MICROCONTROLLERS .

1 Microprocessors

2 Microcontrollers

3 Actuation sensing, process control

1 Microcontrollers, microprocessors

- -what are microprocessors, microcontrollers?
- -what is the difference between them?
- -what are they used for?
- -what they aren’t used for?

1 Microprocessors

- 1.1History overview
- -1.2Overview of marchitectures,parameters,basic building blocks
- -1.3 Problems of development(memory bound), their solutions(cache, multicore)

1.1 Microprocessors' evolution overview

- 4-bit(early versions, calculator,F-14) 1971
- 8-bit(Intel 8008, Commodore64,spacefilght-low power/static core, floating point) 1972
- 16-bit(Intel 8086, Apple IIgs, Super Nintendo)
- Late 70's, early 80's ->
- 32-bit(x86 type PC,AMD,Pentium)
- 64-bit(today Win7 x64,)

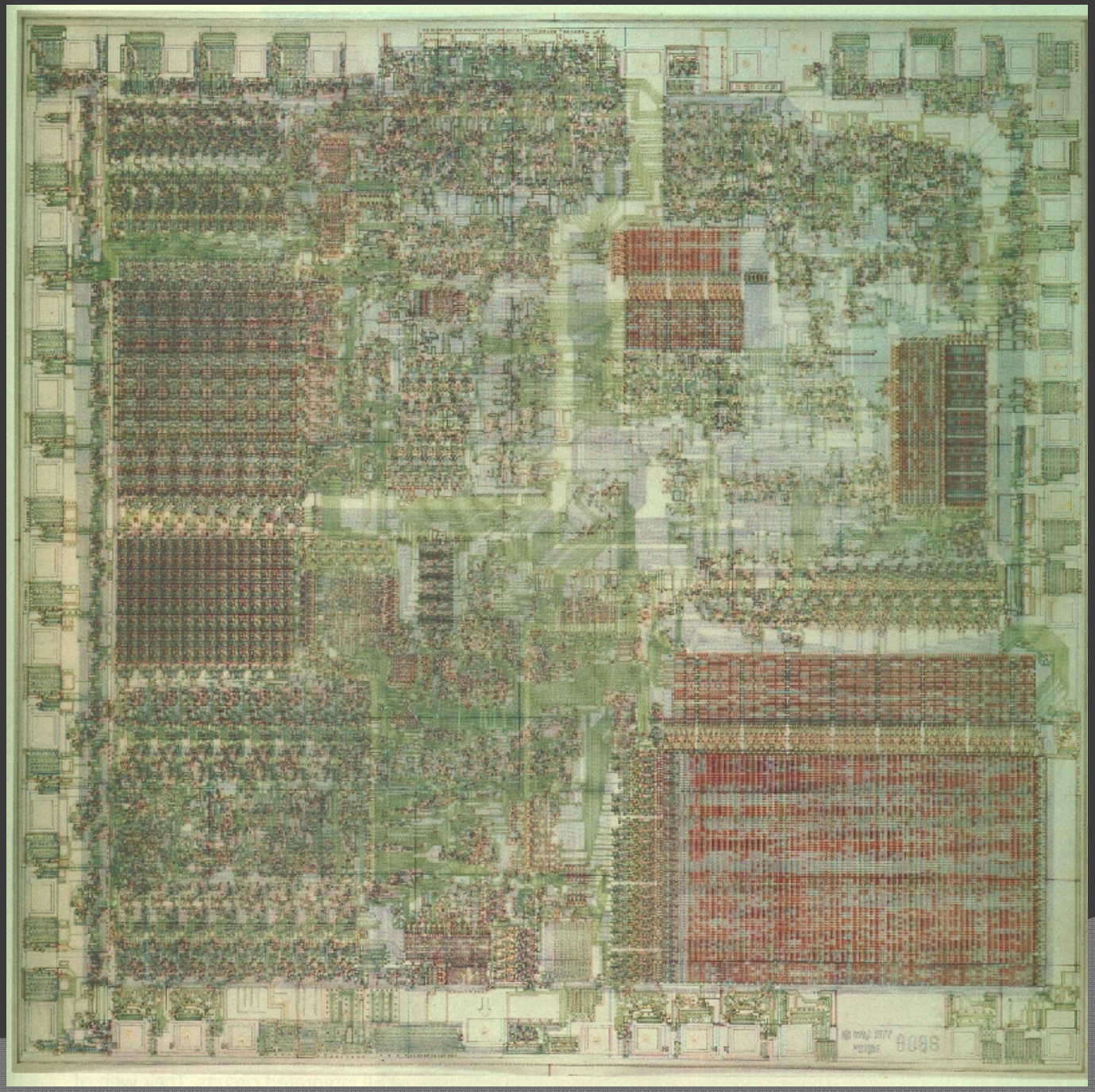

EXECUTIVE

1.2 Overview of basic building blocks, parameters, microarchitecture

- Basic Building Blocks of microprocessors:
- ALU - Arithmetic&Logical Unit
- ROM - contains data or program
- RAM - contains variables, data etc.
- Register - small storages for numbers
- Bus - connection between units
- Clock – frequency generator at which the CPU works, generated by a crystal oscillator

