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Wireless Microcontroller Based Mutlidrop System

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Abstract:
In our daily life, Wireless based industrial automation is a prime concern. The field of approach to Zigbee Based Wireless Network for Industrial Applications has been standardized now a days. A wireless control and monitoring system for a industrial machines realized using the Zigbee communication protocol for safe and economic data communication in industrial fields where the wired communication is either more expensive or impossible due to physical conditions. The machines can be controlled wireless due to the microcontroller interface developed with Zigbee. It is also possible to protect the machines against some critical conditions such as change in temperature, humidity, light, pressure etc. so controlling, monitoring, and protection of the system are realized in real time. So the wireless communication technology is used in this paper, controlling abilities of the system are increased and also hardware and the necessities of other similar equipment for data communication are minimized.
We concerns with designing and implementing the system which can be utilized effectively to reduce human efforts and accuracy of measurement of data. The main work behind this is to make instrumentation system more power full by enabling it modern communication technologies. Here we are using different sensors like temperature and humidity to measure surrounding temperature and humidity. LCD is used to display current and set parameters. The total controlling action done by microcontroller, which is heart of the system and for wireless data transmission Zigbee module is used.

Keywords: *Microcontrollrer, ADC, ZigBee, Tempreture and humidity sensor*

1. Introduction

Wireless sensor network technology has demonstrated a great potential for industrial, commercial, and consumer applications. Specifically, in process monitoring and control, process data, such as pressure, humidity, temperature, flow, level, viscosity, density and vibration intensity measurements can be collected through sensing units and transferred wirelessly to a control system for operation and management. Adopting WSNs for process monitoring and control provides great advantages over traditional wired system. As a ubiquitous technology, general issues regarding WSNs have been extensively researched in the academic arena. However, WSN technology is not considered mature enough to be widely implemented in process control applications. Even though wireless transmission of data has been utilized for over ten years in process control applications such as supervisory control and data acquisition (SCADA), industrial WSN products for process monitoring and control are not commercially available until recently due to its specific requirements and challenges.

This paper presents a comparison of different configurations of a wireless sensor system for capturing various physical parameters. The systems consist of sensor elements which wirelessly transfers values of parameter data to a multiple trans-receiver element. The sensor elements consist of a microcontroller, sensor(s) and a radio transceiver. The receiver element consists of a Zigbee connected through a microcontroller to other ZigBee modules for real time data acquisition. The wireless transmission between the sensor elements and the receiver element is based on the low rate IEEE 802.15.4/ZigBee (XBEE) standard. Configurations with number of sensors are connected by wire to a wireless sensor element. The study shows that it would be feasible to connect 3 sensors in the given setups. The proposed system consisting of interface with various sensors and process carried out at various locations, which will be monitored by a wireless network and also it shares all the data with each other, which helps us to monitor all the data regarding various operations within the wireless network at any of the wireless network module.The proposed system is using three Zigbee module connected with a microcontroller based hardware, to monitor and control physical parameters such as temperature, humidity, flow, etc. and share all the monitored data with each other.

Heater, fan, LEDs are used to indication when process variables exceed preset levels. Security and privacy are important in the industrial automation. Reliability is an important factor where some measurable difference in implementation is required. Industrial

wired networks are generally expected to deliver power to each node, as well as to carry the network signals. In many process plants, the network is also expected to be intrinsically safe, meaning that a cable break will not cause flammable gases to ignite. Wireless networks definitely have the advantage of not using wire and are inherently safe.

2. Microcontroller Based System Design

The AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 4K bytes of Flash programmable and with the industry-standard MCS-51 instruction set and pinout. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications. Erasable read only memory (PEROM). The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible.

