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Using Database and Fuzzy Logic for Static and Dynamic Fitness Tests Representation

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Abstract. The fitness's dynamic and static tests require the person being tested to run or walk as far as possible in a determined period, depending on some main factors it can be decide the status of the athletic. This work aims to create databases dedicated for dynamic and static fitness tests utilizing fuzzy logic to estimates athletic tests in different ages. The procedure of this work is divided into two steps, first determining the factors for processing, the second is the databases and FIS construction. The determined databases are considered as an inputs and output for proposed fuzzy logic system. There are two inputs (Age, Distance) and one output (Status), the membership functions for the first input (Age) are (Young Adults_A, Young Adults_B, Young Adults_C, Young Adults_D, Middle Aged_A, Middle Aged_B), the membership functions for the next input (Distance) are (Very Short, Short, Medium, Long, Very long), while the membership functions of the determined output (Status) are (Very Good, Good, Accepted, Bad, Very Bad). The procedure for creating proposed fuzzy logic structure is repeated twice, one for male and other for female**.**

Keywords. Fuzzy Logic, Olympic Athletes, Fuzzy Database, Fitness Tests Representation.

1. Introduction

The use of numerous technologies by Athletics, students and other specialists today calls for new competencies[1]. Over the past few years, technology and media resources have played an important role in our world to improve the status of our daily business and experiences. On the other hands, a steady increase in the number of half marathon races has been observed [2]. Although they have an impact on management, research works for ensuring lifetime have rarely been explored[3]. An endless variety of truth values between "True" and "False" are introduced by fuzzy logic. Any truth value between "True" and "False" resides in the range between "0" and "1," with True being represented by "1" and False by "0."[4]. An interface for users to access information from databases using sentences of natural language is called a fuzzy query system.[5]. The use of fuzzy analysis to issues for which precise

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formulation is not feasible and the uncertainty in the problem parameters is not probabilistic uncertainty has been one of its main goals.[6]. Fuzzy logic will be used to carry out query optimization [7].

There is no doubt that one of the most important techniques used to calculate estimations in decision-making systems is the Fuzzy Inference System (FIS), which has been employed in many issues of decision-making and classification/prediction. [8]. The creation of expert applications that can mimic the production thinking of experts is necessary due to the use of inadequately formalized specialist knowledge in computerized complexes[9]. The paper is sectioned into an introduction, membership functions, methodology of the proposed work which includes two steps: determining the athletic main factors, processing these factors using Fuzzy Logic system, the obtained results for the proposed work and finally the conclusions for the proposed work

2. Membership Functions

Using a collection of input membership functions, fuzzification aims to convert inputs from a range of databases into values between 0 and 1[10]. A data capture system is used to provide very accurate measurement results and eliminate reading-error or cheating practice measurement data[11]. The definition of the membership function is the technique or method used to overcome scientific problems based on experience, not knowledge. A data capture system is used to provide very accurate measurement results and eliminate reading-error or cheating practice measurement data[12].

3. Methodology

In this paper, a model is designed for estimating the status of athletics fitness depending on some determined factors by combining fuzzy rules set and database with an athletic fitness to determine the status. The work is partitioned into two major steps; first is factors processing and second is constructing Fuzzy Inference System FIS for the determined factors. For the first step, we extracted the required factors from the databases that explained in Figure1:

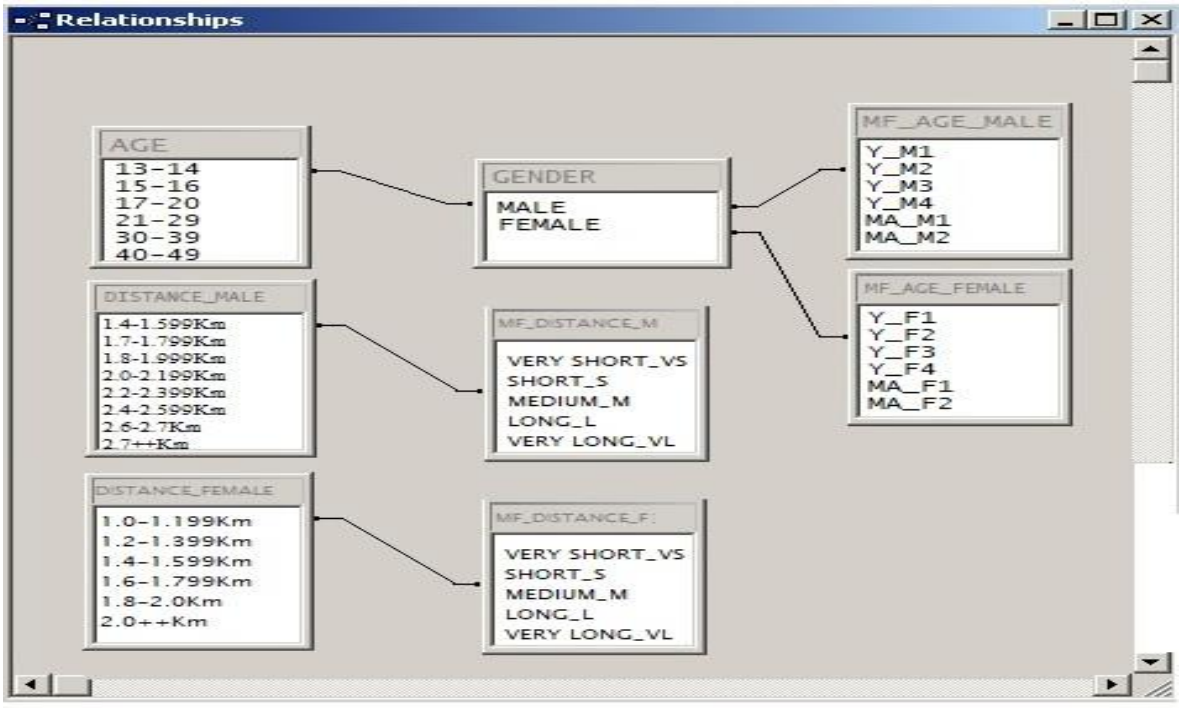

Figure1: Constructed database for dynamic fitness

Depending on the database in Figure1, we constructed fuzzy inference system with two inputs, first input is (Age), with 6 membership functions as explained in the table below:

Table 1: Database of Membership functions for the input (Age)

Membership function	Symbols	Age duration
Young adults_M1	Y_M1	13-14
Young adults_F1	Y_F1	
Young adults_M2	Y_M2	15-16
Young adults_F2	Y_F2	
Young adults_M3	Y_M3	17-20
Young adults_F3	Y_F3	
Young adults_M4	Y_M4	21-29
Young adults_F4	Y_F4	
Middle_aged_M1	MA_M1	30-39
Middle_aged_F1	MA_F1	
Middle_aged_M2	MA_M2	40-49
Middle_aged_F2	MA_F2	

For the second input (Distance), Fuzzy Membership Function made up of Gaussian, triangular, and trapezoidal functions. Finding the most practical, ideal, and straightforward membership function is the goal in order to minimize computation requirements [13]. We designed membership functions as explained in the table below:

Table 2: Database of Membership functions for the input (Distance (Male, Female))

Membership function	Symbols	Distance_Male	Distance_Female
Very_Short	VS	1.4-1.699	-1.2 – 1.5
Short	S	1.7-1.999	1.2-1.599
Medium	M	2.0-2.299	1.5-1 899
Long	L	2.3-2.699	1.9-1.999
Very_Long	VL	2.7++	+2.0

For the determined output (Status), we designed membership functions as explained in the table below:

Table 3: The Output (Status) Membership functions

Output	Membership functions				
Status	Very_Bad	Bad	Average	Good	Very_Good

4. Proposed Fuzzy Rules.

The next step after designing the general structure of the determined system is designing the fuzzy rules. As in Table 4, the proposed membership functions have been configured in this research for each of the inputs and outputs of the fuzzy logic rules set. After that, fuzzy logic rules were applied to specific inputs (Age and Distance), and later the result was compared with the membership functions of the specific outputs of the system (state) in order to determine the status of the particular case. The general structure of the proposed work is implemented through two steps, the first step by analysing and extracting the data set, and the second by applying the fuzzy inference system (Fuzzification, Building the proposed membership functions and removing Defuzzification), see Figure 2.

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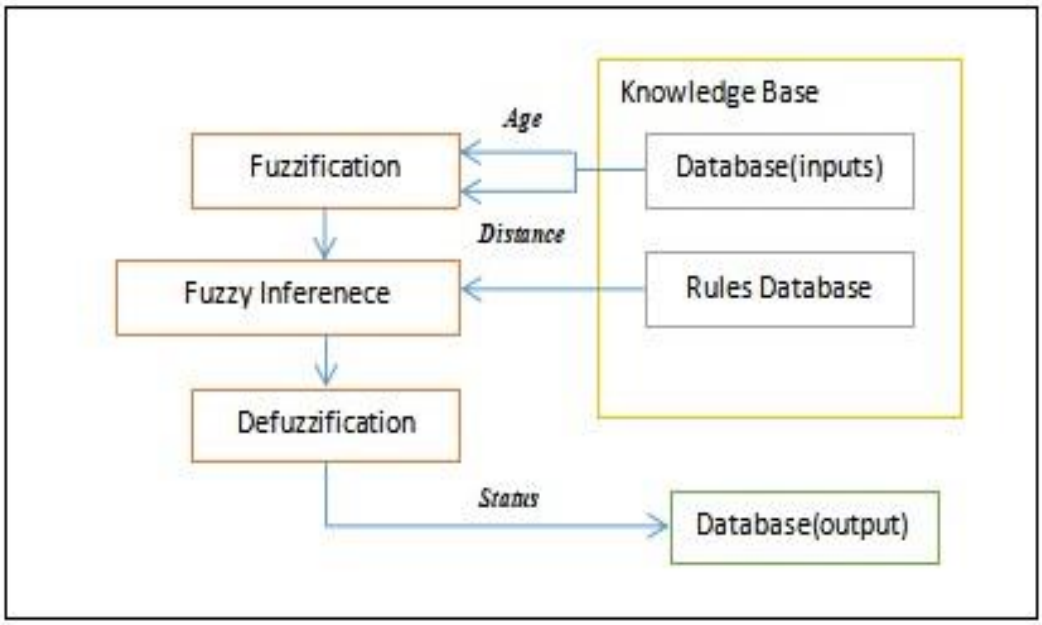

Figure2: The outline structure of the proposed work

The mechanisms for managing databases take into account the power of data and mechanisms for controlling its dissemination, all of which can be accomplished through efficient program operation with no risk or danger[14]. The process of analysing and extracting the tests dataset is achieved depending on the database displayed in Table 4:

Table 4: Static and dynamic fitness database

Age	Gender	Very Good	Good	Average	Bad	Very Bad
13-14	Male	2.7+ km	2.4-2.7 km	2.2-2.399 km	2.1-2.199 km	2.1- km
	Female	2.0+ km	1.9-2.0 km	1.6-1.899 km	1.5- 1.599 km	1.5- km
15-16	Male	2.8+km	2.5-2.8 km	2.3-2.499 km	2.2-2.299 km	2.2- km
	Female	2.1+ km	2.0-2.1 km	1.7-1.999 km	1.6-1.699 km	1.6- km
17-20	Male	3.0+ km	2.7-3.0 km	2.5-2.699 km	2.3-2.499 km	2.3- km
	Female	2.3+ km	2.1-2.3 km	1.8-2.099 km	1.7-1.799 km	1.7- km
21-29	Male	2.8+ km	2.4-2.8 km	2.2-2.399 km	1.6-2.199 km	1,6- km
	Female	2.7+ km	2.2-2.7 km	1.8-2.199 km	1.5-1.799 km	1.5 km
30-39	Male	2.7+ km	2.3-2.7 km	1.9-2.299 km	1.5-1.899 km	1.5- km
	Female	2.5+ km	2.0-2.5 km	1.7-1.999 km	1.4-1.699 km	1.4- km
40-49	Male	2.5+ km	2.1-2.5 km	1.7-2.099 km	1.4-1.699 km	1.4- km
	Female	2.3+ km	1.9-2.3 km	1.5-1.899 km	1.2-1.499 km	1.2- km

Table 5: The structure of the proposed fuzzy rules

Rule No.	Fuzzy Rules
1-	**If** *Age is Y_M1* **or** *Y_F1* **and** *Distance is VS* **then** *Status is Very_bad*
2-	**If** *Age is Y_M1* **or** *Y_F1* **and** *Distance is S* **then** Status is Bad
3-	**If** *Age is Y_M1* **or** *Y_F1* **and** *Distance is M* **then** *Status is Average*
4-	**If** *Age is Y_M1* **or** *Y_F1* **and** *Distance is L* **then** *Status is Good*
5-	**If** *Age is Y_M1* **or** *Y_F1* **and** *Distance is VL* **then** *Status is Very_Good*
6-	**If** *Age is Y_M2* **or** *Y_F2* **and** *Distance is VS* **then** *Status is Very_bad*
7-	**If** *Age is Y_M2* **or** *Y_F2* **and** *Distance is S* **then** *Status is Bad*
8-	**If** *Age is Y_M2* **or** *Y_F2* **and** *Distance is M* **then** *Status is Average*
9-	**If** *Age is Y_M2* **or** *Y_F2* **and** *Distance is L* **then** *Status is Good*
10-	**If** *Age is Y_M2* **or** *Y_F2* **and** *Distance is VL* **then** *Status is Very_Good*
11-	**If** *Age is Y_M3* **or** *Y_F3* **and** *Distance is VS* **then** *Status is Very_bad*
12-	**If** *Age is Y_M3* **or** *Y_F3* **and** *Distance is S* **then** Status is Bad
13-	**If** *Age is Y_M3* **or** *Y_F3* **and** *Distance is M* **then** *Status is Average*
14-	**If** *Age is Y_M3* **or** *Y_F3* **and** *Distance is L* **then** *Status is Good*
15-	**If** *Age is Y_M3* **or** *Y_F3* **and** *Distance is VL* **then** *Status is Very_Good*
16-	**If** *Age is Y_M4* **or** *Y_F4* **and** *Distance is VS* **then** *Status is Very_bad*
17-	**If** *Age is Y_M4* **or** *Y_F4* **and** *Distance is S* **then** Status is Bad
18-	**If** *Age is Y_M4* **or** *Y_F4* **and** *Distance is M* **then** *Status is Average*
19-	**If** *Age is Y_M4* **or** *Y_F4* **and** *Distance is L* **then** *Status is Good*
20-	**If** *Age is Y_M4* **or** *Y_F4* **and** *Distance is VL* **then** *Status is Very_Good*
21-	**If** *Age is MA_M1* **or** *MA_F1* **and** *Distance is VS* **then** *Status is Very_bad*
22-	**If** *Age is MA_M1* **or** *MA_F1* **and** *Distance is S* **then** Status is Bad
23-	**If** *Age is MA_M1* **or** *MA_F1* **and** *Distance is M* **then** *Status is Average*
24-	**If** *Age is MA_M1* **or** *MA_F1* **and** *Distance is L* **then** *Status is Good*
25-	**If** *Age is MA_M1* **or** *MA_F1* **and** *Distance is VL* **then** *Status is Very_Good*
26-	**If** *Age is MA_M2* **or** *MA_F2* **and** *Distance is VS* **then** *Status is Very_bad*
27-	**If** *Age is MA_M2* **or** *MA_F2* **and** *Distance is S* **then** Status is Bad
28-	**If** *Age is MA_M2* **or** *MA_F2* **and** *Distance is M* **then** *Status is Average*
29-	**If** *Age is MA_M2* **or** *MA_F2* **and** *Distance is L* **then** *Status is Good*
30-	**If** *Age is MA_M2* **or** *MA_F2* **and** *Distance is VL* **then** *Status is Very_Good*

