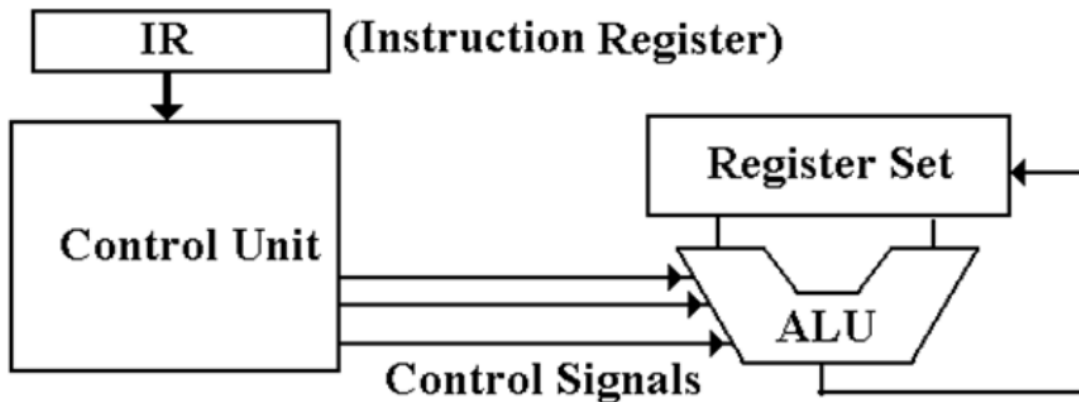


The function of the **control unit** is to decode the binary machine word in the IR (Instruction Register) and issue appropriate control signals. These cause the computer to execute its program.

