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Efficient VLSI Implementation Based On Constructive Neural Network Algorithms

K. Ramkumar[1], S. A. Sivasankari[2]
[1](ECE Department, Saveetha School of Engineering, Saveetha University, Chennai, India)
[2](ECE Department, Saveetha School of Engineering, Saveetha University, Chennai, India)

Abstract: *C-Mantec is a new neural network algorithm that adds competition between neurons with thermal perceptron learning rule. The neuron learning is ruled by the thermal perceptron rule that guarantees the stability of the learnt information while the architecture increases and while the neurons involve in competition for newly incoming data. Competing makes it possible that even after new neurons have been added to the architecture, existing neurons can still learn if the incoming data is similar to that of the stored information, and this sets up a major difference with the existing constructive neural network algorithms. The new algorithm is tested with diabetes, a well-studied and needed real world problem. It has been used to analyze the size of the neural architecture and the generalization ability in order to compare it with those of other neural classification algorithms. The problem of underfitting/overfitting is also analyzed, and a new method to remove noisy samples is also created. Therefore, it has been shown that the new algorithm generates very small neural architectures with very good generalization capabilities.*

Keywords: *Competition, constructing, generalization capability, overfitting.*

I. Introduction

Neural Networks are the systems constructed and inspired by the Human Brain. The central neural systems are important to all the living beings and they seem to work well in their common locality of high complexity. Brain, which is the supervisory centre of the neural system, is able of learn new circumstances, it shows as a system we would describe as very robust decision system, effective classifier and good pattern recognizer. It also has effective memory providing remembrance of the localities, learnt patterns, and performed decisions. From the system modelling view point, neural networks with number of neurons, exhibit a synergic effect. That means the powers of the numbers of connected neurons is exactly higher than the direct addition of the powers of the particular individual neurons.

Models of neural networks generally consists of the basic units called—neurons— and interconnections between these neurons. According to the basic definition, the artificial neurons are one way conversion of incoming data into outgoing data. Although there is only the single function to specify, there are many ways to choose a transfer function comprehending this conversion. Indeed, only one best rule regarding this artificial neurons' functions is in use, reckoning the neurons to have one or many incoming input data and only one outgoing output data. First, it started with single neuron networks. Later it developed to multiple layer networks.

A multi-layered perceptron, neural network consisting of many artificial neurons organized into many successive layers, makes the output even more accurate and generalized. Today we notice large numbers of various types of neural networks as cyclic networks, acyclic networks, feed-forward network, self-organizing networks, fully connected networks, sparsely connected networks, and many others too. Each type of neural networks features has its particular pros which make it helpful and even successful in performing specific tasks. The artificial neuron carries the computational capability of the neural network, the interconnections between the neurons increase the level of calculations, and also the generalization capability. In live human brains the amount of neurons is higher; for instance, in the human brain the number of neurons sum upto 13 digits. At such high density of neurons, the multitudes of mutual interconnections allow even for memory expansion. The neural network consisting of more than one neuron is thus an estimation of the complex neural network structure and is hoped to bring about at least the sturdiness and generalization capability.

II. Proposed Algorithm

C-Mantec (Competitive Majority Network Trained by Error Correction) is a new neural network constructive algorithm that implements competition between neurons and a new perceptron learning rule to build compacted architectures with good forecasting capabilities. The novelty of C-Mantec is that the neurons. compete for learning the new incoming information, and this process permits the creation of very compacted neural network architectures. At the single neuronal level, the algorithm uses the novel thermal perceptron rule, introduced by Frean in the year 1992, that improves the convergence of the standard perceptron for non-linearly

separable methods. C-Mantec, as a CONN algorithm, has in addition the advantage of generating online the topology of the network architecture by adding new neurons during the training phase, resulting in faster training times and more compact architectures. Its network topology consists of a single hidden layer of thermal perceptron that maps the information to an output neuron using a majority function.

