MONITORING AND CONTROL SYSTEM

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
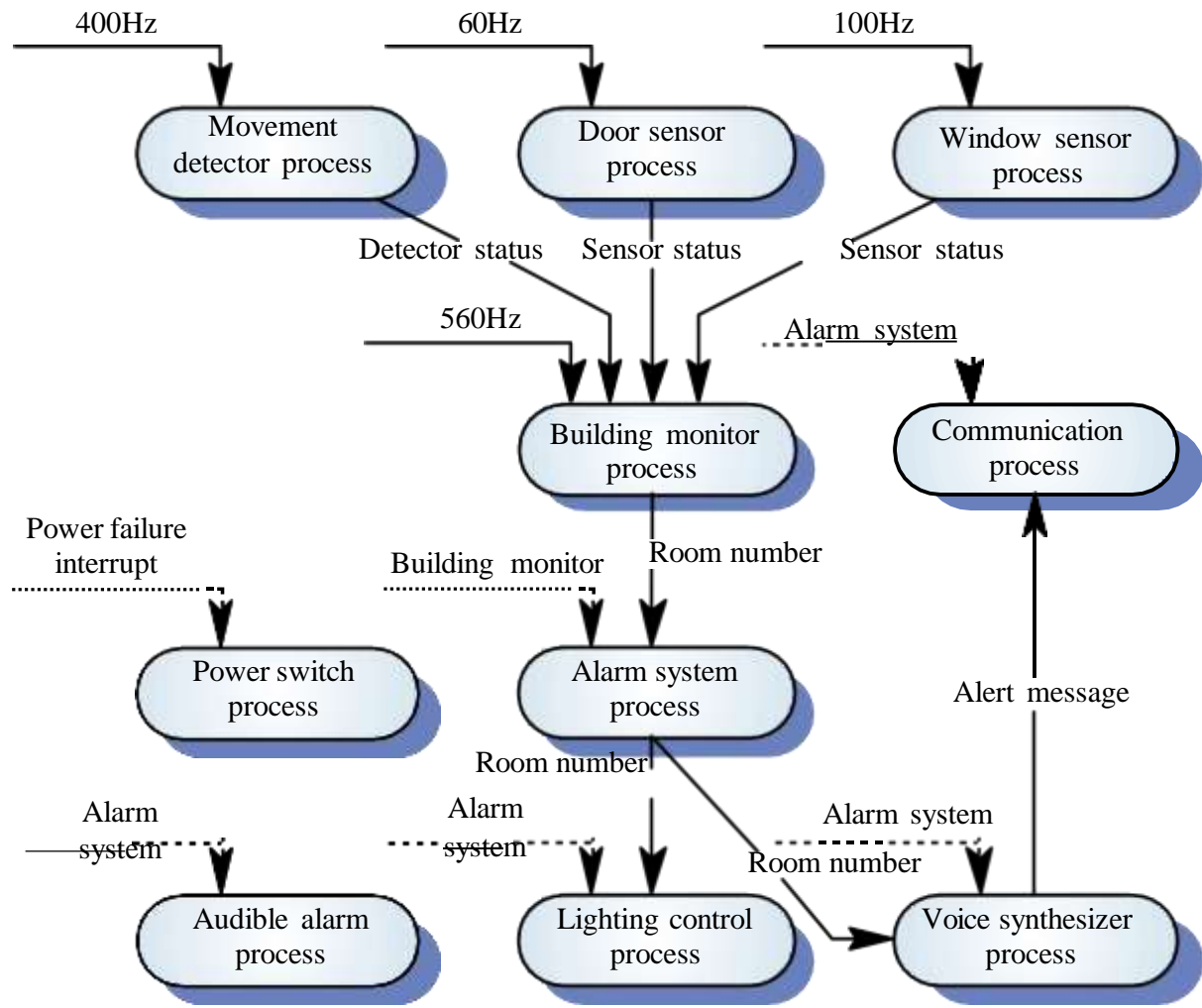
Source: *Software Engineering, Ian Sommerville*

Building Monitor Process 1

```java
// 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
```
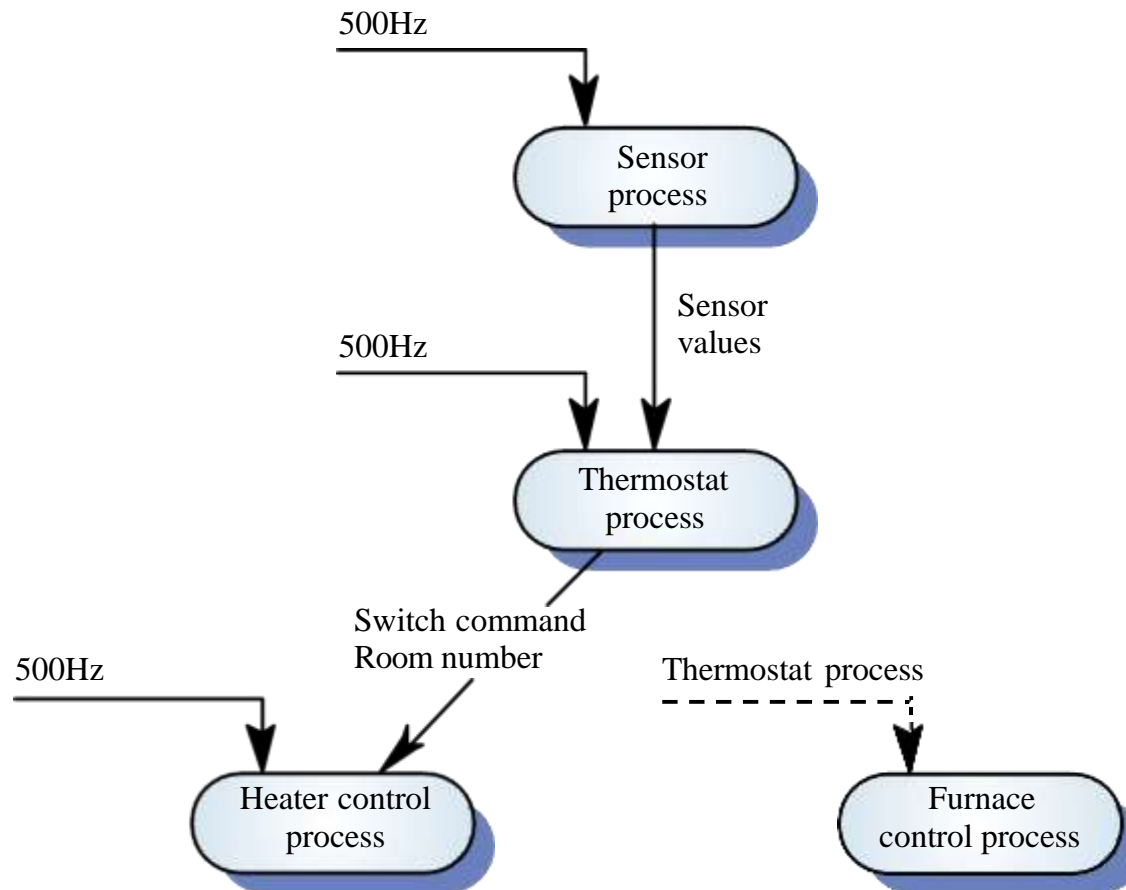
Control System

- 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