Project in Embedded Sensor Systems

1. Outline

Your task will be to implement a smart home solution using Mbed NXP LPC1768 module. The project will consist of three parts where the first part will focus on implementation of the sensor system on individual modules (nodes). The second part will be to create a wireless sensor network. This network will communicate between the nodes and log measurement data into database on a PC. The third part is to implement a system for live data presentation on a PC.

2. Functional requirements

Let us imagine that every module is placed in a different room and independently measures acceleration, temperature and one parameter of your choice. Acceleration data will be used for "earthquake" detection, which should trigger sound alarm on all of the nodes, while temperature data will be used for control of the ventilation system by using servomotors or indicate the need for switching on the ventilation system by turning on LED. Temperature data from every node should be stored into the common database, which allows listing node-specific data.

The three main technical parts of the project are:

a) **Individual development on every module**, which will realize one node of the wireless sensor network. This node should be independently able to measure acceleration and temperature, send and receive alarm messages. The temperature data should be sent once per minute to the database. Every node should display temperature and acceleration data locally on the screen. Integration of one external sensor is mandatory. You are free to choose the sensor type.

b) **Implementation of wireless sensor network**, which will use the same communication standard for sensor data and enable smooth data sending between nodes and PC. The nodes should be able to send the high priority alarm message in case of "earthquake" simulated by shaking one or more of the modules. In that case, the sound signal should be released on all of the nodes.

c) **Live data display**, which makes it possible to track the temperature data from every node and alarm occurrence. It should be possible to read maximum, minimum and mean temperature of the last minute, hour and day. The "earthquake" alarm log and accelerometer data should also be accessible.

3. Technical requirements

a) Integration of the sensor data:
   - Temperature (sending data every minute)

- Accelerometer (continuous measurement)
- If the “earthquake” event occurs, the accelerometer data in period (-10, +20) seconds around earthquake should be send to the PC after the “earthquake” is gone.

b) Integration of actuators
   - Servomotor or LED (controlled locally by temperature data)
   - Speaker (controlled by alarm message)

c) Integration of XBee module with the Mbed kit. Every person will receive an XBee module.

d) The system should be able to work continuously without crashes.

4. Project planning and execution

Every group should prepare a short project plan, which includes responsibilities, deadlines, sub-deadlines, milestones and deliverables. This plan should be included in the final report.

It will be necessary to work as a team in order to set up common standard for communication between the nodes and between nodes and PC. It is important that every person can show individual contribution to the project on the node level or sensor network or database level.

5. Practical information

- Xbee modules can be found in the master lab.
- The project reporting incudes a written report and presentation including a live demonstration of the working system.
- The individual contributions should be clearly described in the report and marked on the presentation.
- We encourage you to cooperate on the project on the team. If the project will be largely done by one person, the whole group will receive lower grade.
- You are welcome to expand the scope of the project with your own ideas.