

AI-based Fuzzy Clustering System for Improving Customer Relationship Management

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Abstract—Artificial Intelligence (AI) is a technology that is becoming more and more widely recognized with the addition of technologies such as personal helpers and chatbots. To get the most out of AI, your company needs to understand how to implement it better. Today, AI enhances almost every business segment and Customer Relationship Management (CRM), which is the area that has the most benefit in enhancing a better customer experience. The existing literature does not provide sufficient empirical evidence of how social media technologies affect a company's distribution chain relationships. Today, Artificial Intelligence empowers almost every business segment and CRM, providing the greatest benefit in enhancing a better customer experience. The main purpose of this study is to show how to successfully implement chatbot in CRM using AI-based Fuzzy Clustering system (AI-FCS), how to integrate chatbot with CRM and how chatbots affect customer relationship management. From forecast lead scoring to service chatbots to customized marketing operations. Chatbots can provide tools to provide a highly productive and better, personalized customer experience to all employees. Chatbots are now easily accessible to everyone in your organization, analyzing data, predicting and planning the next steps, and automating tasks and decisions. Create an optimal control model for Customer Relationship Management using the optimal control theory, depending on the characteristics of customer relationship management. With this model, it can gain effective management insights into Customer Relationship Management for optimal new customer acquisition and existing customer retention strategies.

Keywords: Artificial Intelligence (AI), AI-based Fuzzy Clustering system (AI-FCS), chatbot, Customer Relationship Management (CRM), optimal control, marketing, analyzing data.

1. Introduction

Artificial Intelligence (AI) is expected to have a significant impact on the customer market as they promise to automate tasks that were previously thought to require humans. An interesting trend in this context is the introduction of chatbots by service providers to provide customer service. A chatbot is a

PC program that connects with people through regular language. In a client care climate, chatbots can go about as a bleeding edge of help by giving open, low-limit help and data for much of the time clarified pressing issues and backing undertakings. Retail, monetary, and data and interchanges advances are instances of enterprises that have started to execute chatbots to give client assistance. Client assistance chatbots have extraordinary potential in help productivity, cost reserve funds, and client experience. Chatbots could likewise be important for the specialist co-op's advanced endeavors expected to make due in an undeniably innovation driven market. The chatbot market is supposed to develop by 2025. Driving innovation organizations, for example, IBM and Microsoft have put vigorously in chatbot stages to improve client support capacities. Alibaba and AliExpress are instances of early adopters of chatbots by specialist co-ops that have made chatbots a significant capacity of client support. In any case, spectators bring up that chatbot client enrollment is lower than the business anticipates. One of the reasons may be that the development of chatbots is guided by the push of technology rather than the pull of the market. As a result, development cannot focus on user needs and desires.

Nowadays, CRM (Customer Relationship Management) has become an integral part of any business organization as it has the power to retain customers, strengthen connections with them, and even create new customer groups. In this digital age, CRM has evolved into an ever-changing environment, including technological advances. Chatbots are on the rise in the area of customer relationship management. Collaborative chatbots and CRM are desirable areas where the focus is lacking.

AI-based Fuzzy Inference system (AI-FIS) is it focuses on the impact of chatbot attributes at different stages of CRM. "Chatbots", "Virtual Assistants", or "Conversation Agents": These words are familiar, but the distinction between these words can be ambiguous. A chatbot is actually a bot, an application that

performs automated tasks, and consists of a set of algorithms. In this sense, a chatbot is just a bot version designed to allow conversations. This means that chatbots can understand voice or text input, process it, and generate output in the form of voice or text answers in inevitable conversations. Chatbots provide services similar to mobile apps provided by companies. Chatbots can also be compared to websites when they are considered an entity containing information. There are models for measuring the quality of these two services, but these models need to be suitable for assessing the quality level of chatbots, as they are similar only to chatbots.

