AI Driven Recommendation Systems Based Database Management using Fuzzy Based Nano Heuristic Computational Method

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AI driven Recommendation systems growth is increasing rapidly in the recent years and several numbers of people utilizes this popular channel for purchasing the services and products through internet resources. Presently, Shopping sites have become very important for the customers to purchase the best products and the sales have been increased for these kind of resources. Furthermore, People purchasing through internet resources face several problems and a lot of confusion due to the massive number of products which they find very difficult to choose their favorite product. In the present market various popular traditional algorithms named Collaborative Filtering (CF), Planned Behavioral Theory (PBT), Markov Hidden Model (MHM), Traditional Machine Learning (TMC) and Analysis of Component (AoC) was used in the AI driven Recommendation systems sites for the users to purchase and choose the products in a customized manner with high service and more loyalty. In the traditional methods, Customers face several difficulties in determining the statistical probability of the product due to bulk data information during the time of shopping.In this research, Fuzzy Based Nano Heuristic Computational Method (FHCM) has been integrated with AI driven Recommendation systems sites which helps in optimizing the product search during purchase and customer authentication process in an effective manner. This proposed method has been experimentally analyzed at lab scale testbed software and found it will be more helpful to solve the problems in data sparse to identify the best product on the site for the customers..

Keywords: AI driven Recommendation systems; Statistical Probability; Internet Resources;Nano Heuristic; Deep Learning.

1. Introduction

In the recent past, the Immense amount of information is accessible by means of portable online business sites[1]. This information has enabled profound algorithm learning to follow the purchasers venture on AI driven Recommendation systems sites[2]. Since the machines can hold huge measures of data immediately, while applying learned information, they can anticipate what sort of products a customer can purchase before they have settled on a choice[21]. In General web-based business website can offer the purchaser to buy alternative products depends on the details of the different products they have seen and how much time they spent surveying the products. It will even consider the hour of the day and your watcher's area, regardless of whether they are male or female and some other pertinent settings accessible to the machine[4,5].

For eg; suppose Mary is visiting an online store and choosing at Blue women running shoes. The shoes she chooses are pretty, however, not actually what she needs. She needs a shoe that has progressively curved support. Luckily for Mary, the site utilizes a machine learning algorithm. Mary can tap on the picture of the shoe and she will be offered outwardly comparable items to peruse through the products. The items prescribed were picked by examining the picture where Mary tapped on, alongside her other action since she entered the site. The method of algorithm has proposed on different sets of shoes with comparative shading and shape attributes[6].

The framework has worked with an information yield framework whereby Mary's activities and inclinations have gone about as the information and the shoes that are prescribed to her go about as the output. The accumulation of pixels in the picture that Mary tapped on to fill in as information sources, driving the framework attempt to discover the comparative arrangements of information [3]. The information seems to be basically true[22] [8].

It is clear how this is a groundbreaking method for promoting your items as well as offering customer administration without being available. The client finds what they need effectively, As well as they have numerous choices displayed to them and all the data they may need is promptly accessible. Essentially, your online business website winds up like a virtual store type of assisting[9].

It means that the visual uprightness of your site is of fundamental significance. Your product pictures should be clear and simple to see with the majority of the important data stacked in the picture map editorial manager. For you, as an advertiser profound learning implies more chances to expand your change rates and improve your product image picture through positive client experience [18]. Not exclusively your clients being served focusing on customized content for the buy they are making, yet they are likewise being offered related items to be keen on, in the light of their own individual conduct.

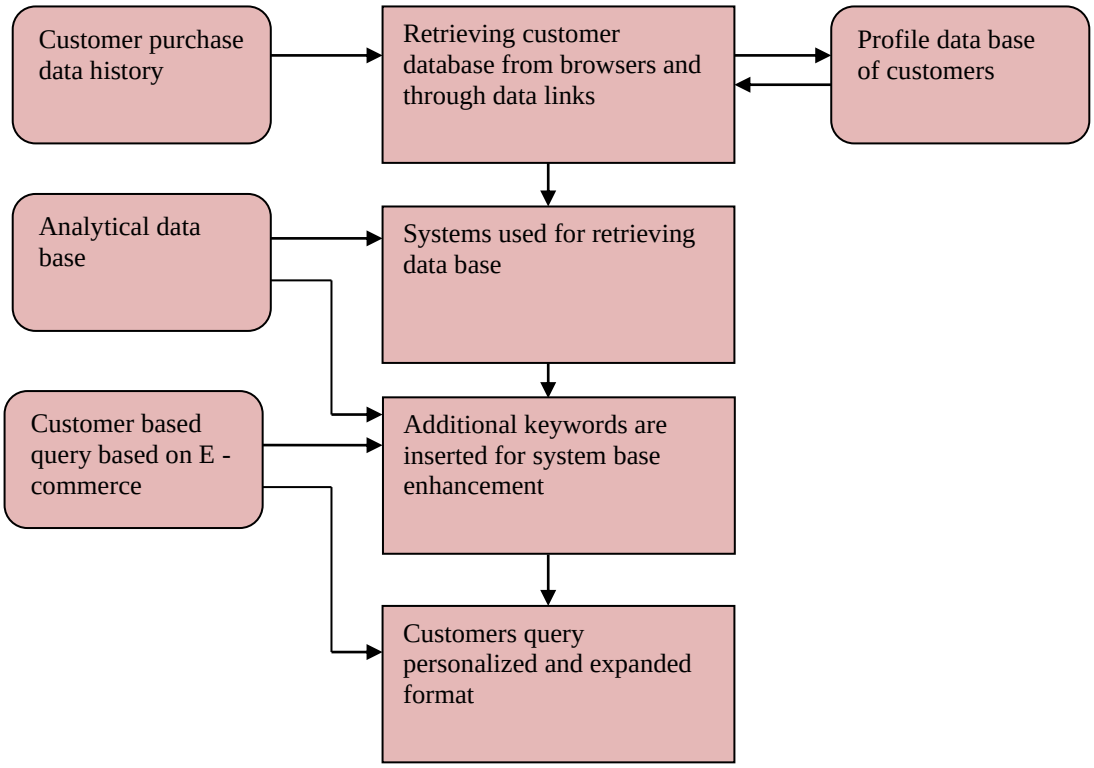


Figure: 1.Query Processing System Design

The above figure.1. Explains in detail about the query processing of system design for customers data, where the customer's information is received from the database or through the web resources and the analytical data analysis is retrieved from the system. The queries of the customers are clarified based on the AI driven Recommendation systems method of analysis, additional types of keywords are inserted here for enhancing the database systems in the form of expanded and personalized method[10].

