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# Contents

Volume 136  
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## Research Articles

### Digital Sensors and Sensor Systems: Practical Design

*Book Review*..... I

### Fast and Simple Measurement of Position Changes

*White Paper, iC-Haus GmbH*..... IV

### A Novel Method of Linearizing Thermistor Characteristic Using Voltage Controlled Oscillator

*Narayana K. V. L and Bhujanga Rao A*..... 1

### A Data Acquisition System Based on DSP for Mechanical Nanoscale Displacement Sensor

*Yong Yu, Qian Wu, Hanyu Sun, Zhengwei Li and Yunjian Ge* ..... 12

### Modified AC Wheatstone Bridge Network for Accurate Measurement of Pressure Using Strain Gauge Type Pressure Sensor

*Subrata Chattopadhyay, Mahuya Banerjee and Sagarika Pal*..... 25

### Fingerprint Sensors: Liveness Detection Issue and Hardware based Solutions

*Shahzad Memon, Nadarajah Manivannan, Azad Noor, Wamadeva Balachadran, Nikolaos V. Boulgouris* ..... 35

### Fiber Optic Vibration Sensor Using Pmma Fiber for Real Time Monitoring

*P. Kishore, D. Dinakar, D. Sen Gupta, P. Saidi Reddy, M. Sai Shankar, K. Srimannarayana* ..... 50

### ARM Processor Based Multisensor System Design for the Measurement of Environmental Parameters

*NarasimhaMurthy Yayavaram, Soundara Rajan, Vishnu Vardhan*..... 59

### A Decoupling Algorithm Based on Homotopy Theory for 3-D Tactile Sensor Arrays

*Junxiang Ding, Yunjian Ge, Yuan Wang, Zhaochui Wang* ..... 72

### Digital Imaging and Piezo-dispenser Actuator in Automatic Flocculation Control

*Jani Tomperi, Markus Honkanen, Pasi Kallio, Kauko Leiviskä, Pentti Saarenrinne, Iiris Joensuu, Marjatta Piironen* ..... 83

### An Embedded Web based Real Time Application for Remote Monitoring & Controlling of MST RADAR Transmitters

*Nagabhushan Raju Konduru, Lakshmi Narayana Roshanna, Rajendra Prasad Thommundru, Chandrasekhar Reddy Devanna* ..... 96

### Advanced Oscilloscope Triggering Based on Signal Frequency

*Shakeb A. Khan, Alka Nigam, A. K. Agarwala, Mini S. Thomas, T. Islam* ..... 105

### Pyramidal Traceability Hierarchy for Pressure Measurements and Calibrations at NIS- Egypt

*A. A. Eltawil*..... 118

<b>Fuzzy Logic Based Autonomous Traffic Control System</b> <i>Muhammad Abbas, M. Saleem Khan, Nasir Ali and Syed Fazil .....</i>	132
<b>Potential of Piezoelectric Sensors in Bio-signal Acquisition</b> <i>Dipali Bansal.....</i>	147
<b>Measurement and Analysis of Sodium in Vegetables Using ATmega16 Microcontroller Based Spectrophotometer</b> <i>K. Murugananthan and P. Neelamegam.....</i>	158

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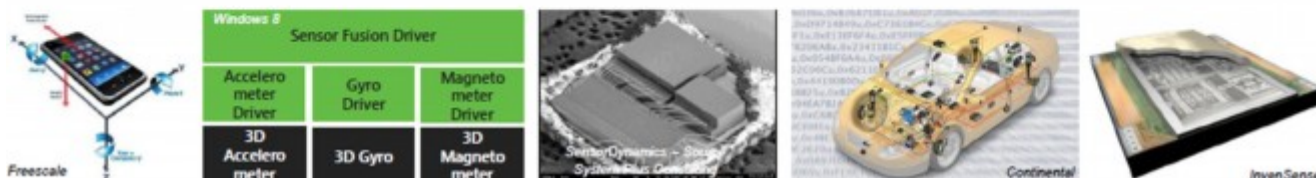
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## Fuzzy Logic Based Autonomous Traffic Control System

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**Abstract:** The aim of this paper is to design and implement fuzzy logic based traffic light Control system to solve the traffic congestion issues. In this system four input parameters: Arrival, Queue, Pedestrian and Emergency Vehicle and two output parameters: Extension in Green and Pedestrian Signals are used. Using Fuzzy Rule Base, the system extends or terminates the Green Signal according to the Traffic situation at the junction. On the presence of emergency vehicle, the system decides which signal(s) should be red and how much an extension should be given to Green Signal for Emergency Vehicle. The system also monitors the density of people and makes decisions accordingly. In order to verify the proposed design algorithm MATLAB simulation is adopted and results obtained show concurrency to the calculated values according to the Mamdani Model of the Fuzzy Control System. *Copyright © 2012 IFSA.*

**Keywords:** Fuzzy inference system, Fuzzy control, Fuzzification, Fuzzy expert systems, Transportation control, Rule base, Inference engine.

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### 1. Introduction

The rapid growth of population in urban areas is continuously increasing the density of vehicles which results in traffic congestion. Conventional traffic light controllers fail to control the over-saturated traffic situation. They are usually fixed time and scheduled on 'time-of-the-day' plan [1]. As fuzzy logic can mimic the human intelligence capability, it can be implemented for controlling the over-saturated traffic flow and therefore can be used as a substitute for the conventional fixed time

controller [2]. Pappis and Mamdani [3] simulated a two way traffic junction model in which each way has a single lane of traffic flow. Later in 2005, fuzzy logic based models were simulated for an isolated four-armed intersection in which triangular membership functions were used [4]. A prototype system for monitoring traffic congestion at an intersection was designed using Visual Basic 6 and MATLAB. Traffic intersection was simulated in Visual Basic 6 and statistical data of traffic density obtained from Visual Basic 6 was sent to MATLAB to decide the extension time for the signal [1]. Recently, a comparison of the fuzzy logic based traffic light simulator with conventional light controller showed that the fuzzy logic based traffic controller reduced the waiting time at queue side [5]. Askerzade and Mahmood [2] computed the optimal extension time for a fuzzy logic based isolated traffic junction in which they compared different fuzzy logic controller algorithms with fixed time controller. They found that Sugeno controller provides less waiting time in traffic flow.

This proposed work is designed keeping in view the traffic congestion issues of Samanabad area of Lahore City (Pakistan). The proposed design work of traffic control system consists of four input variables: arrival, queue, pedestrian and emergency vehicle, and two output variables: Extension in Green and Pedestrian Signals used to monitor the situation of the Traffic Control System. For extension in the green and pedestrian signals, the controller detects the no. of cars (for eastern, western, northern and southern queues), the density of pedestrians and presence of emergency vehicle from detectors after every sampling period. In this way, this research work differs from those mentioned above and will contribute for future work.

The design criteria and basic structure of the proposed work are described in Section 2 and Section 3. Section 4 gives the simplified algorithm of fuzzy logic designed for Traffic Control System. Section 5 describes results and graph simulation work of this system. Conclusion and future work is given in Section 6.

## 2. Design Criteria for the Proposed Traffic Light Controller

The following criteria are assumed during the design of fuzzy logic based traffic light controller [6]:

1. An isolated four-way intersection with traffic coming from the east, west, north and south directions is considered;
2. When traffic from the east moves, traffic from the west, north and south stops, and vice versa;
3. Right and 'U' turns are allowed only for the green signal traffic;
4. The fuzzy logic controller will monitor the density of the east, west, north and south traffic sides along with the density of Pedestrians with the help of detectors;
5. No left turn is allowed at the junction;
6. If the presence of emergency vehicle is detected in a lane which is green then extend its time. In case of emergency vehicle's detection in other lane then allow that lane's signal to be green keeping other signals red.
7. The sequence of the green and pedestrian signals for east, west, north and south lanes is given in the Table 1.

