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REAC-IN Regional Energy Aware Clustering Protocol in Wireless Sensor Network

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Abstract— **An appropriate clustering algorithm for grouping sensor nodes can increase the energy efficiency of WSN's. Here, This paper is proposing a new regional energy aware clustering method using isolated nodes for WSNs, called Regional Energy Aware Clustering with the Isolated Nodes (REAC-IN). In REAC-IN, CH's are selected based on weight. To prolong network lifetime, the regional average energy and there distance between these sensors and the sink are used to determine that whether the isolated node sends its data to CH node in the previous round or to the sink. The simulation results of the current study revealed that the REAC-IN out performs other clustering algorithms.**

Keywords- REAC-IN, DEEC, EM Algorithm

I. INTRODUCTION

Wireless Sensor Network used to monitor the physical and the environmental conditions such as temperature, sound, pressure etc and passing the data through the network to the main location. A sensor network consists of multiple detection stations is called sensor nodes , each of which is small, lightweight and portable. Each wireless network consists of hundreds of nodes which integrate with existing wired measurement and control system. Node consume more energy for transmission purpose, with this network lifetime of WSN will decreased. So the nodes are dies quickly in the network.

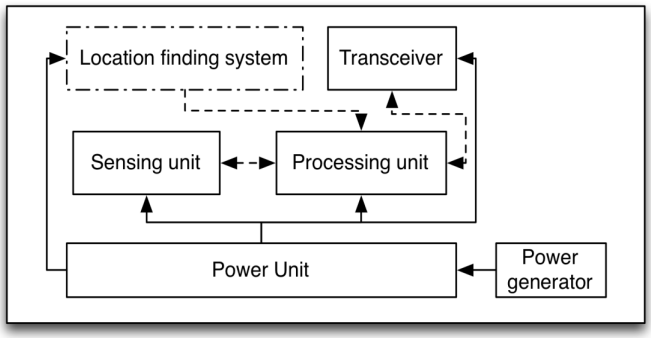

Fig. 1 Wireless Sensor Network [2]

There are various energy efficient protocols which prolonged the network lifetime.

- No need for hard wiring, low distance limits, high energy and cost efficiency.
- Disaster alarm system can also take help from WSN
- Sometimes it is impossible to install equipment in some areas due to lack of access to power.
- Monitor weather conditions by detecting changes in environmental parameters such as temperature, humidity etc.
- Detecting landslide by detecting movement in soil.

Every sensor node is equipped with microcomputer, transceiver, and transducer and power source. The transducer generates their electrical signals based on sensed physical effects and phenomena. The design of WSN (Wireless Sensor Network) depends on the application and considers the factors such as environment, the application design objective, system constraint and cost. One can easily monitor their assets with reliability using WSN.

1.1 WSN Architecture

A wireless sensor network (WSN) consists of three main components : Nodes, Gateways and Softwares . The spatially distributed measurement nodes interface with sensors to monitor assets. The acquired data without wire transmits to the gateway, which can operate independently or it can connect to a host system where you can collect, analyses and process and present your measurements data using softwares. Routers are special types of measurement node that you can use to increase WSN distance and reliability.

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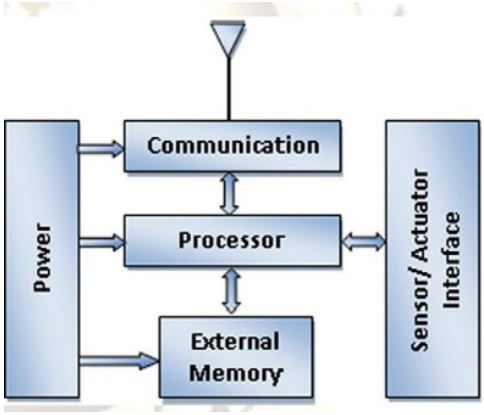

Fig. 2 Wireless Sensor Network Architecture [3]

1.2 Limitations of WSNs

- Possess very little storage capacity – a few hundred kilobytes(KB)
- Possess modest processing power to 8MHZ
- Works in short communication range – consumes a lot of power
- Required minimal energy for constrains protocols
- Have batteries with the finite life time
- Passive devices provide little energy

II. LITERATURE REVIEW

In IEEE [1] Jenq-Shiou Leu, et al. In this paper they discuss the Energy Efficient Clustering Scheme for Prolonging the Lifetime of Wireless Sensor Network(WSN) with Isolated Nodes. A suitable clustering algorithm for grouping sensor nodes can increase their the energy efficiency of WSNs. However, clustering requires additional overhead, such as cluster head (CH) selection and assignment, and cluster construction. This paper proposes a new regional energy aware clustering(REAC) method using isolated nodes for WSNs, called Regional Energy Aware Clustering with Isolated Nodes (REAC-IN). In REAC-IN, CHs are selected based on their weight. Weight is determined according to the residual energy of each sensor node and the regional average energy of all sensors into the each cluster. Improperly designed distributed clustering algorithms can cause nodes to become isolated from CH's.

