Fuzzified Value of the Accidental Conditon on the Road using Fuzzy Expert System

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ABSTRACT
This paper displays a model of fuzzified accidental control system, which is composed by utilizing the idea of fuzzy expert system for the fuzzified accidental condition out and about. Here trapezoidal and triangular membership functions are utilized for input variables and trapezoidal membership function for output variables. This model will give characteristic outcomes to fuzzified accidental conditions and the outcomes from this system will likewise help for the general population , how to drive on the road Assist a contextual analysis is likewise considered to bolster this system.

Keywords
Fuzzy logic, Fuzzy validation expert system, Linguistic variables, Weighted average method(WAM).

1. INTRODUCTION
The issue of accident is an exceptionally intense in roadway transportation because of complex stream example of vehicular activity, nearness of blended movement alongside people on foot. Street accident prompts to death toll and property. Consequently the activity engineers need to attempt a major duty of giving safe movement developments to the street clients and guarantee their wellbeing. Street accidents can't be completely forestalled however by appropriate movement building and administration the accident rate can be decreased to a specific degree. Therefore systematic investigation of car crashes is required to be completed. Legitimate examination of the reason for accident will propose preventive measures as far as outline and control.
Keeping in mind the end goal to lessen the accidental instances of the street, here we will acquaint a few parameters with compute the accidental cases out and about and we will attempt to accomplish our objective, i.e. how we diminish the accidental cases out and about. Here we will present four parameters for which we will locate the valuable consequence of our issue:

1. Crocks and potholes condition of the road
2. Faded point of induction on the road
3. High Speed
4. Weather Condition

2. KEY PROCESS AND KEY FEATURES

2.1. The Choice Of Street Relies On Four Key Procedures, While Controlling The Circumstances Making Out And About.

A. Crocks and potholes condition of the road
B. Faded point of induction on the road
C. High Speed
D. Weather Condition.
These are four key methodologies which may help us for the accidental issue on the road:

2.2. The principle key components of this proposed work are:
(a) The proposed system can assess the productivity of the street

(b) The fuzzy logic expert system for recognizing the effectiveness of the planned model by the record of unclearness system.

(c) A record known as "unclearness there has been planned with a specific end goal to perceive validity while setting such case".

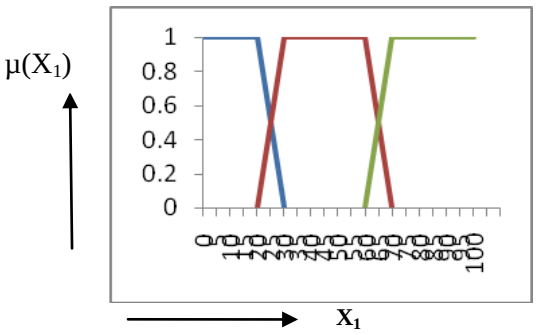
(d) Fuzzy logic is extremely valuable device for managing which psychological thinking, basic leadership handle which includes equivocalness estimate mistake in precision, vulnerability, dubiousness.

(e) The vagueness index for the information selection i^{th}, is given by (say):-

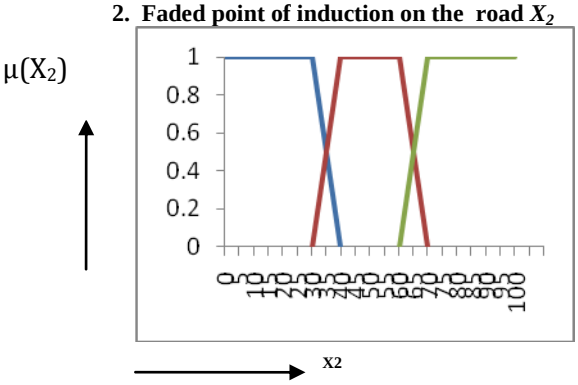
$$X_1 = \frac{\sum_{i=1}^{I}\sum_{j=1}^{J} w_{ij}\Delta_{ij}}{I} \quad (2.1)$$

where w_{ij} is the weighted or impact factor given to the j^{th} information of the i^{th} section and Δ_{ij} is 0-1 variable (if there is any deviation on the road). All the weights for a set of i^{th} information $\sum w_{ij}$ added to unity. Similarly, the values of the other inputs can be determined.