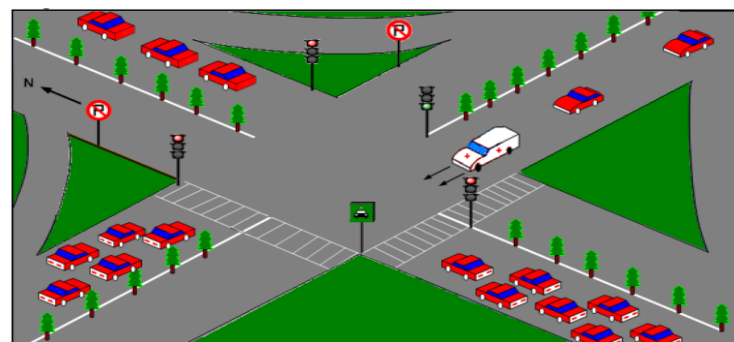
**Table 1.** Sequence of green and pedestrian signal.

Sequence	Green Signal	Pedestrian Signal
1 <sup>st</sup>	Q <sub>E</sub>	P <sub>S</sub>
2 <sup>nd</sup>	Q <sub>W</sub>	P <sub>N</sub>
3 <sup>rd</sup>	Q <sub>N</sub>	P <sub>E</sub>
4 <sup>th</sup>	Q <sub>S</sub>	P <sub>W</sub>

Fig. 1 shows that when east-side traffic signal is green, it is made possible for southern side pedestrians to cross the road. Fig. 2 shows that when the presence of emergency vehicle (ambulance) is detected in the eastern lane then Green Signal is ON for this lane. All signals of the remaining lanes are 'Red' and also pedestrian signal is OFF.



**Fig. 1.** East Side with Green Signal & Southern Pedestrian Signal "ON".



**Fig. 2.** Green Signal for Ambulance.

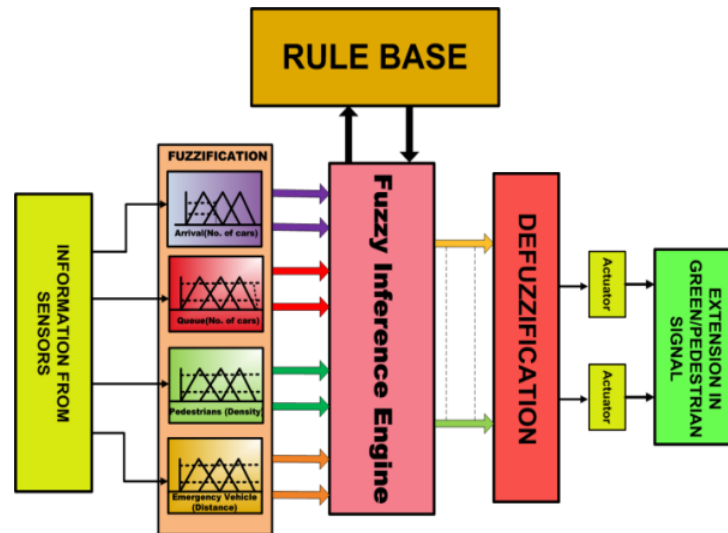
### 3. Basic Structure of the Proposed Traffic Light Controller

Fig. 3 shows the basic structure of the proposed work. Four input crisp values information detected from sensors are given to a fuzzifier. Where a fuzzifier fires eight linguistic values: two for each input variable. Further these linguistic values are then processed through human decision based Rule-Base. Finally after the process of defuzzification, two output crisp values are given to control the green and pedestrian signals duration.

### 4. Design Algorithm

The algorithm designed for traffic light controller has four fuzzy input variables. Four triangular membership functions are equally determined over a scale range of 0 to 30 (number of cars) for arrival and queue sides, density 0 to 15 for pedestrians and the distance 0 (m)-45 (m) to indicate the presence/absence of Emergency Vehicle inputs. The four fuzzy membership functions for arrival and queue side inputs are termed as: only just 0-10, not too many 0-20, numerous 10-30, too many 20-30; queue side: very small 0-10, small 0-20, normal 10-30, large 20-30. The four fuzzy membership functions for pedestrian(density) and emergency vehicle inputs are: very low 0-5, low 0-10, denser

5-15, highly dense 10-15; emergency vehicle: too close 0 m - 15 m, near 0 m - 30 m, too far 15 m - 45 m and not present 30 m - 45 m. Two outputs of this proposed system are: Green Signal Time and Pedestrian Signal Time. The time for Green Signal output variables consists of five membership functions: termination 0 s - 15 s, below normal 0 s - 60 s, normal 55 s - 65 s, small extension 60 s - 120 s and large extension 90 s - 120 s whereas the five membership functions for Pedestrian Signal Time are: termination 0 s - 15 s, below normal 0 s - 55 s, normal 50 s - 65 s, small extension 55 s - 100 s and large extension 85 s - 120 s.



**Fig. 3.** Block Diagram of Fuzzy Logic Based Traffic Control System.

#### 4.1 Fuzzifier

Four fuzzifiers generate eight linguistic values, two for each input variable. The descriptions of range, membership functions and the occupied region for four input variables are discussed in Table 2, Table 3, Table 4 and Table 5 [7].

**Table 2.** Membership functions and ranges of input variable Arrival (number of cars).

Membership Function (MF)	Ranges	Region Occupied
Only Just	0-10	1
Not Too Many	0-20	1-2
Numerous	10-30	2-3
Too Many	20-30	3

**Table 3.** Membership functions and ranges of input variable queue (number of cars).

Membership Function (MF)	Ranges	Region Occupied
Very Small	0-10	1
Small	0-20	1-2
Normal	10-30	2-3
Large	20-30	3

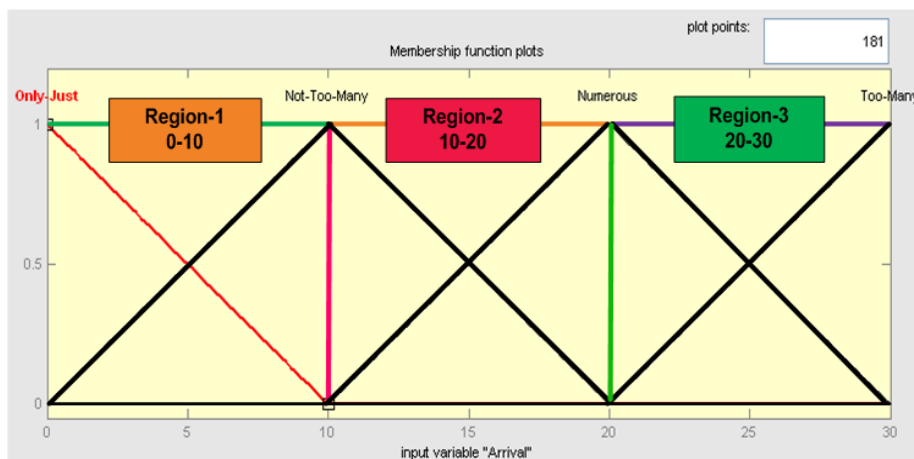
**Table 4.** Membership functions and ranges of input variable pedestrian (density of people).

