CUSTOMERS SATISFACTION ANALYSIS -THE FUZZY MODEL APPROACH

[1] I. Osifo and U. A.Okengwu[2]

[1,2] *Department of Computer Science, University of Port Harcourt, Port Harcourt, Nigeria*

ABSTRACT

Customer Satisfaction is usually utilized as a part of the promoting area. Customer Satisfaction has been a basic part in the mind of researchers for long, however none has possessed the capacity to linguistically deal with fuzzy environment in programming exhaustively customer satisfaction. The standard technique used in determining the customer's satisfaction is subjective in nature, creating vague outcomes. In this paper a target approach which is objective using fuzzy logic paradigm handles imprecision (Vague) and also advances the created result into; "Not Satisfied", "Moderately Satisfied" and "Satisfied" which outpaced the past subjective approach. The new system developed takes care of imprecision in handling customer satisfaction rating at a glance.

Key words: Fuzzy model, Customers, Satisfaction, Knowledgebase

INTRODUCTION

Customer Satisfaction is viewed as a key execution marker in a business and it is regularly part of an adjusted scorecard, in an aggressive market where organizations go after clients, Customer's fulfillment is viewed as a key differentiator of business system [3]. Customer satisfaction evaluations can include capable impact inside an association, they prepare their representatives on the significance of living up to client's desires, moreover when these appraisals plunges, they make issues that can influence deals and gainfulness. These measurements evaluate a vital dynamism [2]. In this manner it is fundamental for business to viably deal with customers Satisfaction which is just achievable using dependable and reliable measurement of satisfaction. In inquiring about satisfaction, firms or organizations ask clients whether their items or administrations have met or surpassed their desire. Along these lines,

desire is a key factor behind satisfaction [1]. At the point when clients have exclusive requirements and the truth miss the mark, they will be baffled and will probably rate their experience as not fulfilled. The significance of customer satisfaction reduces when a firm or organization has expanded bargaining power. For Example, Cell phone suppliers, for example, AT&T and VERIZON, partake in an industry that is an oligopoly, where there are just a couple of suppliers of specific items or administrations. However, numerous wireless arrangement contracts have a considerable measure of fine print with arrangements that they could never escape if there were around 100 mobile phone design suppliers, since clients fulfillment would be unreasonably low, a few clients would effortlessly have the alternative of leaving for a superior contract offer [3]. Firms or organizations need to retain existing clients while focusing on none clients , measuring

customer's satisfaction give a sign of how effective the association is at giving items or administrations to the commercial center. Consumer's loyalty is a questionable and dynamic idea and the genuine indication of the condition of fulfillment that will fluctuate starting with one individual then onto the next and item/administration to another. The condition of fulfillment relies upon number of both mental and physical factors which correspond with fulfillment practices, for example, return and recommend rate. The level of Satisfaction can likewise change contingent upon different alternatives; the clients may have different items against which the client can look at the organization's items [2]. The principal utilization of fuzzy logic control frameworks was the design of a fuzzy algorithm for managing a steam motor. After this beginning stage, the research and utilizations of fuzzy control advanced quickly. Hard computing strategies are not valuable for the development of the robot control frameworks with adequate cost; it is the utilization of soft computing procedures that permits the defeat in the problem of complexity of control systems and, likewise, furnishes them with capacities of resilience for uncertain information(imprecise data), and high productivity and execution.

