Embedded Project
Waveform Generator

In this project we are generating 3 different waveforms using STR912 board and DAC0808 IC. It (STR board) has ARM966E-S RISC core.The generated waveforms are sine wave, triangular wave and square wave.
What we are basically doing is accessing the lookup tables for 8-bit digital values and putting those into GPIO Port-9. There onwards those pins are connected to DAC0808 IC which converts those digital signals to analog signals. These signals are then amplified using LM124 opamp. The amplified signals are then transferred to DSO for observation.

Fig. circuit diagram for waveform generation

Values written in the GPIO_DATA register are transferred onto the GPIO pins if the respective pins have been configured as outputs through the GPIO_DIR register.

Peripheral clock gating

After reset, only the CPU, the Flash memory, the SRAM and a small subset of the peripherals start operating. The other parts of the system remain stopped, because the related Peripheral clock gating register (PCGR) bits are reset. To start them, we have to write 1 to the related register bit. We can stop the peripheral again, by writing 0 to the related bit.
This allows us to dynamically control the number of peripherals that are running which allows us to optimize the power used in a very flexible way.

Digital to Analog Conversion

DAC0808 is a unipolar 8-bit chip. It accepts 8 bit digital input and transforms it into analog value using an R/2R DAC.
In DAC0808, the digital inputs are converted to current (Iout), and by connecting a resistor to the Iout pin, we convert the result to voltage.
The total current provided by the Iout pin is a function of the binary numbers at the DO – D7 inputs of the DAC0808 and the reference current (Iref), and is as follows:
where D0 is the LSB, D7 is the MSB for the inputs, and Iref is the input current that must be applied to pin 14. The Iref current is generally set to 2.0 mA.

ASSEMBLY PROGRAM

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@ _____________________________________________________________________
@ -------------------------OUR PROJECT-------------------------
@ ----------------------Waveform Generator----------------------
@_____________________________________________________________________
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.section .text
.global _start

.equ GPIO9_DIR, 0x5800F400          @ GPIO9_DIR register address
.equ GPIO9_DATA, 0x5800F3FC@ GPIO9_DATA register
.equ SCU_PCGR1, 0x5C002018 @ Peripheral clock gating register
.equ SCU_PRR1, 0x5C002020           @ Peripheral reset register

.equ num, 3                         @ 0 - Sine
                                    @ 1 - Triangle
                                    @ 2 - Sawtooth
                                    @ 3 - Square

_start:
        MOV r2, #num                @ Choice of Waveform

        LDR r10, =SCU_PCGR1
        LDR r9, =0x00800000
        STR r9, [r10]

        LDR r10, =SCU_PRR1
        LDR r9, =0x00800000
        STR r9, [r10]

        LDR r10, =GPIO9_DIR
        LDR r9, =0xFFFFFFFF
        STR r9, [r10]

loop:
        MOV r1, #0
        ADR r4, JumpTable           @ Loading address of jump table

        LDR r4,[r4,r2,LSL #2]

retvalue:
        MOV r3, #1000
delay:
        SUBS r3,r3,#1
        BNE delay

        LDRB r0,[r4,r1]
        CMP r0, #128
        BEQ loop

        LDR r10, =GPIO9_DATA
        STR r0, [r10]
        ADD r1, r1, #1

        B retvalue

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@---------------------------------------------------
JumpTable:
        .word sine_table
        .word triangular_table
        .word Saw_table
        .word Square_table

