



A Pitch Detector for Musical Scale Training

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ABSTRACT

I. General Overview

This application note describes a pitch detector for musical scale training. This technology could be used in a broad range of applications ranging from children's toys to elaborate professional musical training system for professional vocalists. This application note benefits customers by providing a basic functional capability that may be expanded and customized to a mass-market application in the educational/entertainment marketplace.

DISCUSSION

I. Theory of Operation

6th order IIR Digital filters are used to differentiate the various tones. The filters were implemented on the ZiLOG 893XX family of 16Bit fixed point DSP's, specifically the Z89273 target.

II. Results of Operation

The tones Do (f = 440) Re (f = 493) Mi (f = 554) for example may be discriminated using a signal generator as input. Alternatively a user may simply sing the notes Do, Re, Mi and three LED's signals if the user generates the correct frequencies.

SUMMARY

TECHNICAL SUPPORT

I. Source Code(s)

```
biquad:
;-----
;perform filter computations (coeff * sample) using auto increment
;y = b0*X(n) + B1*X(n-1) + b2*X(n-2)
;   + a1*Y(n-1) + a2*Y(n-2)
;-----
mld    @p0:1+,@p0:0+,on ;A= 0 P = (b0 * X11) X11 = X(n)
mpya   @p0:1+,@p0:0+,on ;b1 * X12      X12 = X(n-1)
mpya   @p0:1+,@p0:0+,on ;b2 * X13      X13 = X(n-2)
mpya   @p0:1+,@p0:0+,on ;a1 * Y11      Y11 = Y(n-1)
mpya   @p0:1+,@p0:0+,on ;a2 * Y12      Y12 = Y(n-2)
add    a,p              ;add result of last multiply to Acc.
sll   a                  ;scale back if divide by 2 on coefficients
ret
```

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```
-----  
; Coefficient tables for F1 Band Pass Filter  
; Do f = 440 fs 8KHz  
-----  
coeff1:  
    df    0.0037,  0.0000, -0.0037  
    df    0.9342, -0.4928  
coeff2:  
    df    0.1846, -0.3444,  0.1846  
    df    0.9345, -0.4972  
coeff3:  
    df    0.3161, -0.5994,  0.3161  
    df    0.9420, -0.4973  
  
-----  
; Coefficient tables for F2 Band Pass Filter  
; Re f = 493 fs 8KHz  
-----  
coeff4:  
    df    0.0040,  0.0000, -0.0040  
    df    0.9186, -0.4919  
coeff5:  
    df    0.1913, -0.3504,  0.1913  
    df    0.9184, -0.4968  
coeff6:  
    df    0.3138, -0.5868,  0.3138  
    df    0.9277, -0.4970  
  
-----  
; Coefficient tables for F3 Band Pass Filter  
; Me f = 554 fs 8KHz  
-----  
coeff7:  
    df    0.0045,  0.0000, -0.0045  
    df    0.8987, -0.4910  
coeff8:  
    df    0.1878, -0.3359,  0.1878  
    df    0.8978, -0.4965  
coeff9:  
    df    0.3189, -0.5856,  0.3189  
    df    0.9094, -0.4967
```

TEST PROCEDURE

I. Equipment Used

Sine Generator with Altec Lansing Loudspeaker (any Audio system should suffice)
Vocal tester

Information Integrity

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