Software Reliability Evaluation: A Survey Based

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ABSTRACT: **Software reliability is one of the important factor in software quality evaluation. A lot of research is being going to evaluate a good software for reliability estimation. This paper is a survey which can be used to design a reliability system based on soft technique. Software quality can be evaluated as developer, user and project manager perspective [1].Software reliability can be quantified and evaluated as user perspective. According to ISO 9126 there are a number of factors affects the reliability. This paper is based on the study of those factors and describes how those factors can be quantified. A survey is conducted to collect the data for quantifying the factors.**

This paper reflects a different approach for evaluating the reliability of any software. The survey is conducted over a very simple software ie VLC media player. This software is used for the multi-media application and widely been used by many user on a daily basis.

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Generally it is used for playing the audio and video. The survey can also be extended to calculate the defect density of the software also.

Index Terms: Quality Model, VLC , Reliability, Failure rate, Fuzzy Logic , External Metrics.

I. INTRODUCTION

A. Software Quality Model

ISO (International Standard Organization) 9126 has provided a generic definition of software quality based on six characteristic. These are functionality, efficiency, maintainability, reliability, portability and usability. Almost all the quality model till now been designed cover all the six basic characters but none of them has quantified the characteristic. The table 1.1 below explains the different characteristic and the models that use it.

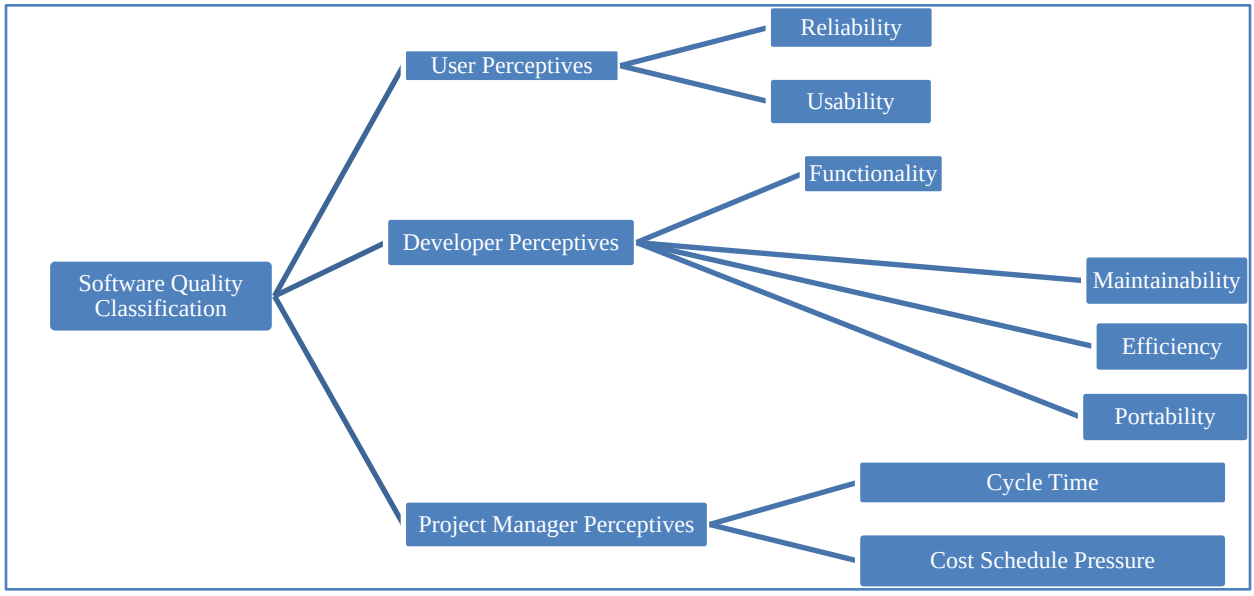
Table 1 Characteristic of Software Quality Model

