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WSNs BASED NETWORK DENSITY ON THE OPTIMAL NUMBER OF CLUSTER USING ARM PROCESSOR

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Abstract
A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to *monitor* physicalor environmental conditions, suchas temperature, sound, pressure, PIR etc. and to cooperatively pass their data through the network to a main location. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

The WSN is built of "nodes" from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding.

Keywords: Zigbee ; wireless sensor network; routing; sensors; clustering; ARM7 processor.

I. INTRODUCTION

Once they are deployed, manual service of these devices is not cost-effective. In some situations, this manual service may not even be possible due to harsh terrains, hazardous environments, hostile environments, or a combination of these and possibly other factors.

- The system doesn't consider the pressure level
- It does not check the conditions of temperature
- No more accuracy

In this paper, we investigate the effect of network density on the optimal number of clusters in LEACH protocol. Since LEACH (Low-Energy Adaptive Clustering Hierarchy) serves as a foundation for much of the hierarchical wireless sensor network research, the results of this work will lead to batter insight and improved designs for many existing protocols.

- Increasing the network size
- Increases the data transmission cost per message.
- Increasing the distance propagation exponent.
- The message transmission cost is high.
- Highly efficient for the network to have fewer cluster heads.

Function of LPC2148

LPC is a family of microcontroller ICs by NXP semiconductors. The LPC chips are based on the 32-bit RISC ARM cores from ARM Holdings, such as cortex-M4F, cortex-M3, cortexM0+, cortexM0, ARM9 ARM7 cores. The legacy LPC families were based on the 8-bit 80C51 core.

ARM7 LPC 2148 is ARM7TDMI-S core board microcontroller that uses 16/32-bit 64 pin (LQFP) Microcontroller number. LPC2148 from Philips. All resources inside LPC2148 is quite perfect, so it is the most suitable one to learn and understand the applications of all resources inside MCU well, it makes user to modify, apply and develop many excellent applications in the features, Because hardware system of LPC2148 includes the necessary devices within only one MCU such as USB, ADC, DAC, timers/counters, PWM, capture, I2C, SPI, UART and etc.

Technical Specifications:

Processor*: LPC2148
Clock speed: 12 MHz
Red LED: Power indicator
Power: 7-15V AC/DC @500 mA
Voltage Regulator: 5V Onboard

Function of Zigbee

Zigbee is a specification for a suite of high level communication protocols used to create personal area networks built from small, low power digital radios. Zigbee is based on an IEEE 802 standard. Though low powered, Zigbee devices often transmit data over longer distances through intermediate devices to reach more distant ones, creating a mesh network: i.e., a network with no centralized control or high-power transmitter/receiver able to reach all of the networked devices. The decentralized nature of such wireless ad-hoc networks make them suitable for applications where a central node can't be relied upon.

Zigbee is used in applications that require a low data battery life, and secure networking. Zigbee has a defined rate of 250 Kbits/sec, best suited for periodic or intermittent data or single signal transmission from a sensor or input device. Applications include wireless light switches, electrical meters with in home displays, traffic management systems, and other consumers and industrial equipment that require short-range wireless transfer of data at relatively low rates. The technology defined by the Zigbee specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth or Wi-Fi.

II. SYSTEM STRUCTURE

The system structure mainly consists of two transmitters and receiver sections which are shown infigure1, figure2 and figure3 respectively.

Transmitter section 1 mainly consists of two sensor networks in this system which senses various effects. Various sensors used here are temperature and pressure sensors. Transmitter section 2 mainly consists of two sensor networks in this system which senses various effects. Various sensors used here are PIR and sound sensors. As the output through these sensors is a physical quantity, they are connected to ADC (Analog to Digital Converter) to convert this analog information to digital format and then this digital information is monitored in pc through zigbee.

The controlling section of this system is of great interest. All the sensors data are stored in the processor memory and continuously monitored. We can also transmit this data to other PC's using zigbee module. Zigbee transmitter is connected to LPC 2148 controller. It continuously checks out the sensor data and sends to the Zigbee receiver. This Zigbee receiver is connected to the PC through UART as the voltage levels are not equal, we can communicate the sensors data to other PC's through Zigbee up to 200 meters long.

