TRAFFIC SYSTEM USING FUZZY LOGIC

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Abstract— Traffic Congestion has become a serious problem in urban districts. Our current traffic systems are static, meaning they do not consider the present status of the traffic. This leads to more traffic in one lane, making other lanes empty. The main aim of our project is to introduce a dynamic traffic system that evaluates the real time traffic parameter like density of vehicles to design the signal time. We have implemented this using fuzzy logic for better efficiency.

Index Terms— Density, traffic control, IR sensors, Fuzzy logic

1.INTRODUCTION

Traffic congestion has many negative impacts on our country. It leads to unnecessary waste of time which leads in delay in time, like late arrival to important meetings, exams etc. It also causes unnecessary wastage of fuel increasing air pollution. This also increases stress and frustration in the motorists and drivers which increases the chances of accidents and road rage, causing harm to the health of the drivers. There are high chances of collisions between vehicles due to tight spacing and immediately starting or stopping the vehicle in such panic situations.

Intelligent traffic control system is the need of today's generation. It will help us to manage the traffic efficiently without changing the roadways. Depending on the real time parameters of traffic like density, we can design a system which uses the green signal depending on the number of vehicles in that particular lane. Fuzzy logic based traffic control system can be implemented in a 4-lane road. Signal improvement is one of the most cost effective method to reduce the problem of traffic congestion. It is a one-time investment, which along with proper maintenance will surely get us desired results.

This project includes a designed traffic system which works on FIS (Fuzzy Inference System) tool box. It has 1 input and 1 output. Density of the vehicles in a particular lane is the input. We can measure the density of the vehicles using IR sensor.

1.1 OVERVIEW OF THE SYSTEM

1.1.1 Implementation idea

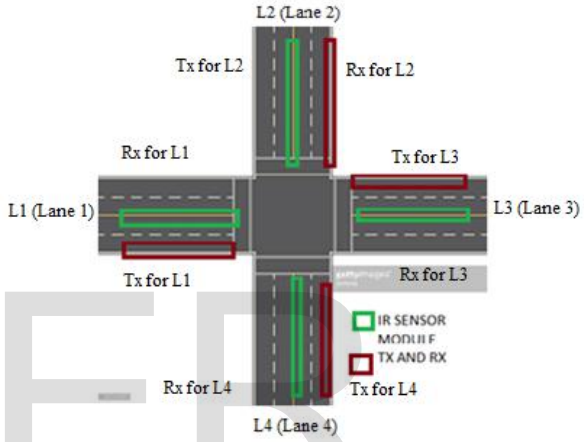

Fig. 1. Prototype for 4 lane road.

The above figure represents a four lane road having L1, L2, L3, L4 as first lane, second lane, third lane and fourth lane respectively. Tx represents transmitter and Rx represents receiver. Transmitter is present on one side of each of the lanes and receiver is present on the other side.

1.1.2 Block Diagram

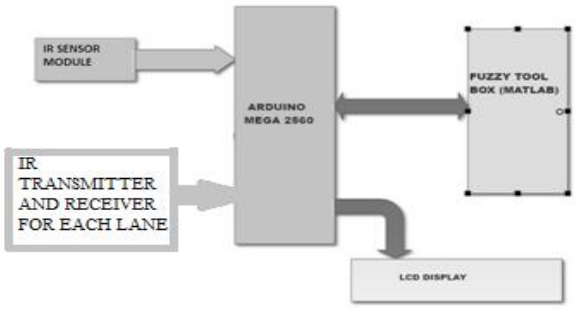

Fig. 2. Block diagram.

The block diagram above displays the assembly of our equipments.

2. Design steps

2.1 Fuzzy Inference System

We have used the 'Mamdani Fuzzy Inference System' for our system. 'Mamdani' was among the first control systems based on fuzzy theory.

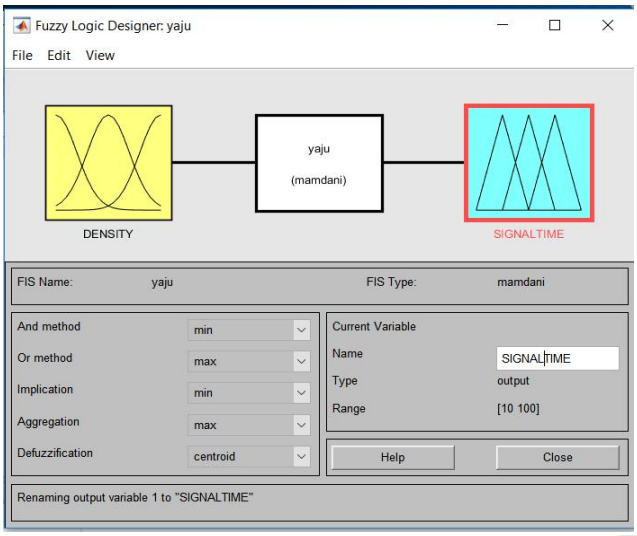

Fig. 3. Mamdani FIS Model.