Membership Function (MF)	Ranges	Region Occupied
Very Low	0-5	1
Low	0-10	1-2
Denser	5-15	2-3
Highly Dense	10-15	3

**Table 5.** Membership functions and ranges of input variable emergency vehicle (m).

Membership Function (MF)	Ranges	Region Occupied
Too Close (Present)	0-15	1
Near (Present)	0-30	1-2
Too Far (Present)	15-45	2-3
Not Present	30-45	3

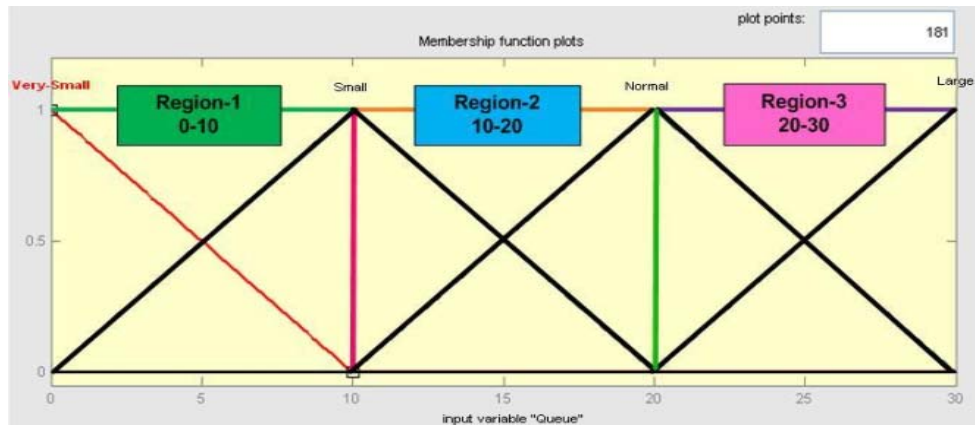
The membership functions for each input variable are shown in Fig. 4, Fig. 5, Fig. 6 and Fig. 7. The four membership functions, “only just”, “not too many”, “numerous”, and “too many” indicate different ranges of input fuzzy variable “ARRIVAL” in a plot having three regions as shown in Fig. 4.

**Fig. 4.** Plot of membership functions for input variable, “ARRIVAL”.

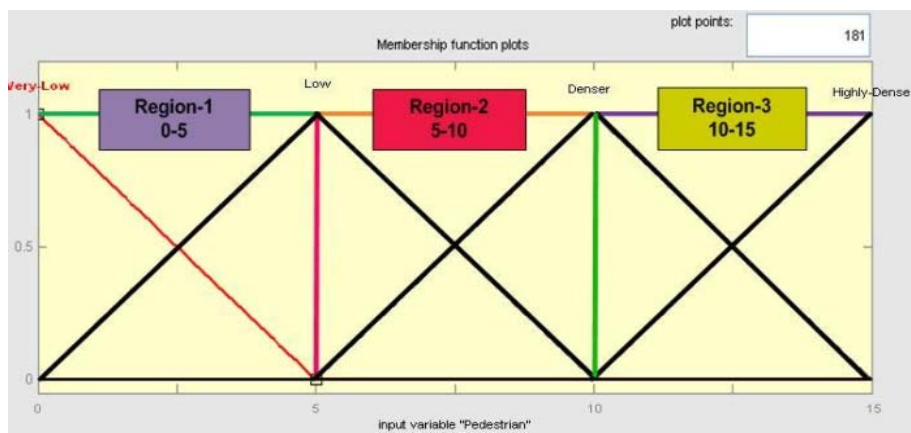
The four membership functions, “very small”, “small”, “normal” and “large” are used to show the various ranges of input fuzzy variable “QUEUE” in a plot also consisting of three regions as shown in Fig. 5.

The four membership functions, “very low”, “low”, “denser” and “highly dense” are used to show the various ranges of input fuzzy variable “PEDESTRIAN” in a plot also consisting of three regions as shown in Fig. 6.

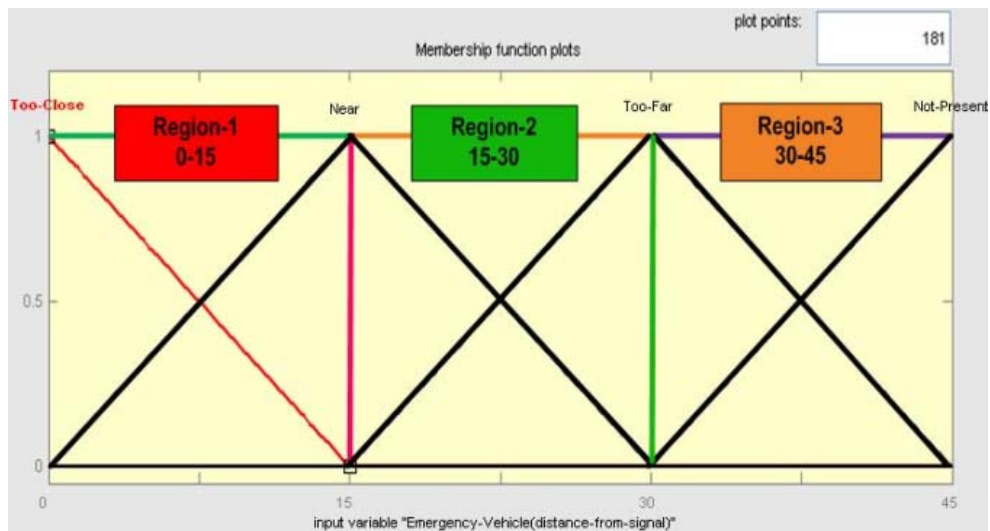
The four membership functions, “too close”, “near”, “too far” and “not present” are used to show the various ranges of input fuzzy variable “EMERGENCY VEHICLE” in a plot also consisting of three regions as shown in Fig. 7.



**Fig. 5.** Plot of membership functions for input variable, “QUEUE”.



**Fig. 6.** Plot of membership functions for input variable, “PEDESTRIAN”.



**Fig. 7.** Plot of membership functions for input variable, “EMERGENCY VEHICLE”.

The eight linguistic values for four input variables and their mapping with the functions in three regions are given in Table 6 and the design of fuzzifier is shown in Fig. 8 [8].

**Table 6.** Linguistic values of fuzzifiers outputs in all regions.

Input Variables	Linguistic Fuzzifiers Outputs	Region 1	Region 2	Region 3
Arrival	$f_1$	$f_1[1]$	$f_1[2]$	$f_1[3]$
	$f_2$	$f_1[2]$	$f_1[3]$	$f_1[4]$
Queue	$f_3$	$f_2[1]$	$f_2[2]$	$f_2[3]$
	$f_4$	$f_2[2]$	$f_2[3]$	$f_2[4]$
Pedestrian	$f_5$	$f_1[1]$	$f_1[2]$	$f_1[3]$
	$f_6$	$f_1[2]$	$f_1[3]$	$f_1[4]$
Emergency Vehicle	$f_7$	$f_2[1]$	$f_2[2]$	$f_2[3]$
	$f_8$	$f_2[2]$	$f_2[3]$	$f_2[4]$

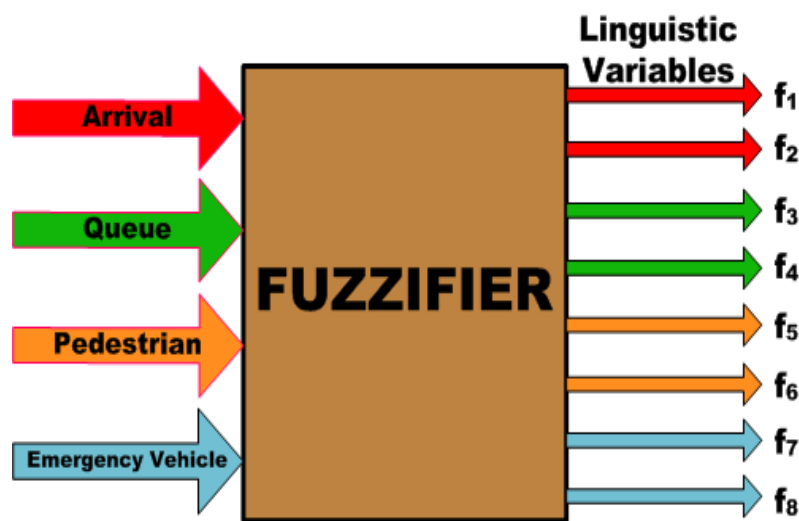
**Fig. 8.** Fuzzifier Block.

