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# Internet of Things in Retail Using Fuzzy Logic for Customer Loyalty

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**Internet of thing in retail should focus their assets and capacities to improve customer loyalty with the end goal to hold existing clients and pull in new clients. Because loyal customer is a good source of revenue. In any case, there are few studies on customer loyalty using Internet of Thing. The aim of this study is to use sensing device that examine customer loyalty and transmit that data to cloud for further study of customer satisfaction retail industries. To test the research model fuzzy logic approach is included. The result will help to launch loyalty programs, companies to improve the customer equity, to boost the clients' esteem and benefit of organizations**

**Keywords- fuzzy logic; internet of thing in retail; customer loyalty;**

## I. INTRODUCTION

IoT in retail is one of the fastest growing and operates in dynamic environment makes companies very reactive to the patterns of market to capture possible customers. [1] The Omni channel has become popular in past few years. Now devices such as iBeacon, Radio Frequency Identification (RFID), Near Field communication (NFC), closed circuit television (CCTV) will help in tracking in customer behaviour. Therefore, this research will help in proposing a IoT model to study customer satisfaction, behaviour and then fuzzy logic is applied on captured data and identify customer loyalty. A customer loyalty analysis that helps organisation to make vital decisions like improvement in customer services and thus profit maximization with help of fuzzy logic. With the help of IoT a database is used to store essential data of customer. Making a learning base model for acquiring imperative information that will be helpful for building up a choice emotionally supportive network.

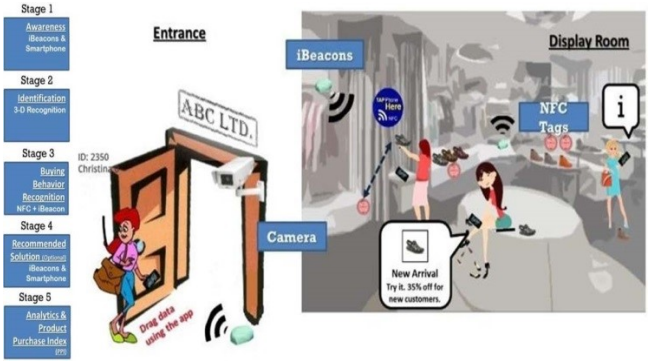


Figure1. The idea of IoT in retail

In the first stage knowledge of smartphones and iBeacon. The beacons are used in retail for mobile marketing, mobile commerce and through point of sale systems mobile payments are enabled. In Second stage 3D recognition technique will be used in order to identify the subject.in third stage buying behaviour will recognised. In forth stage recommendation and solution will be generated through iBeacon and smartphone. In fifth stage analysation of product purchased for future recommendation. In order to achieve our objective IoT in retail for customer loyalty. A hypothetical example, which will be an instrument for managers to investigate so as to construct and keep up faithful customer relationships & thus profit maximization in an organizations.

## II. CUSTOMER LOYALY

[9] Customer loyalty is nothing more than the probability that the old customer will resort to old brand. These suggestions will help in customer loyalty. Customer loyalty revolve around obtaining another client by offering an item or services which fulfils the client needs. On the off chance that the client is satisfied, he or she can be encouraged to good customer loyalty. [6] Educating customer for be customer loyalty what all benefits he or she will get. Customer retention is most difficult because of competitive

market. A company must committee to offer best goods and services that a customer seeks.

## III. RESEARCH OBJECTIVE

This paper will help IoT devices to create a database and apply fuzzy logic on it for customer loyalty to improve reliability, sales accuracy, profit and robustness

