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Opportunistic Power Allocation for Wireless Sensor Networks by Improved RSSI Measurement

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***Abstract*— The project proposes the enhancement of battery lifetime when the sensors are placed nearby distances. The proposed opportunistic power allocation schemes (OPA) suitable for decentralized parameter estimation with WSNs. We adopt the amplify-and-forward technique proposed and convey sensor observations to the FC through a set of orthogonal channels. All the OPA schemes proposed here have one feature in common: only sensors experiencing certain local conditions (i.e. above a global threshold) are allowed to participate in the estimation process. More precisely, the proposed opportunistic schemes merely require (i) both the sensor-to-FC channel gains of the subset of active nodes and statistical CSI at the FC the channel gains of all sensor node s are needed(ii) one bit of feedback per sensor ; and (iii) local CSI and, possibly REI, at each sensor node. In particular, we derive opportunistic power allocation schemes for the following optimization problems: (1) Minimization of distortion (OPA-D) (2) Minimization of transmit power (OPA-P) (3)Enhancement of network lifetime (OPA-LT).We derive the associated power allocation rule on the basis of local CSI only. We propose the one more algorithm to measure the accurate distance between the nodes by Received Signal Strength Indicator (RSSI) measurement. The shortest path to the destination is found by AODV algorithm. The sensors perform energy- efficiency mechanisms to reduce the power consumption for long distance.**

Keywords- Wireless Sensor Networks, Opportunistic Power Allocation , Fusion Center, Adjacent Correction Position.

I. I.INTRODUCTION

A Wireless Sensor Network (WSN) consists of spatially distributed autonomous sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance. They are now used in many industrial and civilian application areas, including industrial process monitoring and control, machine health monitoring, environment and habitat monitoring, healthcare applications, home automation, and traffic control.

In addition to one or more sensors, each node in a sensor network is typically equipped with a radio transceiver or other wireless communications device, a small microcontroller, and an energy source, usually a battery. 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 hundreds of dollars to a few pennies, depending on the size of the sensor network and the complexity required of individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and bandwidth.

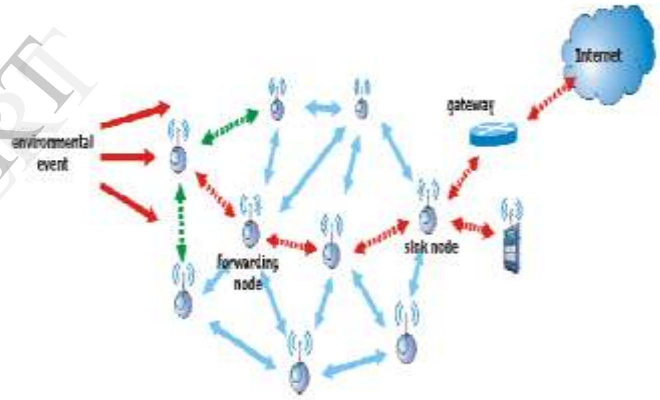

Fig 1: Model of Wireless Sensor Network

A sensor network normally constitutes a wireless ad-hoc network, meaning that each sensor supports a multi-hop routing algorithm. A sensor is a device that measures a physical quantity and converts it into a signal which can be read by an instrument. Sensors are used in everyday objects such as touch-sensitive elevator buttons (tactile sensor) and lamps which dim or brighten b touching the base. A sensor receives and responds to a signal. A sensor's sensitivity indicates how much the sensor's output changes when the measured quantity changes. Technological progress allows more and more sensors to be manufactured on a microscopic scale as micro sensors using MEMS technology. In most cases, a micro sensor reaches a significantly higher speed and sensitivity compared with macroscopic approaches.

II EXISTING SYSTEM

Opportunistic Power Allocation algorithm can able to achieve the following process they are as follows: Minimization of distortion (OPA-D), Minimization of transmit power (OPA-P), Enhancement of network lifetime (OPA-LT). It can be able to find the distance of the node based upon the RSSI measurement. RSSI is the Received Signal strength indication used to measure the signal strength in a wireless environment. RSSI is the received signal strength in a wireless environment, in arbitrary units. It is an indication of the power level being received by the antenna. Therefore, the higher the RSSI number, the stronger the signal. It is a measurement of the power present in a received radio signal.

