Chapter 7

CONCLUSIONS

7.1 Summary

In this system, we have provided an integrated approach for an efficient embedded systems design. We have discussed various design components that are the integral parts of the embedded systems. Embedded systems are found in every field of both engineering and science. To meet the demands of these applications, the designer faces a lot of challenges in terms of: processor selection, RTOS selection, IDE selection, and also different I/O components. To meet the time to market and increase productivity, the designer of the embedded systems is forced to choose right design components, instead of redesigning the components in many cases. Reusability has a lot of benefits especially with regard to embedded systems design.

The main objective of the system is to provide a mechanism with which designers are able to select suitable components for embedded systems design. These components include Microcontrollers, Operating systems and IDEs. An Embedded system deals with the graphical capture of specifications and requirements for embedded systems development, as specified by designers considering the application. Based on these specifications and the available data, a list of the most suitable embedded components is made available to the designer. The designer can then select these components that are
required for embedded systems design. A vast database is usually maintained where specifications of different available embedded components are stored. This database is searched whenever designers specify their requirements, and the components that match with the requirements of the designers are displayed.

These systems not only provide a mechanism for selection but also allow designers to compare different components based on their applicability. This system also allows designers to study the various existing embedded systems; their characteristics and design issues, and their applications. Thus, this system acts as a pre-design tool for embedded system designers, where planning of design and development strategies can be done easily and efficiently.

Selecting a right processor to suit the given application is not only important but it is also a difficult task in the process of designing an efficient embedded system. The selection of the processor involves many aspects such as: architecture, on-chip components, technical and non-technical aspects of the processor. A large number of approaches have been proposed to select a suitable processor for a given application. In this thesis, we have classified and outlined the different techniques used for the processor selection for embedded systems and provided the merits and demerits of exiting techniques. We have presented four case studies of the processor selection by the design centers.

Embedded Systems are used in a wide range of applications, and it is the task of a designer to select a suitable processor from the vast list of processors, ranging form 4 bit to 64 bit with various architectures. Embedded systems performance is mostly dependent on the type of processor being used. Each processor is characterized by a set of parameters and there are almost infinite alternatives which are available for a designer to
select the right or suitable processor which is a multidimensional search problem. We have provided two different Algorithms KT and WSA to find the suitable processor among a large number of alternatives for a specific application of embedded system. It is efficient because we have provided the weights and percentage of accuracy to the designer, to specify the requirements and application characteristics, that are considered in the selection. These can be altered as per the specific needs of the project. It has user-friendly GUI, through which the designer can alter the specifications, and specify the new requirements for selection of these components for a given application. The other technique namely tabular method that is useful in the case of a few alternatives has also been discussed.

Today’s embedded systems developers play a vital role in selecting the right tool for development because there are a large number of IDEs that are available in the market, with various features ranging from simple tool chain to complex tool chain. In this work we have presented the common tool chain used for the embedded systems development, the and selection criteria and evaluation criteria of IDEs. Finally, we have presented the performance metrics of the selected IDEs with four different applications. These results are achieved out with commercially available IDEs which are widely available in the market.

Real time applications have become very popular these days due to the complexity in the system and also because 70 % of products coming out contain the RTOS. To meet those complexities, the developers have been given the invariable task of making the real time software. A large number of RTOS available in the market, and one does get confused as
to which one to select, that really provides the efficient embedded systems design in terms: of cost, power consumption, reliability, speed, etc.

Simple Genetic Algorithm that is applied to find the suitable RTOS for a specific application. The methodology described for RTOS selection is unique and efficient for a large number of RTOSs. It has user-friendly GUI through which the designer can alter the specifications and specify the new requirements for RTOS selection for a given application. It generates the optimal RTOS based on the requirements that are entered by the user keeping in mind the amount of accuracy required. We have also incorporated tabular method and weighted sum algorithms for the RTOS selection. We have observed that the tabular method is good if we have limited options, and for average options we can opt for weighted sum method and for a large number of components, we can go for SGA.

Thus, it provides an integrated solution by providing the methods or algorithms to choose the best suitable processor, IDEs, and RTOS for a specific project to implement it efficiently. Thus it acts as a pre-design tool for the designer.

7.2 Main Contributions and Highlights of the Results

The Following are the main contributions and results of this thesis:

- The KT Method and WSA have been implemented for processor selection.
- The methodology to extract the application characteristics which are used to select the processor for embedded systems design has been demonstrated.
- Survey and Classification of available processor selection methods help the designers to choose the appropriate processor.
• Results of the KT method and WSA help the designer to choose the processor based on the application requirements.

• Comparisons of processor selection methods have been provided which further help the designer to choose the most suitable one.

• A framework for IDE selection and evaluation is provided. Here we have considered eight propriety ids to demonstrate the tool selection (IDE).

• Results of the IDE selection based on various criteria like: processor support, compiler features, debugging features, networking support, RTOS support etc, have been shown, and these IDEs are evaluated based on these criteria. These evaluation results help the designer to choose the most suitable IDE for a given project, and it has been found that these results and the practical results converge.

• RTOS is a unique component in the tool chain. Genetic Algorithm has been proposed to select the one that is suitable for a specific project.

• PreDES – A Pre Design tool for embedded systems is proposed to select different components, which is lacking in any existing IDEs. This IDE acts as a pre-design tool for embedded system design.

• PreDES is a framework that helps the designer to get the design task done easily and effectively with the help of user-friendly interactive GUI. It servers as a pre-design tool, in Project Management, and also in selecting the right processor, right IDE, right RTOS, and other input and output components for a given project as an integrated approach for the efficient designing of embedded systems.
7.3 Future Work

This thesis focuses on the major components such as: processor, IDE and RTOS selection which are important for an efficient design of embedded systems. The work reported in this thesis can be extended to the other components such as memory. The pre-design tool, PreDES can be further integrated with commercial tools or IDEs, along with the components selection methods for the efficient embedded systems' design.