Table 7 gives the results of fuzzification using the given values of input variables. Whereas internal structural design of a fuzzifier is shown in Fig. 9 [9].

**Table 7.** Results of Fuzzification.

Input Variables	Input Voltage $\underline{u}$	Values	Region Selection	Fuzzy Set Calculation
Arrival	1.7 volts	$x=10\underline{u}$ $=17$	$10 \leq x < 20$ Region-3	$f_1=(20-17)/10=0.3$ $f_2=1-f_1=1-0.3=0.7$
Queue	0.8 volts	$x=10\underline{u}$ $=8$	$0 \leq x < 10$ Region-1	$f_3=(10-8)/10=0.2$ $f_4=1-f_3=1-0.2=0.8$
Pedestrian	0.6 volts	$x=5\underline{u}$ $=3$	$0 \leq x < 5$ Region-1	$f_5=(5-3)/5=0.4$ $f_6=1-f_5=1-0.4=0.6$
Emergency Vehicle	2.8 volts	$x=15\underline{u}$ $=42$	$30 \leq x < 45$ Region-3	$f_7=(45-42)/15=0.2$ $f_8=1-f_7=1-0.2=0.8$

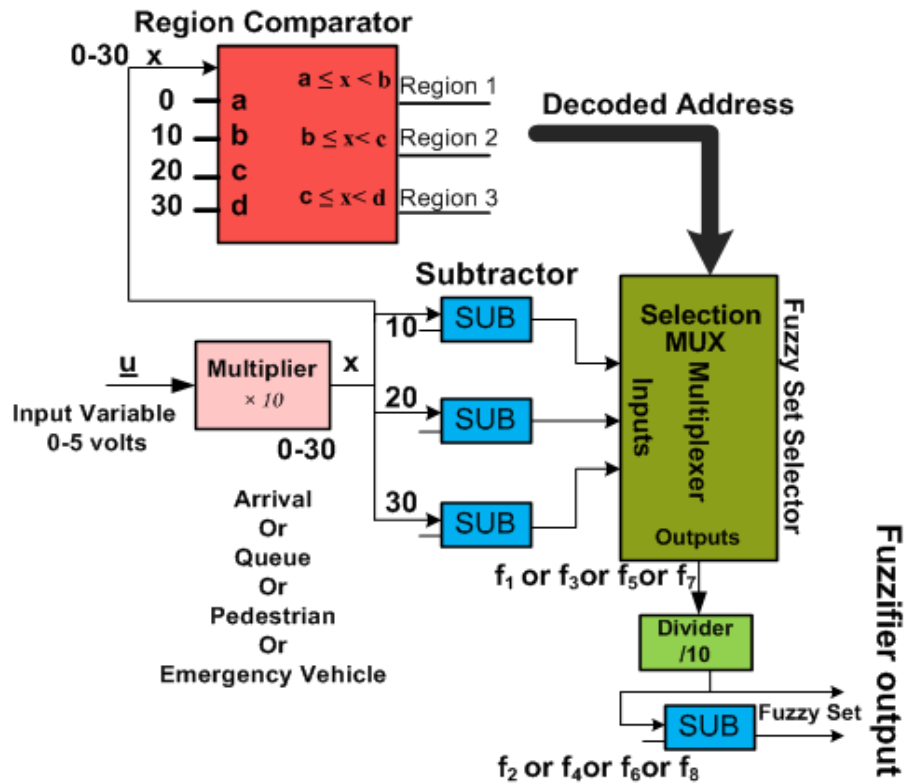


Fig. 9. Design of Fuzzifier for Arrival Input.

#### 4.2. Inference Engine

Number of active rules =  $m^n$ , where  $m$  = maximum number of overlapped fuzzy sets and  $n$  = number of inputs. For this design,  $m = 4$  and  $n = 4$ , so the total number of active rules are 256. The total number of rules is equal to the product of number of functions accompanied by the input variables in their working range [10]. As each value of four variables in a region correspond to mapping of two functions, so 16 rules are needed for the specific values of four variables. The inference engine contains sixteen AND operators that select minimum value input for the output. This inference engine accepts eight inputs from a fuzzifier and applies the min-max composition to obtain the output R values. The min-max inference method uses min-AND operation between the four inputs. The sign  $\wedge$  indicates Min-ANDing process between the membership function values. This interpretation is used in Mamdani-min process. Fig. 10 shows this type of inference process [11].

#### 4.3. Rule Selector

The rule selector gives singleton values of output variables using four crisp values of Arrival, Queue, Pedestrian and Emergency Vehicle as shown in Fig. 11. Sixteen rules are needed to determine the corresponding singleton values of four input variables. These rules are listed in Table 8.

#### 4.4. Defuzzifier

Two defuzzifiers control the actuators; Extension in Green and Pedestrian Signals. The membership functions of the two output variables are given in Table 9 and Table 10 and plots for their membership functions are shown in Figs. 12 and 13.

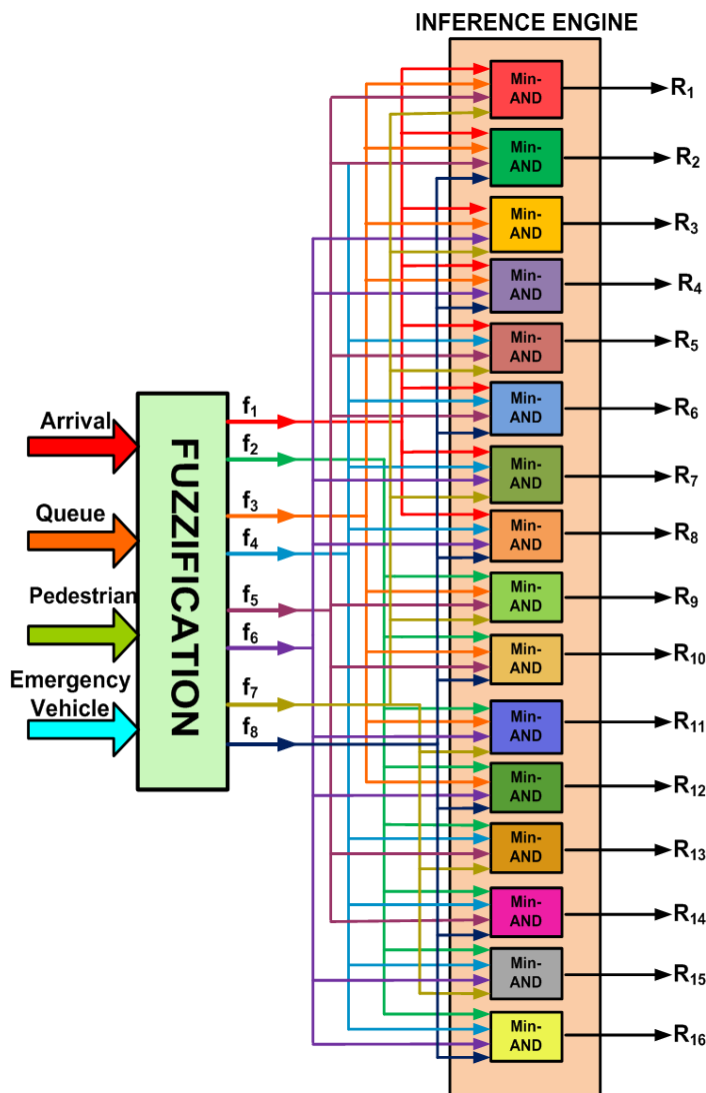


Fig. 10 (a). Block Diagram of Inference Engine.