In this paper Fuzzy Based Nano Heuristic Computational Method (FHCM) is used to solve the problems that are raised in the existing techniques during product selection and purchase, this approach is mainly Introduces to solve the issues for the customers that are raised in purchasing the goods through e- commerce websites.

2. Literature Survey

In [23] authors suggested that Collaborative Filtering method uses data capturing technique for behavioral patterns check in the form of navigational way and also it estimates the level of significance in the form of preference value of the customers for the purchased products, this method is conducted mainly for the recommendations of preference levels. This method compares the existing data works in the form of behavioral patterns of simple variable relationships. Experimental method analysis is done mainly in AI driven Recommendation systems websites and most of the approaches are done in the form of

conventional method in all cases.

In [12] authors suggest that Traditional Machine Learning technique predicts in purchasing the products and the user behavioral activity in a large AI driven Recommendation systems website. This work is based on advanced technology since it is based on extracting the high dimensional feature data for the convenience of customers. This method is mainly introduced to solve the imbalance procedure raised to the customers.

Planned Behavioral Theory approach is introduced for the analysis of shopping orientation to reduce the pressures introduced in the shopping environment in [13]. Here authors paid More importance to the local patronage process in order to produce a higher significance level to the AI driven Recommendation systems sites. This approach is introduced mainly for the convenience to the customers during the purchase of their products in The AI driven Recommendation systems websites [11].

In[14,15]Hidden Markov Model method is used for rating online reputation technique for each and every user which submit the number of ratings and this rating are described in the form of three different matrices to detect the fair and unfair rating products [7]. This filtering technique is used in the form of the clustering method to estimate the quality of the product and this method proved using a filtering technique algorithm which brings very high accuracy value as varied between 0 to 50 percentage[16].

The Component Analysis approach is introduced to solve the strategies involved in the AI driven Recommendation systems website[17,18]. It evaluates every core competitive method based upon component analysis method in differentiating the model into financial and operational basis. The survey is measured in the form of telephone method and this is one of the very effective ways to solve the problems that are introduced in the AI driven Recommendation systems website by the customer[19]. Each and every problem is identified to solve the potential issues and it is managed to bring the right remedial solutions[20].

3. Fuzzy Based Nano Heuristic Computational Method For Ai Driven Recommendation Systems Sites

Though Several popular websites are available in the market for AI driven Recommendation systems, The proposed FHCM has been mainly introduced to improve the AI driven Recommendation systems experience among the popular sites. Presently, Collaborative Filtering (CF), Planned Behavioral Theory (PBT), Markov Hidden Model (MHM), Traditional Machine Learning (TMC) and Analysis of Component (AoC) approaches are used to determine the criteria of accessing the products which lead to complexity in database management . In the proposed method, In order to determine the product accessibility, different type of weights is assigned based upon the experiments using the web design. The experimental weights that are taken here for the analysis are 0.5, 0.25 and 0.5 respectively. The criteria models are taken based upon the five levels of architectural diagram that is explained clearly in figure 2.

This figure.2. is based upon the different criteria's such as main and subsection where the transaction that are done for the customers.

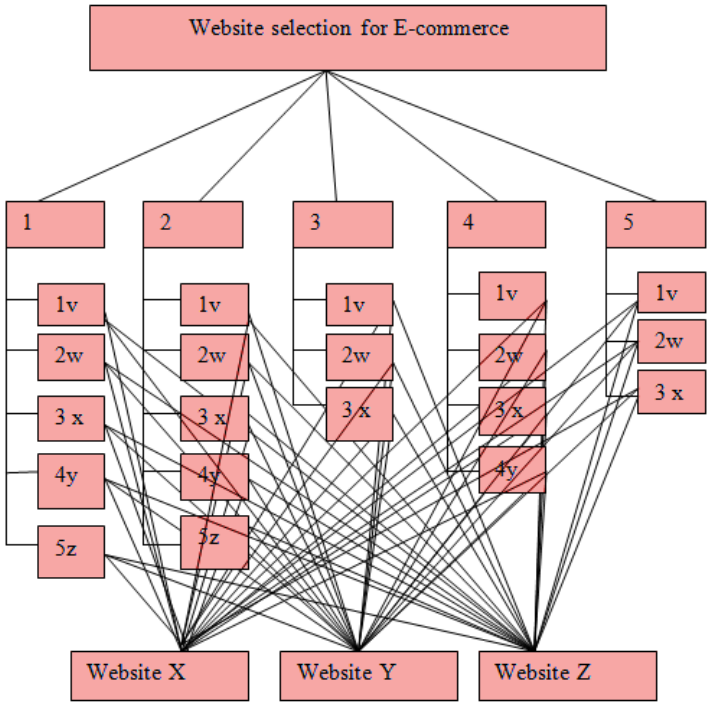


Figure: 2 AI driven Recommendation systems Website Selection Hierarchy Model

A) Criteria Analysis:-1

The criteria's that has been classified as first criteria is named as initial main criteria (1) and the sub criteria (2W) which is named as a transaction criteria. From the initial criteria, sub criteria's are easy to navigate (2W) to find the needs (3X) for online transaction (4Y) to receive a different type of pages in the website (5Z).

B) Criteria Analysis-2:

Further, The second criteria is the product criteria (2) where the sub criteria denote the price tag of the product (1v), Product description as (1v), Quality of product as (3X), Product comments from the customers (4Y) and Competitive price of the product (5Z).

C) Criteria Analysis-3:

Third criteria are security (3) which will be the main criteria and the sub criteria's are security purchasing through online (1V), personal protection (2W), and information statement privacy method (3X).

D) Criteria Analysis-4:

4th main criteria's is a customer relationship (4) and the sub criteria's are customer's quick responses to the demands (1V), registration of direction (2W), online service and customer support (3X) and online status order tracking (4Y).

