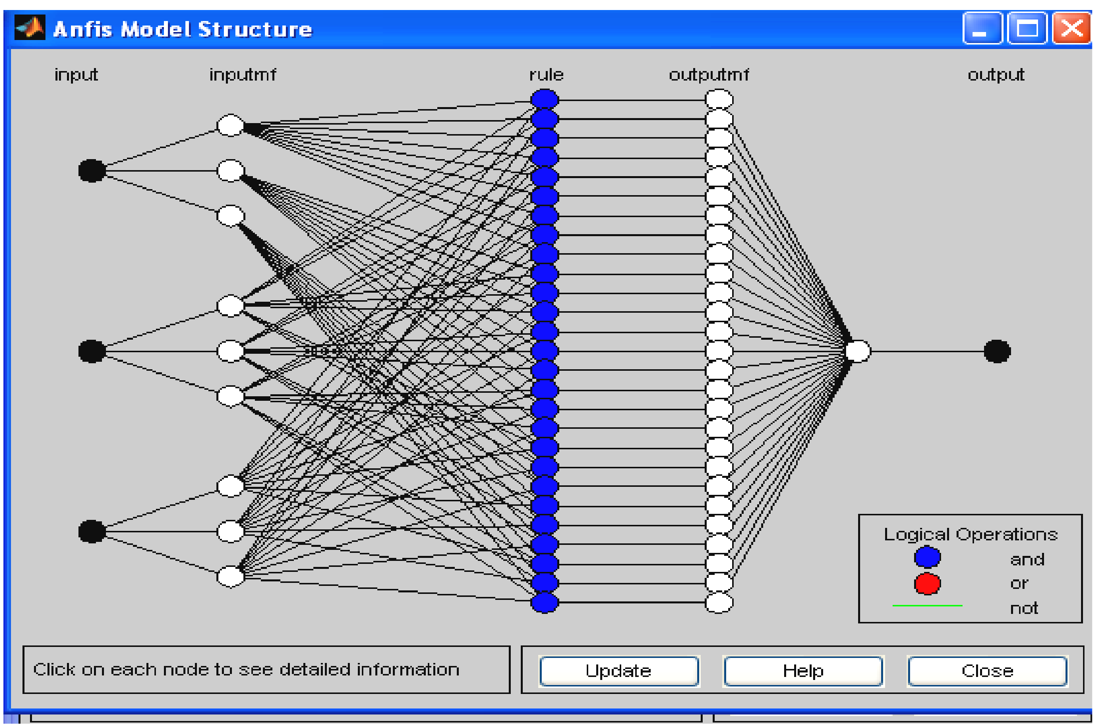


FIGURE 4: Expert ANFIS structure.

Membership Function for Expert ANFIS
Gaussmf are used to build the expert ANFIS model. The shape of membership functions after training the AFNIS for 100 epochs is shown figure 5.

