



APPLICATION OF ENERGY EFFICIENT ALGORITHM - A CASE STUDY

R. Sittalatchoumy¹, Dr.L. Sivakumar²

Department of Electronics and Communication Engineering, Anna University, Chennai, India¹

Vice principal, Sri Krishna College of Engineering and Technology, Coimbatore, India²

ABSTRACT: This Paper proposes a case study on an energy efficient routing protocol for wireless sensor nodes. This routing protocol adopts the Discrete Radio Power Allocation method which verifies that the transmission power is independent of the transmission distance up to certain limit. Here, the nodes are fixed and depending upon distance, the Power setting are made. Using this structure, the shortest path algorithm was carried out and from the results it can be proved that this method reduced the energy consumption of each node and this will increase overall efficiency of the system.

Keywords: Routing protocol, Discrete radio power allocation, Received signal strength, wireless sensor node, Energy efficient

I. INTRODUCTION

A wireless sensor network essentially consists of thousands of standalone nodes which are battery operated and remotely active. They are programmed in such a way as to monitor parameters and report anomalies or simply act as transceivers over long distances depending on the application they are used for. So practically speaking all those nodes are active at any given point of time and relaying information across the network. Wireless sensor networks have many applications, such as military, homeland security, environment, agriculture, manufacturing, and so on. Routing is an essential operation in such a networks. Prolonged network lifetime, scalability and information security are important requirements for many wireless sensor network applications. In most of the research paper, the routing algorithms are based upon software by which the energy consumption was made. But in this paper using the hardware, the energy consumption was reduced, by which efficiency of the system was improved. Generally in wireless transmission the transmission power is sufficiently made high so that the receiver somehow gets a signal. But there are various other factors to be taken into account like the medium and other entities along the transmission path. the RSSI value as a direct measure of the distance between the nodes. Using the RSSI value the cost estimation of each node is estimated [1,6,7].

ZigBee is a specification for a suite of high level communication protocols using small, low-power digital radios based on an IEEE 802 standard for personal area networks. ZigBee devices are often used in mesh network form to transmit data over longer distances, passing data through intermediate devices to reach more distant ones. This allows ZigBee networks to be formed ad-hoc, with no centralized control or high-power transmitter/receiver able to reach all of the devices. Any ZigBee device can be tasked with running the network.

ZigBee is targeted at applications that require a low data rate, long battery life, and secure networking. ZigBee has a defined rate of 250 kbit/s, best suited for periodic or intermittent data or a single signal transmission from a sensor or input device. RSSI and LQI are measured on the receiver node when a packet is received from the transmitter node. As the distance increases, there are more chances for the packet to get lost and hence the RSSI decreases. The LQI (Line Quality Index) is obtained to be a standard value of 108 in case of obstructionless paths. But when we have obstructions the LQI decreases. The algorithm used is based on the concept energy conservation. Now that each Zigbee is characterized by different power levels, we plan to assign the power level to be used wisely so as to reduce energy consumption. We make use of the concept of discrete power levels such that we assign the same cost for nodes at different



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distances accordingly depending upon power levels.

II . WIRELESS SENSOR NETWORKS

A wireless sensor network (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. 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.

The sensor node is given in figure.1. Sensor node uses PIC Microcontroller, which was operated in deep sleep mode by which energy saving was carried out when sensor node not receiving any data. For wireless communication, Zigbee was used.

Wireless Sensor networks have varied applications these days. They are used in various fields like defence, healthcare and so on. Thus they provide good scope for improvement, because of their extensive usage. Power consumption is the Achilles heel of Wireless Sensor Networks.

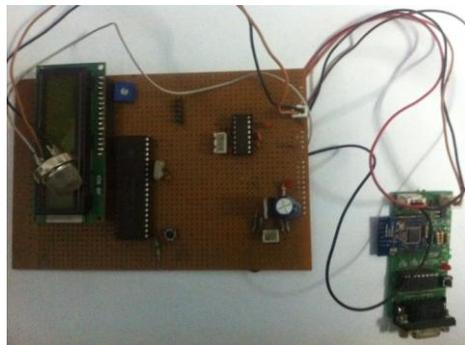


Fig.1. Prototype of Sensor Node

III. MICROCONTROLLER PIC 16877A

Microcontroller PIC16F877A is one among a family of PIC microcontroller. They are popular in use today, ranging from beginners to professionals. This is because it is very practical and uses PIC16F877A FLASH memory technology that can erase the program, a thousand times. The excellence of RISC microcontroller lies in the speed and compression code. In addition, PIC16F877A also quite practical and concise as it has 40-pin to 33 lines I / O.