2.1. Zigbee Sensor Network

Various wireless standards have been established. Among them, the standards for wireless LAN, IEEE 802.11b ("WiFi") (IEEE, 1999b) and wireless PAN, IEEE 802.15.1 (Bluetooth) (IEEE, 2002) and IEEE 802.15.4 (ZigBee) (IEEE, 2003), are used more widely for measurement and automation applications. All these standards use the instrumentation, scientific and medical (ISM) radio bands, including the sub-GHz bands of 902–928MHz (US), 868–870MHz (Europe), 433.05–434.79MHz (US and Europe) and 314–316MHz (Japan) and the GHz bands of 2.400–2.4835 GHz (worldwide acceptable). In general, a lower frequency allows a longer transmission range and a stronger capability to penetrate through walls and glass. However, due to the fact that radio waves with lower frequencies are easier to be more easily absorbed by various materials, such as water and trees, and that radio
waves with higher frequencies are easier to scatter, effective transmission distance for signals carried by a high frequency radio wave may not necessarily be shorter than that by a lower frequency carrier at the same power rating. The 2.4 GHz band has a wider bandwidth that allows more channels and frequency hopping and permits compact antennas. [1]
Wireless LAN (IEEE 802.11) is a flexible data communication protocol implemented to extend or substitute for a wired local area network, such as Ethernet. The bandwidth of 802.11b is 11 Mbits and it operates at 2.4 GHz frequency. Bluetooth (IEEE 802.15.1) is a wireless protocol that is used for short-range communication. It uses the 2.4 GHz, 915 and 868MHz radio bands to communicate at 1 Mbit between up to eight devices. The Bluetooth is considered a cable replacement for mobile devices. It is mainly designed to maximize the ad hoc networking functionality. Figure 1 shows the ZigBee Pro module having 20 pins.[1]

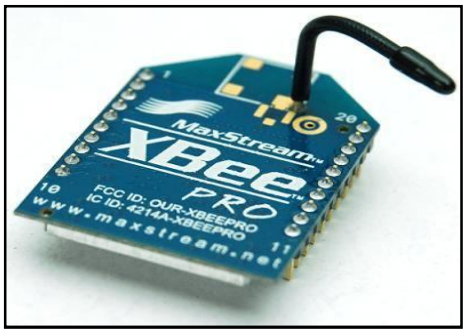

Figure 1: XBee Module

The IEEE 802.15.4 standard is a physical radio specification providing for low data rate connectivity among relatively simple devices that consume minimal power and typically connect over short distances. It is ideal for monitoring, control, automation, sensing and tracking applications for the home, medical and industrial environments. Features of IEEE 802.15.4 devices include:

- 868MHz band, 1 channel, 20 kbps;
- 915MHz ISM band, 10 channels, 40 kbps;
- 2.4 GHz ISM band, 16 channels, 250 kbps;
- connecting up to 255 devices per network;
- full protocol for transfer reliability;
- Power management to ensure low power consumption.

