Comparisons of Membership Functions for Ranking of Components

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ABSTRACT: *Different methodologies are used to design and model a system, which having the ability to rank and to choose the most suitable component. In this paper we present the comparisons of membership and reduced membership functions for ranking of component. A model of different fuzzy rules is designed for three membership functions (mf) and then reduced the rules by reducing the membership functions. The proposed methodology applies on ISO/IEC 9126 quality model. The model having important features including functionality, reliability, usability, efficiency, maintainability and portability.*

Keywords: Quality model, ISO/IEC 9126, Fuzzy rules, Ranking, Membership ranking

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1. Introduction

Components are the unit and parts of a system which plays a vital role in software system. A separate software component is a software suit that provides established functionality. These Separate software components functions are combined based on the principle of component based software engineering. Software system is structured and organized form the collection of different components. The components should be explicitly clear from all perspective for the development of software system. Component may be replaced by other component if the decedent component having the criteria of the antecedent component.

The demanding of large and more complex software system need the reuse of preexisting software component to save huge time and also leads to error graft system, because reusability is already tested. Considering the economics point of view, there is tendency towards components based software development and study shows that recently such systems development are near half of the total developed software systems [1].

The involvement of the proposed approach is to compare membership functions for ranking of components. Using fuzzy tool box, rules are designed for some membership functions and then reduced by reducing the membership functions. Rules knowledge is generally understandable if it is in the form of fuzzy. These rules containing membership function [2].

The organization of the paper is follows as. Section II is related work. Comparison of membership and reduced membership

function are discussed in section III. The paper is concluded in section IV.

2. Related Literature

Several diverse approaches for selection and ranking of component are developed by the community of software engineering. P. Baranyi and Y. Yam approach use singular value decomposition reduction for generalized rational application form. Formulas are presented for huge and complex system [3]. P. M. Cooke et al. proposed a tree search method for reducing membership functions and removing duplication in rules. The method views the data as tree instead of tables and helps as a fast processing in removing of duplication of rules. The efficiency of tree search with linear search method is compared [4]. R. Ketata et al. pointed out a new approach for justifying membership functions and reduced the fuzzy rules. The approach consists of five different steps, i.e. generating fuzzy rules, calculate the similarity of rules, measure the similar rules distance, the distance is greater than base value then merge mf and in the last step regenerate rule of new fuzzy set [5].

S. Chopra et al. provides an approach to attain both the inputs and output and their membership functions. Some of the membership and cluster rules are same in designing the model. By using similarity measuring the number of membership functions are reduced [6]. S. Nazir et al. designed a fuzzy logic based approach for software component selection. They presented and designed the fuzzy inference system for different membership functions. Inputs are evaluated on the basis of proposed fuzzy model [7]. Y. Jin proposed an approach for fuzzy modeling of high dimensional system. It generates fuzzy rules system. On the basis of similarity measure redundant rules are removed and then the structure is optimized by using genetic algorithm and gradient method. The fuzzy system is simplified, interpretable and the interdependencies of the inputs and output are also shown [8].

3. Comparision of MF for Ranking of component

A software component goes under several steps including 1) searching 2) screening 3) analyzing 4) evolution etc. in the proposed method different fuzzy rules are designed for ranking of component, based on different membership functions. Three membership functions are used for inputs which are low, medium and high and then reduced the membership functions to low and high. Model of the inputs and outputs is shown in figure 1.

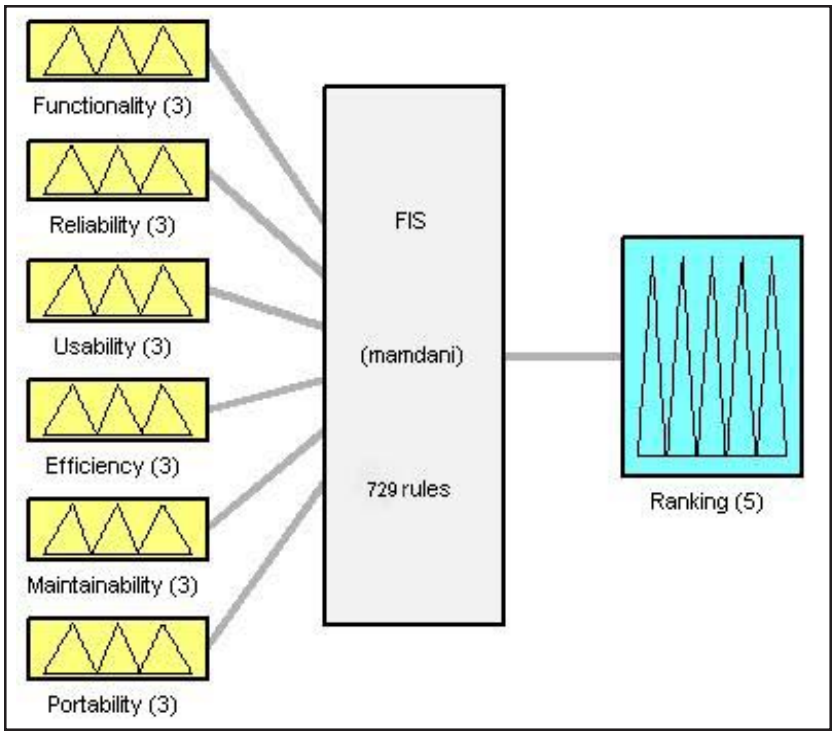

Figure 1. Model for inputs and output

The characteristics function of fuzzy set is represented as $0 \leq \mu_F(x) \leq 1$. In the proposed method inputs for ranking of components are based on quality attributes of ISO/IEC 9126 [9].