1.2 Overview of basic building blocks, parameters, microarchitecture

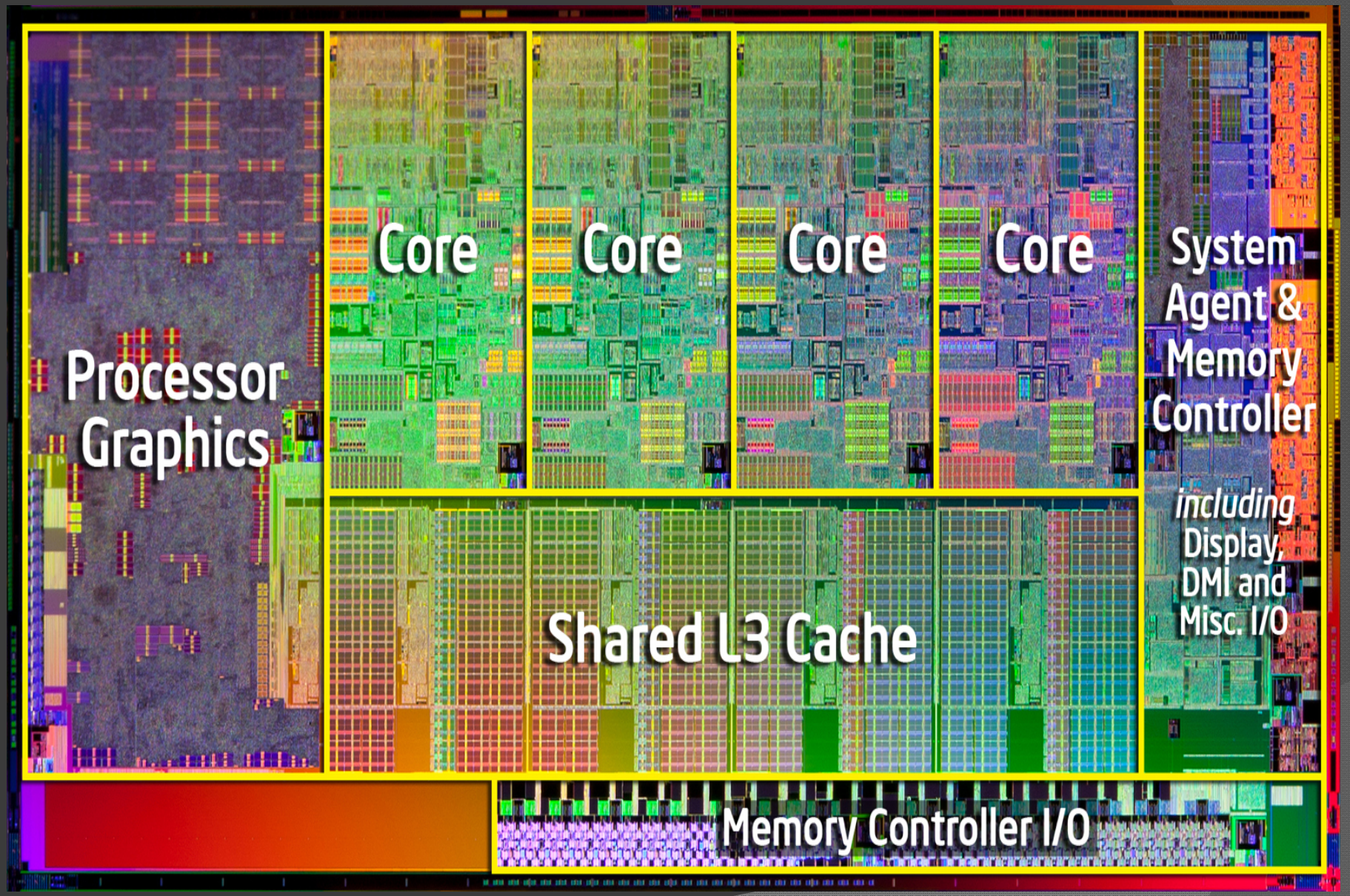
- Instruction set :(x86, x64)CISC,RISC complex/reduced instruction set computer
- Bit(memory range being adressed, used)
- Harvard/Princeton architecture:Harvard , Princeton architecture



Intel 8086

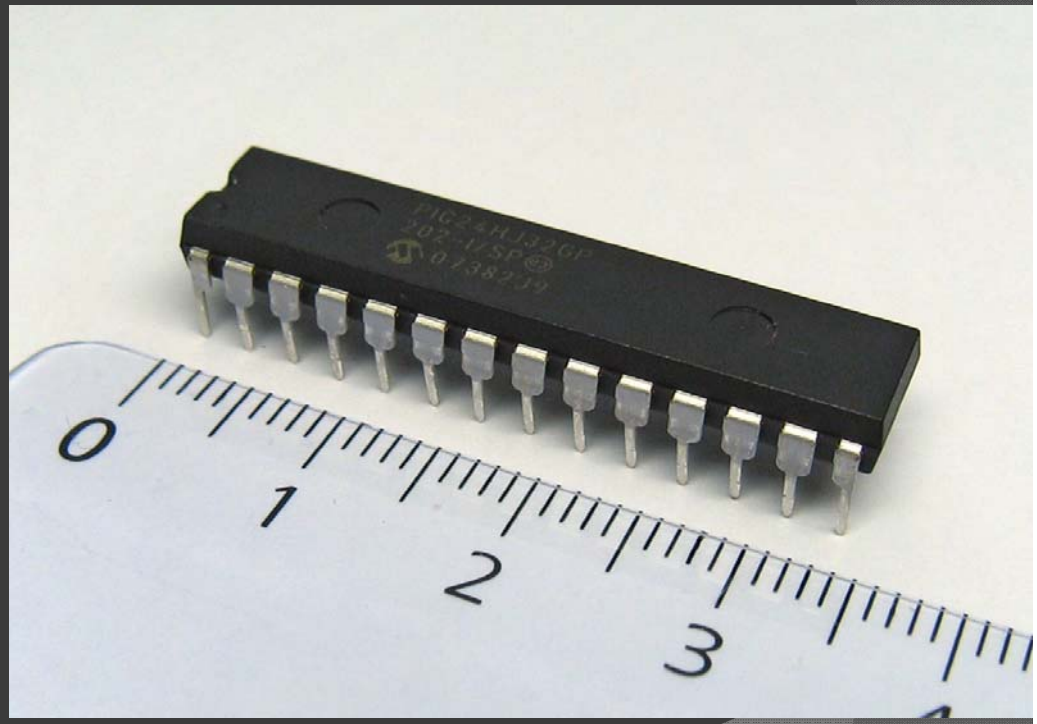
1.3Moore’s law, problems of development, solutions

