RESEARCH ARTICLE OPEN ACCESS

A Review on CPU and Control Unit Design

Mala Dutta
Assistant Professor
Department of computer Engineering, IET DAVV
Indore – India

ABSTRACT

Now a days IT industries is undergoing significant changes due to the development of new technologies. Modern computer system must adapts requirements such as efficient implementation process, efficient inter process communication, efficient memory management, resource managements etc. For control unit design.

Keywords:- Word length, hardwired, micro programmed, Horizontal microcode, Vertical microcode

I. INTRODUCTION

Central processing unit is the brain of the computer, it is a place where data are manipulated. In a microcomputer the entire CPU is contained on a tiny chip called a microprocessor. Every CPU has three main components.

i) Control Unit
ii) Arithmetic Logic Unit
iii) Register

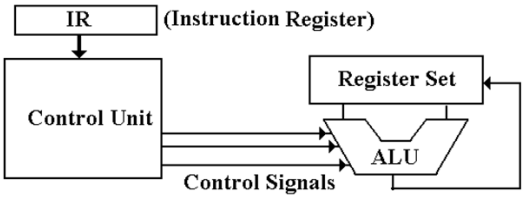
Registers are used for storing intermediate results during program execution, registers are high speed memory unit, and size of register is one of the important factors to measure performance of computer system. Size of register is also called word length or word size, word can be 8bits ,16 bits, 32 bits, 64 bits. More the word size more number of addressable location it has, if word size is k bits , 2^k addresses constitute the address space of the computer.

Register can be of many types:

- General purpose Register
- Special purpose Register
- Data Register
- Address Register
- Instruction Register
- Program Counter

To execute any program the PC (program Counter) must have the address of instruction which is to be executed next, and this address is transfer to the MAR (Memory Address Register) ,by referring this address actual data is fetch from Main Memory of computer and stored in MDR(Memory Data Register)MDR transfer tha data to IR for decoding, and PC is updated with next address for next instruction cycle.The Control Unit along with the Instruction Register interprets the machine Language instruction and issues the control signals to make the CPU execute that instruction.

The **ALU** (Arithmetic Logic Unit) does the arithmetic and logic. Communication between different components takes place through internal bus system.

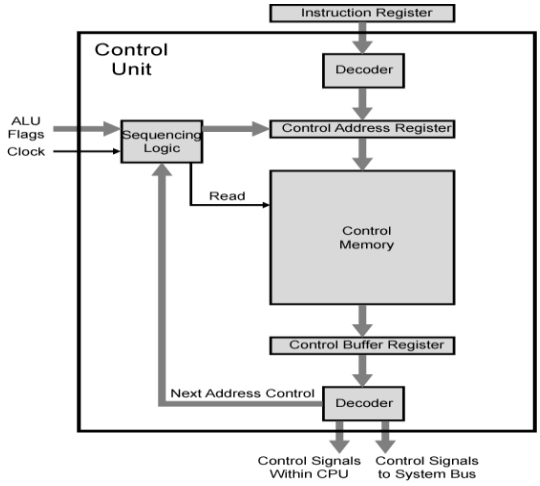


There are two types of control unit:

Hardwired Control Unit:

The control signals are generated as an output of a set of basic logic gates, the input of which derives from the binary bits in the Instruction Register.

Microprogrammed Control Unit



II. MICROPROGRAMMED

The control signals are generated by a microprogram that is stored in **Control Read Only Memory.**The **microcontroller** fetches a control word from the **CROM** and places it into the **µMBR**, from which control signals are emitted.

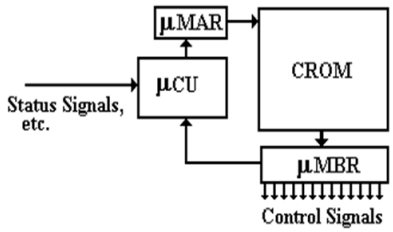


Fig.2 microprogrammed control unit

Design of the µCP

The only function of the **micro-control unit** (µCU) is to compute the address of the CROM word next to be placed into the µMBR. As such, it is extremely primitive and simple even for large sophisticated computer, this simplicity makes the unit very attractive.

Instruction execution is divided into three phases. We focus on the first of these phases: **fetch**, which fetches the next instruction and updates the PC.

