Design & implementation of an efficient Embedded Sensor Network for Environment monitoring & Device Controlling

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***Abstract*—**Sensor networks which have also come up with various applications like surveillance, traffic control, environmental and wildlife monitoring, agricultural application, home automation and industrial process control. Embedded controlled sensor networks (ECSN) are mainly designed to be application- specific so that the energy consumption is minimum as the battery-powered nodes demand life-time of several months or even a few years. The architecture of a typical embedded controlled sensor network is embedded controlled sensor network the available technologies are Bluetooth, Wi-Fi, Wi-Max, wireless mobile Ad-hoc network (WMANET), UMB, wireless HART, Bluetooth and ZigBee. Embedded sensor networks are formed by communicating over wireless links without using a fixed networked infrastructure controlled by microcontroller. Zigbee is the name for a short-range, low-power, low-cost, and low-data-rate wireless multi-hop networking technology. Block diagram of ECSN consists of a master/ circuit which is connected to number of sub networks consisting of the various slaves. Master circuit is connected by a personal computer which can be controlled by the internet. Wireless technologies for environmental monitoring and device control in homes offers many benefits to the users.

***Keywords*- Embedded sensor networks, ARM9 LPC2929, Zigbee; GSM; Environment monitoring system.**

I. METHODOLOGY

Environment monitoring and device control allows new level of comfort in homes and it can also manage the energy consumption efficiently which in turns promotes the saving. Remote controlling [2] of the devices offers many advantages to senior citizens and people with disabilities which helps them in being more autonomous and increasing quality of life. In Addition to remote control, monitoring temperature, flood and carbon monoxide in homes is also a major concern. There is a severe need to monitor temperature or gases as they can be costly and deadly. A monitored low temperature sensor warns about freezing temperatures inside house. Also if the boiler, washer or pipes leaks in the home, it can cause considerable damage. Guangming Song (etc) [2] developed a wireless-controllable power outlet system. Researchers have worked on home

automation and environmental monitoring system in the past but in the existing systems cost is high, size is an issue and they are difficult to maintain the proposed system is cost effective and controlled by user friendly embedded systems. The block diagram of the proposed system is as shown in figure1. In this proposed system, we have designed one master module which consists of microcontroller, GSM module and Zigbee module. Three slave modules are designed using Sbit microcontroller and Zigbee module. Remote control circuit is designed to control the various devices of home for short distance communication.GSM module is used for long distance control of devices and monitoring of environment of home.

II. OVERVIEW OF THE SYSTEM

In this paper, we presented the wireless sensor networks (WSN) [1] to observe the human physiological signals by ZigBee, which is provided with lower power consumption, small volume, high expansion, stylization and two-way transmission, etc. ZigBee is generally used for home care, digital home control, industrial and security control. This paper developed a suite of home care sensor network system by ZigBee's characteristic, which is embedded sensors, such as the biosensor for observe heart rate and blood pressure. The biosensor transmits measured signals via ZigBee, and then sends to the remote wireless monitor for acquiring the observed human physiological signals. The remote wireless monitor is constructed of ZigBee and personal computer (PC). The measured signals send to the PC, which can be data collection. When the measured signals over the standard value, the personal computer sends Global System for Mobile Communication (GSM) short message to the manager. The manager can use the PC or personal digital assistant (PDA) to observe the observed human physiological signals in the remote place.

BLOCK DIAGRAM:

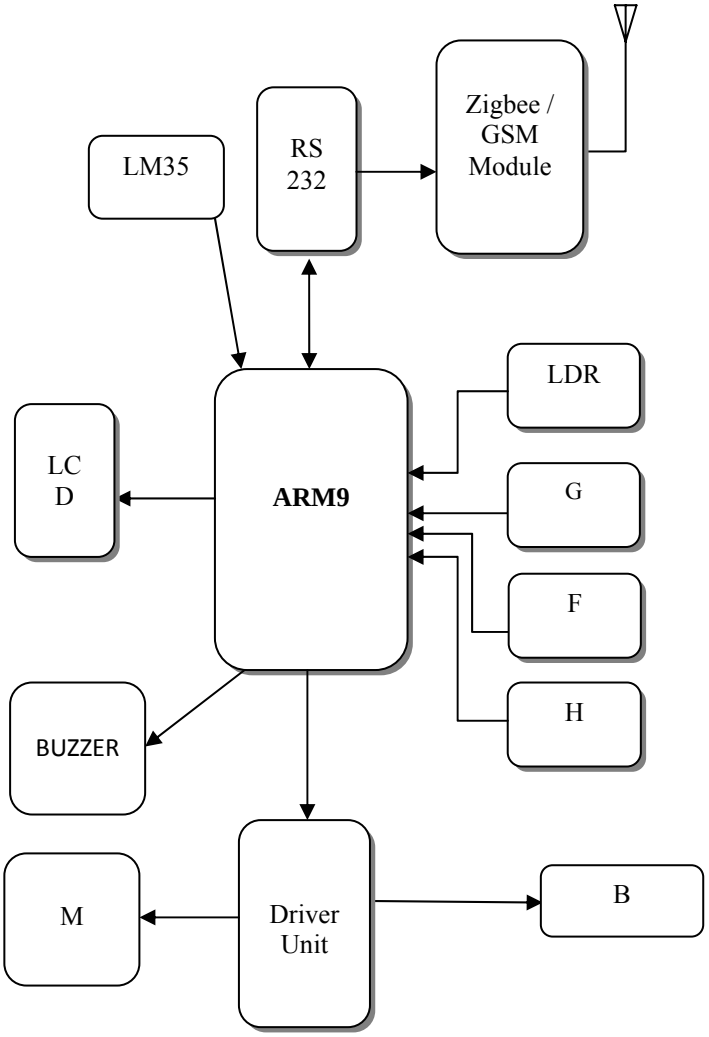

Figure-1: Embedded Sensor Network for Environment Monitoring & Device Controlling.

LM35- Temperature Sensor

LDR - Light Sensor

LCD - LCD Display

G - Gas Sensor

F - Fire Sensor

H - Humidity Sensor

B - Bulb

M -DC Motor

S.C- Serial communication

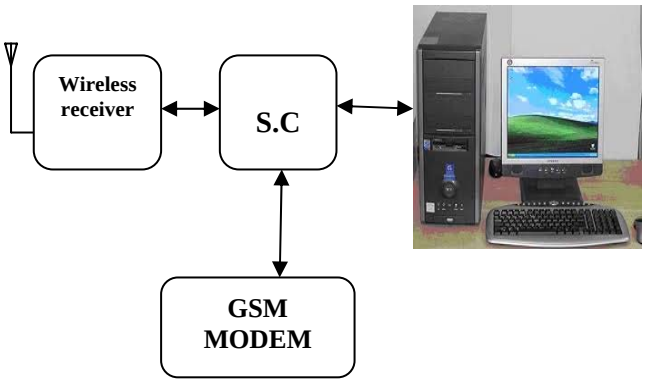

Figure 2: Block Diagram of Receiver Module

A. Temperature Sensor

The LM35 series are precision integrated-circuit temperature sensors [6], whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level.

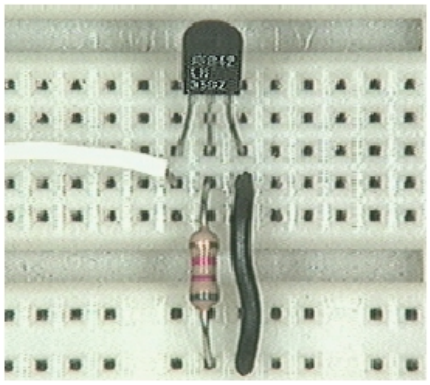

Fig 3 : Temperature sensor-LM35

The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range (−10° with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package. The exceed temperature can be controlled by switch 'on' the dc motor which can be served as Fan or Exhauster.

B. Humidity Sensor

The HIH-3610 Series humidity sensor is designed specifically for high volume OEM (Original Equipment Manufacturer) users. Direct input to a controller or other device is made possible by this sensor's linear voltage output. With a typical current draw of only 200 mA, the HIH-3610 Series is ideally suited for low drain, battery operated systems.

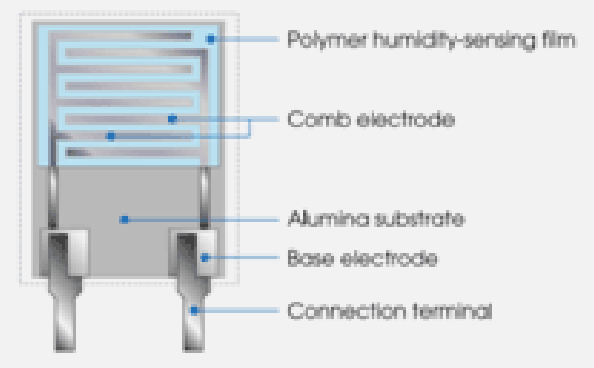

Figure.4: Humidity Sensor

Tight sensor interchange ability reduces or eliminates OEM production calibration costs. Individual sensor calibration data is available. The HIH-3610 Series delivers instrumentation-quality RH (Relative Humidity) sensing performance in a low cost, solderable SIP (Single In-line Package).

