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A Distributed Clustering Scheme for Dense Wireless Sensor Networks

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Abstract: A sensor node, also known as an Alfeo (mainly in North America), is a sensor network node capable of processing, collecting sensor data, and communicating with other connected nodes in the network. Alpheus is a node, but a node is not always a point. Each sensor node has a microprocessor and some memory. In addition, each sensor node has one or more sensor devices such as acoustic sensors, microphone arrays, and video cameras, infrared, seismic or magnetic sensors. However, dead batteries in sensor nodes are difficult to replace. A typical sensor node consumes part of its energy during wireless communication. This research paper proposes to develop a well estimated distributed clustering model for dense wireless sensor network fields that provides improved performance over the existing clustering algorithm LEACH. The two robbery concepts behind the proposed system are the hierarchical distributed clustering mechanism and the threshold concept. Energy consumption is significantly reduced, which significantly extends the life of sensor nodes.
Keywords: Wireless sensor network, sensor node, cluster head, base station, residual energy, energyUtilization, network lifetime.

I. INTRODUCTION

Area tracking is a common WSN application. When monitoring the area, the WSN is placed in the area where some phenomenon must be monitored. a military example is the use of sensors to detect enemy penetration; A civilian example is geofencing of gas or oil pipelines. Medical applications can be of two types: portable and implanted. Portable devices are used on the surface of the human body or only close to the user. Implantable medical devices are those that are placed in the human body. There are also many other applications, such as measuring body position and human location, general monitoring of sick patients in hospitals and at home. The body's regional networks can collect information about an individual's health, condition and energy consumption. There are many applications of monitoring environmental parameters, examples of which are given below. They share the challenges of the harsh environment of the and the lower power of the. Wireless sensor networks have been deployed in several cities (Stockholm, London and Brisbane) to monitor dangerous gas concentrations for citizens.

They can use ad hoc wireless connections instead of a wired installation, which also makes them more mobile to test readings in different areas. A network Sensor nodes can be installed in the forest to detect the start of a fire. Nodes can be equipped with sensors that measure temperature, humidity and gases produced in trees or vegetation during a fire. Early detection is critical to the success of firefighters; Thanks to Wireless Sensor Networks, the Fire Department knows when a fire starts and how it spreads. The landslide detection system uses a network of wireless sensors to detect small ground movements and changes in various parameters that may occur before or during a landslide. Based on the collected data, it may be possible to know the imminent occurrence of landslides long before they actually occur. Water quality monitoring includes analysis of the water characteristics of dams, rivers, lakes and oceans, as well as groundwater resources.

The use of multiple wireless distributed sensors enables more accurate water condition mapping and allows permanent deployment of monitoring stations in hard-to-reach locations without manual data acquisition. Wireless sensor networks can effectively prevent the consequences of natural disasters such as floods. Wireless nodes have been successfully deployed in rivers where water level changes need to be monitored in real time. Wireless sensor networks have been developed for machine condition-based maintenance (CBM) because they offer significant savings and enable new functionality. Wireless sensors can be placed in places that are difficult or impossible to reach with a wired system, such as rotating machinery and unconnected vehicles. Because of the high density of server racks in data centers, cabling and IP addresses are often a problem. To solve this problem, more and more racks are equipped with wireless temperature sensors that monitor the inlet and outlet temperatures. Since ASHRAE recommends up to 6 temperature sensors per rack, the 's wireless network thermal technology provides an advantage over traditional wired sensors.

Wireless sensor networks are also used to collect data for environmental monitoring, this can be as simple as monitoring the temperature of a refrigerator to the water level of overflow tanks at a nuclear power plant . The statistical data can then be used to indicate system performance. An advantage of WSNs over traditional recorders is the "real-time" data input that is possible. Water quality and water level monitoring includes many activities such as controlling the quality of groundwater or surface water and ensuring the water infrastructure of the country for the benefit of both people and animals. It can be used to protect against water loss. Wireless sensor networks can monitor the state of civil infrastructure and related geophysical processes in real time and over long periods of data collection using well-defined sensors. a wireless sensor network is used to monitor wine production both in the field and in the cellar [1-11]. Although wireless sensor nodes have existed for decades and have been used in applications as diverse as earthquake measurement to warfare, the modern development of small sensor nodes dates back to 1998's Smart dust project and NASA's Sensor Webs project. One of the goals of the Smart dust project was to create an autonomous sensor and communication in a space of cubic millimeters.