In [9] Qureshi. N. et al. In this paper they discuss the Multi-level stable and the energy-efficient clustering protocol in heterogeneous wireless sensor networks Classical clustering protocols in wireless sensor networks (WSN) assumes that all nodes are equipped with the same amount of energy. As a result, they cannot take full advantages of the presence of node heterogeneity. The proposed protocol is a heterogeneous aware-ness to prolong the stability period, which is crucial for many applications. The performance of the proposed protocol is compared by the existing homogeneous and heterogeneous protocols. Simulation results show that the proposed protocol provides a longer stability period, which is more energy efficient and higher average throughput than the existing protocols.

In [7] Amrinder kaur, Sunil Saini: In this paper they discuss A New Approach for Clustering in Wireless Sensors Networks Based on LEACH which Centerlized is similar to the LEACH protocol. In this, instead of nodes randomly self-selecting as a CH, the in LEACH performs a centralized algorithm. The sink collects location data from the nodes and they broadcast its decision of which nods are to act as CH. The overall performance LEACH-C is better than LEACH. But once the energy cost of communicating with sink becomes higher than the energy cost for cluster formation, LEACH-C no longer provides good performance. Their sinks may be located far from the network in most WSN applications.

In IJDSN [13] Hanady M. Abdulsalam and Bader A. Ali: In this they paper they discuss W-LEACH Based Dynamic Adaptive Data Aggregation Algorithm for the Wireless Sensor Network(WSN) Weighted Low Energy Adaptive Clustering Hierarchy Aggregation (W-LEACH), is a centralised data aggregation algorithm. As in LEACH, W-LEACH is consists of Set-up phase and Steady-state phase
In the setup phase, W-LEACH will first calculates a weight value, *wi*, and assigns it to each sensor. The selection of CH is based on the calculated weights, such that the higher the weights then there are the better chance for them to be CH's. unlike LEACH, W-LEACH does not take into consideration whether or not this sensor was a CH for previous near rounds. In steady-state phase, the candidates for sending data to CH's are also chosen based on their weights, such that sensors with less weight are better candidates to send data to their CH's to make sure that areas with low densities and far from their CHs are covered.

In [10] Vidya K S Arun Anoop et al: A Probabilistic Approach to Location Verification in Wireless Sensor Networks. The proposed Probabilistic Location Verification algorithm leverages the probabilistic dependence on the number of hops is broadcast packet traverses to reach a destination and the distance between the source and destination point. A small number of verifier nodes determine the likely of the claimed location, which is represented by a real number between zero and the number one. Using the calculated likely metric, it is possible to create arbitrary numbers of the trust levels in the location claimed. Simulation studies verify that the proposed solution provides the high performance in the face of various types of attacks .

III. PROTOCOLS

REACH IN: In existing work proposes a new regional energy aware clustering method with isolated nodes for WSN's is called Regional Energy Aware Clustering with Isolated Nodes (**REAC-IN**) . In **REAC-IN**, CH's are selected based on. Weight is determined according to the residual energy of each sensor and their the regional average energy of all sensors in each cluster. Improperly designed distributed clustering algorithms can cause nodes to become the isolated from CH's. Such isolated nodes communicate with the sink by consuming excess amount of the energy.

$$\Pr\{An \mid A_0 A1 \ldots A_{n-1}\} = \sum_{k=0}^{Mn} [\frac{(\wedge n(t))^k}{k!} \exp(\wedge_n(t)) \times \frac{1}{M' n_k^!}$$

$$\times \Gamma(M_{n,k}^{'} + 1 \sum_{m=0}^{n-1} (R_{m,n}^1 . \wedge_m (t))]$$

To prolong network lifetime , the regional average energy and the distance between sensors and the sink are used to determine that whether the isolated node sends its data to a CH node in the previous round or to the sink.

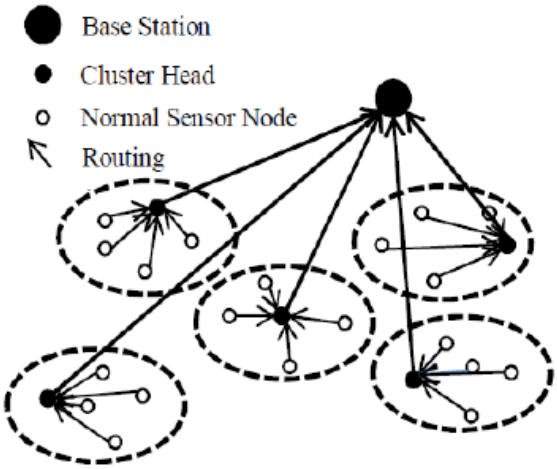

Fig. 3 Regional energy aware clustering with isolated nodes[4]