$$\begin{aligned}
 R_1 &= f_1 \wedge f_3 \wedge f_5 \wedge f_7 = 0.3 \wedge 0.2 \wedge 0.4 \wedge 0.2 = 0.2 \\
 R_2 &= f_1 \wedge f_3 \wedge f_5 \wedge f_8 = 0.3 \wedge 0.2 \wedge 0.4 \wedge 0.8 = 0.2 \\
 R_3 &= f_1 \wedge f_3 \wedge f_6 \wedge f_7 = 0.3 \wedge 0.2 \wedge 0.6 \wedge 0.2 = 0.2 \\
 R_4 &= f_1 \wedge f_3 \wedge f_6 \wedge f_8 = 0.3 \wedge 0.2 \wedge 0.6 \wedge 0.8 = 0.2 \\
 R_5 &= f_1 \wedge f_4 \wedge f_5 \wedge f_7 = 0.3 \wedge 0.8 \wedge 0.4 \wedge 0.2 = 0.2 \\
 R_6 &= f_1 \wedge f_4 \wedge f_5 \wedge f_8 = 0.3 \wedge 0.8 \wedge 0.4 \wedge 0.8 = 0.3 \\
 R_7 &= f_1 \wedge f_4 \wedge f_6 \wedge f_7 = 0.3 \wedge 0.8 \wedge 0.6 \wedge 0.2 = 0.3 \\
 R_8 &= f_1 \wedge f_4 \wedge f_6 \wedge f_8 = 0.3 \wedge 0.8 \wedge 0.6 \wedge 0.8 = 0.3 \\
 R_9 &= f_2 \wedge f_3 \wedge f_5 \wedge f_7 = 0.7 \wedge 0.2 \wedge 0.4 \wedge 0.2 = 0.2 \\
 R_{10} &= f_2 \wedge f_3 \wedge f_5 \wedge f_8 = 0.7 \wedge 0.2 \wedge 0.4 \wedge 0.8 = 0.2 \\
 R_{11} &= f_2 \wedge f_3 \wedge f_6 \wedge f_7 = 0.7 \wedge 0.2 \wedge 0.6 \wedge 0.2 = 0.2 \\
 R_{12} &= f_2 \wedge f_3 \wedge f_6 \wedge f_8 = 0.7 \wedge 0.2 \wedge 0.6 \wedge 0.8 = 0.2 \\
 R_{13} &= f_2 \wedge f_4 \wedge f_5 \wedge f_7 = 0.7 \wedge 0.8 \wedge 0.4 \wedge 0.2 = 0.2 \\
 R_{14} &= f_2 \wedge f_4 \wedge f_5 \wedge f_8 = 0.7 \wedge 0.8 \wedge 0.4 \wedge 0.8 = 0.4 \\
 R_{15} &= f_2 \wedge f_4 \wedge f_6 \wedge f_7 = 0.7 \wedge 0.8 \wedge 0.6 \wedge 0.2 = 0.2 \\
 R_{16} &= f_2 \wedge f_4 \wedge f_6 \wedge f_8 = 0.7 \wedge 0.8 \wedge 0.6 \wedge 0.8 = 0.6
 \end{aligned}$$

Fig. 10 (b). Sixteen Rules.

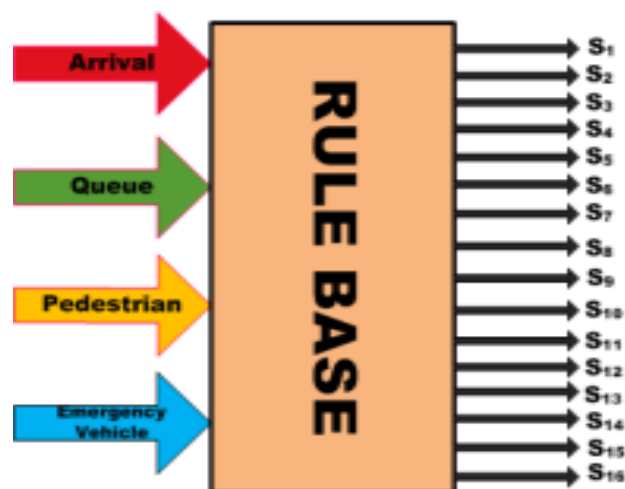


Fig. 11. Rule Base.

**Table 8.** Illustration of rules applied model.

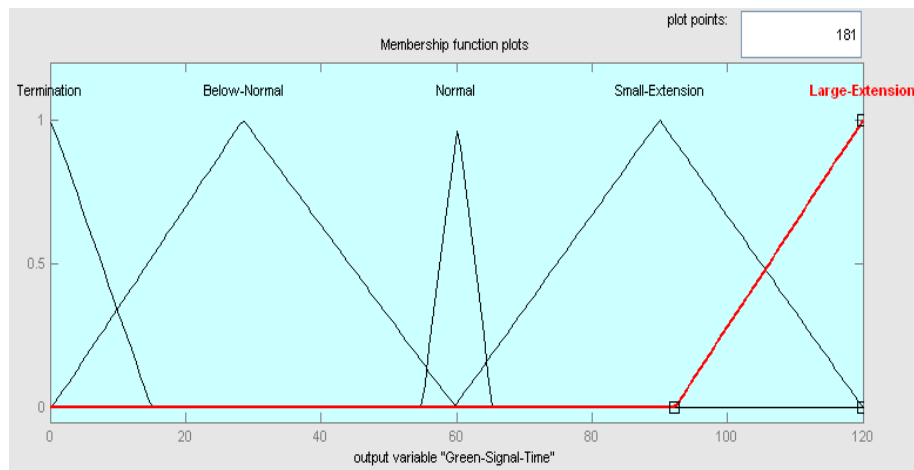
1.	Not Too Many	Very Small	Very Low Density	Too Far	Normal = 0.5	Below Normal = 0.2	S <sub>1</sub>
2.	Not Too Many	Very Small	Very Low Density	Not Present	Normal = 0.5	Below Normal = 0.2	S <sub>2</sub>
3.	Not Too Many	Very Small	Low Density	Too Far	Normal = 0.5	Normal = 0.45	S <sub>3</sub>
4.	Not Too Many	Very Small	Low Density	Not Present	Normal = 0.5	Normal = 0.45	S <sub>4</sub>
5.	Not Too Many	Small	Very Low Density	Too Far	Normal = 0.5	Normal = 0.45	S <sub>5</sub>
6.	Not Too Many	Small	Very Low Density	Not Present	Normal = 0.5	Below Normal = 0.2	S <sub>6</sub>
7.	Not Too Many	Small	Low Density	Too Far	Normal = 0.5	Below Normal = 0.2	S <sub>7</sub>
8.	Not Too Many	Small	Low Density	Not Present	Normal = 0.5	Below Normal = 0.2	S <sub>8</sub>
9.	Numerous	Very Small	Very Low Density	Too Far	Large Extension = 1.0	Below Normal = 0.2	S <sub>9</sub>
10.	Numerous	Very Small	Very Low Density	Not Present	Large Extension = 1.0	Below Normal = 0.2	S <sub>10</sub>
11.	Numerous	Very Small	Low Density	Too Far	Large Extension = 1.0	Normal = 0.45	S <sub>11</sub>
12.	Numerous	Very Small	Low Density	Not Present	Large Extension = 1.0	Normal = 0.45	S <sub>12</sub>
13.	Numerous	Small	Very Low Density	Too Far	Large Extension = 1.0	Below-Normal = 0.2	S <sub>13</sub>
14.	Numerous	Small	Very Low Density	Not Present	Large Extension = 1.0	Below-Normal = 0.2	S <sub>14</sub>
15.	Numerous	Small	Low Density	Too Far	Large Extension = 1.0	Below-Normal = 0.2	S <sub>15</sub>
16.	Numerous	Small	Low Density	Not Present	Large Extension = 1.0	Below-Normal = 0.2	S <sub>16</sub>

