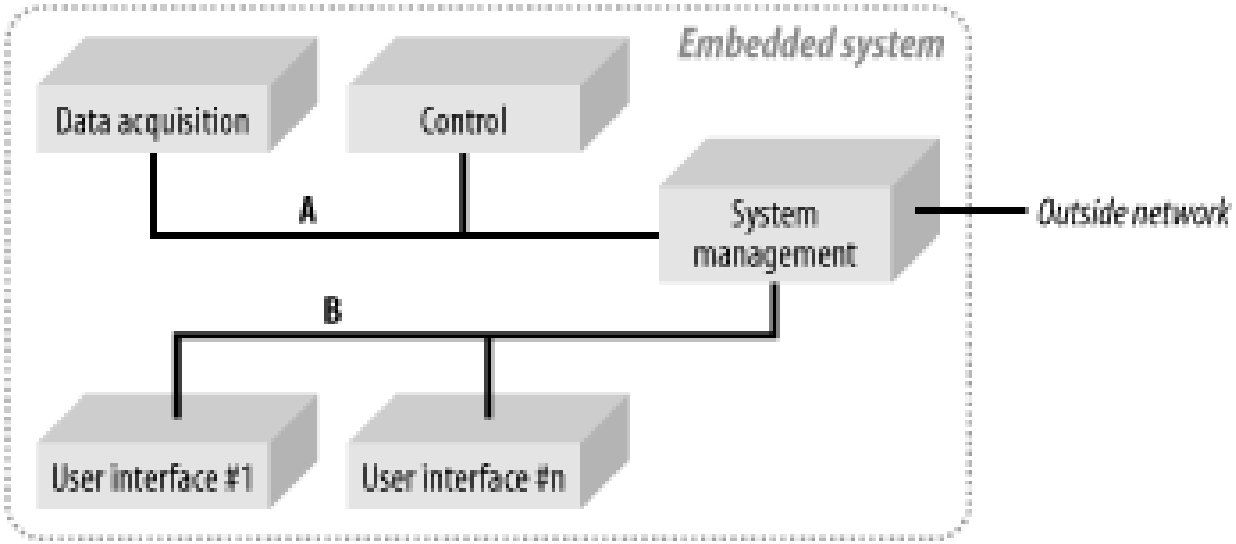
uProcesoru sistēmu projektēšana un skaņošana

Piezīmes

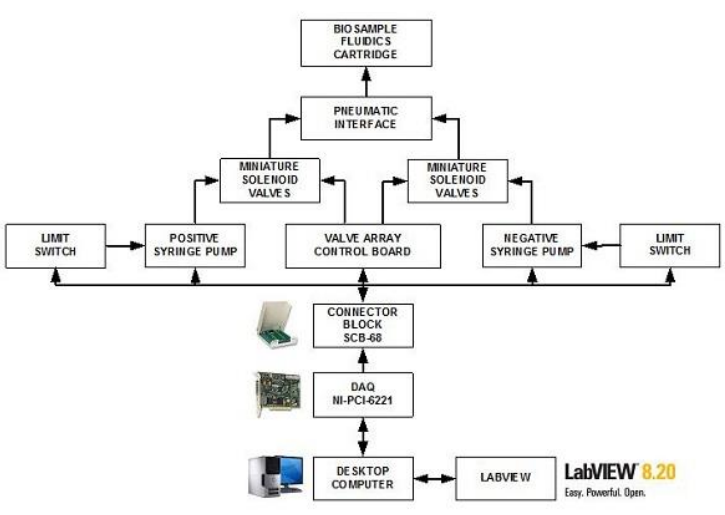
Notes

Example of control uProc system. Most common case



- Each component is an individual embedded system.
- Control system is composed of networked computers.
- Different components grouped and interconnected via system control module, being interface to “outside world”.

Data Acquisition Module



- The first in process measurement are transducers – convert phy. phenomenon into electrical sig.
- Elec. signals from transducers often go through stages of signal conditioning before DAQ module.
- DAQ (e.g. card in desktop controller via Comedi) samples and converts elec. sig. to digital form and stores values in sample buffer(s).
- Software use these values to plot curves, analysis and control parameter modification.
- The desktop is concerned as a medium-sized embedded system with stringent time constraints and no user interface, while being connected to the rest system via Ethernet.

