



MONITORING AND CONTROL SYSTEM

**Monitoring & Control System / 19ITT203- Software Engineering /K.S Mohan/ IT /
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Monitoring and control systems

- Important class of real-time systems
- **Continuously check sensors and take actions** depending on sensor values
- **Monitoring systems examine sensors** and report their results
- **Control systems** take sensor values and **control hardware actuators**



Burglar Alarm system

- Designed to detect intrusion, unauthorized entry
- Used in residential, commercial, industrial, and military for protection against **burglary** (**theft**).





Burglar Alarm system

- A system is required to **monitor sensors on doors and windows** to detect the **presence of intruders in a building**
- When a **sensor indicates a break-in**, the system **switches on lights around the area** and calls police automatically
- The system should include provision for **operation without a mains power supply**





Burglar Alarm system

- **Sensors**

- Movement detectors, window sensors, door sensors.
- 50 window sensors, 30 door sensors and 200 movement detectors
- Voltage drop sensor

- **Actions**

1. When an intruder is detected, **police are called automatically.**
2. **Lights are switched on** in rooms with active sensors.
3. An **audible alarm** is switched on.
4. The system switches automatically to **backup power when a voltage drop** is detected.



IR Movement Sensor



Door Sensor



RT System Design Process

1. **Identify stimuli** and associated **responses**
2. **Define the timing constraints** associated with each stimulus and response
3. **Allocate system functions** to concurrent processes
4. **Design algorithms** for stimulus processing and response generation
5. **Design a scheduling system** to meet their deadlines
6. Integrate with Real Time Executives



Stimuli to be Processed & Responses

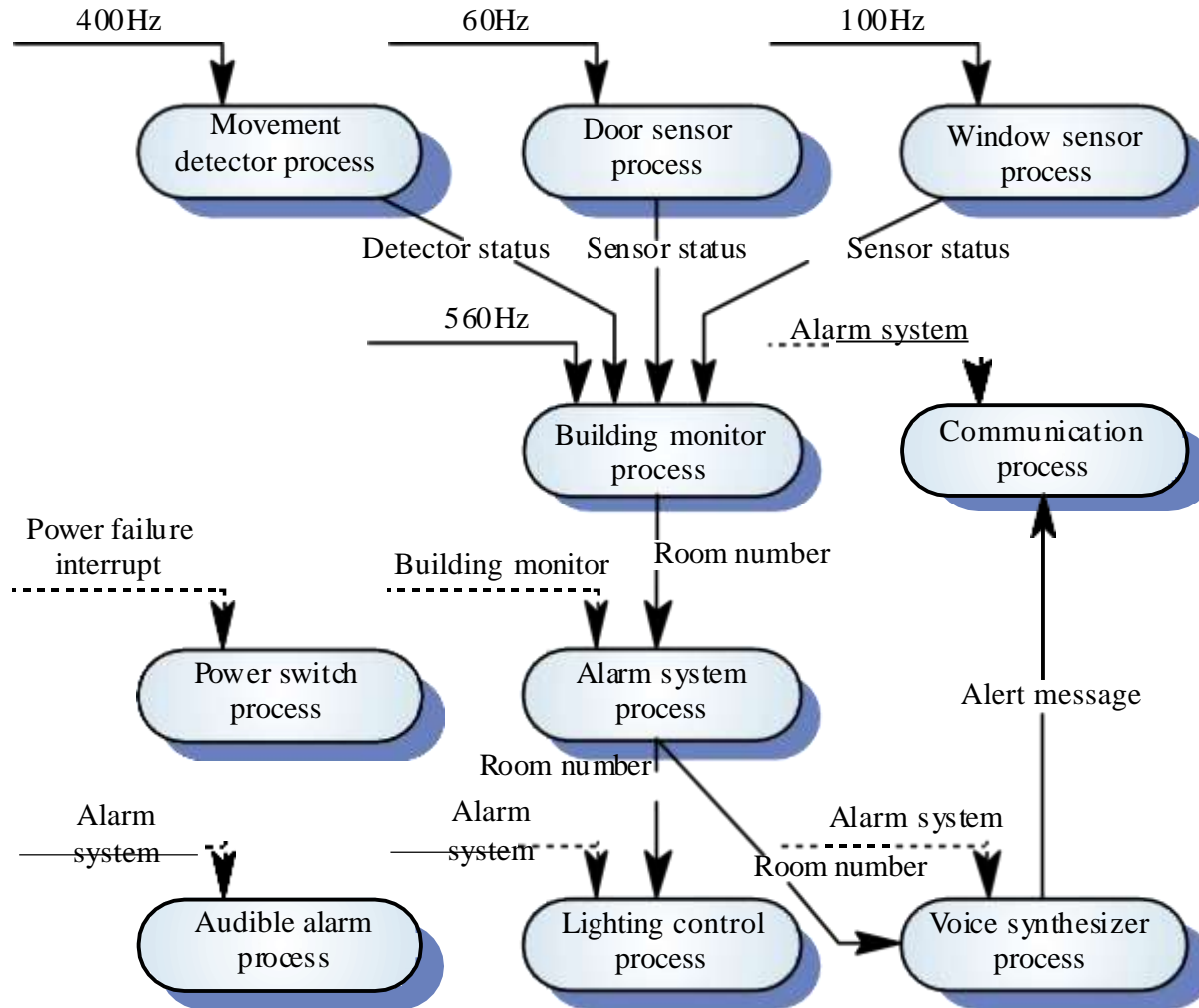
- **Power failure**
 - Generated **aperiodically** by a circuit monitor.
 - When received, the system must **switch to backup power within 50 ms**
- **Intruder alarm**
 - Stimulus **generated by system sensors**
 - Response is to call the police,
 - switch on building lights
 - and the audible alarm



