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Wireless Sensor Network for Energy Efficient Target Coverage

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ABSTRACT
A critical aspect of applications with wireless sensor network lifetime. Power –constrained wireless sensor networks are usable as long as they can communicate sensed data to a processing node. In this paper, we have depicted the over view of the blocks required for the wireless sensor network information about the hardware parts to some extent .These hardware parts are the necessary requirement for enhancement of our work further sensing and communications consume energy, therefore judicious power management and sensor scheduling can effectively extend network lifetime.[1] Moreover, in existed paper which only had few sensor and 8051 processor have been replaced by the efficiently proposed method having PIC processor to be processed along with sensor module which can be of any type based on their availability.[7] This paper propose an efficient method to extend the sensor network life time by organizing the Sensors into a maximal number of set covers that are activated successively. Only the sensors from the current active set are responsible for monitoring all targets and for transmitting the collected data, while all other nodes are in a low-energy sleep mode. By allowing sensors to participate in multiple sets, our problem formulation increases the network lifetime. [3]

Introduction

Sensor nodes are small devices equipped with one or more sensors. One or more transceivers, processing, storage resources and possible actuators. [2]Sensor nodes organize in networks and collaborate to accomplish a larger sensing task. A critical issue in wireless sensor networks is power scarcity. Driven in part by battery size and weight limitations. As judicious management of the available energy resources directly impacts the sensor network operation lifetime and the performance of the application, methods that optimize the sensor energy utilization have great importance. [1]. In order to emphasize on the energy efficiency of the network one of the leading factor is its power consumption.

A sensor node's radio can be in one of the following four states: transmit, receive, idle, or sleep. The idle state is when the transceiver is neither transmitting nor receiving, and the sleep mode is when the radio is turned off.

Power saving techniques can generally be classified in the following categories:

1) Schedule the wireless nodes to alternate between active and sleep mode
2) Power control by adjusting the transmission range of wireless nodes
3) Energy efficient routing, data gathering
4) Reduce the amount of data transmitted and avoid useless activity.

This ll can be analyzed by doing simulation on NS2. [1]

This work describes the following: for faster processing of collected data: This paper uses pic-micro-controller and ARM processor for its efficient serial communication and A/D conversion. It has increased the no. of sensor nodes to increase the network life time. Further, With NS2 to compare the energy level for different no. of sensors.

Methodology/Block diagram:

Data collected by the sensors is converted to its digital form by inbuilt A/D converter in controller. And this collected data is transmitted to zigbee by using serial communication feature involving RS232. Thereafter it is transmitted through zigbee to PC where we get the varying value.

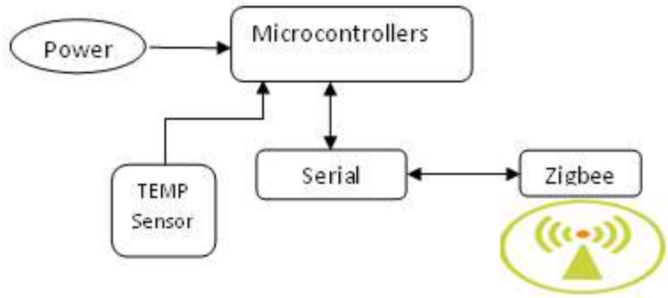


Figure 1: Remote section

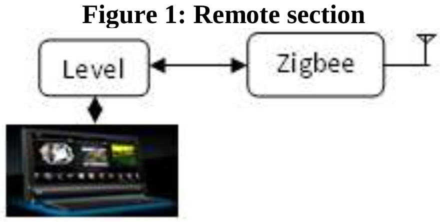


Figure 1: Base station

Transmitter & Receiver:

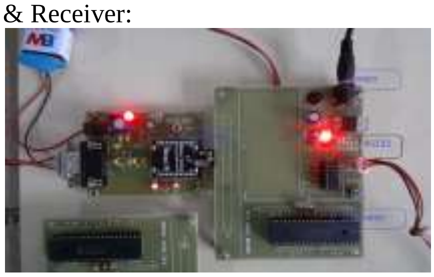
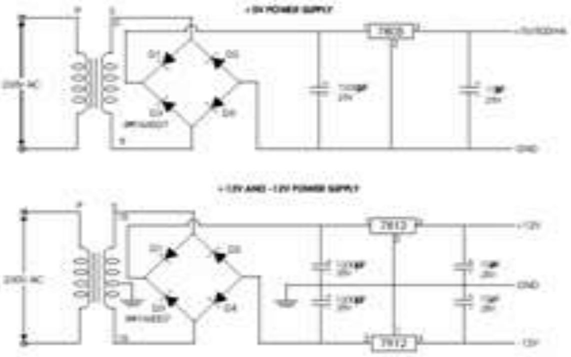


Figure 2: Transmitter

Tele:
E-mail addresses: arun.kumar1986@live.com

Figure: Receiver

Power supply



Working principle:

The AC voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired DC output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes.