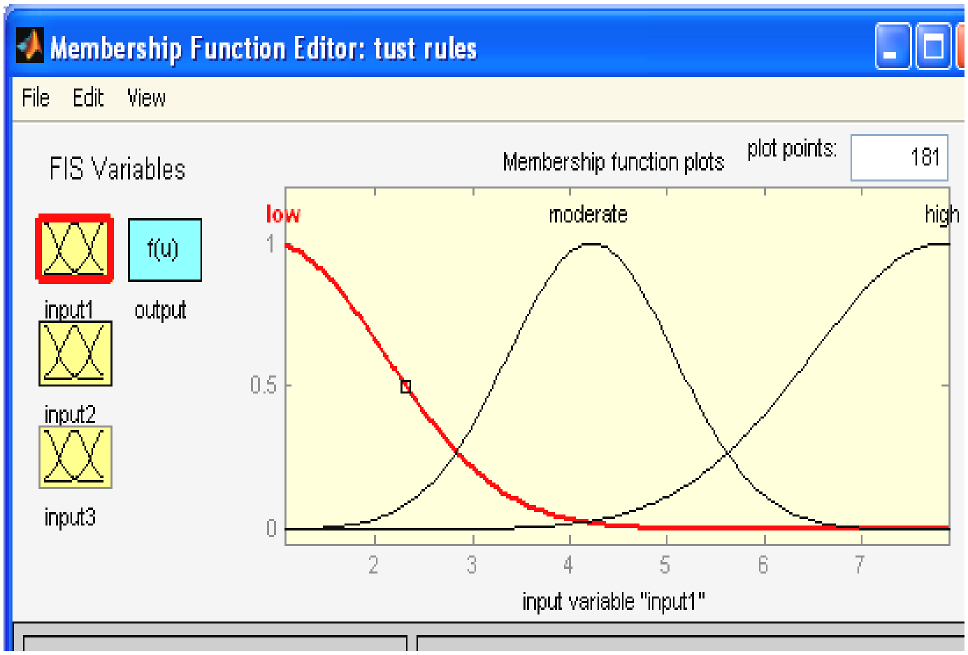


FIGURE 5: Memberhip Function for ANFIS

ANFIS was proposed in an effort to formalize a systematic approach to generating fuzzy rules from an input-output data set. In ANFIS model 27 rules for trust level and 15 rules for B2C level is used. Table 3 shows number of rules of trust and B2C model.

TRUST	**B2C LEVEL**
NUMBER OF RULES	
27	15

TABLE 3: number of rules of the fuzzy system model obtained from FCM clustering

The rules describing the trust level are based on the degree of security, familiarity, and design that these degrees have been formulated like linguistic variable .similarly, the degree for trust level has been graded from very low to very high in 5 distinctive fuzzy, collections .these rules have been reached from the users ' answers after ordering, analyzing, and clustering .One of the collection rules of confidence level can be like following:

If (security = high and familiarity = low and design = moderate) then (trust =moderate).

Trust has been shown like a five fuzzy collections, while competitiveness and B2C level has been shown as 3 linguistic variables for fuzzy collection. One rule of the collection of b2c level rules can be like following:

If (trust = low and competitiveness = highly) then (b2c level = moderate).

Totally there are 27 rules for trust that has been created by clustering the user's answers.

Also, the rules of the b2c level are 15 numbers. The rules from base of resultant system that consist of 2 separate and relative systems in order that the b2c level is gained despite the security inputs, familiarity inputs, design inputs, and competitiveness level of website.

Training Data for Trust Level

The entire data set of trust level is 27 samples. They are referred to as training data, testing data and checking data. Upon training, the ANFIS shows the training error which reflects the how good the mapping function is. To validate the model, we further apply the testing data to see how the ANFIS behaves for known data. ANFIS maps the function onto the testing data as per the training. Having created the data set the next step is to train the network. This means we create a new FIS to fit the data into membership functions. Using the grid partitioning method, the ANFIS automatically selects the membership function and also generates the new FIS. Figure 6 shows training and testing data in ANFIS network that is loaded.

