International Journal of Mathematical Research
2020 Vol. 9, No. 1, pp. 62-71.
ISSN(e): 2306-2223
ISSN(p): 2311-7427
DOI: 10.18488/journal.24.2020.91.62.71

SMART PARKING SYSTEM USING FUZZY LOGIC CONTROLLER FOR ALIEN CITIES

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Article History
Received: 23 July 2020
Revised: 25 August 2020
Accepted: 14 September 2020
Published: 5 October 2020

Keywords
FIS (Fuzzy Interface System)
Fuzzy logic controller (FLC)
MATLAB
Linguistic input/ output
Smart parking system
Artificial intelligence
GPS.

ABSTRACT

Traffic is regarded as one of the biggest issues in cities especially in metropolitan areas with high population density. It is the cause of wastage of precious resources that include fuel, money, and most importantly time. One of the reasons for traffic jams is the people finding an appropriate place to park. To address the issue, various techniques have been implemented by different traffic management authorities, and systems of modern cars have been integrated with smart parking solutions. The fuzzy logic controller is regarded as an Artificial Intelligence product that may be used to alleviate the problem. Four linguistic inputs are used in the paper such that parking car unit, distance, number of traffic signals, and parking area to provide one output that is time. This Fuzzy Logic Controller will be useful for the drivers to locate the shortest track among other tracks in the least amount of time. Moreover, the issue of finding an appropriate parking spot can be solved.

Contribution/Originality: This study is one of very few studies which have investigated the application of Fuzzy Logic Controller in parking system. All the calculations are done using MATLAB's fuzzy logic controller toolbox and its mobile usability is also presented.

1. INTRODUCTION

Smart Parking and traffic control systems have extensively grown over the years with the growth of population and various new means of transport. Nowadays, route schemes and GPS systems are widely used. Most of the vehicles driven these days are equipped with such gadgets. Recent surveys suggest a great increase in road vehicles over the years. More accurately, a 32.6 % increase has been observed in road vehicles from 2005 to 2013 [1]. Two approaches are taken by different traffic control organizations to tackle this problem. The first method is to modify buildings and street structures in such a way that they have their own parking space one way or the other. The other is building computer-based solutions based on specific AI and machine learning solutions that guide the driver to a suitable parking spot by analyzing the area and locating parking sites.

A superior approach is the productive utilization of an attainable parking place. Several GPS enabled plans to get are connected in such a way that they find the most optimal path for the user. For instance, Retschers Mortal on a journey as a pedestrian, NAVIO [2] which highlights the thoughts of building conjecture by the combination of

different smart sensors for controlling guests in college or school offices. Presumably, in cell phones, it can also be integrated. In contrast, with the scholarly functions of the recent cell phones, the emphasis on blaze appliances is affected. Campbell and Choudhury [3]. To form a Nericell monetarily things are necessary [4]. And utilizing these in making pathways to perform vehicle-based applications, the benefit of sensors and features of cell phones are in a row [5]; [6]; [7]; [8].

Street activity is analyzed in Barkley mobile millennium project (USA) by the use of cell phone monitoring. This work incorporates GPA units to get in touch with the main unit and the vehicles. Hull, et al. [8] gives the best explanation of this work in which a gadget is placed in the vehicle to do the analysis using GPS and radio waves. This information is further used in required functions, for instance, Surface Street, traffic estimation workload, etc. In the 20th century, Smith-et-al worked to block cell phones utilizing the cell towers containing all information [9]. At the time and the location at which the analysis was done, the speed determined was the exact speed of the vehicle. If we consider the ITS structures, there are other divisions of analysis other than used in blockage of cell phones to create more sufficient cars. Accelerometers are being inserted which increases the lifetime of the device used [10]; [11]. This paper focuses on the utilization of Fuzzy Logic Control (FLC) to point out the parking locations. First control design was introduced by Mamdani [12]. After this development many techniques are suggested by Shen, et al. [13]; Shen, et al. [13]; Van Leekwijck and Kerre [14] to accurate and precise the fuzzy logic controller. After this development, many applications are presented by the researchers in different fields [15-18]. The application of FLC in finding the nearest gas station is used by Jafar, et al. [19].