C. Gas Sensor

Ideal sensor for use to detect the presence of a dangerous LPG leak in your car or in a service station, storage tank environment. This unit can be easily incorporated into an alarm unit, to sound an alarm or give a visual indication of the LPG concentration. The sensor has excellent sensitivity combined with a quick response time. The sensor can also sense iso-butane, propane, LNG and cigarette smoke.

Applications

- Gas leak detection system
- Fire/Safety detection system
- Gas leak alarm
- Gas detector

Figure.5: Gas Sensor

Features

- High Sensitivity
- Detection Range: 100 - 10,000 ppm iso-butane propane
- Fast Response Time: <10s
- Heater Voltage: 5.0V
- Dimensions: 18mm Diameter, 17mm High excluding pins, Pins - 6mm High

D. Zigbee Module

The XBee/XBee-PRO RF Modules are designed to operate within the ZigBee protocol and support the unique needs of low-cost, low-power wireless sensor networks [5]. The modules require minimal power and provide reliable delivery of data between remote devices. The modules operate within the ISM 2.4 GHz frequency band and are compatible with the following:

- XBee RS-232 Adapter
- XBee RS-232 PH (Power Harvester) Adapter
- XBee RS-485 Adapter
- XBee Analog I/O Adapter
- XBee Digital I/O Adapter
- XBee Sensor Adapter
- XBee USB Adapter
- XStick
- Connect Port X Gateways
- XBee Wall Router.

The XBee/XBee-PRO ZB firmware release can be installed on XBee modules. This firmware is compatible with the ZigBee 2007 specification, while the ZNet 2.5 firmware is based on Ember's proprietary "designed for ZigBee" mesh stack (EmberZNet 2.5). ZB and ZNet 2.5 firmware are similar in nature, but not over-the-air compatible. Devices running ZNet 2.5 firmware cannot talk to devices running the ZB firmware.

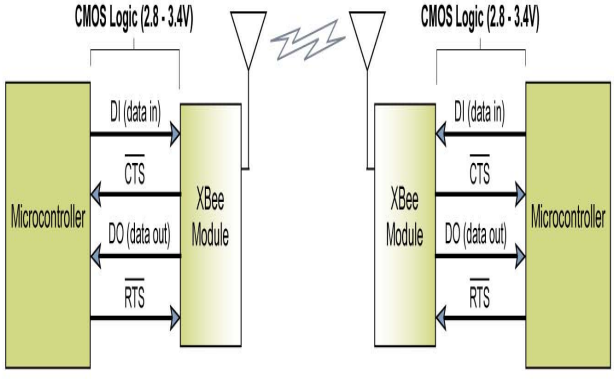

Fig 6: Zigbee Network

ARM9 LPC29229

The LPC29xx combine an 125 MHz ARM968E-S CPU core, Full Speed USB 2.0 OTG and device, CAN and LIN, up to 56 kB SRAM, up to 768 kB flash memory, external memory interface, two or three 10-bit ADCs, and multiple serial and parallel interfaces in a single chip targeted at consumer, industrial, medical, and communication. To optimize system power consumption, the LPC29xx has a very flexible Clock Generation Unit (CGU) that provides dynamic clock gating and scaling. Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. The ARM968E-S is based on the ARMv5TE five-stage pipeline architecture. Typically, in a three-stage pipeline architecture, while one instruction is being executed its successor is being decoded and a third instruction is being fetched from Memory. In the five-stage pipeline additional stages are added for memory access and Write-back cycles.