RSSI is a generic radio receiver technology metric, which is usually invisible to the user of the device containing the receiver, but is directly known to users of wireless networking of IEEE 802.11 protocol family.

Higher the RSSI value stronger the signal. The RSSI in Opportunistic power allocation cannot find the accurate position of the nodes so that it consumes more power. This is the major problem identified in existing system.

III PROPOSED SYSTEM

In this paper we propose OPA with some modifications and ACP algorithm which is used to measure the accurate position of nodes.

OPA Algorithm:

Opportunistic Power Allocation (OPA) and sensor selection schemes for parameter estimation in wireless sensor networks. In all cases, only sensors experiencing favourable conditions participate in the estimation process by adjusting their transmit power on the basis of local Channel State Information (CSI) and Residual Energy Information.

Opportunistic Power Allocation (OPA) is characterized by the following algorithm and communication protocol:

Step 1: Initialization: Compute and broadcast the reporting energy value. This energy ultimately depends on the design criterion: minimization of the transmit power, maximization of the overall distortion, or the enhancement of network lifetime.

Step 2: Identification of the active sensor set: Each sensor node notifies the FC whether it will participate in the estimation process or not. Only sensors above the energy will participate. The number of active sensors N is then broadcasted by the FC.

Step 3: Power Allocation and Transmission: The N active sensor nodes adjust their transmit power accordingly and send their observations to the FC.

Step 4: Go to step 2 :

• At the Fusion Center: Only statistical CSI (and, in some cases, REI) is needed in order to compute the closed-form expressions of the reporting threshold in Step 1. The channel gains of the subset of active nodes are also necessary to estimate the underlying parameter. All the channel gains must be known to the FC. The average number of active Nodes is on the order of 10-20% of the whole population. Consequently, the savings in terms of signalling and energy consumption are potentially very high.

• At the sensor nodes: Each sensor must be aware of its own channel gain (i.e. local Channel State Information) and, possibly, REI in order to (i) determine whether it belongs to the subset of active nodes (Step 2); and (ii) adjust its transmit power accordingly (Step 3). Besides, the number of active sensors in each time slot must also be broadcasted by the FC. Finally, one signalling bit is needed for each sensor to indicate to the FC whether it belongs or not to the subset of active nodes in the current time-slot (Step 2).

ACP Algorithm :

Adjacent correction positioning (ACP) algorithm finds the accurate position of the nodes and reduces the power when the data's are transmitted through zigbee. The weighted average recursive filtering algorithm and smooth factor do a simple process for the RSSI signal. It is used to reduce the influence caused by unilateral ranging error in the calculation of multilateral positioning. The N active sensor nodes adjust their transmit power accordingly and send their observations to the FC (Fusion Center).

In order to improve the location accuracy further, an adjacent correct location algorithm has been applied in this system; the main purpose of the algorithm is to reduce the influence of unilateral ranging error in the process of multilateral positioning calculation. Its principle can be described in figure.

Suppose the system is composed by one blind node, one adjacent node, and eight reference nodes. The coordinate of blind node is B(x, y), the coordinate of correction node is C(Δx, Δy), and the eight reference nodes' coordinate is R1 (x, y) , R2 (x, y)… R8 (x, y) .Suppose the correction node had been arranged on a circle which the center point is B(x, y) and radius is r. In order to describe the algorithm distinctly, define several different concept of distance as follow:

Step 1: Mark the actual distance between reference node Rn and correction node C as dΔn .

Step 2: Mark the measured distance between reference node Rn and correction node C as d'Δn.

Step 3: Mark the measured distance between reference node Rn and blind node B as d'n .

