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**IMPLEMENTATION OF HYBRID CLUSTERING
BASED ROUTING PROTOCOL FOR WIRELESS SENSOR
NETWORKS**

**J.Gnanambigai^[1], N. Rengarajan^[2], R.Vasanth, M.N. Gowthaman, M.R.Gokul,
V.Vignesh^[3]**

K.S.R. College of Engineering Tiruchengode, Tamilnadu

E-mail id: ^[1] gnanadhamodharan@gmail.com, ^[3] vigneshkutta@gmail.com

Abstract: - The Recent development in wireless sensor networks (WSNs) made it as effective tool for monitoring, capturing and exporting event of interest under varies application. As each sensor nodes in WSN are battery operated, energy efficient routing process becomes essential and challenging. Q-LEACH integrating feature of quadrant based directional routing (Q-DIR) and clustering architecture in LEACH is preferred for better performance. LEACH protocol can be used to manage the energy consumed congregating and distributing data, with Q-DIR as a proactive routing protocol overhead routing in and flooding can be downgraded. This paper will be concluded with implemented results of Q-LEACH protocol in Altium Nanoboard.

Keywords-Energy efficient routing, LEACH Protocol, Location based routing, Quadrant based approach, Wireless Sensor Networks

I. INTRODUCTION

Typically WSN's are composed of huge number of sensors, battery sources, processors and communication devices. Each sensor node in the network is battery driven and hence energy stays as vital parameter for maximizing performance of wireless sensor network extending lifetime of battery can be achieved through development of efficient routing protocols.

Protocol enables autonomous operation of wireless sensor network. Sensor nodes are deployed to pick up interest in the physical world. These nodes have the ability to transform physical parameters in electrical signals which can be processed by control units. To incorporate various features in WSN's a wide range of protocols were developed, among those cluster based approach was found to be more energy efficient.

II. RELATED WORKS

A. LEACH

LEACH (Low energy efficient adaptive clustering hierarchy). LEACH is a graded clustering algorithm in which cluster may be compacted or dispersed. In LEACH, clusters are formed in sparse manner and Cluster head (CH) is declared periodically. After detecting CH, CH sends a broadcast message to all other nodes to join them. The selection curb for CH is that only 5% of total nodes available. Each node then aggregates and transmits physical parameters and information to its associated CH. LEACH uses a randomize rotation of high-energy CH position rather than selecting in static manner, to give a chance to all sensors to act as CHs and avoid the battery depletion of an individual sensor and dieing quickly.

This protocol is defined by two different phases namely

- Setup phase
- Steady state phase

In setup phase Cluster Head (CH) for present round broadcast an advertisement message to rest of sensor node receivers are enabled and based on the strength of broadcast signal. Each non CH node decides their cluster for this session (refer Fig. 1)

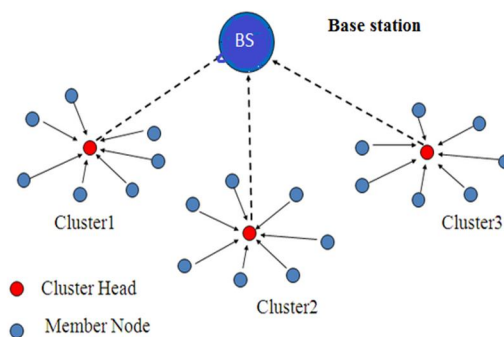


Fig. 1 LEACH model

In the steady state phase CH node aggregates the data from other nodes and transmits it to base. After a short span defined previously next round begin and above two steps takes place.

In steady state phase each node is randomly assigned with values between 0 and 1 which is generally compared with threshold value.

$$T(n) = \begin{cases} \frac{p}{1-p(r \bmod 1/p)} & \text{if } n \in G \\ 0 & \text{otherwise} \end{cases}$$

Where 'r' indicates the number of rounds of selection, 'p' refers the probability of a node to be chosen as CH. These probability increases with every round. If present random number is smaller than T(n) then that node is made as CH[4].