**Table 9.** Output variable time for green signal Membership functions.

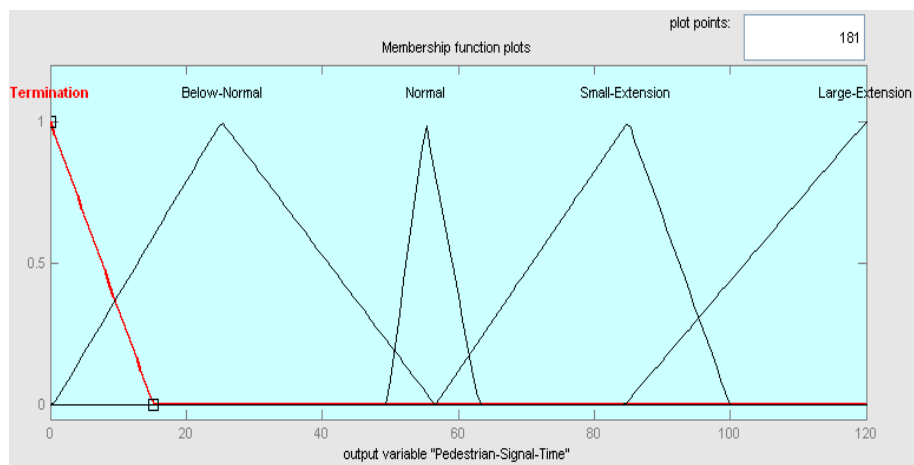
MFs	Range	Extension (Green Signal)
MF1	0-15	Termination
MF2	0-60	Below Normal
MF3	55-65	Normal
MF4	60-120	Small Extension
MF5	90-120	Large Extension

**Table 10.** Output variable time for pedestrian signal membership functions.

MFs	Range	Pedestrian Signal
MF1	0-15	Termination
MF2	0-55	Below Normal
MF3	50-60	Normal
MF4	60-120	Small Extension
MF5	85-120	Large Extension



**Fig. 12.** Plot of Membership Functions for Output Variable, “Green Signal Time”.



**Fig. 13.** Plot of Membership Functions for Output Variable, “Pedestrian Signal Time”.

In this scheme there are 32 inputs that are given to each of the two defuzzifiers. Sixteen values of  $R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, R_{12}, R_{13}, R_{14}, R_{15}, R_{16}$  from the outputs of inference engine and sixteen values  $S_1, S_2, S_3, S_4, S_5, S_6, S_7, S_8, S_9, S_{10}, S_{11}, S_{12}, S_{13}, S_{14}, S_{15}, S_{16}$  from the rule selector are shown in Fig. 14. The mathematical expression,  $\sum S_i * R_i / \sum R_i$ , where  $i = 1$  to 16 represents the center of average (C.O.A) method. For the sake of simplicity each output variable membership function plot consists of five functions with the same range values. One defuzzifier consists of: one adder for  $\sum R_i$ , 32 multipliers for the product of  $S_i * R_i$ , one adder for  $\sum S_i * R_i$ , and one divider for  $\sum S_i * R_i / \sum R_i$ . Finally a defuzzifier gives the estimated crisp value output [12].

## 5. Results and Graph Discussions

According to the results of inference engine

$$\sum R_i = R_1 + R_2 + R_3 + R_4 + R_5 + R_6 + R_7 + R_8 + R_9 + R_{10} + R_{11} + R_{12} + R_{13} + R_{14} + R_{15} + R_{16} = 4.1$$

The designed values for extension in green and pedestrian signals are given in Table 11 and Table 12.

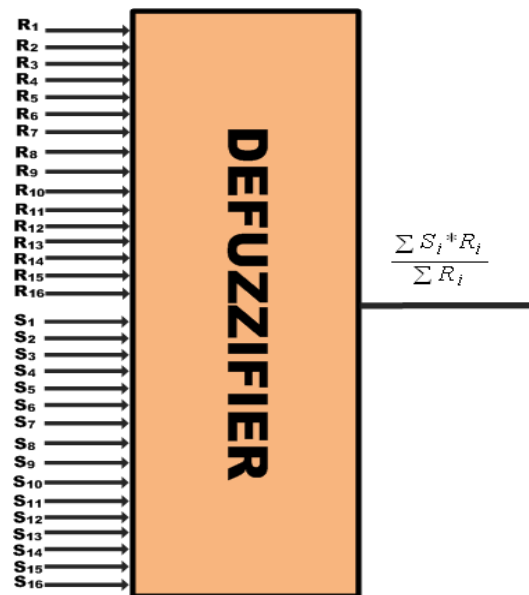


Fig. 14. Defuzzifier Block.

Table 11. Designed value for extension in green signal.

$i$	$R_i$	$S_i$	$R_i * S_i$
1	0.2	0.5	0.1
2	0.2	0.5	0.1
3	0.2	0.5	0.1
4	0.2	0.5	0.1
5	0.2	0.5	0.1
6	0.3	0.5	0.15
7	0.3	0.5	0.15
8	0.3	0.5	0.15
9	0.2	1.0	0.2
10	0.2	1.0	0.2
11	0.2	1.0	0.2
12	0.2	1.0	0.2
13	0.2	1.0	0.2
14	0.4	1.0	0.4
15	0.2	1.0	0.2
16	0.6	1.0	0.6

Table 12. Designed Value For Pedestrian Signal Extension.