2. PROPOSED MODEL

The study revolves around the point that due to the rise in the number of vehicles in the world, there is a major issue to park those vehicles. Moreover, with the growth of cities, it is causing wastage of important resources including fuel, time, and money. Figure 1 elaborates on a trip of a vehicle from starting to its destination. Now, the driver has three choices to park his vehicle at different distances. So, by Using the Fuzzy logic Control System, the driver will be able to find the nearby spot to park his vehicle. The driver is intended to go there in the minimum time. These four criteria are selected in the model:

- Four Linguistic inputs and an output.
- During the trip, how many traffic signals are sensed by the sensor?
- The measure of motor threshold on the way up to the final spot as shown by PCU (Parking Car Unit).
- The Separation between the parking spot and destination.

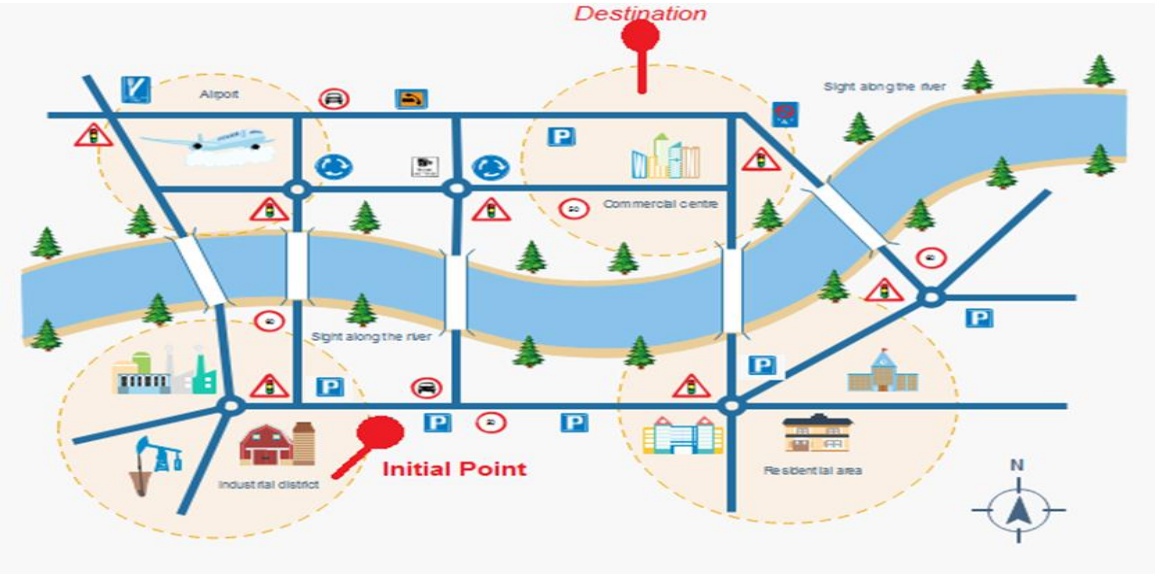

Figure-1. Initial problem model.

3. FLC MODEL AND CALCULATIONS

The commands of the four factors taken into consideration are not affected by the info and yield factors. Therefore, altering the info and yield factors will affect the model thus changing it or enhancing it. The adaptations are then based on info and yield factors in the following manner:

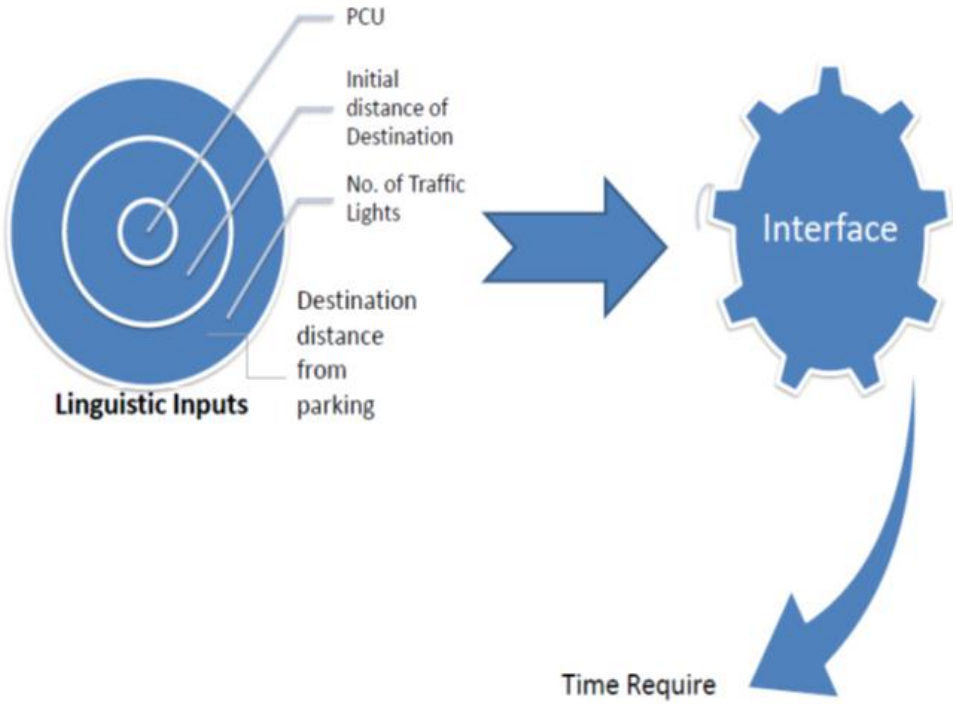

Figure-2. FLC approach of the proposed Model.

- Three Options are given in a median parking car unit
    - Normal
    - Medium
    - Dense
- Three belonging roles of traffic signals are titled as 1, 2, and 3 to represent the terms and equalize the name of the variables. The bases are arranged according to input variables.
- The names of several input variables were kept the same and considered suitable, but S and L were replaced by near and away.
- L, M, and H are replaced by normal, medium, and dense and are linked to traffic flow.

The data from the specialized person (driver) is required to alter the hypothesis (discoveries from research directed on for instance street clients, experts' activity guidelines and institutionalizations, area-based culture and conventions, climatic conditions, street systems, and so forth) therefore the changes done are only in information and yield factors.

3.1 Membership Function Editor

Fundamentally, this tool allows us to display and change the enrollment capacities linked to info and yield factors for the structures. This tool allows the Fuzzy Logic Designer enhanced features. The involvement of phonetic origins of info is displayed in the figure below.

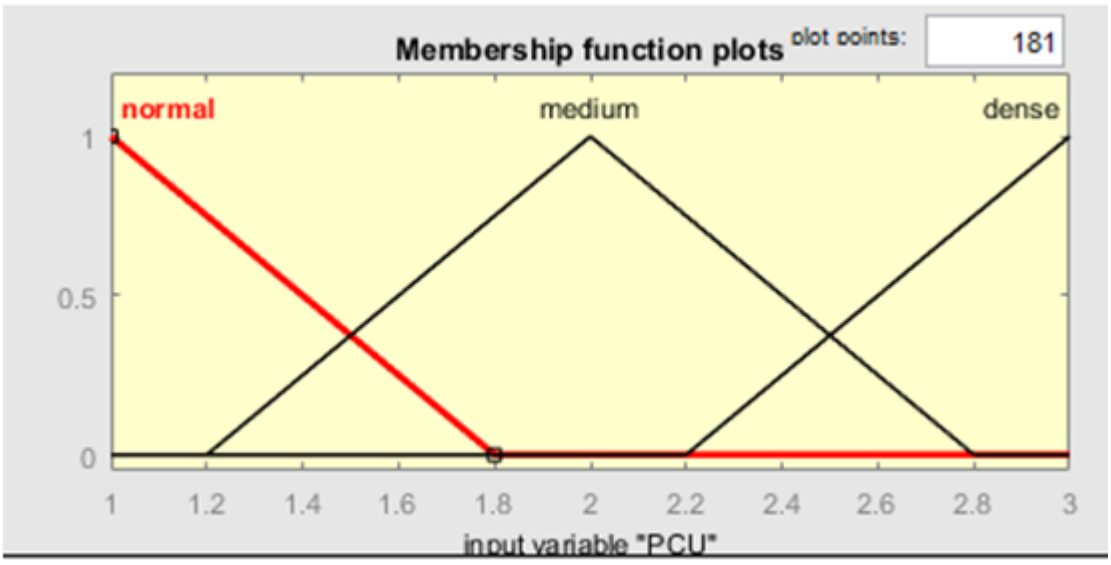

Figure-3 (a).

