Study and Comparative Analysis of Msp430, Arm and Microcontroller 8051 According to their Addressing Modes

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***Abstract*-- In this research paper the analysis of MSP430, ARM and Microcontroller 8051 has been done according to their addressing modes. The most specific application of these microcontrollers is in embedded systems. An embedded system can be defined as a control system or computer system designed to perform a specific task. Common examples of embedded systems include MP3 players, navigation systems on aircraft and intruder alarm systems. An embedded system can also be defined as a single purpose computer. Embedded systems Operate in constrained environments in which computer memory and processing power are limited. They often need to provide their services within strict time deadlines to their users and to the surrounding world. Billions of computing systems are built every year embedded within larger electronic devices. Its software embeds in ROM (Read Only Memory. Embedded Systems does not need secondary memories as in a computer; their extensive use and integration in everyday products marks a significant evolution in information science and technology. Embedded computers are considered economical when the cost of implementing a product designed in software on a microprocessor and some small amount of hardware, is cheaper, more reliable, or better for some other reason than a discrete hardware design; It also happens that one generic embedded system with a standard input and output configuration can be made to perform in a completely different manner simply by changing the software. Embedded systems are often required to provide Real-Time response. Examples of such systems are flight control systems of an aircraft, sensor systems in nuclear reactors and power plants.**
Our goal is to analysis the performance of MSP43, ARM and Microcontroller 8051 according to their Addressing Modes. So that we can use that microcontroller with some enhanced characteristic properties in some particular applications.

Keywords*-- *Embedded system, Microcontroller, Rom, Microprocessor, Real-Time response.

I. INTRODUCTION

The term ***addressing modes*** refers to the way in which the operand of an instruction is specified. Information contained in the instruction code is the value of the operand or the address of the result/operand. The operand can be in a register or fully included in the instruction. Addressing modes affects the code length and execution speed of the assembly language program.Microcontroller application program code size can directly affect the cost and power consumption of products therefore it is almost always viewed as an important factor in the selection of a microcontroller for embedded projects.

The MSP430 supports seven addressing modes for the source operand and four addressing modes for the destination operand (see Table). The following sections describe each of the addressing modes, with a brief description, an example and the number of CPU clock cycles required for an instruction, depending on the instruction format and the addressing modes used.

Mode	Source operand	Destination operand	Description
Register mode	**X**	**x**	**Single cycle**
Indexed mode	X	x	Table processing
Symbolic mode	X	x	Easy to read code, PC relative
Absolute mode	X	x	Directly access any memory location
Indirect register mode	X		Access memory with pointers
Indirect auto increment mode	X		Table processing
Immediate mode	X		Unrestricted constant values

ARM processor supports following different addressing modes. All instructions can fit into a single word (32 bits).

Name	Alternative Name	ARM Examples
Register to register	Direct Rgister	MOV R0, R1
Absolute	Direct	LDR R0, MEM
Literal	Immediate	MOV R0, #15 ADD R1, R2, #12
Indexed, base	Register indirect	LDR R0, [R1]
Pre-indexed, base with displacement	Register indirect With offset	LDR R0, [R1, #4]
Pre-indexed, Autoindexing	Register indirect pre-incrementing	LDR R0, [R1, #4]!
Post-indexing, Autoindexed	Register indirect post-increment	LDR R0, [R1], #4
Double Reg indirect	Register indirect Register indexed	LDR R0, [R1, R2]
Double Reg indirect with scaling	Register indirect indexed with scaling	LDR R0, [R1, r2, LSL #2]
Program counter relative		LDR R0, [PC, #offset]

MC 8051 supports eight modes of addressing. The different addressing modes determine how the operand byte is selected.