The Common Fetch Sequence:

The Fetch sequence is divided into four phases, each having duration of one clock pulse. Here are the micro-operations associated with the first three phases of the fetch sequence.

Step 1: (PC) → MAR, READ.
Step 2: (PC) + 4 → PC.
Step 3: (MBR) → IR.

Control Signals are More Primitive

Control signals directly enable transfers, so they must be very low level.

Note that the inputs (Fetch, T0, T1, T2) are discrete binary signals.

Fetch, T0: (PC) → B1, **tra1**, B3 → MAR, READ.

Fetch, T1: (PC) → B1, 4 → B2, **add**, B3 → PC.

Fetch, T2: (MBR) → B2, **tra2**, B3→ IR.

Hardwired Signal Generation

The first phase of the fetch sequence has Fetch = 1 and T0 = 1.

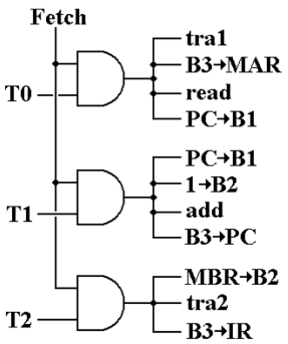
If Fetch = 1 and T0 = 1 then

tra1 = 1 (it is asserted)

B3 → MAR = 1

read = 1

PC → B1 = 1



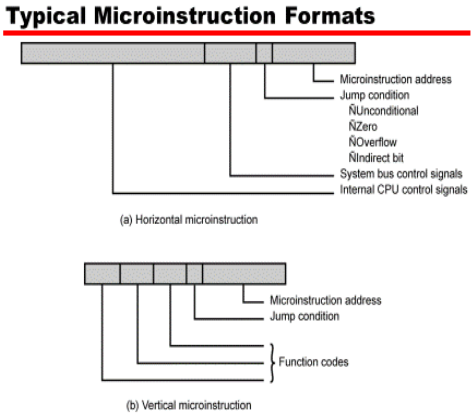
Horizontal and Vertical Microcode

Consider a bus, B1,that can be fed by seven different signal sources. In **horizontal microcode**, each signal has a bit in the micro-memory. The B1 field would have 8 bits.

In **vertical microcode**, the field would have a binary encoding to indicate the single source to be placed on the bus; here 3 bits.

III. ADVANTAGES OF VERTICAL MICROCODE

One advantage is that it allows a "narrower micro–memory", fewer bits per word in the micro–memory. But memory is cheap. The major advantage is that it prevents the assertion of two or more data. Sources on a given bus or two or more simultaneous ALU operations. Each microinstruction includes the address of the instruction to be executed next. Here is a format that supports a branch. There are two 8-bit addresses. The signal S2 will indicate whether or not the branch is taken. Non-branching instructions have the same value in both fields.



Typical Microinstruction Format

Benefits of Microprogramming

In microprogramming only need to modified is the microcode. No hardware modification is needed. It is flexible and easy to design. Allows for convenient hardware /software trade offs .If something we want not implemented in hardware it can be implemented in software.

Drawbacks of Microprogramming:

The drawback of Micro programmed unit is that it will be somewhat slower than the hardware unit. Development is expensive due to software tools. The microcode has always been memory performance; the CPU clock cycle is limited by the time to read the memory. In the 1950's, microprogramming was impractical for two reasons.

i) The memory available was not reliable

ii) The memory available was the same slow core memory as used in the main memory of the computer.

A Taxonomy of Microinstructions:

Vertical/horizontal
Packed/unpacked
Hard/soft microprogramming
Direct/indirect encoding

IV. CONCLUSION

In this paper we have presented overview of the organization of of the computers Central Processing Unit. The choice of particular organization involves trade offs between speed of execution and cost of implementation. Two approaches were presented for implementing the Control Unit of a processor, Hardwired control and & Microprogrammed control. Hardwired control is the best approach when speed of operation is important. Microprogrammed control provides considerable flexibility in implementing instruction sets.

REFERENCES

[1]]http://www.uniassignment.com/essay-samples/information-technology/registers-in-modern-computers-information-technology-essay.php

[2] By carl Hamacher Zvonko Vranesic Safwat Zaky.International Edition of Computer organization fifth edition.

[3] William Stallings, Computer Organization and Architecture, eighth edition.