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Fuzzy Rule Based Expert System to Represent Uncertain Knowledge of E-commerce

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***Abstract*—Fuzzy Rule based system for e-commerce is a system consists of a rule repository and a mechanism for accessing and running the rules. The repository is often constructed with a collection of related rule sets these are business policies, security policies or transaction policies. Fuzzy logic as the principal method of evaluating rules. Fuzzy Logic rules should be organized and written to address the uncertainty and imprecision of business decisions. This system can assist the consumer to take suitable decision in complicated situation and imprecise information, by attempting to capture knowledge in terms of a set of rules. Today it is very common to buy goods online. When customers buy something, they usually want to compare several products and trying to find the best choice.**

Security includes authenticating business transactions, controlling access to resources such as Web pages for registered or selected users, encrypting communications, and, in general, ensuring the privacy and effectiveness of transactions.

***Index Terms*—Fuzzy logic, E-business, fuzzy rules.**

I. Introduction

Due to globalization ,today's world becoming more competitive every day, is demanding from companies the flexibility to adjust themselves to the permanent situations of market change, readiness for constant innovation and guarantee of the quality of products and services. At present , Internet being used initially as a great source of shopping.Rule based systems employ fuzzy rule to automate complex processes, and facilitate the management of change across the entire enterprise and holds the situation in a proper way.

A business rules engine is a software system that helps manage and automate business rules. The rules which a business follows would be taken from legal regulation, company policy, association rules or other sources.

E-commerce:- E-commerce means doing business over interconnected networks. E-commerce is the buying and selling of goods and services on the Internet. E-commerce is also conducted through the more limited electronic forms of communication called e-mail, facsimile or fax, and the emerging use of telephone calls over the Internet. Most of this is business-to-business. We could use software programs that run the main functions of an e-commerce Web site, including product display, online ordering, and inventory management. The software resides on a commerce server and works in conjunction with online payment systems to process payments.

Electronic commerce is a way of conducting, managing, and executing business using computer and telecommunication networks. There are two main paradigms in e-commerce, namely, E-commerce is also called online shop for activities like finding products , selling , purchasing on the world wide web. The different categories are business to consumer, business to business, consumer to consumer and business to government. The two main categories are B2B and B2C.

B2B (Business to Business Electronic-Commerce): Refers to one business selling to another business via the Web. The volume of B2B transaction is much higher than B2C transaction. For example, an automobile manufacturer company makes several B2B transactions such as buying tires, glass for windscreens, and rubber hoses for its vehicles.

B2C (Business to Consumer): Refers to a business communicating with or selling to an individual rather than a company. Now the web is here as a new advantage of the opportunity. An online marketing and sales channel is the most useful example.

II. Fuzzy Control

The input variables in a fuzzy control system are in general mapped into by sets of membership functions, known as "fuzzy sets". The process of converting a crisp input value to a fuzzy value is called "fuzzification".

The fuzzy controller - is composed of the following four elements:

1) *A* rule-base (a set of If-Then rules)
2) *A*n inference mechanism
3) *A* fuzzification interface,
4) A defuzzification interface

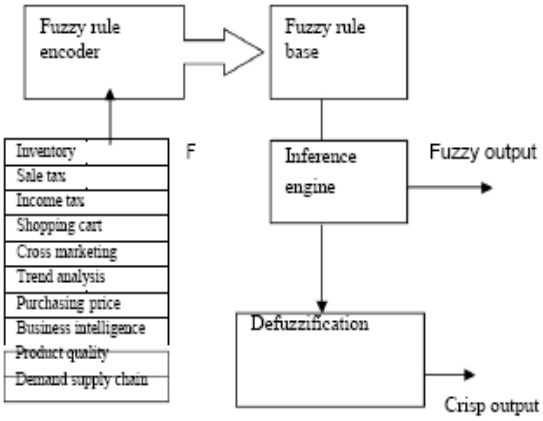

Fig 1: Basic architecture of fuzzy rule based expert system

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Fig. 1 shows Basic architecture of fuzzy rule based expert system where rule encoder used to construct Rule base by considering sale tax, income tax, cross marketing, trend analysis, product quality ,demand supply chain etc. The fuzzy input from Fuzzy rule base is given to Inference engine and find out the fuzzy output and after Defuzzification we could get crisp output.

III. Modelling And Working Of Fuzzy Expertsystem

We should take following steps:

1) Define Select relevant input and output variables membership functions, fuzzy operators, reasoning mechanism etc..
2) Choose a specific type of fuzzy inference system (for example, Mamdani, Takagi–Sugeno etc.).
3) Design a collection of fuzzy rules (If-then rules).