- Moore’s law- number of transistors double every 2 years
- Already faster processors than memories
- Cache memory(very fast, very small only to help the CPU)
- Multicore designs(low power(laptop)/non-linear,lock cond., few parallel applications, mimicing human brain)


Processor Graphics
Core
Core
Core
Core
System Agent & Memory Controller
including Display, DMI and Misc. I/O
Shared L3 Cache
Memory Controller I/O

2 Microcontrollers

- History
- Why we use them?
- What they differ in from MP’s
- Classification, examples
- Main characteristics
- Languages used



2.1 Evolution of Microcontrollers

- Strongly related to memory development
- -EPROM/PROM for early MP’s
- (eraseable programmed ROM/prog. ROM)
- -EEPROM 1993-Microchip PIC
- (Electrically Erasable ROM)
- -Flash memory- Atmel 1993
- -future: MPROM-magnetoresistive, data stored in magnetic field.

2.2 Why we use them?

- They make automation, repeated processes easier, easily controllable
- They add flexibility, gives opportunity to create and develop multi-purpose machines
- Simplicity comp. To mechanic devices
- Microcontrollers act as a microcomputer without any digital parts.
- Usage of microcontroller is simple, easy for troubleshoot and system maintaining.

2.2 Some Disadvantages

- Microcontrollers have got more complex architecture than that of microprocessors.
- Only perform limited number of executions simultaneously.
- Mostly used in micro-equipments.

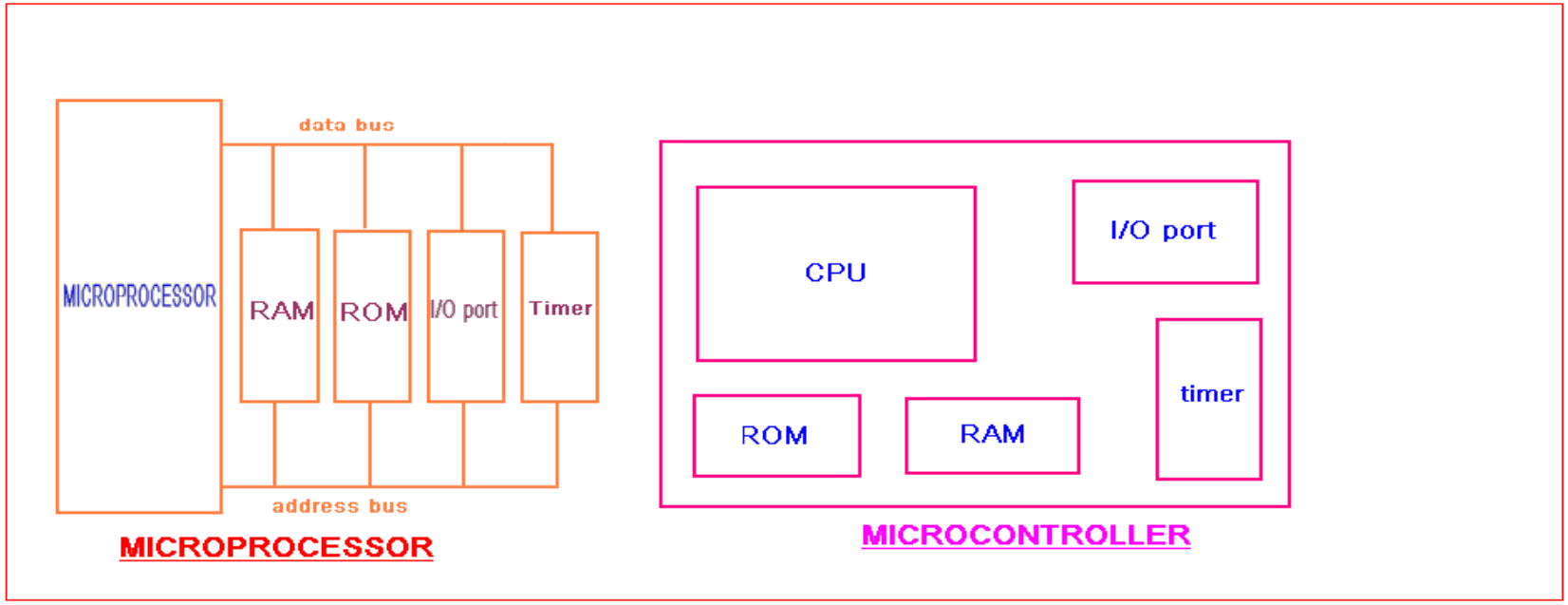
Cannot interface high power devices directly.