IV. ZIGBEE

ZigBee is a low-cost, low-power, wireless mesh network standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications. Low power-usage allows longer life with smaller batteries. Mesh networking provides high reliability and more extensive range.

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lows ZigBee networks to be formed ad-hoc, with no centralized control or high-power transmitter/receiver able to reach all of the devices. Any ZigBee device can be tasked with running the network.

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V. EXPERIMENT

RSSI and LQI are measured on the receiver node when a packet is transmitted from the transmitter node. As the distance increases, there are more chances for the packet to get lost and hence the RSSI decreases. The LQI (Link Quality Indicator) is obtained to be a standard value of 108 in case of obstruction less paths. But when we have obstructions the LQI decreases. The algorithm used is based on the concept energy conservation. Now that each Zigbee is characterized by different power levels, we plan to assign the power level to be used wisely so as to reduce energy consumption. We make use of the concept of discrete power levels such that we assign the same cost for nodes at different distances accordingly depending upon power levels.

The procedure used for this experiment was to place the transmitter and receiver nodes a starting distance apart such as five meters. Then 10 packets are sent from the transmitter to the receiver with each power level setting available. Once all the power level settings were tested, the receiver node was moved. The Two nodes are used practically and RSSI, LQI values for different distances are estimated. Ten nodes are chosen and depending on the RSSI value, the cost are estimated. Using MATLAB Programming, the shortest path was carried out from one node to another node. Depending on the discrete power allocation, the cost is assigned and the same routing algorithm is used.

From the results, it can be proved that, the routing algorithm based on discrete power allocation is more energy efficient. RSSI and LQI are measured on the receiver node when a packet is received. from the transmitter node. As the distance increases, there are more chances for the packet to get lost and hence the RSSI decreases. The LQI (Line Quality Index) is obtained to be a standard value of 108 in case of obstruction less paths. But when we have obstructions the LQI decreases. The algorithm used is based on the concept energy conservation. Now that each Zigbee is characterized by different power levels, we plan to assign the power level to be used wisely so as to reduce energy consumption. We make use of the concept of discrete power levels such that we assign the same cost for nodes at different distances.

In this paper, the various power modes of Zigbee is used, depending upon that the cost calculations was carried out. In order to implement the work, 10 nodes are taken with different locations. Instead of providing same power for all the nodes, different power levels setting are done depending upon the distance. The ZIGBEE has two modes of operation viz. Command mode and Transceiver mode. The command mode is used for performing special functions with the ZIGBEE like acquiring signal strength etc. The transceiver mode is used for transmission and reception of signal.



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VI. EXPERIMENTAL RESULTS

RSSI(dB)	LQI	Distance(m)
-7	108	Overlap
-23	108	Closest
-37	108	5
-48	108	8
-75	108	10
-79	108	15
-85.3	108	18
-89	108	20
-92.5	108	26
-94	108	30