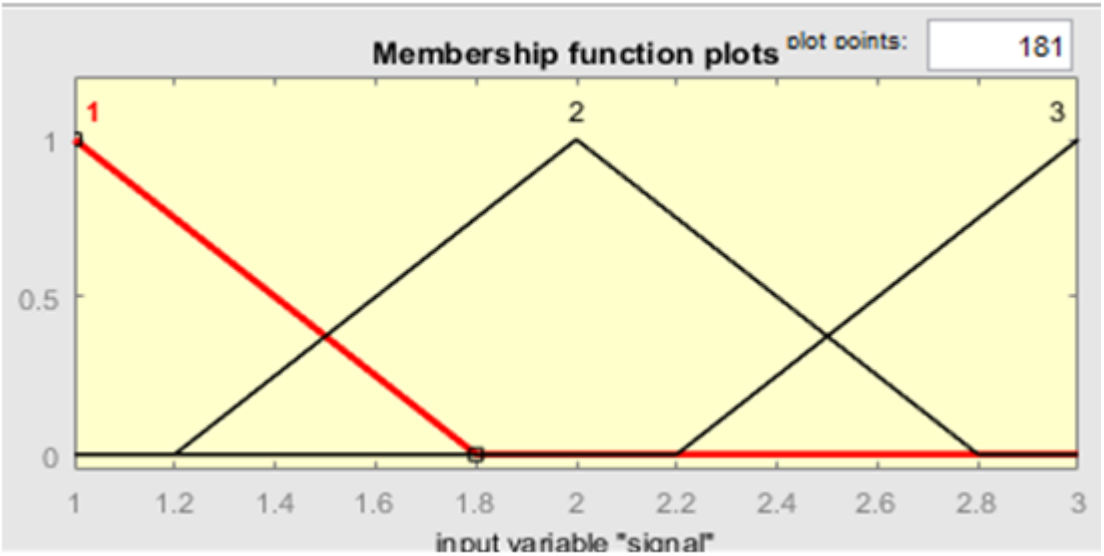

Figure-3 (b).

Figure-3 (c).

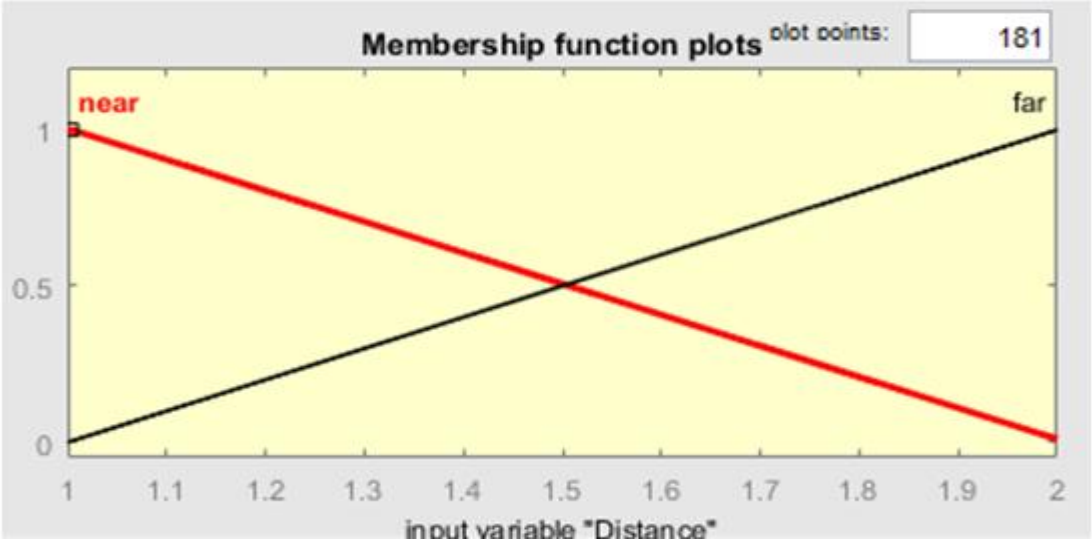

Figure-3 (d).

