

Design of Wireless Sensor Network Based Smart Generator Switching and Fuel Monitoring System

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Abstract— The rapid progress in the field of wireless communication and embedded systems has made wireless sensor networks (WSN) technology. A WSN consists of many cheaper and smaller wireless sensors, which are capable of collecting and processing environmental information, and communicating with neighboring nodes in the wireless medium. In this paper, we propose an architecture for monitoring of fuel level and switching of smart generator using wireless sensor network (WSN) technology. For establishment of WSN technology, ZigBee/IEEE 802.15.4 protocols[1] are used. In the proposed model, whole system is divided in to two units first is communication unit and second is sensor unit. The communication unit consists of mainly one pair of zigbee S2 modules to provide a wireless communication and the sensor unit consists of mainly ATMEGA328P microcontroller, ultrasonic sensor, LCD display and a buzzer. The proposed model based on WSN technology has many of the advantages such as Low-power consumption, Huge network capacity, high reliability, low cost etc. [2]-[7].

Key words: Fuel Monitoring System, Wireless Sensor Network

I. INTRODUCTION

In base paper[2] it was mentioned that in the earlier time, sensors are connected by dedicated wires. With the development of ad hoc networking technologies, tiny sensors can communicate through wireless medium [2] in a more convenient manner. Technologies for wireless local area networks or Personal Area Networks like IEEE 802.15.4 can, in principle, be used as a replacement for wired links [3,4]. There are many alternative ways of wireless links[2] such as GSM, GPRS, WiMAX. Recently, WSNs have been recognized as a promising technology that can enhance various aspects required for better wireless communication between end devices. Wireless sensor networks (WSNs) are a family of wireless network consisting of spadally distributed autonomous devices physical or environmental conditions at different locations. The main purpose of Wireless Sensor Networks is to collect and process environmental Information and communicating them to the observer through the wireless links.

The Wireless Sensor network nodes have low power consumption because of having small size, and carry limited electrical energy usually, and have wide distribution in the complex environment. Wireless sensor networks require the network to accommodate ten thousands or even some thousands of nodes hence it has large network capacity. The distance between two of the sensor nodes is usually between tens to hundreds of meters for its better performance. Sensor networks are usually transmitted information periodically, such as temperature, humidity, and other sensor data. The amount of data is small, and the

frequency of data collection is low[5]. The sensor network must have dynamic network functions because environmental interference and energy depletion may lead to node failures. The sensor network is located in the complex geographical environment[6].

II. EXISTING MODEL

As mentioned in base paper[2], the existing model is Wireless Power Monitoring system Using GSM Technology. The basic architecture and hardware arrangement is shown in below figure 1 and 2.

The power monitoring modules were used to monitor the power consumed by different loads using GSM technology. The GSM communication module was implemented using 8051 microcontroller with the GSM module. The DAC output is connected to the ADC of the 8051 microcontroller. The 8051 was programmed to sample the ADC channels to measure the DAC's output voltage. The GSM module sends this measured power to the another GSM module ,connected with a computer system at the grid end[2].

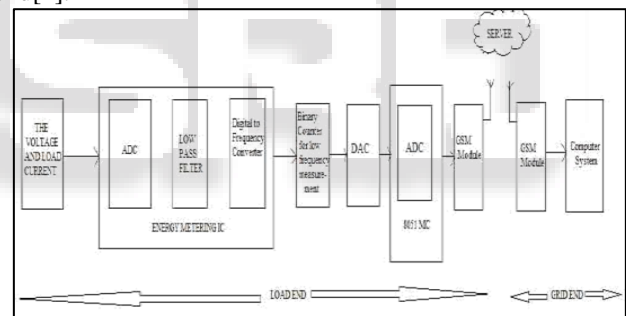


Fig. 1: Basic architecture of existing model

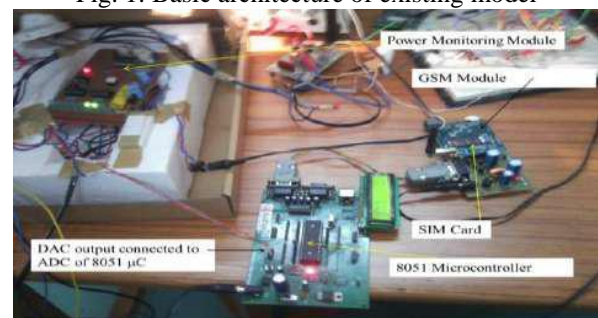


Fig. 2: Hardware arrangement of existing model.