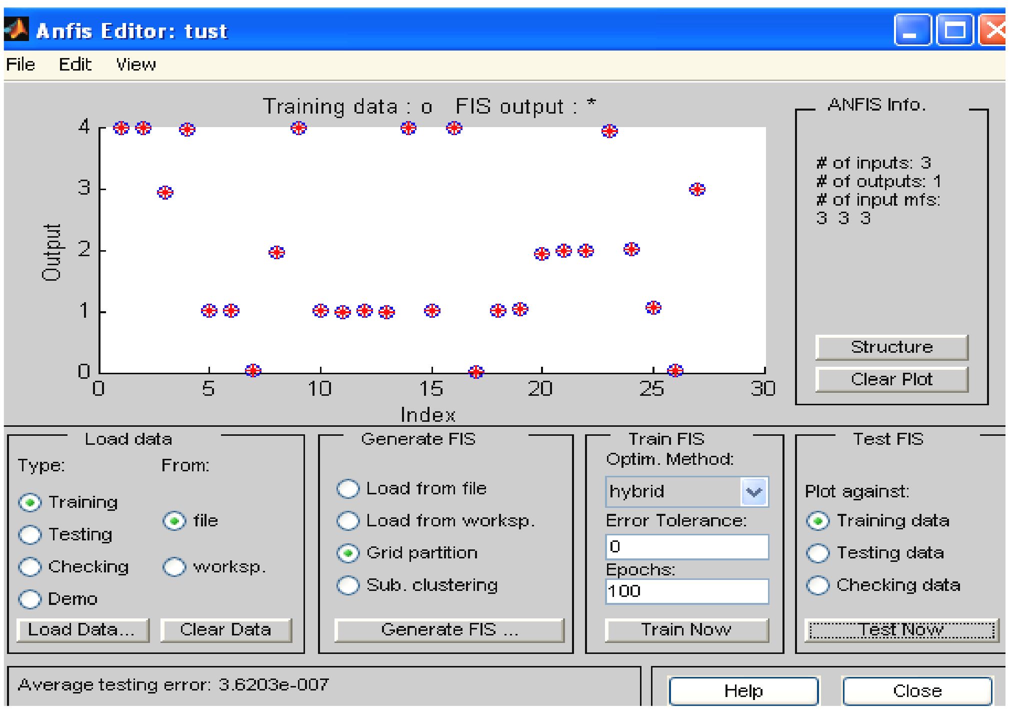


FIGURE 6: training and testing data in ANFIS network.

In figure 7, the course of error during the training of adaptive network is shown.

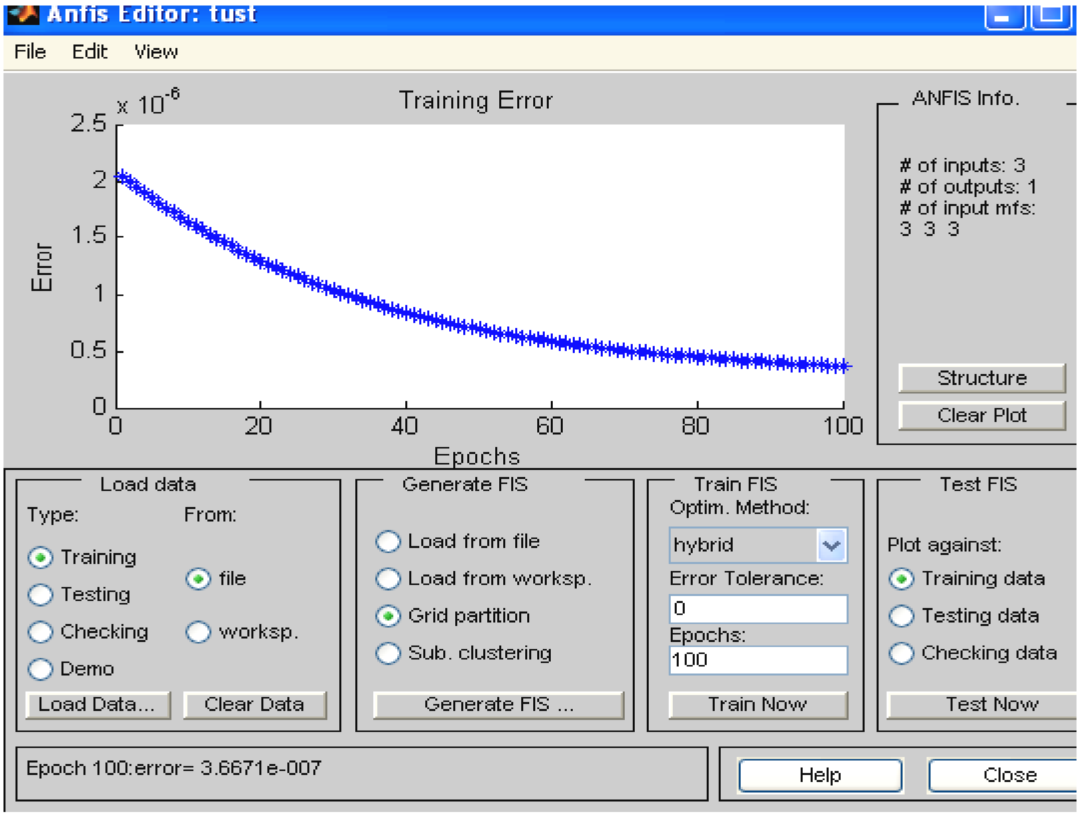


FIGURE 7: course of error during the training of adaptive network.

