ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Energy Aware Sensor Node Design With its Applications in Wireless Sensor Networks

Prashanth.K
Gokaraju Rangaraju Institute of Engineering and Technology.

Guide: Y.Sudharshan Reddy
Gokaraju Rangaraju Institute of Engineering and Technology.

ABSTRACT:

Energy consumption remains as a major obstacle for full deployment and exploitation of wireless sensor network (WSN) technology nowadays. This paper presents the design and implementation of an energy-aware sensor node, which can help in constructing energy-efficient WSNs. An energy-efficient strategy, which aims at minimizing energy consumption from both the sensor node level and the network level in a WSN, is proposed.

To minimize the communication energy consumption of the sensor node, the distance between the transmitter and the receiver is estimated before available transmission, and then, the lowest transmission power needed to transmit the measurement data is calculated and determined. The sensor nodes are also set to sleep mode between two consecutive measurements for energy saving in normal operating conditions. Furthermore, energy saving can be achieved by estimating the energy consumption within the whole network under different network configurations and then by choosing the most energy-efficient one.

INTRODUCTION:

Energy plays an important role in modern era. These days, even though there are many new IT services, these cause another t kind of problems. There is an increase in the diversity of services and service quality, but there is also much higher energy consumption.

Related solutions are being developed and commercialized by many companies but these products have a passive property. That is, these kinds of solutions need to include intelligent management of power because of passive operation according to hourly variation or battery status.is needed to monitor these statuses and provide proper management services.

For example, even though there are various variables such as future power demands, generation status depending on weather conditions, and current battery status, current solutions do not consider these variables, so it is hard to expect high efficiency .Therefore, for much higher efficiency of renewable energy, an intelligent system An intelligent energy management system is developed. The concept of dynamic assignment of priorities for the entire consumer is established in this project. Slicing of interrupt timings is also discussed which can be used to improve the performance. According to the generated power amount, power shut down will be notified and it will reach the consumer in the uniform level based on priorities.

We are controlling the power of homes. If there is any shortage of power it will be indicated in the display. The project is working on the transformers which are (current transformer, power transformer) connected to micro controller. The output pins are connected to relay through micro controller. All modules will work based on the voltage. When any one of the interrupt is given to the micro controller automatically based on the programming the interrupt will execute. Relays play a major role in the project. One interrupt you are giving means one relay will be on-off condition. The Lcd is the indication purpose of all the values.hte power that consumes that will calculate the values and displayed in the lcd, when one after another will execute the interrupts. The micro controller receives the interrupts through GPIO pins the voltage will give output based on the interrupts.

The concept of the project is to develop a system used to estimate the power requirements of the individual loads according to the generated quantity, allowing availability to most prioritized loads. The project is a special one considering fact that we can estimate the requirements of the each and every load by accessing from remote location this system requires minimal power and provides reliable delivery of data between sensor node and control station.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

2. System Architecture Description:

The overall design of proposed system, Energy Aware Sensor Node Design with Its Applications in Wireless Sensor Networks, is illustrated in fig 2.1. This design consists of three types of relays, current and voltage transformers, Microcontroller block and load modules. The three types of relays are mapped with three different priorities dynamically. The input load is read and given to the ADC pins of LPC2148. Here the signals are converted into digital signals through analog to digital converter. These signals are sent to the serial communication block (SPI) where the input data is sent bit by bit manner. Upon reading the status of generated power, the loads are given the supply according to the priorities they have been assigned. The status of divided power can be observed on computer screen back I the control room.

a) Potential Transformers:

PTs or VTs are the most common devices used. These devices are conventional transformers with two or three windings (one primary with one or two secondary). They have an iron core and magnetically couple the primary and secondary. The high side winding is constructed with more copper turns than the secondary (i.es), and any voltage impressed on the primary winding is reflected on the secondary windings in direct proportion to the turns ratio or PT ratio.

b) Current transformer:

A current transformer (CT) is a type of instrument transformer designed to provide a current in its secondary winding proportional to the alternating current flowing in its primary. They are commonly used in metering and protective relaying in the electrical power industry where they facilitate the safe measurement of large currents, often in the presence of high voltages. The current transformer safely isolates measurement and control circuitry from the high voltages typically present on the circuit being measured.

c) Relay:

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical. Relays are very simple devices.

