**Configuration of Real Time System which includes Simple Physical Analog**

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**Introduction**

The application of computer has pervaded different areas of human endeavor. The increasing demands of computer usage and application to complex and sophisticated problems has led to the research in computing known as real-time systems. Real-time system is the base for many applications today. Whatever the designed system is a high accuracy and flexibility, it still not efficient unless be a real-time with the overall system.

**Understanding a Real-Time System**

A real-time computing (RTC) or reactive computing describes hardware and software systems subject to a 'real time constraint'.

An analog or analogue signal is any [continuous](https://en.wikipedia.org/wiki/Continuous_function) [signal](https://en.wikipedia.org/wiki/Signal_(circuit_theory)) for which the time varying feature (variable) of the signal is a representation of some other time varying quantity, i.e., analogous to another time varying signal. For example, in an analog [audio signal](https://en.wikipedia.org/wiki/Audio_signal), the instantaneous [voltage](https://en.wikipedia.org/wiki/Voltage) of the signal varies continuously with the [pressure](https://en.wikipedia.org/wiki/Sound_pressure) of the sound waves. It differs from a [digital signal](https://en.wikipedia.org/wiki/Digital_signal_(signal_processing)), in which the continuous quantity is a representation of a sequence of [discrete values](https://en.wikipedia.org/wiki/Discrete_space) which can only take on one of a finite number of values. The term analog signal usually refers to [electrical signals](https://en.wikipedia.org/wiki/Electrical_signal); however, [mechanical](https://en.wikipedia.org/wiki/Classical_mechanics), [pneumatic](https://en.wikipedia.org/wiki/Pneumatic), [hydraulic](https://en.wikipedia.org/wiki/Hydraulic), human speech, and other systems may also convey or be considered analog signals.

An analog signal uses some property of the medium to convey the signal's information. For example, an [aneroid barometer](https://en.wikipedia.org/wiki/Aneroid_barometer) uses rotary position as the signal to convey pressure information. In an electrical signal, the [voltage](https://en.wikipedia.org/wiki/Voltage), [current](https://en.wikipedia.org/wiki/Electric_current), or [frequency](https://en.wikipedia.org/wiki/Frequency) of the signal may be varied to represent the information.

Any information may be conveyed by an analog signal; often such a signal is a measured response to changes in physical phenomena, such as [sound](https://en.wikipedia.org/wiki/Sound), [light](https://en.wikipedia.org/wiki/Light), [temperature](https://en.wikipedia.org/wiki/Temperature), position, or [pressure](https://en.wikipedia.org/wiki/Pressure). The physical variable is converted to an analog signal by a [transducer](https://en.wikipedia.org/wiki/Transducer). For example, in sound recording, fluctuations in air pressure (that is to say, [sound](https://en.wikipedia.org/wiki/Sound)) strike the diaphragm of a [microphone](https://en.wikipedia.org/wiki/Microphone) which induces corresponding fluctuations in the current produced by a coil in an electromagnetic microphone, or the voltage produced by a condensor microphone. The voltage or the current is said to be an "analog" of the sound.

An analog signal has a theoretically infinite resolution. In practice an analog signal is subject to [electronic noise](https://en.wikipedia.org/wiki/Noise_(electronic)) and [distortion](https://en.wikipedia.org/wiki/Distortion) introduced by [communication channels](https://en.wikipedia.org/wiki/Communication_channel) and [signal processing](https://en.wikipedia.org/wiki/Signal_processing) operations, which can progressively degrade the [signal-to-noise ratio (SNR)](https://en.wikipedia.org/wiki/Signal-to-noise_ratio). In contrast, digital signals have a finite resolution. Converting an analog signal to digital form introduces a constant low-level noise called [quantization noise](https://en.wikipedia.org/wiki/Quantization_noise) into the signal which determines the noise floor, but once in digital form the signal can in general be processed or transmitted without introducing additional noise or distortion. Therefore, as analog signal processing systems become more complex, they may ultimately degrade signal resolution to such an extent that their performance is surpassed by digital systems. This explains the widespread use of digital signals in preference to analog in modern technology. In analog systems, it is difficult to detect when such degradation occurs. However, in digital systems, degradation can not only be detected but corrected as well.