Although this project ended early, it led to many other research projects. These include the major research centers at Berkeley NEST and CENS. Researchers involved in these, projects coined the term Mote to refer to the sensor node. In the NASA Sensor Webs project, the equivalent term for a physical sensor node is a pod, although a sensor node in a sensor network may be another sensor network itself. Physical sensor nodes could increase their capabilities according to Moore's law. The chip footprint includes more complex and lower power microcontrollers [12-17]. So the same node footprint can pack more silicon capacity in it . Today, wafers focus on providing users with the longest wireless range (tens of kilometers), the lowest power consumption, and the easiest development process for users.

WSN consumes more energy during wireless communication. The energy consumption of for sending one bit of data corresponds to thousands of CPU cycles of operations. These wireless sensor nodes collect data from , observation areas that are probably inaccessible to , people. The data collected from the identification field is normally transmitted to the remote station (BS). High redundancy in sensor power can significantly improve sensor resolution and make sensor networks resilient to rapidly changing environments. Some promising applications of wireless sensor networks include studying wildlife habits, environmental monitoring, and health monitoring. Since wireless sensor nodes are power-limited devices, long-range transmissions should be reduced to extend network lifetime. Thus, direct communication between nodes and the base station is strongly undesirable. An effective method to increase efficiency is to arrange the network into several clusters (Figure 1),

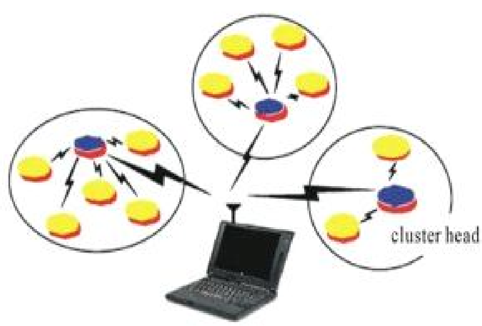

Figure 1: Clustering method in a sensor network

so that each cluster chooses a single node or cluster head (CH) as its leader [18-21]. The cluster head collects data from other sensor nodes in the cluster directly or by hopping through attached nearby nodes. Data from nodes in the same cluster correlate very well. Data can be merged during the data fusion course. The combined data is then sent directly to the base station or with multiple hops. With this arrangement, only channels are required for data transmission

II. LITERATURE REVIEW

Extensive research has been conducted to reduce power consumption and extend the life of WSNs [28-30]. The algorithm described in this section is fully distributed, with CH varying between nodes depending on some parameters. They usually differ mainly in the CH selection method. Bandyopadhyay and Coyle used EEHC, a stochastic clustering algorithm that organizes sensor nodes into a hierarchical group with the goal of minimizing total power consumption. A system that transmits data collected by data processed by sensors. Center has unequal group numbers and static CH aggregation sends data to base station. It works well for large WANs. An obvious disadvantage of this algorithm is that very few nodes remain unclustered during the clustering process.

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Barker, Ephremides and Flynn proposed LCA [19], which was mainly developed to avoid communication collisions between nodes using TDMA slots. It uses single hop method to get better connection speed when CH is randomly selected.

An updated version of LCA, LCA2, is implemented to reduce the number of nodes compared to the original LCA algorithm. The main flaw of this algorithm is that one-hop clustering leads to the formation of multiple clusters, which wastes a lot of energy. Nagpal and Core adopted CLUBS [20], implemented with the idea of forming overlapping clusters with a maximum cluster diameter of two hops.

The clusters are formed by local diffusion, and their convergence depends on the local compactness of the wireless sensor nodes. The algorithm can be implemented in an asynchronous environment without losing efficiency. The main problem is that the clusters overlap, the CHs of the clusters are within a hop of each other, the two clusters are crumpled, and the CH selection process starts over. Demirbas, Arora and Mittal presented FLOC [21], which introduces a radio model for dual-band landscape communication. Nodes may communicate reliably with nodes in areas inside the group and unreliably with nodes in areas outside the group. It is scalable and therefore has the potential to heal itself.