III. PROBLEM IDENTIFICATION

In many referances[2-7] , it was mentioned that in order to establishment of WSN there are a wide range of topologies available .In the base paper[2], an application of WSN technology are described. The GSM communication model was implemented using 8051 microcontroller with the GSM module. And there is a separate DAC required which leads circuit complexity, power consumption as well as circuit

delay problems. In order to resolve above issues, In this paper, we propose an architecture for another application of WSN technology that is monitoring of fuel level and switching of smart generator using ATMEGA328 microcontroller and ZigBee module[7] as explained in next section.

IV. PROPOSED MODEL

The proposed model is “Design of Wireless Sensor Network based Smart Generator Switching And Fuel Monitoring System”. Under this model, the fuel monitoring and generator switching is performed automatically by using ATMEGA328P Microcontroller and zigbee module. The basic block diagram of proposed model is shown in below figure 1.

This project model includes mainly two circuits circuit-1 and circuit-2. Circuit-1 is established at admin side and circuit-2 is located at power generator side. A ATMEGA328P microcontroller with zigbee module is used in both circuits. Here, buzzer is used to indicate the fuel level used in generator when it becomes lesser than a reference threshold level. And a LCD display is used to display the value of fuel level remaining in the generator. Two Zigbee series 2 modules are used to establish wireless connection between circuit-1 and circuit-2. Now, a fuel level detector is used at the power generator end which continuously check the level of fuel used in generator. The output voltage of level detector corresponding to the actual fuel level in the generator is compared with a reference voltage V_t corresponding to a critical level of fuel through an op-amp comparator. When actual level is lesser than a predefined critical level then an indicating signal is sent by microcontroller used in circuit-2 to microcontroller used in circuit-1 through zigbee modules. And buzzer starts to raise up as well as the value of fuel level is also shown in the LCD display. The microcontroller in circuit-1 continuously senses the availability of mains. When mains is not available then microcontroller at generator side operates the relay switch to switch ON the power generator in order to provide power supply to the admin. And similarly, when mains is again available then the generator will be switched off via signal produced by microcontroller in circuit-2.

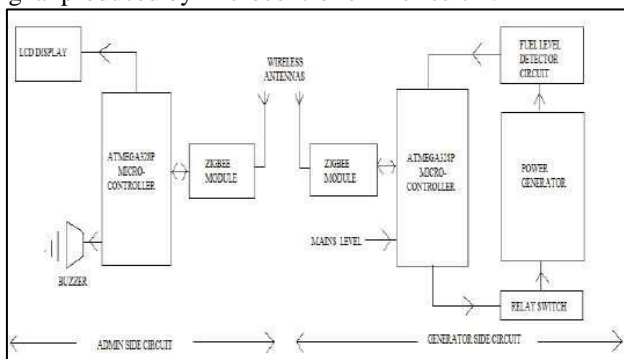


Fig. 3: Block Diagram of Proposed Model

V. HARDWARE-SOFTWARE CO-DESIGN SIMULATION AND RESULTS

The simulations done with the Proteus software are very motivating as it gives the confidence of correction of our circuit building and programming concepts. Following figure is showing simulation setup for proposed model.

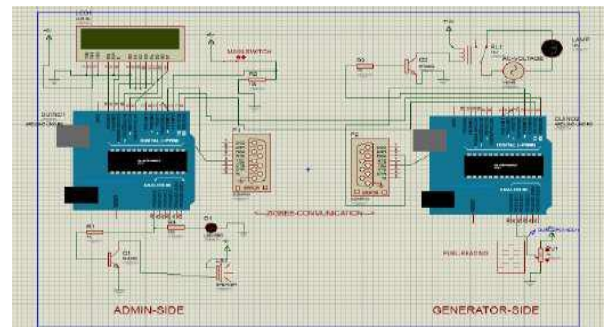


Fig. 4: simulation setup for proposed model

A. When mains is available the relay switch at the generator end is open and generator is switched off as shown in below figure

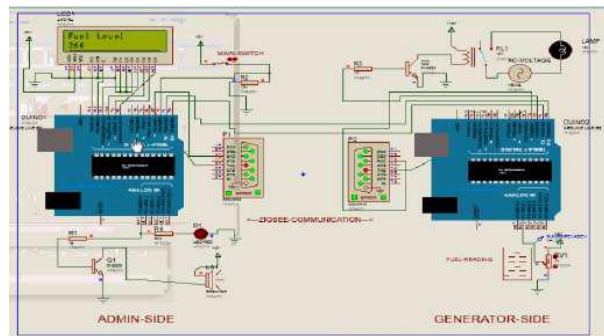


Fig. 5: When Mains is available, Relay Switch is open.