Table.1. Relationship Between RSSI and LQI Vs Distance



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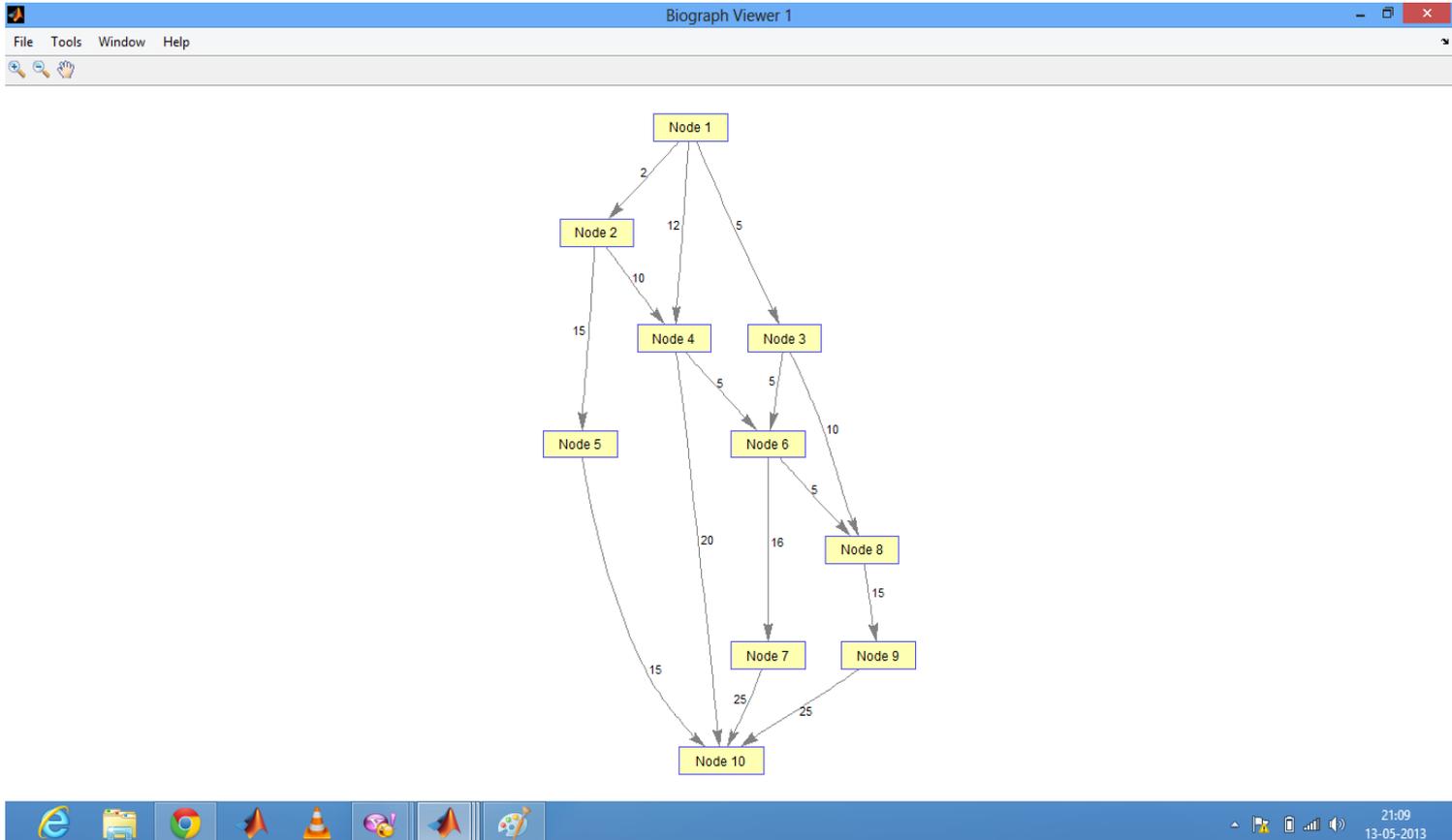