At the end of 100 training epochs, the network error (mean square error) convergence course of each ANFIS was derived. From the curve, the final convergence value is 3.6671e–007.

5. B2C AND TRUST LEVELS IN THE DEVELOPED FUZZY SYSTEM

After discovering the rules related to trust level, relevant inputs and outputs for earning trust level in fuzzy tool box to be organized and were created relevant membership for input and output figure 8 shows the fuzzy system that can be used to derive the trust level.

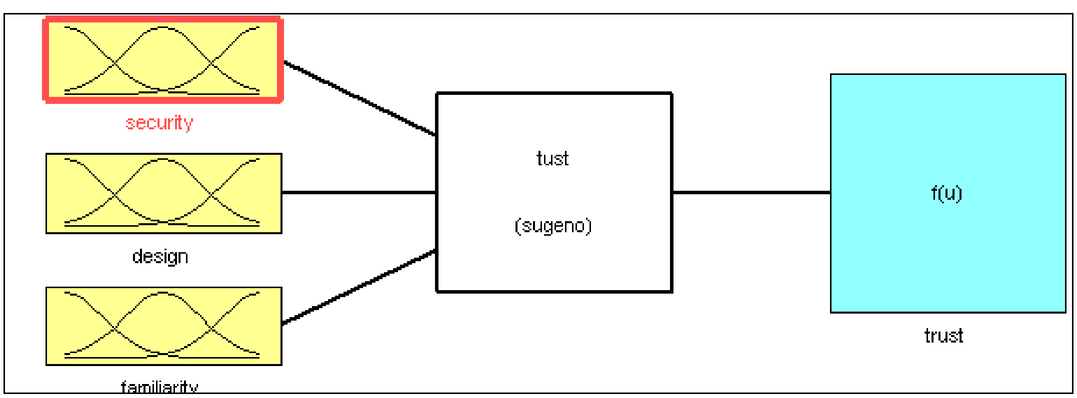


FIGURE 8: Fuzzy system to obtain trust level based on security, familiarity and design inputs

Also after that discovering the rules related to b2c level, relevant inputs and outputs for earning b2c level in fuzzy tool box were organized and were created relevant membership function for input and output. Figure 9 shows the fuzzy system that can be used to derive the b2c level.

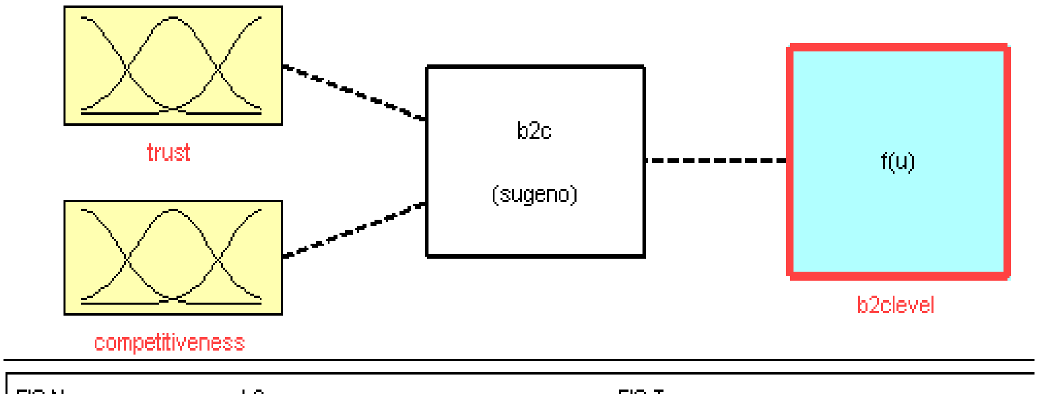


FIGURE 9: Fuzzy system to obtain B2C level based on trust, competitiveness inputs

6. ANALYSIS OF TRUST VERSUS SECURITY FACTOR

For complete understanding of participation needed in trust level, it is necessary to separately test the participation of each factor.

