Probability Based Clustering For Efficient Energy Conservation Routing in Sensor Network

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Abstract - The sensors of the wireless network are battery operated and the energy is limited to them because all are wireless sensors. The sensors placed in a network has to send data to the base station about whatever they placed for and on every information exchange the energy of the sensors goes down and it goes until the battery or energy is zero. It happens with the all sensors randomly and network works till last sensor works. Such time is called as a network lifetime and it is highly depend on the way information exchange between sensor and base station. So to make lifetime of the network longer the wireless network deployed with the routing protocols and these will regulate the energy of the sensors to make network exist longer than usual. In this paper we have taken a clustering routing protocol to make certain changes in the clustering probability to increase the lifetime of the network than existing work.

Keywords - WSN, Clustering Routing Protocol, Throughput, Lifetime.

I. INTRODUCTION

The concept of wireless sensor networks is based on a simple equation: Sensing + CPU + Radio = Thousands of potential applications [6] . It is a sensing technology where tiny, autonomous and compact devices called sensor nodes or motes deployed in a remote area to detect phenomena, collect and process data and transmit sensed information to users. The development of low-cost, low-power, a multifunctional sensor has received increasing attention from various industries. Sensor nodes or motes in WSNs are small sized and are capable of sensing, gathering and processing data while communicating with other connected nodes in the network, via radio frequency (RF) channel.

WSN term can be broadly sensed as devices range from laptops, PDAs or mobile phones to very tiny and simple sensing devices. At present, most available wireless sensor devices are considerably constrained in terms of computational power, memory, efficiency and communication capabilities due to economic and technology reasons. That‘s why most of the research on WSNs has concentrated on the design of energy and computationally efficient algorithms and protocols, and the application domain has been confined to simple data-oriented monitoring and reporting applications. WSNs nodes are battery powered which are deployed to perform a specific task for a long period of time, even years. If WSNs nodes are more powerful or mains-powered devices in the vicinity, it is beneficial to utilize their computation and communication resources for complex algorithms and as gateways to other networks. New network architectures with heterogeneous devices and expected advances in technology are eliminating current limitations and expanding the spectrum of possible applications for WSNs considerably.

Some general information about WSN, where this technology can be used, its components, architecture and routing algorithms. The first WSN was designed and used in 70s, in military field during the Vietnam war. WSN consist of nodes, from few to several one, which work together to capture data from an environment region and send this data to a base station. These sensor nodes use to track and monitor heat, temperature, vibratory movement, etc. They are small with limited computing resources and base on a routing algorithm, they can transmit data to the user. This routing algorithm depends on the network architecture and they can be changed. Since the sensor node have limited memory and they can be located in places which are hard to access, a wireless communication between nodes is needed. Because of this specific behavior, many routing and power management have been designed specially for WSN. As explained in paper [11], development of smart nodes have been researched in recent decades.

Areas where WSN can be implemented:

- The most common one is area monitoring. In this scenario a WSN is distributed over a region which need to be monitored. The example of military belongs to this application.
- Another area of WSN usage can be agriculture. Many jobs can be done with WSN, like monitoring the gravity feed water and the pump can be controlled using wireless I/O device.

- The advancement of WSN gives new opportunities also in health-care system. In traditional method, a patient should visit a doctors in regular intervals and self-reporting experienced symptoms.

But in smart homecare the WSN collects data in the base of physician's specification and provides continuous record to assist diagnosis. This method is also used for emergency situation and medicine reminder.

Architecture:

The basic block diagram of a wireless sensor node is presented in Figure 1.1. It is made up four basic components: a sensing unit, a processing unit, a transceiver unit and a power unit. There can be application dependent additional components such as a location finding system, a power generator and a mobilizer.