LEACH:-A lot of protocols to reduce the energy consumption have been proposed .It is the one of the most well-known clustering approaches is **LEACH** that utilizes a randomized rotation of local cluster head to evenly distribute the energy load among the sensors in the network . The operation of **LEACH** is broken up into the rounds which each round consists of two diffrent phases, the set up phase and other is the steady state phase. In the set up phase, each node decides whether or not to become a CH for the current round. The decision is based on threshold.

$$T(n) = \left\{ \frac{P}{1 - P * (r \bmod \frac{1}{p})} \right\} if \ n \in G$$

Where p is the percentage of cluster; r is the number of rounds; G is the collection of nodes that have not yet been head nodes on the first 1/P rounds.

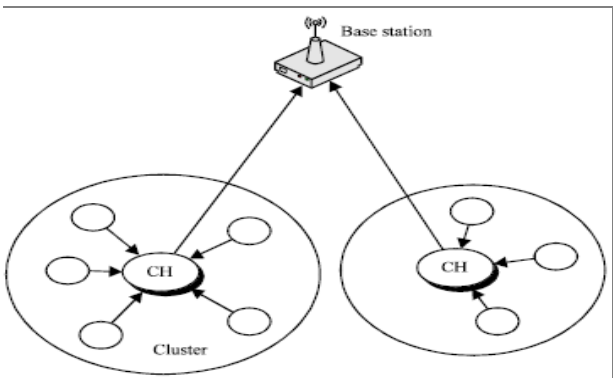

Fig.4 LEACH[6]

DEEC:-DEEC (Distributed Energy Efficient Clustering):- In DEEC protocol ,all nodes use the initial and the residual energy level to define the CH's . DEEC estimate the ideal value of network lifetime to compute the reference energy that the each node should expend during the each round . In a two-level heterogeneous network, where we have two categories of nodes, m . N advanced nodes with initial energy equal to Eo. (1+a) and (1 − m). N normal nodes, where the initial energy is equal to Eo. Where a and m are the two variable which control the nodes percentage types which is (advanced or normal) and the total initial energy in the network of ETotal.

- The value of Total Energy is given as

  Etotal = N. (1−m).Eo+N.m.Eo.(1+a) (1)

- energy of rth round is set as follows

  E(r) =1/N Etotal(1 –R)

  Where R denotes total rounds of network lifetime

  R=ETotal/ ERound

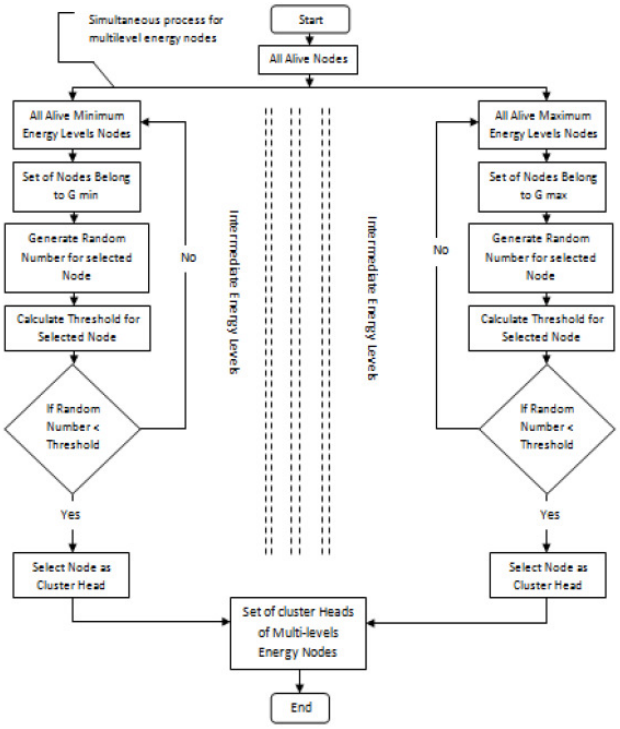

Fig.5 Flow chart of CH selection in Distributed energy efficient Clustering protocol[5]

IV. CONCLUSION

A WSN is a combination of wireless communication and sensor nodes. Their network must be energy efficient and stable and have a long lifetime . The REAC-IN protocol presented in this paper improves the CH selection process and solves the problem of node isolation. The simulation results revealed that the performance of the algorithms used in REAC-IN to improve the lifetime and the stability of a network is more favourable than that of the algorithms used in other protocols. In our paper we are laying stress to increase the network life time and for the improvement in performance of existing protocol further we will use EM algorithm.

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Mr. Jagdeep Singh pursed Bachelor of Computer Science Engineering from Punjab Technical University, Punjab in 2008. He is currently pursuing masters and currently working as Executive in IT sector in reputed company, Punjab. He has 4 years experience in IT sector.

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