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AN INTELLIGENT FUZZY LOGIC CURB METHOD FOR OPTIMAL TRAFFIC HELM

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Abstract

The use of fuzzy logic application and technology for intelligent traffic signal control is introduced in this study. Traffic jams are a major concern in most of our country's cities. We know that present traffic light controllers will not provide the optimum answer to this problem because they change traffic lights (wait, stop, and go) according to a fixed cycle period. To control signal timings, fuzzy logic controllers can be utilised to deal with multilingual and unpredictable traffic data. The goal of this study is to construct an intelligent traffic light controller using fuzzy logic techniques and to present a control mechanism utilising if-then rules.

Key words: FIS editor, Membership function, Triangular membership function, Fuzzy rule base system, Fuzzy logic, Traffic control.

Introduction

Congestion on the road due to traffic is one of the most pressing issues that must be addressed in order to boost a country's economy. The proper technique to regulate traffic congestion is to use traffic lights. Due to an increase in the number of vehicles on the road, public behaviour and

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fixed-time traffic signal systems have failed to alleviate traffic congestion. The goal of the traffic congestion problem is to reduce road delays by utilising existing traffic signal systems rather than building additional roadways.

The traffic system is highly reliant on variables such as time, day, season, weather, and unexpected events. The difficulties and uncertainties in the current traffic system can be alleviated by employing an intelligent traffic control system that continuously senses and adjusts traffic light timings in response to traffic congestion. The traffic control system will cause delays if certain characteristics are not taken into account. The difficulties and ambiguity of traffic congestion made such study the ultimate portrayal. As a result of communications between the objective and the congestion over space, traffic congestion patterns expand over time. Congestion occurs when the volume of traffic exceeds the capacity of the road. To deal with the uncertainties that exist in real-world settings, L.A Zadeh created a fuzzy set theory. The fuzzy logic controlled traffic signal uses sensors to count autos, allowing for a more accurate assessment of changing traffic patterns. Choudhary, Keshkar 2014 presented an adaptive controlled design technique to propose the average weight of vehicles at an intersecting lane. Askerzade IJECS-IJENS vol 10(02). conducted a comparison of several fuzzy logic control algorithms. Zachariah,damuut 2017 proposed a fuzzy logic inference technique to optimise traffic light system state phase scheduling (SPSTLS). Dilip, bharathi 2012 proposed an efficient architecture based on the states machine. Erwan, Prasetiy 2015 presented an adaptive traffic light controller using the sugeno approach. For a 6-phase intersection, a traffic signal control mechanism was developed by chan,jiang 2013. Kulkarni,wainankar using VB6 environment in MATLAB proposed a fuzzy traffic controller for an isolated intersection. This simulation result verify the performance of our proposed integrated traffic light control system using RFID technology and fuzzy logic was projected by Alam,pandey. Fuzzy control principles, according to Niittymaki , are particularly competitive isolated multi-phase movements. A fuzzy decision support system and component of a fuzzy controller with fuzzy rule basis were proposed by Pandey,yadu 2015. In a VB6 environment, Kaushal, suggested two fuzzy rule base system

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techniques for an isolated traffic intersection. Olanrewaju,obiniyi 2017 demonstrated that pedestrian delays have a major impact on traffic control and pedestrian safety. Mehan 2011 investigates the effectiveness and current state of the traffic control procedure. Mohanaselvi, Shanpriya 2019 introduced a fuzzy logic application to control traffic. The use of fuzzy logic to control traffic flow for an isolated four-lane traffic intersection is explored in this study. The following is a breakdown of the structure of this publication. The next section II provides a brief overview of fuzzy traffic signal controllers. In part III, the assumptions and limits of an isolated four-lane traffic controller are explained. Then, in sections IV and V, fuzzy inputs, output, linguistic variables, and their membership functions are discussed. Then, for traffic signal processing, multiple fuzzy rule bases were developed, and a simulation of fuzzy rules was done using Mat Lab, with the results being displayed.