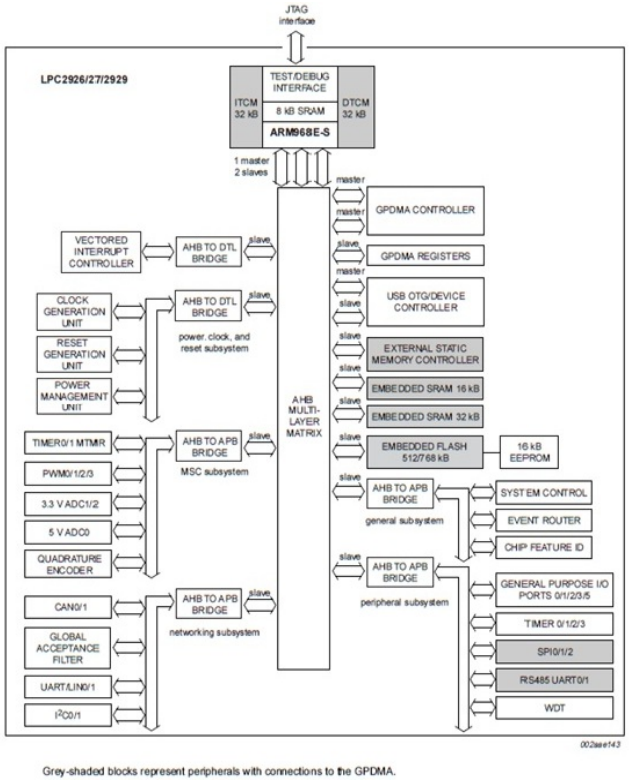

Fig 7: ARM9 LPC2929

The ARM968E-S processor also employs a unique architectural strategy known as THUMB, which makes it ideally suited to high-volume applications with memory Restrictions or to applications where code density is an issue. The key idea behind THUMB is that of a super-reduced instruction set. Essentially, the ARM968E-S processor has two instruction sets:

• Standard 32-bit ARMv5TE set

• 16-bit THUMB set

The THUMB set's 16-bit instruction length allows it to approach twice the density of Standard ARM code while retaining most of the ARM's performance advantage over a traditional 16-bit controller using 16-bit registers. This is possible because THUMB code operates on the same 32-bit register set as ARM code. THUMB code can provide up to 65 % of the code size of ARM, and 160 % of the performance of an equivalent ARM controller connected to a 16-bit memory system.

The ARM968E-S processor is described in detail in the ARM968E-S data sheet memory map. This is the address range for which code residing in that area is written. Each memory space remains permanently fixed in the same location, eliminating the need to have portions of the code designed to run in different address ranges. Because of the location of the exception-handler vectors on the ARM9 processor (at Addresses 0000 0000h through 0000 001Ch) By default, after reset, the embedded flash is mapped at address 0000 0000h to allow initial code to be executed and to perform the required initialization, which starts executing at 0000 0000h. The LPC29xx generates the appropriate bus-cycle abort exception if an access is attempted for an address that is in a reserved or unused address region or unassigned peripheral spaces. For these areas both attempted data accesses and instruction fetches generate an exception. Note that write-access addresses should be word-aligned in ARM code or half-word aligned in Thumb code. Byte-aligned writes are performed as word or half-word aligned writes without error signalling. Within the address space of an existing peripheral a data-abort exception is not generated in response to an access to an undefined address. Address

decoding within each peripheral is limited to that needed to distinguish defined registers within the peripheral itself. Details of address aliasing within a peripheral space are not defined in the LPC29xx documentation and are not a supported feature.

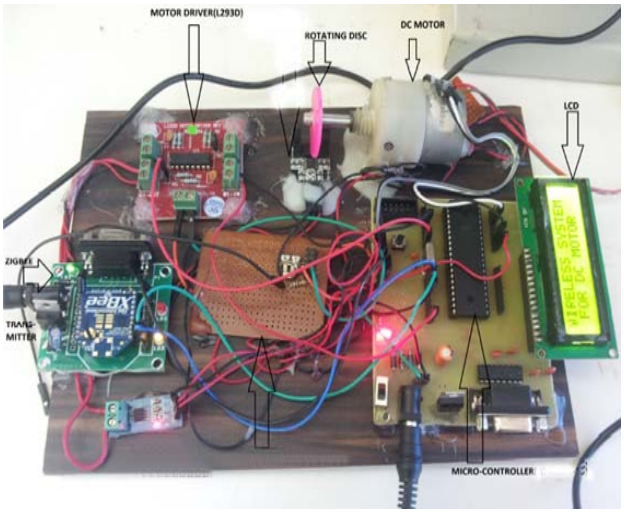

Figure 8: Hardware Implementation

III. CONCLUSION

This paper reports the design and development of embedded controlled sensor networks used for controlling the home devices as well as monitoring the environmental parameters with a smart wireless sensor network (WSN). Monitoring environment for various factors such as temperature and humidity along with other factors can be of significance. The ability to document and detail changes in parameters of interest has become increasingly valuable. Embedded controlled sensor networks have proven themselves to be a reliable solution in providing remote control and sensing for indoor environmental monitoring systems Investigations were performed for a remote monitoring system using Zigbee. These nodes send data wirelessly to a central server, which collects the data, stores it and allows it to be analyzed and displayed as needed.

References

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