The Fuzzy System
Fuzzy logic is a logic having many values, estimated reasoning and has an uncertain boundary [4]. Fuzzy components appropriate for tasks including thinking have been proposed as an augmentation to traditional formal logic, they were first presented in set hypothesis. The idea of a "fuzzy set" has been utilized to expand traditional sets, which are portrayed by crisp limits. This expansion allows a level of adaptability for each object having a place

with a specific set. This quality is acknowledged by the definition of membership functions that give fuzzy sets the ability to model linguistic, vague expression [7]. Fuzzy sets constitute the reason for fuzzy logic, a novel route for creating reasoning models by dealing with uncertain data, which truth can expect a continuum of qualities in the vicinity of 0 and 1. This sort of data is frequently termed as fuzziness: it ought to be noticed that fuzziness does not originate from arbitrariness, but rather the unverifiable and loose nature of conceptual considerations and ideas. Fuzzy thinking, utilizing specific mathematical inference, determines decision in light of an arrangement of fuzzy IF-THEN rules, where linguistic variables could be included. Along these lines, fuzzy logic is reasonable for portraying the conduct of framework, which are either excessively perplexing or too poorly characterized, making it impossible to be manageable to exact numerical examination. Classical system can't adapt to vague or deficient data, since they don't give any methods for representing imprecise propositions and do not have any recommendations from such propositions. Fuzzy logic framework usually contains IF-THEN control and can be described as far as their key constituents: fuzzification, rule base inference, and defuzzification. The fuzzification segment changes over the input signals into fuzzy values with the assistance of membership functions in the structures communicated by the fuzzy linguistic variables [5]. The strategy for recognizing, investigating and building up the information relationship of the physical framework is known as modeling [5]. A parameterized fuzzy relation is acquainted to portray the fuzzy data granules utilizing the lower and upper approximations of a

choice are developed, and another fuzzy rough set model is presented [6].

Customer Satisfaction

When a client or recipient of a good or services is pleased because of the condition of goods or quality of service rendered, Customer's satisfaction can be said to have been achieved. It is important to note that the degree of customer's satisfaction varies from one customer to another.

MATERIAL AND METHOD

Fuzzy logic can be executed utilizing the following advances:

i. Characterize the control goals and set the criteria.
ii. Decide the information and yield relationship and pick a minimum number of factors for contribution to the fuzzy logic engine (normally error and rate-of change of error).
iii. Utilizing the rule-based structure of fuzzy logic, Break the control issue down into arrangement of IF X AND Y THEN Z rule that characterize the coveted framework output conditions. The number and unpredictability of rules relies upon the number of fuzzy variables related with each parameter.
iv. Make fuzzy logic membership functions that characterize the meaning (values) of input/output terms utilized in the rules.
v. Make the important pre-and post-processing fuzzy logic routine, otherwise program the rules into the fuzzy logic hardware engine.
vi. Test the framework, assess the outcomes, tune the rules and membership functions, and retest until satisfactory results are acquired.

In designing our system, for customer satisfaction system the following components are incorporated:

a. Customer Satisfaction Criteria: The customer satisfaction criteria forms the fuzzy set or parameters for determining customer satisfaction based on the fuzzy components and fuzzy rule base paradigm. These criteria are usually robust and can run from 1-n depending on the base or class domain.
b. The fuzzy inference system (FIS): The fuzzy inference structure pertains basically to the fuzzification, processing and defuzzification. The fuzzification point maps crisp set (0 or 1) as received from the outside or real world domain into fuzzy set (0-1) for optimal processing. Without this component actualization of fuzzy boundary classification would be impossible. The processing utilize the fuzzy mapping (Low Moderate and High), apply the fuzzy based rules and determining classification domain. The defuzzification returns the fuzzy set back to crisp set for forward utilization within the outside world.
c. System Knowledgebase: The system knowledgebase is special database stores information pertaining to customer satisfaction for future logical analysis or processes.
d. The Output Generated: The output generated is the front-end paradigm either mobile or stationary electronic device by which remote access to predetermined customer satisfaction criteria are made possible. It simply displays the output result for end-user utilization.