Fig .2. Implementation of wireless network of around 10 nodes using MATLAB



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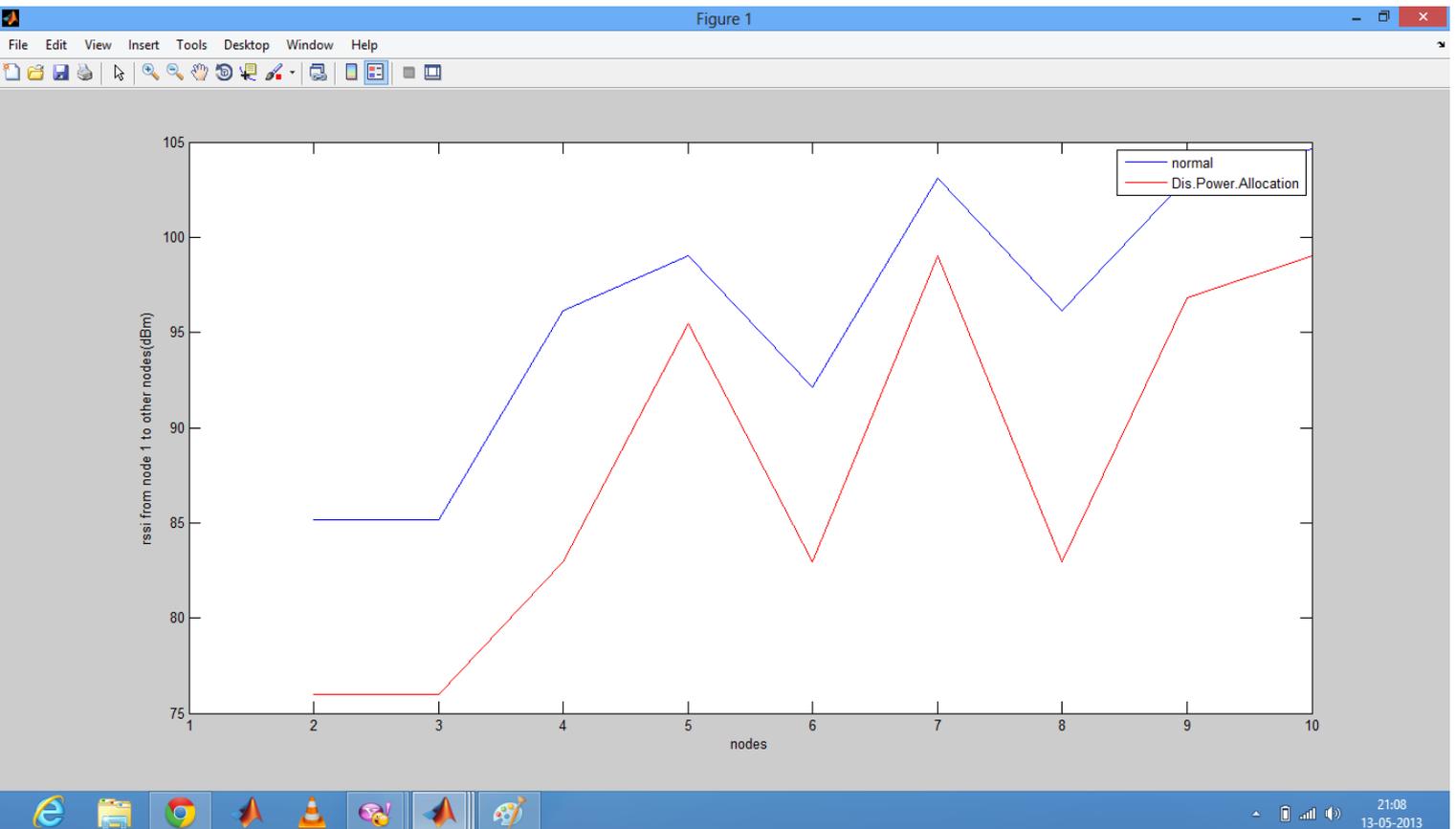


Fig .3. Energy Efficiency Comparison using MATLAB

From the graph, it can be proved that RSSI value without discrete power levels was more. This implies, the efficiency of the routing algorithms by taking discrete power level is more compared to the normal method, where the power consumption is varied depending upon the distance.

The Shortest Path algorithm was carried for 10 nodes, and the readings are noted. The Matlab Program are written depending on the structure given above for both cases. From the tabulation , it can identified discrete level was better than the normal.



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Source Node	Destination Node	Shortest Path	Cost Normal	Cost Discrete
1	10	1,4,10	32	20
2	10	2,4,10	30	20
3	10	3,6,7,10	46	35
4	10	4,10	20	15
5	10	5,10	15	15
6	10	6,7,10	41	30
7	10	7,10	25	15
8	10	8,9,10	40	30
9	10	9,10	25	15

Table .2. Minimum Cost Table for Normal and Discrete Power level structure

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Mrs. R. Sittalatchoumy has 17 years of experience in the field of academic and is actively involved in research and development activities. She obtained her B.Tech., (Electronics and Communication Engineering) degree from Pondicherry University, Puducherry and M.E., (Communication Systems) degree from Anna University, Chennai. Her field of interest is Wireless Sensor Networks, Microprocessor and Micocontroller, Communication Networks, Linear Integrated Circuits. She is a Life Member of ISTE.



Dr.L.Sivakumar obtained B.E.(Electrical Engg.) from Regional Engineering College , Tiruchirapally and M.Sc.,(Engg) in Applied Electronics & Servo Mechanism from PSG College of Technology, Coimbatore in 1970 and 1972 respectively. He completed his Ph.D., in Electrical Engineering at IIT Kharagpur in the year 1980. He joined Bharat Heavy Electricals Limited (BHEL), during October 1975 and retired as General Manager, Corporate R&D Division during December 2007. Presently he is working as Vice Principal in Sri Krishna College of Engineering and Technology, Coimbatore. His areas of work include Mathematical Modelling and Simulation, Training Simulators, Embedded System Applications, Hardware In-loop Testing Simulators, Development of Software Modules for Performance Analysis Diagnostics & Optimization for Power Plants. He has been felicitated as an Eminent Electrical Engineer by Institution of Engineers (India) during 2007 for his contribution to Power sector. He is a member of IEEE, ASME and ISTE.