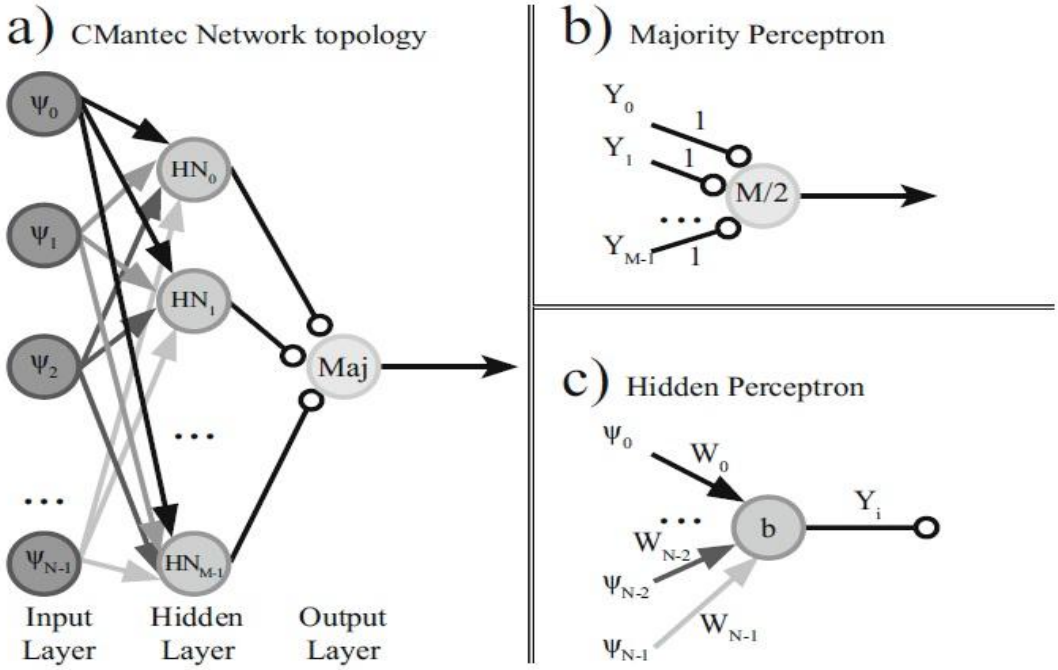

Fig: 2.1 Architecture of C-Mantec Algorithm

III. Design Summary

Xilinx ISE (**I**ntegrated **S**oftware **E**nvironment) is the software tool used for synthesis and analysis of HDL design. Modelsim was used for Simulation. ModelSim provides seamless, scalable performance and capabilities. Through the use of a single compiler and library system for all ModelSim configurations, employing the right ModelSim configuration for project needs is as simple as pointing your environment to the appropriate installation directory.

ModelSim also supports very fast time-tenet-simulation turnarounds while maintaining high performance with its new black box use model, known as bbox. With bbox, non-changing elements can be compiled and optimized once and reused when running a modified version of the testbench. bbox delivers dramatic throughput improvements of up to 3X when running a large suite of test cases.

An intelligently engineered graphical user interface (GUI) efficiently displays design data for analysis and debug. The default configuration of windows and information is designed to meet the needs of most users. However, the flexibility of the ModelSim SE GUI allows users to easily customize it to their preferences. The result is a feature-rich GUI that is easy to use and quickly mastered.

A message viewer enables simulation messages to be logged to the ModelSim results file in addition to the standard transcript file. The GUI's organizational and filtering capabilities allow design and simulation information to be quickly reduced to focus on areas of interest, such as possible causes of design bugs. Therefore, Model Sim is used for simulation.