Data Source

Survey questionnaires where used as the research tool for gathering data via interview of customers of a particular manufacturing company. The criteria considered are:

After Sales Service, Prompt Response to Query, Product Timeliness, Reliability of Product, Balance Product Cost, Frequency of Delivery and Product Variety.
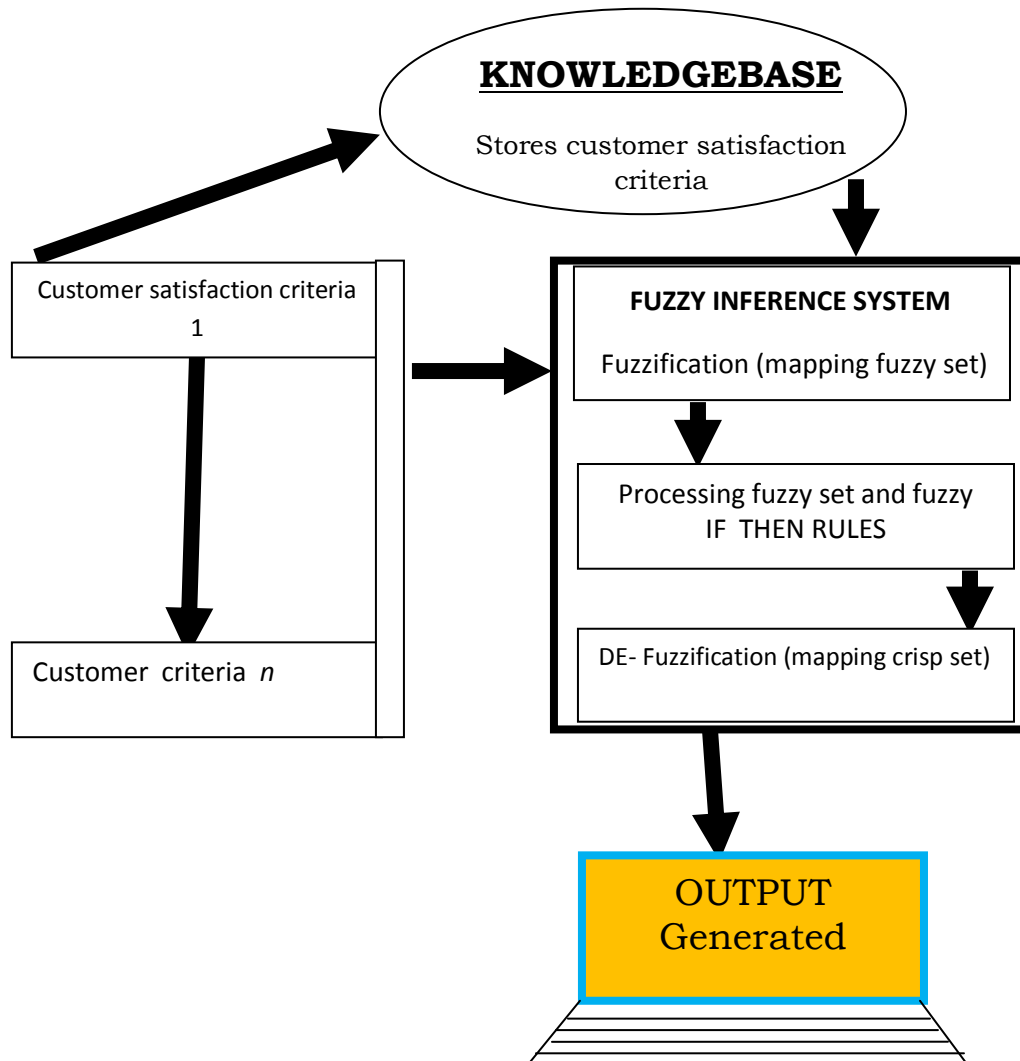

Fig.1. Architecture of the fuzzy based model for customer satisfaction.

Model Functionality

The functionality of our model depends on our predefined fuzzy rules utilizing our linguistic variables/customer satisfaction criterion which was derived utilizing a research survey in which questionnaires served as the research tools after an exhaustive fuzzy set gathering approaching utilizing observation and interview of relevant experts.

These criteria's includes; After Sales Service, Prompt Response to Query, Product Timeliness, Reliability of Product, Balance Product Cost, Frequency of Delivery and Product Variety.