The Figure 10 shows contribution to Trust of a given Website originating from the Security. Therefore, the contribution from Familiarity and Design has been kept constant at three levels, namely: low, moderate and high corresponding to numeric values for Familiarity and Design of (1–7 and 15).Figure 4 shows that Trust level is monotonically increasing for increasing perceived security of a website for any given level of Familiarity and Design. However when both F and D is 'High' (numeric value of 15) the Trust level is at its maximum for maximum Security. The three curves have one common feature that they exhibit a 'staircase shaped' curvature.

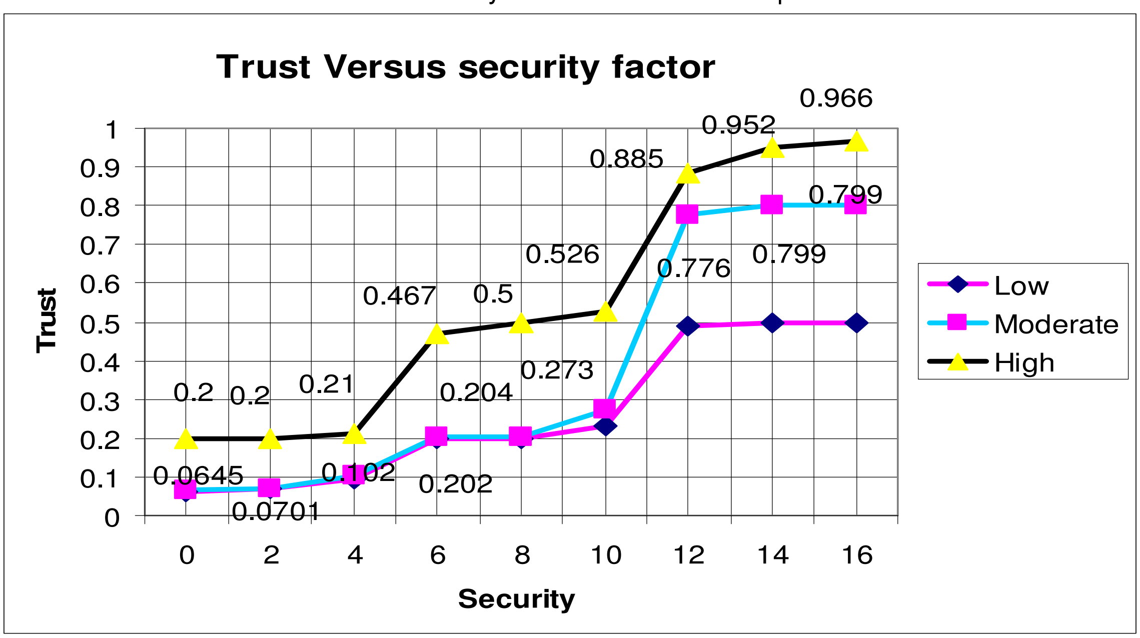


FIGURE 10: Trust versus security factor

7. ANALYSIS OF TRUST VERSUS SECURITY AND DESIGN FACTOR

In this section Trust level is depicted as a continuous function of its input parameters as security and familiarity. Figure 10 intends to depicture variation of Trust as encapsulated in the rules for Trust. The highest gradient for Trust is when Familiarity is 'moderate' and Security is 'moderate' to 'high'. This suggest that when people are somewhat familiar with a website then a small increase in security levels from between moderate to high security will boost their trust in a significant way. Looking at Figure 11 diagonally from (low, low) to (high, high) levels of Security and Familiarity one observes three plateaus where the last one is around 0.966, and remains at that level even when the input factors are increased further. This result is somehow unexpected and may be due to the fuzzy nature of the expert system where a 'Trust' level of 100% is unrealistic.