Data Acquisition Module. Operations

- DAQ operations:
  - Stores data in local buffer
  - May analyze:
    - On site with further data/critical exchange with SYSM
    - Send data to SYSM for whole analyze
  - DAQ carry out commands from SYSM
  - DAQ exchanges with configuration and status with SYSM periodically or on-demand basis.

Data Acquisition Module. Construct

- DAQ typically boots from some sort of flash and uses RAM disk or CRAMFS (compressed ROM file system) - easy replicable if needed.
- DAQ doesn’t provide such services as FTP, HTTP or NFS.
- Instead runs daemon(-s) to communicate with SYSM.
- DAQ has only minimal support for user tools, like BusyBox package.
- DAQ utilizes fixed IP address thus SYSM may check if it is available and its status at any time.

Control Module

- Because PLCs and similar systems are expensive, moreover run their own OSes, need special configuration procedures, usage of mainstream HW (PCs) becoming more common in process control.
- The control module (CM) is an industrial computer with an interface to the HW being controlled.
- The computer runs medium-sized embedded system with stringent time-constraints and with no user interface, like DAQ.
- Is connected to the rest of the system via Ethernet link.

Control Module. Operations

- The CM's main task is to issue commands to HW it controls, while monitoring the progression of the hardware's behavior in reaction of the commands.
- Typically control commands are issued from the SYSM. And they are connected to DAQ module output.
- The CM coordinates the HW to execute SYSM issued commands.
- The CM exchanges with an info with SYSM:
  - Upon request;
  - Operation is completed;
  - Any special situation occurs.

Control Module. Construct

- CM typically boots from some sort of flash and uses RAM disk or CRAMFS (compressed ROM file system) - easy replicable if needed.
- The PC runs a kernel configured for preemption along with a real-time kernel, such as RTAI or RTLinux.
- Hard real-time response times are necessary to control complex HW. Thus hard real-time drivers are used for that HW control.
- No outside communication, too. Only custom daemons communicates with SYSM. Uses fixed IP address, too.

System management module

- Main tasks:
  - Coordinate interactions between components;
  - Providing a point of entry to the sys. from outside world.
- It is a large embedded system with no UI.
- Contains three network adapters with different rules:
  - DAQ and CM;
  - UIs;
  - Outside world.

System management module. Links' overview

- SYSM retrieves data from DAQ
- Stores the data + may run backup procedures to store the data in local database.
- Sends pertinent data to UIs for display.
- Whether the analysis done in DAQ or SYSM the control commands are issued to CM.
- On outside network SYSM provides HTTP and SSH services. For monitoring, controlling and configuration purposes.
- Provides means to report an end-user on alar condition via SNMP, UIs.
- On link B SYSM offers DHCP so UIs can dynamically allocate their addresses.
- UIs must register themselves with the SYSM to receive data to work with.

System management module. Construct

- SYSM is a large embedded system.
- Utilizes HDD for boot off. Becomes more likely as workstation computer.
- SYSM kernel is configured for preemption, too.
- As well multiuser support is introduced since SYSM is addressed from different sources.
- The filesystem is the same as in workstations and servers.

User Interface modules

- UIs are used to interact with ongoing process:
  - Viewing its state;
  - Modifying variables that control the process.
- UIs are small embedded systems, network enabled and may be mobile;
- UIs retrieves and displays values from SYSM:
  - Critical values are displayed always;
  - Users may choose which variables they want to see.

User Interface modules. Construct

- UI is a small module which boots from:
  - Flash;
  - Network.
- IP address is obtained via DHCP;
- Especially mobile UI are built on ARM, MIPS architecture processors.
- UI run standard kernels with additional graphics library.

Design and Implementation. Creating a Target Linux System

- Determine system components
  - Is close to a simple list of required components.
  - Need to have Linux's compliance to these requirements.
  - In case of feature updates – you should know that it may result in retesting of whole system with undefined errors.
- Configure and build the kernel
  - Keeping kernel up-to-date is a good practice – get rid of errors in kernel. Old kernels are not supported by community.
  - Keep the kernel configuration constant.
- Build root filesystem:
  - Embedded Linux has size limited filesystem.
- Set up boot software and configuration
  - Booting is highly dependent on the architecture.