The above figure shows the input and output of our system. They are explained below in detail.

2.2 Input

We have applied density of the vehicles as the input to the model.

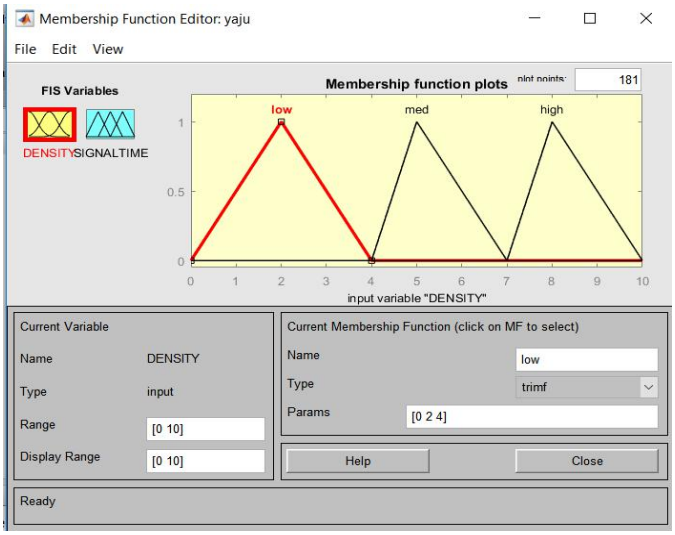

Fig. 4. Applied input.

In the above figure, input is defined in 3 ranges :

'**LOW**','**MEDIUM**' **and** '**HIGH**'depending on the number of vehiclesor the traffic in that lane.

LOW RANGE = 0-4
MEDIUM RANGE = 4-7
HIGH RANGE= 7-10

These values are considered for designing rules.
In practical implementation, the range of values can be different.

2.3 Output

Output of our designed system is the signal time or the time for which the green signal will remain ON.

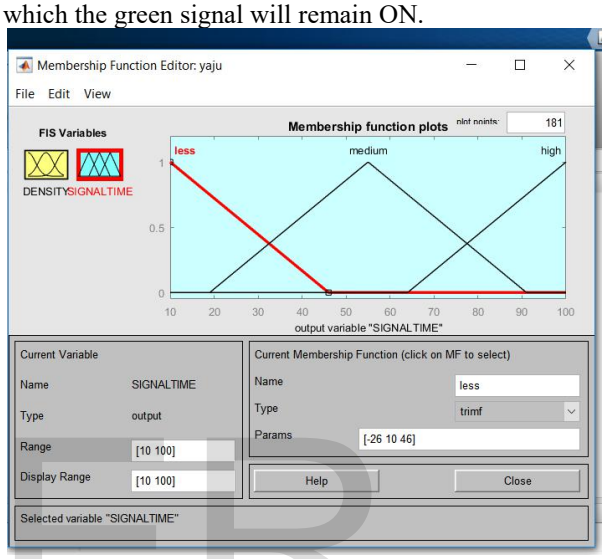

Fig. 5. Desired output.

In the output, again we have defined 3 different ranges '**LESS**','**MEDIUM**' **and** '**HIGH**'.
We have considered output in seconds for our model.

We have used Mamdani Inference System .To compute the output of this FIS based on given inputs, one must go through the below six steps-

1. Determining a set of fuzzy rules.
2. Fuzzifying the inputs using the input membership functions.
3. Combining the fuzzified inputs according to the fuzzy rules to establish a rule strength.
4. Finding the consequence of the rule by combining the rule strength and the output membership function.
5. Combining the consequences to get an output distribution.
6. Defuzzifying the output distribution (this step is used only if a crisp output (class) is needed).

