Chapter 8

CONCLUSION

The significance of multilingualism has reached newer heights due to the drive in globalization of business and e-Governance initiatives of countries with multiple languages in their national language list. This enforces that each human has to know more than one language for their official life and/or social life to meet the demands. Hence IT services, which are inevitable to the human life, have to be designed to exhibit multilingualism. So, appropriate software has to be designed to make the computer to function in multilingual mode. Multilingual software is the one which exhibits multilingualism in one or more aspects like IO, UI, storage, process etc.,. The development of multilingual software is driven by stakeholders of multilingual software, namely software engineers, computational linguists, language engineers and end users. Formal multilingual software design and development activities are today’s requirement. In order to accomplish the formal multilingual software design, this research work has been carried out.

It was proposed to formalize the existing multilingual software and analyze them for their capabilities. As a next step, a new model for multilingual software was proposed. Based on this proposed model, a reference model for multilingual software was designed to satisfy the quality requirements. This reference model was applied to develop a framework for the multilingual software development and the architectural experience was stated.

8.1 Summary of Approach

A study of literature was carried out to understand the multilingual software and its characteristics. The classification of multilingual software and the classification of multilingual software development techniques were also presented in order to obtain a clear understanding about the evolution of multilingual software.
There was no explicit domain model for multilingual software development. In order to overcome this difficulty in developing multilingual software, models have been mined by studying the existing multilingual software and represented using the algebraic structures. The mined models of multilingual software were compared for multilingual software qualities and found that they had inadequacies of qualities.

Design space approach was used to analyze the models in order to overcome the inadequacies. The requirements of multilingual software have been analyzed using the design space approach and the factors which limit the qualities of multilingual software were identified. An aspect based language library model was proposed and it was formally represented using the algebraic structure. Unit operations were used to refine the aspect based language library model into reference model. Different multilingual software architectures were designed by applying ARMMS combining with different architectural styles like layered, client-server, interpreter, object-oriented etc, using object-oriented approach and UML. Architectural experience in building the multilingual architectures helped in fine tuning the model.

8.2 Summary of Key Findings

This Research work was carried to this direction and the findings are summarized below.

1. The formal models of multilingual software were mined based on the existing multilingual software. Also, an effort was made to formalize it with implementation/technology independent representation. Inadequacies of these models from the quality perspectives were also presented.

2. Design space approach was used to find the inadequacies of the existing multilingual software models and these inadequacies were addressed by separating the language aspects. Based on this, an aspect based language library model for multilingual software was proposed and formalized.

3. Applying the unit operations on the aspect based language library model, an Architectural Reference Model for Multilingual Software (ARMMS) was
derived. Also, the layers of ARMMS and the views of ARMMS were presented in detail. A discussion was made to present the positive impact of this model from quality perspectives which are demanded by the stakeholders.

4. Application of ARMMS on multilingual software development was comprehensively presented with an example. This reference model was applied to build a multilingual based framework which acts as a platform for multilingual software development and the architectural experience was discussed.

8.3 Future Research Work

Change is the only permanent process in the world. Architecture reference model for multilingual software should get changes in terms of evolution and improvements. The future work concerned with ARMMS can be stated with respect to two perspectives, namely language perspective and architectural perspective. From the language perspective, more languages can be made suitable for ICT applications and used in the PONN framework. Enriching the language aspect component repository is another major task which is to be carried out. From the architectural perspective, patterns in PONN framework and the associated multilingual software have to be mined in order to increase the reusability in the PONN framework. Another endeavor can be devised in proposing a metric suite for multilingual software and its development which will quantify the qualities in the ARMMS and other models of multilingual software. These models, metrics, and patterns could be effectively used only through a development methodology. A new or improved development methodology can be proposed for the multilingual software development.