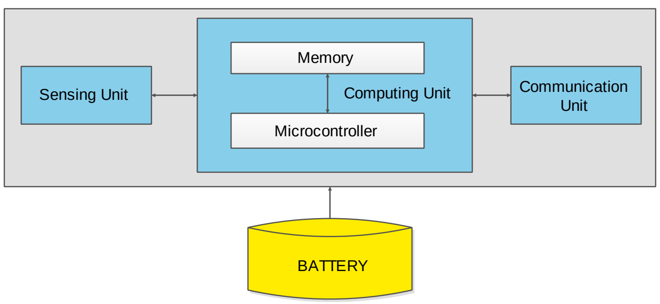

Figure 1.1: Architecture

Sensing Unit:

Sensing units are usually composed of two subunits: sensors and analog to digital converters (ADCs). Sensor is a device which is used to translate physical phenomena to electrical signals. Sensors can be classified as either analog or digital devices. There exists a variety of sensors that measure environmental parameters such as temperature, light intensity, sound, magnetic fields, image, etc. The analog signals produced by the sensors based on the observed phenomenon are converted to digital signals by the ADC and then fed into the processing unit.

Processing Unit:

The processing unit mainly provides intelligence to the sensor node. The processing unit consists of a microprocessor, which is responsible for control of the sensors, execution of communication protocols and signal processing algorithms on the gathered sensor data. Commonly used microprocessors are Intel's Strong ARM microprocessor, Atmel‘s AVR microcontroller and Texas Instruments' MP430 microprocessor. For example, the processing unit of a smart dust mote prototype is a 4 MHz Atmel AVR8535 micro-controller with 8 KB instruction flash memory, 512 bytes RAM and 512 bytes EEPROM. TinyOS operating system is used on this processor, which has 3500 bytes OS code space and 4500 bytes available code space. The processing unit of μAMPS wireless sensor node prototype has a 59–206 MHz SA-1110 micro-processor. In general, four main processor states can be identified in a microprocessor: off, sleep, idle and active. In sleep mode, the CPU and most internal peripherals are turned on, and can only be activated by an external event (interrupt). In idle mode, the CPU is still inactive, but other peripherals are active.

Transceiver Unit:

The radio enables wireless communication with neighboring nodes and the outside world. It consists of a short range radio which usually has single channel at low data rate and operates at unlicensed bands of 868-870 MHz (Europe), 902-928 MHz (USA) or near 2.4 GHz (global ISM band). For example, the TR1000 family from RF Monolithic works in the 800–900 MHz range can dynamically change its transmission power up to 1.4 mW and transmit up to 115.2 Kbps. The Chipcon‘s CC2420 is included in the MICAZ mote that was built to comply with the IEEE 802.15.4 standard [8] for low data rate and low cost wireless personal area networks.

There are several factors that affect the power consumption characteristics of a radio, which includes the type of modulation scheme used, data rate, transmit power and the operational duty cycle. At transmitted power levels of -10dBm and below, a majority of the transmit mode power is dissipated in the circuitry and not radiated from the antenna. However, at high transmit levels (over 0dBm) the active current drown by the transmitter is high. The transmit power levels for sensor node applications are roughly in the range of -10 to +3 dBm [9]. Similar to microcontrollers, transceivers can operate in Transmit, Receive, Idle and Sleep modes. An important observation in the case of most radios is that, operating in Idle mode results in significantly high power consumption, almost equal to the power consumed in the Receive mode. Thus, it is important to completely shut down the radio rather than set it in the idle mode when it is not transmitting or receiving due to the high power consumed. Another influencing factor is that, as the radio's operating mode changes, the transient activity in the radio electronics causes a significant amount of power dissipation. The sleep mode is a very important energy saving feature in WSNs.

Battery :

The battery supplies power to the complete sensor node. It plays a vital role in determining sensor node lifetime. The amount of power drawn from a battery should be carefully monitored. Sensor nodes are generally small, light and cheap, the size of the battery is limited. AA batteries normally store 2.2 to 2.5 Ah at 1.5 V. However, these numbers vary depending on the technology utilized. For example, Zinc–air-based batteries have higher capacity in Joules/cm3 than lithium batteries. Alkaline batteries have the smallest capacity, normally around 1200 J/cm3. Furthermore, sensors must have a lifetime of months to years, since battery replacement is not an option for networks with thousands of physically embedded nodes. This causes energy consumption to be the most important factor in determining sensor node lifetime.

I. PROPOSED METHODOLOGY

Wireless Sensor Network has been designed to monitor physical or environmental condition and many research works has been done on this topic. But power supply in this model of network makes problem. Because of using battery as a power ,the probability that network die will increase. Therefore should try to not waste energy, in the aim of increasing network's life time.

The idea of EH-WSN is proposed for solving the problem of power in WSN.