E) Criteria Analysis-5:

A fifth main criterion is the fulfillment (5) and the sub criteria's are perfect times (1V), delivery product (2W), accurate delivery and accurate building method (3X).

3.1 Structure of Fuzzy Interference Model

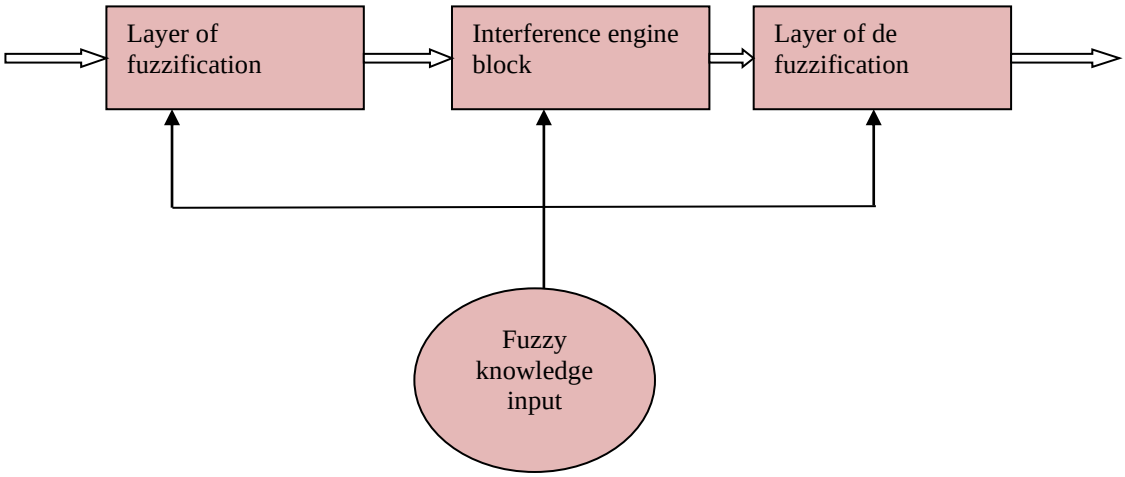


Figure: 3 Fuzzy Interference Model

The above figure 3 represents the input equations are received to the layer of Fuzzification model and transferred to the interference engine block which is placed to convert all the layer of inputs to the Fuzzy model.Further, it has been send to the layer of Defuzzification process to produce the desired output based upon Fuzzy algorithm.

In FHCM, Initially we start with a decision making criteria to determine the problem in an alternative hierarchy method. In this hierarchical method the entire details and information of the customers received to determine the problem faced during the purchase of the product is explained in Eq (1). Here the data base has been stored in the Sentiword Net 3.0 Cloud based data analysis software to review customer loyalty and product satisfication analysis as shwon in the Figure.3(a).

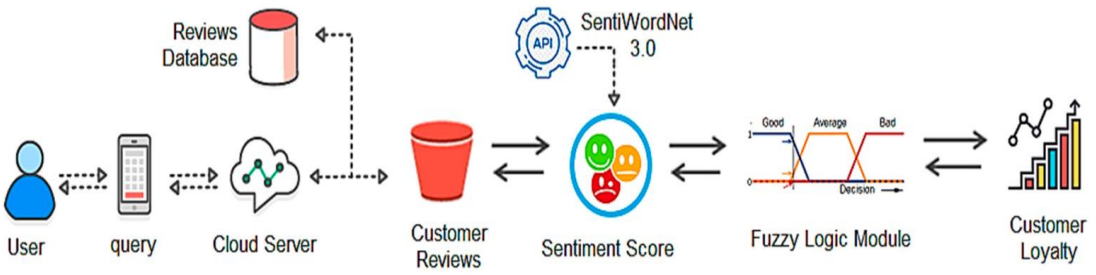


Figure.3.(a) Customer Loyalty measurement analysis flow.

$$V_{j\,i} = V_{j\,i1} + V_{j\,i2} + V_{j\,i3} + V_{j\,i4} + V_{j\,i5} \quad (1)$$

Initially Eq(1) compares each and every factor in the hierarchical method and the decision is applied using Fuzzy method of analysis. The experimental data are explained based on the knowledge perception and background to receive the entire details about the comparison models. Furthermore, Different weights are allocated based upon the decision making on the criteria of experiencing the knowledge and background which is shown in Eq (2).

$f_a \in [0,1]$, $f_1+f_2+\ldots\ldots\ldots+f_n=1$ (2)

For an instance, any decision makers to accept the n^{th} and j^{th} decision maker to assign the problem has been formulated in the Eq(3).Initially the main purpose of applying the operator acceptable format is to group the individual reference model. The weight f_a of the aggregation is performed, when you apply weighted fuzzy triangular operating method which is multiplied in the Eq (3) as shown below.

$V_{ji} = V_{ji1}*f_1+V_{ji2}*f_2+\ldots..+V_{jin}*f_n$ (3)

V_{ji} is the aggregated fuzzy value of the score which is compared to the decision makers. Here in FHCM ,Let us convert all the first negative scores into the positive values corresponding to exponential format. However, Each and every negative score are translated and the conversion is done in the Eq (4).

$V^*_{ji} = \boldsymbol{e}^{(}V_{ji}/4)$ (4)

The conversion factor of V_{ji} is $V_{ji} = (a_{ji},b_{ji},c_{ji})$ (5)

From the analysis the above equations are calculated with the weight of the priority factors and then consider for the fuzzy triangular comparison matrix model that is expressed in the Eq (6).

$$\bar{\boldsymbol{D}} = (\bar{\boldsymbol{V}}_{ji}) = \begin{bmatrix} (\boldsymbol{1,1,1}) & (\boldsymbol{a_{12},b_{12},c_{12}}) \ldots & (\boldsymbol{a_{1m},b_{1m},c_{1m}}) \\ (\boldsymbol{a_{21},b_{21},c_{21}}) & (\boldsymbol{1,1,1}) \quad \boldsymbol{u} & (\boldsymbol{a_{2m},b_{2m},c_{2m}}) \\ (\boldsymbol{a_{m1},b_{m1},c_{m1}}) & (\boldsymbol{a_{m2},b_{m2},c_{m2}}) \ldots \boldsymbol{2} & (\boldsymbol{1,1,1}) \end{bmatrix} \quad (6)$$

Where $(\bar{\boldsymbol{V}}_{ji}) = (a_{ji},b_{ji},c_{ji})$ here j, i = 1, 2,…,m and $j \neq \boldsymbol{i}$

From the Eq(6) inverse factor of representation is used to determine the positive and negative fuzzy values.