BLOCK DIAGRAM:

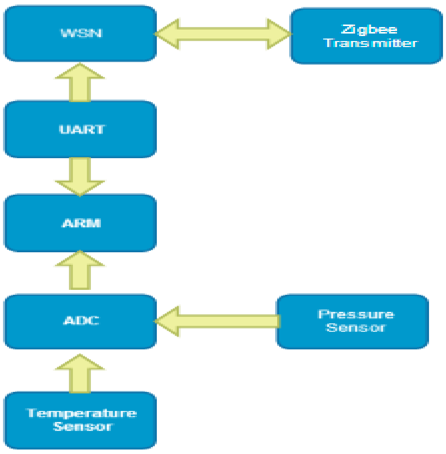

Figure1: Transmitter Section 1

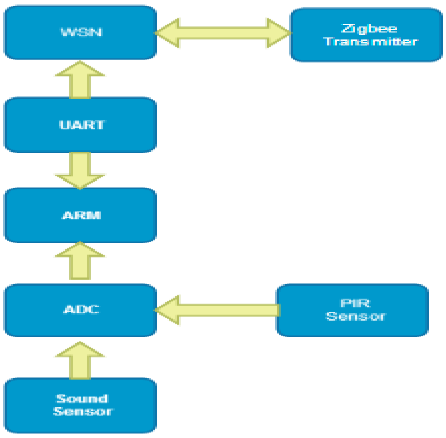

Figure2: Transmitter Section 2

Figure3; Receiver Section

III. HARDWARE DEPLOYMENT

1. Function of temperature sensor

The LM35 series are precision integrated-circuit temperature sensors, 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. 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.

Features
Calibrated directly in ° Celsius (Centigrade)
Linear + 10.0 mV/°C scale factor
0.5°C accuracy guarantee able (at +25°C)
Rated for full −55° to +150°C range
Suitable for remote applications
Low cost due to wafer-level trimming
Operates from 4 to 30 volts
Less than 60 µA current drain
Low self-heating, 0.08°C in still air
Nonlinearity only ±1⁄4°C typical
Low impedance output, 0.1 W for 1 mA load

2. Function of PIR Sensor

The passive infra Red (PIR) sensor will, under typical conditions, detect a human being moving around within approximately 10m from the sensor. This is an average value, as the actual detection range is between 5m and 12m.As the performance of the sensor is determined primarily by environmental conditions. No guarantees can be offered regarding the detection range. However, the range is typically sufficient for the majority of interior spaces. Some garages may be large enough that one sensor cannot cover that whole area – we suggest testing this in the actual environment if there's any doubt.

The sensor has a horizontal 110° vertical 60° field of view. The main blind spots are above, below or behind the sensor itself. Typically, the ideal placement in an environment is the upper corner of a room, facing slightly towards the ground (perhaps 20-25°, depending on the height of the sensor). Try to cover typical paths through the room, focusing particularly on likely entry and exit points. If the room has several entry points, try to cover as many of these as practicable. A visible PIR motion sensor can be a great deterrent to intruders – but on the other hand, skilled intruders can avoid obviously visible sensors. Try to mix it up a bit.
Installing wireless PIR sensors: Installation height is about 2.2 meters above ground and You need consider the best coverage. Do not install the PIR sensors in direct sunlight or near any device which emits heat or cold, Such as air conditioners, refrigerators, ovens, heaters, microwaves or other electronic Equipment which generates heat as a by-product of operation. Replace the batteries in the units regularly.

Technical Parameters:

Power Supply: DC9V (inner 9V battery)
Static Current: ≤100 mA
Transmission Current: ≤20mA
Frequency: 433MHZ
Transmission Distance: less 80M
Detective Speed: 0.3 - 3m/s
Detective Distance: 5 – 12M
Detective Range: Horizontal 110° Vertical 60°
Working Condition: Temperature –10 c+ 40 c
Humidity ≤ 90 rh

3. Function of Sound Sensors

The PASCO CI-6506B Sound Sensor is designed to be used with a PASCO computer interface to make Measurements of relative intensity of sound. The sensing element of the Sound Sensor is an electrets condenser microphone, which consists of an electrets membrane, metal electrode, and field effect transistor that are in an efficient configuration yielding superior signal-to-noise ratios (>60 dB) and excellent frequency response (20 to 16,000 Hz).Two stages of amplification are provided to condition the low-level signal from the microphone for input into the Science Workshop computer interface. The output from the sensor is bipolar and ranges between ±10 volts. When the sensitivity is raised to high in Science Workshop (700interface only), the Sound Sensor detects voltage levels as low as 0.0005 volts, corresponding to sound levels that are barely audible to the human ear. Sound levels ranging from classroom background noise (45 dB) to levels exceeding 100 dB are easily detected with the Sound Sensor. The Oscilloscope and Fast Fourier Transform (FFT) functions of Science Workshop may be used effectively with the Sound Sensor: the Oscilloscope allows the student to view the Sound Sensor output directly, and the FFT function will transform the time domain signal from the sensor to a frequency domain display. These two functions allow the student to investigate the frequency composition of sound produced by the human voice, at using fork, or loud speaker driven by a complex waveform such as a square wave. Both the Oscilloscope and FFT functions may be used simultaneously. The Sound Sensor can be plugged directly into any PASCO computer interface box or can be connected to the interface box using the supplied cable with 8-pin DIN connectors.
Sound Impact Sensor:

The Sound Impact Sensor provides a means to add noise control to your project and responds to loud noises such as a clap of the hands. Through the on-board microphone, this sensor detects changes in decibel level, which triggers a high pulse to be sent through the signal pin of the sensor. This change can be read by an I/O pin of any Parallax microcontroller. Features y Detection range up to 3 meters away y On-board potentiometer provides an adjustable range of detection y Single bit active-high output y 3-pin SIP header ready for breadboard or through-hole projects y Built-in series resistor for compatibility with the Propeller microcontroller and other 3.3 V devices

Key Specifications:

Power requirements: 5 VDC
Communication: Single bit high/low output
Operating temperature: 32 to 158 °F (0 to +70 °C)
Dimensions: 0.6 x 1.5 in (1.5 x 3.8)

4. Function of pressure sensor

A Pressure sensor is a device which senses pressure and converts it into an analog electrical signal, whose magnitude depends up on the pressure applied. Since they convert pressure into an electrical signal, they are also termed as pressure transducer. Since a long time, pressure sensors have been widely used in fields like automobile, manufacturing, aviation, bio medical measurements, air conditioning, hydraulic measurements etc.

In the airplanes, these sensors are needed to maintain balance between the atmospheric pressure and thee control systems of airplanes. This not only protects the circuitry and various internal components of the airplane but also gives exact data to the system about the external environment. Also particular levels of air pressure need to be maintained in the cockpit and the passengers lobby to provide nominal ground like breathing conditions.

5. Function of ADC

In this paper we are using ADC0808 converters to convert the analog data coming from various sensors to digital data. The ADC0808 data acquisition component is a monolithic CMOS device with a8-bit analog to digital converter, 8-channel multiplexer and microprocessor compatible control logic. The 8-bit A/D converter uses successive approximation as the conversion technique. The converter features high impedance chopper stabilized comparator, a 256R voltage divider with analog switch tree a successive approximation register. The 8-channel multiplexer can directly access any of 8-singleended analog signals. The device eliminates the need for external zero and full-scale adjustments. Easy interfacing to microprocessor is provided by the latched and decoded multiplexer address inputs and latched TTL TRI-STATE outputs. The design of the ADC0808, ADC0809 has been optimized incorporating the most desirable aspects of several A/D conversion techniques. The ADC0808, ADC0809 offers high speed, high accuracy, minimal temperature dependence, excellent long- term accuracy and reliability consumes minimal power. The features make this device ideally suited to applications from process and machine control to consumer and automotive applications. Such as EIA RS-232

6. Function of UART

The universal Asynchronous Receiver and Transmitter is a type of “Asynchronous Receiver/Transmitter”, a piece of computer hardware that translates between parallel and serial forms. UARTs are commonly used in conjunction with other communication standard such as EIA RS-232.

A UART is usually an individual integrated circuit used for serial communication over a computer or peripheral serial port. UARTs are now commonly included in micro- controllers. A dual UART or DUART combines two UARTs into a single chip.

The UART controller is the key component of the serial communication subsystem of a computer. It takes bytes of data and transmits individual bits in a sequential fashion. At the destination, a second UART re-assembles the bits into complete bytes. Each UART contains a shift register which is the fundamental method of conversion between serial and parallel forms.

FEATURES OF UART1:-

UART1 is identical to UART0, with the addition of a modem interface.16 byte Receive and Transmit FIFOs. Register locations conform to ‘550 industry standard .Receivers FIFO trigger points at 1, 4, 8, and 14 bytes. Built-in fractional baud rate generatorswith auto banding capabilities..Mechanism that enables software and hardware flow control implementation. Standard modem interface signals included with flow control (auto-CTS/RTS) fully supported in hardware (LPC2144/6/8 only).

Specifications of Board:-

- It Use 16/32 Bit ARM7TDMI-S MCU No.LPC2148 from Philips (NXP)
- It Has 512KB Flash Memory and 40KB Static RAM internal MCU
- It Use 12.00MHz Crystal, so MCU can process data with the maximum high speed at60MHz when using it with Phase-Locked Loop (PLL) internal MCU.
- It Has RTC Circuit (Real Time Clock) with 32.768 KHz XTAL and Battery Backup.
- It Support In-System Programming (ISP) and In-Application Programming (IAP)through On-Chip Boot-Loader Software via Port UART-0 (RS232)

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- It has circuit to connect with standard 20 Pin JTAG ARM for Real Time Debugging 7-12V AC/DC Power Supply.
- It Has standard 2.0 USB as Full Speed inside (USB Function has 32 End Point)
- It Has Circuit to connect with Dot-Matrix LCD with circuit to adjust its contrast by using 16 PIN Connector.
- It Has RS232 Communication Circuit by using 2 Channel.
- It Has SD/MMC card connector circuit by using SSP.
- It Has EEPROM interface using I2C.
- It Has PS2 keyboard interface.
- All port pins are extracted externally for further interfaces.