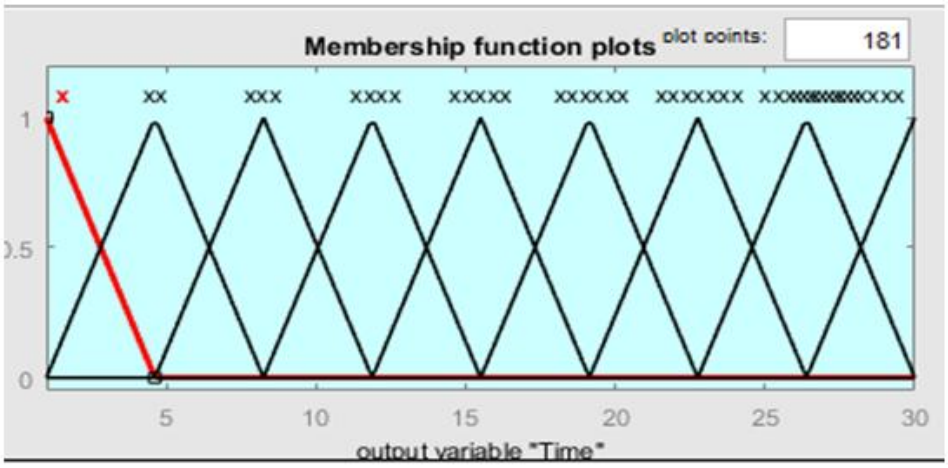

Figure-3 (e).

Figure-3. MF of inputs (a) (b) (c) (d) and output (e) variables.

3.2. The Rule Editor

For the calculation and deduction process, the rule viewer is a mentor portrayed in the past segment is pivot on fleecy deduction. In the window displayed below, there are ten plots positioned. At the top of the figure, three of them are being positioned:4 speak to the antecedent and evolving of the principle rule. Each level is a bar of plots and every portion is a variable. On the left of each column, the standard numbers are shown. The user can tap on a standard number to see the standard, to see the level on the status bar Figure 5 this possibility will depend upon the data esteem for the structures. The vertical bar represents the defuzzified yield and surface perspective of standards in the Figure 6.

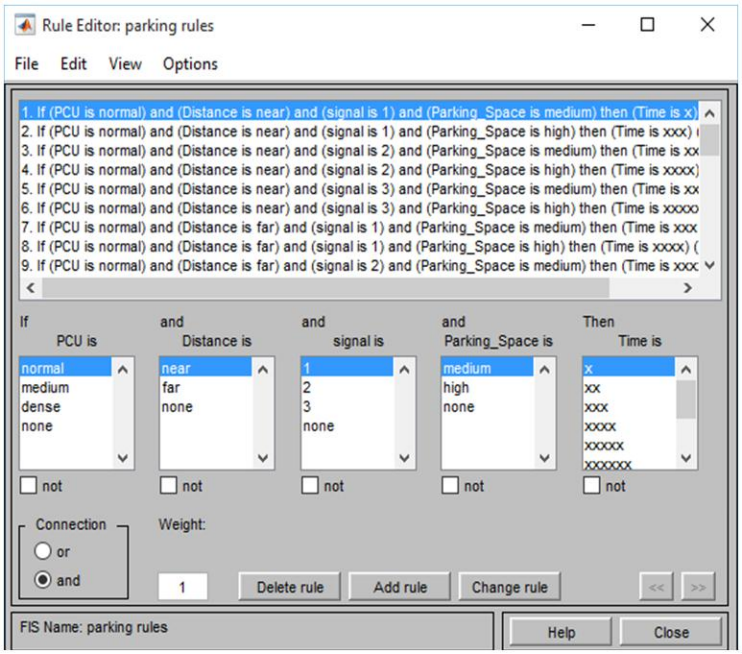

Figure-4. MATLAB rule editor.

Figure-5. MATLAB Rule Editor.

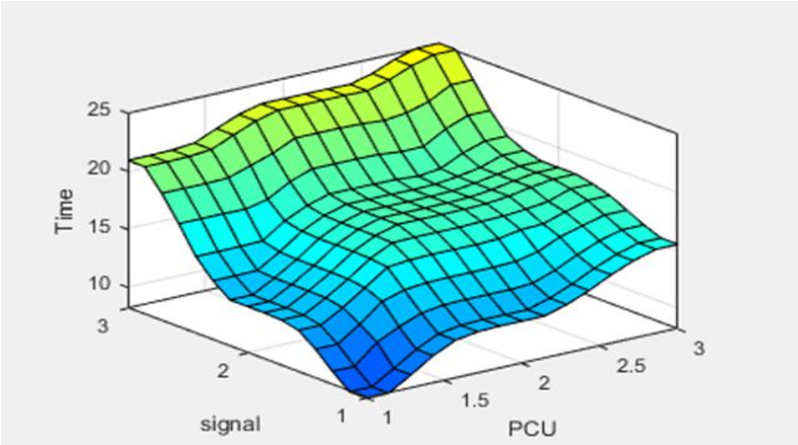

Figure-6. MATLAB surface viewers.