Controller of Fuzzy Traffic Signals

To control traffic congestion, scheduled traffic signals are now implemented under a time of day strategy. However, it does not provide the best option for changing traffic conditions. For the fluctuating traffic system, a fuzzy logic control system provides a better optimal solution. Fuzzy technology, when used to control traffic flow, has the ability to translate human thought processes into algorithms using mathematical models. Fuzzy if-then rules can be used to implement genuine regulations that are akin to how traffic cops would think about managing traffic signal lights. The cycle period of the green light signal is expected to be adjusted by traffic signal controllers based on the number of cars arriving, maximising traffic flow and reducing the average waiting time. The fuzzy signal control system's inputs are developed with the use of experience. By developing if-then rules that express the relationship among the linguistic variables, a fuzzy rule-based system creates actions from supplied inputs. In general, a fuzzy traffic signal controller will increase traffic safety in the intersection, maximise junction usage, and reduce delays. In a traffic light system, a red light signals that arriving vehicles must stop, a green light indicates that arriving vehicles must proceed, and a yellow light indicates that arriving vehicles must proceed.

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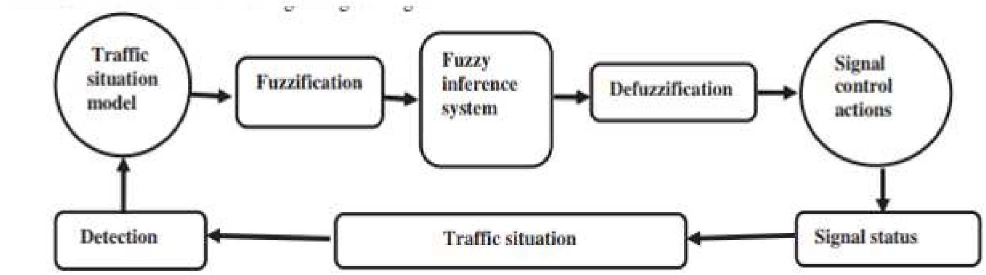

Figure 1: Fuzzy Traffic Signal Controller

An layout of isolated four lane traffic junction is given

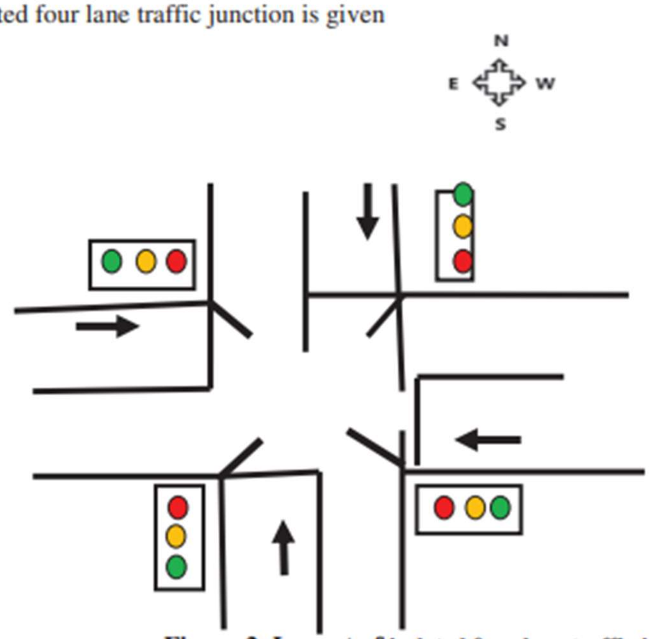

Figure 2: Layout of isolated four lane traffic junction

Constraints and Assumptions

The proposed fuzzy traffic signal control system is designed using the following criteria:

• Traffic is allowed from the north, south, west, and east directions in an isolated four-lane traffic junction.

• Traffic from the north will be allowed to move first, followed by traffic from the east, south, and west directions.

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• When traffic from the north and south is allowed to move, traffic from the east and west is stopped, and vice versa.

• No left or right turns are taken into account.

• The fuzzy logic controller's primary responsibility is to monitor traffic from the north and south on one side, as well as from the east and west on the other.

• The main lane is assumed as north south direction.