$(\bar{\boldsymbol{V}}_{ji}) = (1/f_{ij}, 1/g_{ij}, 1/h_{ij})$ (7)

From the Eq(7) we have to simplify the fuzzy equation, to avoid the normalization complicated formula using the normalized matrix as shown in the Eq (8) that is followed as $\bar{\boldsymbol{K}}$.

$$\bar{\boldsymbol{M}} = [\bar{\boldsymbol{m}}_{\boldsymbol{ji}}]_{\boldsymbol{n*m}} \quad (8)$$

In the above equation (8) the values are substituted to form the simplified form of equation and this is formulated in Eq (9)

$$\bar{\boldsymbol{m}}_{\boldsymbol{ji}} = \left(\frac{\boldsymbol{a_{ji}}}{\boldsymbol{c_i^*}}, \frac{\boldsymbol{b_{ji}}}{\boldsymbol{c_i^*}}, \frac{\boldsymbol{c_{ji}}}{\boldsymbol{c_i^*}}\right) \quad (9)$$

The representation of $\boldsymbol{c_i^*}$ is determined as $\boldsymbol{c_i^* = \max_j c_{ji}}$. The factor of normalization method is classified in the property as triangular normalized fuzzy numbers that varies from 0 to 1. The importance of the weight factor can be calculated in the Eq (10) as follows

$$\boldsymbol{R_j'} = \frac{\sum_{i=1}^{m} \bar{m}_{ji}}{\sum_{l=1}^{m}\sum_{i=1}^{m} m_{li}} \tag{10}$$

The representation of l= 1,2,3…,m. In the above Eq(10) the alternative weight is multiplied to the sub criteria to receive the local rating of each and every criterion. The multiplied weight of the aggregated criteria is used to receive the global ratings as mathematically shown in the Eq(11).

$$\bar{\boldsymbol{M}} = \left(\frac{a_{ji}}{c_i^*}, \frac{b_{ji}}{c_i^*}, \frac{c_{ji}}{c_i^*}\right) * (1/f_{ij}, 1/g_{ij}, 1/h_{ij}) \tag{11}$$

From the analysis of Eq(11)The ranked numbers are compared with weights and the integral values are expressed in the form of ranking method that is shown in above Eq(11).From the Computation let us assume some decisions group of "S" people that has an alternative rating with respect to every criteria and it can be calculated in the equation (12)

$$\bar{\boldsymbol{Y}}_{ji} = \frac{1}{h}[\bar{\boldsymbol{Y}}_{ji}^{\sim 1}(+)\bar{\boldsymbol{Y}}_{ji}^{\sim 2}(+).....(+)\bar{\boldsymbol{Y}}_{ji}^{\sim s}] \tag{12}$$

The rating of the s^{th} decision maker is expressed as $\bar{\boldsymbol{Y}}_{ji}^{\sim s}$,which represents the terms j^{th} and i^{th} factor.Then the weights of the fuzzy criterion rating is obtained with respect to the alternative form as shown in the Eq (12). The represented fuzzy multi criterion and decision making problem in the form of matrix as follows in Eq (13) represents the Fuzzy weight factor for product selection in an optimized manner.

$$\bar{\boldsymbol{E}} = \begin{bmatrix} \tilde{\boldsymbol{Z}}_{11} & \tilde{\boldsymbol{Z}}_{12} & & \tilde{\boldsymbol{Z}}_{1m} \\ \tilde{\boldsymbol{Z}}_{21} & \tilde{\boldsymbol{Z}}_{22} & \cdots & \tilde{\boldsymbol{Z}}_{2m} \\ & \vdots & & \\ \tilde{\boldsymbol{Z}}_{n1} & \tilde{\boldsymbol{Z}}_{n2}\ \mathbf{2} & & \tilde{\boldsymbol{Z}}_{nm} \end{bmatrix} \tag{13}$$

The fuzzy weight factor in the Eq(13) is determined as the decision of alternative criteria as denoted as in Eq (14)

$$S = [S_1, S_2, \ldots, S_m] \text{ and the determinant } i = 1,2,3,\ldots m \tag{14}$$

From the Eq(14) the Rating of the alternative factor is expressed as $\tilde{\boldsymbol{Z}}_{ji}$ with respect to V_j that denotes the importance of the weight factor during product analysis.Then the De fuzzification process is carried out in the first matrix decision format in calculating with the weight of each and every criterion in the form of Crisp values for customized product selection. Here, Each and every fuzzy number $\bar{\boldsymbol{L}} = (L_1+L_2+L_3)$ can be transformed into a few numbers of values that shows in the Eq (15).

$$Q(\bar{\boldsymbol{L}}) = L = \frac{\boldsymbol{L1+4L2+L3}}{\boldsymbol{6}} \tag{15}$$

Then the best fuzzy value (BFV, $\overline{\boldsymbol{g}}_{\boldsymbol{i}}^{*}$) is determined by comparing the crisp product number similar to worst fuzzy value (WFV, $\widetilde{\boldsymbol{g}}_{\boldsymbol{i}}^{-}$) For the functional analysis of criteria as shown in the Eq (16)

$$\overline{\boldsymbol{g}}_{\boldsymbol{i}}^{*}=\max_{j}\widetilde{\boldsymbol{V}}_{\boldsymbol{ji}},\ i\in \boldsymbol{C};\quad \widetilde{\boldsymbol{g}}_{\boldsymbol{i}}^{-}=\min_{j}\widetilde{\boldsymbol{V}}_{\boldsymbol{ji}},\ i\in \boldsymbol{B}; \tag{16}$$