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sine_table:
        .byte 40, 40, 41, 42, 42, 43, 44, 44, 45, 46
        .byte 46, 47, 48, 48, 49, 50, 51, 51, 52, 53
        .byte 53, 54, 54, 55, 56, 56, 57, 58, 58, 59
        .byte 60, 60, 61, 61, 62, 62, 63, 64, 64, 65
        .byte 65, 66, 66, 67, 67, 68, 68, 69, 69, 70
        .byte 70, 71, 71, 71, 72, 72, 73, 73, 73, 74
        .byte 74, 74, 75, 75, 75, 76, 76, 76, 77, 77
        .byte 77, 77, 78, 78, 78, 78, 78, 78, 79, 79
        .byte 79, 79, 79, 79, 79, 79, 79, 79, 79, 79
        .byte 80, 79, 79, 79, 79, 79, 79, 79, 79, 79
        .byte 79, 79, 79, 78, 78, 78, 78, 78, 78, 77
        .byte 77, 77, 77, 76, 76, 76, 75, 75, 75, 74
        .byte 74, 74, 73, 73, 73, 72, 72, 71, 71, 71
        .byte 70, 70, 69, 69, 68, 68, 67, 67, 66, 66
        .byte 65, 65, 64, 64, 63, 62, 62, 61, 61, 60
        .byte 60, 59, 58, 58, 57, 56, 56, 55, 54, 54
        .byte 53, 53, 52, 51, 51, 50, 49, 48, 48, 47
        .byte 46, 46, 45, 44, 44, 43, 42, 42, 41, 40
        .byte 40, 39, 38, 37, 37, 36, 35, 35, 34, 33
        .byte 33, 32, 31, 31, 30, 29, 28, 28, 27, 26
        .byte 26, 25, 25, 24, 23, 23, 22, 21, 21, 20
        .byte 20, 19, 18, 18, 17, 17, 16, 15, 15, 14
        .byte 14, 13, 13, 12, 12, 11, 11, 10, 10, 9
        .byte 9, 8, 8, 8, 7, 7, 6, 6, 6, 5
        .byte 5, 5, 4, 4, 4, 3, 3, 3, 2, 2
        .byte 2, 2, 1, 1, 1, 1, 1, 1, 0, 0
        .byte 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
        .byte 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
        .byte 0, 0, 0, 1, 1, 1, 1, 1, 1, 2
        .byte 2, 2, 2, 3, 3, 3, 4, 4, 4, 5
        .byte 5, 5, 6, 6, 6, 7, 7, 8, 8, 8
        .byte 9, 9, 10, 10, 11, 11, 12, 12, 13, 13
        .byte 14, 14, 15, 15, 16, 17, 17, 18, 18, 19
        .byte 20, 20, 21, 21, 22, 23, 23, 24, 25, 25
        .byte 26, 26, 27, 28, 28, 29, 30, 31, 31, 32
        .byte 33, 33, 34, 35, 35, 36, 37, 37, 38, 39
        .byte 128

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triangular_table:
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        .byte 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
        .byte 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
        .byte 20, 21, 22, 23, 24, 25, 26, 27, 28, 29
        .byte 30, 31, 32, 33, 34, 35, 36, 37, 38, 39
        .byte 40, 41, 42, 43, 44, 45, 46, 47, 48, 49
        .byte 50, 51, 52, 53, 54, 55, 56, 57, 58, 59
        .byte 60, 61, 62, 63, 64, 65, 66, 67, 68, 69
        .byte 70, 71, 72, 73, 74, 75, 76, 77, 78, 79
        .byte 80, 79, 78, 77, 76, 75, 74, 73, 72, 71
        .byte 70, 69, 68, 67, 66, 65, 64, 63, 62, 61
        .byte 60, 59, 58, 57, 56, 55, 54, 53, 52, 51
        .byte 50, 49, 48, 47, 46, 45, 44, 43, 42, 41
        .byte 40, 39, 38, 37, 36, 35, 34, 33, 32, 31
        .byte 30, 29, 28, 27, 26, 25, 24, 23, 22, 21
        .byte 20, 19, 18, 17, 16, 15, 14, 13, 12, 11
        .byte 10, 9, 8, 7, 6, 5, 4, 3, 2, 1
        .byte 128
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@-------------------------------------------------------
Saw_table:
        .byte 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
        .byte 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
        .byte 20, 21, 22, 23, 24, 25, 26, 27, 28, 29
        .byte 30, 31, 32, 33, 34, 35, 36, 37, 38, 39
        .byte 40, 41, 42, 43, 44, 45, 46, 47, 48, 49
        .byte 50, 51, 52, 53, 54, 55, 56, 57, 58, 59
        .byte 60, 61, 62, 63, 64, 65, 66, 67, 68, 69
        .byte 70, 71, 72, 73, 74, 75, 76, 77, 78, 79
        .byte 128

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Square_table:
        .byte 30,30,30,30,30,30,30,30,30,30
        .byte 80,80,80,80,80,80,80,80,80,80
        .byte 128

.end
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