• Maximum and Minimum time of green light signal is 60 seconds and 2 seconds respectively.

Linguistical Variables of Fuzzy Inputs and Outputs

Three fuzzy input variables are chosen in the suggested fuzzy logic signal controller:

1. number of cars coming at the junction or number of vehicles passing during green light (AV Arrival Vehicle)

2. The number of vehicles in the queue at the intersection or the number of vehicles stopped at a red signal (QV-Queuing Vehicle)

3. Changes in weather (F-Humidity or Fog).

The green light duration (GD) is the output variable which will provide the extension time required for green light on the arrival side.

The following table 1 provides the range of values for fixing the input and output variables

TABLE 1

Arriving vehicle		Queuing vehicle		Fog		Green light duration	
Range	Linguistic variables	Range	Linguistic variables	Visual range (in meters)	Linguistic variables	Time (in sec)	Linguistic variables
00 – 10	Less	00 - 10	Less	1000 – 1500	Low	00 - 10	Short
07 - 25	Medium	07 - 25	Medium	400 - 1200	Medium	08 - 30	Medium
20 - 50	High	20 - 50	High	50 - 500	High	25 - 60	Long

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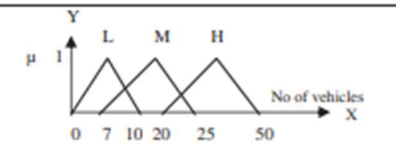
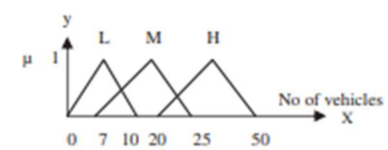
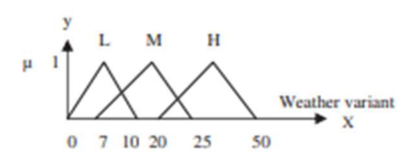
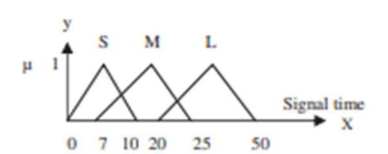
The Membership Functions of Fuzzy Inputs and Outputs

Due to their computational efficiency, triangular fuzzy numbers are frequently employed in a variety of applications. The membership functions of the input and output variables are represented graphically below. The number of cars in the arriving, queued traffic is (Less, Medium, High), and the weather variant fog is (Less, Medium, High), and the Green time length is (Less, Medium, High) (Short, Medium and Long).

The membership function of each input and output variable is shown in Table 2.

TABLE 2

		MEMBERSHIP FUNCTIONS	DIAGRAM
INPUTS	Arriving vehicle	Less Medium High	
	Queuing vehicle	Less Medium High	
	Fog	Less Medium High	
OUTPUT	Gduration	Short Medium Long	

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The universe of discourse (x-axis) for the arriving vehicle and queuing vehicle input fuzzy variables is the number of vehicles, the fog universe of discourse is the visibility range in metres, and the y-axis for all input variables is the visibility range in metres. The degree of membership ranges from 0 to 1. The universe of discourse of the output fuzzy variable is the length of time in seconds that the signal will be expanded.

Fuzzy If-Then Rules

Human beings create rules for carrying out any activity. The fuzzy inference method is analogous to this human cognitive process. Nearly 27 fuzzy rules are framed on the basis of three input variables to produce the following output, as shown in table 3.

TABLE 3

Rules	Inputs			Output
No	Arrivingvehicle	Queuingvehicle	Fog	G duration
1	H	L	L	S
2	H	L	M	M
3	H	L	H	H
4	H	M	L	M
5	H	M	M	M
6	H	M	H	H
7	H	H	L	H
8	H	H	M	H
9	H	H	H	H
10	M	L	L	S
11	M	L	M	M
12	M	L	H	M
13	M	M	L	M
14	M	M	M	M
15	M	M	H	M
16	M	H	L	H
17	M	H	M	H
18	M	H	H	M
19	L	L	L	S
20	L	L	M	M
21	L	L	H	M
22	L	M	L	M
23	L	M	M	H
24	L	M	H	M
25	L	H	L	S
26	L	H	M	M
27	L	H	H	H

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The proposed fuzzy logic control system for an isolated four-lane traffic junction and fuzzy rule set is implemented in this study using the fuzzy logic tool box in Mat lab. The membership function of input and output variables (Fig 3) is constructed using the graphical user interface (GUI).