2. Related work

A chatbots for online basic encouragement for people focusing on stressors. In view of broad experimental examination, have fostered a social connection specialist that empowers simple discussions with pushed individuals looking for consistent encouragement [1]. Resolves the issue of the viability of this chatbots to assist clients with managing unpleasant circumstances. Artificial Intelligence (AI) is broadly utilized in various enterprises. This assignment will zero in on what AI can do in the assembling business as chatbots [2]. Have planned a chatbot that will assist clients with finishing get together errands in a reproduced producing climate. To recreate this setting, requested that clients gather in numerous stages utilizing an intelligent discourse framework [3]. Chatbots can give answers and directions to clients in case of an issue during the gathering system, in view of the grouping of the client's purpose. The information driven strategy shows additional promising outcomes, yet because of the absence of preparing information accessible in the Arabic assignment situated, it is rule-based to foster the Arabic undertaking focused [4].

Online entertainment has gotten extensive exploration consideration in an assortment of regions, yet it is still in its earliest stages with regards to functional administration. Specifically, the current writing doesn't give adequate exact proof of what web-based entertainment innovation means for an organization's inventory network connections [5]. The effect of client combination on essential new item development has been widely examined for Support Vector Machines (SVMs) throughout the course of recent many years [6]. Up to this point, this significant theme addresses a conflicting exact disclosure that should be blended. In any case, past exploration shows that such frameworks have a high disappointment rate and monetary foundations experience critical monetary misfortunes [7].

Existing benefit streamlining research seldom considers client variety and elements. This can antagonistically influence long haul benefit development because of unfortunate client relationship the board [8]. To broaden the RFM (Recent, Frequency, and Money) model, split the recurrence and cash all out data into week by week level information. The outcome is a critical expansion in the quantity of factors that compare to the client, making high-layered issues. Investigation [9]. To resolve this issue supplant the regularized k-implies bunching technique

with L 1 (free case standard) with a grouping strategy with flexible net punishments zeroed in on relationship factors.

Control and improving chatbot content is a dreary cycle and isn't yet normalized. With regards to this normalization, an absence of managerial cycles can corrupt the chatbot client experience [10]. Web based learning gives individuals the opportunity to control their learning progress and follow their own learning styles. Nonetheless, research shows that most e-learning stages don't have human-like collaborations, so e-learning can make clients feel confined and separated [11]. In view of broad observational exploration, have fostered a social cooperation specialist that empowers simple discussions with focused individuals looking for basic encouragement [12]. Researchers and professionals will read up how these devices for speaking with clients or interior groups can be improved from a presentation, acknowledgment, and sending viewpoint. There are a lot of examinations accessible nowadays, yet not every one of them address the effect of chatbots on computerized business change [13].

Making this information open and helpful to end-clients is one of the chatbot's principal objectives for connected information. Building chatbots in light of connected information presents difficulties, for example, understanding client questions, multi-information base help, and multilingual perspectives [14]. The front line of chatbot convenience analyses can be recognized by amassing research questions and looking at the qualities and measurements utilized in the examination to assess chatbot ease of use. As a rule, the semantic relationship between's client questions and comparing reactions is viewed as a vital component of discourse demonstrating in created and positioning based visit frameworks [15].

3. Materials and Method

Today, human chat service agents are often replaced by chat software agents or software. These systems are designed to interact with human users using natural language based on Artificial Intelligence (AI). Although cost-saving and time-saving opportunities lead to widespread processing, many AI-based Fuzzy Inference system (AI-FIS) for analyzing chats fail to meet customer expectations, and as a result, users are less likely to respond to chatbot requests. For cluster customers, use the obscure AI-based Fuzzy Inference system (AI-FIS) algorithm. The proposed problem is first designed as a purpose mathematical programming model. The objective function of the model is to increase the number of comprehensive customers and the overall satisfaction effect of the service provided.

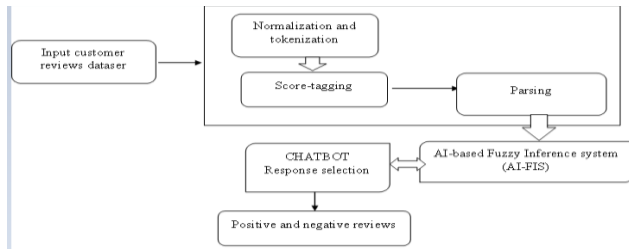


Figure 1: Proposed diagram

Figure 1 described as, Proposed block diagram for customer based reviews management for chatbot response and analysis the reviews based on the AI-FIS. Before analysis the dataset removing the extra words (Normalization and tokenization) for score tagging and parsing the comments to the result part.