IV. Metagraph

Metagraphs(Basu and Blanning), are graphical structures in which edges represent directed relationships between sets of elements. They extend both directed graphs and hypergraphs. Consider a set *X*,called a generating se*t*. Each member $x \in X$ is called an element. A metagraph is an ordered pair $S = < X,E >$ where *E* is a set of *edges*.

Now consider for Fuzzy rule based sytem metagraph as Š ={X, æ ,Ě) where X is a finite set and æ is a fuzzy set on X and Ě is a fuzzy edge set $\{ě_{k\,,\,k=1.....K}\}$. where each component $ě_k$ in Ě is characterized by an ordered pair . The fuzzy logic was developed to present inexact knowledge in the form of computer algorithm. In that scheme each edge represents a rule

V. Theory Of Rule Based System

5 Theory of rule based system : The rule based system is start with a rule- base, which contains all of the appropriate knowledge encoded in to if-then rules, and a working memory , which may contain some information. The system would be examines all rule condition (IF) and determines a subset, the conflict set, of the rules whose condition are satisfied, and any action is carried out by THEN clause. This loop is of firing rule is continue until conditions are satisfied.

VI. Fuzzification Of Inputs And Outputs

The buyer offer evaluation block could be implemented by taking three inputs such as Offer price, Economic condition and quality level while the output shows the acceptance through fuzzy evaluation for offering product.

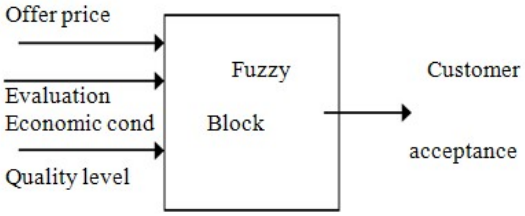

Fig 2: implementation of offer evaluation block

Here fig 2 shows the buyer offer evaluation block, In which two input and one output is shown.

Input1: Offer price={Low, Medium, High};
Input2: Economic condition={Low, Medium, High};
Input3: Quality level={Low, Medium, High}

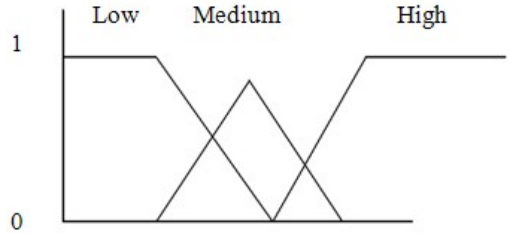

Fig3: Fuzzy membership graph

Rule 1: If offer price is low and economic condition of buyer is low and quality level is low then customer acceptance is moderate.
(P_{low} & E_{low}& $Q_{low} \rightarrow C_{mod}$)

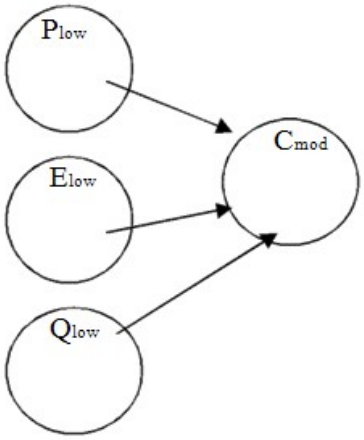

Fig 4.1:Graphical representation of rule 1.

Rule 2: If offer price is low and Economic condition of buyer is low and quality level is high then. customer acceptance is high.
(P_{low} & E_{low} & $Q_{high} \rightarrow C_{high}$).

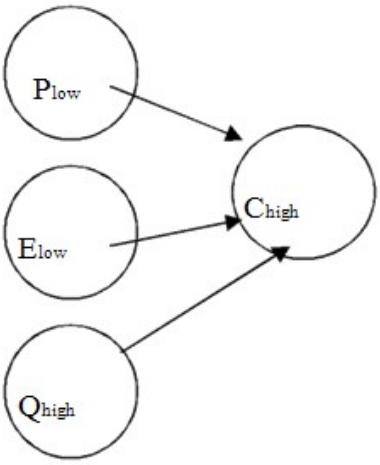

Fig4.2 :Graphical representation of rule2.

Rule 3: If offer price is low and Economic condition of buyer is low and quality level is medium then customer acceptance is high.
(P_{low} & E_{low} & $Q_{medium} \rightarrow C_{high}$).