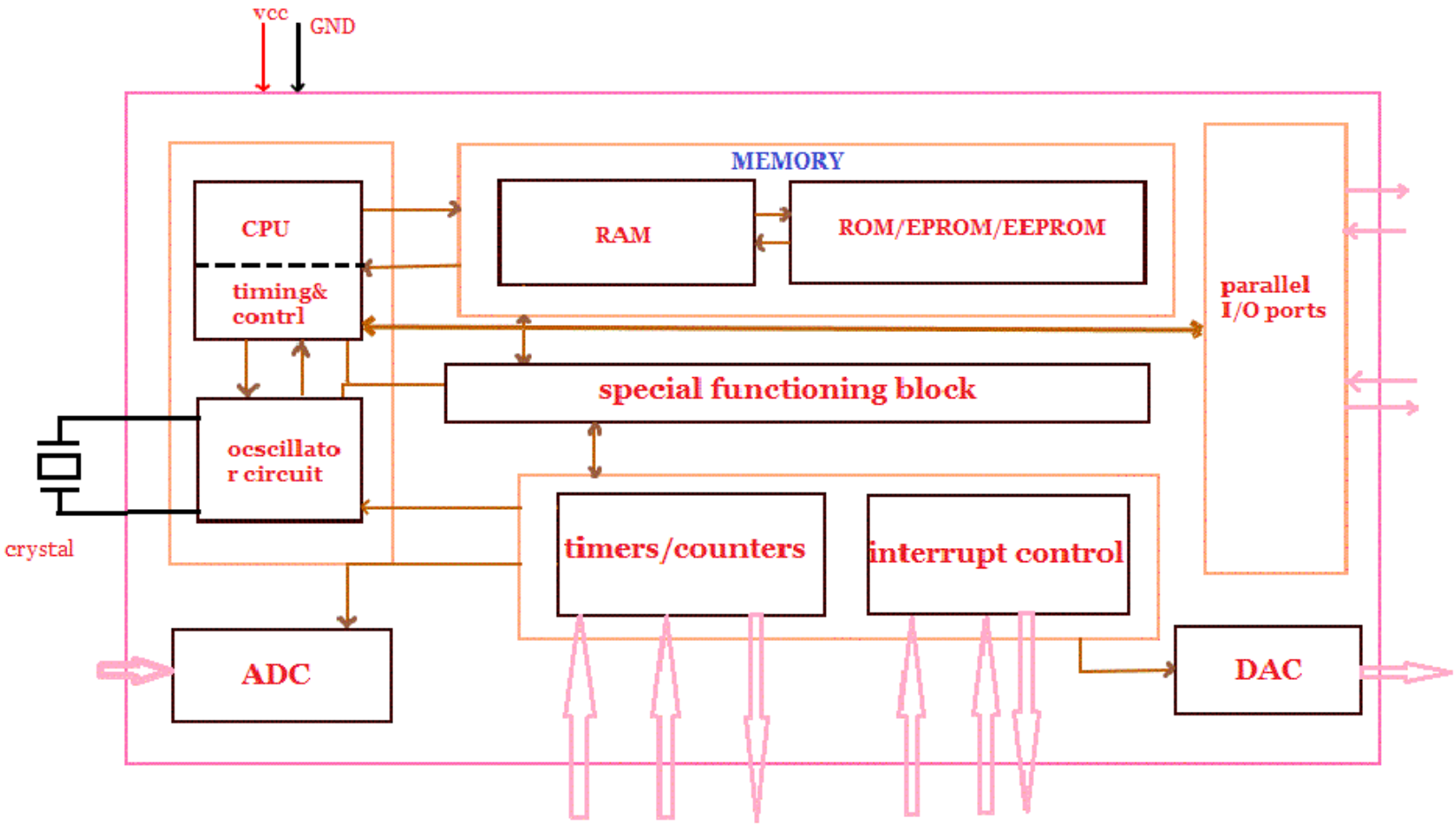
2.2 How many are we using?

- 8 billion sold in 2006
- MCU market grew 36.5% in 2010 and 12% in 2011
- An average household has approx. 4 general MP’s and 36 Mcontrollers
- washing machines, microwave ovens, and telephones contain.
- An average car has 30-40 MC’s inside

2.3 What they differ from MP’s

- They are small computers an a chip with their own memory, clock and interfaces (embedded systems)
- A MP lacks the preipherials
- Back then they had to build circuits around MP’s
- Embedded systems have interrupt mechanisms