Addressing Modes	Instructions
Register	MOV A , B
Direct	MOV 30H , A
Indirect	ADD A , @R0
Immediate Constant	MOV A , #30H
Indexed	MOV A , @A+PC

A. Main characteristics of a MSP430 microcontroller

Although there are variants in devices i-n the family, a MSP430 microcontroller can be characterized by:

- Low power consumption:
- 0.1 mA for RAM data retention;
- 0.8 mA for real time clock mode operation;
- 250 mA/MIPS at active operation.
- Low operation voltage (from 1.8 V to 3.6 V).
- < 1 □ s clock start-up.
- < 50 nA port leakage.
- Zero-power Brown-Out Reset (BOR).
- On-chip analogue devices:
- 10/12/16-bit Analogue-to-Digital Converter (ADC);
- 12-bit dual Digital-to-Analogue Converter (DAC);
- Comparator-gated timers;
- Operational Amplifiers (OP Amps);
- Supply Voltage Supervisor (SVS).
- 16 bit RISC CPU:
- Instructions processing on either bits, bytes or words;
- Compact core design reduces power consumption and cost;
- Compiler efficient; 27 core instructions;
- 7 addressing modes;
- Extensive vectored-interrupt capability.
- Flexibility:
- Up to 256 kB In-System Programmable (ISP) Flash;
- Up to 100 pin options;
- USART, I2C, Timers; LCD driver;
- Embedded system

B. Address space

All memory, including RAM, Flash/ROM, information memory, special function registers (SFRs), and peripheral registers are mapped into a single, contiguous address space. The MSP430 is available with either Flash or ROM memory types. The memory type is identified by the letter immediately following "MSP430" in the part numbers. Flash devices: Identified by the letter "F" in the part numbers, having the advantage that the code space can be erased and reprogrammed.

C. ROM devices

Identified by the letter "C" in the part numbers. They have the advantage of being very inexpensive because they are shipped pre-programmed, which is the best solution for high-volume .

D. Flash/ROM

The start address of Flash/ROM depends on the amount of Flash/ROM present on the device. The start address varies between 01100h (60k devices) to 0F800h (2k devices) and always runs to the end of the address space at location 0FFFFh. Flash can be used for both code and data. Word or byte tables can also be stored and read by the program from Flash/ROM.

E. Information memory (Flash devices only)

The MSP430 flash devices contain an address space for information memory. It is like an onboard EEPROM, where variables needed for the next power up can be stored during power down. It can also be used as code memory. Flash memory may be written one byte or word at a time, but must be erased in segments. The information memory is divided into two 128-byte segments. The first of these segments is located at addresses 01000h through to 0107Fh (Segment B), and the second is at address 01080h through to 010FFh (Segment A). This is the case in 4xx devices. It is 256 bytes (4 segments of 64 bytes each) in 2xx devices. ide in this memory space.

F. Boot memory (Flash devices only)

The MSP430 flash devices contain an address space for boot memory, located between addresses 0C00h through to 0FFFh. The "bootstrap loader" is located in this memory space, which is an external interface that can be used to program the flash memory in addition to the JTAG. This memory region is not accessible by other applications, so it cannot be overwritten accidentally. The bootstrap loader performs some of the same functions as the JTAG interface (excepting the security fuse programming), using the TI data structure protocol for UART communication at a fixed data rate of 9600 baud.

G. RAM

RAM always starts at address 0200h. The end address of RAM depends on the amount of RAM present on the device. RAM is used for both code and data.

H. Peripheral Modules

Peripheral modules consist of all on-chip peripheral registers that are mapped into the address space. These modules can be accessed with byte or word instructions, depending if the peripheral module is 8-bit or 16-bit respectively. The 16-bit peripheral modules are located in the address space from addresses 0100 through to 01FFh and the 8-bit peripheral modules are mapped into memory from addresses 0010h through to 00FFh.

CONCLUSION

Addressing modes are the method used to determine which part of memory is being referred to by a machine instruction. Addressing modes are an aspect of the instruction set architecture in most central processing unit (CPU) designs. An addressing mode specifies how to calculate the effective memory address of an operand by using information held in registers and/or constants contained within a machine instruction or elsewhere

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