Quality attribute	Description	Membership function
Functionality	For highly functionality, the component should be ranked as so that it may be easy to understand for developer and are easily to adoptable.	$\mu_{Functionality} = \left\{ \begin{array}{l} 0 \leq x \leq 0.35 = low \\ 0.36 \leq x \leq 0.65 = Medium \\ 0.65 \leq x \leq 1 = High \end{array} \right\}$
Reliability	The ability of a system to perform and maintain its function although the system face unexpected situation.	$\mu_{Reliability} = \left\{ \begin{array}{l} 0 \leq x \leq 0.36 = low \\ 0.36 \leq x \leq 0.66 = Medium \\ 0.63 \leq x \leq 1 = High \end{array} \right\}$
Usability	Usability is how easily a component may be used. A simple component may be used easily. Usability improves ease of use through the design process.	$\mu_{Usability} = \left\{ \begin{array}{l} 0 \leq x \leq 0.34 = low \\ 0.34 \leq x \leq 0.66 = Medium \\ 0.65 \leq x \leq 1 = High \end{array} \right\}$
Efficiency	The ability of a component to provide the required concert	$\mu_{Efficiency} = \left\{ \begin{array}{l} 0 \leq x \leq 0.36 = low \\ 0.36 \leq x \leq 0.67 = Medium \\ 0.65 \leq x \leq 1 = High \end{array} \right\}$
Maintainability	Maintenance process objectives deal with issues such as cost of maintenance or ease. The most important and critical phase in software development is its maintenance.	$\mu_{Maintainability} = \left\{ \begin{array}{l} 0 \leq x \leq 0.32 = low \\ 0.32 \leq x \leq 0.64 = Medium \\ 0.63 \leq x \leq 1 = High \end{array} \right\}$
Portability	A component may be transferred from one surroundings to another with some modification if needed. The component should be platform independent.	$\mu_{Portability} = \left\{ \begin{array}{l} 0 \leq x \leq 0.36 = low \\ 0.36 \leq x \leq 0.66 = Medium \\ 0.64 \leq x \leq 1 = High \end{array} \right\}$

