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Real-Time System: Fire and Smoking Control System (Case Study)

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Abstract—A real-time system is software where the correct functioning of the system depends on the results produced by the system and the time at which these results are produced. The main objective of this study is to show the importance of real-time system as an application that uses computer system in the human life. Since it helps to control vital and dangerous aspects, that otherwise can not be controlled.

The motivation for this study is to avoid fire occurrence and smoking habits in certain places. Since by using this system the place and time of event can be determined in short period. For that reason, the need for using real-system raised.

Keywords- Real time system; Fire and Smoking Control System; Very High Speed Integrated Description Language (VHDL).

I. INTRODUCTION

A real-time system is software where the correct functioning of the system depends on the results produced by the system and the time at which these results are produced. A 'soft' real-time system is a system whose operation is degraded if results are not produced according to the specified timing requirements. A 'hard' real-time system is a system whose operation is incorrect if results are not produced according to the timing specification. A general model of real-time system is presented in Figure 1.

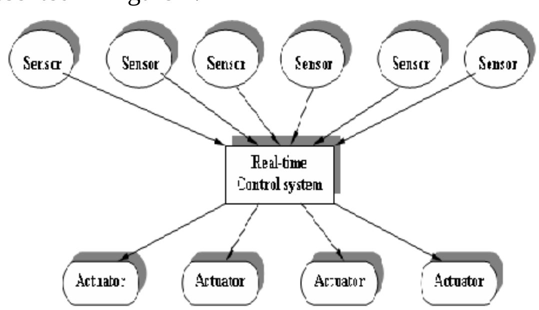

Figure 1: General model of a real-time system [1].

One way of looking at a real-time system is as stimulus/response system. Given a particular input stimulus, the system must produce some corresponding response. The behavior of a real-time system can therefore be defined by listing stimuli that are received by the system, the associated responses and the time at which the response must be produced. The stages of real-time system are system design, real-time executives, monitoring and control [1].

The design process for real-time system differs from other software design process because the system response times must be considered early in the process. Events (stimuli) rather than objects or functions should be central to the design process. There are several stages in design process: (1) identify the stimuli and the associated responses, (2) identify the timing constraints for each stimulus and associated responses, (3) Aggregate the stimulus and response processing into a number of concurrent processes, (4) design algorithms to carry out the required computations, (5) design a scheduling system to ensure that processes are started in time to meet their deadlines, and (6) integrate the system under the control of real-time executive.

Real-time systems have to respond to events occurring at irregular intervals. These events often cause the system to move to a different state. For this reason, state machine modeling may be used as a way of describing a real-time system [1].

The programming language used for implementing a real-time system may also influence the design. Hard real-time system are still sometimes programmed in a simply language so that tight deadlines can be met. The advantage of using low-level language is that it allows the development of very efficient programs [1].

A real-time executive is analogous to an operating system in a general-purpose computer. It manages processes and resource allocation in a real-time system [1]. An important difficulty in executive stage is a communication delay between the different parts of the control systems and the process. Figure 2 shows a schematic drawing of a communication delay.

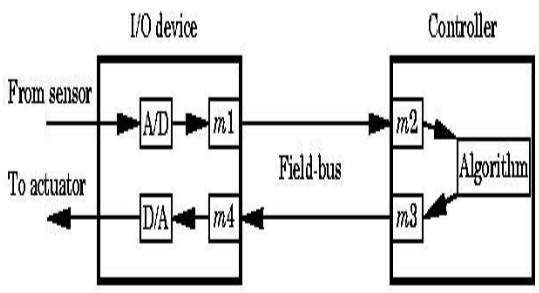

Figure 2: Schematic drawing of a communication delay [2].

Many real-time applications require a high-resolution time tick in order to work properly. However, supporting a high-resolution time tick imposes a very high overhead on the system. In addition, such systems may need to change scheduling discipline from time to time to satisfy some user requirements such as Quality of Service (QoS). The dynamic changing of the scheduling discipline is usually associated with delays during which some deadlines might be missed [3].

Monitoring and control systems are important stage of real-time system. They check sensors providing information about the system's environment and take actions depending on the sensor reading. Monitoring systems take action when some exceptional sensor value is detected. Control systems continuously control hardware actuators depending on the value of associated sensors [1].

II. SYSTEM DESCRIPTION

Smoking and Fire control system is considered one of real-time system applications. It detects fire occurrence and it controls smoking in any building or location. It mainly depends on hardware and software, where Very High Speed Integrated Description Language (VHDL) is used in programming this system.

III. SYSTEM ANALYSIS

A flow chart in Figure 3 describes briefly parts of system and services that can be performed by the system.

