Networked Remote Meter-Reading System Based on Wireless Communication Technology

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Agenda:

• Introduction- meter reading, Bluetooth and GSM
• Motivation
• Structure of the proposed system
• Hardware design:
  1. Measuring meter
  2. Intelligent terminal
  3. Communication modules
• System management
• Actual implementation of this system
• Conclusion
• References
Introduction:

**Meter reading**-
- Critical first-step in the utility revenue collection.
- A labor-intensive activity.
- Helps to detect leaks, hazards and safety issues.

**Bluetooth**-
- Wireless technology standard for exchanging data over short distances.
- Uses short-wavelength radio transmissions in the ISM band from 2400–2480 MHz.
- Standardized as IEEE 802.15.1.

**GSM**-
- Describes protocols for second generation (2G) digital cellular network.
- Developed by the European Telecommunications Standards Institute (ETSI).
Automatic meter reading-
Motivation:

- Hiring and training effective and efficient meter readers increases the cost of meter reading.

- Changes in industry and economy have forced Utilities to reduce operating costs.

- Demand for better customer service and satisfaction.

- Support real-time pricing initiatives, load forecasting, demand-side management, load control

- Growing need for more timely access to energy usage information.

- Status and usage information is needed on an event basis to improve reliability, power quality, and to identify outages.
System structure:
Fig. 1 Structure diagram of meter-reading system
• Consists of terminal sensors, measuring meters, intelligent terminals, wireless communication network and management centre.

• The intelligent terminal is used to acquire data from meters and control the energy-consuming devices in residence.

• The core of the intelligent terminal is composed of ARM MPU S344BOX and embedded operating system “uclinux”.

• Communication between the intelligent terminals and management centre is through GSM.

• The measuring meter and the intelligent terminal use bluetooth as the communication method.

• Meter reading, bill computation and fault detection can be finished at the management centre itself.
Hardware design:
Measure meters-

- Consists of sensor circuit, transducers and mechanical measuring meters.

- New meters also include microcontrollers and digital LCD display.

- Depending on the sensor used, the mechanical data is converted to analog or digital quantities.

- Data sources for the meter reading system.
Intelligent terminal-

- Consists of a central process unit, data-acquisition & storage module, wireless communication module, sensor-monitoring module, device-controlling module and display module.

1) Samsung S3C44BOX microprocessor:

32-bit ARM7TDMI RISC microprocessor (66MHz) that includes-

- Internal SRAM, LCD controller, 2-channel UART with handshake, 4-channel DMA, System manager, 5-channel timers with PWM, I/O ports, RTC, 8-channel 10-bit ADC, JIC-BUS interface, IIS-BUS interface, Sync, SIO interface and PLL for clock.

- Also includes thumb de-compressor, an on-chip ICE breaker debug support, and a 32-bit hardware multiplier. Thus, the S3C44BOX minimizes overall system costs and eliminates the need to configure additional components.
2) **Peripherals:**

The following peripherals have been connected to the microprocessor-

- **AMD's AM29LV160 as FLASH memory** -
  address is defined from OxOOOO, 0000 to OxOOIf, ffff.

- **Hyundai's HY57V641620 SDRAM** -
  required to run the embedded operating system (uclinux). Its address is defined from 0x0c00 0000 to OxOc7f ffff.

- **nRF903 as Bluetooth Wireless Communication Module** -
  it’s a single chip multi-channel UHF transceiver that operates in the unlicensed 433MHz, 868MHz and 915MHz ISM-/LPRD bands. 
  nRF903 provides a standard connection of SPI interface, so it can be interfaced with MAX3232 chip easily.

- **PDA160160 LCD as the display device**
Fig. 2 Samsung SC344B0X ARM processor.

Fig. 3 AMD AM29LV160 FLASH

Fig. 4 Siemens TC35 Arduino
Communication modules-

1) Bluetooth Wireless Communication-
   • Within a range of 20 meters, it offers outstanding features such as agility, low-cost and flexibility.
   • nRf9O3 chip is used for bluetooth communication between meters and the intelligent terminal.

2) GSM Wireless Communication-
   • Has very wide coverage around the world.
   • The management centre and the intelligent terminals form star model network via GSM.
   • The management centre broadcasts the acquisition signal and operation commands to the intelligent terminals.
   • Siemens TC35 GSM module has been used for communication between intelligent terminals and the management centre.
Fig. 6 Block diagram of the intelligent terminal
System management:
1) **Remote Automatic Meter-reading**-
   - The communication structure of management computer and the intelligent terminals is one host and multi-slave.
   - Commands are sent from the management computer according to the address of the intelligent terminal. The corresponding terminal then transmits its data to the management computer.
   - The management computer sends meter-reading command (asking frame) according to the address of the intelligent terminal.
   - The intelligent terminal compares the address in the asking frame with its own. If there’s a match, it transmits data to the management computer.

2) **Database Management**-
   - SQL Server 2000 is the background database.

3) **Resident Seeking**-
   - The resident could find data about utility usage on a particular day or for any given week.

4) **Remote Monitoring**-
   - Designed to control energy consuming devices at a residence.
   - Data about remote monitoring and malfunction information will recorded in the database for future reference.
Actual implementation:
The AMR/AMI system-

Fig. 7 The AMR/AMI system structure
Conclusion-

The system has many significant excellences, such as:

- Accurate meter reading, no more estimates.
- Improved security and tamper detection for equipment.
- Energy management through profile data graphs.
- Less accrued expenditure.
- Less financial burden correcting mistakes.
- Improved billing and tracking of usage.
- Power outages may be restored faster with greater meter communication capabilities.
References-