IV. APPLICATIONS

Wireless sensor networks are used in wide range of applications, mainly in monitoring and control of various industries.

1. Military applications

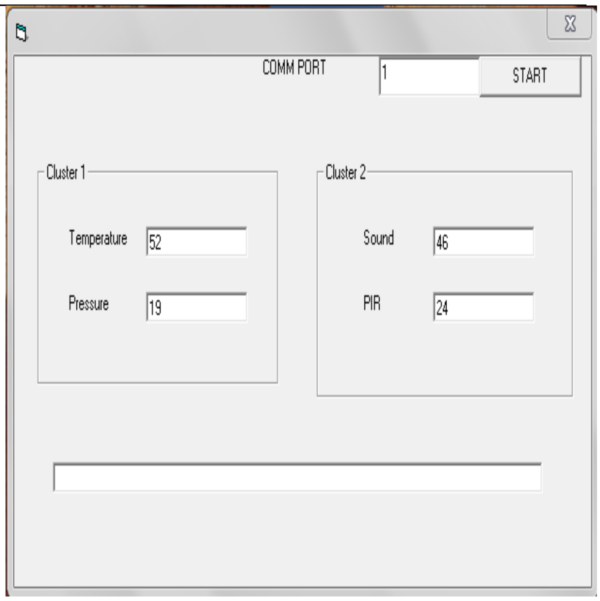
In Military applications such as monitoring of troop movement and target tracking originally motivated the development of wireless sensor networks. However, currently, wireless sensor networks are being considered for many civilian applications
.

2. Industrial applications

In industries wireless sensor networks are used to monitor the pressure, temperature buildups. New wireless mesh networking topologies are one factor that drives new levels of reliability. In a mesh network topology, each node has at least.

V. RESULT ANALYSIS

In this paper we are having two clusters and from this we can see different sensor out puts. We can see temperature and pressure sensor variations from cluster 1, sound and passive infrared sensor variations from cluster2.finally these results we can monitor on the personal computer..Based on these variations from different clusters we can control the industrial and consumer applications.



VI. CONCLUSION

The hardware and software design of an embedded monitoring system for real time applications is presented in this paper. Vibration signals have been analyzed to detect the mechanical faults and necessary steps are taken to reduce the faults. The implementations of analysis technique in time and frequency domain are given. The proposed system imbalance detection technique is verified with different level of severity.

REFERENCES

[1] I.Mahgoub and M. Ilyas, SMART DUST: sensor network applications, architecture, and design. CRC Press, 2006.

[2] M. Ilyas and I.Mahgoub, Handbook of sensor Networks: Compact Wireless and Wired sensing systems. CRC press. 2005.

[3] I. Mahgoub and M. Ilyas, sensor network protocols. CRC press. 2005.

[4] I.F.Akyildz, W. Su, Y. Sankarasubramaniam. and E.Cayirci, “A Survey on sensor networks”. IEEE Communication magazine, vol.39,no.12, pp. 102-114, august 2002.

[5] C. Inatanagonwiwat, R.Govindan, D.Estrin and F. Heidemann, J. and silva.”Directed diffusion for wireless sensor networking” IEEE/ACM Transactions on networking vol.11, pp.1-16, feburary 2003.

[6] S.Soro and W.B. Heinzelman, “cluster head election technics for coverage preservation in wireless sensor networks” AdHOC Networks, vol.7. no.5, pp 955-972, July 2008.

[7] Jagannath, V.M.D and B.Raman (2007). “ WiBeam: Wireless Bearing Monitoring System” communication systems software

and Middleware, COMSWARE 2007, 2nd International conference.

[8] Wright, P.; D. Dornfeld; R. Hillaire; and N. Ota (2006). "Tool Temperature Measurement and its Integration within a Manufacturing System." Transactions of NAMRI/SME, Vol. 34, pp. 63-70.

[9] Sudararajan, V.; A. Redfern; M. Schneider; and P. Wright (2005). "Wireless Sensor Networks for Machinery Monitoring," ASME International Mechanical Engineering Congress and Exposition.

[10] C. Cheng, C. Tse, and F. Lau, "A delay-aware data collection network structure for wireless sensor networks", IEEE sensors J., vol. 11, no. 1, Apr. 2011.

[11] D.G. Senesky, B. Jamshidi, K.Cheng, and A.P. Pisano, "Harsh environment silicon carbide sensors for health and performance monitoring of aerospace systems: A review", IEEE sensors J., vol 9, no. 11, Nov 2009.

[12] C. Cheng, C.Tse, and F. Lau, "A clustering algorithm for wireless sensor networks based on social insect colonies", IEEE sensors J., vol 11, no. 1, Apr. 2011.