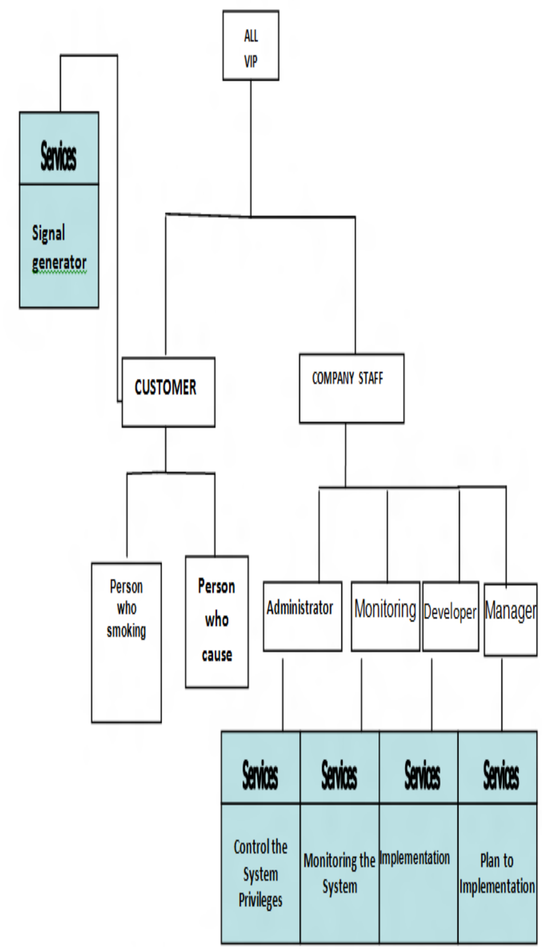

Figure 3: Flow chart of parts and services of the system.

IV. SYSTEM REQUIREMENTS

IV.I User Requirements

1. Detecting fire occurrence,
2. Controlling smoking habit in a building, and
3. Easy to use.

IV.II Software Requirements

1. Generate signal,
2. Convert signal,
3. Compare signal over three levels,
4. Store data,
5. Display, and
6. Sending output signal to the speaker.

IV.III Hardware Requirements

1. Smoking sensor,
2. Temperature sensor,
3. Analog multiplexer 4*1 (Input, one output, two selection line,
4. Amplifier filter (to amplify an input signal),
5. Analog to Digital converter (10 M.sec),
6. Personal Computer,
7. Digital to Analog converter, and
8. Amplifier System and Speaker.

V. System Design

Hardware Diagram

Figure 4 shows a diagram of hardware components and their sequence that is needed in the system.

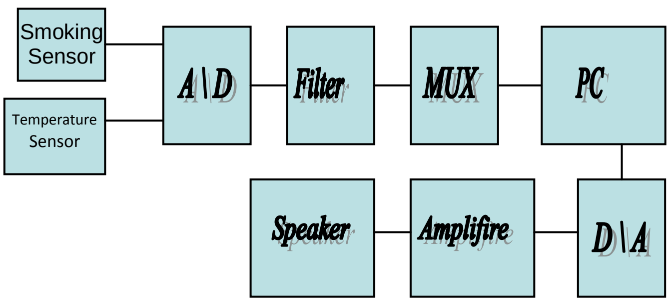

Figure 4: A diagram of hardware components and their sequence that is needed in the system.

VI. Subsystem Definition

1. Subsystem data compare: Data compare subsystem where object is compare an input signal with three levels.
2. Subsystem process control: Process control where object is control the process of data and output signal type.
3. Subsystem data store: Data store where object is store the result of compare and state in the database.
4. Subsystem display: Display subsystem where object is display the result by value and histogram.
5. Subsystem output: Data output subsystem where object is output the data through output interface.
6. Subsystem interface: Interface layer where object are supply a user interface by menu.

VII. System Building

VII.I Hardware Stage

1. Analog signal (sensor, filter, amplifier, MUX, DEMUX, signal actuator, output device).
2. Digital signal (A/D, D/A, buffer).
3. Personal computer.
4.

VII.II Software Stage

The software system consists of multi-subsystem:

1. Input subsystem
2. Compare subsystem
3. Store subsystem
4. Monitor subsystem
5. Output subsystem

VIII. Conclusions

Real-time system is considered one of the important subjects in controlling different aspects of life. The proposed system helps in avoiding fire occurrence and smoking habits in certain places, by detecting fire occurrence and controlling smoking habits in public places or any location.

In the future this system will be implemented using hardware and software, where Very High Speed Integrated Description Language (VHDL) and high level programming languages is used in programming this system.

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