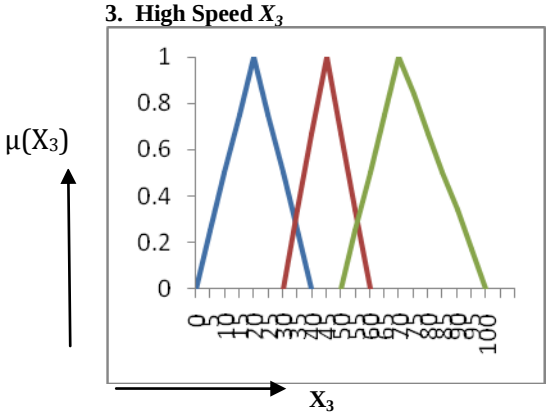
1. Crocks and potholes condition of the road X_1



2. Faded point of induction on the road X_2



3. High Speed X_3



4. Weather Condition X_4

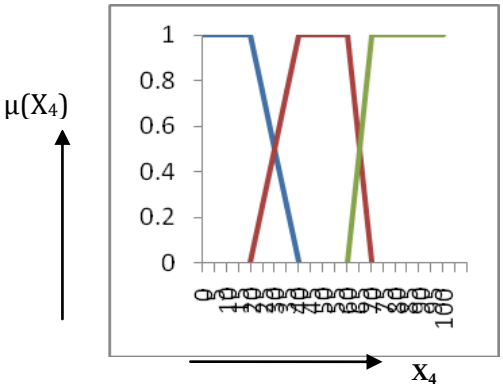


Figure 1: Membership functions of inputs

3. ALGORITHM- USING FUZZY APPROACHES

Inputs:

1. The crisp value of the inputs settlements and other information obtained.

2. Evaluated the inputs: - Determined Crocks and potholes condition of the road X_1, Faded point of induction on the road X_2, High Speed X_3, Weather Condition X_4

3. Fuzzify the crisp value inputs: Using membership functions characterized for each linguistic variable, decided the level of membership of a crisp value in each fuzzy set. The conditions of processing membership are:

$$f(x,a,b,c,d)=\begin{cases}\dfrac{x-a}{b-a} & a \le x \le b\\ 1 & b \le x \le c\\ \dfrac{d-x}{d-c} & c \le x \le d\end{cases} \quad (3.1)$$

$$\mu_L(x_1)=\begin{cases}1 & x_1 \le 20\\ \dfrac{30-x_1}{10} & 20 \le x_1 \le 30\end{cases} \quad (3.2)$$

$$\mu_M(x_1)=\begin{cases}\dfrac{x_1-20}{10} & 20 \le x_1 \le 30\\ 1 & 30 \le x_1 \le 60\\ \dfrac{70-x_1}{10} & 60 \le x_1 \le 70\end{cases} \quad (3.3)$$

$$\mu_H(x_1)=\begin{cases}\dfrac{x_1-660}{10} & 60 \le x_1 \le 70\\ 1 & x_1 \ge 70\end{cases} \quad (3.4)$$

$$\mu_L(x_2)=\begin{cases}1 & x_2 \le 30\\ \dfrac{40-x_2}{10} & 30 \le x_2 \le 40\end{cases} \quad (3.5)$$

$$\mu_M(x_2)=\begin{cases}\dfrac{x_2-30}{10} & 30\le x_2\le 40\\ 1 & 40\le x_2\le 60\\ \dfrac{70-x_2}{10} & 60\le x_2\le 70\end{cases} \quad (3.6)$$

$$\mu_H(x_2)=\begin{cases}\dfrac{x_2-60}{10} & 60\le x_2\le 70\\ 1 & x_2\ge 70\end{cases} \quad (3.7)$$

$$\mu_L(x_3)=\begin{cases}\max\{0,\ \dfrac{x_3-0}{20} & x_3<20\\ \max\{0,\dfrac{40-x_3}{20} & 20\ge x_3\end{cases} \quad (3.8)$$

$$\mu_M(x_3)=\begin{cases}\max\{0,\ \dfrac{x_3-30}{15} & x_5<45\\ \max\{0,\dfrac{60-x_3}{15} & 45\ge x_5\end{cases} \quad (3.9)$$

$$\mu_H(x_3)=\begin{cases}\max\{0,\ \dfrac{x_3-50}{20} & x_3<70\\ \max\{0,\dfrac{100-x_3}{30} & 70\ge x_3\end{cases} \quad (3.10)$$