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5. Experience and Results

Information, expertise, and data are intangible assets for any business, and the effectiveness of these assets depends on how effectively they are processed and distributed to users in a way that best satisfies their needs[15]. The Internet, fuzzy logic, and fuzzy group theory have all contributed to expanding the explanation of derivative concepts used to solve medium to high-complexity problems that support the decision-making simulation process [16]. In this work, the MATLAB application was used in the software part by using the functions of the fuzzy logic toolbox, in order to obtain a computer model that shows both the user and the fuzzy inference in order to assist in obtaining an empirical decision for the best control decision.

The membership functions for both inputs and output are explained in the Figures 3-5.

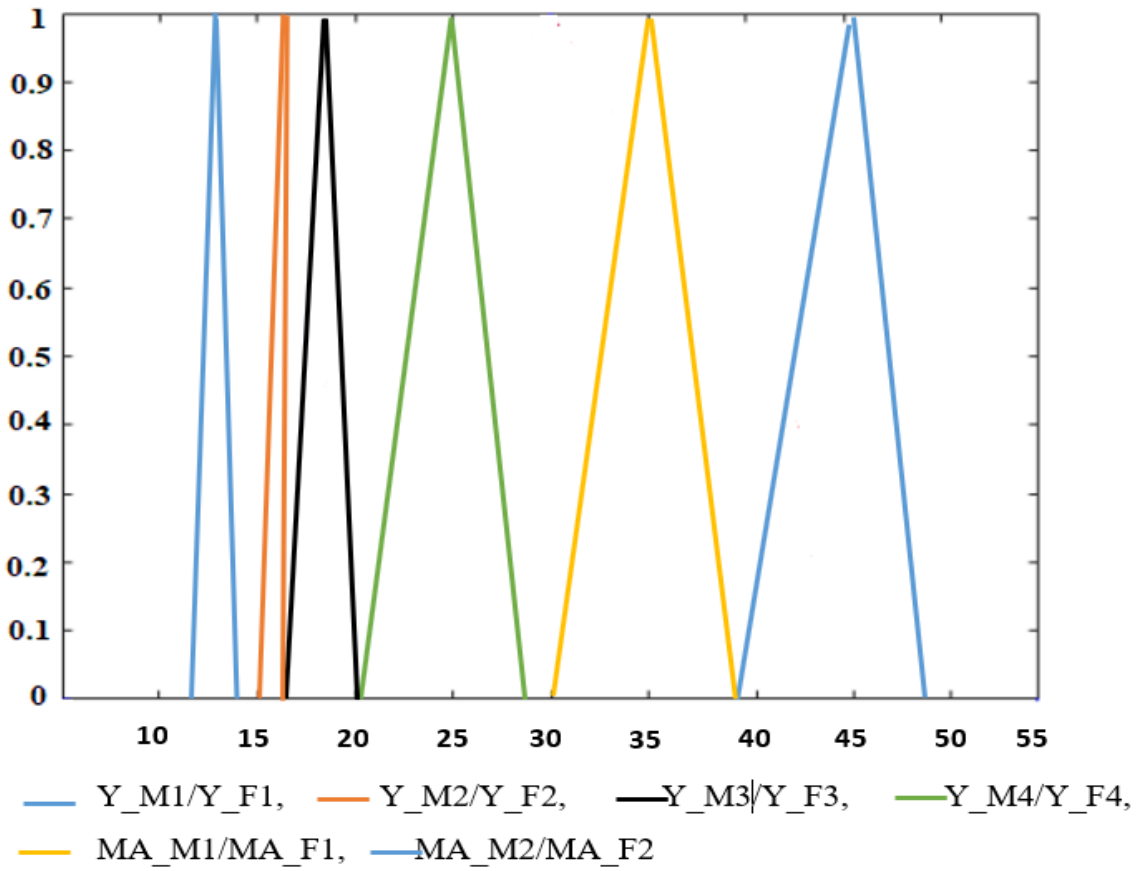

Figure 3: Membership functions plot the input ***Age***

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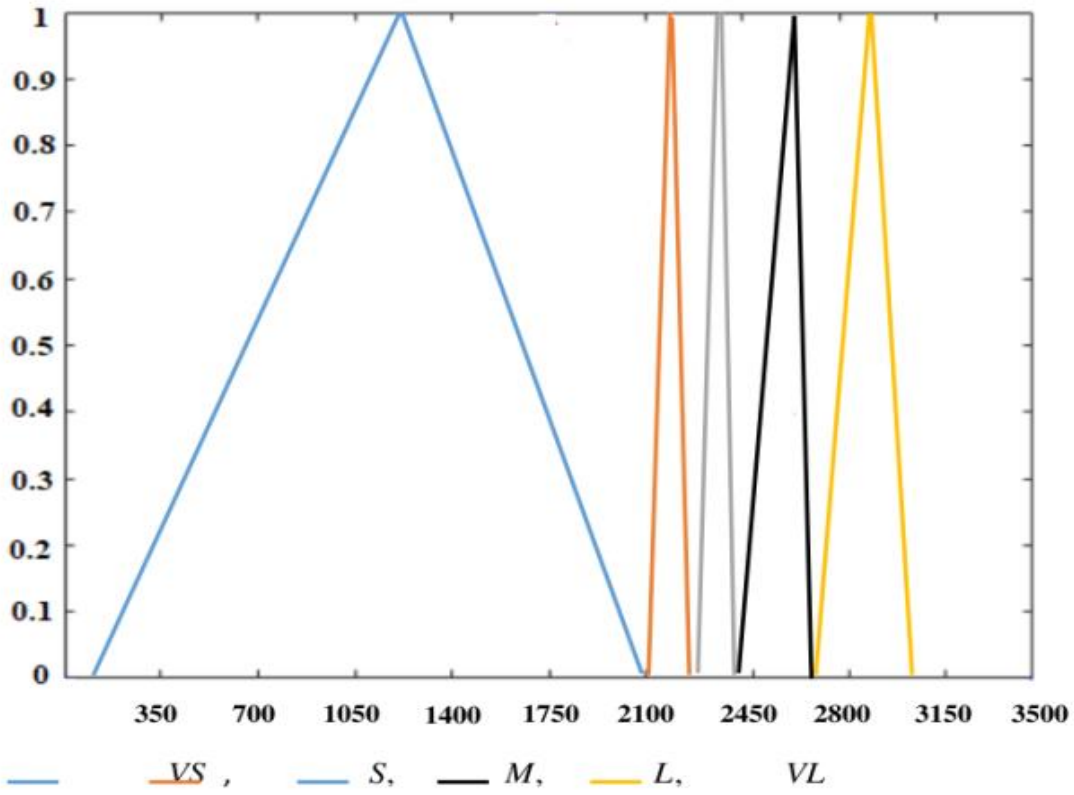