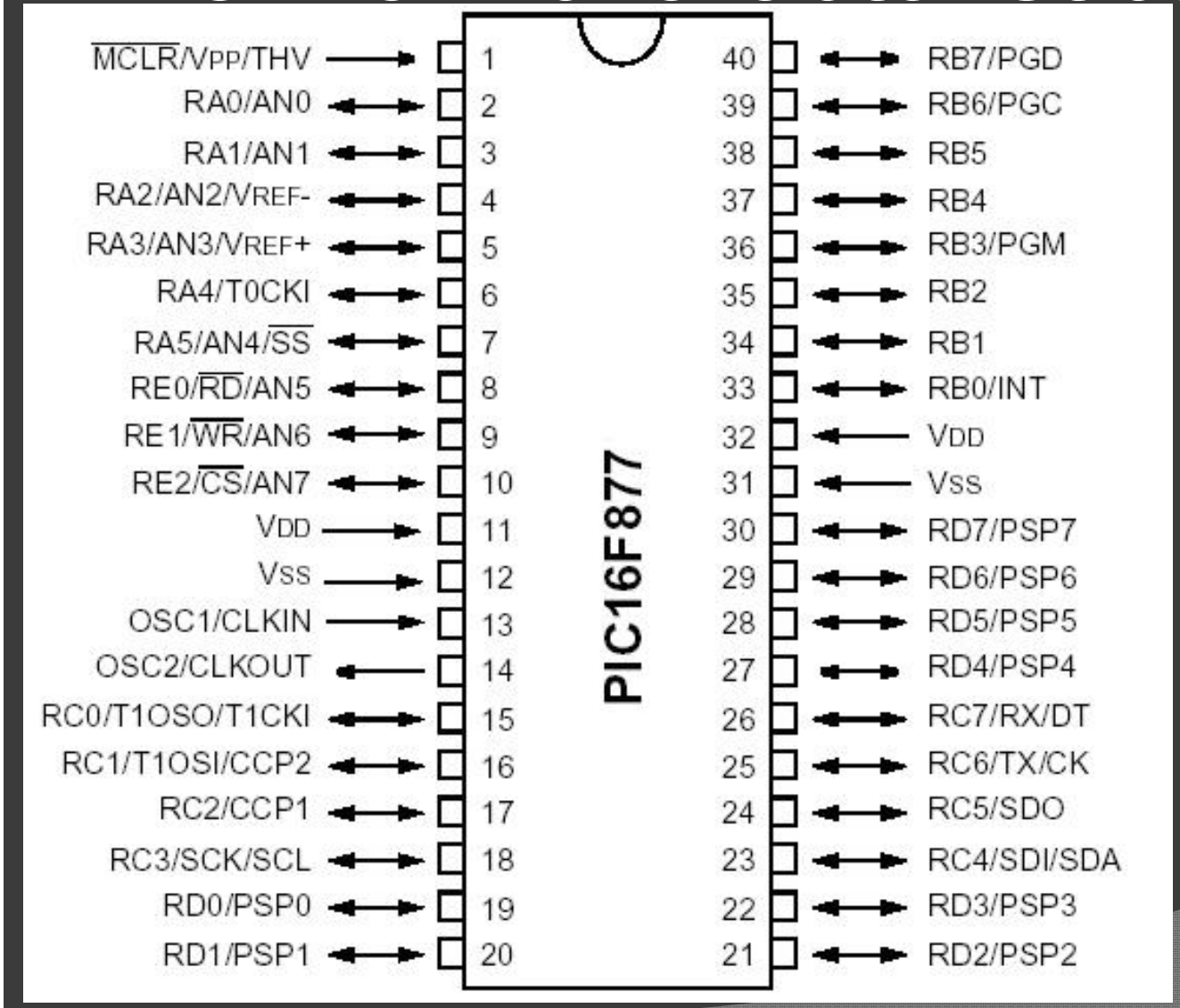

data bus
MICROPROCESSOR
RAM
ROM
I/O port
Timer
address bus
MICROPROCESSOR
CPU
I/O port
timer
ROM
RAM
MICROCONTROLLER


vcc
GND
MEMORY
CPU
timing&
contrl
RAM
ROM/EPROM/EEPROM
parallel
I/O ports
special functioning block
ocscillato
r circuit
crystal
timers/counters
interrupt control
ADC
DAC

2.4 Classification, examples

- Basically can be classified as microprocessors were
- peripheral interface controller, PIC (Microchip PIC series, AVR Atmega series) for simple applications, development
- Programmable logical controller PLC (Siemens S5,S7, Omron) for industrial environment, complexity.

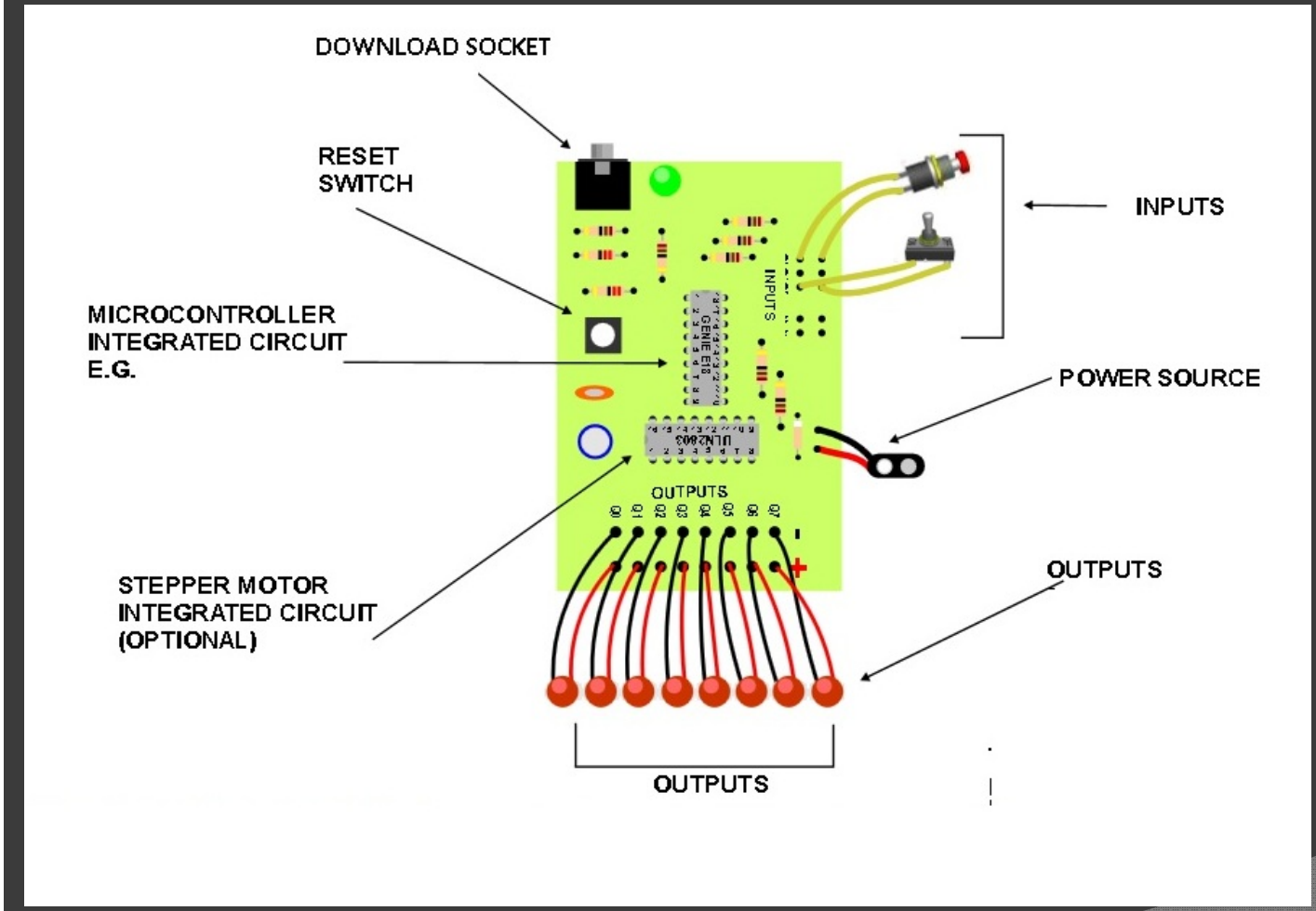
2.5 Main characteristics



- A typical pin layout
- Every pin has its designated role, some are A,D inputs, outputs etc
- These pin names are in the program code.