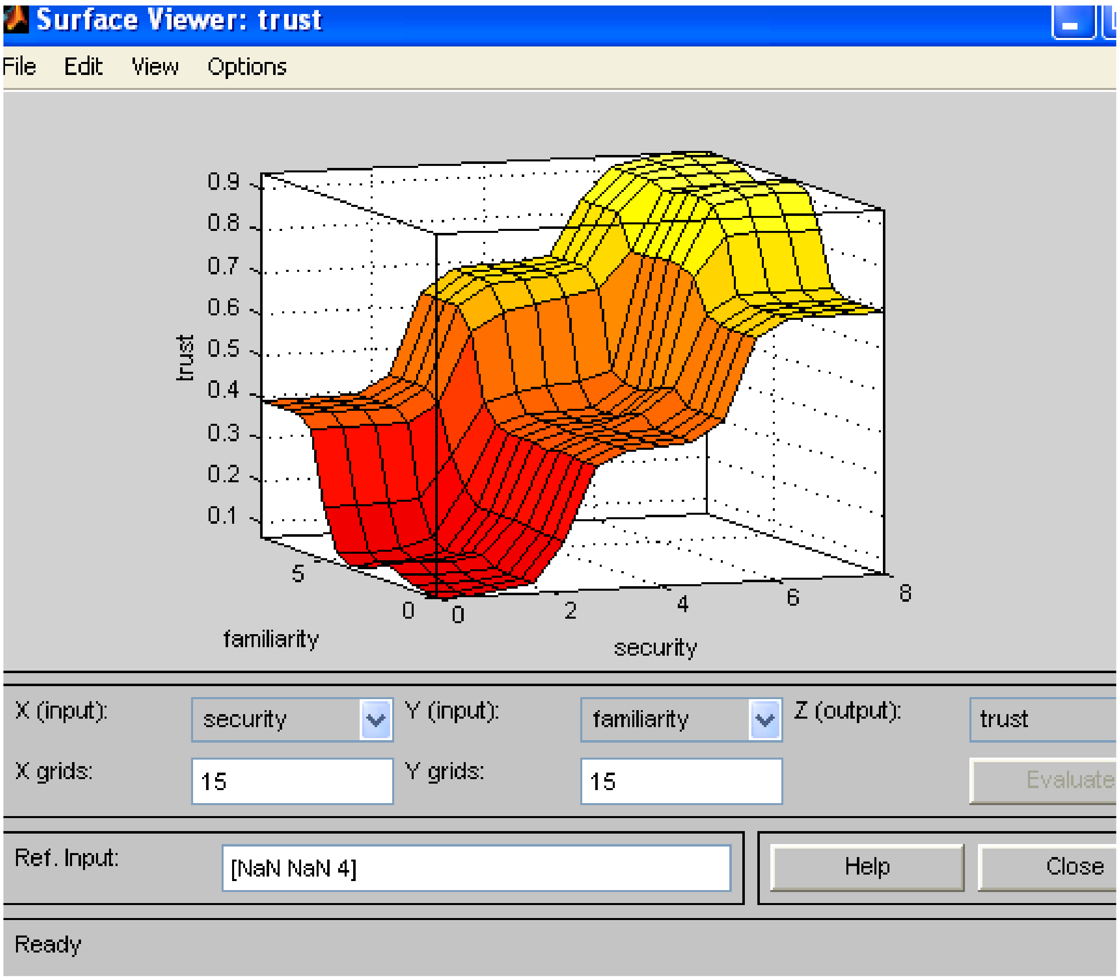


FIGURE 11: Trust level is positively related to levels of security and familiarity.