In this theory, network harvest power from environment and use this power instead of battery. The aim in EH-WSN network is not keeping network alive longer, but because there are enough energy in this theory the goal changes to maximizing the workload.

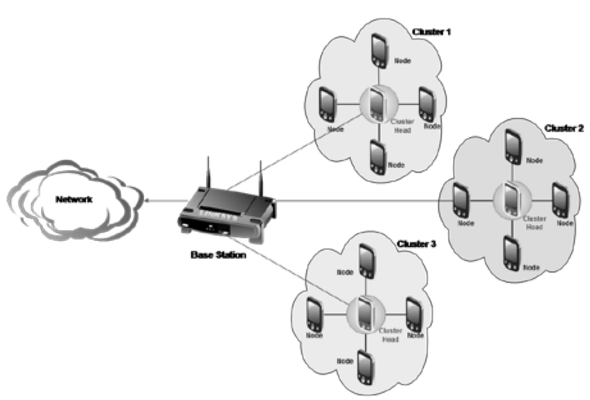

Fig. 3.1 Network Diagram of Proposed Methodology with Improved-DEEC

The purpose of this thesis is following in some steps: _rst of all review literature about the group of energy-aware routing algorithms in WSN and more deeper be involved in the algorithms that are specified to support energy harvesting technology. In the next step should choose some candidate routing algorithms from the category of EH-WSN routing algorithms base on their evidence in literature. After selecting the candidate we have to design and implement a simulator to simulate the given algorithms in different scenario. With the help of some analysis metrics, at the end, we should highlight the behavior of our candidate in different simulation condition.

Here we are making changes in one of the routing protocol i.e. distributed energy efficient routing (DEEC), where changes are being made in the information aggregation energy. The proposed approach is to have the lower data aggregation energy and the energy can be conserve for such frequent changes in the network. The proposed diagram of network is presented in Fig. 3.1.

The above mentioned proposed routing strategy is implemented and its step by step execution is shown in below steps which are as follows:

a) *Start the program.*
b) *Initialization environmental variables (with Different CH Selection Probability)*
c) *Generation of wireless sensor network model*
d) *Set loop for the number of rounds*
e) *Set number of alive nodes at the beginning of network*
f) *Check number of dead nodes*
g) *Select the cluster heads.*
h) *Calculate energy consumptions to transfer data between cluster head (CH) to Base station(BS) and nodes(N) to cluster head(CH)*
i) *Check alive nodes after data transfer*
j) *If alive nodes are > 0 then Go back to Next Round (step c)*
k) *If alive nodes are = 0 then calculate Throughput of the network*
l) *Compare and display results*
m) *End of program*

Table I: Network Simulation Parameters

Operation	Energy Dissipated
Transmitter / Receiver Electronics	Eelec = Etx = Erx = 50nJ/bit
Data aggregation energy	EDA = 5nJ/bit/signal
Transmit amplifier (if d to BS < do)	E_{fs} = 10pJ/bit/4m^2

Transmit amplifier (if d to BS > do)	$E_{mp} = 0.0013pJ/bit/m^4$

II. SIMULATION RESULTS

Wireless Sensor Network(WSN) is having lots of research areas to work on and here we have chosen routing protocol to make network lifetime more than the previous work. The simulation performed on distributed energy efficient clustering (DEEC) which is based on reducing the data aggregation energy.

The simulated outcomes are in terms of number of alive nodes and number of dead nodes versus number of transmission rounds and throughput curve.

In the previous work lifetime of the network with low energy adaptive clustering hierarchy(LEACH) is calculated up to 2490 transmission rounds.

If the network sustain for more number of rounds means lifetime of the network is going better. In proposed approach the lifetime of the network increased up to 3099 rounds in 100x100 network, 2826 rounds in 134x134 network, 2521 rounds in 150x150 network and 2867 rounds in 200x200 network which is greater than the previous work. Table II shows comparison of the network lifetime with existing work.