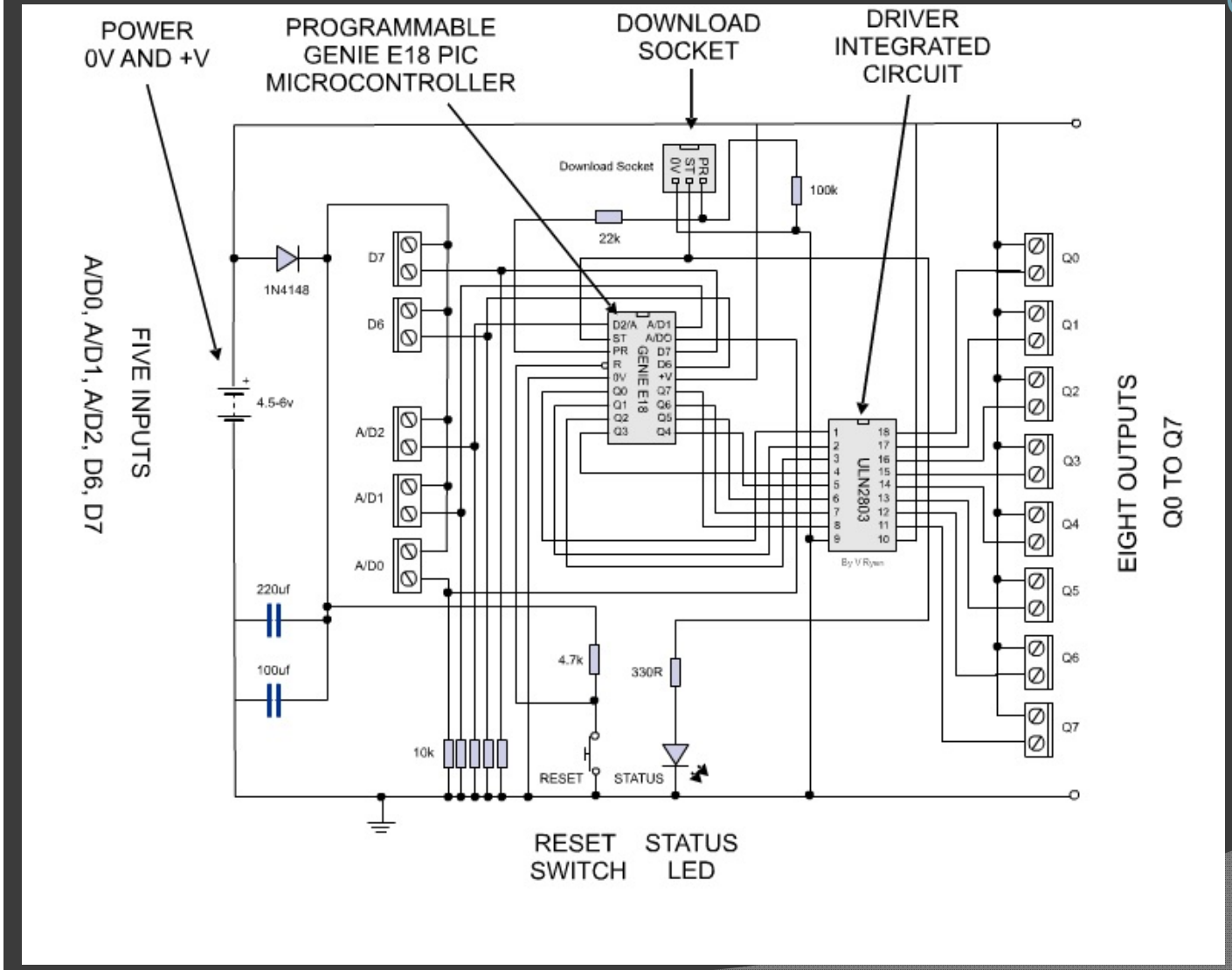
2.5 Main characteristics

- Lets look at a regular circuit involving a PIC



2.5 Main characteristics

- Circuit Diagram of the same board



2.6 Languages used

- MC’s are originally programmed in assembly
- Several high-level languages are developed, and there are variations for existing ones like C++
- These usually work through a compiler, which translates the orders to assembly
- MC’s usually have a free tool, developed by the manufacturer for developement, and these tools can be used to easily program certain MC’s

2.5 Languages used

- Some MCs have a simulator that enables the modeling of the system, and allows debugging before application.
- Either ST(Structured Text format, or IL(Instruction List), ST is usually used by high order programming languages, IL is mainly for assembly.

