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Automated LPG Billing and Security System Using Wireless Sensor Networks

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Abstract

Wireless Sensor Networks are networks consisting of sensors as their main components. Sensors are arranged and connected with each other dynamically. We are implementing a system which can remotely monitor and control the LPG supply. It also provides in built facility of LPG billing. The readings of LPG meter can be check in regular manner at gas billing officer wirelessly This can be achieved by the use of microprocessor unit that continuously monitors and records the LPG flow Meter readings in its permanent (non-volatile) memory location. For wireless communication we are Xbee.

Keywords - Xbee, WSN, LPG, LCD, VB, GUI

Introductions

Gas and electricity are essential to keep your life running smoothly, safely and efficiently. When your service is interrupted or in need of repair, you expect a reasonable and timely response. [7]

The Automatic meter reading system uses innovative technology to read gas meters remotely, in addition to being the first system in the world to utilize gas pipelines to transmit the radio frequency data.

LPG cylinders are stored in a cylinders bank at the ground level and the regulators are installed in all the apartments. The system has multiple pressure regulation stages to supply LPG to user at low pressure and to make the system safer. This system is compatible to piped natural gas after the availability of natural gas in respective cities.

This system will monitor the uses of the gas and it display on the LCD screen. When billing has to be done it is send on the customer and particular user will send back reply to the office about it uses.

At the office, it will calculate by the program automatically. And calculated bill and due date will be send to the user and display on the LCD.

When any user will not pay bill then his/her gas supply will get cut off

WSN structure

Recent advances in integrated circuits manufacturing technology in one hand and expansion of wireless communication technology in other hand caused to designing of wireless sensor/actuator networks (WSAN). The basic difference of these networks is their connection to environment and physical phenomena. Traditional networks provide the relation between humans and data bases, while sensor/actuator network is connected with physical world directly. By using sensors, this network senses physical environment and decides based on its observations and performs suitable operations. By attention to sensor's collected data, WSN performs special operations for environment controlling, by using actuators. Unlike traditional networks which are general purpose, sensor/actuator networks are single purpose typically. While the nodes can to be mobile, network can be considered as a group of small robots which work with each other as a team and they are designed for a special purpose such as playing football or combat with enemy. In other sight, if we remove base stations in mobile cellular phone network and suppose that every receiver is as a node, the connection between nodes must be confirmed directly or via one or several nodes. This is a type of wireless sensor/actuator network by itself. Although, the history of WSAN returns to cold war era and its first idea regards to military designers of American Defense Industries, but this idea could be formed in mind of independent mobile robots designers or even mobile wireless networks designers too. Vast usage of this network and its relation with deferent subjects of computer and electronic such as network security, real time connection, video and voice processing, data mining, robotic, automatic designing of digital embedded systems, control and etc. has provided a wide area for researchers with different interests.[5]

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Figure:

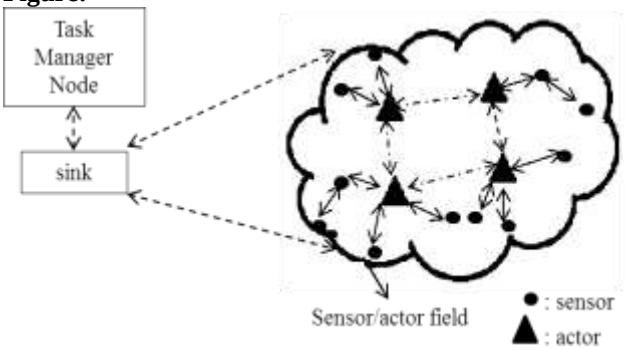

Figure 1. Sensor/Actuator network basic structure

WSAN are including sensors and actuators with very low power consumption that are connecting with each other by radio waves [4][5][7]. Specially, one node may be only a sensor or only an actuator. Nodes in high density are distributed in one region which is termed sensing/actuating area. A sink monitors whole of the network permanence. Information is collected by sink and also the commands distribute in network through it. Management in WSAN can be centralized or distributed. These are two automatic and semiautomatic different structures related to decision making level. We can use their combination too. [1][2]

A. Automatic structrure

The sensors which identify an event send the sensed data to actuator nodes for processing and suitable reacting. Basically, the adjacent actuator nodes decide and act appropriately. In fact, there is no any centralized control and decisions take place locally. Figure 2 shows WSAN automatic structure.[5]

Figure:

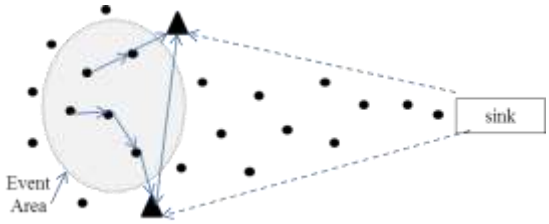

Figure 2. WSAN automatic structure

B. Semiautomatic structure

In this structure, data are forwarded to the sink by nodes and sink sends commands to the actuator nodes. Figure 3shows Semiautomatic structure.[5]