Table 1: Degree of membership functions for ascertaining customer satisfaction in an online store.

Customer Satisfaction Fuzzy Set	Codes	Degree Of Membership		
		Cluster 1	Cluster 2	Cluster 3
After sales service	R01	0.65	0.15	0.96
Prompt response to query	R02	0.20	0.28	0.60
Product timeliness	R03	0.10	0.80	0.68
Reliability of product	R04	0.20	0.87	0.74
Balance product cost	R05	0.30	0.69	0.80
Frequency of delivery	R06	0.95	0.05	0.90
Product variety	R07	0.00	0.70	0.65

The fuzzy rules generated are:

a.   Poor (0.00 – 0.30)
b.   Good (0.31 – 0.60)
c.   Excellent (0.61 – 1.00)

If the customer (C) experiences less than or equal to two ($P \leq 2$) of the parameters for assessing customer satisfaction *THEN* (C_1), if customer (C) experiences three (C = 3) of the parameters for assessing customer satisfaction *THEN* (C_2), if the customer (C) experiences four ($P \geq 4$) or more parameters for assessing customer satisfaction *THEN* (C_3).

Rule 1:   If after sale service *THEN* (C1)
Rule 2:   If after sale service and prompt response to query THEN (C1)
Rule 3:   If after sale service, prompt response to query and product timeliness THEN (C2)

Rule 4:   If after sale service, prompt response to query product timeliness and reliability of product *THEN* (C3)
Rule 5:   If after sale service, prompt response to query product timeliness, reliability of product and balance product cost *THEN* (C3)
Rule 6:   If after sale service, prompt response to query product timeliness, reliability of product, balance product cost and frequency of delivery *THEN* (C3)
Rule 7:   If after sale service, prompt response to query, product timeliness, reliability of product, balance product cost, frequency of delivery and product variety *THEN* (C3).

RESULTS

Table 2: Generated Result

| Customer Satisfaction Fuzzy Set	Codes	Degree Of Membership		
		Cluster 1	**Cluster 2**	**Cluster 3**
After sales service	R01	Good	Poor	Excellent
Prompt response to query	R02	Poor	Poor	Excellent
Product timeliness	R03	Poor	Excellent	Excellent
Reliability of product	R04	Poor	Excellent	Excellent
Balance product cost	R05	Poor	Excellent	Excellent
Frequency of delivery	R06	Excellent	Poor	Excellent
Product variety	R07	Poor	Poor	Excellent
RESULT		**C1 (Not Satisfied)**	**C2 (Moderately Satisfied)**	**C3 (Satisfied)**
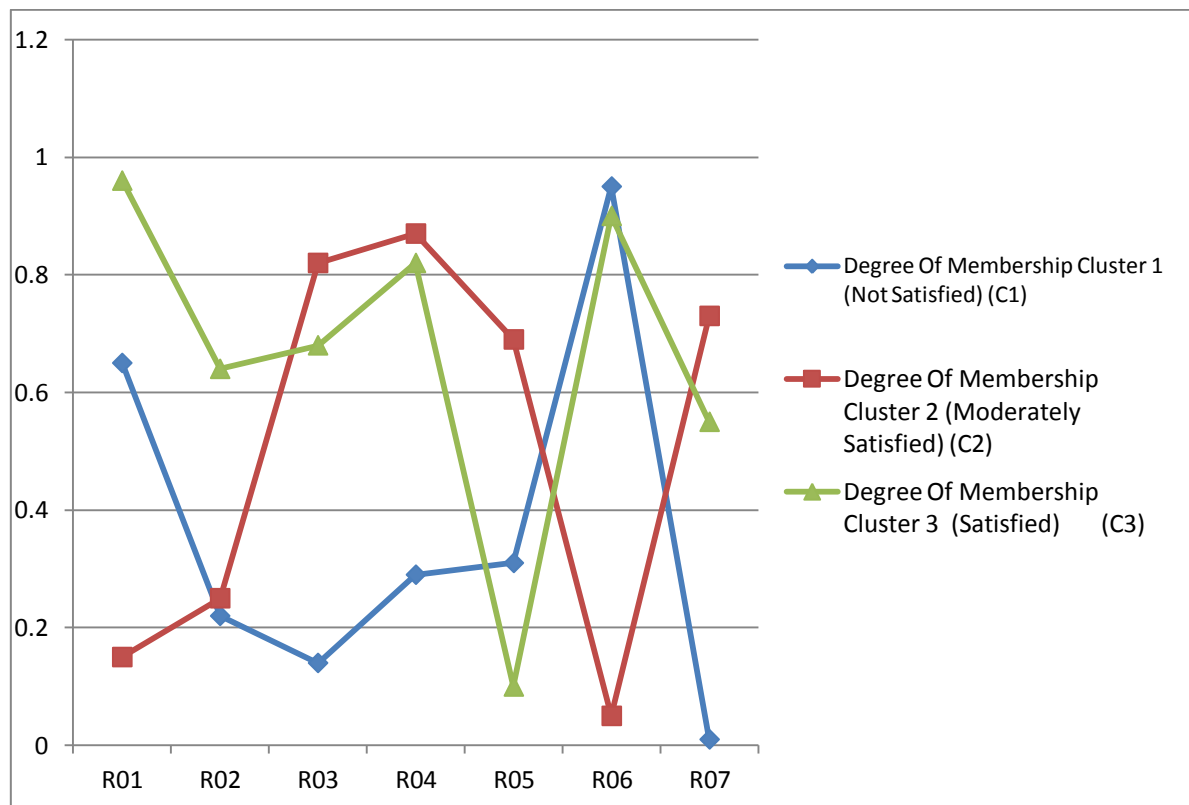
Fig. 2: Graph showing Degree of Membership Cluster