The best and the worst product value are computed using the Eq(16) and separation of customized product search in an effective way has been computed in the Eq(17 & 18) as denoted as $\widetilde{\boldsymbol{R}}_{\boldsymbol{j}}$ and $\widetilde{\boldsymbol{S}}_{\boldsymbol{j}}$

$$\widetilde{\boldsymbol{R}}_{\boldsymbol{j}} = \sum_{i=1}^{m}\widetilde{\boldsymbol{Y}}_{\boldsymbol{i}}\,(\overline{\boldsymbol{g}}_{\boldsymbol{i}}^{*}-\widetilde{\boldsymbol{V}}_{\boldsymbol{ji}})/(\overline{\boldsymbol{g}}_{\boldsymbol{i}}^{*}-\widetilde{\boldsymbol{g}}_{\boldsymbol{i}}^{-}); \tag{17}$$

$$\widetilde{\boldsymbol{S}}_{\boldsymbol{j}}= \max_{i}[\widetilde{\boldsymbol{Y}}_{\boldsymbol{i}}(\overline{\boldsymbol{g}}_{\boldsymbol{i}}^{*}-\widetilde{\boldsymbol{V}}_{\boldsymbol{ji}})/(\overline{\boldsymbol{g}}_{\boldsymbol{i}}^{*}-\widetilde{\boldsymbol{g}}_{\boldsymbol{i}}^{-})] \tag{18}$$

- $\widetilde{\boldsymbol{R}}_{\boldsymbol{j}}$ Represents the separation measuring value of V_j from the best fuzzy value
- $\widetilde{\boldsymbol{S}}_{\boldsymbol{j}}$ Represents the separation measuring value of V_j from the worst fuzzy value.

From the Above derived Eq(17 & 18) the values are calculated to form a strategy of weight with respective to products that is followed in equation (19)

$$\widetilde{\boldsymbol{R}}^{*} = \min_{j}\widetilde{\boldsymbol{R}}_{\boldsymbol{j}}\ ,\ \widetilde{\boldsymbol{R}}^{-} = \max_{j}\widetilde{\boldsymbol{R}}_{\boldsymbol{j}}$$

$$\widetilde{\boldsymbol{S}}^{*} = \min_{j}\widetilde{\boldsymbol{S}}_{\boldsymbol{j}}\ ,\ \widetilde{\boldsymbol{S}}^{-} = \max_{j}\widetilde{\boldsymbol{S}}_{\boldsymbol{j}} \tag{19}$$

Thus the alternatives of the ranking Eq(19) are expressed in the form of decreasing order with the value of minimum number of majority rule factor as follows in the Eq(20).

$$V(X'') - V(X')\ (\boldsymbol{CV} \tag{20}$$

The above equation represents the second and the first position of the alternative factor corresponding to the products purchased.Further an optimized Fuzzy Based Nano Heuristic Computational Method is derived to provide remedial solution as follows in the Algorithm.1.,

Algorithm:1 Fuzzy Based Nano Heuristic Computational Method

1. Procedure: learning the algorithm based on Fuzzy Based Nano Heuristic Computational Method.
2. Input: let us get the input of N' set of tasks ($v_1, v_2, \ldots, v_M$)
3. Output: set of tasks are determined as ($s_1, s_2, \ldots, s_{N'}$)
4. Repeat the process till it is arranged in the form of non-increasing form of the cycle.
5. For j=1to N' do
6. $S_j \leftarrow \emptyset$;
7. End for
8. For j=1 to M do

9. Determine the set of tasks S_j with smaller value
10. $S_j \leftarrow S_j + \{S_j\}$;
11. End for
12. Reorder S_j in the non-decreasing order.
13. Return($s_1, s_2, \ldots, s_{N'}$);

In the Algorithm.1. The Fuzzy Based Nano Heuristic Computational Method is studied to determine the problems faced by the customers to Find a right remedial solutions from the agent side. This method will help you to find out the smallest value in which you can quickly verify with the customers authenticity. While comparing with the existing methods the proposed algorithm gives the best results in terms of accuracy, Error rate, prediction, stability and Mathew's Correlation Coefficient.

The algorithm of Fuzzy Based Nano Heuristic Computational Method (FHCM) is learning to find the set of tasks in the non-decreasing order. Here all the inputs are repeated continuously to attain the non-decreasing order to find the smallest value to satisfy the custormer during the purchase has been graphically represented in the Figure.3(b). This Process is continued until it attains the small value and the Equation has been returned in non-decreasing format.

3.2 Analysis of Buyers Feedback Fuzzy Approach based on the Algorithm.1.

In this analysis the buyers prefer only fuzzy defined terms that are exactly placed with the set of products. The Unbiased feedback is obtained from the seller's agent to receive the product as per the recommendations ,that are very similar to the revised products. The concept is based upon fuzzy linear programming and a logical computational approach which helps to identify the buyer's feedback and it shows better presentation of the required products. This analysis is mainly used to determine the customer's degree in the form of AI driven Recommendation systems agent. Let us explain in detail with a set of 3 cases.

3.2.1 Directive Analysis:1-

In Analysis 1 let us consider an example, that the buyer is asking to compromise the price of the computer since the normal printer that is available only for lesser price and he is asking to include along with this purchase. Generally, while considering these types of cases the individual product should not be added to the weight of the attributes. In case , if it is added then the data is transacted and it will not work out the same principle simultaneously to rank the value of the product in the form of numerical strength. Here when considering the information object the minimum Eq (21) is followed as,

$$\boldsymbol{a_{ji}} = \frac{y_{ji} - y_i^{min}}{y_i^{max} - y_i^{min}}, \; j = 1, 2, \ldots, m \; i \in \boldsymbol{\tau}_1 \qquad (21)$$

So when you consider in the form of fuzzy relationship you should only compare the product quality and the preference of the product. Here let us take the information of the object that is followed by "m" number of products and $S_1, S_2, \ldots, S_m$ in the market strategy. It considers "n" evaluated products of the attributes such as B_1, B_2,..., B_n. Therefore the maximum value of the attribute is given as in the Eq (22).

$$\boldsymbol{a_{ji}} = \frac{\boldsymbol{y_i^{max} - y_{ji}}}{\boldsymbol{y_i^{max} - y_i^{min}}}, \text{ j= 1, 2,…, m i} \in \boldsymbol{\tau_1} \quad (22)$$