Step 4: Mark the measured distance between reference node Rn and correction node C as d'Δn

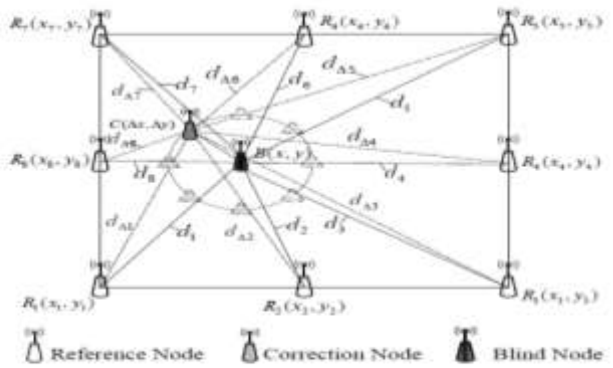

Fig 2 : Adjacent Correction Positioning

In the positioning calculation process, the correction factor η and difference coefficient will be applied, make its definition as below:

Definition 1: The correction factor η is the sum of every relative measure error between reference node and correction node.

Definition 2 : The discrimination coefficient between reference node Rn and blind node B is µn. The range error between reference nodes Rn and correction node C is n ε

$$\varepsilon n = d' \Delta n - d\Delta n$$

Afterwards, the correction processing distance between reference Rn and blind node B is

$$dn : dn = d'n - \mu n \varepsilon n$$

METHODOLOGY :

A source initiates the process by demanding a neighbour discovery process. It get backs the RSSI from each and every node. Next it selects the node with higher RSSI and transmits the packet through that node, whereas remaining nodes are in the sleep state.In the next means of packet transmission, the energy of every node is taken into account, and the node with higher remaining energy is used as the forwarding node to transmit packet to the destination. An effective usage of energy of every node in the network is utilized and energy consumption is attained to a greater extent. Efficient network node energy is obtained.

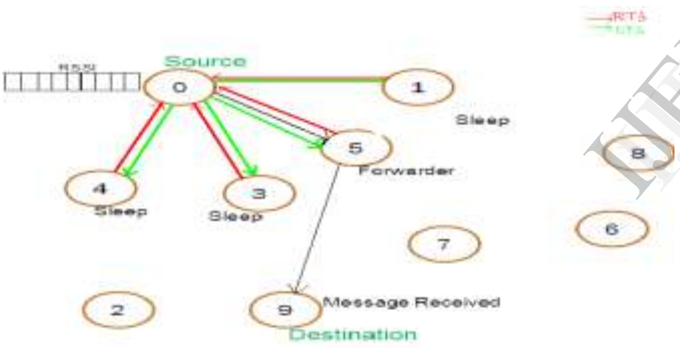

Fig 3 : Methodology

Power Consumption using sleep nodes :

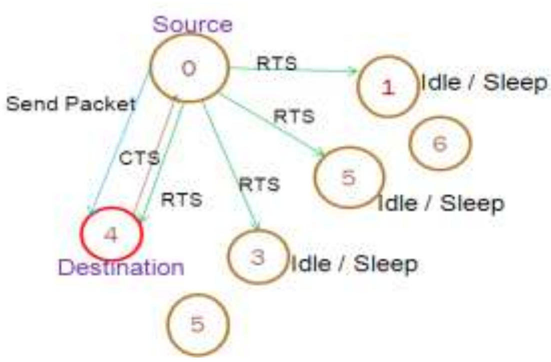

Fig 3 : Packet Transmission by making Idle Nodes to Sleep

In this case, the source considers a set of neighbours within its range by neighbour discovery process, by using RTS/CTS concept. The intended node after receiving the request responds, thereby source sends data only to it. It is also ensured that the other nodes go to sleep state instead of idle state.

RSSI METRIC DETERMINES THE FORWARDER :

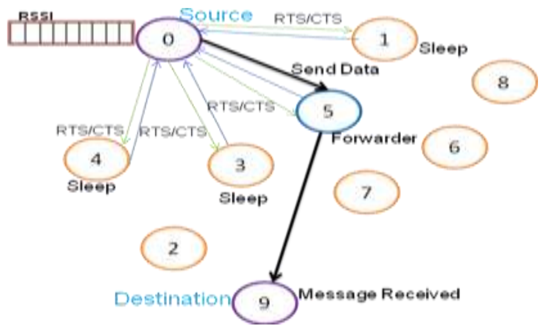

Fig 4 : Election of forwarder using RSSI

NEIGHBOR TABLE :