Implanting a fuzzy based methodology for the design of this system has been largely helpful. Using the traditional IF-THEN-ELSE rules for the recognition would have been very difficult and cumbersome to implement, as the linguistic variables associated with customer satisfaction are much and the combination of variables that would help determine whether or not an end-user has been satisfied or not. The use of a fuzzified dataset has helped to overcome this hitch. The period of testing has helped to optimize the effectiveness of the system. In future research, the application of neural network will be optimal in the advanced learning algorithms processes so that the system can better its state and self-optimize its future recognition results and predict future area/parameters of customer satisfaction.

REFERENCES

Customlnsight (2014), what is Employee Satisfaction, http://www. Custominisght.Com/Employee-Engagement-Survey/What-is-Employee- Satisfaction. Asp.

Eshani Mishra and Sachin Tiwari (2017), "Comparative analysis of fuzzy logic and PI controller based electronic load controller for self-excited induction generator", Advanced in Electrical Engineering, Vol.2017(2017): 3-4. https://doi.org/10.1155/2017/5620830.

Farris P. W., Neil T. B., Philip E.P. and David J.R. (2010), "Marketing Metrics: The Definitive Guide to Measuring Marketing Performance, Upper Saddle River, New Jersey: Pearson Education, Inc, ISBN 0-13-705829-2.

Gitman L. J., Carl D.M. (2005). The Future of Business: the Essentials. Mason, Ohio: South-Western, ISBN 0-324- 2028-0.

Kapil Dev Sharma, Ayyub M., Sumit Saroha, Ahmad Faras (2014), "Advanced controllers using fuzzy logic controller(FLC) for performance improvement" International Electrical Engineering Journal 5(6):1453-1454.

Patel M.G.C., Krishna P., and Parappagoudar M.B.(2015), Prediction of Secondary dendrite arm spacing in squeeze casting using fuzzy logic based approaches. Archives of Foundry Engineering. 15(1): 55-56.

Wang C., Yali Qi, Lin Y.(2017), "A fitted model for feature selection with fuzzy roughness", IEEE Transactions on Fuzzy Systems, 25(4): 741- 74