S.NO	CHARACTERISTIC	DEFINATION	MODELS USING THEM	SUB CHARCTERISTICS
1	FUNCTIONAILITY	A set of attributes that bear on the existence of a set of function and their specified properties.	ISO/IEC 9126 Model [2], Boehm's Model [3], Dromey's Model [4] and the FURPS Model[5]	• Security • Accuracy • Suitability • Functionalitycompliance • Interoperability
2	EFFICIENCY	A set of attributes that bear on the relationship between the level of performance of the software and amount of resources used.	ISO/IEC 9126 Model [2], Boehm's Model [3], Dromey's Model [4] and the FURPS Model[5]	• Time Behaviour • Resource Behaviour • Efficiency compliance
3	MAINTAINABILITY	A set of attributes that bear on the effort needed to make specified modification.	ISO/IEC 9126 Model [2], Boehm's Model [3], Dromey's	• Analyzability • Change ability • Testability • Operability • Attractiveness

			Model [4] and the FURPS Model[5]	• Maintainability compliance
4	RELIABILITY	A set of attributes that bear on the capability of software to maintain its level of performance under stated condition for a stated period of time.	ISO/IEC 9126 Model [2], Boehm's Model [3], Dromey's Model [4] and the FURPS Model[5]	• Maturity • Fault tolerance • Recoverability • Reliability Compliance
5	PORTABILITY	A set of attribute that bear on the ability of software to transfer from one environment to another.	ISO/IEC 9126 Model [2], Boehm's Model [3], Dromey's Model [4] and the FURPS Model[5]	• Replace ability • Adaptability • Install ability • Co-existence • Portability Compliance
6	USABILITY	A set of attributes that bear on the effort needed for use and on the individual assessment of such use by a stated on implied set of users.	ISO/IEC 9126 Model [2], Boehm's Model [3], Dromey's Model [4] and the FURPS Model[5]	• Usability compliance • Understandability • Learn ability • Operability • Attractiveness

Software Quality models set some characteristics based on which we can design a quality software..According to IEEE 610.3[6] standard the software can be defined on the basis of the fulfillment of the requirement, meeting the expectation of the customer and meeting the requirement specification. The quality of the software is measured in terms of its capability to fulfill the needs of the users and also its ability to achieve the developer's goals. Quality is mainly studied by quality models. The quality model describes the set of characteristics, which are the basis for establishing the quality requirements and for evaluating software quality. The characteristics of software quality can be also classified on the basis of the end users. They can be classified as below

Figure.1 Classification based on users



B. Software Reliability

Now a day's our life is dependent of software world so we need to design reliable software A number of factors affect the reliability like number of defect found , failure recovery rate etc. The characteristic of reliability is further defined and quantified into sub characteristics based on which be an evaluate reliability. ISO 9126 has defined [6] the sub characteristics as follows:-

- Maturity: describes the frequency of failure of the software by faults.
- Fault Tolerance: evaluates the robustness of the software. It describes the software attributes that describe the ability of the software to maintain a specified level of performance in cases of software faults or the violation of its specified interface.
- Recoverability: describes the capability of the software to re-establish its level of performance and to recover the data directly affected in case of failure and the time and effort needed for it
- Reliability Compliance: determines whether the software adheres to the compliance standards of reliability or not.

Software reliability is a set of attributes which that the software been designed is according to the requirement and is capable of handling the fault and failure[9]. Infact reliability also deals with recovering of data too .This paper also will quantify the sub characteristics further to calculate the reliability for any specific software. In this paper we will design some questionnaire based on which we will calculate the reliability.

C. Fuzzy Logic

Fuzzy logic is soft computing technique which is used to deal with problems in a state of uncertainty. Fuzzy logic represent the human intelligent behavior of dealing with problem when we have no fixed equation or measuring instrument for determining the output .For example "calculating the room temperature without using a thermometer". For designing a fuzzy system we first design a membership function which is designed based on observation. In this paper we will use a triangular membership function which is designed for three parameters. In the given figure 2 is representation of different type of membership function.