Table-1. Defuzzified results of proposed rules.

Linguistic Inputs					Linguistic Output
Serial no.	PCU	Distance	No. of Traffic signals	Parking space	Time Required
1	α	א	–	M	2.12
2	α	א	–	h	8.25
3	α	א	=	M	4.62
4	α	א	=	h	11.9
5	α	א	≡	M	15.5
6	α	א	≡	h	19.1
7	α	ב	–	M	8.2
8	α	ב	–	h	11.8
9	α	ב	=	M	15.3
10	α	ב	=	h	19
11	α	ב	≡	M	22.6
12	α	ב	≡	h	26.2
13	β	א	–	M	4.62
14	β	א	–	h	11.9
15	β	א	=	M	8.25
16	β	א	=	h	15.5
17	β	א	≡	M	19.1
18	β	א	≡	h	22.8
19	β	ב	–	M	11.7
20	β	ב	–	h	19
21	β	ב	=	M	18.9
22	β	ב	=	h	26.2
23	β	ב	≡	M	26.7
24	β	ב	≡	h	28.7
25	γ	א	–	M	8.25
26	γ	א	–	h	15.5
27	γ	א	=	M	11.9
28	γ	א	=	h	19.1
29	γ	א	≡	M	22.8
30	γ	א	≡	h	28.9
31	γ	ב	–	M	15.4
32	γ	ב	–	h	22.6
33	γ	ב	=	M	19
34	γ	ב	=	h	28.6
35	γ	ב	≡	M	26.3
36	γ	ב	≡	h	29.8

$\alpha = normal, \beta = medium, \gamma = dense$ a nd $\aleph = near, \beth = far\ also\ -represent\ 1, = represent\ 2, \equiv represent\ 3$ and

$\mathbb{M}$ *represent medium,* $\mathbb{h}$ *represent high*

3.3 Defuzzification

The input which consists of four elements and these four elements makes the program interlinked because it follows the commitments to the expert principles since it shows a large duration of time before a stopping point is considered. The results of the MATLAB sheet are shown in the Table: 1 shows the philosophy and experimental results with all obligations towards the respective outcome. The results of the reproduction in four of them explain that it requires minimal hypothesis for a driver to locate a stopping point and movement issues are kept under consideration in making judgments.