8. SIMULATE FUZZY TRUST MODEL THROUGH MATLAB SOFTWARE

Simulink is a tool used to visually program a dynamic system and look at results. Any logic circuit or a control system for a dynamic system can be built by using standard BUILDING BLOCKS available in Simulink Libraries. Various toolboxes for different techniques, such as Fuzzy Logic, Neural Networks, DSP, Statistics etc. are available with Simulink, which enhance the processing power of the tool. The main advantage is the availability of templates / building blocks, which avoid the necessity of typing code for small mathematical processes.

The model equations were implemented in MATLAB/ SIMULINK with standard blocks in a sub model. SIMULINK offers a block to include a Fuzzy controller designed by the MATLAB Fuzzy Toolbox.

After obtain of trust FIS, fuzzy trust model was simulated in MATLAB software. Figure 12 shows the simulation fuzzy trust model. A Simulink model shown in figure 12 is developed which has 2 fuzzy logic controllers with a rule viewer, a process, 2 multiplexer, difference element, 4 constant blocks, and a display window.

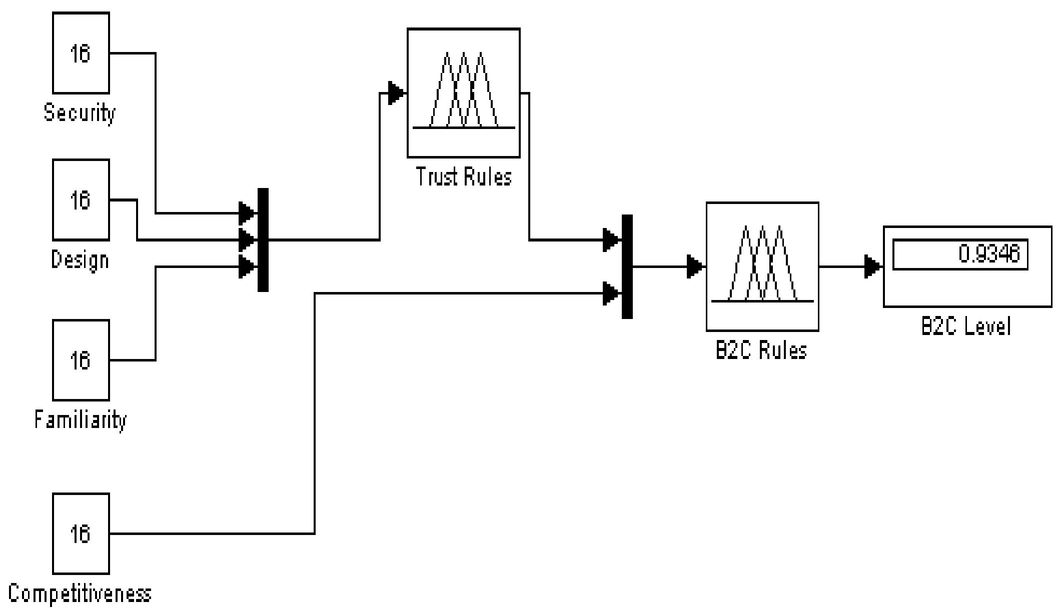


FIGURE 12: Block Diagram of fuzzy trust model.

9. CONCLUSION

Trust to B2C website depends on different factors. From our observation we have found that the easiest way to be reliable and trusted to the Customers is to maintain an easy and simple image in online environment.

The results of this research will be useful to online companies who are investing huge amounts of money on developing ecommerce web sites. Results show that trustworthiness plays a moderately important role in success of B2C e-commerce web sites. In addition, we used the AHP method to analyze the gathered data. By using AHP method and completing questionnaire through face to face meeting we finally were able to provide ranking of all factors and sub-factors. This ranking shows the relative importance of success factors compared to each other. This will provide a clear map to webmasters and marketing managers of online companies who are trying to improve their web site's performance and reach customer satisfaction.

In addition the vendor can use the survey data to ascertain the Trust level of the site as per user's perception and rectify if needed if this is not obvious or is having a negative impact on the Trust level. Furthermore a measure of the competitiveness is directly deductible from this survey and could be used to retain or increase market share. Lastly as the usage of the survey procedure matures (possibly by providing incentives as discounts on a completed transaction) the Fuzzy Inference Systems could be modified and adjusted where necessary.

