

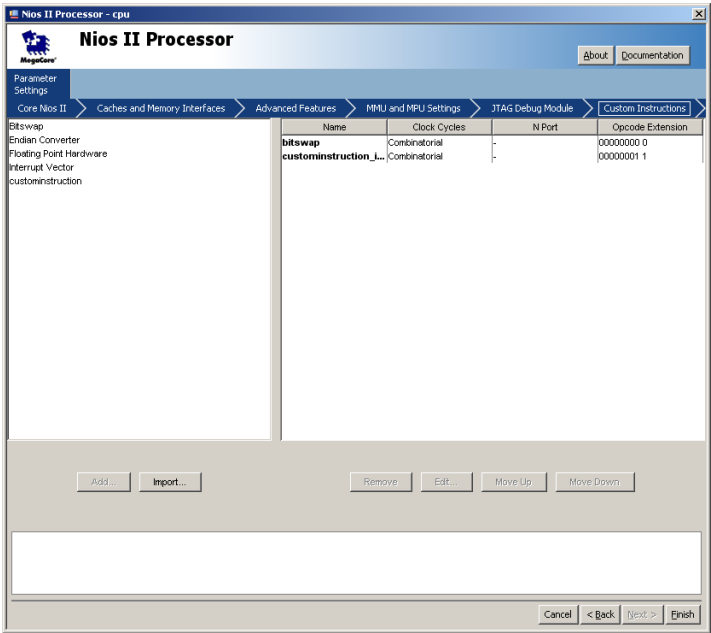
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Embedded System Design

## **Homework 8 – Custom Instruction BITSWAP**

# Snapshot of SOPC CI



## C Code

```
#include <stdio.h>
#include <string.h>
#include <time.h>
#include <system.h>

#define switches (volatile char *) 0x01901050
#define leds (char *) 0x01901060
/** Look up the SW and LED base address from SOPC builder ***/

void wait ( int s ) /* Custom wait since usleep() not available*/
{
    int u,v,sum=0;
    for (u=1;u<100000;u++)
        for (v=1;v<s;v++)
            sum+=v;
}

int SW_BITSWAP(int a) {
    int lsb, k, r=0;
    int t=a;
    for (k=0; k<8; k++) {
        lsb = t & 1;
        r = r*2 + lsb;
        t >>= 1;
    }
    return(r);
}

int main( void )
{
    int a=0;
    int b=0;
    int a_swap=0;
    int i;

    printf("This Homework 8 by Paul Kafka\n");
    int start_time, finish_time, total_time, speed_up, c_time;

    //
    //while (1) { /* run forever */
    //    a = *switches;
    //
    //    a_swap = SW_BITSWAP(a);
    //
    //    //a_swap = ALT_CI_CUSTOMINSTRUCTION_INST(a,b);
    //    //a_swap = ALT_CI_BITSWAP(a);
    //    // a_swap >>=24;
    //    *leds = a_swap;
    //}

    //-----SW_BITSWAP-----
    start_time = alt_ticks();
    for (i=0; i<100000; i++) {
```

```

    a = *switches;
    a_swap = SW_BITSWAP(a);
    *leds = a_swap;
}
finish_time = alt_nticks();
total_time = ((finish_time - start_time)*1000) / alt_ticks_per_second();
c_time = total_time;
printf("SW_BITSWAP Time Used=%d ms\n", total_time);

//-----ALT_CI_CUSTOMINSTRUCTION_INST-----
start_time = alt_nticks();
for (i=0; i<1000000; i++) {
    a = *switches;
    a_swap = ALT_CI_CUSTOMINSTRUCTION_INST(a,b);
    a_swap >>=24;
    *leds = a_swap;
}
finish_time = alt_nticks();
total_time = ((finish_time - start_time)*1000) / alt_ticks_per_second();
speed_up = c_time / total_time;
printf("ALT_CI_CUSTOMINSTRUCTION_INST Time Used=%d ms\n", total_time);
printf("ALT_CI_CUSTOMINSTRUCTION_INST Speed Up=%d ms\n", speed_up);

//-----ALT_CI_BITSWAP-----
start_time = alt_nticks();
for (i=0; i<1000000; i++) {
    a = *switches;
    a_swap = ALT_CI_BITSWAP(a);
    a_swap >>=24;
    *leds = a_swap;
}
finish_time = alt_nticks();
total_time = ((finish_time - start_time)*1000) / alt_ticks_per_second();
speed_up = c_time / total_time;
printf("ALT_CI_BITSWAP Time Used=%d ms\n", total_time);
printf("ALT_CI_CUSTOMINSTRUCTION_INST Speed Up=%d ms\n", speed_up);
//-----

return 0;
}

```

## Measurements (Terminal Output)

**Altera Monitor Program [Nios II] - hw8a.ncf : led\_count.srec [Running]**

File Settings Actions Windows Help

**Disassembly**

Goto instruction Address (hex) or symbol name:  Go Hide

```
/*
 * When not using exit, provide an _exit symbol to provide
 * references to _exit from the linker script.
 */
#ifdef ALT_NO_EXIT
    .globl _exit
    _exit:
#endif

/*****
 |
 | TEXT SECTION (.text)
 |
 *****/
```

**Registers**

Reg	Value
pc	0x00800138
zero	0x00000000
r1	0x00000000
r2	0x00000000
r3	0x00000000
r4	0x00000000
r5	0x00000000
r6	0x00000000
r7	0x00000000
r8	0x00000000
r9	0x00000000
r10	0x00000000
r11	0x00000000
r12	0x00000000
r13	0x00000000
r14	0x00000000

**Terminal**

```
JTAG UART link established using cable "USB-Blaster [USB-0]",
device 1, instance 0x00
This Homework 8 by Paul Kafka
SW_BITSWAP Time Used=2163 ms
ALT_CI_CUSTOMINSTRUCTION_INST Time Used=306 ms
ALT_CI_CUSTOMINSTRUCTION_INST Speed Up=7 ms
ALT_CI_BITSWAP Time Used=307 ms
ALT_CI_CUSTOMINSTRUCTION_INST Speed Up=7 ms
```

**Info & Errors**

```
Verifying 00800000 ( 0%)
Verifying 01880000 (99%)
Verified OK
Connection established to GDB server
Symbols loaded.
Source code loaded.
INFO: Program Trace not enabled, bec
II processor to be configured with J
```

Info & Errors GDB Server

## Camera Images