Timing Requirements

Stimulus/Response	Timing requirements
Stimulus & Timing	
Power fail interrupt	must be completed within a deadline of 50 ms.
Door alarm	should be polled twice per second.
Window alarm	should be polled twice per second.
Movement detector	should be polled twice per second.
Response & Timing	
Audible alarm	should be switched on within 1/2 second of an alarm being raised
Lights switch	should be switched on within 1/2 second of an alarm being raised
Communications	The call to the police should be started within 2 seconds of the alarm
Voice synthesiser	A synthesised message should be available within 4 seconds of an alarm

Process Architecture



Source: Software Engineering, Ian Sommerville

Building Monitor Process 1

```
// See http://www.software-engin.com/ for links to the complete
// Java code for this example

class BuildingMonitor extends Thread {

    BuildingSensor win, door, move ;

    Siren    siren = new Siren () ;
    Lights  lights = new Lights () ;
    Synthesizer synthesizer = new Synthesizer () ;
    DoorSensors doors = new DoorSensors (30) ;
    WindowSensors windows = new WindowSensors (50) ;
    MovementSensors movements = new MovementSensors (200) ;
    PowerMonitor pm = new PowerMonitor () ;

    BuildingMonitor()
    {
        // initialise all the sensors and start the processes
        siren.start () ; lights.start () ;
        synthesizer.start () ; windows.start () ;
        doors.start () ; movements.start () ; pm.start () ;
    }
}
```

