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EMBEDDED TESTING SYSTEM WITH AI

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Abstract -- Testing of embedded systems is most High end technique and time consuming task because of its different infrastructure, organizations and techniques used for its development.. This paper gives a new artificial intelligent approach for testing of various Embedded Systems. It focuses on three different aspects. First is the efficient use of an Artificial Intelligence approach to test the Embedded System. Second is the development of one universal platform for testing. Third is development of safety critical character generator device. Safety critical characteristics are being monitored, tested and analyzed with an Artificial Intelligence. An Artificial Intelligence approach uses Artificial Neural Network to train the neural network. Multiple embedded systems are successfully tested together in real time environment using the above approach. Platforms and application developments. Embedded system testing is very difficult task because of large variety of execution platforms, cross-development environments, wide range of deployment architectures, and coexistence of various implementation paradigms, timing constraints and tight resources on the platform where they will be executed, lack of clear design models and emerging quality and certification standards.

RESEARCH WORK PLAN

Research plan begins with embedded system's testing life cycle, were all of testing requirements are analyzed, test plans are designed and coded. The verification and validation techniques are used.

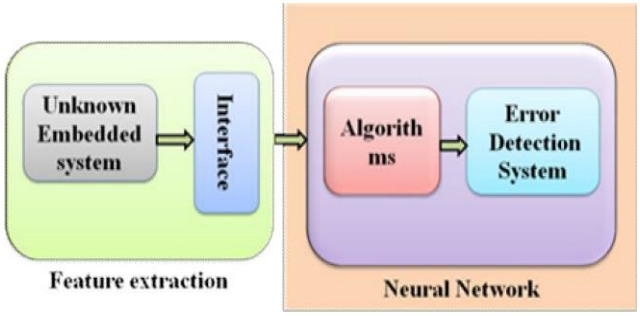
I. INTRODUCTION

Embedded system is very difficult task. Embedded Systems are becoming more and more important in today's life in many ways. Embedded Systems can be in general defined as special purpose information processing systems, containing both hardware and software development. Embedded systems are integrated in larger systems, which interact with environment for achieving a set of predefined tasks or applications. Testing of each Embedded Systems required separate tool or separate code .There is no such mechanism is presents in market, which is responsible to check number of Embedded Systems together. As we are dealing with differential Embedded Systems each of Embedded System is developed as an application specific one and having different approaches for testing. These systems are characterized by Life cycles, Infrastructures, Techniques and Organization. These cornerstones can be treated as basics for categorization of embedded systems and can be responsible for allocating techniques for performance sensitive devices, running in real-time applications. All too often, the available testing techniques are failed to run the performance and the space requirements, and the tester must program separate code for testing of each embedded system. In the drastic and changing environment, the rapid growth in the Embedded Systems marketplace demands efficient automated testing tool, which will be capable to solve testing problems of Embedded Systems.

The resource, performance, and timing constraints of real time Embedded Systems suggest that significantly more powerful testing techniques should be required during the final stages of program development. The testing time provided from developers to tester is also very short for completing tests and covering faults. Stronger and more costly techniques might become essential for the Embedded Systems testing process, which are affected by some issues important to the embedded world. First is the separation between the executions Testing is performed in all of development processes of embedded systems. Planning and control is provided to Recognition analysis, Specification, and Execution and completion phase. Different embedded systems are identified before considering under test. If we will take ten numbers of Embedded Systems and we have to test them under one platform, first we have to identify their type. In order to test them via one tool as it is a very difficult task. Embedded System is the application specific one and each embedded system contains its specific testing tool. It contains hardware as well as software, so there is a need to test hardware as well as software. On the basis of hundred samples collected from the Embedded System under test through the interface card, which communicated using serial port PC and the USART of ATMEGA16 of interface card. The Embedded System is designed around PIC16F877 which is performing four different tasks and the changes on IO's are detected by the interface card on parallel ports. The system scan maximum of twelve input pins and six output pins and four critical inputs around 1us and the changes on IOs are detected and transfer to the neural network. The sequential samples are creating different patterns for different applications. These patterns are used to train neural network.