Table 1. ISO/IEC 9126 Quality Model

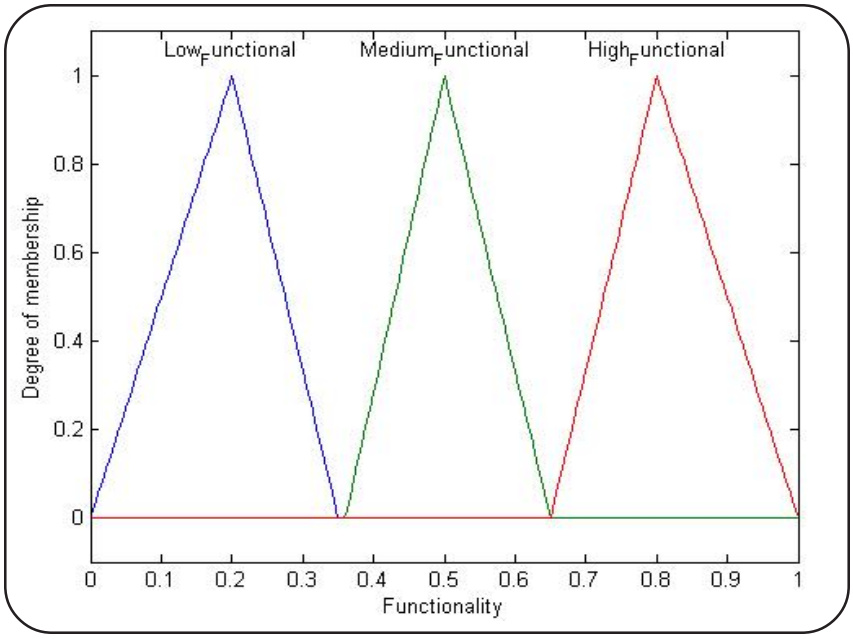

Figure 2. MF graph for functionality

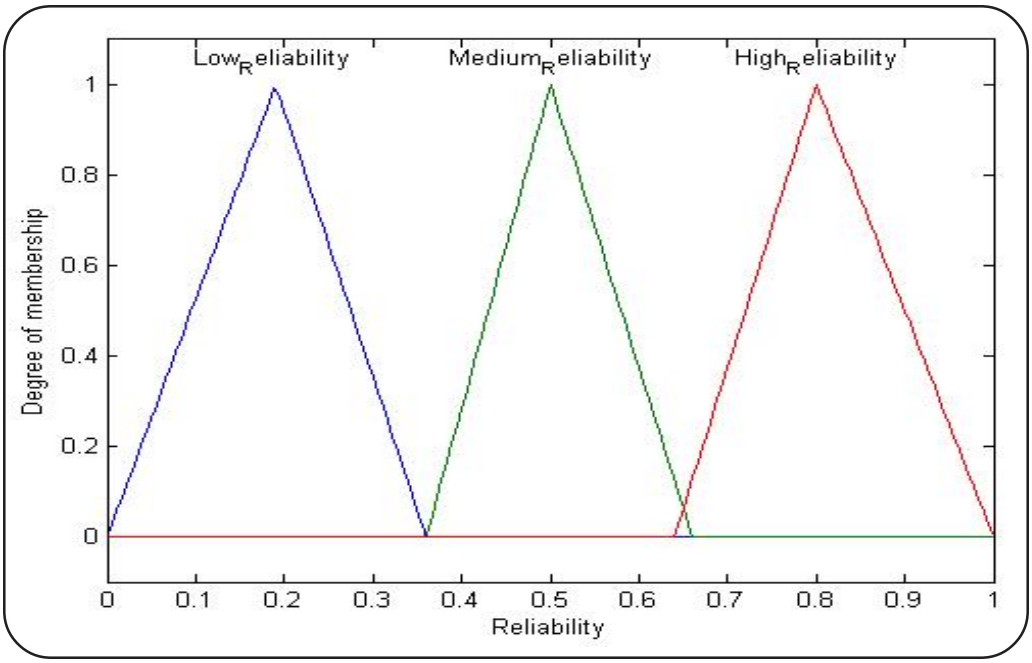

Figure 3. MF graph for reliability

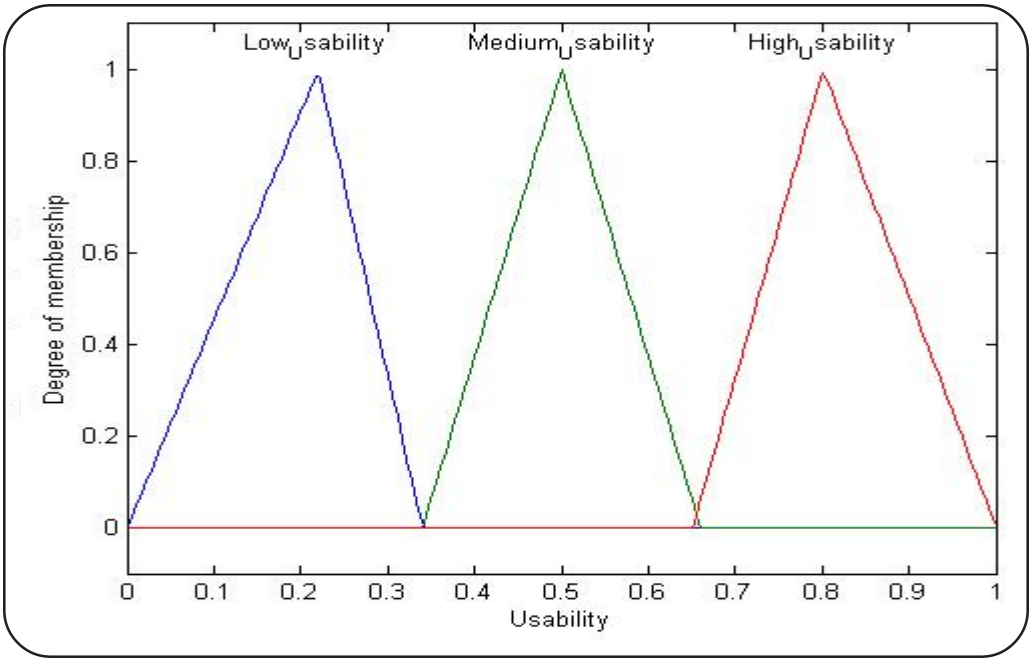

Figure 4. MF graph for usbility

A total of 3^6 fuzzy rules are designed for three membership functions. The rules are in the form like as:

1. If (Functionality is Low_Functional) and (Reliability is Low_Reliability) and (Usability is Low_Usability) and (Efficiency is Low_Efficiency) and (Maintainability is Low_Maintainability) and (Portability is Low_Portability) then (Ranking is Very_Low_Rank) (0.1)

2. If (Functionality is Low_Functional) and (Reliability is High_Reliability) and (Usability is Low_Usability) and (Efficiency is High_Efficiency) and (Maintainability is Low_Maintainability) and (Portability is High_Portability) then (Ranking is Medium_Rank) (0.5)