Microcontroller

The PIC microcontrollers are based on Harvard architecture. Harvard architecture has the program memory and data memory as separate memories which are accessed from separate buses. This improves bandwidth over traditional von Neumann architecture in which program and data are fetched from the same memory using the same bus.

PIC microcontrollers have a data memory bus of 8-bit and a program memory bus of 12, 14 or 16 bit length depending on the family. All PIC microcontrollers have a mix of different on-chip peripherals like A/D converters, Comparators, weak pull-ups, PWM modules, UARTs, Timers, SPI, I2C, USB, LCD, and CAN etc.

The main function of pic-microcontroller here is that it receives all the data from sensors and processes it to digital format with A/D converter present in it and then given to serial communication port.

Serial communication

The Universal Synchronous Asynchronous Receiver Transmitter (USART) module is one of the two serial I/O modules. (USART is also known as a Serial Communications Interface or SCI.) The USART can be Configured as a full-duplex asynchronous system that can communicate with peripheral devices, such as CRT terminals and personal computers, or it can be configured as a half-duplex synchronous system that Can communicate with peripheral devices, such as A/D or D/A integrated circuits, serial EEPROMs, etc.[11]

Sensors

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.[13]

Zigbee

ZigBee offers unique advantages for wireless applications, including low-cost radios, mesh networking, a basis in standards, and low power consumption. But with a technology this new, realizing a successful ZigBee implementation requires under-standing its architecture and operation, assessing design options at the chip and module level, and weighing practical considerations relative to specific application needs. [12]

Target coverage problem (TCPs)

We consider a number of targets with known locations that need to be continuously observed (covered) and a large number of sensors randomly deployed closed to the targets. We also consider a central data collector node. Which we will refer as the base station (BS). This BS can be the cluster head into a more general. Cluster-based framework. Sensed data might be processed locally by the sensors or at the BS, from where it is aggregated and forwarded to the user. We also assume the sensors have location determination capabilities (e.g. GPS). As we assume the number of sensors deployed in the field is greater than the optimum needed to perform the required task. An important energy-efficient method consists in scheduling the sensor nodes activity to alternate between active states and sleep state. We consider that a sensor node radio can go to the sleep mode when the node is not scheduled to perform the sensing task.

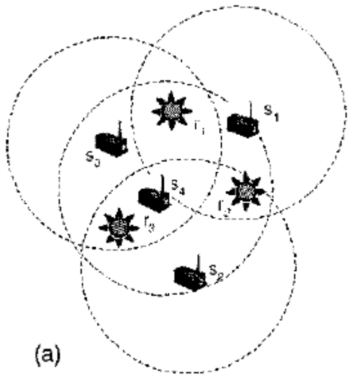
The sensor scheduling mechanism can be accomplished as follows:

1) Sensors send their location information to the BS

2) BS executes the sensor scheduling algorithm and broad- casts the schedule when each node is active

3) Every sensor schedules itself for active/sleep intervals.

In this paper we are concerned with designing the node scheduling mechanism, and do not address the problem of selecting which protocol is used for data gathering or node synchronization. To efficiently transmit data from the sensors to the BS. a mechanism like LEACH[14] canbe used. For node synchronization, one method is to have the BS periodically sending short beacons. *[1]*



s-sensors
r- targets

1. Algorithm:

1. Include the header files for microcontroller/o function and for time delay.
2. Define the oscillator, devices (target), and sensors.
3. Declare the variables for temperature, voltage and current.
4. Initialize the serial communication.
5. Configure the input and output ports along with analog and digital values.
6. Initialize the interrupt enable and interrupt flag.
7. While
8. /*assign the variables for T,V,C*/
9. if sensor is set to 1 then

10. flag value is set to 1 and
11. TXREG=Temp_value with some delay frequently
12. else
13. flag=0
    end if
14. while(TXIF is reset)
15. end while
16. TXREG=Voltage_values along with some delays
17. TXREG=Current_values along with some delays often
18. end while
19. /*Analog to digital conversion*/
20. within the temperature function select the channel for displaying temperature values; thereafter delay
21. while(until ADC conversion ends)
22. Get the temperature value.
23. within the voltage function select the channel for displaying voltage values; thereafter delay
24. while(until ADC conversion ends)
25. Get the voltage value
26. within the current function select the channel for displaying current values; thereafter delay
27. while(until ADC conversion ends)
28. Get the current value.
29. /*start the serial communication here*/
30. Set USART mode to transmit enable mode.
31. Baud rate is set to 9600 at 10 MHz
32. Receive enable mode is set to receive the collected data.
33. After reception is completed TXIF is set.