Table 1 : RSSI Table

NODE	NEIGHBOR NODE	RSSI
0	1	-53.23
0	3	-42.68
0	4	-49.08
0	5	-42.76

In this case, the destination 9 is present in an extremity range; here the source 0 starts a neighbour discovery process to find out its neighbour. It then updates its routing table with the received RSSI value of all the nodes. It correspondingly sends the RTS to the nodes of higher RSSI, rest goes to sleep state to save energy. Node 5 is selected as the forwarding node to transmit the data packet. As a sequential approach, the source checks out the residual power of each node and continues transmission through that nodes for an effective utilization of individual node power in the network.

PROTOTYPE DEVELOPED :

The WSN nodes are arranged in the network as shown in Figure where N1, N2, N3, are the different Nodes. 'N3' indicates the destination node which is connected to computer. The data from the network is processed and displayed by this computer. The Node lifetime depends upon the power consumption of PIC16F877A, transmit and receive mode consumption of zigbee. Also it depends upon the sleep and active times i.e. duty cycle. The node is programmed with <1% of duty cycle. The Average current consumption and the node lifetime are calculated by taking the different parameters.

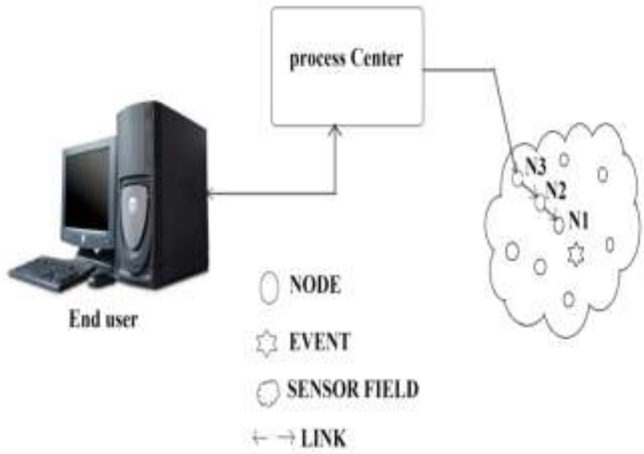

Fig 5 : Node Creation

Table 5.2 Current Consumption Vs Node Life Time

Current Consumption	Years
12.6 mA	4 years
9.5 mA	5.1 years
7.8 mA	6.2 years
7.3 mA	7 years

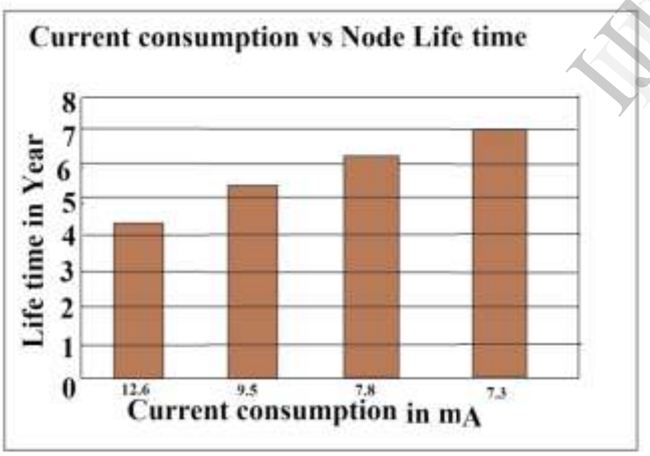

Fig 6 : Node Life Time for various transmitter Levels of zigbee

IV RESULTS AND CONCLUSION

The energy consumption of the nodes in the sleep state is calculated in the network scenario.

SLEEP STATE BEHAVIOUR :

The source node 0 spends much of its energy for sending RTS packets and updating the routing table with RSSI, and the destined node 4 spends energy for acknowledging the received messages. The nodes 1, 3, 5 which are in the sleep state consumes a considerable amount of energy and the remaining nodes 2, 9, 7, 6, 8 have a constant energy.