2.2. ZigBee module with 89C51 Microcontroller

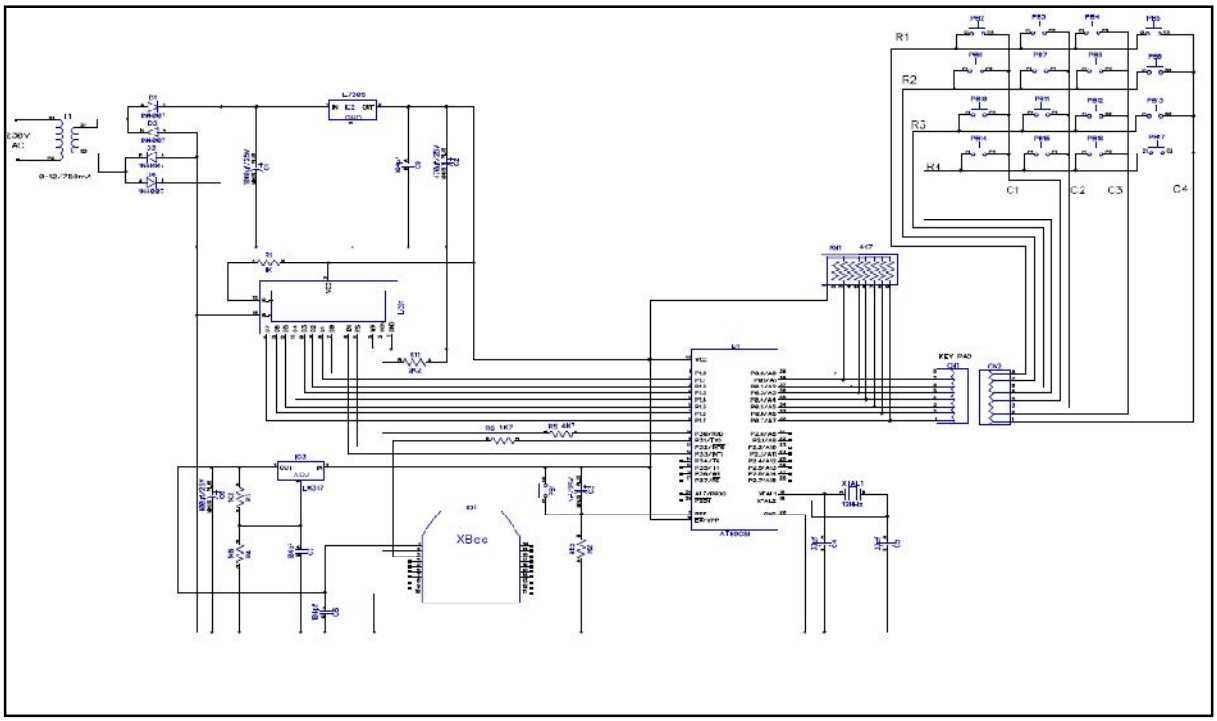

Figure 2: XBee Module with 89C51 Master Microcontroller

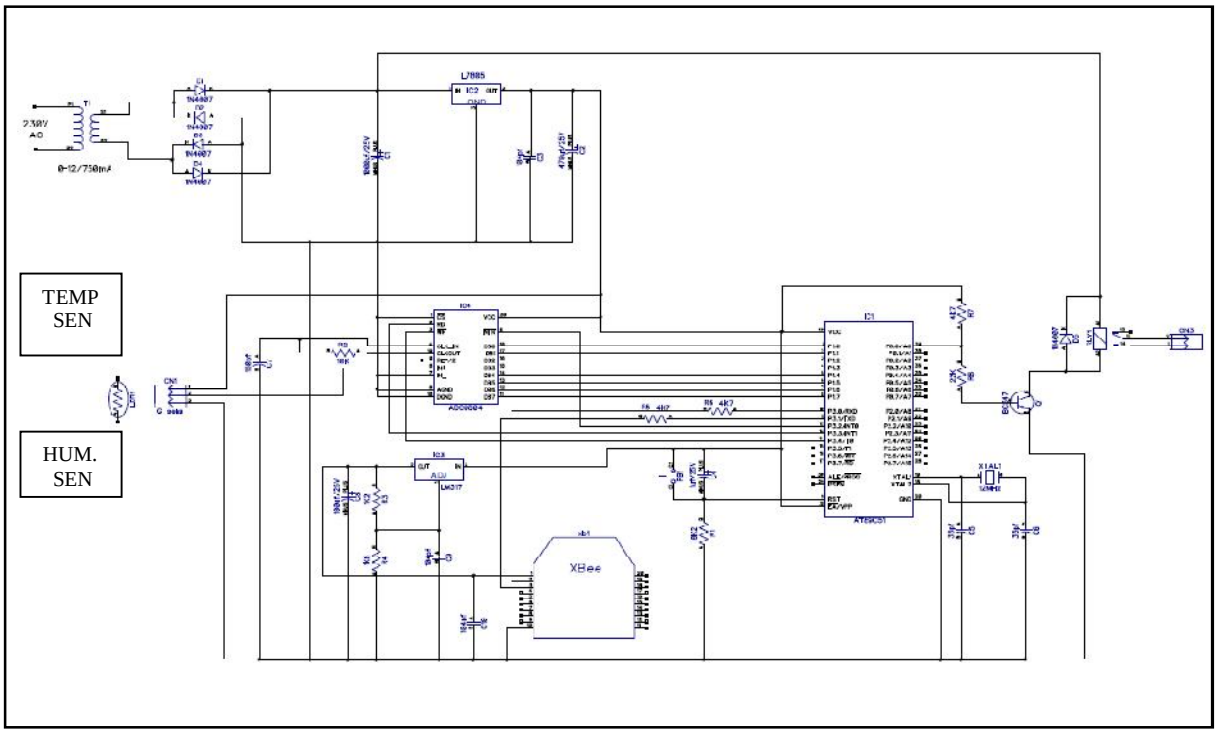

Figure 3: XBee Module with 89C51 Slave Microcontroller

2.3. Temperature Sensor

The LM 35 is integrated circuit sensor that can be used to measure temperature with an electrical output proportional to temperature (in ^{o}C). The LM 35 generates a higher output voltage than other temperature sensors like thermocouples,RTD, thermistor. For LM 35, the scale factor is 0.01V/ ^{o}C meaning the nominal output voltage is 250mV at 25 ^{o}C and 1.000V at 100 ^{o}C.

The most important characteristics of LM35 is that it drawn only 60µA from its supply and produce low self heating capability.

2.4. Humidity Sensor

Humidity gives the amount of water in the air. Relative Humidity is the ratio actual vapor pressure to saturation vapor pressure. Humidity sensors represent humidity in two types; Relative humidity (RH) and absolute humidity (AH). Relative humidity is amount of water content in air measured in percentage. Absolute sensor is the amount of water content in air measured in unit volume of air.