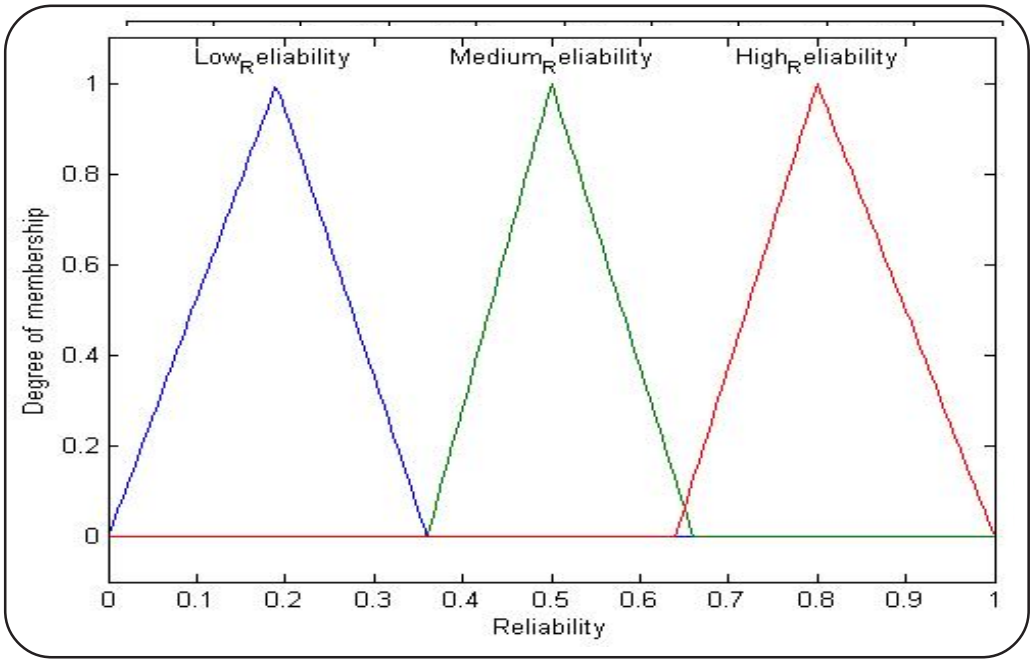

Figure 5. MF graph for efficiency

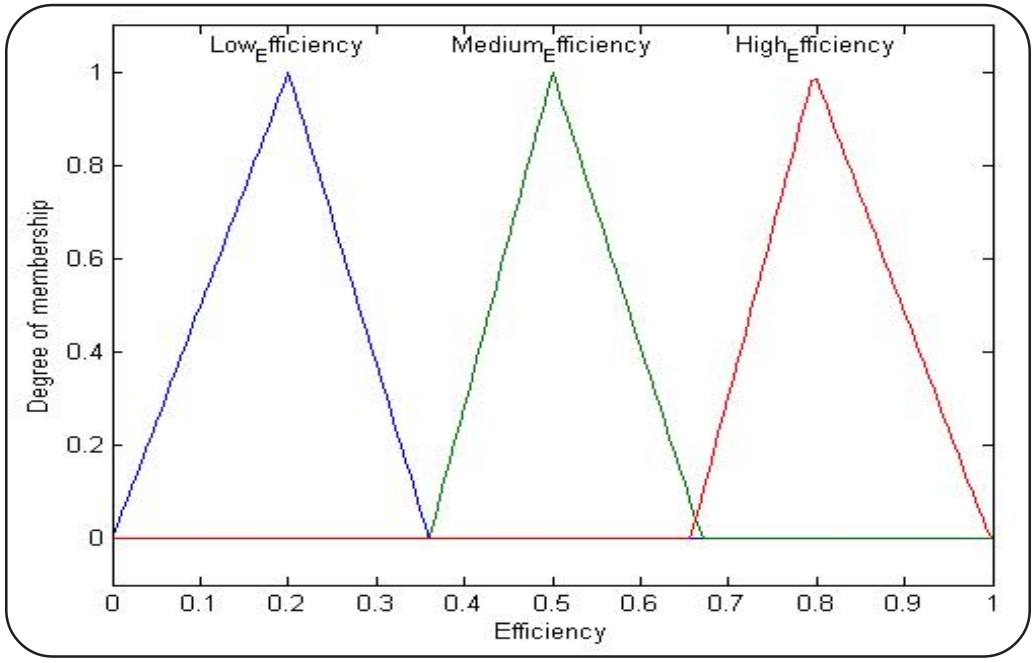

Figure 6. MF graph for maintanibility

3. If (Functionality is Low_Functional) and (Reliability is High_Reliability) and (Usability is High_Usability) and (Efficiency is High_Efficiency) and (Maintainability is High_Maintainability) and (Portability is High_Portability) then (Ranking is Very_High_Rank) (1)

. . . .

729 rules of Fuzzy inference system.

Calculation are done based on rules as:

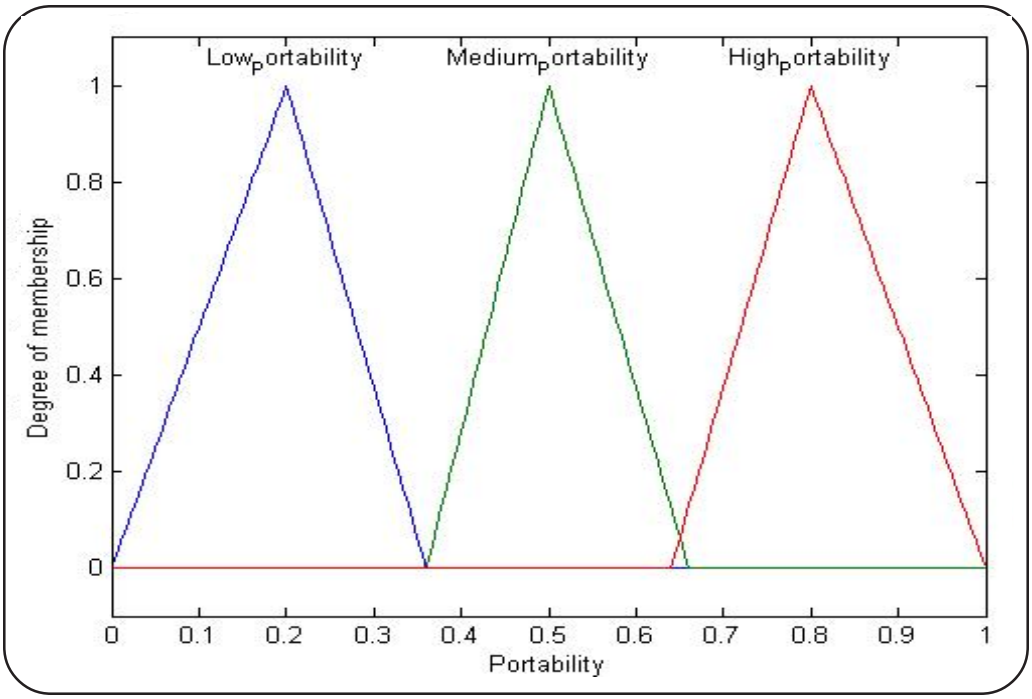

Figure 7. MF graph for portability

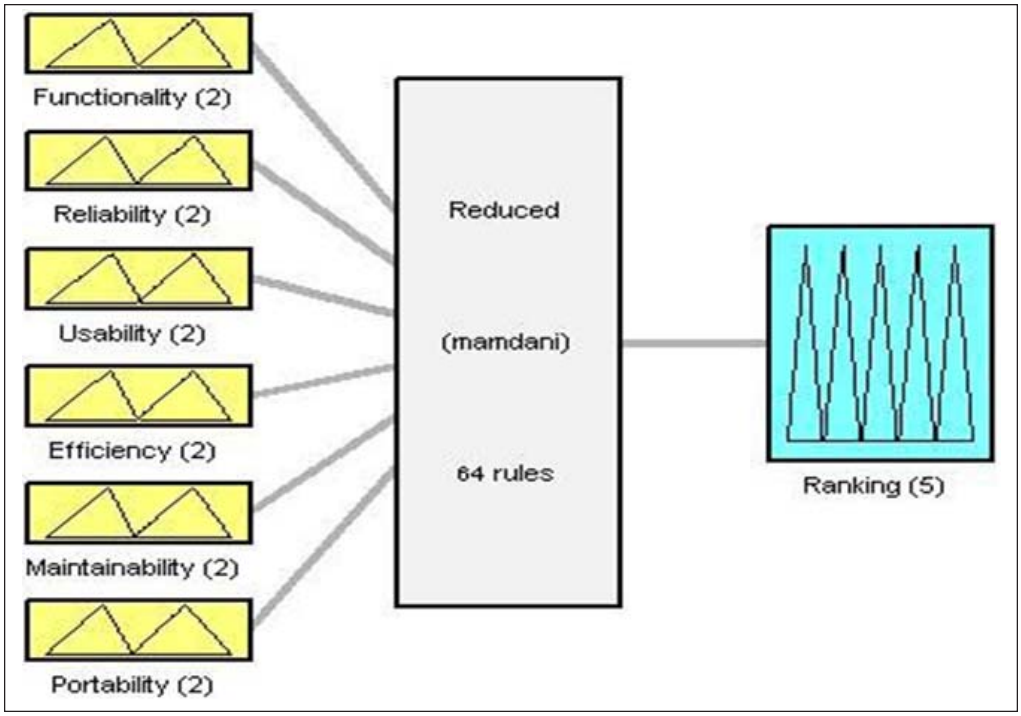

Figure 8. Reduced membership functions for inputs and output

After assessment of proposed rules the output results are obtained for the given inputs.

As the designing of more fuzzy rules is very complex activity. So for the easiness of rules designing, we amalgamate the membership's functions from three to two to reduce the number of MF and fuzzy rules. For this a total of 2^6 rules are obtained. The amalgamation of MF can be shown in figure below:

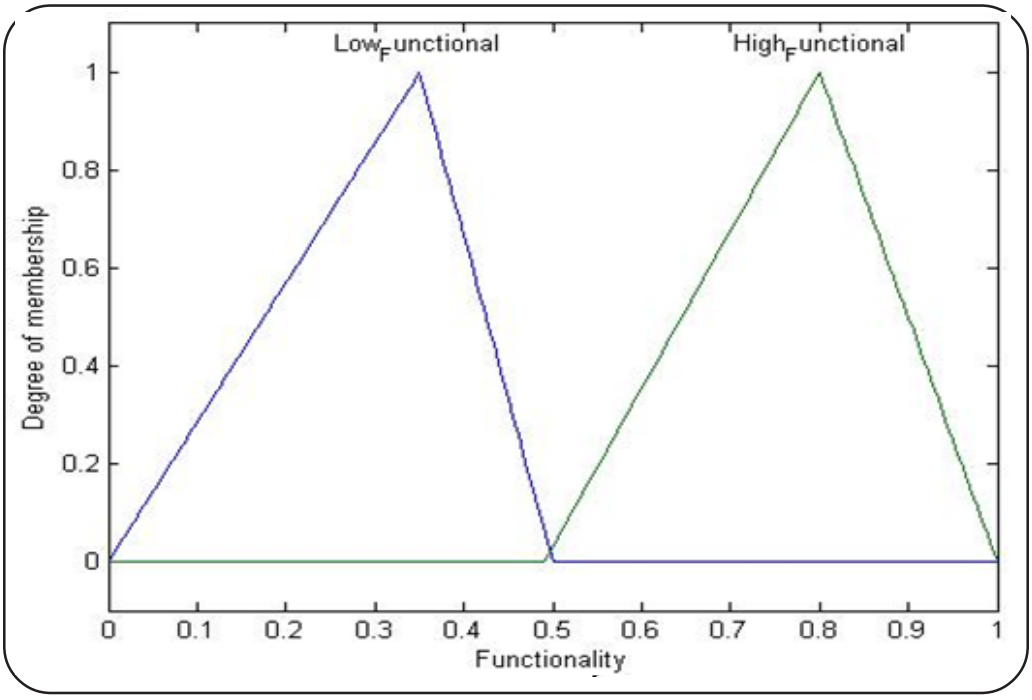

Figure 9. RMF graph for functionality

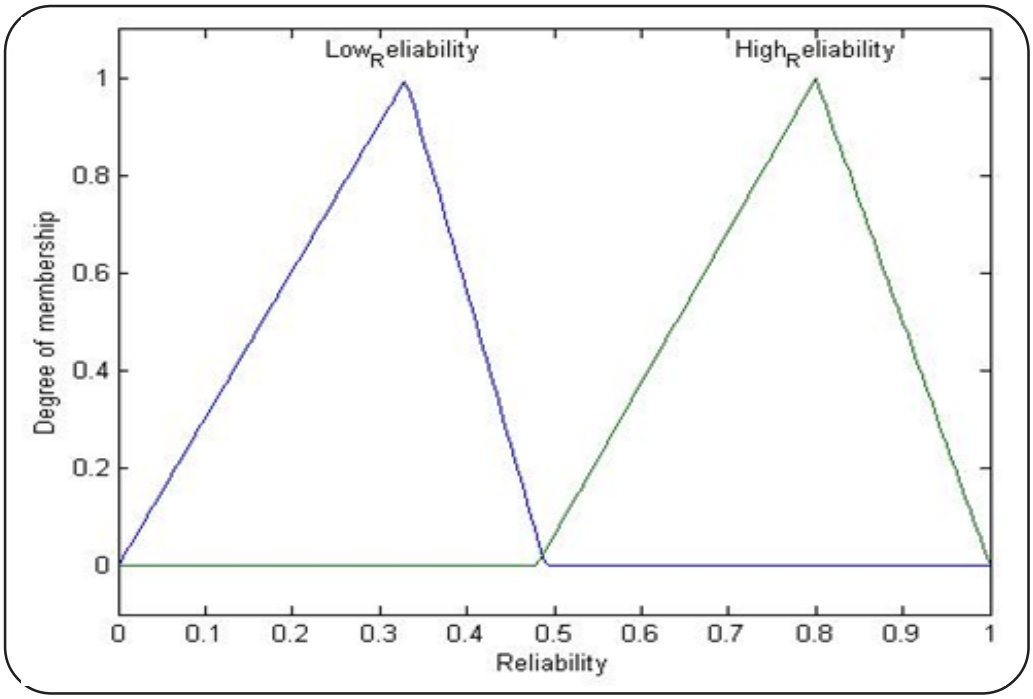

Figure 10. RMF graph for reliability

F	R	U	E	M	P	R
0.1	0.1	0.2	0.3	0.2	0.3	0.09
0.7	0.8	0.9	0.8	0.6	0.8	0.9
0.7	0.1	0.5	0.6	0.3	0.2	0.5

Table 2. Original rules (inputs and outputs)