## IV. RESEARCH METHODOLOGY

IoT structure

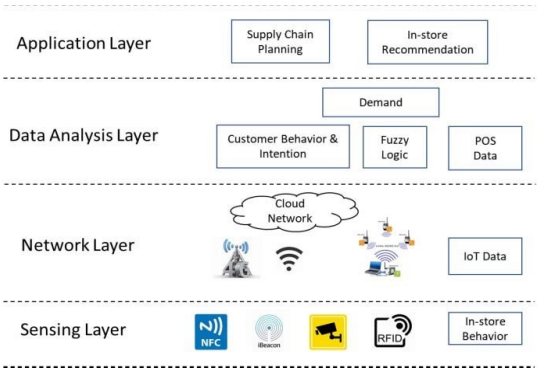


Figure 2. IoT system architecture

[4]Figure 2 shows the architecture of IoT for customer loyalty. An IoT system will collect data of customer that will help companies to give an accurate customer recommendation for their satisfaction. IoT architecture consist of four layers. These layers will create a database for customer and that database will generate parameter for customer loyalty. [5] The design of fuzzy logic model for customer loyalty analysis and both dynamic and static data about the choice factors and about the diverse components that impact client and advertising organizations' choice for customer loyalty and relationship management for profit optimization

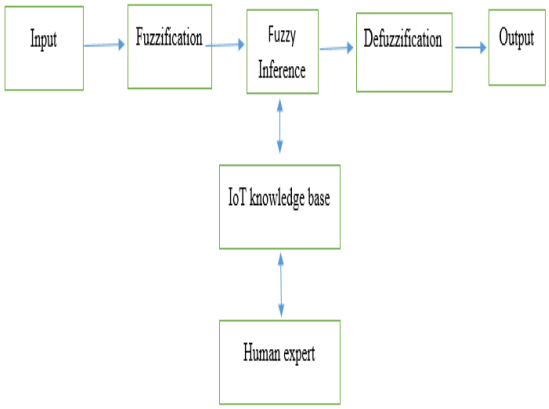


Figure 3. Flow chart for customer loyalty

For every, problem there are different solutions. For making initial decision approximate solution can be useful. The essential components of a fuzzy logic design of customer loyalty analysis are the following: (i) Fuzzification unit (ii) Defuzzification unit.

[4] Fuzzification: The process which maps crisp set to fuzzy set. This operation helps in translating accurate crisp input values into linguistic variable. The parameter used in customer loyalty fuzzy set are: Payment behavior Turnover, Loyalty and Proximity. We used Triangular curves. These a1, a2 and a3 are the parameter used by equation (1) peak of triangular is defined by a2, while a1 and a3 defines end points.

$$\mu(x) = \begin{cases} 0 & \text{if } x < a_1 \\ x - a_1/a_2 - a_1 & \text{if } a_1 <= x < a_2 \\ a_3 - x / a_3 - a_2 & \text{if } a_2 <= x < a_3 \\ 0 & \text{if } x > a_3 \end{cases}$$

Equation (1)

$$TO(x) = \begin{cases} \text{If } 25 <= x < 50 & \text{“Low Turnover”} \\ \text{If } 50 <= x < 75 & \text{“Medium Turnover”} \\ \text{If } 75 <= x <= 100 & \text{“High Turnover”} \end{cases}$$

Equation (2)

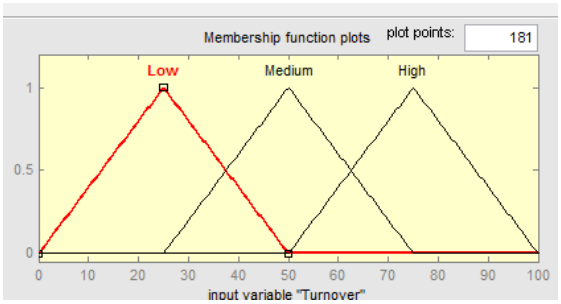


Figure 4.Turnover output

$$PB(x) = \begin{cases} \text{If } 25 <= x < 50 & \text{“Less Attractive”} \\ \text{If } 50 <= x < 75 & \text{“Attractive”} \\ \text{If } 75 <= x <= 100 & \text{“More Attractive”} \end{cases}$$

Equation (3)