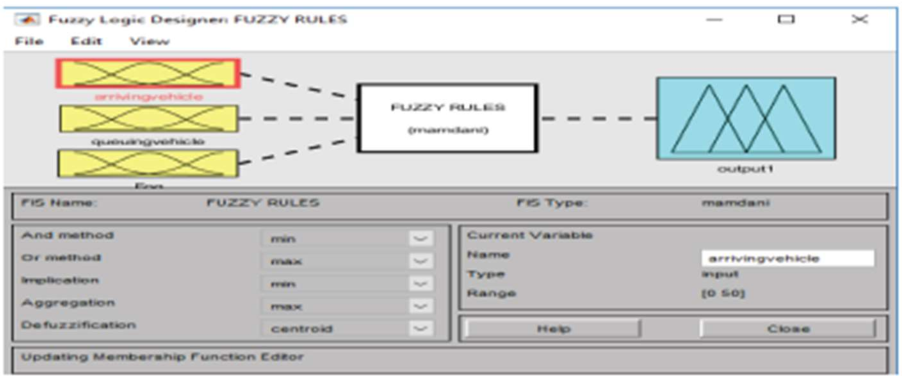

FIGURE: 3 FIS editor

The membership function for the input variable arriving vehicle is shown in Figure 4. (AV). Less = 0 to 10, medium = 7 to 25, and high = 20 to 50 are the membership functions for the arriving vehicle.

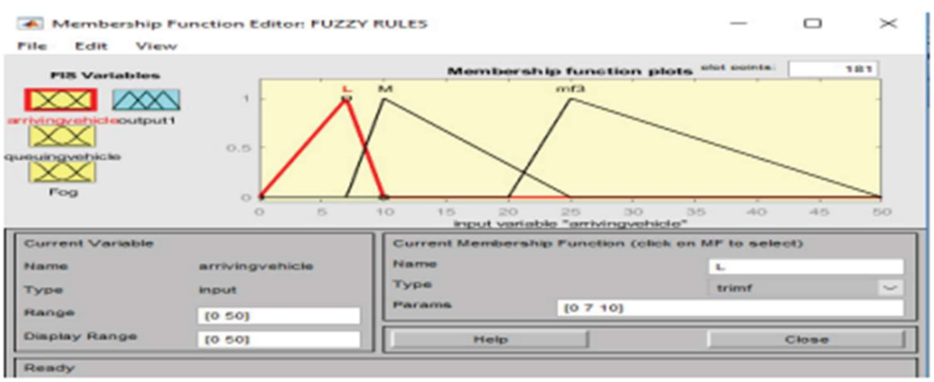

FIGURE 4 : Membership function (Arriving vehicle)

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The membership function for the input variable queuing vehicle is shown in Figure 5. (QV). Less = 0 to 10, medium = 7 to 25, and high = 20 to 50 are the membership functions for the queuing vehicle.

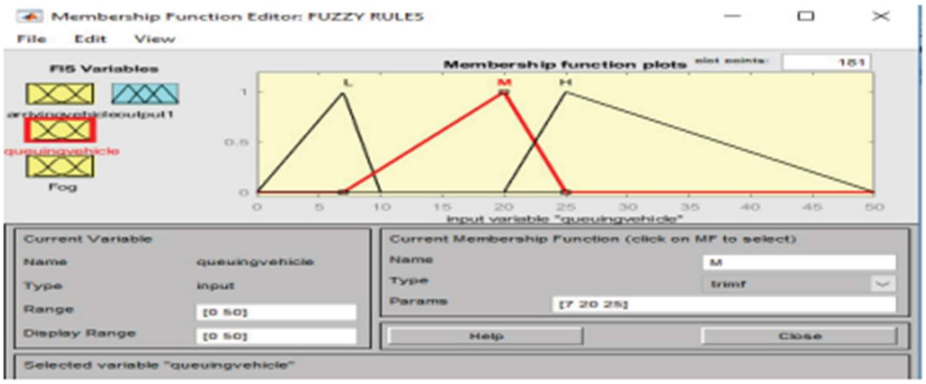

FIGURE 5 : Membership function (Queuing vehicle)