From the attributed the weight has been calculated in the case:2 as follows,

3.2.2 Directive Analysis:2-

In this case each and every weight of the attribute values in all the transactions has been calculated, while calculating you can see the difference from one transaction to the other that is expressed in the Eq (23).

$$\boldsymbol{Q_{ai}} = \frac{\boldsymbol{1}}{\boldsymbol{4}} [(\boldsymbol{\mu_{b1}(b_{1i})} + (\boldsymbol{\mu_{b2}(b_{2i})} + (\boldsymbol{\mu_{b3}(b_{3i})} + \boldsymbol{\mu_{b4}(b_{4i})}] \quad (23)$$

Here $\boldsymbol{b_{ji}}$ = (j= 1, 2, 3, 4) that represents the ith attribute value of the product. Further to calculate the product attribute to the average value, the entire transaction in the form of business model has been computed. When this practice is started, you can easily check the attribute value of the transaction that is taken as total attributes as followed in Eq (24).

$$\boldsymbol{Q_i} = \frac{\boldsymbol{1}}{\boldsymbol{S}} \sum_{\boldsymbol{k=1}}^{\boldsymbol{s}} \boldsymbol{Q_{ai}} \quad (24)$$

This method mostly helps to determine the total transactions that have been taken place by the customers and also it receives the feedback from the customer side on AI driven Recommendation systems database management .The Frequency of Transaction has been analyzed using the case:3,

3.2.3 Directive Analysis:3-

Here, Determine the frequency of the transaction value of the id attributes function and this can be termed as a new set of equations which is expressed in the Eq (25).

$$\boldsymbol{Q_{inew}} = \frac{\boldsymbol{1}}{\boldsymbol{S}} \sum_{\boldsymbol{k=1}}^{\boldsymbol{s}} \boldsymbol{Q_{ainew}} \quad (25)$$

The degree of attribute association is determined by the power set of values and here you can easily calculate the confidence degree of the customers attribute as denoted as $\boldsymbol{\varphi}$ has been shown in the Eq (26).

$$\boldsymbol{\alpha_{i\varphi}} = \frac{\sum_{\boldsymbol{k=1}}^{\boldsymbol{s}} \boldsymbol{Q_{ainew}}}{\boldsymbol{Q_{inew}}} \quad (26)$$

From the Case analysis report the degree of confidence value is determined by using the three cases and here the buyer's information is also received with the feedback of the product and service in an effective manner. This proposed method has been experimentally analyzed at lab scale tested software and found it will be more helpful to solve the problems in data sparse to identify the best product on the site for the customers in terms of optimization parameters such as stability ratio, prediction, accuracy ,error rate and Mathew's Correlation Coefficient.

4. Results and Discussion

In the present market various popular traditional algorithms named Collaborative Filtering (CF), Planned Behavioral Theory (PBT), Markov Hidden Model (MHM), Traditional Machine Learning (TMC) and Analysis of Component (AoC) has been used in the AI driven Recommendation systems sites for the users to purchase and choose the products in a customized manner with high service and more loyalty. In the traditional methods, Customers face several difficulties in determining the statistical probability of the product due to bulk data information during the time of shopping.In This research, Fuzzy Based Nano Heuristic Computational Method (FHCM) has been integrated with AI driven Recommendation systems sites which helps in optimizing the product search during purchase and customer authentication process in an effective manner which covers all the touch point analysis as shown in the Figure.3.(b), Which covers awareness,consideration of the products by the customers,purchase,services of the websites and loyalty. Further, various optimization factors such as accuracy, Root Mean Squared Error Rate, Positive Prediction Ratio, Mathew's Correlation Coefficient and stability ratio as discussed below.

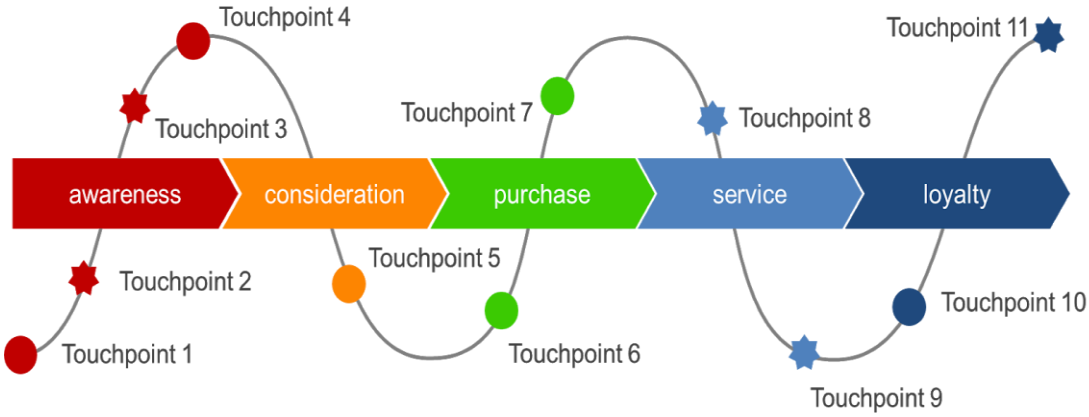


Figure.3(b). Fuzzy Based Nano Heuristic Computational Method (FHCM) customer journey

4.1 Accuracy

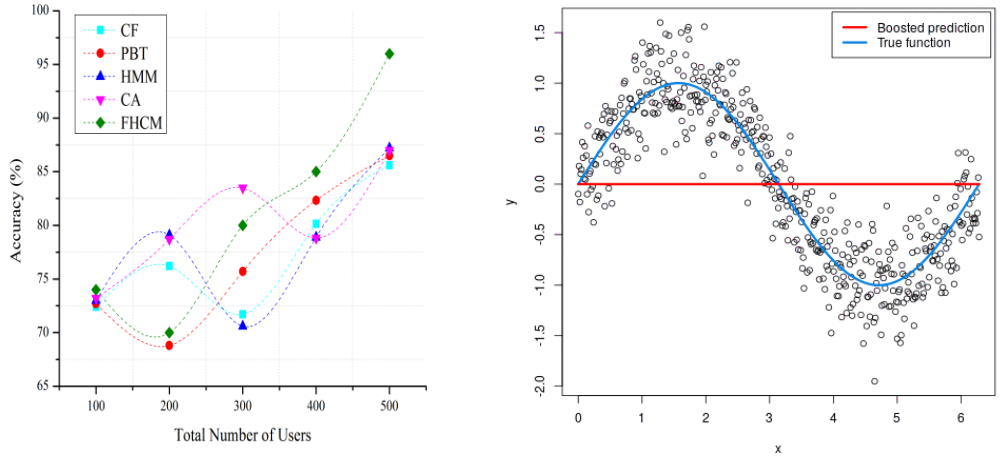
Accuracy is the set of measurement refers to very closest specific values, whereas the precision factor of the product is referred very close to the value of measurement. Here the data points are repeated with the same values and with the same quantity of product that is very close and accurate and numerically represented in the Table.1.