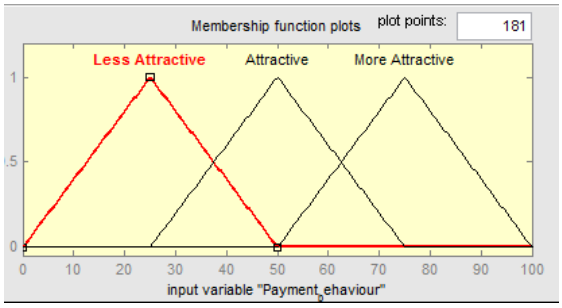


Figure5. Payment Behaviour

$$PR(x) \begin{cases} \text{If } 25 <= x < 50 & \text{“Close”} \\ \text{If } 50 <= x < 75 & \text{“Closer”} \\ \text{If } 75 <= x <= 100 & \text{“Closest”} \end{cases}$$

Equation (4)

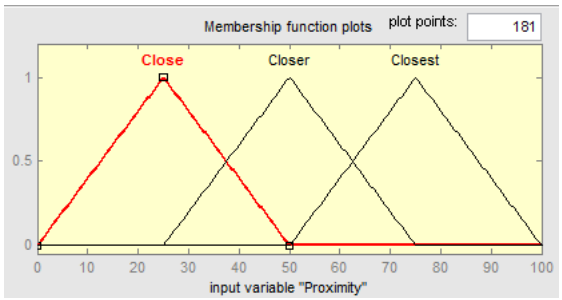


Figure 6. Proximity

$$SP(x) = \begin{cases} \text{If } 25 <= x < 50 & \text{“Low”} \\ \text{If } 50 <= x < 75 & \text{“Medium”} \\ \text{If } 75 <= x <= 100 & \text{“High”} \end{cases}$$

Equation 5

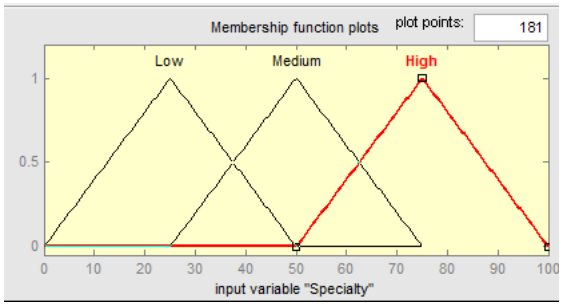


Figure 7. Specialty

$$LO(x) \begin{cases} \text{If } 25 < x < 50 & \text{“Pseudo Loyalty”} \\ \text{If } 50 <= x < 75 & \text{“Latent Loyalty”} \\ \text{If } 75 <= x <= 100 & \text{“True Loyalty”} \end{cases}$$

Equation (6)

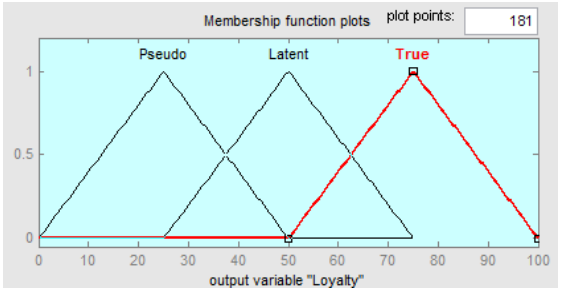


Figure 8. Loyalty

$$\mu_{Low\text{-}To}(x) = \begin{cases} 00 & \text{if } x<0 \\ (x - 0)/25 & \text{if } 0<= x <25 \\ (50- x)/25 & \text{if } 25<= x <= 50 \\ 0 & \text{if } x >50 \end{cases}$$

Equation (7)

$$\mu_{Med\text{-}To}(x) = \begin{cases} 0 & \text{if } x< 25 \\ (x -25)/25 & \text{if } 25 <= x < 50 \\ (75-x)/25 & \text{if } 50 <= x <= 75 \\ 0 & \text{if } x >75 \end{cases}$$

Equation (8)

$$\mu_{High\text{-}To}(x) = \begin{cases} 0 & \text{if } x< 50 \\ (x -50)/25 & \text{if } 50 <= x < 75 \\ (100-x)/25 & \text{if } 75 <= x <= 100 \\ 0 & \text{if } x >100 \end{cases}$$

Equation (9)

Linguistic variables are assigned to the value, an example Turnover is shown in Equation (2) Turnover case is shown. Linguistic value In (7) to (9) Equations.