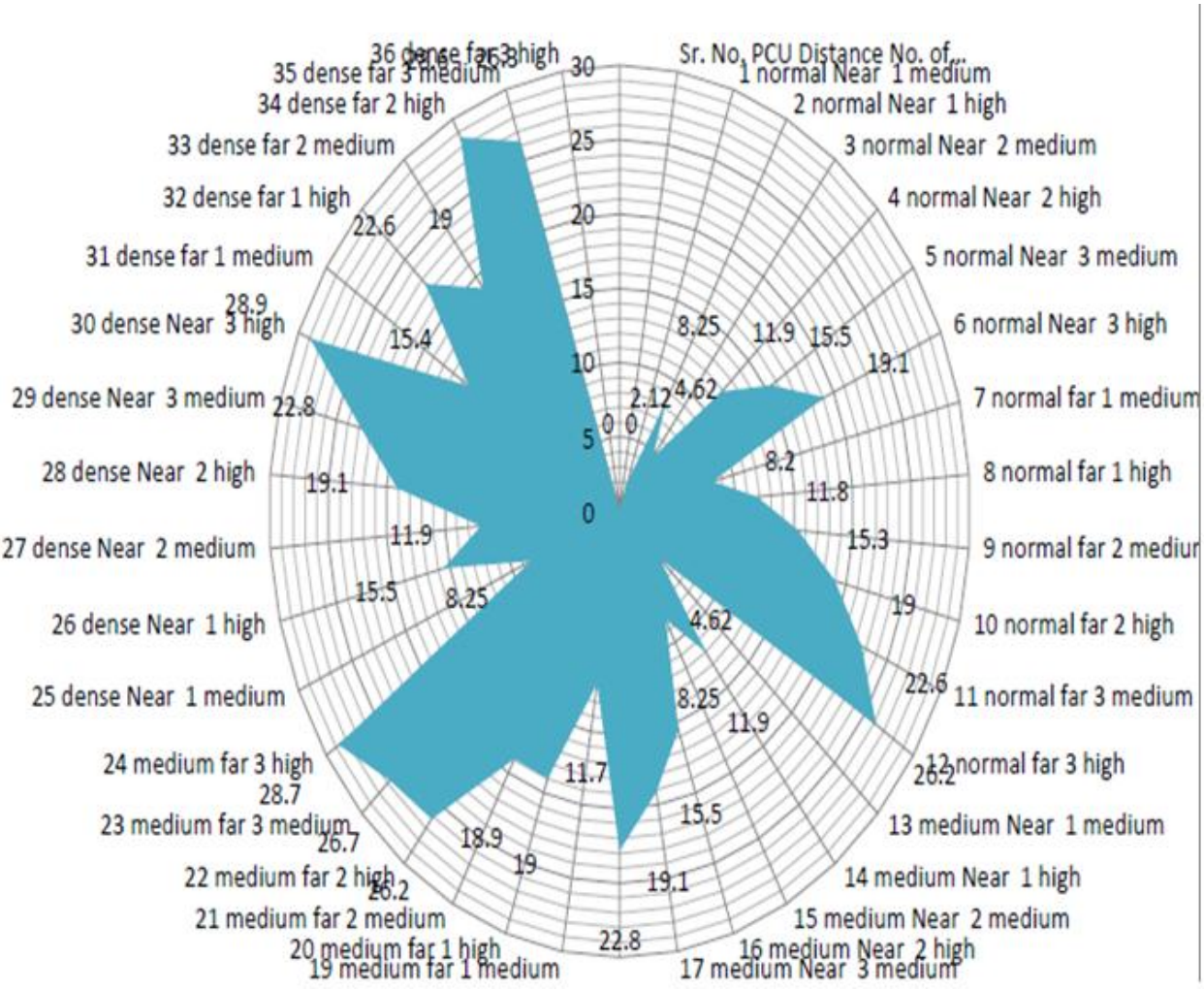

Figure-7. Graphically defuzzified results.

3.4 Mobile Usability

FLC is quite versatile and can be implemented in smart systems in numerous ways. To make an advantageous structure, the transportable usage of the event will alter the conditions and make new orders. Transport utilized circumstances are much better and unique as compared to stationary utilized circumstances.

Figure-8. Mobile Implementation

4. RESULT DISCUSSION

Through the diagram, the results shown are noticeably better. When the results are compared with the normal outcomes, the consequences show that this model is beneficial if implemented to a greater extent. To unfold this analysis MATLAB/ Fuzzy Rationale tool compartment has been deployed. This process is carried out by implementing the necessary mechanical and hardware designing ideas. The future of this result is to take Fuzzy Logic Control at a higher level. To bring corrections in sufficiency's, these undertakings could be recommended:

- By increasing the number of enrollment capacities to get more benefit from infrastructural factors.
- To accurately locate difficult locations to find, for example, corner stores, lodgings, and so on.
- The Fuzzy induction process can be performed.

Most importantly, the period of stopping for a vehicle (because every vehicle has a different size and weight) should be kept under consideration. It also affects the choice of parking spots by the motorist.

5. CONCLUSION

With an increase in population, the needs to travel are increasing thus increasing the number of vehicles resulting in the blockage of streets and limiting the number of parking slots for the motorist to park their vehicles. Another issue faced by the driver of the vehicle is the problem of locating a free slot for parking. Precious resources like time, money, and fuel are wasted during the struggle. This quest encouraged the man to find a solution, for example, the Fuzzy interface is a good approach utilizing MATLAB's tool to cover this problem. This will reduce the period to find the location precisely through the diagrams. The outcomes of these examinations are great. Moreover, these results give a better outcome as compared to other ways.

Funding: This study received no specific financial support.
Competing Interests: The authors declare that they have no competing interests.
Acknowledgement: All authors contributed equally to the conception and design of the study.

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