3. Design Rules -

Considering the input and output, we have defined 3 rules according to which our system will work. They are as follows :

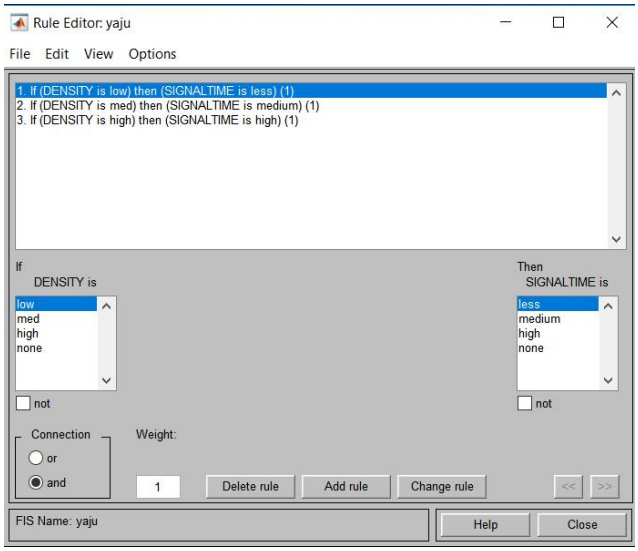

Fig. 6. Rule Editor

RULE 1- If the density of the vehicles is '**LOW**',then '**TIME**'for which the signal will remain green is '**LESS**'.

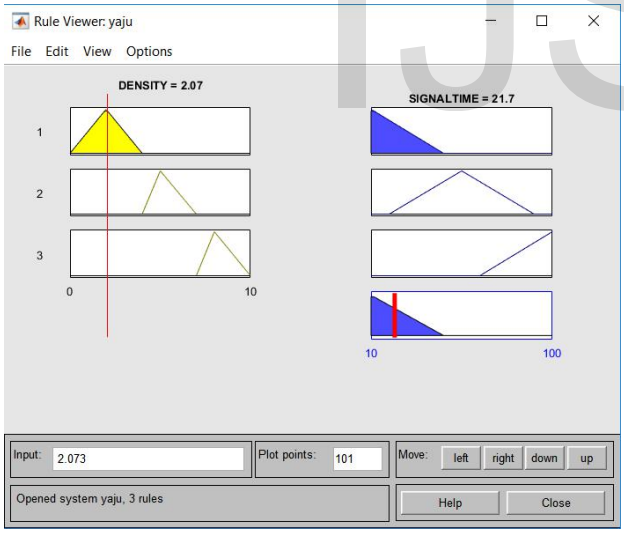

Fig.7. Rule 1

RULE 2- If the density of the vehicles is '**MEDIUM**', then'**TIME**' for which the signal will remain green is '**MODERATE**'.

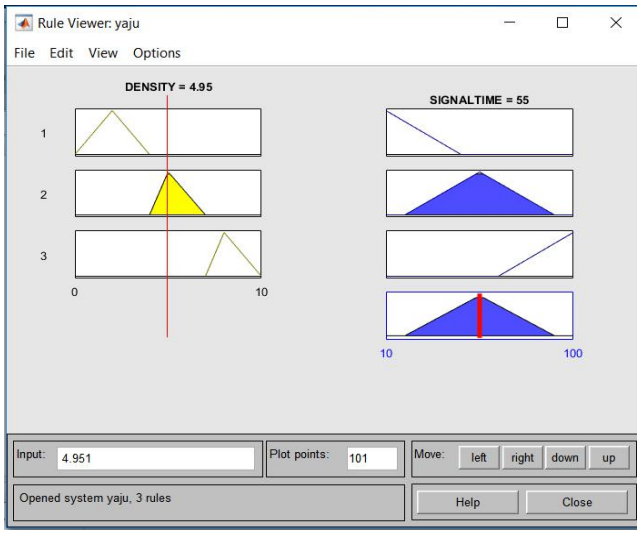

Fig. 8. Rule 2

RULE 3- If the density of the vehicles is'**HIGH**',then '**TIME**' for which the signal will remain green is '**HIGH**'.