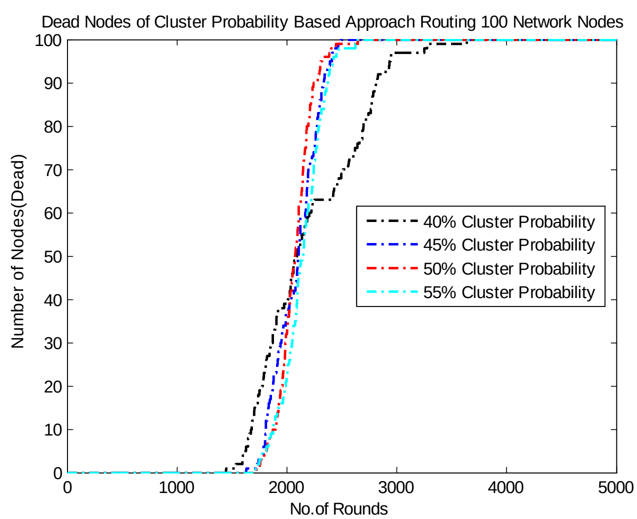

Fig. 4.1 Network lifetime in terms of dead nodes versus no. of rounds

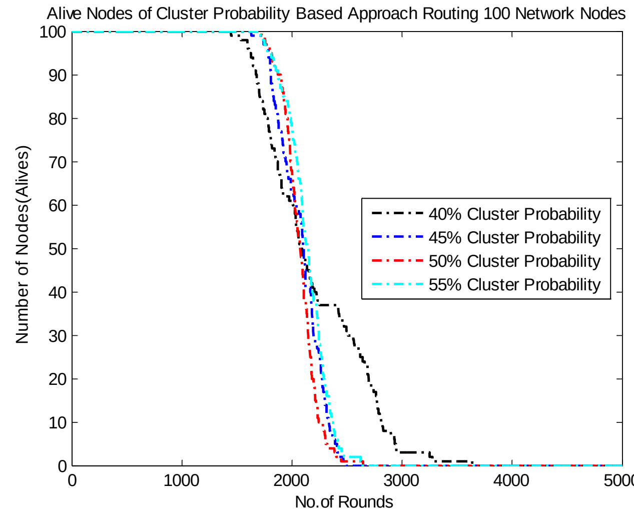

Fig. 4.2 Network lifetime in terms of alive nodes versus no. of rounds

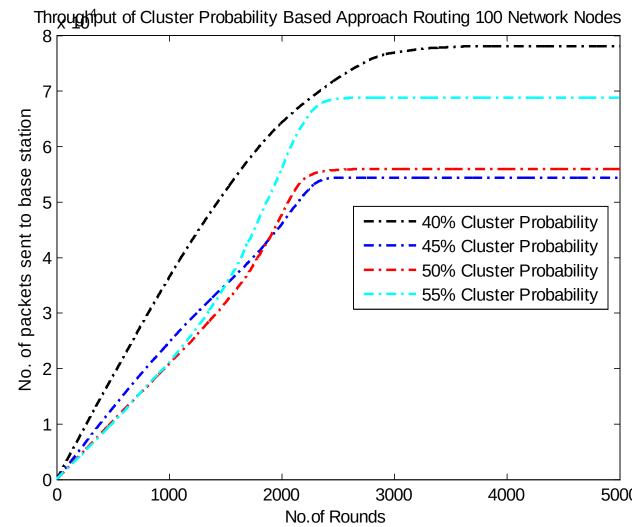

Fig. 4.3 Throughput versus no. of rounds

The alive nodes versus no. of transmission rounds graph is shown in the Fig. 4.1 and dead node versus no. of transmission rounds graph is shown in Fig. 4.2 the Throughput is also shown in the Fig. 4.3.

III. CONCLUSION AND FUTURE SCOPE

In Wireless Sensor Networks(WSNs), energy consumption and delay guarantee issues are of major consideration in developing efficient routing schemes and from the proposed methodology and simulation results analysis it is clear that with the lower cluster head selection probability in the Improved distributed energy efficient clustering (DEEC) routing will have longer network lifetime which is higher than the existing methodologies. During simulation of proposed methodology number of dead nodes vs transmission rounds are analysed and the same for alive nodes and throughput i.e. packets send to base station also calculated for lower cluster head selection probability and found longer network lifetime(the sensor nodes survived to more number of transmission rounds) with better throughput. In the upcoming era of technology researcher will work out by adopting hybrid routing methodologies with proposed work of this paper will definitely lower energy consumption and increases network lifetime.

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