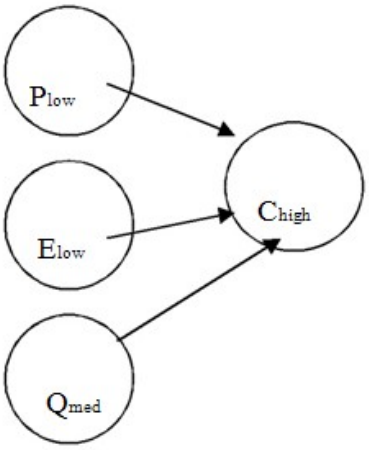

Fig 4.3:Graphical representation of rule 3.

Rule 4: If offer price is high and Economic condition of buyer is low and quality level is high then customer acceptance is low.

(P_{high} & E_{low} & Q_{high} → C_{low}).

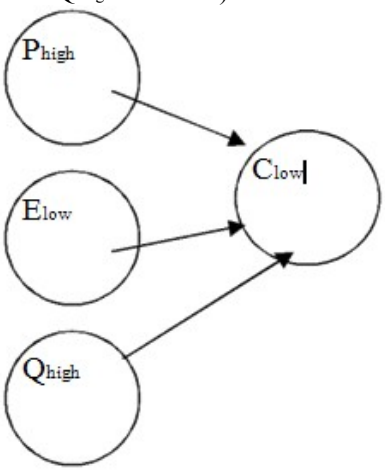

Fig 4.4:Graphical representation of rule 4.

Rule 5: If offer price is high and Economic condition of buyer is low and quality level is medium then customer acceptance is low.

(P_{high} & E_{low} & Q_{mediu} → C_{low}).

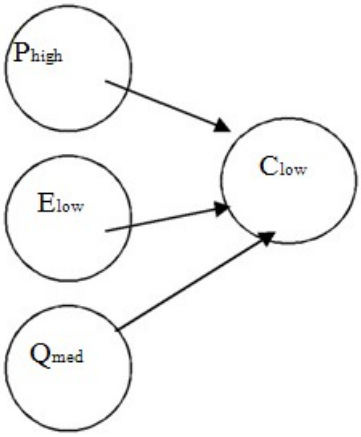

Fig 4.5 :Graphical representation of rule 5.

Rule 6: If offer price is high and Economic condition of buyer is medium and quality level is medium then customer acceptance is low.

(P_{high} & E_{medium} & Q_{medium} → C_{low}).

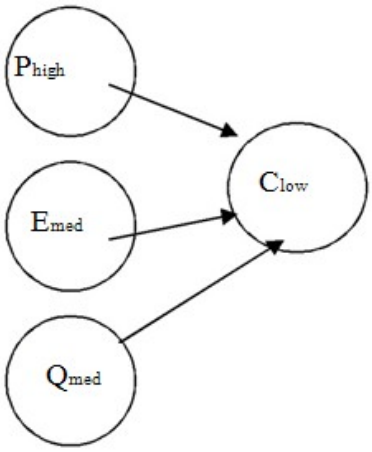

Fig 4.6:Graphical representation of rule 6.

Rule 7: If offer price is medium and Economic condition of buyer is medium and quality level is high then customer acceptance is high.

(P_{medium} & E_{medium} & Q_{high} → C_{high}).

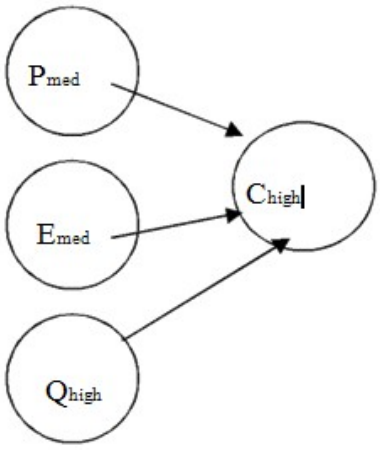

Fig 4.7 :Graphical representation of rule 7.

Rule 8: If offer price is medium and Economic condition of buyer is medium and quality level is low then customer acceptance is low.

(P_{medium} & E_{medium} & Q_{low} → C_{low}).

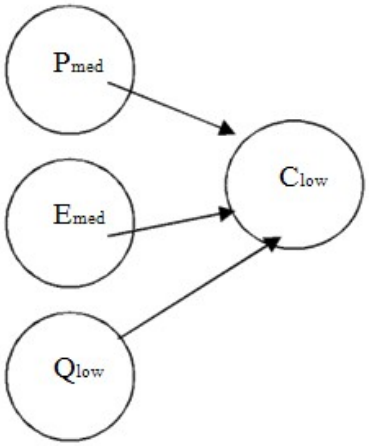

Fig. 4.8:Graphical representation of rule 8.