Table 1. Accuracy of FHCM method

Total Number of Users	CF	PBT	HMM	CA	FHCM
100	72.4	72.7	73	73.2	74
200	76.2	68.8	79.1	78.7	70
300	71.7	75.7	70.6	83.5	80
400	80.14	82.34	78.9	78.8	85
500	85.6	86.5	87.2	87	96

The Fuzzy Based Nano Heuristic Computational Method (FHCM) has the highest Accuracy

factor, because individual product should not be added to the weight of the attributes for product based on the Prediction search as shown in the Figure.4(a) has not been addressed in the following methods existing methods such as CF, PBT, HMM and CA. In FHCM $\boldsymbol{b_{ji}}$ = (j= 1, 2, 3, 4) that represents the i^{th} attribute value of the product. Further to calculate the product attribute to the average value, the entire transaction in the form of business model has been computed with higher accuracy factor as shown in the Figure.4(b).



(a) Prediction Analysis (b) Accuracy Analysis

Figure: 4 Prediction and Accuracy of FHCM methods

4.2 Root Mean Squared Error Rate(RMSER)

Root Mean Squared Error Rate is used to determine the deviation of standard values and peak signal to noise ratio during product search. This is commonly referred to the analysis of the experiment in the form of regression analysis of product and customer authentication values has been shown in the Table.2. to validate the RMSER.

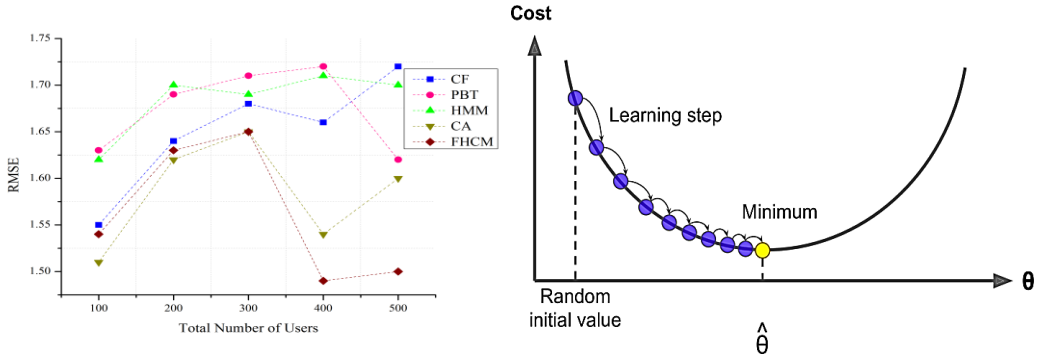
Table 2. Root Mean Squared Error Rate for FHCM method

Total Number of Users	CF	PBT	HMM	CA	FHCM
100	1.55	1.63	1.62	1.51	1.54
200	1.64	1.69	1.70	1.62	1.63
300	1.68	1.71	1.69	1.65	1.65
400	1.66	1.72	1.71	1.68	1.471
500	1.72	1.66	1.73	1.69	1.50

The Fuzzy Based Nano Heuristic Computational Method (FHCM) has the lowest ratio factor and the attribute value of the transaction that is taken in the total attributes gives better search of products because the degree of confidence value based on the random initial value as shown in the Figure.5(a)is determined by using the three cases and here the buyer's information is also received with the feedback of the product and service in an effective manner with less RMSE as shown in the Figure.5.(b), Figure 5 shows the minimum Root

Mean Squared Error Ratefactor ratio of the FHCM based

method.



(a) Cost analysis Vs Error (b) RMSE Ratio

Figure: 5 Root Mean Squared Error Rate for FHCM methods

4.3 Positive Prediction Ratio (PPR)

Figure.6 Shows the Positive Prediction Ratio which is calculated for considering the negative and positive values in the form of screening test format to avoid confusions during the screening process of the products. Here the proposed Fuzzy Based Nano Heuristic Computational Method (FHCM) gives the highest ratio when compared to other existing techniques discussed in this paper as depicted below.

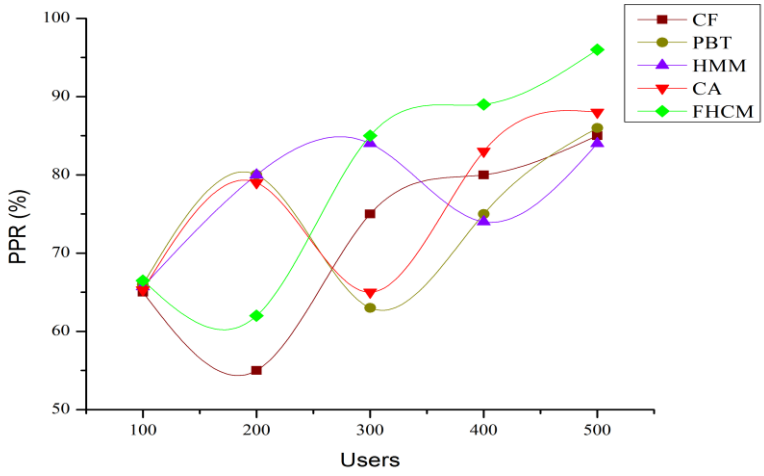


Figure: 6 Positive Prediction Ratio for FHCM methods

Here the FHCM has the highest Positive Prediction Ratio factor, because The factor of normalization method is classified in the property as triangular normalized fuzzy numbers that varies from 0 to 1, which has not been addressed in the following methods such as CF,

PBT, HMM and CA.