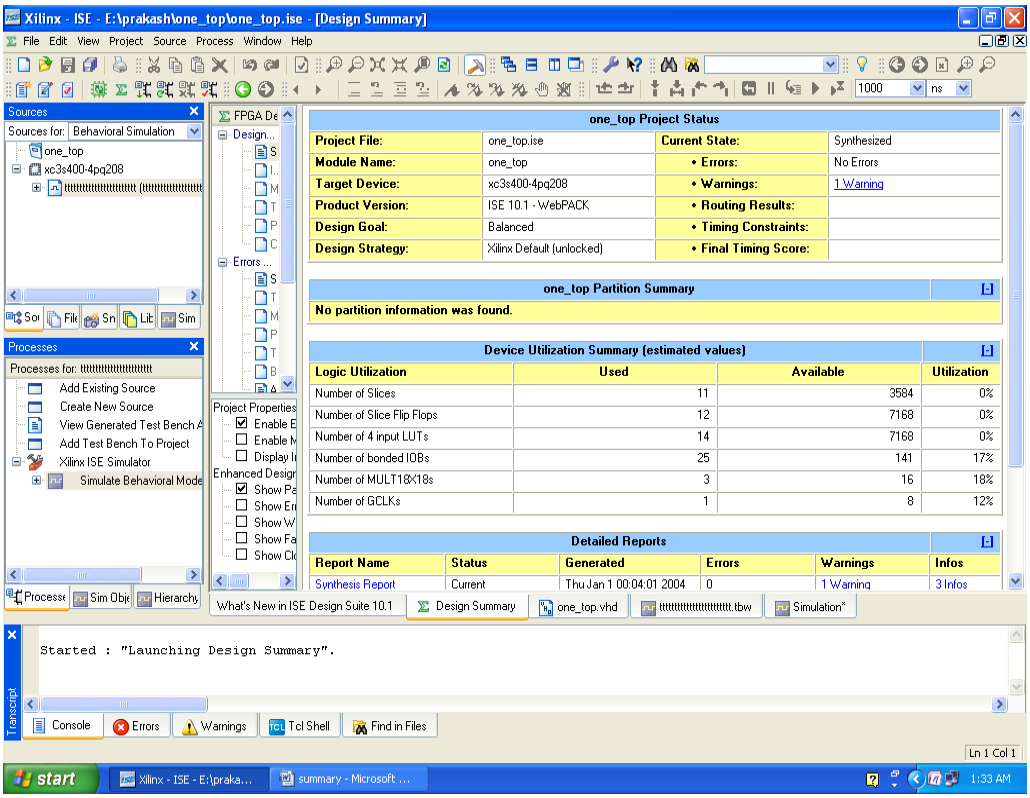

Fig: 3.1 Synthesis report from Xilinx software

IV. Output Explanation

The output is obtained after three clock cycles. In the first clock cycle the input and weights are to transferred to the system. In the second clock cycle weights are multiplied and accumlated. The output is checked with the threshold and output is obtained in the third cycle.

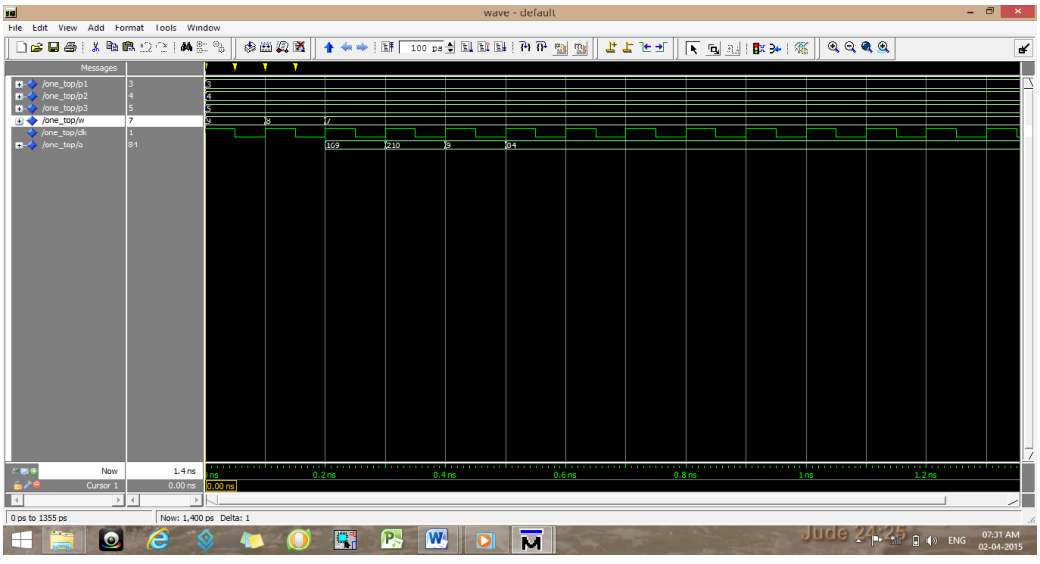

Fig: 4.1 Simulation result from Modelsim software

V. Conclusion

This study was carried out to determine the performance of ANNs in modeling glucose level fluctuations on a daily basis for finding if a patient is affected with diabetes. Results obtained have shown that the network has been able to model the process with low RSME values. The different network algorithms that have simulated the glucose levels indicate that the same algorithm need not provide the same result for different conditions. It is also observed that a clear understanding of the field conditions is also required for the decision

of input parameters. Also it can be concluded that the network performs well even with antecedent conditions of only two days considered for input along with the input parameters at current values. However this study provides an insight into the application of ANN in health management and further understanding of the physical processes will increase the performance of the network.

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