Figure:

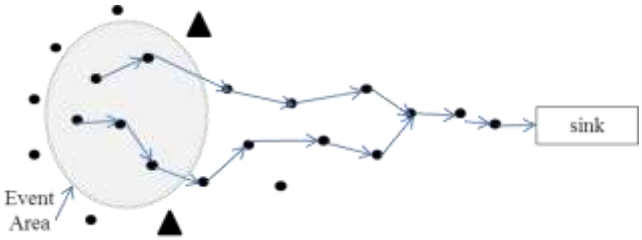

Figure 3. Wsan semiautomatic structure

In other hand, in special application, it may use cellular or clustering structure that there is a cluster-head in each section that it collects its nodes information and sends to the sink. In fact, each cluster-head works like a gateway.[5]

System block diagram

Figure:

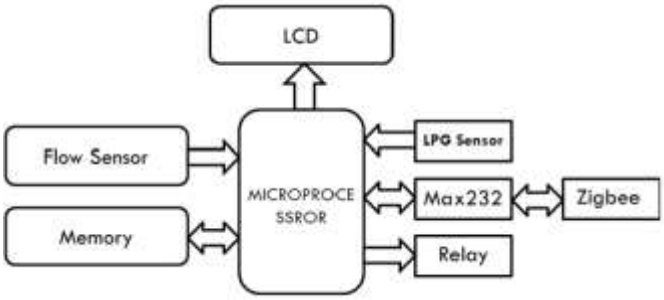

Figure 4.block diagram of module 1 present at house

Figure:

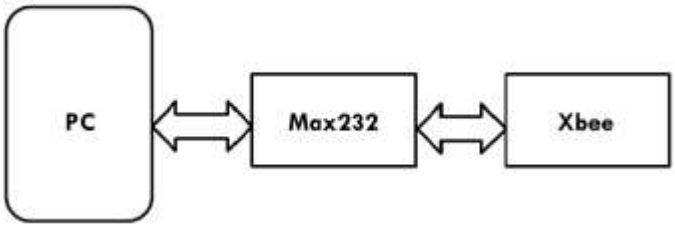

Figure 5.block diagram of module 2 present at billing office

1. Microcontroller: It is used for processing the signals coming from different sensors and computing the controlling action according to the signals. For this purpose ARM processor (2148). This is based on a 32 or a 16 bit ARM7 TDMI CPU with real time emulation

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& embedded trace support that combines the microcontroller with memory interface & unique accelerator architecture enable 32 bit code execution at the maximum clock rate.

2. Flow sensor (HLC001): This is a device for sensing the rate of fluid flow. Flow sensor works on principle of "Hall Effect". A Hall Effect sensor is a device that detects the presence of magnetic field. It states that when current is passed through the conductor and same conductor is placed in a magnetic field normal to the current flow then hall voltage is generated normal to both the current & magnetic field.
3. LPG Sensor (MQ-06): If this sensor senses any gas leakage from storage the output becomes low. This low signal is monitored by the microcontroller & it will identify the LPG leakage.
4. ZIGBEE: It meets the standard of ieee802.15.4. For wireless communication it is a good option. It is used because it is a low cost, low input power wireless sensor networks. It operates within the ISM2.4GHz frequency band & pin for pin compati1ble with each other.
5. MAX 232: This IC is used to convert the TTL/CMOS logic levels to RS 232 logic levels during serial communication of microcontroller with PC. It operates at TTL logic level(0-5V) whereas serial communication in PC works on RS232 standards. It is a dual drivers/receivers that includes a capacity voltage generator to supply RS232 voltage level from single 5V supply
6. LCD: It is used for displaying usage of LPG.
7. Relay: We can use general purpose relay. When energized the metal in the center of the coil becomes magnetic And draws the floating metal towards it. This in turn causes multiple contacts to make and break.
8. Memory: It is used to store data. EEPROM memory is more suitable for this application because it is rewritable and erasable.

Proposed model

At House:

The Microcontroller based system continuously records the readings and calculate the units consumed or usages of the gas on that particular day. According to usages per unit cost the total unit consumed and its total cost will be continuously display on the LCD and the live meter reading can be sent to the LPG gas billing department on request form billing office with help of Xbee. This system also can be used to disconnect the gas supply to the house in case of non-payment of LPG gas bills.[6]

Person will get his total bill amount after 1 month in his home and will give indication that bill amount has come , show message send by LPG gas office that 'pay --- amount before due date'. If user will not pay the amount before its due date then they will disconnect LPG gas supply of that house.[5][6]

At Billing Office:

When they want to dispatch the bill to people, they will just request then our system through one specific id via xbee.