An embedded system is a [computer](https://en.wikipedia.org/wiki/Computer) [system](https://en.wikipedia.org/wiki/System) with a dedicated function within a larger mechanical or electrical system, often with [real-time computing](https://en.wikipedia.org/wiki/Real-time_computing) constraints.[[1]](https://en.wikipedia.org/wiki/Embedded_system#cite_note-Barr-glossary-1)[[2]](https://en.wikipedia.org/wiki/Embedded_system#cite_note-2) It is *embedded* as part of a complete device often including hardware and mechanical parts. Embedded systems control many devices in common use today. 98 percent of all [microprocessors](https://en.wikipedia.org/wiki/Microprocessors) being manufactured are used in embedded systems.

Examples of properties typical of embedded computers when compared with general-purpose counterparts are low power consumption, small size, rugged operating ranges, and low per-unit cost. This comes at the price of limited processing resources, which make them significantly more difficult to program and to interface with. However, by building intelligence mechanisms on the top of the hardware, taking advantage of possible existing sensors and the existence of a network of embedded units, one can both optimally manage available resources at the unit and network levels as well as provide augmented functionalities, well beyond those available. For example, intelligent techniques can be designed to manage power consumption of embedded systems.

**Why Real-Time Systems?**

* Performance
* Throughput
* Fault tolerance
* Reliability
* Safety
* Availability
* Security

**Uses of Real-Time Systems**

* Vehicle Systems are automobiles, subways, aircraft, railways and ships
* Traffic control for highways, airspace, railway tracks and shipping lanes
* Process control for power plants, chemical plants, and consumer products such as soft drinks and beer.
* Medical systems for radiation therapy, patient monitoring, and defibrillation
* Military uses such as firing weapons, tracking, and command and control.
* Manufacturing systems with robots
* Telephone, radio and satellite communications
* Computer games
* Multimedia systems that provide text, graphic, audio, and video interfaces
* Household systems for monitoring and controlling appliances
* Building managers that control such entities as heat, lights, doors and elevators

**Configuration of Real-Time System**

1. *Embedded Real-Time Systems*

Real-time systems are implemented and configured majorly as Embedded Systems. This is the incorporation of real-time systems within devices to monitor, respond to, or control an external environment. This environment is connected to the connected to the computer system through sensors, actuators, and other input-output interfaces. It may consist of physical or biological objects of any form and structure. Often humans are part of the connected external world, but a wide range of other natural and artificial objects, as well as animals, are also possible.

The ever-decreasing price/performance ratio of microcontrollers makes it economically attractive to replace conventional mechanical or electronic control system within many products by an embedded real-time computer system. There are numerous examples of products with embedded computer systems: cellular phones, engine controllers in cars, heart pacemakers, computer printers, television sets, washing machines, even some electric razors contain a microcontroller with some thousand instructions of software code. Because the external interfaces (particularly the man–machine interface) of the product often remain unchanged relative to the previous product generation, it is often not visible from the outside that a real-time computer system is controlling the product behavior.

*Characteristics:* An embedded real-time computer system is always part of a well-specified larger system, which we call an intelligent product. An intelligent product consists of a physical (mechanical) subsystem; the controlling embedded computer, and, most often, a man–machine interface. The ultimate success of any intelligent product depends on the relevance and quality of service it can provide to its users. A focus on the genuine user needs is thus of utmost importance.

Embedded systems have a number of distinctive characteristics that influence the system development process:

* Mass Production: many embedded systems are designed for a mass market and consequently for mass production in highly automated assembly plants. This implies that the production cost of a single unit must be as low as possible, i.e., efficient memory and processor utilization are of concern.
* Static Structure: the computer system is embedded in an intelligent product of given functionality and rigid structure. The known a priori static environment can be analyzed at design time to simplify the software, to increase the robustness, and to improve the efficiency of the embedded computer system. In many embedded systems there is no need for flexible dynamic software mechanisms. These mechanisms increase the resource requirements and lead to an unnecessary complexity of the implementation.
* Man–Machine Interface: if an embedded system has a man–machine interface, it must be specifically designed for the stated purpose and must be easy to operate. Ideally, the use of the intelligent product should be self-explanatory, and not require any training or reference to an operating manual.
* Minimization of the Mechanical Subsystem: to reduce the manufacturing cost and to increase the reliability of the intelligent product, the complexity of the mechanical subsystem is minimized.

