

Multi-utility Sensor Networks

Introduction: - *Basic description of Sensor Networks and what our solution proposes*

A sensor network consists of a large number of Sensor Nodes that can be deployed either inside the measured object or very close to it. These nodes may be deployed in remote locations and thus allow for remote monitoring of various parameters. The Sensor Nodes are complete with onboard processors. Thus the nodes carry out simple calculations and transmit only the required and partially processed data.

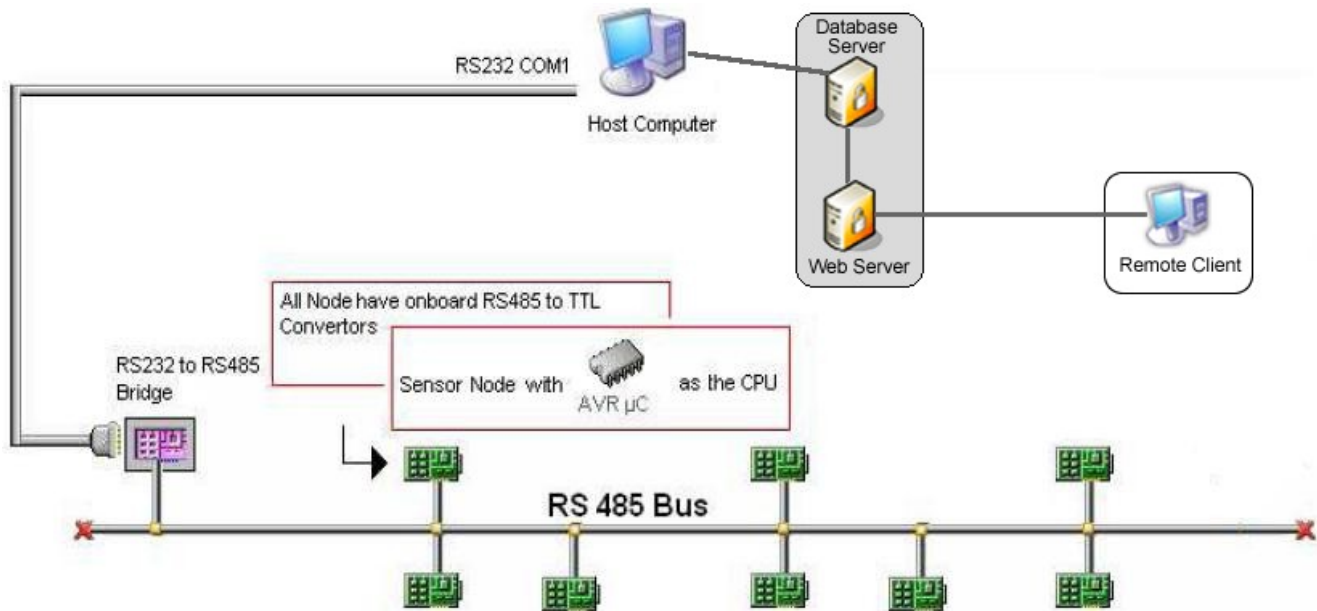
The above-described features enable sensor networks to be used for wide range of applications. In health, for example, sensor networks can be deployed to monitor and assist disabled patients. In military, the rapid deployment and fault tolerant characteristics of sensor networks make them a very promising sensing technique for military command and control. Other commercial applications include voting pads for game shows, home security, inventory management, monitoring product quality, monitoring disaster-prone areas.

The Sensor Nodes are usually strategically placed in the sensor field. Each of these nodes has the capability to collect and route data back to the host monitoring system. Data are routed back using a multi-drop network. This network reduces the number of wires required to connect field devices to the host.

Our multi-utility sensor network aims at satisfying the following criteria:

1. Cost effectiveness
2. Easy availability of components
3. High immunity to noise
4. Ease of operation, flexibility and user friendly GUI
5. Ease of reconfiguration for other applications
6. Scalability
7. Rudimentary built-in processing capability

Sensor Network Scheme:



The project was divided in three modules and three teams worked in simultaneously on these modules :

A. Hardware Implementation *Circuit design and implementation*

The physical existence of the network itself is ensured by the hardware implementation. This includes designing the circuits and the layouts for the Sensor Nodes and the RS-232 to RS-485 Bridges. Various features considered while designing are status-LEDs, on board ISP programming, on board crystal, reset circuitry, etc. EMC design issues are considered, as high-speed data transfer is involved.