System will back reply the unit consumed to the office. At the office side, bill will be automatically generated using programming application and send back to that particular person. After that person will get intimation of reception of bill, due date on his LCD.[7]

Figure:

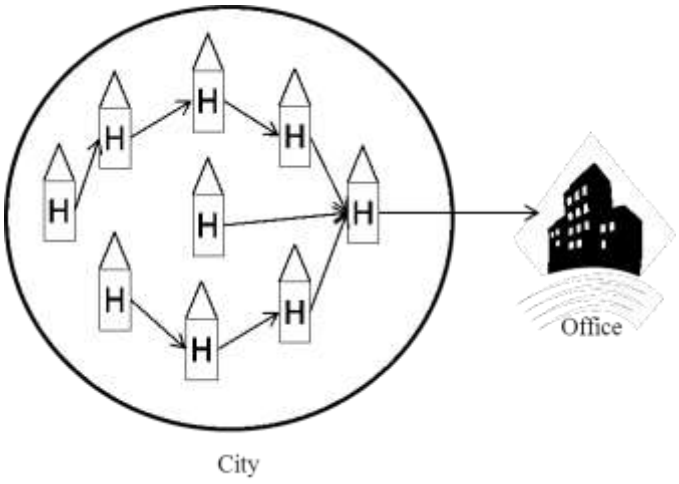

Figure 6. Proposed model

Algorithm

1) Start
2) Initialize all the devices
3) Read the input from LPG gas sensor
4) If in case there is any leakage.
   - If yes turn on exhaust fan, turn off the valve
   - If no read the LPG sensor
5) Check any input from flow sensor
   - If yes display the usages as unit on LCD
   - If no go to step 3
6) Check if any data on serial port
   - If yes, check if any request from office for usages to calculate the bill or command to turn off/on solenoid valve, the gas supply or bill amount /due date from the office

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- If no go to step 3.

Flow of working

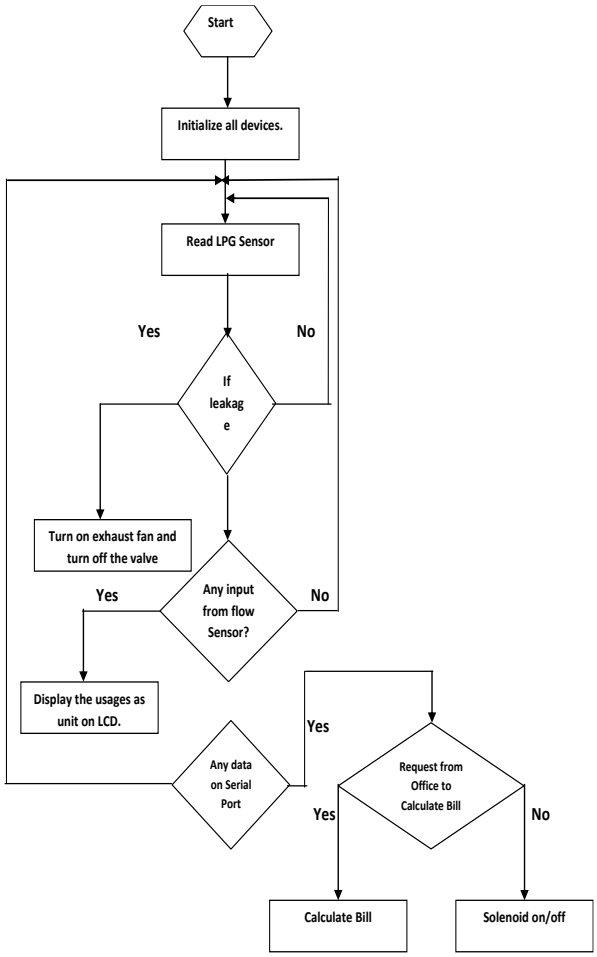

Figure 7. Flow of workking model

Result obtained

We are using Graphical User Interface to display result. That is designed in VB. The simulation is performed using software by which virtually we can verify the result.
Fig. 8 Shows the simulation result of LCD interface.
Fig. 9 Shows the GUI of system.
Fig. 10 Shows Database created at billing office for documentation.

Figure 9: gui for displaying usag, bill & status

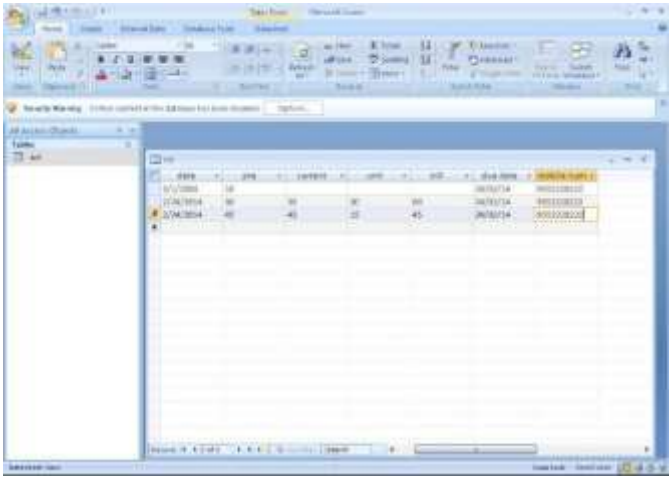

Figure 10: database for billing office

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