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
```

```
;------------------------------------------------------------------------
; 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

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