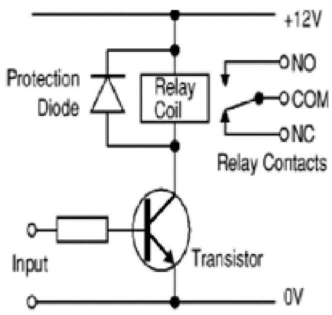

Fig: Drive circuit and protection diodes for relays

d) Power Supply:

A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones and rarely to others.

e) Microcontroller:

Microcontroller is a heart of this project. ARM 7 is suitable microcontroller for this proposed embedded system. LPC2148 is ARM 7 controller used in this project. The main feature of LPC2148are as follows,LPC2148 microcontroller board based on a 16-bit/32-bit ARM7TDMI-S CPU [5] with real-time emulation and embedded trace support, that combine microcontrollers with embedded high-speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30% with minimal performance penalty. The meaning of LPC is Low Power Low Cost microcontroller. This is 32 bit microcontroller manufactured by Philips semiconductors (NXP).Due to their tiny size and low power consumption, LPC2148 is ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. The LPC2148 contains one SSP.

The SSP controller is capable of operation on a SPI, 4-wire SSI, or Micro wire bus. It can interact with multiple masters and slaves on the bus. However, only a single master and a single slave can communicate on the bus during a given data transfer. The SSP supports full duplex transfers, with data frames of 4 bits to 16 bits of data flowing from the master to the slave and from the slave to the master. Often only one of these data flows carries meaningful data.

Features of LPC2148 Microcontroller:

•16bit/32bit ARM7TDMI-S microcontroller in a tiny LQFP64 package.

•40kB of on-chip static RAM and 512kB of on chip flash memory.

•In System programming/In application programming via on chip boot loader software.

•USB 2.0 full speed compliant device controller with 2kB of endpoint RAMS.

•In addition, the LPC2148 provides 8kB of on chip RAM accessible to USB by DMA.

•Two 10-bit ADCs provide a total of 14 analog inputs, with conversion times as low as 2.44 ms per channel.

•Single 10-bit DAC provides variable analog output.

•Two 32-bit timers/external event counters (with four capture and four compare channels each), PWM unit (six outputs) and watchdog.

•Low power Real-Time Clock (RTC) with independent power and 32 kHz clock input.

•Multiple serial interfaces including two UARTs (16C550), two Fast I2C-bus (400 kbit/s), SPI and SSP with buffering and variable data length capabilities.

•Up to 45 of 5 V tolerant fast general purpose I/O pins in a tiny LQFP64 package.

•Up to 21 external interrupt pins available.

•60 MHz maximum CPU clock available from programmable on-chip PLL with settling time of 100 ms.

•On-chip integrated oscillator operates with an external crystal from 1 MHz to 25 MHz and Power saving modes includes idle and Power-down.

•Individual enable/disable of peripheral functions as well as peripheral clock scaling for additional power optimization.

•Processor wake-up from Power-down mode via external interrupt or BOD.

•CPU operating voltage range of 3.0 V to 3.6 V (3.3 V ± 10 %) with 5 V tolerant I/O.

SENSING MECHANISMS:

The concept of wireless sensor node implies that, except for the physical sensing capabilities, the nodes will also be able to process the obtained data and communicate the results wirelessly. In recent years, many energy conservation schemes have been proposed which assume that data acquisition and processing have an energy consumption that is significantly lower than communication. In addition, since each of the sensor nodes in the network is energy constrained and each component in a sensor node consumes a certain amount of energy, power supply becomes important to ensure proper operation of the entire WSN as the number of sensors deployed in a network grows. Hence, constructing effective network structures for the application of WSN with consideration of energy efficiency is of critical importance.

