week 1 - introduction

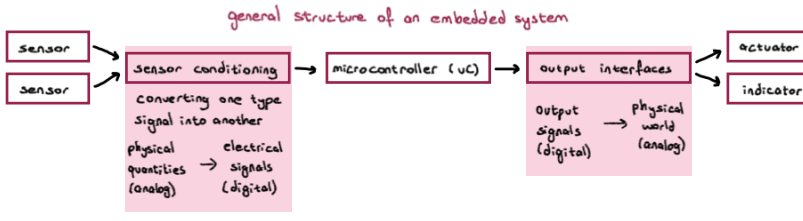
embedded system = combination of hardware and software designed for a specific function

↳ device / devices that contain one or more dedicated computers, microprocessors, or microcontrollers

↳ not general purpose computers

↳ cheap, safe, limited computation and memory, robust to harsh conditions

general structure of an embedded system



actuator = a device that converts the electrical signals into the physical events

indicator = shows various information about the system

absolute encoder = can tell the exact position of the shaft in its rotation at any given time

incremental encoder = can only report the change in position

amplifier = electronic device that can increase the power of a signal

gyro sensors = detect changes in rotation angle per unit of time, angular velocity sensors

development

↳ development takes place on a host, separate than the target

↳ final product usually has ROM and a very small RAM

hardware vs software

↳ hardware is faster but less flexible and more difficult to debug

↳ software can be updated but runs slower and consumes computational resources

↳ hardware failures can cause software failure and vice-versa

processors

↳ general purpose processors = programmable, used in a variaty of applications - microprocessors

↳ has memory and general ALU, low cost, high flexibility

↳ pentium = widely used x86 arch. microprocessor produced by Intel

↳ application-specific processors = programmable processor optimized for a particular class of applications

↳ has memory and special functional units (custom ALU)

↳ some flexibility, good performance, size and power

↳ single-purpose processors = digital circuit designed to execute exactly one program / task

↳ coprocessor, accelerator, peripheral

↳ no program memory, only needed components

↳ fast, low power, small size

processor architectures

↳ CISC - complex instruction set computer = many instructions can be performer

↳ higher cost, single inst. may take many clock cycle

↳ shorter code: mult (1,2), (2,3) does mult jobs

↳ RISC - reduced instruction set computer = more modern and faster

↳ an inst does a single operation, each inst fewer clock cycle

↳ longer code: load A, (1,2) → load B, (2,3) → prod A,B → store (2,3), A

↳ DSP - digital signal processor = specialized type of microprocessor (uP)

↳ designed for real-time manipulation

* one of the three or a combination can be used

microprocessor (μP)

* an integrated circuit which forms the central processing unit for a computer or embedded controller

requires additional support circuity to function

↳ consist of only CP

↳ used in computer systems

↳ external bus to interface RAM, ROM...

↳ Von Neumann model

↳ complicated and expensive

↳ large number of instructions to process

- raspberry Pi

Microcontroller (μC)

* a microprocessor plus additional peripheral support devices integrated into a single package

↳ consist a CPU, memory, I/O

↳ in embedded systems

↳ internal controlling bus

↳ Harvard architecture

↳ inexpensive and straightforward

↳ fewer instructors

- arduino