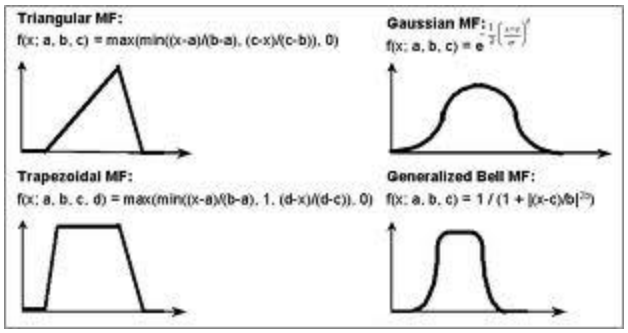


Figure 2 Example of type membership function.

After the consideration of the membership function we design our system and fuzzify the input data and calculate a single scalar output by the process of defuzzification. Infact the concept of fuzzy logic is been used from ancient time by the " king – minister relationship".Whenever a king has to take a decision he discuss it to ministers the King give a optimized solution. This system simply represent a fuzzy system

The paper is structured as follows: Section 1 has introduced the different concept for which system is been designed. Section 2 will discuss how the sub characteristic can further be quantified and calculated survey. Section 3 will give the detail description of the survey, how it will be conducted along with the questionnaire that will be used in this paper. In section we will discuss some limitation of this study.

II. EVALUATION OF THE SUB CHARACTERISTICS

This paper has divided the sub characteristics of reliability into further sub characteristics [1] which are quantified by fuzzy logic to calculate the reliability. As discussed in section 1 that reliability is a factor considered by the user. So by considering the fact a questionnaire is designed to evaluate and quantify the sub characteristics. The table below will give a brief introduction to the sub factors been considered.

Table 2 Sub characteristics of reliability

SNO	SUB CHARACTERISTIC FURTHER QUANTIFIED AS EXTERNAL REAL TIME METRICS
1	MATURITY: 1) Number of successful version. 2) Level of CMM.

2	FAULT TOLERANCE: 1) Exception handling.[1] 2) Capable of detecting the fault. 3) Percentage of functionality met.[1]
3	RECOVERABILITY: 1)Capability to recover from failure. 2)Back of data.[1]
4	RELAIBILITY COMPLIANCE: 1)Capability to achieve the requirement been defined.[1]

Based on the table1.2 we will design some questionnaire which can be used to calculate the quantified value of the sub characteristic been designed. Below given is the definition of the different sub characteristics:

- Maturity:

1. Number of successful version released: The factor will be used to calculate the rate of successful version released for particular software. It can be calculated as

SVR (Successful version released)= No of successful version/ Total no of version released.

2. Level of CMM: This factor deals with organization. We have to check that the organization belongs to which level of CMM(Capability maturity model)If a organization is of CMM level 4,5 then it will be considered to be more reliable.

- Fault Tolerance:

1. Exception handling: This a situation where program responds to an undesirable situation. For example: " X/0"(A variable divided by zero). If a software is able to perform exception handling then it will be considered more reliable the other.
2. Capability of detecting faults: A fault may be a logical or semantic error that exists in a program.
3. Percentage of functionality successively met:

FS(functionality successively met)=Total no of functionality met/ total no of functionality.

- Recoverability:

1. Capability to recover from failure: This is the ability of software to tolerant failure.
2. Back of data: This parameter tells us how the availability of the backup of data affects recoverability[1]. If software has a data backup facility available, the recoverability of the software is very high, otherwise it is low.

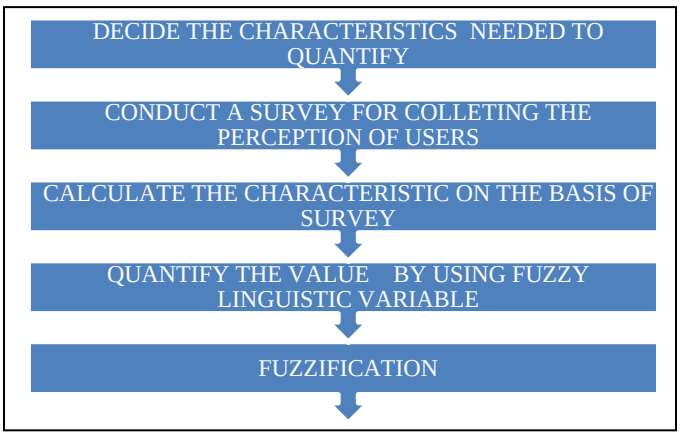
- Reliability Compliance:

1. Capability to achieve the requirement been defined:

The parameter tells us how adherence of the software to reliability compliance standards affects reliability compliance. It can be calculated by using the equation below:
RC(Reliability Compliance)= No of requirement meet/total no of requirement.