3.1 customer reviews dataset collection

A database of customer reviews for emotion analysis is used to analyze user responses to different products, brands or topics through the social media site CHATBOT using user comments. The database is compiled using online reviews and has approximately 160,000 reviews. It can answer frequently asked questions via Chatbots. When used properly, chatbots will definitely improve customer satisfaction.

3.2 Normalization and tokenization

Normalization is the process of converting tokens to their basic form. The normalization process removes the suffix form of the word and restores the basic form. So, in the above example, the usual form of anti-nationalism is nationalism. Normalization helps to reduce the number of unique tokens in the text and eliminates variation in the text. It removes unnecessary information and deletes text.

Tokenization (removal of symbols): This step breaks up the string particles into separate words. At the same time, meaningless strings like symbols and spaces are also removed.

Algorithm steps

Begin

Initialize the minimum word of iteration (W) and Maximum iteration (N)

Compute Normalization for secure normal word count

Set I to initial value ($\text{intVal} \leq \sigma, \lambda$)

For each I_w do

Min (count (λ_w))

End

End

Tokenizing

List of unwanted Character

String word count

For A=1 to number of character in string

If (string word (w) == 'unwanted character')

Remove String Words (w);

End if

End for

String split (String_cont words)

Where, w-minimum word count, N-maximum word count, Stop and remove the word from the article. A stop word is a list of nonsense words stored in a database. StopWords usually contain a list of proposals, articles, and pronouns. However, can add other nonsense words. Extracts meaningful words as a result of this training.

3.3 AI-based Fuzzy Inference system (AI-FIS)

To create chats that use Fuzzy logic algorithms such as pattern analysis, sentiment analysis and some techniques such as machine learning and its algorithms are used to analyze sentences in chatbots. Proposes a new customer relationship emotion analysis method that integrates the results of classic classifiers. Artificial Intelligence for Internet (AI) for CRM in the context of chats. The proposed method uses AI-based Fuzzy Inference system (AI-FIS) measurements to determine the significance of each classifier for final decision making. Fuzzy measurement is used with Fuzzy Integral to link the output of the classifier to create the final label. To convert the model to a single integer programming model, use the concept of fuzzy logic. Finally, use the numerical example to validate the proposed resolution process. Experiments with various reviews emotion databases have shown that classification based on ambiguous integration improves the average accuracy of combination emotion classification.

Steps for AI-based Fuzzy Inference system (AI-FIS)

Step 1: Initialize the word count (U)

$$U = [U_{ab}]_{Matix}, U^0$$

Step 2: At step U: Calculate the word score $W^0 = [U_{ab}]$ using U^w

Step 3: Update the word score U^w, U^{w+1}

Step 4: If $\|U^{w+1} - U^w\| < \delta$ then STOP;

Otherwise return to step 2.

AI-FIS → decision to make analysis the reviews based on chatbots

Step 5: End

Where δ is the final criterion between 0 and 1 and k is the number of iterative steps. Where δ is the final criterion between 0 and 1 and k is the number of iterative steps.

4. Result and discussion

The proposed Customer relationship management for analyzing reviews based on the algorithm is tested on the Stanford dataset, which is available for free for customer reviews. The given dataset consists of positive and negative reviews. 80% of the dataset is used for training from a particular dataset, and 20% is used for testing.

Table 1: Simulation parameters for the proposed method

Parameters	Values
Dataset	UCI dataset
No.of. dataset	200
Tool	Anaconda
Language	Python
Training data	200
Testing data	100

Table 1 shows the simulation parameters for analyzing the customer reviews dataset based on the training and testing process.