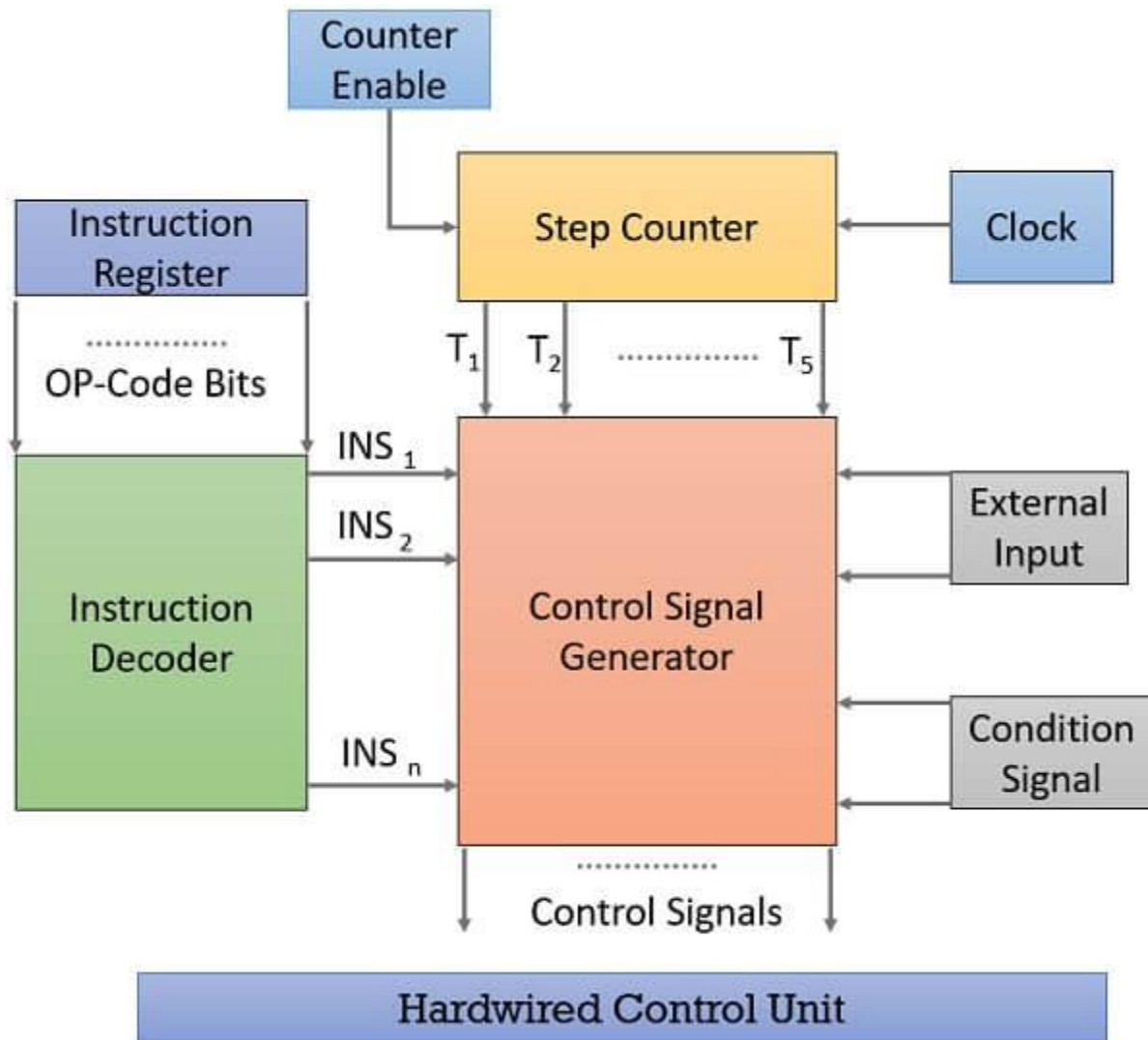


Hardwired: The **control signals are generated** as an output by a **set of basic logic gates**, the input of which derives from the binary bits in the Instruction Register.

The hardwired control unit is created with the hardware; it is a **circuitry** approach.

Microprogrammed: The **control signals are generated** as an output by a **microprogram** that is stored in **Control Read Only Memory (CROM)**.

The **program that creates the 'control signals'** is called **Microprogram**. This **microprogram is placed** on the processor chip which is fast memory, it is also called **control memory** or **control store** or **control read only memory(CROM)**

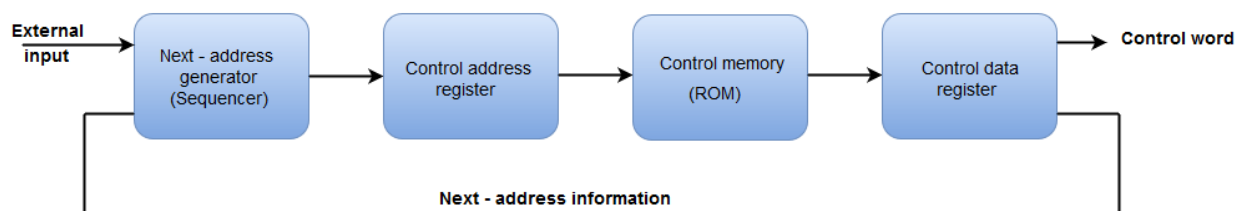


- The **instruction register** is a processor's register that has the 'instruction' which is currently in execution.
- The instruction register generates the **OP-code bits** respective of the **operation** and the **addressing modes** of the operands, mentioned in the instruction.
- **Instruction decoder** receives the Op-code bits generated by the instruction register and **interprets the operation and addressing modes** of the instruction.
- Now, based on operation and addressing mode of the instruction in instruction register it sets the corresponding **Instruction signal** INS_i to 1.
- Now, the control unit must be aware of the current step, the instruction is in. For this, a **Step Counter** is implemented which has signals from T_1, \dots, T_5 .

The **step counter** sets one of the signals **T1 to T5** to **1** on the basis of the step, the instruction is in.

- the **Control Signal Generator** generates the **control signals**, based on the inputs obtained by the Instruction register, Step counter, Condition signals and External inputs.

Microprogrammed Control Unit of a Basic Computer:



- The **Control memory address register** specifies the **address of the micro-instruction**.
- The **Control memory is assumed to be a ROM**, within which all control information is permanently stored.
- The **control register holds the microinstruction fetched from the memory**.
- The **micro-instruction contains a control word that specifies one or more micro-operations for the data processor**.
- While the **micro-operations are being executed**, the **next address is computed in the next address generator circuit** and then **transferred into the control address register** to read the next microinstruction.
- The **next address generator** is often referred to as a micro-program sequencer, as it **determines the address sequence** that is read from control memory.

Hardwired control unit generates the control signals needed for the processor using logic circuits

Hardwired control unit is faster when compared to microprogrammed control unit as the required control signals are generated with the help of hardwares

Difficult to modify as the control signals that need to be generated are hard wired

More costlier as everything has to be realized in terms of logic gates

It cannot handle complex instructions as the circuit design for it becomes complex

Only limited number of instructions are used due to the hardware implementation

Used in computer that makes use of Reduced Instruction Set Computers(RISC)

Microprogrammed control unit generates the control signals with the help of micro instructions stored in control memory

This is slower than the other as micro instructions are used for generating signals here

Easy to modify as the modification need to be done only at the instruction level

Less costlier than hardwired control as only micro instructions are used for generating control signals

It can handle complex instructions

Control signals for many instructions can be generated

Used in computer that makes use of Complex Instruction Set Computers(CISC)