In this system, RHI-112A humidity sensor is used to measure relative humidity. This sensor converts relative humidity to voltage. The range of relative humidity is 10 percent to 100 percent RH. RHI-112A is a capacitive type sensor. It includes 3 pins B, W and R as shown in Figure 4 Pin B is ground, pin W is output and R is supply pin. It has a following specification.

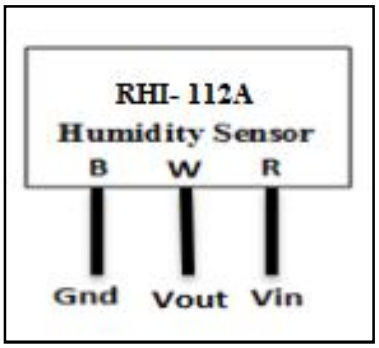

Figure 4: Humidity Sensor RHI-112A

- Rated voltage is DC 3.15 to 5.5V,
- Current consumption is less than 0.5 mA to 0.75 mA.
- Operating temperature range is 0-60 ^{o}C.
- Operating humidity range is 10% to 100%.
- Storable temperature range is from -20 ^{o}C to 70 ^{o}C .
- Standard output range is DC 0.15V to 3.3V (at 10 ^{o}C to 25 ^{o}C, 60%RH).
- Accuracy is+/- 3% RH (at 25 ^{o}C, 50%RH).

3. Master and Slave System

Figure 3 shows the block diagram of Master and Slave of the controller based system.