Rule 9: If offer price is medium and Economic condition of buyer is medium and quality level is medium then customer acceptance is medium.

(P_{medium} & E_{medium} & Q_{medium} → C_{medium}).

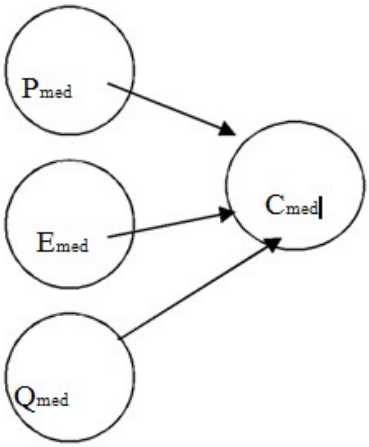

Fig 4.9 :Graphical representation of rule 9.

Rule 10: If offer price is low and Economic condition of buyer is high and quality level is low then customer acceptance is low

(P_{low} & E_{high} & Q_{low} → C_{low}).

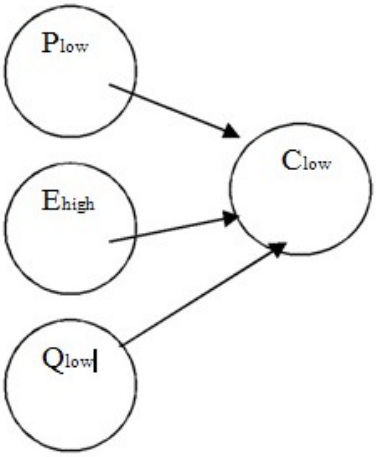

Fig 4.10 :Graphical representation of rule 10.

Rule 11: If offer price is low and Economic condition of buyer is high and quality level is medium then customer acceptance is medium.

(P_{low} & E_{high} & Q_{medium} → C_{med}).

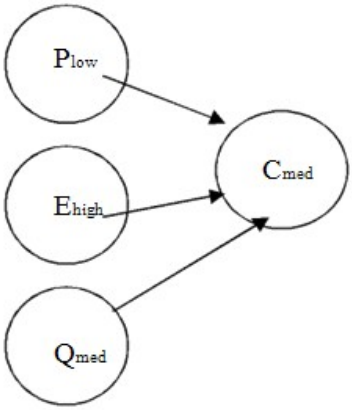

Fig 4.11 :Graphical representation of rule 11.

Rule 12: If offer price is low and Economic condition of buyer is high and quality level is high then customer acceptance is high.

(P_{low} & E_{high} & Q_{high} → C_{high}).

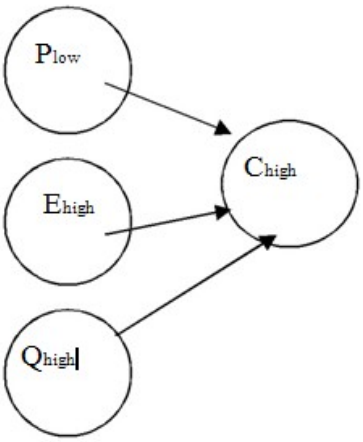

Fig 4.12 :Graphical representation of rule 12.

It is quite natural that the customer wants the product of high quality at minimum price. These rules are easy to implement and understand by everyone. When customers make a purchase for a multi-functional product, customers are normally aware of their basic needs but often have little idea of types, function, usage and terminology of the desired product. A fuzzy inference model is employed to establish the relationship between customer needs and alternatives for a multi-functional product. This product customization evaluation model is established for a product consisting of multi-features and their corresponding alternatives. By means of fuzzy inference rules, consumer needs can be translated into ideal combination of alternatives. Furthermore, fuzzy numeric variables are used here to quantify linguistic variables as well as the intensity of consumer's needs.

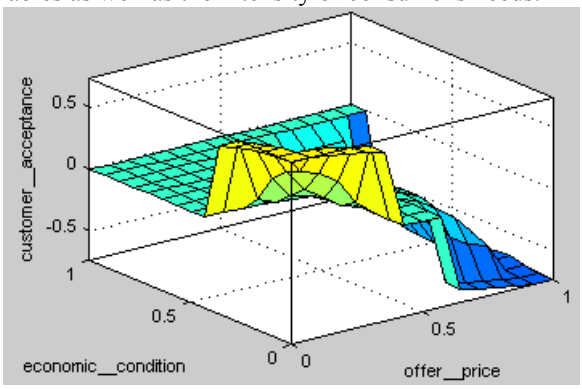

Fig 5: Surface diagram with offer_ price as X input and economic_ condition as Y input