4.4 Stability Ratio

Stability Ratio is considered as the long term analysis and this process is used for supporting and investigating the company in the form of balanced equity function of the product With consistent values are listed in the table.4 in accordance with exisiting methods.

Table 4. Stability Ratio for FHCM method

Total Number of Users	CF	PBT	HMM	CA	FHCM
100	72.2	72.56	73.45	73	73.5
200	76.7	70.34	79.24	77.67	72.1
300	70.2	79.67	84.34	80.34	82.45
400	80.5	84.87	76.5	85.56	88.89
500	86.78	86.45	85.4	88.45	95.47

FHCM has the highest Stability Ratio because The proposed concept is based upon fuzzy linear programming and logical computation approach which helps to identify the buyer's feedback and it shows better presentation of the required productswhen compared to CF, PBT, HMM and CA as shown in the Figure.7.

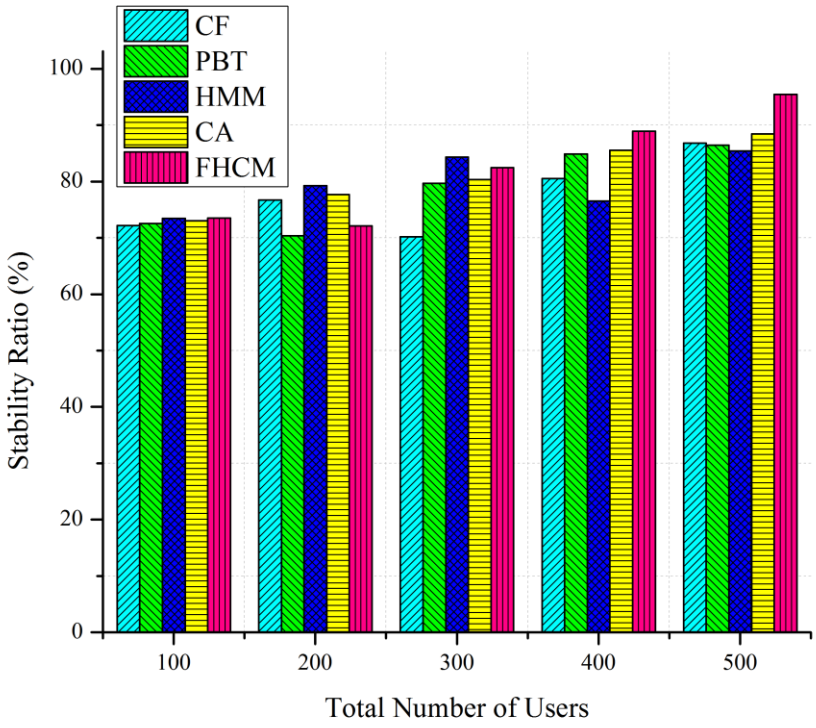
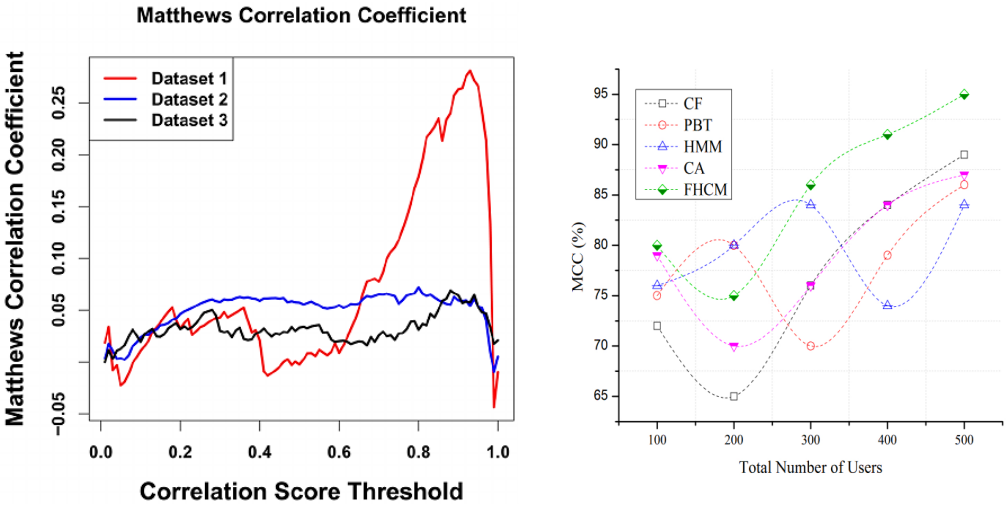


Figure: 7 Stability Ratio for FHCM methods

4.5 Mathew's Correlation Coefficient

Mathew's Correlation Coefficient is the method of machine learning process is used to determine the quality of two binary values that are introduced in this proposed model during product search. This process helps in determining the set of negative of positive values of the equation.



(a) Correlation Threshold (b) Mathew's Correlation Coefficient

Figure: 8 Mathew's Correlation Coefficient for FHCM methods

The highest Mathew's Correlation Coefficient because the total transactions that have been taken place by the customers based on the correlation score threshold as shown in the Figure.8(a) and also it receives the feedback from the customer side on AI driven Recommendation systems database management , which has not been addressed in the following methods such as CF, PBT, HMM and CA is shown in the Figure.8 (b). This proposed method has been experimentally analyzed at lab scale testbed software and found it will be more helpful to solve the problems in data sparse to identify the best product on the site for the customers.

5. Conclusion

In this paper Fuzzy based Nano Heuristic computational method has determined the information regarding bulk purchase and also the useful information from the customers are selected for verification purpose. When compared to the existing techniques such as Collaborative Filtering, Planned Behavior Theory, Markovian Hidden Model, Traditional Machine Learning and Analysis of Component, the proposed method has solved lot of confusions in identifying the sparseness of the better product in the AI driven Recommendation systems website. This method helps customers to find easiest way to choose their favorite product with the bulk number of products in The AI driven Recommendation systems websites simultaneously the sales is also increased in these resources.

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