Evaluation of Software Quality using Choquet Integral Approach

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ABSTRACT

Software development comprises of processes which can be controlled, managed and improved by software measurement. The efficiency of software measurement is determined by software quality, which assesses the position of any software company in the international economic scenario. This calls for a need to develop quality models which would quantify the various quality parameters. However, these quality parameters are highly vague, by nature, and cannot be easily quantized nor measured. The Boehm’s Model, McCall’s Model, and ISO/IEC 9126 Model are existing quality models made by software quality researchers in this regard. This paper uses the ISO/IEC 9126 quality model as the baseline model, with enhanced criteria, to give a holistic approach to software quality. A methodology is proposed in this paper for comparing different software solutions based on the SRS to a common problem. As software product quality is highly unpredictable, and considering the interaction between the quality criteria, Choquet Integral is used to efficiently compare the set of software products.

Keywords: Choquet Integral, Fuzzy Measure, Interaction Degree, Multi Criteria Decision Making, Quality Parameters, Software Quality

INTRODUCTION

Software engineering is the discipline which governs the rules of software application development. The Institute of Electrical and Electronics Engineers (IEEE) defines “software engineering” as:

- The application of systematic, disciplined, quantifiable approach to the development, operation and maintenance of software; i.e., the application of engineering to software;
- The study of approaches stated above.

Due to the revolutionary advancement of technology in the IT industry, the importance of the field of software engineering is increasing.
at a rapid pace. The IT industry is experiencing a paradigm shift from mere application development to enforcing highest level of quality into the applications due to which the importance of the field of software quality has grown in direct proportion to the growth of software engineering. Today’s market is highly competitive, methods, processes and procedures which provide various different alternatives to a common problem. Which alternative to choose is decided by the quality of the solution provided i.e. the degree to which the desired set of inherent characteristics fulfills the requirements. Software quality is a very important aspect from the perspective of transcendental view, product view, manufacturing view, user view and value-based view (Kitchenham & Pfleeger, 1996). Quality measures the functional aspects of the software (what a system does) and also describes extra functional properties (how the system is built and performs). Various researchers have worked in developing suitable models that define software quality as described in quality models like Boehm’s model (Boehm, Brown, & Lipow, 1976), McCall’s Model (Cote et al., 2006), and ISO/IEC 9126 Model (ISO/IEC 9126, 2001). These models are used for developing generic software applications. Out of these models, ISO/IEC 9126 model (ISO/IEC 9126, 2001) acts as the baseline model for other models. This model is widely accepted and recognized in the industry and research community. Considering the emphasis on software quality, an effort is made to evaluate the software applications based on common software requirement specification (SRS) using quality parameters which are inter-dependent. This paper proposes a model to rank the software applications using Choquet integral considering the importance of each criteria as well as the degree of interaction among them. The ranking, thus obtained, allows commercial and educational institutions to take appropriate decisions on software application selection from a quality point-of-view.

The remainder of the paper is structured as follows: first we mention Background work, then next section is about software quality, definition and formulae of quality parameters, next this paper deals with application of Choquet Integral for quantification, another section that explains the proposed architecture of this paper followed by analyses the Choquet Integral with separate section demonstrating a case study followed by discussion about current and previous methodologies proposed. At last we provide the conclusion and future scope of this paper.

BACKGROUND WORK

As the software industry started growing, the demands from the software’s developed also increased drastically. Soon the competitiveness in the IT industry made the concept of quality of software a great concern. Now the software’s are demanded both functionality and quality, i.e. the extent to which the inherent characteristics exist fulfilling the functional requirements. This also gave birth to the problem of evaluating or measuring the software quality so that two or more solutions to a common problem can be measured on the basis of functional and non-functional requirements and can be worked upon.

Software quality and its assessment has been one of the most sought after research topics for ages where software has been quantified based on various software quality parameters. There are various problems related to the measurement of quality attributes:

- Firstly is the existence of multiple metrics to determine software quality. Several criteria and sub criteria have been quantified using various metrics to estimate the software quality. Slaughter et al. (1998) had used the cost as a metric to determine software quality. Maryoly, Perez and Rojas (2003) evaluated software products using a systemic quality model. Lamouchi et al. (2008) had also attempted to quantify the software quality factors by dividing the factors into criteria and sub criteria. This was done by the aid of metrics that affected the criteria. The quality, effort, and cycle
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