B. Q-DIR

Quadrant based directional routing protocol is deployed in Mobile Ad-hoc Network (MANET) in a peer to peer wireless infrastructure. As nodes in MANET are mobile in nature, routing becomes tricky. To eliminate the problem of complex computation Q-DIR makes use of Quadrant approach which will limit broadcast area to a quadrant containing source and destination nodes.

Arrival of global positioning system (GPS) enabled these position based restricted flooding protocol to come effective and alive. Location based geocasting and forwarding technique calculates the distance to all nodes in the network and compares it with the distance between source and destination (Fig 2)[2]. Now based on the compared results data is either directly (or) by a linked node from source to destination which enables efficient routing and it is quite similar to shortest path forwarding technique.

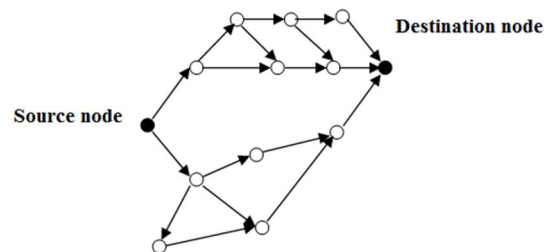


Fig. 2 Concept of flooding

In Q-DIR location information of source and destination is broadcasted in the Route Request (RREQ) packet. On receiving these packets intermittent nodes will perform a simple mathematical comparison which is normally based on the location of source, destination and current nodes which directs packet data from source to destination[3]. Mathematical comparisons are as follows:

- Quadrant of myself (node) is compared to source.
- Quadrant of destination is compared to source.
- If same, forward the data.
- Else drop it.

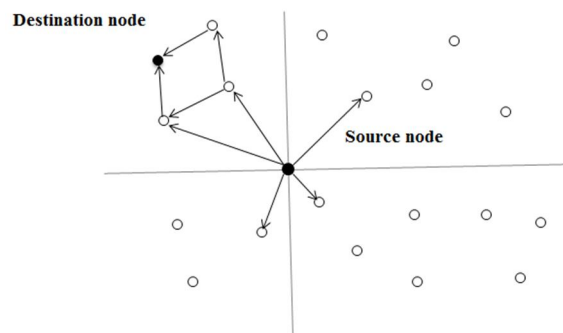


Fig. 3 Q-DIR model

C. Q-LEACH

Q-LEACH is a fusion protocol that imports advantages of two routing protocol i.e., LEACH in WSN's and Q-DIR in MANET. After initializing the network the nodes are made to form cluster and they are partitioned based on LEACH contrivance. Now based on Q-DIR mechanism Quadrant is formed such that destination node comes under the source node limit which is normally done by making adjustments with coordinates of quadrant. Now data is routed from source to destination node. Quadrant structure enables reduced flooding in transmission. In these quadrant pitches CH performs the role of a Liaison, distance and redirect zone information are determined at each nodes which helps to forward data towards destination. Above mentioned steps are carried out until the data from source reaches the destination node. Thus it clearly shows that this amalgam routing protocol reduces the number of participating nodes, flooding problem and rapid energy diminishment [1].

III. PROPOSED WORK

A. Altium Nano Board

Presents a high-level block diagram of the Desktop NanoBoard reconfigurable hardware development platform, the heartbeat of which is the Nano Talk Controller(fig 4). Motherboard resources are highlighted, as well as an indication of how satellite boards (daughter board, peripheral boards and Desktop Stereo Speaker Assembly) fit together within the system.

