1.1. System Specification

- Group discussion
  - Finish the System Specification for the digital clock

2. Embedded System Design Issues

- **Design issues** are problems that make it difficult to design an embedded system

1. Constraint issues

- cost may matter more than speed
- long life cycle
- Reliability/safety
- Low-power
- Size / weight

Examples: Portable heart-beat monitor

- Long life cycle (10 years)
- Reliability (accuracy 99%)
- Low-power (5 using days)
- Light weight (<1kg)

2. Embedded System Design Issues

1. Constraints

Examples for smart home system

No.	Constraints	Note
1	Low price (< 1.000.000 dong)	Correct
2	Ability to detect smoke and fire	Wrong
3	Low power (100mW when idle, 3W when active)	Correct
4	Response time for control < 1ms	?
5	Support remote control by smartphones	?
6	Easy to install	?

Constraints are limitations or restrictions of some parameters of the system

2. Embedded System Design Issues

2. Functional issues

- safety-critical applications
- damage to life, health, economy
- affect to environment, society, politics

Example:

- Message LED for a shop
  - Display message for customers
  - Malfunctions result in small damage
- Message LED for a stock market
  - Display stock data
  - Malfunctions could damage to economy
- Battery charger
  - ?

2. Embedded System Design Issues

2. Functional issues

Examples for battery charger

No.	Issues	Note
1	Battery can be over-heat, it need to be detected by a sensor	Correct
2	Display a charging current and battery status	Wrong
3	The system must have a fuse for protection of over current	?
4	Support 3 charging modes	?
5	Apply efficient algorithm for fast charging and increase battery life cycle	?

Functional issues are problems which can affect to life, health, economy, environment, society, politics, ethics.

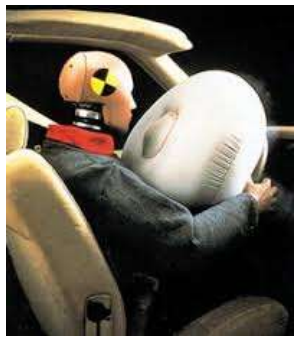
2. Embedded System Design Issues

3. Real-time issues

- Determine whether the system is hard/soft/non real-time
- Determine the time constraint (delay)

Example

- Door entry alarm
  - Non/soft real-time system: delay < 1-2s
- Video recorder
  - Soft real-time system: delay < 1ms
- Car airbag system
  - ?
- Weather temperature monitoring
  - ?



2. Embedded System Design Issues

4. Concurrent issues

- System and environment run concurrently
- multi-functions
- interface with other systems
- May need a scheduler to manage concurrent tasks

Examples: Weather temperature monitoring

Multi-functions:

- Read temperature values from the sensor
- Write data to memory
- Display data on LCD

2. Embedded System Design Issues

5. Reactive issues

- **Continuous / discontinuous interaction**
  - Power on demand
    - Turn ON when using
    - **Ex:** MP3 player, Tivi system
  - Always ON, once started run forever
    - Continuous interaction with their environment
    - Termination is a bad behavior => watchdog timer
    - **Ex:** Camera surveillance system, data acquisition system
- **Response to external periodic/non-periodic events**
  - Events are periodic: the system needs a scheduler to capture the events
  - Events are non-periodic: the system needs to estimate miss event cases