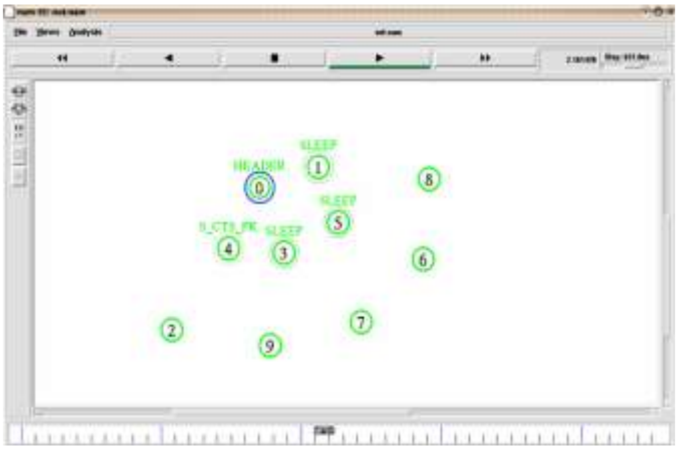

Fig 7 : Animation for Sleep State Behavior

RSSI MEASUREMENT :

Every node Energy Consumption is shown individually for both ideal and sleep states. Here we can clearly see that the corresponding source during its ideal state spends maximum energy for sending requests, messages and receiving acknowledgements and destined node for sending reply and acknowledgements. The other neighbour nodes which were originally in ideal state consumed more energy due to overhearing are made to sleep to conserve energy. A constant energy level is maintained by the far off nodes. By taking these two parameters into account the Average Energy Consumption is estimated to be around 6.97 %.

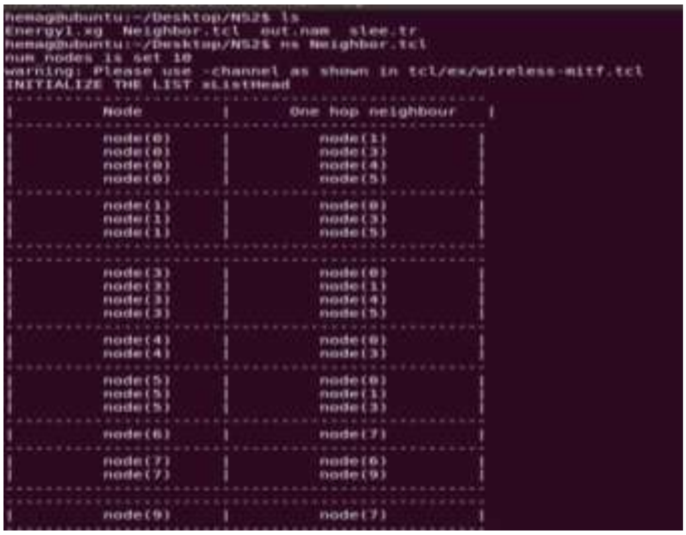

Fig 8 : One Hop Neighbouring

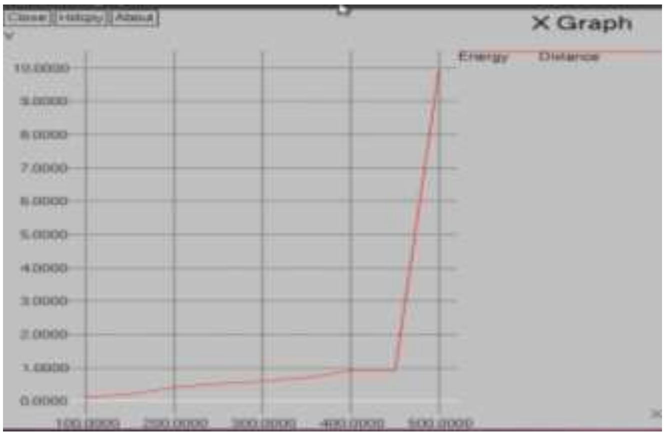

Fig 9 : Energy Vs Distance

Thus the accurate distance of the node is measured based upon the Received signal strength indication by ACP algorithm using NS2 and the influence caused by unilateral ranging error in the calculation of multilateral positioning, is reduced by bringing an adjacent node into the position, so as to amend the positioning result. The simulated results are presented.

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