B. When mains is not available then relay switch at the generator side is closed as shown in below figure

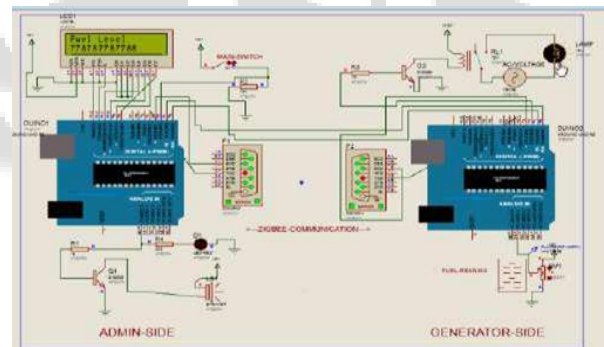


Fig. 6: When Mains is not available, Relay Switch is close.

C. When the fuel level detected by fuel level detector is greater than the reference level L_1 then this reading is shown by LCD display at the admin side as shown in below figure

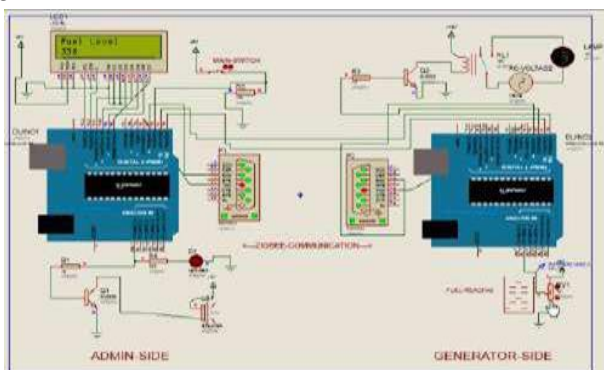


Fig. 7: When fuel level is greater than L_1 , alarm is not beep.

D. When the fuel level detected by fuel level detector is equal to the reference level L_1 then this reading is shown by

LCD display as well as alarm starts buzzing at the admin side as shown in below figure

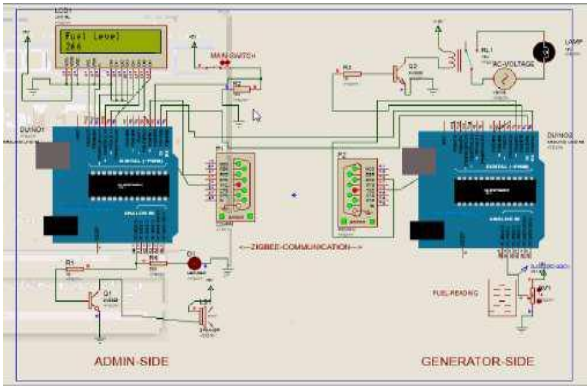


Fig. 8: When fuel level is equal to L1, alarm starts beeping. A simple comparison table shows in following figure which shows the comparison of proposed model with existed model[2].

| Sr. No. | EXISTING MODEL | PROPOSED MODEL |
|---------|---|---|
| 1. | 8051 microcontroller was used. | ATMEGA328P microcontroller is used. |
| 2. | There are required interfacing devices in this model. | There are not required interfacing devices in this model. |
| 3. | In this model, DAC is used externally. | In this model, DAC is not externally used because it is inbuilt in ATMEGA328P. |
| 4. | Circuit complexity is high. | Circuit complexity is low. |
| 5. | Circuit size is larger. | Circuit size is smaller. |
| 6. | Power consumption is high. Active Mode-0.5mA. | Power consumption is low. Active Mode-0.75uA. |
| 7. | Total circuit delay is more clock cycle time at serial port is 1us. | Total circuit delay is less clock cycle time at serial port is 0.45us. |
| 8. | Overall operational speed is 3.5-12MHz. | Overall operational speed is 0-20 MHz. |
| 9. | It is design for power monitoring using WSN technology. | It is design for fuel monitoring and switching of power generator using WSN technology. |

Fig. 3: Comparison Table between Existed Model and Proposed Model

VI. CONCLUSION

This paper introduces an architecture for the wireless sensor network based smart generator switching and fuel monitoring system. It helps in home automation applications like power generator automation. The design presents a switching and fuel monitoring system which consists of mainly two module circuits. One circuit can be installed at the admin side and other circuit can be installed at generator side. The key idea incorporated in the switching of generator corresponding to the availability of mains supply and monitoring of fuel level and provides a visual as well as a sound indication.

Now, we are confident that in coming years our project if used in proper and in efficient direction will become a boon and serve the mankind.

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