$$\mu_L(x_4)=\begin{cases}1 & x_4\le 20\\ \dfrac{40-x_4}{20} & 20\le x_4\le 40\end{cases} \quad (3.11)$$

$$\mu_M(x_4)=\begin{cases}\dfrac{x_4-20}{20} & 20\le x_4\le 40\\ 1 & 40\le x_4\le 60\\ \dfrac{70-x_4}{10} & 60\le x_4\le 70\end{cases} \quad (3.12)$$

$$\mu_H(x_4)=\begin{cases}\dfrac{x_4-60}{10} & 60\le x_4\le 70\\ 1 & x_4\ge 70\end{cases} \quad (3.13)$$

where *L, M, H,* represent the fuzzy set for low, medium and high respectively.

4. FIRE THE RULE BASES THAT CORRESPOND TO THESE INPUTS

All expert system which are based on fuzzy logic, uses *if-then* rules. The "*if*" part is known as conditions, where as the *"then"* part is termed as a consequence or conclusion. Since four inputs have three fuzzy sets (*L*-low, *M*-medium, *H*-high,) therefore *81(3X3X3X3)* fuzzy decisions are to be fired. Here are three outputs: conditions of the accident of Level 1 or Level 2 or Level 3.

4.1 Execute the inference engine

When all crisp input value have fuzzified into their individual linguistic values, the deduction motor will gets to the fuzzy run base of the fuzzy expert system to infer linguistic values for the middle of the road and in addition the output linguistic variables. The two fundamental strides in the surmising procedure are accumulation and sythesis. Collection is the way toward registering the values of if (antecedent) part of the guidelines while organization is the way toward processing the value of the then (conclusion) part of the principles. Amid collection, every condition in the if part of an administer is appointed a level of truth in light of the level of membership of the comparing linguistic term. From here, product (PROD) of the level of truth of the conditions are processed to cut the level of truth from the if part. This is allocated as the level of truth of the then part. The following stride in the induction procedure is to decide the level of truth for each linguistic term of the output linguistic variable. More often than not, either the greatest (MAX) or aggregate (Whole) of the degrees of truth of the tenets with the same linguistic terms in the then parts is processed to decide the degrees of truth of each linguistic term of the output linguistic variable.

5. DEFUZZIFICATION

The last stage is in the fuzzy expert system is the defuzzification of the linguistic values of the output linguistic variables into crisp values. The most well-known methods for defuzzification, Centre of Maximum (COM) is utilized here for the defuzzification of output albeit one may go for (Centre of area (COA). COM, first decides the most run of the mill value for each linguistic term for an output linguistic variable, and after that processes the crisp value as the best trade off for the normal values and individual degrees of membership.

6. OUTPUT OF DECISIONS OF THE EXPERT SYSTEM

For this situation, the outputs are: Great Street and terrible street. The specific elements of every controller rely on the model and execution measure. In any case, on a basic level, in all the fuzzy logic based expert system, we investigate the certain and unequivocal connections inside the system by emulating human speculation and along these lines build up the ideal fuzzy control administers and additionally learning base.

7. CASE STUDY

For the purpose of illustration, we consider that the nature of the road using four inputs *viz* Crocks and potholes condition of the road X_1, faded point of induction on the road X_2, High Speed X_3, Weather Condition X_4.

(1) Evaluate the authenticity of the road: The values of the inputs of the road have to evaluated, $X_1=64$, $X_2=31$, $X_3=53$, $X_4=52$*(Say).*

(2) Fuzzification of the crisp values of inputs: Through the use of membership functions defined for each fuzzy set for each linguistic variable. The degree of membership of a crisp value in each fuzzy set is determined as follows:

$\mu_L(x_1) = 0, \mu_M(x_1) = 0.6, \mu_H(x_1) = 0.4$

$\mu_L(x_2) = 0.9, \mu_M(x_2) = 0.1, \mu_H(x_2) = 0$
$\mu_H(x_3) = 0, \mu_M(x_3) = 0.46, \mu_L(x_3) = 0.15$
$\mu_L(x_4) = 0, \mu_M(x_4) = 0.8, \mu_H(x_4) = 0.2$

(3) Fire the rule bases that correspond to the inputs: Based on the value of fuzzy membership function values for the example under consideration, the following rules are apply-

