



APPLICATION OF FUZZY BASED METHODOLOGY IN SELECTION OF VEHICLE ACCORDING TO FUEL TYPE

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Abstract: Number of Private vehicles in India is growing very rapidly. Poor public transportation system in most of the urban cities has enforced many middle class to switch to own a vehicle for their daily commuting of family commuting. This paper is an attempt to choose suitable vehicle according to fuel type using fuzzy based methodology. Time is changing rapidly; climatic condition due to vehicular pollution is going to worst. So in addition to economy a number of other important factors should be considered at the time of buying vehicle. Using the proposed methodology a new customer can easily choose a proper fuel type for his individual requirement.

Index term: Fuzzy, Hybrid, Petrol, Fuel, Diesel

I. INTRODUCTION

Our fossil fuel sources are limited and depleting quickly. Petrol and diesel will eventually get all used up. Atop this are concerns regarding burning exhaust gases and particulate matter from vehicles adding to air pollution. Considering all these factors, the recent focus has shifted towards the use of alternative fuel sources for mobility. India still falls short in terms of awareness though. A number of options are at hand, Electric Vehicles, Hybrid technology and Hydrogen fuel cells. Hydrogen fuel cell powered vehicles are the most sensible

source, but unfortunately it will take years to install the infrastructure in place. Hybrids and electric cars are the only clever option, however due to the complexities of engine construction they cost a fortune [1]

II. CONCEPT OF FUZZY LOGIC

Fuzzy logic has rapidly become one of the most successful of today's technologies for complex decision making applications. The reason for which is very simple. Fuzzy logic addresses such applications perfectly as it resembles human decision making with an ability to generate precise solutions from certain or approximate information. While other approaches require accurate equations to model real-world behaviors, fuzzy design can accommodate the ambiguities of real-world in human language and logic. Although genetic algorithms and neural networks can perform just as well as fuzzy logic in many cases, fuzzy logic has the advantage that the solution to the problem can be cast in terms that human operators can understand, so that their experience can be used in the design of the controller. This makes it easier to mechanize tasks that are otherwise already successfully performed by humans. [2] In a broad sense, fuzzy logic refers to fuzzy sets - a set with unclear boundaries. Examples of fuzzy sets are "hot," "tall," "medium," etc. In a narrow sense, fuzzy logic is a logical system that aims to formalize approximate reasoning. In fuzzy logic a fuzzy symbol can take any truth

values from the closed set $[0, 1]$ of real numbers thus generalizing the Boolean truth values. As the technology was further embraced, fuzzy logic was used in more useful applications.

III. FUZZY SETS BACKGROUND

The precision of mathematics owes its success in large part to the efforts of Aristotle and the philosophers who preceded him. In their efforts to devise a concise theory of logic, and later mathematics, the so-called "Laws of Thought" were posited. One of these, the "Law of the Excluded Middle," states that every proposition must either be True or False. Even when, Parmenides proposed the first version of this law around 400 B.C.E. There were strong and immediate objections: for example, Heraclitus proposed that things could be simultaneously, True and not True. It was Plato who laid the foundation for what would become fuzzy logic, indicating that there was a third region (beyond True and False) where these opposites "tumbled about." Other, more modern philosophers echoed his sentiments, notably Hegel, Marx, and Engels.[3] But it was Lukasiewicz who first proposed a systematic alternative to the bi-valued logic of Aristotle.

In the early 1900's, Lukasiewicz described a three-valued logic, along with the mathematics to accompany it. The third value he proposed can best be translated as the term "possible" and he assigned it a numeric value between True and False. Eventually, he proposed an entire notation and axiomatic system from which he hoped to derive modern mathematics. Later, he explored four-valued logics, five-valued logics, and then declared that in principle there was nothing to prevent the derivation of an infinite-valued logic.

Lukasiewicz felt that three- and infinite-valued logics were the most intriguing, but he ultimately settled on a four-valued logic because it seemed to be the most easily adaptable to Aristotelian logic.

IV. FUZZY BRIEFS

The mechanisms which make fuzzy logic machines work, it is important to realize what fuzzy logic actually is. Fuzzy logic is a superset of conventional (Boolean) logic that has been extended to handle the concept of partial truth-truth values between "completely true" and

"completely false". As its name suggests, it is the logic underlying modes of reasoning which are approximate rather than exact. The importance of fuzzy logic derives from the fact that most modes of human reasoning and especially common sense reasoning are approximate in nature. The essential characteristics of fuzzy logic are as follows.