The results of this study will help businesses understand consumer online shopping for the trust factor. Although the model of this study can not include "trust" of all possible factors, but levels of "security", "design"," familiarity" and "competitiveness" are detected.

10. REFERENCES

1. C.Centeno, “Building Security and Consumer Trust in Internet Payments”, the potential of “soft” measures – Background Paper No. 7, Electronic Payment Systems Observatory (ePSO).

2. R.Pauline. “The Evolution of Trust in Businessto-Besiness E-Commerce”.Copyright 2006, Idea Group.

3. J.Benoit, John.I, “Consumer TRUST in E-commerce”, Copyright © 2006, Idea Group Inc., distributing in print or electronic forms without written permission of IGI is prohibited.

4. O.Andrea, Jana.D. “Trust in E-Technologies”. Copyright © 2006, Idea Group Inc., distributing in print or electronic forms without written permission of IGI is prohibited.

5. L.Jo, Lisa .M. “How Does Personality Affect Trust in B2C c-Commerce?” ICEC’06, August [4-16 2006, Fredericton, Canada.

6. B.Shneiderman., “Designing Trust into Online Experiences”, Communications of the ACM, 43(12), 2000, 57 -59.

7. A.Fahim, “Trust in Electronic Commerce: Social, Personal, and Technical Perspective”, In Proceedings of the International Conference of the Information Resources Management Association: Innovations through Information Technology, New Orleans, USA.

8. Allen C. Johnston , Merrill Warkentin "The online consumer trust construct: a web merchant practitioner perspective" , Proceedings of the 7th Annual Conference of the Southern Association for Information Systems.

9. Fukuyama, F. (1995). Trust: the social virtues and the creation of prosperity, the free press,New York.

10. Gefen, David. & Detmar W, Straub. (2004). Consumer trust in B2C e-commerce and the importance of social presence: experiments in e-products and services. The international journal of management science. Omega 32, pp. 407-424.

11. Mayer, R.C., Davis, J. H. & Schoorman, F.D. (1995). An integration model of organizational trust. Academy of management review, 20(3), pp. 709-734.
12. Reichheld, F.F. & Schefter, P. (2000). ‘E-loyalty: your secret weapon on the web,’ Harvard business review,78. pp.105-113.

13. Lightner, Nancy. J. (2004). Evaluating e-Commerce functionality with a focus on customer Service. Communications of the ACM, Vol. 47 Issue 10, p.88, 5p; (AN 14523142).

14. Singh, M.,Costtabile, A., Paull, S. (2001). E-commerce and customer relationship management (eCRM), heidelberg press, Melbourne, pp.95-108.

15. Ciji Pearl Kurian , V.I.George, Jayadev Bhat & Radhakrishna S Aithal Manipal Institute of Technology Manipal – 576104, India"Anfis Model For The Time Series Prediction Of Interior Daylight Illuminance"

16. Sengur, A. (2008a). Wavelet transform and adaptive neuro-fuzzy inference system for color texture classification. Expert Systems with Applications, 34, 2120–2128.

17. Buragohain, M., & Mahanta, C. (2008). A novel approach for ANFIS modeling based on full factorial design. Applied Soft Computing, 8, 609–625.

18. Avci, E. (2008). Comparison of wavelet families for texture classification by using wavelet packet entropy adaptive network based fuzzy inference system. Applied Soft Computing, 8, 225–231.

19. Ying, L. C., & Pan, M. C. (2008). Using adaptive network based fuzzy inferencesystem to forecast regional electricity loads. Energy Conversation and Management, 49, 205–211.

20. Kosko, B., (1992). Neural Networks and Fuzzy systems: A Dynamical Systems Approach to Machine Intelligence. Prentice-Hall, Englewood Cliffs, NJ.

21. Bezdek, J.C., 1981. Pattern Recognition with Fuzzy Objective Function Algorithms. Plenum, New York.