The figure 6 shows the membership function for the input variable fog (F). The membership function for the fog (in meters) are low = 1000 to 1500, medium = 400 to 1200 and high = 50 to 500.

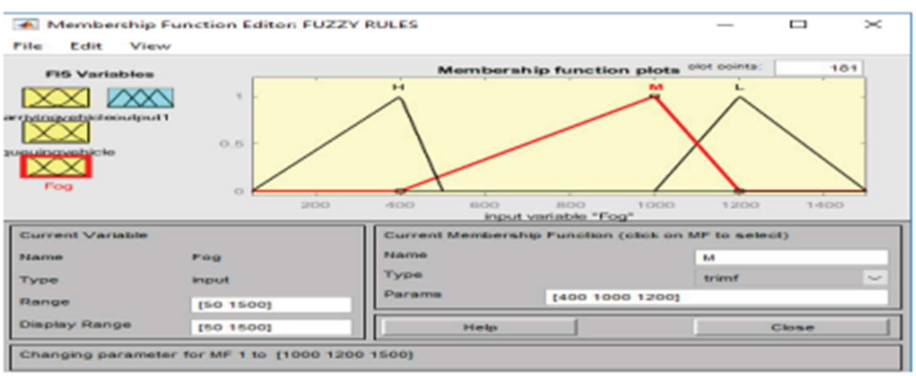

FIGURE 6: Membership function (Fog)

The membership function for the output variable green light duration is shown in Figure 7. (GD). Short = 0 to 10, medium = 08 to 30, and high = 25 to 60 are the membership functions for green light time (in seconds).

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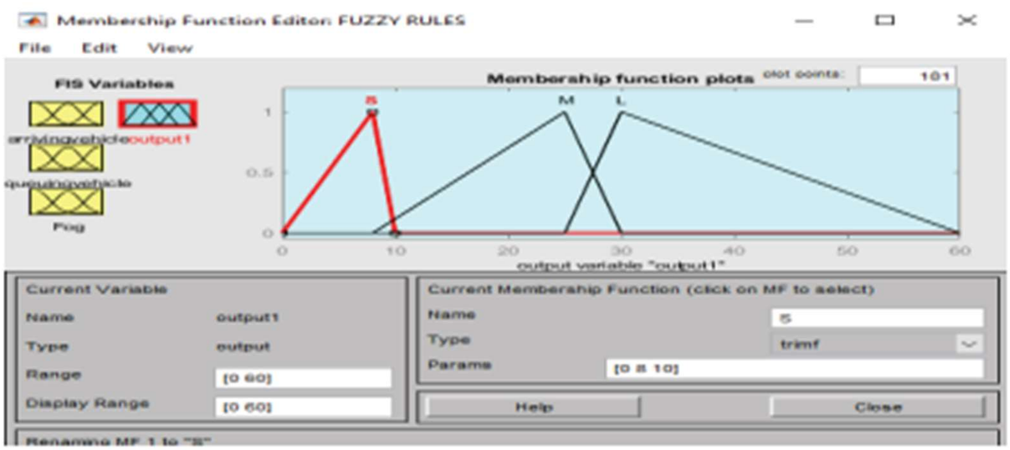

FIGURE 7: Membership function (Gduration)

Using FIS editor in MATLAB the proposed fuzzy if-then rules are inserted.