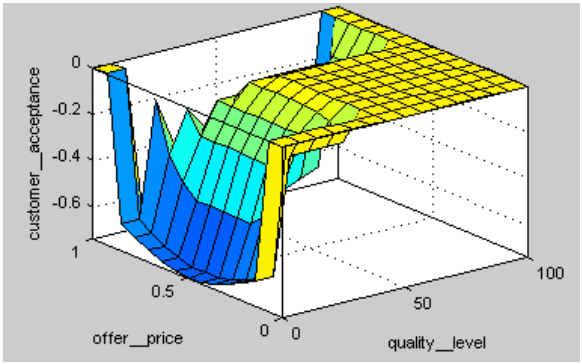

Fig 6: Surface diagram with quality level as X input and offer_ price as Y input

VII. Rule Viewer

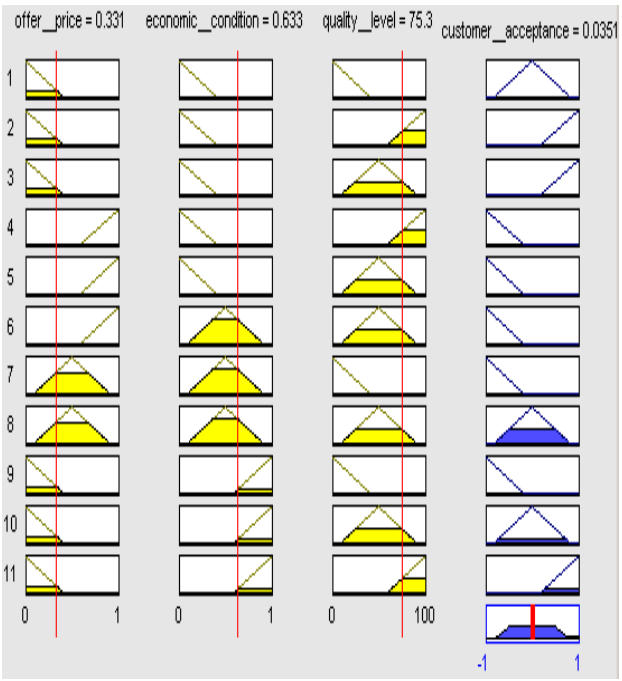

Fig 7: Rule viewer for customer acceptance (Offer price=0.331,economic condition =0.633,Quality level = 75.3,Customer acceptance =0.0351)

Offer Price	Economic Condition	Quality Laval	Customer Acceptance
0.202	0.83	89.8	0.677
0.202	0.83	65.8	0.0639
0.945	0.83	65.8	-0.639
0.62	0.83	65.8	-0.0393
0.102	0.83	65.8	0.058
0.102	0.631	66.8	0.12
0.825	0.631	66.8	-0.365
0.825	0.631	21.2	-0.225
0.395	0.631	89.8	-0.26
0.825	0.181	29.6	-0.939

Table: Customer Acceptance Results for Different Input Values

Table shows the Customer acceptance at different values of Offer Price, Economic Condition, and Quality Level.

VIII. Business Rules Applications

Business rules are applicable in various fields of business ; some of them are as follows :

1) Enterprise Resource Planning- Deciding Rules ,Pricing and Product configuration.
2) Software Development:- Dialog control work flow control, webpage control.
3) Business compliance:- Transaction analysis, Rating.
4) Business process management :- claims and Invoice processing; Sale tax, and income tax controlling.
5) Customers Relationship Management:- Customer profiting, Sales controlling, Selection management.
6) Business Intelligence:- Traffic Light controlling, Scoring .
7) Supply Chain Management : As per demand of consumer goods availability planning and Out-of-stock detection.

IX. Conclusion

Fuzzy rule based expert system is very effective for knowledge representation of any system.The fuzzy rule base can be use to optimize the E_Commerce services and rule discovery facilities and could be used to optimize policy knowledge. E_Commerce rule based fuzzy models provide a powerful and robust tool for encapsulating and exploiting knowledge. Fuzzy logic rules could be used with such architectures as the evolving Java Management Extensions to build solutions to many problems in such diverse areas as online retailing, information retrieval, customer relationship management, supply chain maintenance, inventory, business discovery, cross-marketing, business controlling and service provisioning and optimization.

Fuzzy rule based expert system could be applied in every important field like business ,robotics, manufacturing ,online services etc.

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Prof. Pankaj Dashore is reader in SOC&E IPS Academy Indore(INDIA) and a Member of IACSIT . Having good research record and published 20 research paper in the field of fuzzy logic and metagraph. He was start their research on Fuzzy metagraph from IET DAVV, Indore.

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