3 Actuation Sensing, Process control

- Functions of progammable controllers(PLC, mcontroller)
- sensor recievers

They themselves can handle signals from sensors, with the appropriate transducers applied.(for example sensing and and processing acceleration data)

- Communication (PLC-PLC, PLC-computer, PLC-network)

3.1 Functions of progammable controllers

- sensor recievers

They themselves can handle signals from sensors)

- Communication (PLC-PLC, PLC-computer, PLC-network)

3.1 Functions of progammable controllers

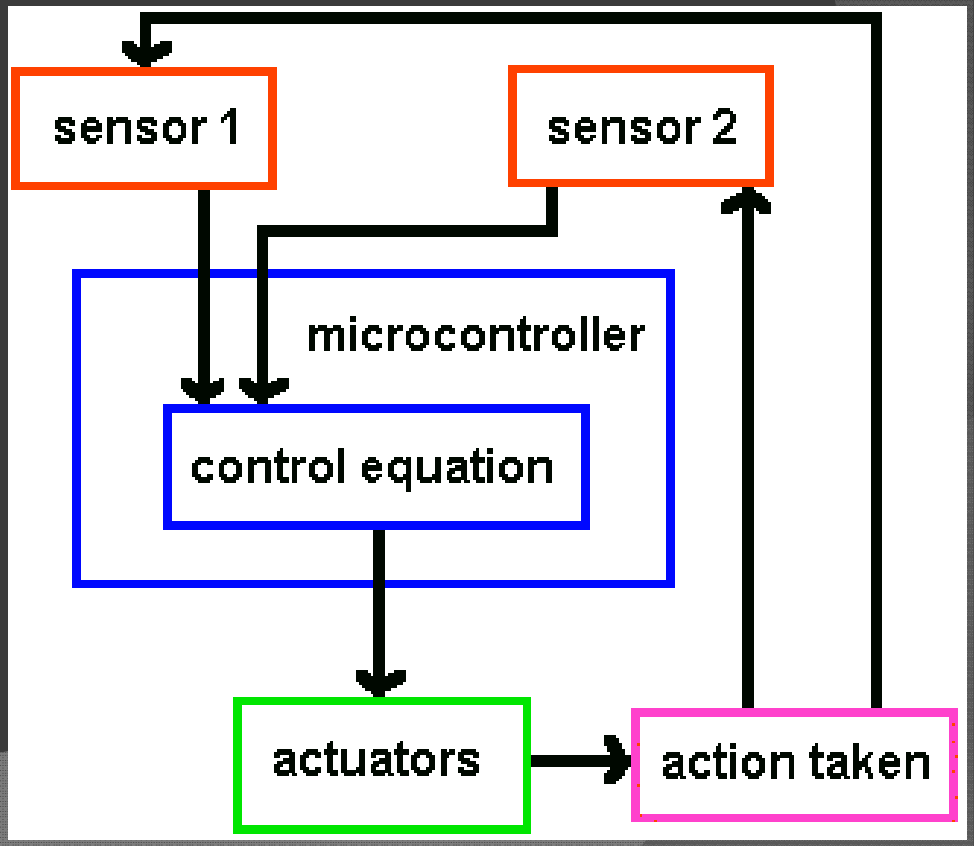
- Human-machine interface function:PLC’s create a channel between man and machine through the program code.
- Programming, testing, documentation function

Sensor signal processing

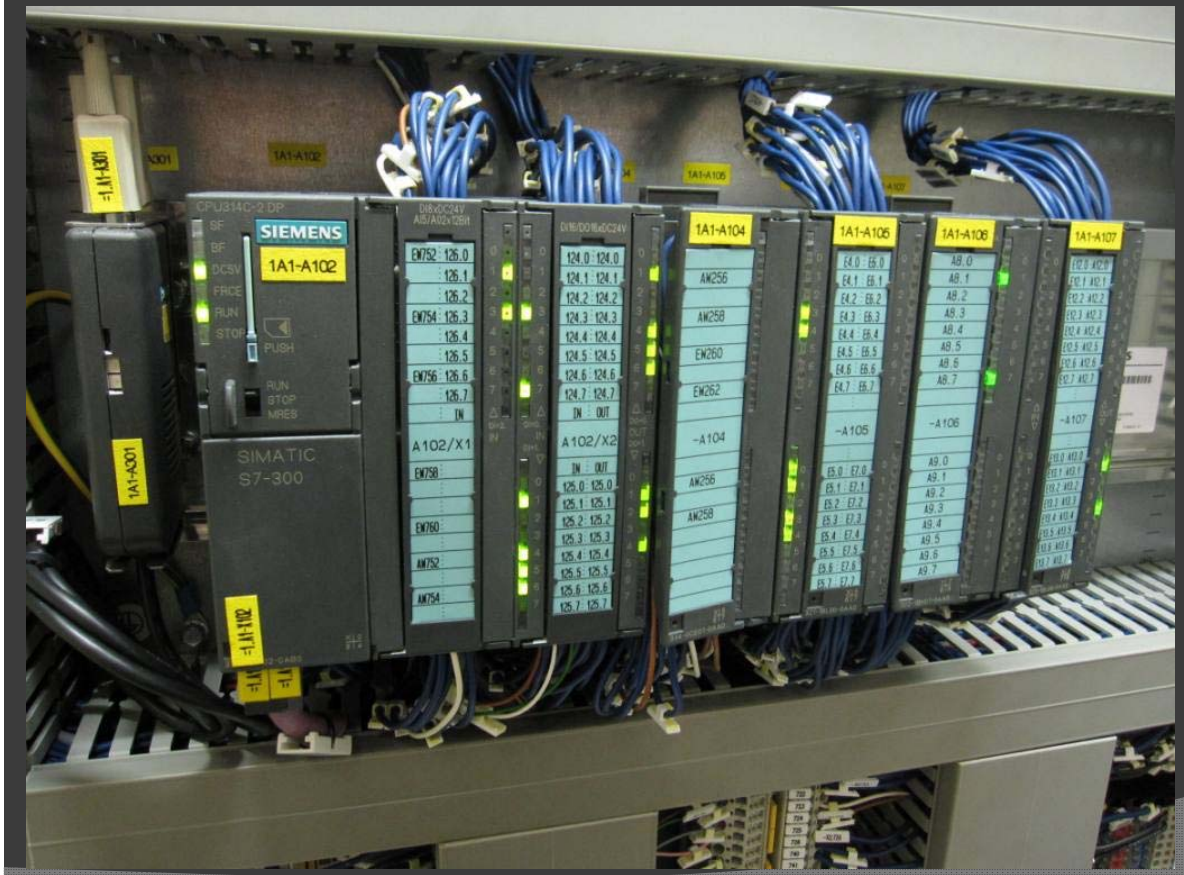
- Microcontrollers can interpret incoming signals from sensors via their built-in interfaces, and ADC if it exists. This is called input signal. These signals could be filtered instantly by software averaging, then processed further by the control program, resulting in an output signal, usually a binary vaule for the actuators.