In the two sensing schemes designed for the WSN, it is assumed that the transmission power is minimized to ensure reliable reception at the receiver end, according to the communication distance between two sensor nodes. Hence, awareness of the communication power as well as the adjustability of the transmitter's output power becomes critical in performing the sensing scheme for the designed sensor node. By assuming a unit signal gain provided by antennas, the output power of the communication module is dominated by the consumption for power amplifier. PTs or VTs are the most common devices used. These devices are conventional transformers with two or three windings (one primary with one or two secondary). They have an iron core and magnetically couple the primary and secondary.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

The high side winding is constructed with more copper turns than the secondary (ies), and any voltage impressed on the primary winding is reflected on the secondary windings in direct proportion to the turns ratio or PT ratio. Potential transformers are designed to provide as accurate a voltage step-down ratio as possible. To aid in precise voltage regulation, loading is kept to a minimum: the voltmeter is made to have high input impedance so as to draw as little current from the PT as possible. As you can see, a fuse has been connected in series with the PTs primary winding, for safety and ease of disconnecting the PT from the circuit.

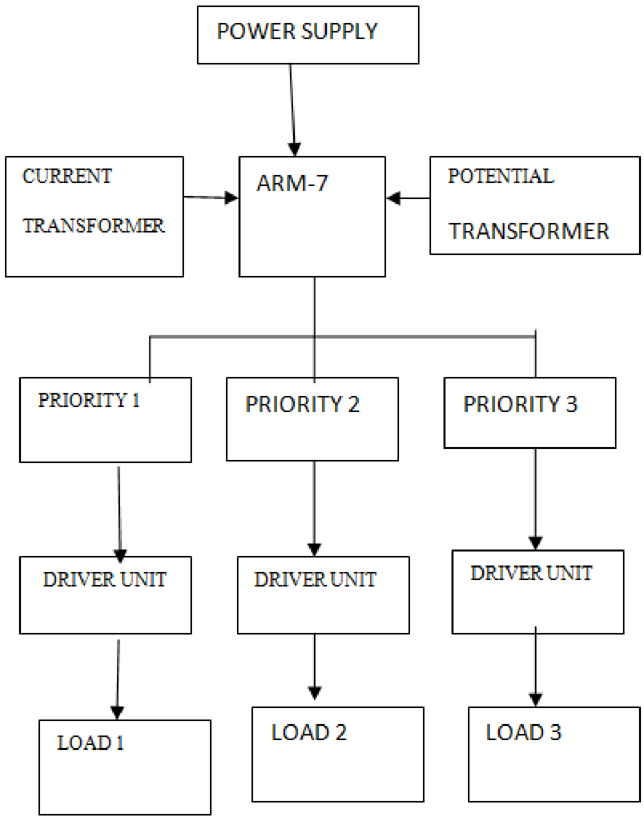

Fig: Block Diagram of the Transmitting unit

A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones and rarely to others.

Whenever we give the power supply the controller activates and the current transformer and potential transformer gets charged by the current flow and depending up on the priorities the particular driver load will be activated so the load related to that driver unit will goes to their particular on and off states.

Control Room:

UART communication:

We are using serial communication technique to make a communication between PC and Processor.The rate of data transfer in serial data communication is stated in bps (bits per second). Another widely used terminology for bps is baud rate. However, the baud and bps rates are not necessarily equal.

This is due to the fact that baud rate is the modem terminology and is defined as the number of signal changes per second. In modems, there are occasions when a single change of signal transfers several bits of data. As far as the conductor wire is concerned, the baud rate and bps are the same.