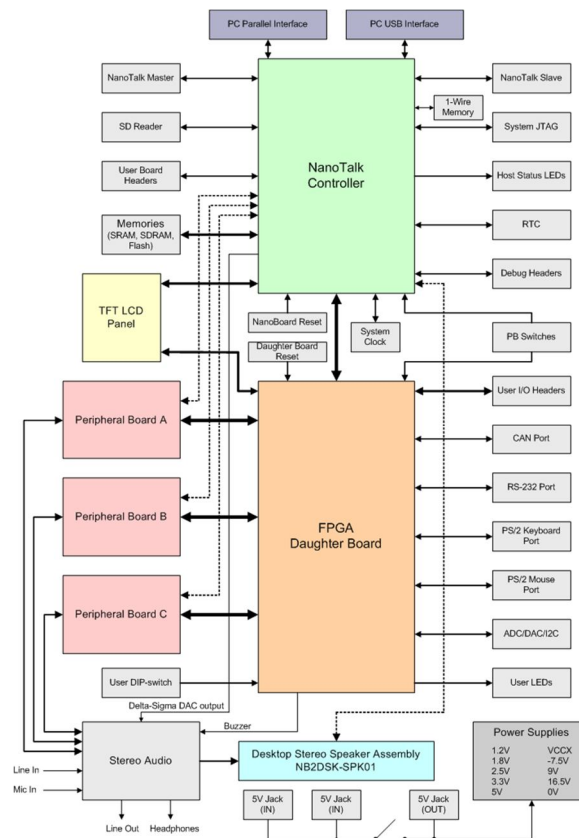


Fig. 4 Architecture of Altium Nanoboard

Reprogrammable hardware development platform that harnesses the power of a dedicated high-capacity, low-cost programmable device to allow rapid and interactive implementation and debugging of designs, Perfect entry-point to discover and explore the world of FPGA based embedded systems design. Programmable hardware realm allows you to update the design quickly and many times over without incurring cost or time penalties. Altium Designer High-capacity FPGA located on the motherboard, and provision for a single plug-in peripheral board (Altium or user's own) for additional system flexibility Automatic peripheral board detection and configuration, Dual boot system, allowing the board to update its firmware in the field by itself, over a standard USB connection – no parallel port or USB JTAG Adapter required[12].

B. Implementation Environment and Results

The Q-LEACH protocol was implemented in Altium nanoboard using C++. For implementation, 150 nodes and each node having 2J of battery energy are considered. The obtained implementation result is compared with the simulation environment for two parameters namely lifetime of battery and Percentage of power consumed. Figure 5 explains about the percentage of battery lifetime for various number of rounds, When Q-LEACH is implemented and simulated. From this graph, it clearly shows that implemented Q-LEACH protocol and simulated Q-LEACH protocol are quite similar in their characteristics.

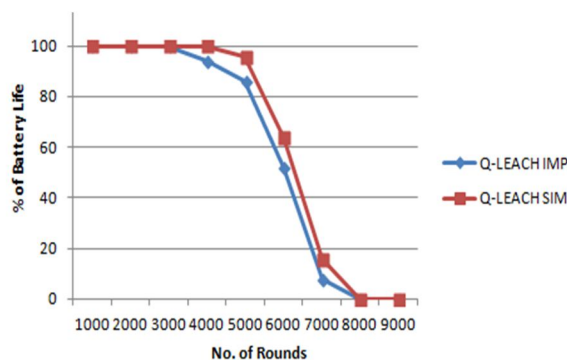


Fig. 5 The lifetime of battery in Percentage with Number of rounds

The percentage of energy consume for diverse number of rounds, When Q-LEACH is implemented and simulated as shown in Fig. 6. From this graph, it clearly shows that implemented Q-LEACH protocol and simulated Q-LEACH protocol are closely alike in their distinctiveness.

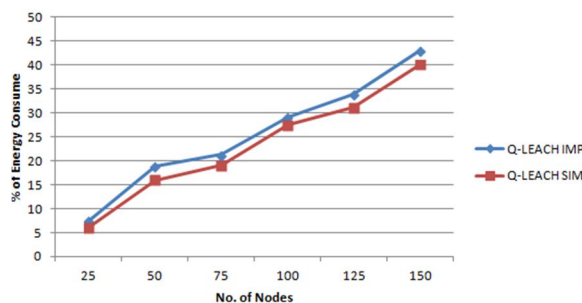


Fig. 6 Percentage of energy consumption vs. Number of nodes

IV. CONCLUSION

In this Paper, the Q-LEACH protocol is implemented in Altium nanoboard. The results show that both implementation and simulation are likewise similar to each other for energy consumption and node aliveness. From this Q-LEACH protocol stays as fine energy efficient protocol when compared to other protocol.

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