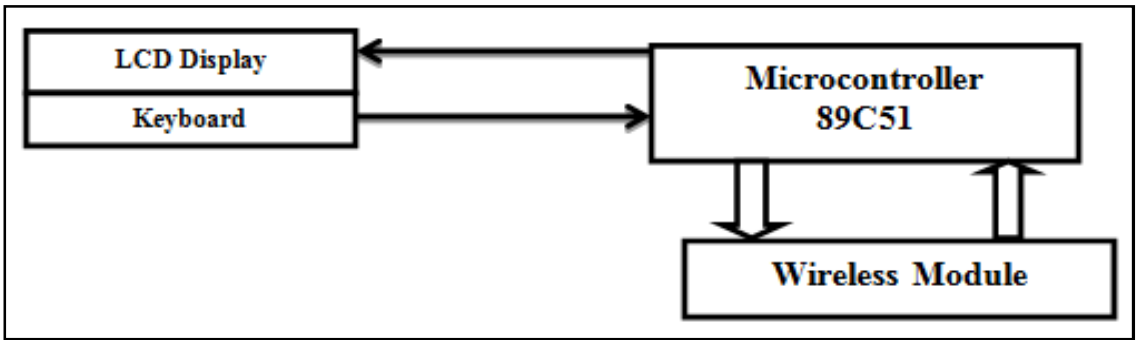

Figure 5: Master Section

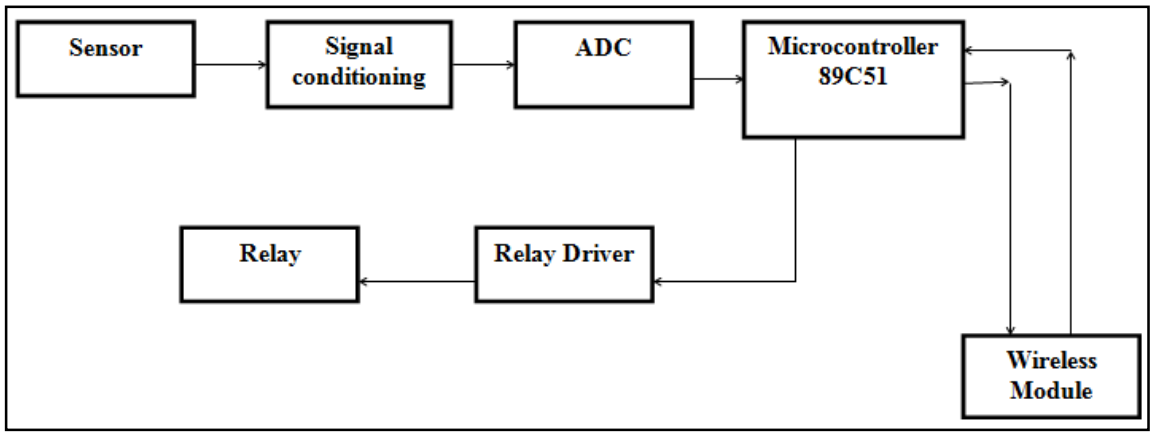

Figure 6: Slave Section

The Slave section is deployes inside the industry with instruments and sensors are connected to the microcontroller. Set point is given in master only through keypad and display is also interfaced to display the measured parameter and set parameter values i.e temprature and humidity. Facility of enabling /disabling a slave will be in master microcontroller based system. For present case MASTER will ask slave to take ON/OFF controlling action. Full control will be in master micro controller.

The fig.6 SLAVE block diagram. Sensors analog output is fed to the signal conditioning block (SBC). Sensors are used for temperature LM 35 and humidity RHI-112A sensor is used. SBC will amplify the signal and fed it to ADC. Analog to digital converter will provide digital data to microcontroller. Intelligent microcontroller will calibrate the incoming data and send data information to MASTER microcontroller when the same is ask for.

Switching on the power supply for the slave(s) and the master will start initialization of the peripherals attached to the individual units. Sign on message will be displayed on all the units. Set point for the process is given to the master by the user, through keyboard. Initially, Master is set in transmit mode and slave is set in receive mode. Mode of communication is 9-bit Asynchronous transfer mode. Whenever master wants to get information about parameter, it will output address of that particular slave. Address will be received by all the slaves. Each will analyze the address and compare the same with their unique address. If address matches, slave will change the mode from 9 bit to 8 bit. The same is true for the master. Selected slave will be ready for data communication. Remaining slaves will ignore the next commands. It will transmit parameter information to the master. To achieve this, slaves have to execute, internally, ADC routine for reading the status of the parameter. ADC count is also calibrated by the slave. Slave will terminate the communication by switching back to 9-bit serial mode. Thus master will communicate with each slave and gather parameter information. Finally, analysis is done at master end. Communication will be re-established for instructing slaves to switch control Element ON/OFF. Thus the result is expected in terms of controlling the parameter through the relay.

4. Conclusion

The paper present the wireless solution of wireless microcontroller based multi- drop system based on ZigBee technology and design the wireless nodes, network establishment and software system with the capability of self-organization, self-configurations, self-diagnosing, the ZigBee based monitoring and control unit system provide any unlimited installation flexibility of sources, increases network robustness and considerably reduce cost. It concludes that the wireless microcontroller based multi-drop system can be good solution for industrial maintaining and control.

5. References

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