In RS232, a 1 is represented by -3 to -25V, while a 0 bit is +3 to +25V, making -3 to +3 undefined. For this reason, to connect any RS232 to a microcontroller system we must use voltage converters such as MAX232 to convert the TTL logic levels to the RS232 voltage level, and vice versa. MAX232 IC chips are commonly referred to as line drivers.

The ARM transfers and receives data serially at many baud rates. The baud rate in the ARM is programmable. This is done with the help of timer 1.The relationship between the crystal frequency and the baud rate is discussed here. The ARM divides the crystal frequency by 12 to get the machine cycle frequency.

In the case of XTAL = 11.0592 MHz, the machine cycle frequency is 921.6 kHz (11.0592 MHz / 12 = 921.6 kHz). The ARM's serial communication UART circuitry divides the machine cycle frequency of 921.6 kHz by 32 once more before timer 1 to set the baud rate uses it. Therefore, 921.6 kHz divided by 32 gives 28,800 Hz. Using this interface we are communicating between the PC and the Processor.

Rapid Development of a system miniaturization, wireless communication, and on-chip signal processing has promoted the development of wireless sensor technology, which has enabled its wide applications from condition based maintenance to industrial system monitoring and environmental sensing. The number of wireless sensors, which are typically considered as a wireless sensor network (WSN), deployed for real-life applications has rapidly increased.

Conclusion:

The proposed system is used to monitor the energy of load and controlling load according to priority. The controlling is done from electric board station and it will be operated according to generation of power. If generation is high, they will allow supply to all priority lines. If the generation low they will allow supply to only high priority lines. This system consists of current transformer and potential transformer. Using these two transformers it will measure the energy and will displays on monitor with amount. If any load cross the stipulated limit, it will display on monitor. Now we are monitoring and controlling the load, and we are manual paying amount to EB station due to this time delay and not effective so, in future we can Pay the total amount of energy from home through wireless using GSM.

Future scope:

• The module can be used in wireless sensor networks to minimize the usage of limed power available in battery operated devises.

• Zigbee modules can be used both at controlling station and load section to make the wireless communication between them.

• Presently the monitoring and controlling of the load is done manually paying amount to electric station. It can be made more effective in future by paying the total amount of energy from home through wireless using GSM.

REFERENCES:

[1] Megalingam, R.K.; Krishnan, A.; Ranjan, B.K.; Nair A.K.; , "Advanced digital smart meter for dynamic billing, tamper detection and consumer awareness," Electronics Computer Technology (ICECT), 2011 3rd International Conference on , vol.4, no., pp.389-393, 8-10 April 2011.

[2]LPC2148(www.nxp.com/documents/data_sheet/LPC2141_42_44_46_48.pdf) datasheet.

[3] Khalifa, T.; Naik, K.; Nayak, A.; , "A Survey of Communication Protocols for Automatic Meter Reading Applications," Communications Surveys & Tutorials, IEEE , vol.13, no.2, pp.168-182, Second Quarter 2011 Khalifa, T.; Naik, K.; Nayak, A.; , "A Survey of Communication Protocols for Automatic Meter Reading Applications," Communications Surveys & Tutorials, IEEE , vol.13, no.2, pp.168-182, Second Quarter 2011.

[4] Rahman, M.M.; Mto, A.; , "Technologies required for efficient operation of a smart meter network," Industrial Electronics and Applications (ICIEA), 2011 6th IEEE Conference on , vol., no., pp.809-814, 21-23 June 2011 [3] Grütz, A.: Jahrbuch Elektrotechnik '98, Berlin • Offenbach: VDE VERLAG, 1997.

[5] Depuru, S.S.S.R.; Lingfeng Wang; Devabhaktuni, V.; Gudi, N.; , "Smart meters for power grid — Challenges, issues, advantages and status," Power Systems Conference and Exposition (PSCE), 2011 IEEE/PES , vol., no., pp.1-7, 20-23 March,2011K. Elissa.