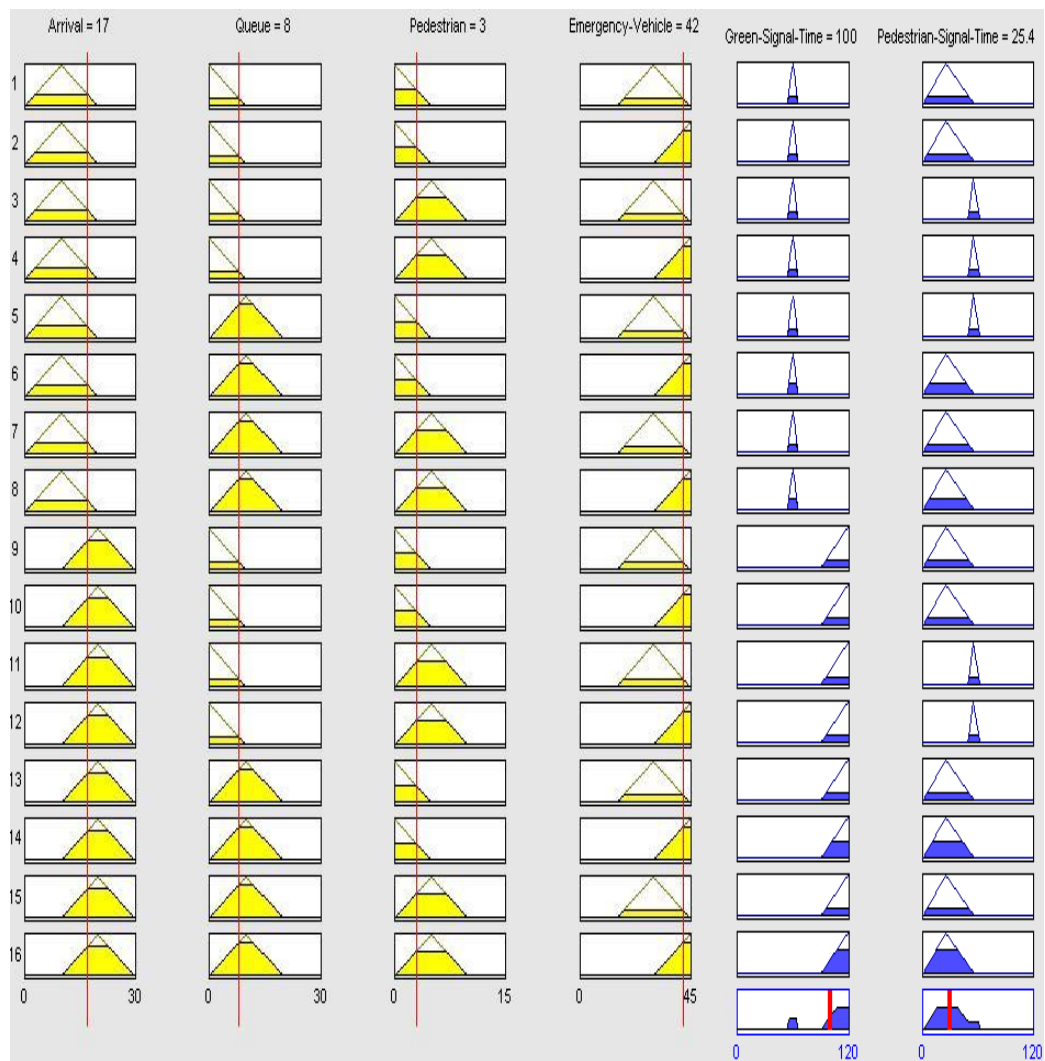
$i$	$R_i$	$S_i$	$R_i * S_i$
1	0.2	0.2	0.04
2	0.2	0.2	0.04
3	0.2	0.45	0.09
4	0.2	0.45	0.09
5	0.2	0.45	0.09
6	0.3	0.2	0.06
7	0.3	0.2	0.06
8	0.3	0.2	0.06
9	0.2	0.2	0.04
10	0.2	0.2	0.04
11	0.2	0.45	0.09
12	0.2	0.45	0.09
13	0.2	0.2	0.04
14	0.4	0.2	0.08
15	0.2	0.2	0.04
16	0.6	0.2	0.12

$\sum R_i * S_i = 4.15$ ;  $\sum R_i * S_i / \sum R_i = 4.15 / 4.1 = 1.012 = 101.2\%$  of the Green Signal will be Extended.
  $\sum R_i * S_i = 1.07$ ;  $\sum R_i * S_i / \sum R_i = 1.07 / 4.1 = 0.2609 = 26.09\%$  of Pedestrian Signal will be extended.

Table 13 gives an arrangement for the membership functions for simulation where four values of input variables are Arrival=17, Queue=8, Pedestrian=3, Emergency Vehicle=42. These simulated values were verified using MATLAB-Rule viewer as shown in Fig. 15.

**Table 13.** Arrangement of Membership Functions for Simulation.

Rule No.	INPUTS				OUTPUTS	
	Arrival 17	Queue 8	Pedestrian 3	Emergency Vehicle 42	Green Signal Time	Pedestrian Signal Time
1.	Not Too Many	Very Small	Very Low Density	Too Far	Normal	Below Normal
2.	Not Too Many	Very Small	Very Low Density	Not Present	Normal	Below Normal
3.	Not Too Many	Very Small	Low Density	Too Far	Normal	Normal
4.	Not Too Many	Very Small	Low Density	Not Present	Normal	Normal
5.	Not Too Many	Small	Very Low Density	Too Far	Normal	Normal
6.	Not Too Many	Small	Very Low Density	Not Present	Normal	Below Normal
7.	Not Too Many	Small	Low Density	Too Far	Normal	Below Normal
8.	Not Too Many	Small	Low Density	Not Present	Normal	Below Normal
9.	Numerous	Very Small	Very Low Density	Too Far	Large Ext	Below Normal
10.	Numerous	Very Small	Very Low Density	Not Present	Large Extension	Below Normal
11.	Numerous	Very Small	Low Density	Too Far	Large Extension	Normal
12.	Numerous	Very Small	Low Density	Not Present	Large Extension	Normal
13.	Numerous	Small	Very Low Density	Too Far	Large Extension	Below-Normal
14.	Numerous	Small	Very Low Density	Not Present	Large Extension	Below-Normal
15.	Numerous	Small	Low Density	Too Far	Large Extension	Below-Normal
16.	Numerous	Small	Low Density	Not Present	Large Extension	Below-Normal

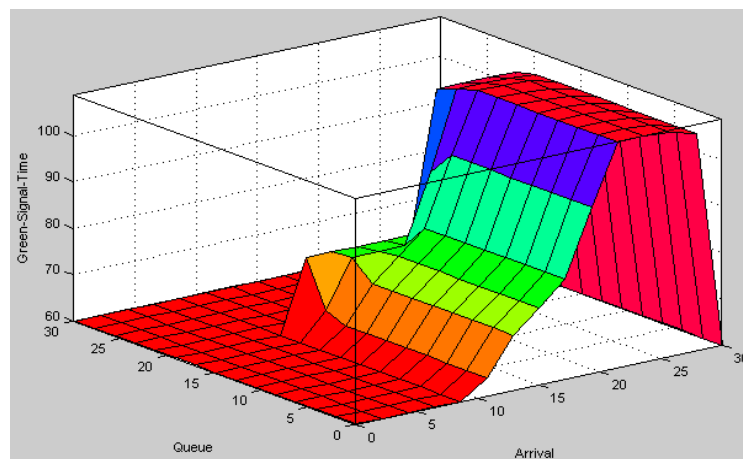
**Fig. 15.** MATLAB Simulation.

The results obtained from the comparison of the designed value and MATLAB simulation show the validity of the model as listed in Table 14. Sixteen rules were applied for MATLAB simulation according to this range scheme. In this design model, Extension time for Green and Pedestrian Signals depend upon the selected values of Arrival, Queue, Pedestrian and Emergency Vehicle inputs. The simulated and calculated results are according to the dependence scheme.