Lets take an example, turnover is evaluated in Equation (2) Turnover = 50, influence = 0.5 (50%) severity, high Turnover= 75. The Use of MATLAB for plotting membership function. The fuzzy membership curves are represented graphical which shows the Loyalty, Specialty, Proximity, Payment Behavior and Turnover. The defined ranges are base for overlapping parameters of 0.5.

Triangular associates functions is use to describe the variables. The amount of associates for a "TurnOver" = 65 will be lets assume, increases up to center of the covering some bits of "medium" and "high" function outcome will "medium" associates = 0.40 and "high" associates = 0.60, low will be zero. The output response will describe "medium" and "high" turnover.

[3]Defuzzification

A process in which fuzzy set is convert into Crisp set. This is used in fuzzy control system. There are number of rules to transform variables into fuzzy set and these results are described as membership in fuzzy sets.

One more example, 4 fuzzy inputs values, Turnover =(TO), Payment Behavior=(PB) , Proximity=(P), and Specialty=(S), so TO=65, PB=35, P= 40 and S=65 calculating Fuzzification

TABLE 1: To Evaluate TO, PB, P AND S

| Rule No. | Premise Variables | | | | Conclusion Part of rule | Min.Value (non-zero) |
|---|---|---|---|---|---|---|
| | Turnover | Payment Behavior | Proximity | Specialty | | |
| 29 | 0.40 | 0.55 | 0.40 | 0.40 | Pseudo | 0.40 |
| 30 | 0.40 | 0.55 | 0.40 | 0.60 | Latent | 0.40 |
| 32 | 0.40 | 0.55 | 0.60 | 0.40 | Latent | 0.40 |
| 33 | 0.40 | 0.55 | 0.60 | 0.60 | True | 0.40 |
| 38 | 0.40 | 0.45 | 0.40 | 0.40 | True | 0.40 |
| 42 | 0.40 | 0.45 | 0.60 | 0.60 | True | 0.40 |
| 56 | 0.6 | 0.55 | 0.40 | 0.40 | Latent | 0.40 |
| 57 | 0.6 | 0.55 | 0.40 | 0.60 | True | 0.40 |
| 59 | 0.6 | 0.55 | 0.60 | 0.40 | Latent | 0.40 |
| 60 | 0.6 | 0.55 | 0.60 | 0.60 | True | 0.55 |
| 65 | 0.6 | 0.45 | 0.40 | 0.40 | True | 0.40 |
| 68 | 0.6 | 0.45 | 0.60 | 0.40 | True | 0.40 |
| 69 | 0.6 | 0.45 | 0.60 | 0.60 | True | 0.45 |

TO = 65 => L =0.00, M=0.40, H=0.60.
PB = 35 =>Less captivating = 0.55, captivating = 0.45, More captivating = 0.00.
P = 40 => near = 0.40, nearer = 0.60, nearest = 0.0.
S= 65 => L= 0.00, M=0.4, H=0.6.
Crisp value $=\frac{25x0.40+50x.50+70x.50}{.40+.50+.50} = 52.79 \cong (53\%)$ latent loyalty

## V. CONCLUSION

This research will bring dynamic change in customer loyalty and will help companies to maximize their profit. Fuzzy logic control system helps to resolve uncertainty, conflicts and fuzziness. The Fuzzy logic system provided the accurate level of pseudo or true loyalty. The capability to resolve conflicts by aggregation, propagation and act human like reasoning. IoT devices will help in attracting customer, as these devices are more effective and efficient for companies. IoT's power can be highlighted by beacons to encourage in store visits and enhance shopping experience. Wireless sensors in automobiles and appliances allows companies to diagnose and prevent devices from malfunctioning.

Building loyalty is all about making connection with each customer and helping them on their purchase journey. Companies need to make sure that they have right partners who can help recognize the customer.

## VI. ACKNOWLEDGMENT

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