Project Proposal: Implementation of an Artificial Neural Network in an FPGA

Advisor: Dr. Jianjian Song

Students: Joseph Doherty, Robert Fendricks, Ian Kowalski

**Executive Summary**

An Artificial Neural Network is a commonly used method for machine learning applications and pattern recognition. By using a large amount of training data, they are able to accurately solve complex problems through an iterative training method.

The goal of this project is to compare a purely software based approach to an FPGA design. In theory, this would allow the artificial neural network to run in a parallel environment, taking better advantage of the structure of the artificial neural network which is highly parallel in nature.

The projected end result of this project is to implement a voice recognition system that will act as an access control system by recognizing which voices are to be allowed or rejected.

The project would be during Spring Quarter, 2014.

We are requesting $460 to cover material costs.

The students will be doing this project for academic credit under ECE498.

No special accommodations will be required for this project.

**Project Description**

The neural network will be created on a FPGA using the Xilinx IDE. The algorithm implemented will be based off of a standard neural network, and will be implemented in both software and hardware. The network will consist of at least four layers, and will use back propagation to adjust values during training. At least one hundred student voices will be captured with their consent for this project and will be used for training and testing purposes of the network. Students will say several simple phrases in a variety of tones in order to build a complete database and provide multiple variations for training and testing. Implementations of the network will vary in software and hardware to take advantage of each systems strengths. Sounds will have several transformations performed on them in order to extract usable data, including Fourier transformations. In order to assess the validity of our methods, we will keep track of three pieces of data: DIR (Detection Identification Rate), FAR (False Acceptance Rate), and time elapsed. DIR and FAR will be used for evaluation of the accuracy and validity of our method, while the time elapsed will be used for evaluating the efficiency of the method. Time elapsed will be kept track of using the system clock on a computer and by building an onboard counting system. Data will be transmitted from the FPGA board to a computer for data collection purposes, in addition to a signaling system implemented.

The main difficulty of this project will be in properly designing and training a neural network in hardware. This will require complex computations requiring us to design our own ALU (Arithmetic Logic Units) in order to properly process sound files for use and for the back propagation training method. In order to assist with rapid prototyping and testing we feel it is necessary for each team member to have their own board. This project will enhance our knowledge of FPGA design techniques and neural networks, both of which are valuable in today’s marketplace. Neural networks are a common method for classifying large amounts of data based off of a smaller training sample, and fpga designs are used to test the validity of chip designs.

**Budget**

**Equipment**

Nexystm 4 Artix-7 FPGA Board \* 3 $460

**Supplies/Consumables**

No additional supplies are required

**Total Request** $460

Goals:

Perform a cost/benefit analysis between Software and Hardware designs focusing on:

Speed

Cost

Implementation time

Flexibility