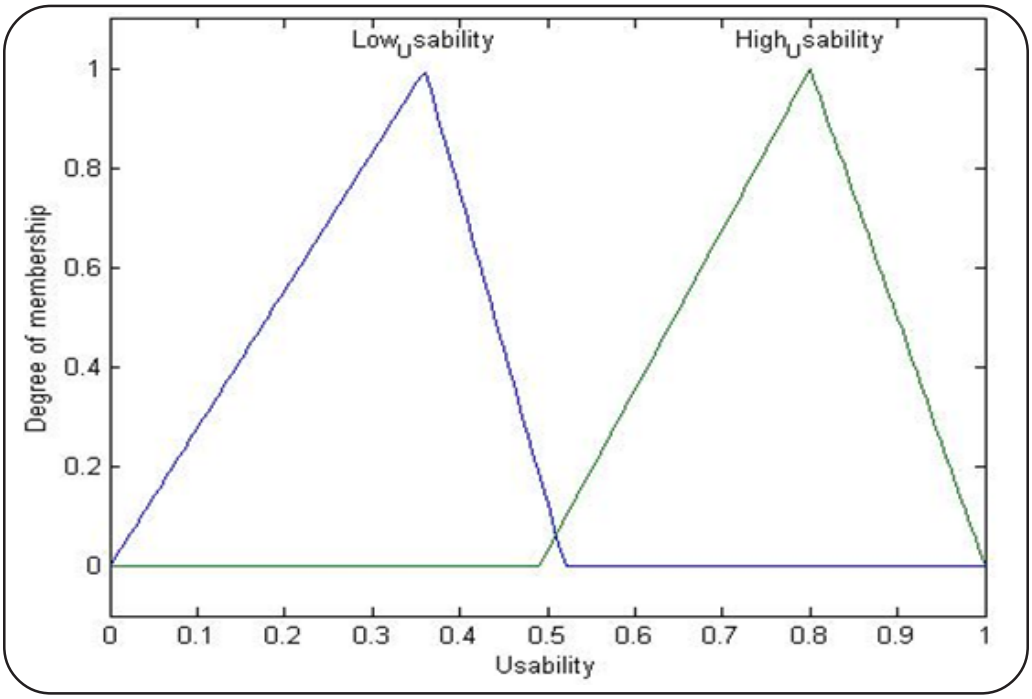

Figure 11. RMF graph for usability

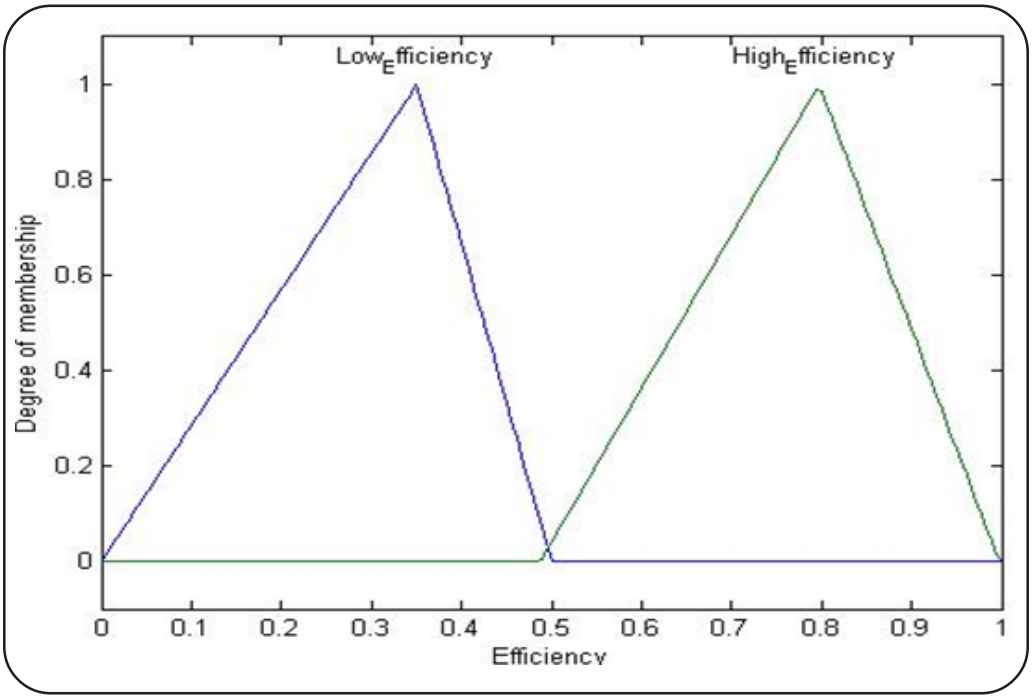

Figure 12. RMF graph for efficiency

F	R	U	E	M	P	R
0.1	0.1	0.2	0.3	0.2	0.3	0.09
0.7	0.8	0.9	0.8	0.6	0.8	0.9
0.7	0.1	0.5	0.6	0.3	0.2	0.5

Table 3. Reduced rules (inputs and outputs)