Knuth proposed a three-valued logic similar to Lukasiewicz's, from which he speculated that mathematics would become even more elegant than in traditional bi-valued logic.[4] His insight, apparently missed by Lukasiewicz, was to use the integral range 12 alternative failed to gain acceptance, and has passed into relative obscurity. It was not until relatively recently that the notion of an infinite-valued logic took hold. In 1965 Lotfi A. Zadeh published his seminal work "Fuzzy Sets" which described the mathematics of fuzzy set theory, and by extension fuzzy logic [5] This theory proposed making the membership function (or the values False and True) operate over the range of real numbers $[0.0, 1.0]$. New operations for the calculus of logic were proposed, and showed to be in principle at least a generalization of classic logic. It is this theory which we will now discuss.

- In fuzzy logic, exact reasoning is viewed as a limiting case of approximate reasoning.
- In fuzzy logic everything is a matter of degree.
- Any logical system can be fuzzified
- In fuzzy logic, knowledge is interpreted as a collection of elastic or, equivalently, fuzzy constraint on a collection of variables.
- Inference is viewed as a process of propagation of elastic constraints.

The third statement hence, defines Boolean logic as a subset of Fuzzy logic.

V. FUZZY SETS THEORY

Fuzzy Set Theory was formalised by Professor Lotfi Zadeh at the University of California in 1965. [6] What Zadeh proposed is very much a paradigm shift that first gained acceptance in the Far East and its successful application has ensured its adoption around the world. A paradigm is a set of rules and regulations which

defines boundaries and tells us what to do to be successful in solving problems within these boundaries. For example the use of transistors instead of vacuum tubes is a paradigm shift - likewise the development of Fuzzy Set Theory from conventional bivalent set theory is a paradigm shift. Bivalent Set Theory can be somewhat limiting if we wish to describe a 'humanistic' problem mathematically

VI. SELECTION OF VEHICLE BASED ON FUELTYPE

To buy a vehicle is an important time to general person. He should keep each and every fact in

mind. Present day demand of petrol and gas cars is increasing and demand of diesel car is going to decrease because of likely same prices of diesel and petrol. [6] Figure 1 and 2 shows the comparisons of diesel and petrol vehicles market share. And it is clear from these figures but there are many factors which affect the choice for a vehicle according to fuel type. These factors are discussed in table 1 and 2. These factors may be suitably modified according to their applicability in a particular situation

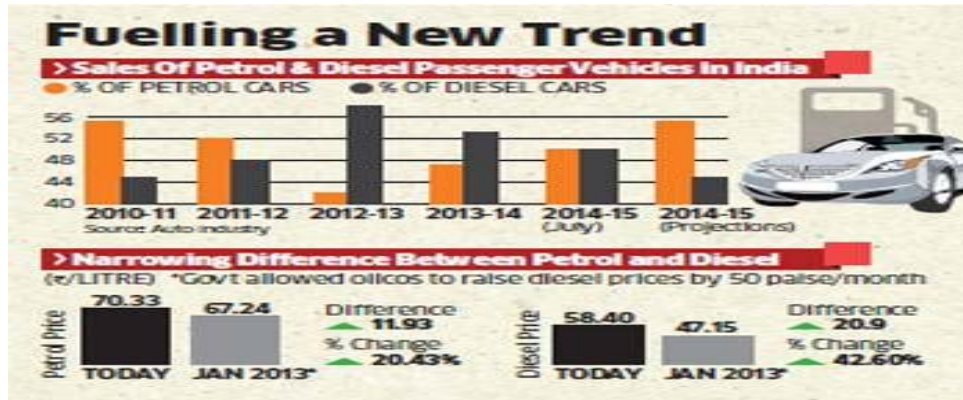


Figure 1: Sales trend of Petrol and diesel cars [7]

