CERTIFICATE

This is to certify that the thesis, entitled "Improving the Modeling and Implementation of Software Reliability using Fuzzy Logic Techniques" submitted by Syed Wajahat Abbas Rizvi for the award of Degree of Doctor of Philosophy by Babu Banarasi Das University, Lucknow is a record of authentic work carried out by him under our supervision. To the best of our knowledge, the matter embodied in this thesis is the original work of the candidate and has not been submitted elsewhere for the award of any other degree or diploma.

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DECLARATION

I, hereby, declared that the work presented in this thesis, entitled "Improving the Modeling and Implementation of Software Reliability using Fuzzy Logic Techniques" in fulfillment of the requirements for the award of Degree of Doctor of Philosophy of Babu Banarasi Das University, Lucknow is an authentic record of my own research work carried out under the supervision of Dr. Vivek Kumar Singh and Dr. R. A. Khan.

I also declare that the work embodied in the present thesis is my original work and has not been submitted by me for any other Degree or Diploma of any university or institution.

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PREFACE

Today, the influence of information technology has been spreading exponentially, from high level research going on in top labs of the world to the home appliances. Such a huge demand is compelling developers to develop more software to meet the user expectations. As a result reliability has come up as a critical quality factor that cannot be compromised. Therefore, researchers are continuously making efforts to meet this challenge. In general an accurate estimate of reliability can be obtained through software reliability models only in the later phases of software development like testing. Predicting the software reliability early would be useful for software designers since it provides vital information to take decision on design and resource allocation and thereby facilitates efficient and effective development process towards developing a reliable product. Therefore, it is reasonable to develop models that more accurately arrest the faults as early as possible, before they propagate undetected to later stages and cause severe and unrecoverable damage.

It is evident from the review of the literature that no such fuzzy logic based framework exists that guides the process of quantifying software reliability on the basis of requirement and design measures, before the coding of the software start. This fact further strengthens its significance as well as developmental feasibility. With this spirit, the research has proposed "Fuzzy Logic based Software Reliability Quantification Framework (^{FL}SRQF)". Subsequently the framework has been implemented, and the research has developed an "Early Stage Reliability Prediction Model" (ESRPM)

through Fuzzy Inference System, which can predict software reliability of the developing software up to its design stage.

The development process starts with conceptualization as well as the description about the current situation along with the highlights of early reliability prediction. A comprehensive state-of-the-art on software reliability prediction and estimation has been put forth as the second step followed by a summary of critical findings. Subsequently the research has proposes a structured framework that may overcome the inadequacies of earlier studies and quantifies the reliability, on the basis of the requirement and design phase measures, before the coding starts.

All the eight phases of the framework has been implemented systematically, and the ESRPM has been validated theoretical as well as statistically along with a comprehensive sensitivity analysis. During the validation process it has been found that the deffuzzified values of reliability from the ESRPM have strong correlation with the already known corresponding values of reliability. Predictive Accuracy of the model is also presented with encouraging quantitative values of MMRE, BMMRE, MdMRE and Pred(n).

Subsequently in order to strengthen its claim to be a better reliability prediction model and to enhance its acceptance the ESRPM has been compared theoretically as well as empirically with existing reliability models. The findings from the comparison have ensured that the model developed in this research has an edge over the already existing Models.

One of the major significant contribution of this research is the Fuzzy Logic based Software Reliability Quantification Framework (^{FL}SRQF). The framework is quite prescriptive in nature, and will definitely facilitate industry professionals and researchers to predict software reliability in the early stage of development, and subsequently decrease the probability of software's unreliability. Besides that the consideration of the requirements phase along with the design provides this research an edge over other studies those are based on only design phase, because ignoring or overlooking requirements deficiencies and only concentrating on making the design constructs superior will not seems good enough.

Identification of the suitability of various requirement and design measures as a contributor for the software reliability is also one of the major effort of this research. Further In most of the cases, developed models only provide quantitative values but neither provides suggestions on how to make improvement, nor the precautions on how to avoid abnormalities. Therefore, to fill this gap this research recommends to provide needed suggestive measures based on the results and contextual interpretations. Apart from above based on the predicted reliability of developing software upto its design stage, the developers may predict the reliability of the final software to be delivered in future.

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