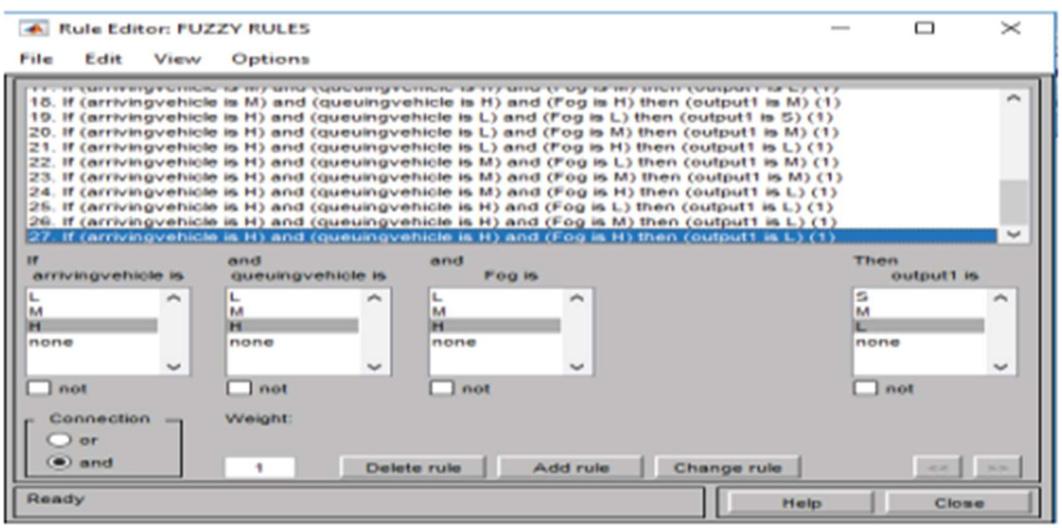

FIGURE 8: Rule Editor

FIS can view graphically using rule viewer and surface viewer

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FIGURE 9: Rule viewer

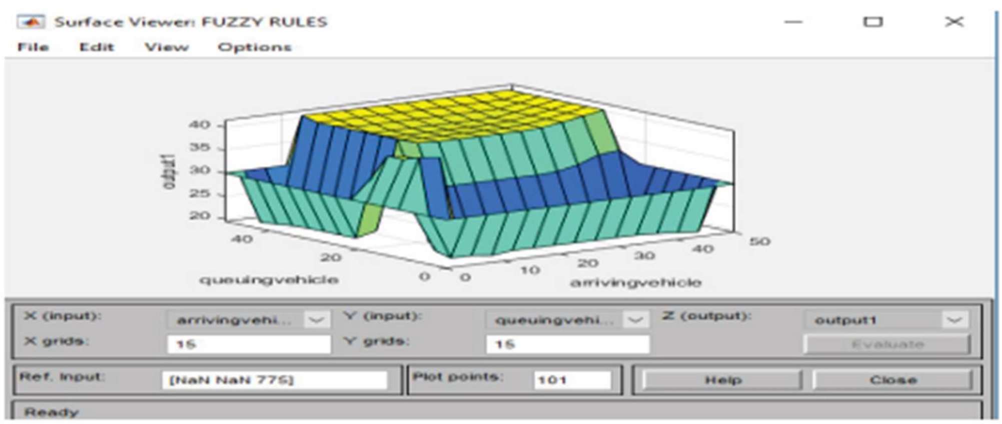

FIGURE 10: Surface viewer

Figure 10 depicts the proposed control system's surface viewer. The surface viewer is a three-dimensional output surface that has been drawn for an arriving vehicle and a queuing vehicle in this example. We can generate different surface viewers for different outputs.

This work proposes a fuzzy logic control system to control traffic congestion at a junction in order to offer suitable performance. The traffic congestion at a junction was calculated using the fuzzy inputs AV, QV, and F, and fuzzy rules framed using the fuzzy logic tool box in Matlab. It has been discovered that utilising fuzzy logic approaches, one may get a better estimate of traffic congestion at an intersection during traffic flow.

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Conclusion

The goal of this study is to design a fuzzy logic controller to improve the traffic signal controller's performance. The proposed fuzzy logic controller was used to estimate the green light extension time by taking into account the number of arriving cars and queuing vehicles during various weather conditions.

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