Simulation Result:

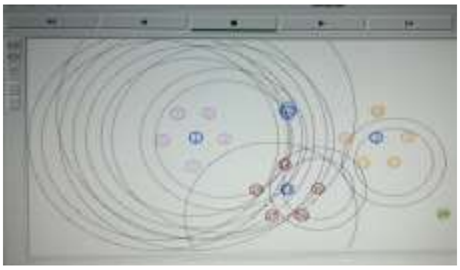


Figure 3: 3 targets with sensors allocated

Figure 4: Graph of no of sensors Vs life time.

In this section, evaluation on the performance of TSCs in order to compute maximum number of set covers by using NS2 is done. In the simulation we consider the following tunable parameters:

Varying the number of randomly deployed sensor nodes between 20 and 70 to study the effect of node density on the performance and targets to be covered. The lifetime of network is presented by using cluster and routing method. When more sensors are deployed, each target is covered by more sensors, thus more set covers can be formed. Thus by increasing the number of sensors we get the lifetime of network to be increased linearly.

The simulation results can be summarized as follows:

For a specific number of targets, the network lifetime output by heuristics increases with the number of sensors and the sensing range.

For a specific number of sensors and sensing range, the network lifetime increases as the number of targets to be monitored decreases.

Pication

It is having its application in:

1. national security
2. Surveillance,
3. Military,
4. Health care,
5. Environmental monitoring.

Advantage and disadvantage*:*

1. Since the life time of network increases with increase in number of sensors as sensors are easily available at a very low cost.
2. The next advantage is that it consumes very less amount of energy so it is energy efficient.
3. The chance of data loss is comparatively low as we have continuously monitored the area with the change in number of sensors.
4. We can establish such connection in remote areas where human interference is not allowed and could be easily monitored or accessed.

Disadvantage:

1. We have to consider many criteria such as coverage problem, power scheduling, and to put sensors in active and sleep modes during the course of our design.
2. We need to have license to use zigbee in larger field.

Software used:

1. NS2 Network animator v1.14.
2. MP lab IDE 8.6.3

2. Technology used:

Embedded Technology:

An embedded system is one that has computer-hardware with software embedded in it as one of its most important component. It is a dedicated computer-based system for an Application or product. It may be either an independent system or a part of a larger system. As its software usually embeds in ROM (Read Only Memory) it does not need secondary memories as in a computer. [15]

Application interface:

Figure 5: step 1

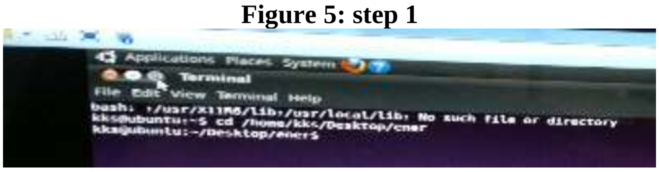


Figure 6: step 2

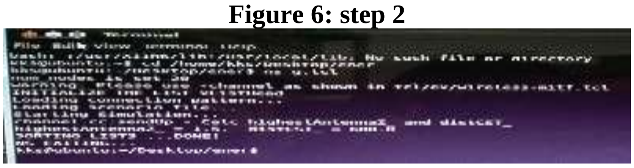


Figure 7: step 3

Data log of energy consumed

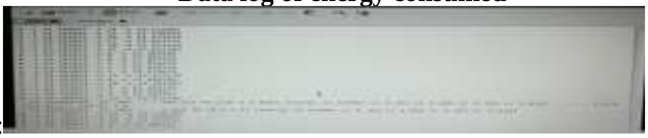


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Figure 8: Trace analysis of energy

Conclusion*:*

Wireless sensor networks are battery powered, therefore prolonging the network lifetime through a power aware node organization is highly desirable. An efficient method for energy saving is to schedule the sensor node activity such that every sensor alternates between sleep and active state. One solution is to organize the sensor nodes in set covers, such that every cover completely monitors all the targets. These covers are activated in turn, such that at a specific time only one Sensor set is responsible for sensing the targets, while all other sensors are in the sleep state. This problem is modeled as Target coverage Problem which is simulated using NS2.

Power-constrained wireless sensor networks are usable as long as they can communicate sensed data to a processing node. Sensing and communications consume energy, therefore judicious power management and sensor scheduling can effectively extend network lifetime.

We also increase the lifetime of the network by increasing the number of sensors. Further, we depicted this by taking the lifetime and runtime to calculate its energy and it resulted to make it more energy efficient than ever.

More ever the data transmitted and received are clearly monitored by using Zigbee to interface value to our PC.

The lack of precise sensor placement is compensated by a large Sensor population deployed in the drop zone that would improve the probability of target coverage. The data collected from the, sensors is sent to a central node (e.g. cluster head) for processing.

In future aspects work, we will make its coverage on network lifetime to be a robust coverage by designing a distributed and localized algorithm for it and also implement a real time clock (RTC),for more energy-efficient target coverage.

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