Implementation of PWM Technique Using Artificial Neural Networks over Wireless Medium

R. Devasaran¹, Pankaj Roy² and A. K. Singh³
¹Professor, Dept of E&EE, G.N.D. Engg. College, BIDAR, Karnataka, India
²Professor and HOD, Dept of E&EE, BIT, Sindri, Bihara, India
³Sr. Lecturer, NERIST, Arunachal Pradesh, India

(E-mails: rdsaran56@yahoo.com, pr_bit2001@yahoo.com, aksinghnerist@yahoo.co.in)

Abstract: An artificial neural network (ANN) is a flexible mathematical structure which is capable of identifying complex nonlinear relationships between input and output data sets. The proposed project is one such attempt of implementing a PWM technique using artificial neural network schema. In this project a three dimensional accelerometer and a touch screen sensor are used as input devices for the system. The output of these two devices are analog in nature, to digitize these signals and to transmit over wireless medium we are using arduino based ATmega8 micro controller. ISM band RF modules are used to communicate over wireless medium. The MSP430 is a mixed-signal microcontroller family from Texas Instruments. Built around a 16-bit CPU, the MSP430 is designed for low cost and, specifically, low power consumption embedded applications. This micro controller is used at the receiver end to receive data and control the motor speed depending on the received data.

Keywords: ANN, PWM, Arduino, MSP430, Accelerometer, Touch screen.

1. INTRODUCTION

Although most practical applications of artificial neural systems can be carried out by using software simulators, the very large scale integration (VLSI) implementation is still required in many applications where portable hardware and real-time processing are needed. One example is the automatic transcription. There are various implementation methods in either digital or analog techniques. Basically, the analog neural systems have compact structures, efficient asynchronous operations, and no quantization effects. But the signals are not robust against noise and interference. On the other hand, the digital VLSI neural systems are robust, easily transmitted and regenerated, and fast. However, the implementation is area and power consuming. In order to combine the advantageous features of both analog and digital VLSI neural systems, the pulse-stream technique has been proposed. In the pulse-stream technique, digital signals are used to control motor speed. One efficient way of solving complex problems is following the lemma “divide and conquer”. A complex system may be decomposed into simpler elements, in order to be able to understand it. Also simple elements may be gathered to produce a complex system.

The nodes can be seen as computational units. They receive inputs, and process them to obtain an output. This processing might be very simple (such as summing the inputs), or quite complex (a node might contain another network...)

2. SYSTEM ARCHITECTURE

In this system we have two units, transmitter unit and receiver unit. In the transmitter unit we are using two input devices, accelerometer and touch screen sensor. In order to select one input device we are using push to ON-push to OFF switch. The output of accelerometer and touch screen are analog in nature, to convert these analog signals into digital form we are using in-built six channel ADC of Atmega8 micro controller. By using matching algorithm we are comparing present input readings with already observed pre-defined input readings. For matched readings we will transmit four digital data bits through RF transmitter.

In the receiver unit RF receiver will receive four data bits from transmitter and depending on the received data bits motor speed will be controlled. For this purpose we are
using MSP430 controller. But micro controller cannot control motor directly in between it needs a driver circuit. L293D IC is used as driver circuitry.

Figure 2: Transmitter Unit

Figure 3: Receiver Circuit

3. TOUCH SCREEN SENSOR

Touch screen sensors are composed of a transparent touch screen surface surrounded by a sensor array that provides positional information to a processor. A touch screen sensor enables the display to be used as input device and replaces the keyboard or mouse as the primary method of input for interacting with a display’s content. Touch screen sensors can be attached to computers and handheld devices. Touch screen technology is used by banks in the form of automatic teller machines (ATMs).

Figure 4: Touch Screen

In this project we are using touch screen as an input device for the system. First we will observe the analog values for different positions on touch screen. Depending on these values complete touch screen module is divided into four quadrants, for each quadrant we will assign the duty cycle at receiver end.

4. ACCELEROMETER GESTURE RECOGNITION

Accelerometer sensor is used for gesture recognition. An accelerometer is a device that measures the vibration, or acceleration of motion and produces different voltage levels. The force caused by vibration or a change in motion (acceleration) causes the mass which produces an electrical charge that is proportional to the force exerted upon it. Since the charge is proportional to the force, and the mass is a constant, then the charge is also proportional to the acceleration.

Figure 5: Flow Chart for Gesture Recognition

In this project we are using ADXL335 accelerometer which is a 3-dimensional accelerometer. This board measures acceleration in three dimensions (X, Y&Z) and produces three different voltage levels. The output of accelerometer is analog in nature, to convert these analog signals into digital form, we are using in-built ADC of Atmega8 micro controller.

Here, Atmega8 micro controllers continuously read data from accelerometer and convert them into digital form. This digitized data is compared with the data which is already taken in the accelerometer analysis part. And for every movement of accelerometer four data bits are assigned. Now, in the comparison phase digitized data is compared with the pre-defined ranges, and for matched range corresponding data bits will be transmitted through ISM band RF transmitter.

5. PWM IMPLEMENTATION

At the receiver end, RF receiver will receive data bits from transmitter and it compares received data with pre-defined data. Using this Artificial Neural Network schema, MSP430 micro controller will control the duty cycle of motor. Below figure shows the flow chart for received data bits and processing in the receiver end.
6. EXPERIMENTAL RESULTS

We have successfully implemented the project tested for different duty cycles with input device as accelerometer and touch screen. when the accelerometer is in forward direction duty cycle is 100%, when it is in right direction duty cycle is 75%, when it is in left direction duty cycle is 50%, and when it is in back direction duty cycle is 25%. Similarly when the select switch is LOW touch screen is selected, when we touch in 1st quadrant motor runs with 100% duty cycle, when we touch in 2nd quadrant motor runs with 75% duty cycle, when we touch in 3rd quadrant motor runs with 50% duty cycle, and when 4th quadrant is pressed motor runs with 25% duty cycle. The hardware circuitry is as shown below.

7. CONCLUSION AND FUTURE SCOPE

A neural-network-based pulse width modulator has been implemented that gives excellent performance in terms of duty cycle. The turn-on times are generated by the ANN and then converted to pulse widths through a simple logic circuit. The ANN significantly reduces the computational efforts of the modulation technique and makes the implementation of pulse width modulation algorithm very fast without losing precision compared to the conventional SVM algorithm implementation using look up table. In practice, the use of DSP micro controller and simple logic circuits can be used for the generation of PWM pulses. It is found that with the ANN implementation of the PWM algorithm not only results in faster implementation of the algorithm and reduced computational burden on DSP but also gives better performance than existing systems.

Artificial neural network based PWM to control DC motor speed has been implemented successfully. ANN is used to determine the sector and region in PWM inverter. The proposed method is a good solution to the classical method at higher abstraction level numbers in multilevel inverters. The proposed control algorithm used in the PWM can be easily applied to multilevel inverters.

REFERENCES