Figure 4 : Membership functions plot the input ***Distance.***

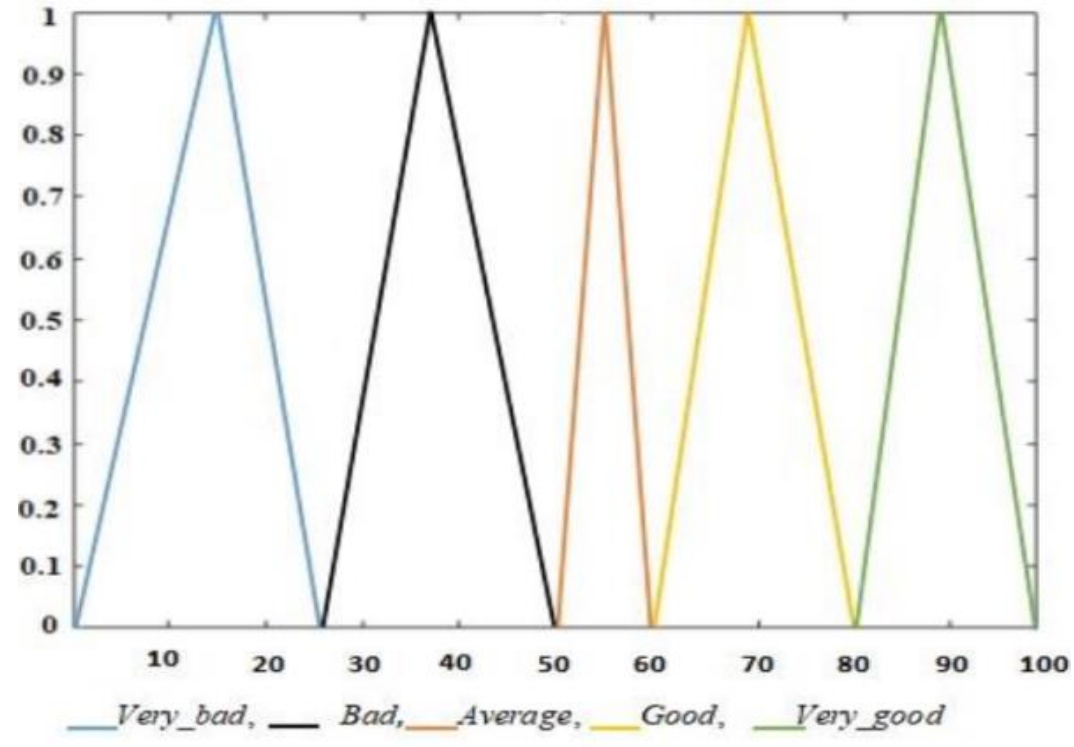

Figure 5 : Membership functions plot the output ***Status.***

6. Conclusion:

In this work, a fuzzy logic structure and database for fitness analysis was designed and implemented. Selection of processes for selecting membership functions and base rules in order to determine the output. The triangular membership function was used to manipulate the system variables tightly. The foundations of the rules were chosen based on the experience provided by an expert in the system. This study identified the linguistic changes of the input and output due to the input and output variables along with their membership functions such as *Age* (*Y_M*$_1$, *Y_F*$_1$,*Y_M*$_2$, *Y_F*$_2$, *Y_M*$_3$, *Y_F*$_3$, *Y_M*$_4$, *Y_F*$_4$, *MA_M*$_1$, *MA_F*$_1$, *MA_M*$_2$, *MA_F*$_2$) and *Distance* (*VS, S, M, L ,VL*) and the output *Status* (*Very bad, Bad, Average, Good, Very good*). From the above results, we noticed as a sample, that when the distance value is less than 2100, this leads to 100% very bad status for ages (13-14), while in the case of age value was (40-49), we got 100% when the very bad distance value was less than 1200 (The degree of influence or severity of each linguistic variable is evaluated. Table 2 and 3 show the fuzzy logic model of the determined input variables, while table 4 shows the fuzzy logic model of the determined output variable. The fuzzy model proposed in this study was based on the relationship management of a specific set of data in some athletics in the Olympic Games to analyse the fitness of athletics players.

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