Building Monitor Process 2

```
public void run () {
    int room = 0 ;
    while (true) {
        // poll the movement sensors at least twice per second (400 Hz)
        move = movements.getVal () ;
        // poll the window sensors at least twice/second (100 Hz)
        win = windows.getVal () ;
        // poll the door sensors at least twice per second (60 Hz)
        door = doors.getVal () ;
        if (move.sensorVal == 1 | door.sensorVal == 1 | win.sensorVal == 1)
            {
                // a sensor has indicated an intruder
                if (move.sensorVal == 1)          room = move.room ;
                if (door.sensorVal == 1)          room = door.room ;
                if (win.sensorVal == 1)           room = win.room ;

                lights.on (room) ; siren.on () ; synthesizer.on (room) ;
                break ;
            }
        lights.shutdown () ; siren.shutdown () ; synthesizer.shutdown () ;
        windows.shutdown () ; doors.shutdown () ; movements.shutdown () ;

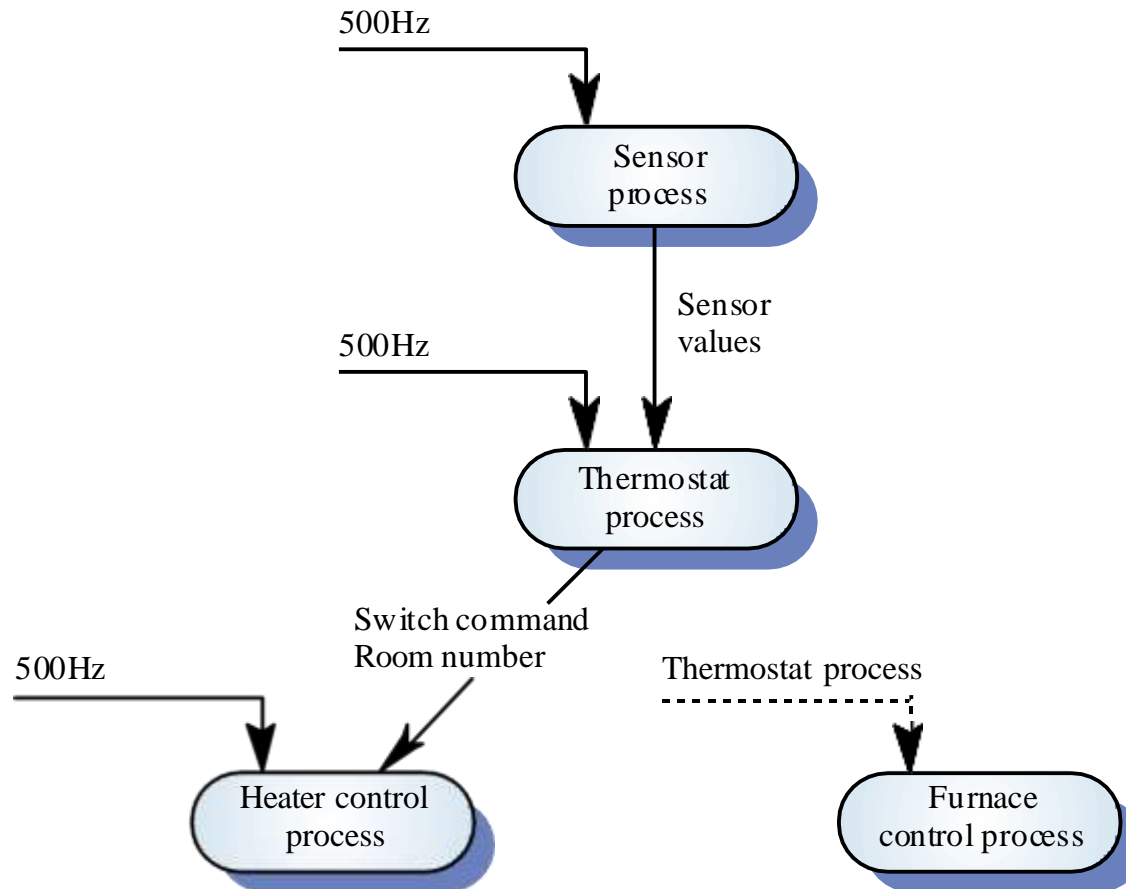
    } // run
} // BuildingMonitor
```



Control System

- A **burglar alarm system is primarily a monitoring system**. It collects data from sensors but **no real-time actuator control**
- Control systems are similar but, in response to sensor values, **the system sends control signals to actuators**
- An example of a **monitoring and control system** is a system which **monitors temperature and switches heaters on and off**

Temperature Control System



Source: *Software Engineering*, Ian Sommerville

ASSESSMENT

MATCH THE FOLLOWING

Match

- | | |
|-------------------------------|-------------------|
| a. Burglar Alarm System | Control System |
| b. Door Sensor | Power Failure |
| c. Aperiodic Stimuli | Twice per second |
| d. Temperature Control System | Monitoring System |
| e. Movement Sensor | Periodic Stimuli |



Reference

Software Engineering 6th Edition Ian Sommerville

Thank You