Based on this sub-characteristics we have designed some questionnaire which will be used to evaluate the calculate the reliability of any software. The questionnaire will designed for the user of the software VLC media player. The VLC media Player is media playing software basically used by all computer user for listening to music and watching movies. VLC media player is a free and open source media player and multimedia framework written by the VideoLAN project. VLC is a portable multimedia player, encoder, and streamer supporting many audio and video codecs and file formats as well as DVDs, VCDs, and various streaming protocols. It is able to stream over networks and to trans-code multimedia files and save them into various formats. Users are very known with the software so it become very easy for us to conduct the survey.

The flow of the research work can be described with the help of the flow graph given below.
Figure3 Flow of Work



III. SURVEY

The survey is conducted over the user of the software. But one of the most important factor that we have to considered is that common people will have little knowledge in this field. So the user who we will consider should have some computer programming skill also. Let the user needed for this survey be referred as "Experts". The experts are asked to answer the given questionnaires based on which the result can be evaluated. Then based on that we will calculate the different parameters according to the different users [8]. Based on that the parameters will be quantified in fuzzy logic. For fuzzification we have to first design a membership function. In this paper we have considered a trapezoidal membership corresponding to four different elements of the universal set. The universal set in the case are all the user of VLC media player out of which we have consider four users

which will constituent the fuzzy. The general representation is given as

$\tilde{A}$ = [(U1,0.3)(U2,0.3)(U3,0.7)(U4,0.7)]

where $\tilde{A}$ represents the fuzzy set.
(U1,0.3) represents the element and associated membership value.
In this paper we have designed the fuzzy set for the following linguistic variable according to which all the parameters will be quantified.

Table 3. Fuzzy Criteria fuzzy score are assigned according to the user judgment

SNO	FUZZY CRITERIA	FUZZY SET	FUZZY SCORE
1	excellent	(1.0,1.0,0.9,0.9)	90-100
2	good	(0.9,0.85,0.8,0.75)	75-90
3	normal	(0.75,0.7,0.65,0.6)	60-75
4	bad-the work	(0.6,0.5,0.4,0.0)	below 60

Based on this above table we will design the fuzzy set for the real time metrics as mentioned in table 2. Given below are the fuzzy real time metric based on the above criteria for calculating the usability.

- Maturity:

1. Number of successful version released: The metrics can be fuzzified as
   [>90(excellent), 90-75(good), 75-60(normal), 60<(bad at work)]
2. Level of CMM: Fault Tolerance: The metrics can be fuzzified as
   [level 5,4(excellent), level3(good), level 2(normal), level 1(bad at work)]

- Fault Tolerance:

1. Exception handling: The metrics can be fuzzified as
   [Yes(excellent), No(bad at work)]
2. Capability of detecting faults: The metrics can be fuzzified as
   [Yes(excellent),No(bad at work)]
3. Percentage of functionality successively met: The metrics can be fuzzified as
   [>90(excellent), 90-75(good),75-60(normal), 60<(bad at work)]

- Recoverability:

1. Capability to recover from failure: The metrics can be fuzzified as
   [Yes(excellent),No(bad at work)]
2. Back of data: The metrics can be fuzzified as
   [Yes(excellent),No(normal)]

- Reliability Compliance:

1. Capability to achieve the requirement been defined:
   [Adheres to Compliance Standards (excellent);Doesn't Adhere to Standards (normal)].

IV. CONCLUSION

This is a different approach for evaluating the reliability of any software. We have defined some of the real time reliability evaluation metrics in this paper. The data regarding this metrics will be

collected by conducting a survey. Then based on that survey we will evaluate the fuzzy data. So it can be considered as a efficient technique since we are working with real time data. This a very simple approach and considered almost all external metrics. So in way if we calculate reliability by using this method then the result will be much better as compared to other failure density model.

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