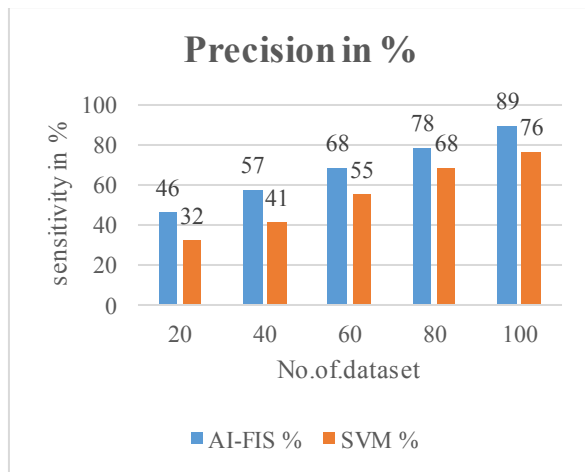


Figure 2: Analysis of Precision

Figure 2 shows the precision for consumer review data, and it predicts the positive results based on the AI-based Fuzzy

Inference system (AI-FIS) is 89%, and Support Vector Machine (SVM) is 78%.

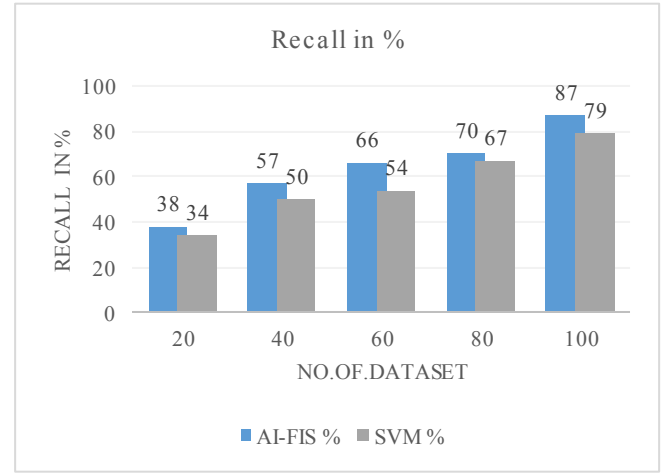


Figure 3: Analysis of Recall

Figure 3 shows Recall customers to monitor review data and predict recent calculations based on the AI-based Fuzzy Inference system (AI-FIS) is 87%, and Support Vector Machine (SVM) is 79%.

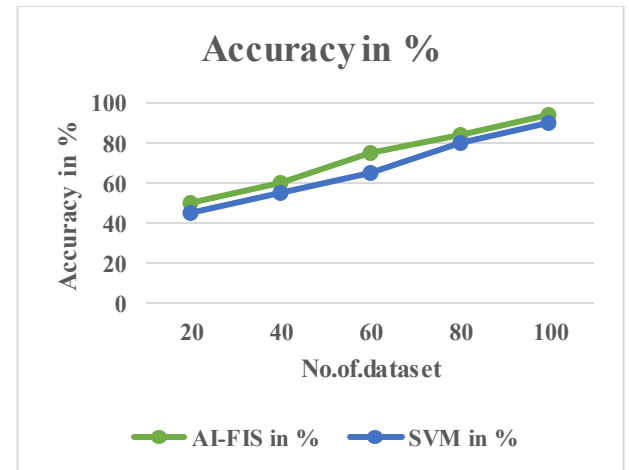


Figure 4: Analysis of Accuracy

Figure 4 shows the accuracy of customer review data, and it's based on true ranges calculation results based on the AI-based Fuzzy Inference system (AI-FIS) is 94%, and Support Vector Machine (SVM) is 90%.

5. Conclusion

Customer Relationship Management (CRM) initiatives have received a lot of attention in recent years. This research study concluded that, CRM is the best-suited strategy for conducting business in relation to customers. The proposed study has successfully used the AI-based Fuzzy Inference system (AI-

FIS) algorithm for clients. From the results, it is proposed AI based chatbot programming model increases the number of target customers as well as their overall satisfaction with the provided services. Further, a fuzzy logic is implemented to convert the proposed model into a single integer programming model. The integration of advanced AI in CRM process will provide useful knowledge for publishing new research, highlighting new topics that can make significant theoretical and experiential contributions to CRM chatbots and assist in analyzing the customer reviews.

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