PROJECT PROPOSAL
GOETZEL DFT ALGORITHM

1. SUBJECT AND PURPOSE

The subject of the project is to design a first order system to compute Goertzel algorithm for N=5 and n=1, and 8-bit coefficient and input data. Using Goertzel algorithm is more efficient than any other algorithm such as Fast Fourier Transform (FFT) when $\log_2 N$ or fewer coefficients of the Discrete Fourier Transform (DFT) are needed. As a result it finds its application in Dual Tone Multi Frequency (DTMF) (touch tone) decoding, Call progress (dial tone, busy, and so on) decoding, Frequency response measurements etc.

2. DEFINITION OF THE PROBLEM

Applications such as DTMF etc. require the calculation of fewer DFT coefficients. Using FFT algorithms to calculate these coefficients reduces the device performance significantly since FFT algorithms begins processing only when the entire sample window arrives. FFT algorithms also require large data memory to store these sample window values. Therefore, Goertzel algorithm which performs the recursive computation of DFT coefficients by processing the input data as it arrives has a tremendous advantage in calculating fewer DFT coefficients.

3. IMMEDIATE BACKGROUND OF THE PROBLEM

Although specific Integrated Chips (IC) exists for the applications above, implementing these algorithms in software costs less. It is unfortunate that many embedded systems don't have the horsepower to perform continuous real-time FFTs. The Goertzel algorithm is very efficient in such applications as it calculates fewer coefficients with high speed.

4. NEED FOR SOLUTION TO THE PROBLEM

Certain applications such as DTMF, frequency measurements etc require fewer DFT coefficient calculations. Implementing FFT algorithms to calculate these few coefficients has low performance speed when compared to Goertzel algorithm. Hence it is necessary to design this algorithm as a solution for faster performance requirements for the above applications.

5. BENEFITS THAT WILL COME FROM THE SOLUTION

Implementing the Goertzel algorithm results in an efficient design, both in performance as well as in memory requirements, for applications requiring fewer DFT coefficient calculations such as DTMF, call progress decoding etc.

6.   SCOPE STATEMENT

For the project, a length five(5) Goertzel algorithm is to be implemented. The coefficient and input data required for the implementation are restricted to eight bits. The design is then required to be simulated using the three given input sequences.

7.   METHODS TO BE USED

A VHDL program is to be written to implement the algorithm. The program can be written in MaxPlusII software. The design can then be simulated using the wave form editor in MaxPlusII. A test bench for the output using the given input sequences can be performed using Matlab software.

8.   TIME AND WORK SCHEDULE

TASKS	02/12 To 02/18	02/19 To 02/25	02/26 To 03/03	03/04 To 03/09	03/10 To 03/16	03/17 To 03/23	03/24 To 03/30
Study of Goertzel Algorithm	■						
Construction of Signal Flow Graph(6.3 a)		■					
Computaion of Register Contents (6.3 b)			■				
Implement Algorithm using VHDL (6.20 a)				■	■	■	
Create a Test Bench					■		
Simulate the Design (6.20 b&c)						■	■

9.   FACILITIES TO BE USED

MaxPlusII and Matlab software will be a few of the facilities that will be utilized for the design project.

10.   REFERENCES

1.   U. Meyer-Baese: *Digital Signal Processing with Field Programmable Gate Arrays* (Springer, Heidelberg, 2001).
2.   J.H. McClellan, R.W. Schafer, M.A. Yoder: *DSP FIRST: A Multimedia Approach* (Prentice Hall, 1998).
3.   Sanjit K. Mitra: *Digital Signal Processing.*
4.   www.mathworks.com/access/helpdesk/help/toolbox/signal/goertzel.shtml
5.   http://www.embedded.com/story/OEG20020819S0057
6.   http://www.numerix-dsp.com/goertzel.html