Future Trends. During the last few years, the variety and number of embedded computer applications have grown to the point that, by now, this segment is by far the most important one in the computer market. The embedded system market is driven by the continuing improvements in the cost/performance ratio of the semiconductor

industry that makes computer-based control systems cost-competitive relative to their mechanical, hydraulic, and electronic counterparts. Among the key mass markets are the domains of consumer electronics and automotive electronics. The automotive electronics market is of particular interest, because of stringent timing, dependability, and cost requirements that act as technology catalysts.

1. *Plant Automation System*

Historically, industrial plant automation was the first field for the application of real-time digital computer control. This is understandable since the benefits that can be gained by the computerization of a sizable plant are much larger than the cost of even an expensive process control computer of the late 1960s. In the early days, human operators controlled the industrial plants locally. With the refinement of industrial plant instrumentation and the availability of remote automatic controllers, plant monitoring and command facilities were concentrated into a central control room, thus reducing the number of operators required to run the plant. In the 1970s, the next logical step was the introduction of central process control computers to monitor the plant and assist the operator in her/his routine functions, e.g., data logging and operator guidance. In the beginning, the computer was considered an add-on facility that was not fully trusted. It was the duty of the operator to judge whether a set point calculated by a computer made sense and could be applied to the process (open-loop control). In the next phase, Supervisory Control and Data Acquisition (SCADA) systems calculated the set-points for the programmable logic controllers (PLC) in the plant. With the improvement of the process models and the growth of the reliability of the computer, control functions have been increasingly allocated to the computer and gradually the operator has been taken out of the control loop (closed-loop control). Sophisticated non-linear control techniques, which have response time requirements beyond human capabilities, have been implemented.

Usually, every plant automation system is unique. There is an extensive amount of engineering and software effort required to adapt the computer system to the physical layout, the operating strategy, the rules and regulations, and the reporting system of a particular plant. To reduce these engineering and software efforts, many process control companies have developed a set of modular building blocks, which can be configured individually to meet the requirements of a customer. Compared to the development cost, the production cost (hardware cost) is of minor importance.

Maintenance cost can be an issue if a maintenance technician must be on-site for 24 h in order to minimize the downtime of a plant.

Future Trends. The market of industrial plant automation systems is limited by the number of plants that are newly constructed or are refurbished to install a computer control system. During the last 20 years, many plants have already been automated. This investment must pay off before a new generation of computers and control equipment is installed.

Furthermore, the installation of a new generation of control equipment in a production plant causes disruption in the operation of the plant with a costly loss of production that must be justified economically. This is difficult if the plant’s efficiency is already high, and the margin for further improvement by refined computer control is limited.

The size of the plant automation market is too small to support the mass production of special application-specific components. This is the reason why many VLSI components that are developed for other application domains, such

as automotive electronics, are taken up by this market to reduce the system cost. Examples of such components are sensors, actuators, real-time local area networks, and processing nodes. Already several process-control companies have announced a new generation of process-control equipment that takes advantage the of lowpriced mass produced components that have been developed for the automotive market, such as the chips developed for the Controller Area Network.

1. *Multimedia Systems*

Characteristics. The multimedia market is a mass market for specially designed soft and firm real-time systems. Although the deadlines for many multimedia tasks, such as the synchronization of audio and video streams, are firm, they are not hard deadlines. An occasional failure to meet a deadline results in a degradation of the quality of the user experience, but will not cause a catastrophe. The processing power required to transport and render a continuous video stream is large and difficult to estimate, because it is possible to improve a good picture even further.

The resource allocation strategy in multimedia applications is thus quite different from that of hard real-time applications; it is not determined by the given application requirements, but by the amount of available resources. A fraction of the given computational resources (processing power, memory, bandwidth) is allocated to a user domain. Quality of experience considerations at the end user determine the