Automated Test case generation based on coverage analysis Paper focuses on automated generations of unit tests. They have developed tool, which is symbolically executed java byte code for searching execution path through program, for searching choice-point generation, constraint solving and backtracking was used .They have proposes a novel way to reduce the test cases, which was based on their contribution to the global coverage of the data flow and control flow. Basic aim behind work is elimination of repeated and meaningless test cases. For example a method for handling AVL trees should only be tested by AVL trees rather than with arbitrary trees.

An Artificial Intelligence approach uses Levenberg-Marquardt algorithm to train the neural network. The Levenberg–Marquardt algorithm gives numeric calculations for solving the problem of minimizing a nonlinear function. Levenberg-Marquardt algorithm is alternative to the Gauss-Newton method. Gauss –Newton method is used to find the minimum of a function. The training problem can be treated as a general function optimization problem; Gauss-Newton method adjusts parameters being the weights and biases of the network. Neural network is used to map between a set of numeric targets and data sets of numeric inputs. The Neural Network Training is performed via Levenberg-Marquardt back propagation algorithm. When the network does not perform well after training then we have to change the number of neurons. Training automatically stops when generalization stops improving, as indicated by an increase in the mean square error of the validation samples.



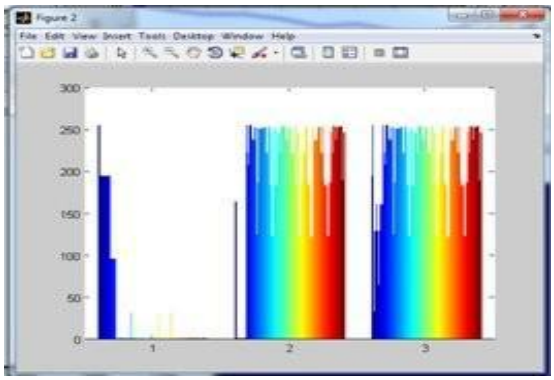
Architectural Block Diagram of Research Plan

Figure three shows neural network for training the samples. It shows neural network training results, were levenberg algorithm is used. Figure four is for set of inputs, figure five is for set of outputs and figure six is for training set. Experimental set up for second pattern gives similar results. In second case set of saved inputs and outputs are used. They are trained via neural network fitting tool. Fitting Tool is used for selecting data, creating and training a network and use to evaluate performance using mean square error and regression analysis. After selecting data for input and target

II. RESULTS

Experiment setup is used for demonstration of actual verses virtual testing of Embedded Systems. Some results are obtained. First set of outputs are obtained via hardware developed for Safety Critical Characteristics Generator. Training is performed via Levenberg-Marquardt back propagation algorithm. When the network does not perform well after training then we have to change the number of neurons.

Training automatically stops when generalization stops improving, as indicated by an increase in the mean square error of the validation samples. The neural network for training the samples. It shows neural network training results, were levenberg algorithm is used. for set of inputs, The set of outputs and training set. Experimental set up for second pattern gives similar results. In set of saved inputs and outputs are used. They are trained via neural network fitting tool. The set of inputs and outputs generated via safety critical character generator hardware device. The real time input and output from Safety Critical Character Generator device, which is the great achievement of research work.



Its gives graphical diagram for training sets. Neural network is used to compare the desired and generated input outputs. Tool is used to train the network.

III. CONCLUSION

In this paper, we have demonstrated an Artificial Intelligent approach to test the inputs and outputs of Safety Critical Embedded Systems. The Safety Critical characteristics are generated via hardware; Safety Critical Character Generator device. Research work gives a new approach for testing of embedded systems .Testing of heterogeneous embedded system is not possible over a one tool, as testing of pace maker is not similar to testing of ABS. Each of application specific embedded system requires its own specific tool. Inputs of Embedded systems which are responsible to generate safety critical characteristics are tested here via neural network means via an Artificial Intelligent Approach. The process of Training Validation and Testing is performed. This is the universal methodology for Embedded System Testing. This approach is capable to test ten or more number of Embedded Systems together. Experimental result shows that this method is promising for solving testing problems of embedded systems. This paper describes the testing framework that is black box based and capable of testing several Embedded Systems over on single platform in real time. LM method has been proposed for research work which gives less error faster computation time and moderate complexity and has been implemented successfully. Future scope will be the modification of testing tool for heterogeneous Embedded Systems, where the number of device under test can be increased.

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