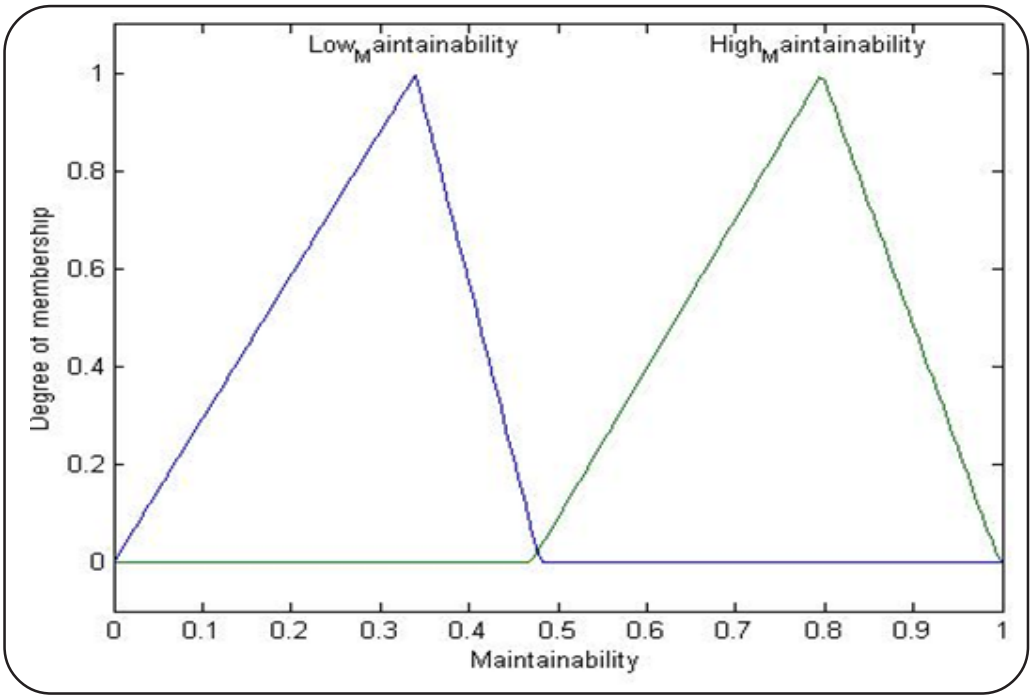

Figure 13. RMF graph for maintainability

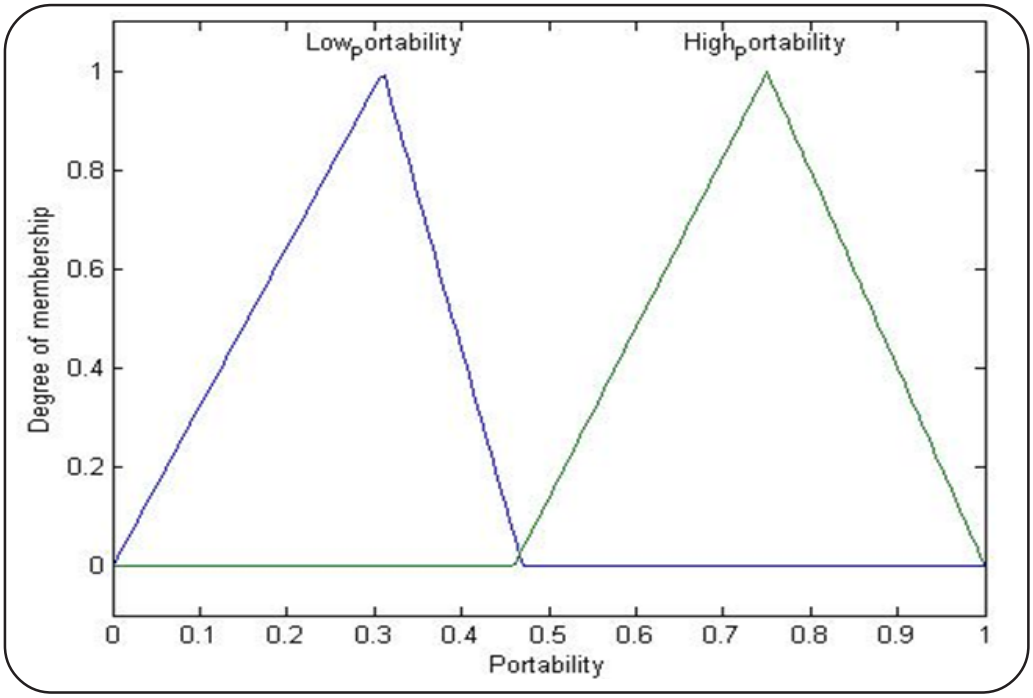

Figure 14. RMF Graph for Portability

Overall probability ranking is

$$Ranking\ (R) = \sum_{i \in F, R, U, E, M, P} \mu_i \qquad (1)$$

(F = Functionality, R = Reliability, U = Usability, E = Efficiency, M = Maintainability, P = Portability)

For each input the membership functions are plotted as

Reduced fuzzy rules are in the form as:

1. If (Functionality is Low_Functional) and (Reliability is Low_Reliability) and (Usability is Low_Usability) and (Efficiency is Low_Efficiency) and (Maintainability is Low_Maintainability) and (Portability is Low_Portability) then (Ranking is Very_Low_Rank) (0.1)

2. If (Functionality is Low_Functional) and (Reliability is Low_Reliability) and (Usability is Low_Usability) and (Efficiency is High_Efficiency) and (Maintainability is High_Maintainability) and (Portability is High_Portability) then (Ranking is Medium_Rank) (0.5)

3. If (Functionality is High_Functional) and (Reliability is High_Reliability) and (Usability is High_Usability) and (Efficiency is High_Efficiency) and (Maintainability is high_Maintainability) and (Portability is High_Portability) then (Ranking is Very_High_Rank) (1)

64 fuzzy Rules.

Calculation of the reduced membership are: From the above table it is clear that both the output is nearly the same for the same inputs.

5. Conclusion

A huge amount of time is invested in the designing of fuzzy rules and modeling for a specific problem. The proposed method is avoiding such phenomenon during the designing and development of component based system. The method amalgamates the membership functions for reducing the fuzzy rules. The method is quite simple to implement and easy to adopt.

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