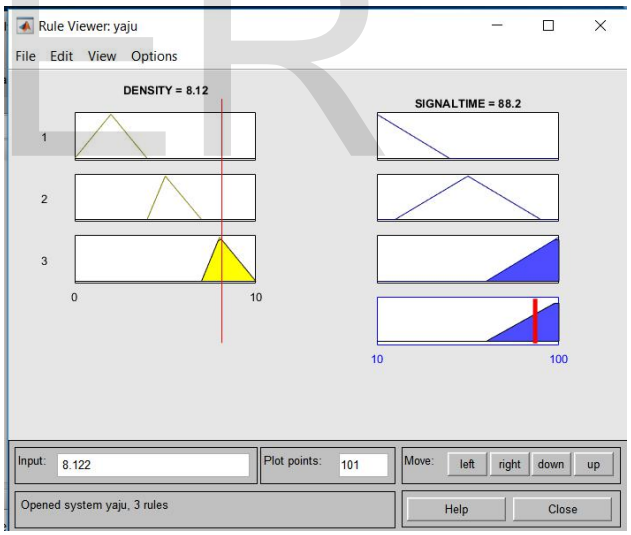

Fig. 9. Rule 3

4. Simulation

To interface **Arduino Mega** with Fuzzy toolbox**,**we have used Simulink in MATLAB. Simulink, developed by MathWorks, is a simulation and model-based design environment for dynamic and embedded systems, integrated with MATLAB. Simulink is a data flow graphical programming language tool for modeling, simulating and analyzing multi-domain dynamic systems. It is basically a graphical block diagramming tool with customizable set of block libraries.

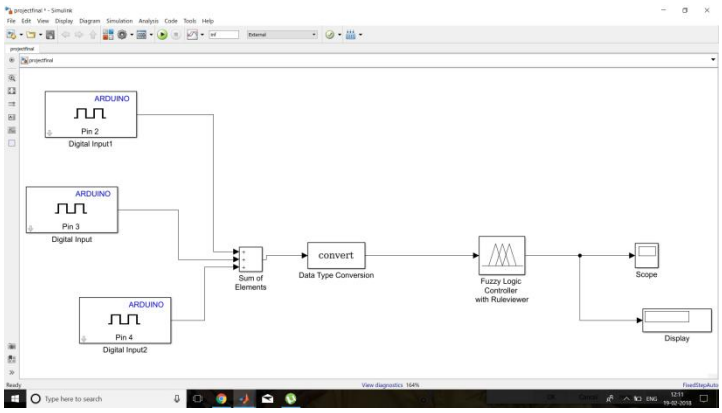

Fig. 10. Simulation model

Input is given to various digital pins on **Arduino Mega 2560** and added using adder. Then they are converted according to required data type and applied to the Fuzzy tool box. The Fuzzy tool box will consider the input and depending upon the rules it will give us desired defuzzified output. The output waveform will be displayed on the '**SCOPE**', and the time for which the signal will remain green will be displayed on the '**LCD**' display.

Arduino Mega 2560 will be connected to the **IR sensors** placed on opposite sides of the road. They play the most important role in determining the inputs to the proposed system.

5. Hardware Implementation

The hardware components used in fuzzy based traffic system are mentioned below with their working explained in short :

1.**Arduino Mega 2560-**Arduino Mega 2560 is used as a controller to operate all the digital components. It is interfaced with sensors, potentiometer, FIS tool box and LCD to get the proper results.

1. IR sensors- The IR transmitters and receivers are placed on the opposite side of the roads to determine the density of traffic in that lane. This plays a vital role in the traffic system.

2. LCD- LCD is used to display the output, which is nothing but the time for which the green signal will remain on.

6. Result

As seen in the picture below, use of LCD for displaying green signal time duration has not been done by us. In our model, the connections will be made using the same Arduino Mega 2560 and the necessary output will be achieved using MATLAB Simulink software, all the mentioned hardware components and prototype of vehicles. The time duration of green signal will be displayed on LCD. Also, we will be implementing our project on single lane prototype for simpler understanding in our actual model.

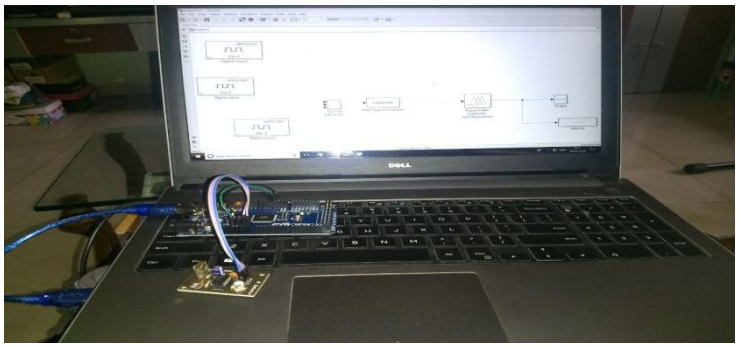
Fig. 11. Basic connection between hardware and software

7. Conclusion

Thus, we have successfully been able to deliver an efficient solution to the problem of traffic congestion using Fuzzy logic. Through this project, our target of reducing traffic by displaying the green signal based on the real time density of vehicles on road has been achieved.

Acknowledgment

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