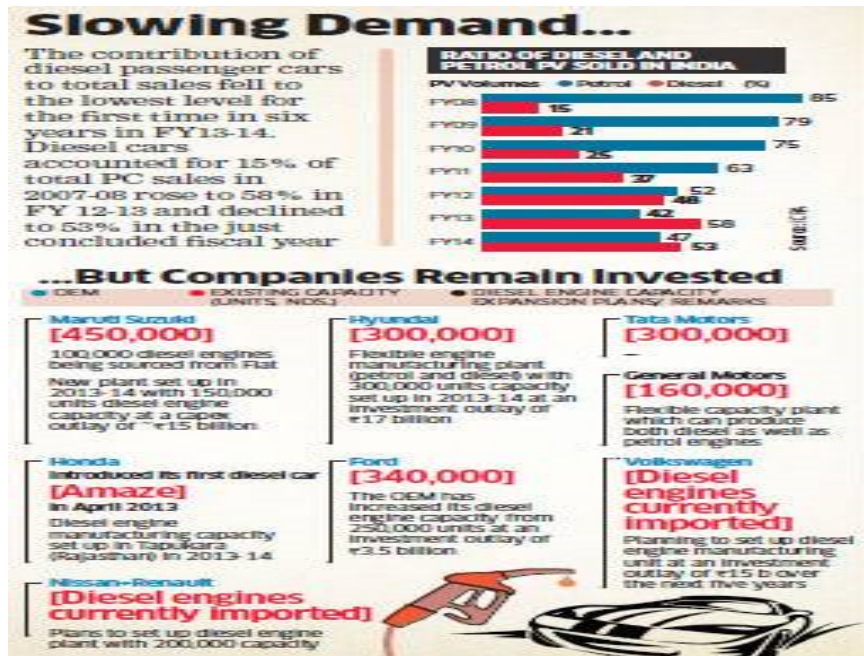


Figure 2: Reduction of the demand of Diesel Cars in India [8]

VII. SELECTION CRITERIA:

Selection of vehicle for a person is an important factor. In this paper, there are following 7 representative factors have been considered, though nit can be modified to incorporate any other factor.

1. Price
2. Environment Impact
3. Availability of fuel
4. Daily Running requirement
5. Load
6. Climate condition
7. Maintenance

Price: if a person does not have money, he cannot arrange his requirements but has to manage all things for his family in limited resources. In case of buying vehicle, he has to see all the aspects related to money and post expenses in fuel so price of fuel is important factor for a person who is buying vehicle.

Environment Impact: To keep clean environment is our responsibility. We should keep in mind this factor, when we do any work. So Environment Impact factor is also important in present scenario while pollution has become more discussion issue.

Availability of fuel: Friends indeed, friends in need, whether a fuel why not a so good but this is not available, it is meaningless for us. So we have to choose that fuel which is easily available.

Daily Running requirement: A person travel daily from one place to other, his requirement depends on this.

Load: According his purpose, vehicle has to bear that load.

Climate condition: Temperature, pressure, road condition are also factor , which has to keep in mind while buying vehicle.

Maintenance: To buy a vehicle is easy but, it is very difficult of its maintenance.

Table 1: Fuel Selection criteria and respective weight factors

S. No.	Selection factor	Notation	Weight factor	Person's Rating	Weighted rating
1	Price	P	W_1	R_1	$W_1 * R_1$
2	Environment Impact	E	W_2	R_2	$W_2 * R_2$
3	Availability of fuel	A	W_3	R_3	$W_3 * R_3$
4	Daily Running requirement	R	W_4	R_4	$W_4 * R_4$
5	Load	L	W_5	R_5	$W_5 * R_5$
6	Climatic condition	C	W_6	R_6	$W_6 * R_6$
7	Maintenance	M	W_7	R_7	$W_7 * R_7$
	Total weightage		$\sum W_i$	$\sum R_i$	$\sum R_i * W_i$

$$Membership\ value = \frac{\sum(R_i * W_i)}{(\sum W_i * R_{max})}$$

Illustrative example

Table 2: Illustrative example

S. No.	Selection factor	Weight factor	S.I.(Petrol & CNG)		C.I.(Diesel)		EL(SOLAR & HYBRID)	
			Person's Rating for C1	Weighted rating C1	Person's Rating for C2	Weighted rating C2	Person's Rating for C3	Weighted rating C3
1	Price	0.55	6	3.3	8	4.4	9	4.95

2	Environment Impact	0.9	6	5.4	5	4.5	9	8.1
3	Availability of fuel	0.7	7	4.9	7	4.9	5	3.5
4	Daily Running requirement	0.85	6	5.1	8	6.8	4	3.4
5	Load	0.75	7	5.25	8	6	4	3
6	Climatic condition	0.7	6	4.2	4	2.8	7	4.9
7	Maintenance	0.5	7	3.5	9	4.5	8	4
	Total	4.95		31.65		33.9		31.85
	Membership value		0.6393 94		0.684 848		0.643 434	

VIII. CONCLUSION:

Selection of the fuel type for the vehicle is a very complex problem for the first time vehicle buyers. Present fuzzy based approach is an attempt to help the vehicle buyer in the selection of type of fuel , It takes care of the environmental, availability of the fuel, climatic factors etc. Thus it is a suitable method for this problem.

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