B. Embedded Software Implementation *Microcontroller code*

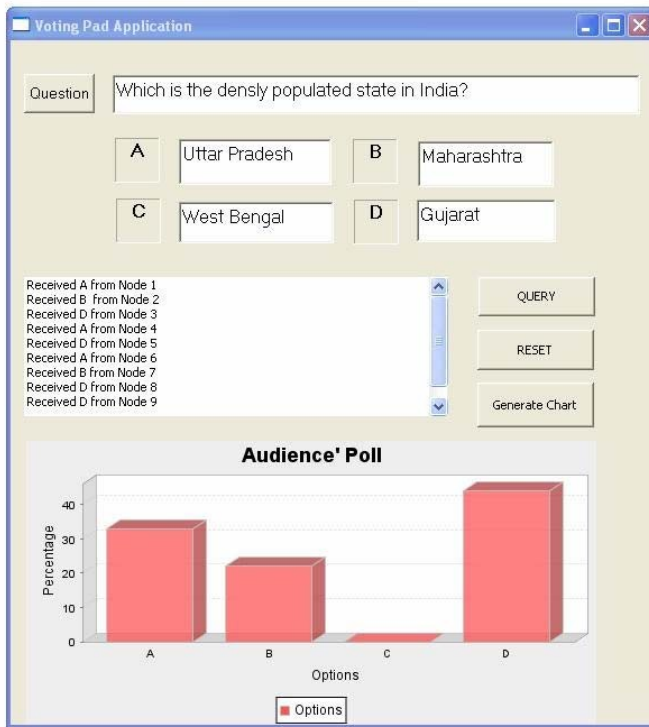
The focus of using embedded software is to develop the intelligence for the Sensor Nodes. The software development for the on-board AVR micro controllers, which collect and process sensor data. Programming for applications is as varied as Industrial Process Monitoring, Home Monitoring and Voting Pads has been done. Communication between the Sensor Network and the Host Computer follows a self-developed protocol. The calibration of sensors is also done based on the available data for the sensors.

C. Host Implementation *Host Computer code and Remote Monitoring*

The host computer runs software for acquiring data from the network. The software running on the host computer is written in Java. The Mysql database server stores data from the Host computer. The Web server runs a PHP based application that is Ajax enabled. The PHP application takes the details from the database server and passes it on to the client machines in graphical format. Ajax is used to reduce the load on the Web server as new data is sent to the client at regular intervals to reduce bandwidth requirements. On receiving the data from the web server, the JavaScript at the client side updates the graphs and views in the browser. The PHP application is also capable to communicate with a java daemon on the host machine to directly control and communicate with the network.

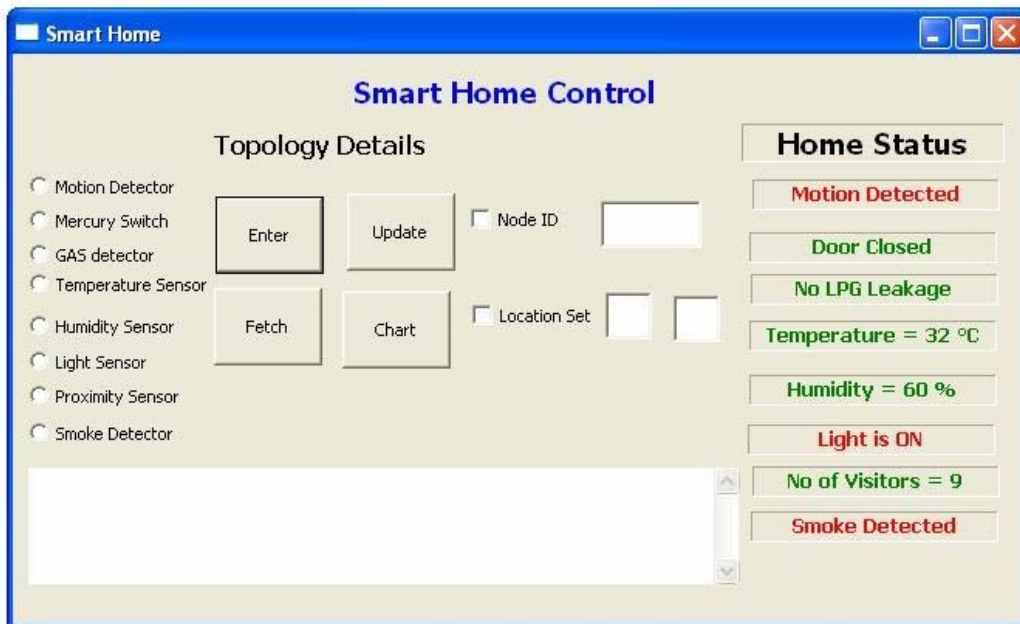
Implementation - Applications Shown/Developed:

1. Voting Pad application:



In this application, the sensors were replaced by voting pads. We demonstrated a quiz similar to Kaun Banega Crorepati.

2. Smart Home Application:



In this application, the sensor nodes were connected to the environment sensors in a house. The host software shows the readings/alerts collected from the sensors. The same data can also be monitored on the web.