3.2 Process Control

- The way microcontrollers control processes is best shown by a simple diagram.
- The sensors record physical data from the actions taken, for example by a robot arm, this recorded data is then passed forward to the microcontroller as analog or digital values,
- The microprocessor executes the program code, substituting the required variables by the values from the sensors
- The equations provide signals for the actuators, about what to do next and how.

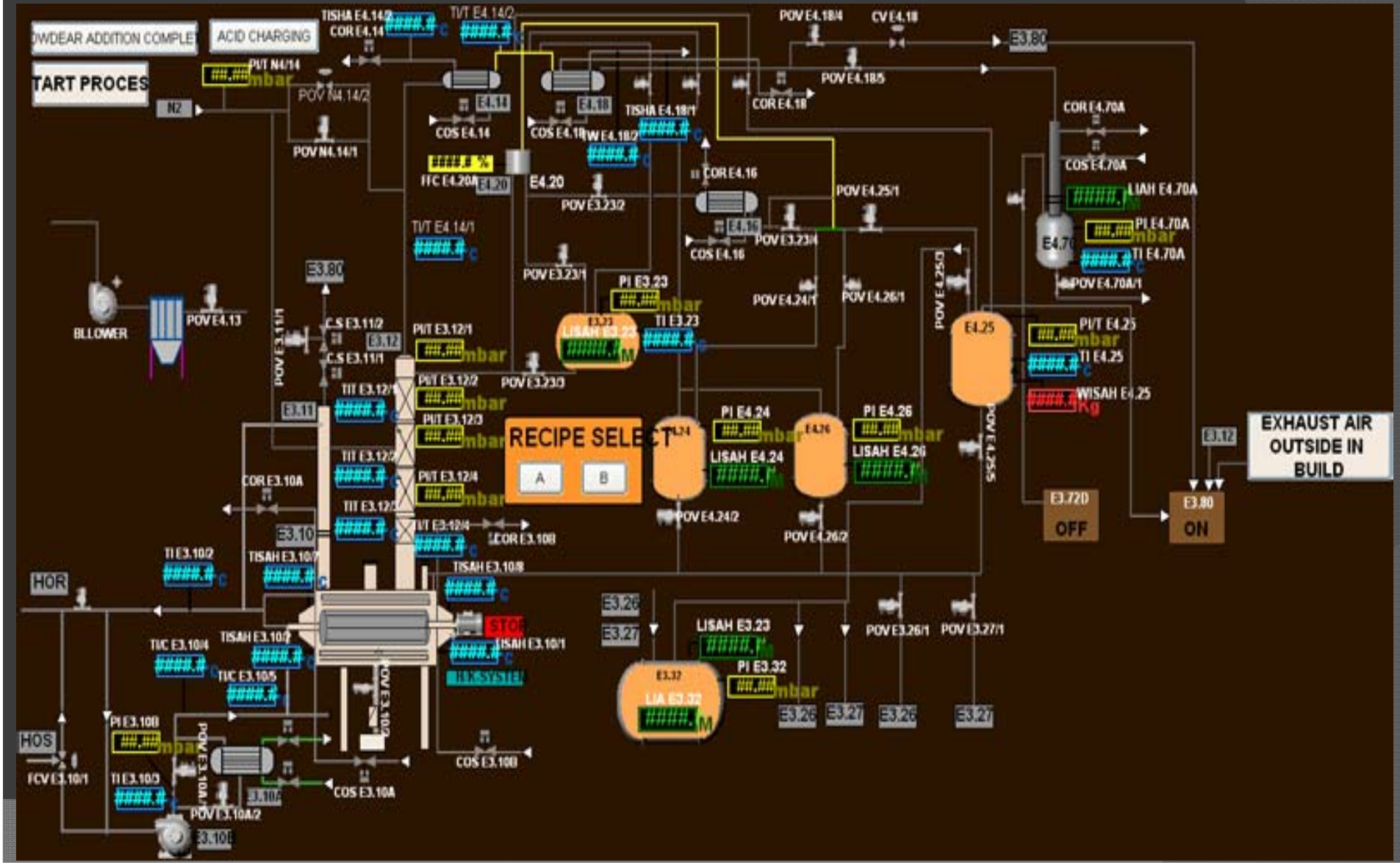


3.2 Industrial Process Control



- Today we use PLC's for industrial process control
- These machines are designed for industrial environment

Example for a chemical process.



- Thank you for your attention

literature

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- http://en.wikipedia.org/wiki/Microcontroller
- http://en.wikipedia.org/wiki/Microprocessor
- http://en.wikipedia.org/wiki/Process_automation_system
- http://www.bipom.com/documents/lectures/
- http://www.societyofrobots.com/programming_PID.shtml

- http://www.youtube.com/watch?v=rG_2Gnteqwl
- http://www.youtube.com/watch?v=ESLTEmdeL7Y