Table 1: Fire the rule base that correspond the inputs

Rule Number	IF				THEN
	X_1	X_2	X_3	X_4	
1	MEDIUM	LOW	MEDIUM	MEDIUM	LEVEL 1
4	MEDIUM	LOW	MEDIUM	MEDIUM	LEVEL 2
9	LOW	LOW	HIGH	HIGH	LEVEL 3
12	LOW	MEDIUM	HIGH	HIGH	LEVEL 3
15	MEDIUM	MEDIUM	MEDIUM	MEDIUM	LEVEL 1
17	MEDIUM	MEDIUM	MEDIUM	MEDIUM	LEVEL 2
19	LOW	LOW	HIGH	HIGH	LEVEL 2
20	LOW	LOW	HIGH	HIGH	LEVEL 2
21	MEDIUM	LOW	MEDIUM	MEDIUM	LEVEL 1
23	MEDIUM	MEDIUM	MEDIUM	MEDIUM	LEVEL 2

(4) Execute the inference engine: We use the "Root Sum Squares" *(RSS)* method to combine the effects of all applicable rules, scale the functions at their respective magnitude. The respective output membership function strengths (range: *[0, 1]*) from possible rules (*R1-81)* are:

$$Level\ 1 = \sqrt{\sum_{i \in L_1} \left(\mu_{R_i}\right)^2} = \sqrt{(0.46)^2 + (0.1)^2 + (0.46)^2} = 0.6581$$

$$Level\ 2 = \sqrt{\sum_{i \in L_2} \left(\mu_{R_i}\right)^2} = \sqrt{(0.46)^2 + (0.1)^2 + (0.2)^2 + (0.2)^2 + (0.1)^2} = 0.5582$$

$$Level\ 3 = \sqrt{\sum_{i \in L_3} \left(\mu_{R_i}\right)^2} = \sqrt{(0.2)^2 + (0.1)^2} = 0.2236$$

8. DEFUZZIFICATION

We utilize "weighted Average Method" for defuzzification. The defuzzification of the information into crisp output is expert by joining the aftereffects of the induction procedure. The weighted normal strategy is framed by weighting every membership function in the output by its separate max membership value and the outcome is taken as the crisp output. Figure-2 demonstrates the crisp output has a place with level (as apparent from its membership function). Subsequently the choice for this situation is LEVEL 2 with level of exactness 35.51%.

9. OUTPUT THE DECISION OF THE EXPERT SYSTEM

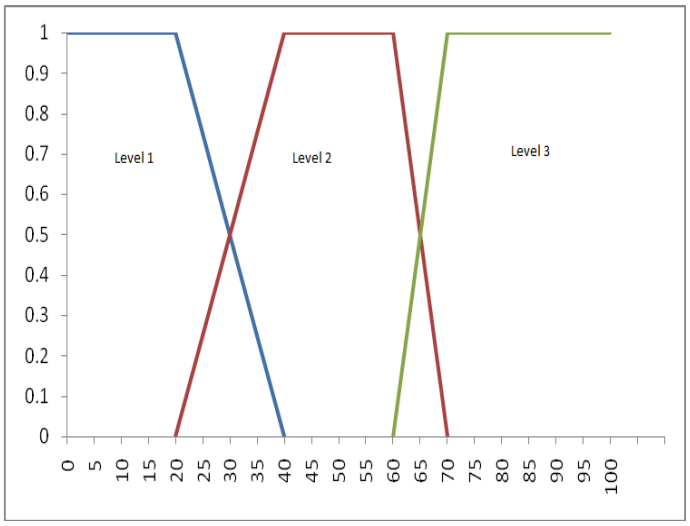


Figure 2: Output of the decision of the expert system

$$Output = \frac{(0.6581\times 0.20)+(0.5582\times 0.40)+(0.2236\times 0.70)}{0.6581+0.5582+0.2236} = 0.3551$$

This output show that the accident is of LEVEL 2 with 35.51% degree of precession.

10. CONCLUSION

This paper provides a fuzzy rule based method to calculate the indicative result of our system. Here we used four input parameters. We have limited our work to these four parameter that play a important role in this area .In this whole process we think about the effective output and try to find that, what parameter are useful for the effective result and at last we got the effective result for the selection of road to travel. We propose that the use of genetic algorithm, neural network and MATLAB can produce an optimum for the tired combination.

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