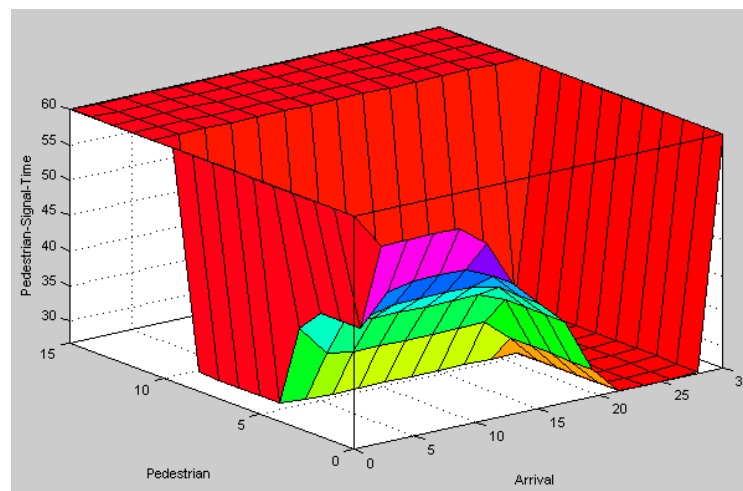
**Table 14.** Comparison of Simulated and Calculated Result.

Result	Extension in Green Signal	Pedestrian Signal
Design Values	101.2	26.09
MATLAB Simulation	100	25.4
Error, %	1.18	2.64

Fig. 16 shows that the Extension in Green Signal is directly proportional to Arrival i.e. density of cars on the arrival side. Fig. 17 shows that the Time for Pedestrian Signal is directly proportional to density of people (Pedestrian).



**Fig. 16.** Plot between Arrival-Queue Green Signal Time.



**Fig. 17.** Plot between Arrival–Pedestrian Pedestrian Signal Time.

## 6. Conclusion

In this paper, a fuzzy logic based traffic control system was designed to solve the traffic congestion issues. The designed model also has the capability to monitor the pedestrian crossings and provides the easy flow of emergency vehicle in critical situations. The results obtained from the designed model and simulation indicates the validity of the proposed model. This research work provides less waiting time for vehicles which in turn will reduce the fuel consumptions, noise and air pollution problems. The designed work can be used to control multiple intersections and is being carried out to design state of the art fuzzy logic traffic control system in future using FPGAs.

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# GlobeNet 2012

29 February - 5 March 2012 - Saint Gilles, Reunion Island



## The Eleventh International Conference on Networks **ICN 2012**

### Wireless communications:

Satellite, WLL, 4G, Ad Hoc, sensor networks



## The Seventh International Conference on Systems **ICONS 2012**

### System Instrumentation:

Metering embedded sensors; Composing multi-scale measurements; Monitoring instrumentation; Smart sensor-based systems; Calibration and self-calibration systems; Instrumentation for prediction systems

### Specialized systems [sensor-based, etc.]:

Sensor-based systems; Biometrics systems; Nano-technology-based systems, etc.

**Deadline for papers: 5 October 2011**

<http://www.iaria.org/conferences2012/GlobeNet12.html>



# BioSciencesWorld 2012

25-29 March 2012 - St. Maarten, Netherlands Antilles

## The Fourth International Conference on Bioinformatics, Biocomputational Systems and Biotechnologies

### **BIOTECHNO 2012**

**Deadline for papers: 5 November 2011**

### Biodevices:

Biosensors; Biochips; Specialized biodevices;  
Nanotechnology for biosystems

### Biomedical technologies:

Biomedical instrumentation; Biomedical metrology and certification;  
Biomedical sensors; Biomedical devices with embedded computers;  
Biomedical integrated systems, etc.

<http://www.iaria.org/conferences2012/BioSciencesWorld12.html>

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## Guide for Contributors

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### Aims and Scope

*Sensors & Transducers Journal* (ISSN 1726-5479) provides an advanced forum for the science and technology of physical, chemical sensors and biosensors. It publishes state-of-the-art reviews, regular research and application specific papers, short notes, letters to Editor and sensors related books reviews as well as academic, practical and commercial information of interest to its readership. Because of it is a peer reviewed international journal, papers rapidly published in *Sensors & Transducers Journal* will receive a very high publicity. The journal is published monthly as twelve issues per year by International Frequency Sensor Association (IFSA). In addition, some special sponsored and conference issues published annually. *Sensors & Transducers Journal* is indexed and abstracted very quickly by Chemical Abstracts, IndexCopernicus Journals Master List, Open J-Gate, Google Scholar, etc. Since 2011 the journal is covered and indexed (including a Scopus, Embase, Engineering Village and Reaxys) in Elsevier products.

### Topics Covered

Contributions are invited on all aspects of research, development and application of the science and technology of sensors, transducers and sensor instrumentations. Topics include, but are not restricted to:

- Physical, chemical and biosensors;
- Digital, frequency, period, duty-cycle, time interval, PWM, pulse number output sensors and transducers;
- Theory, principles, effects, design, standardization and modeling;
- Smart sensors and systems;
- Sensor instrumentation;
- Virtual instruments;
- Sensors interfaces, buses and networks;
- Signal processing;
- Frequency (period, duty-cycle)-to-digital converters, ADC;
- Technologies and materials;
- Nanosensors;
- Microsystems;
- Applications.

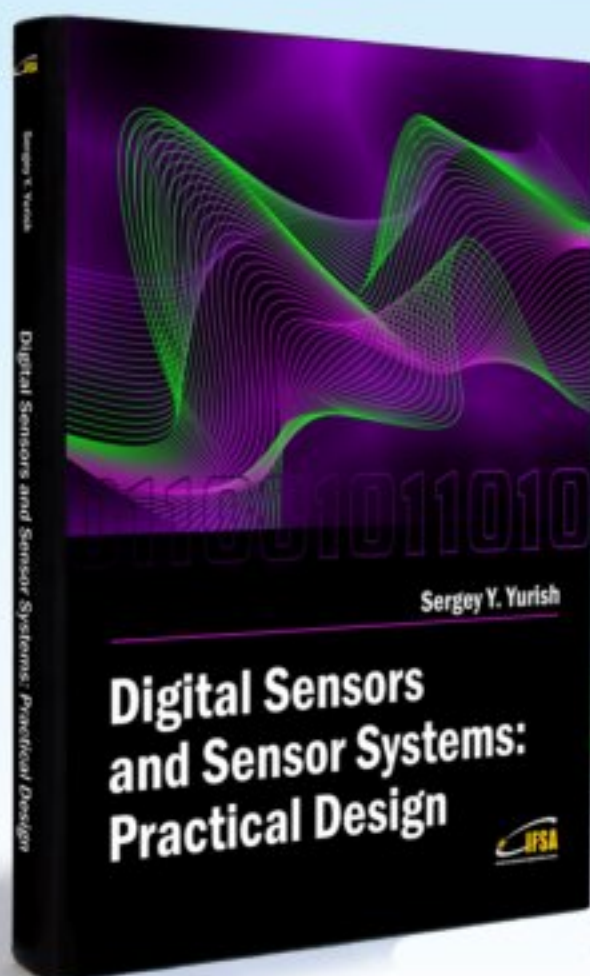
### Submission of papers

Articles should be written in English. Authors are invited to submit by e-mail [editor@sensorsportal.com](mailto:editor@sensorsportal.com) 8-14 pages article (including abstract, illustrations (color or grayscale), photos and references) in both: MS Word (doc) and Acrobat (pdf) formats. Detailed preparation instructions, paper example and template of manuscript are available from the journal's webpage: <http://www.sensorsportal.com/HTML/DIGEST/Submission.htm> Authors must follow the instructions strictly when submitting their manuscripts.

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