It happens occasionally locally, so time, finds content that works on the wider network. The main problem of this algorithm is the unreliable communication of outgoing nodes, and the probability of message loss in the communication process is highest. Ye, Li, Chen and Wu proposed EECS [22], assuming that all CHs can communicate directly with the base station. Cluster size is variable, so clusters closer to the CH are larger, while clusters farther from the CH are smaller. Intergroup communication is really energy efficient and a great improvement in network lifespan. EEUC [23] is designed for continuous energy consumption in the network. It forms different clusters, assuming that each cluster can vary in size. The probabilistic choice of CH is an important shortcoming of the algorithm. Some nodes may be lost and not part of the cluster, in which case there is no guarantee that every node will participate in the cluster mechanism. Yu, Li, and Levy proposed DECA, which selects a CH based on residual energy, connectivity, and node ID. It is very energy efficient as it uses less messages for channel selection. The main problem of this algorithm is the high probability of incorrect CH selection, which leads to the rejection of all packets sent by the sensor nodes. Ding, Holliday, and Celik proposed a DWEHC that selects CHs based on their weights, residual energy combinations, and distances from neighboring nodes. This will create a balanced cluster independent of the network topology. The main weight node of the cluster is called CH. The algorithm creates multi-level clusters and the nodes of each cluster reach CH by broadcasting through other intermediate nodes.This shows a great improvement in energy consumption within and within the group. The main problem occurs due to the high power consumption in the few iterations before the nodes are in the most power efficient topology. HEED [2] is a widely propagated clustering algorithm, where CH selection is performed considering the residual energy of nodes and the intra-cluster communication cost, resulting in an increase in network lifetime. Obviously, it can contain a variable number of clusters and support heterogeneous sensor nodes.

CH is static, it performs data aggregation and transmits the processed data to the base station. Problems with HEED include its limited application to static networks, the assumptions of complex probabilistic methods, and multiple packet messages per node for CH selection, although it prevents arbitrary CH selection. LEACH is one of the most popular clustering mechanisms for WSNs and is considered an energy efficient protocol.

In this protocol, sensor nodes are grouped together to form clusters. In all clusters, a sensor node is arbitrarily selected as the cluster head (CH), collects data from its member nodes, aggregates the data, and then transmits it to the base station. It divides the unit of work into rounds, and each round consists of two phases, the establishment phase and the stabilization phase. During the configuration phase, a cluster is formed and a cluster leader is selected. After choosing itself as CH, a node usually sends an advertisement containing its ID. Non-clustered master nodes can decide which cluster to join based on the strength of the received advertising signal. After making a decision, each non-cluster head must send a membership request to the selected cluster head, indicating that they are a member of the cluster. The cluster leader generates and broadcasts a time division multiple access (TDMA) program after receiving all membership request messages to exchange data between sensor nodes outside the cluster without collisions. The smoothing phase begins after the accumulation and allocation of the TDMA program. Each sensor node uploads its data to the group edge once per turn in its assigned transmission slot according to the TDMA schedule, and at other times it turns off the radio to reduce power consumption. But the leader of the herd must remain vigilant at all times. Therefore, it can receive all the information from the nodes in its cluster. Once the cluster leader has received all the data from the cluster, it aggregates the data and sends it directly to the base station. This is a complete leveling process. After a certain predetermined time, the network moves on to the next round. LEACH is the simplest cluster protocol, which can extend network lifecycle compared to multi-hop routing and static routing. However, there are still some obvious downsides to consider.

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III. PROPOSED SYSTEM

The first step in creating LEACH (Low Energy Adaptive Clustering of Hierarchy) is clustering. Specifically, each sensor node decides whether or not to change the cluster head to the current ring. The selection is based on the priority and the number; in this case the node is the leader of the cluster therefore. Cluster nodes collect data and send it to the end of the cluster. If not detected, each of the node radios in the cluster may be disabled. After receiving all the data, the cluster leader aggregates the data into a single composite signal. The composite signal is then sent directly to the base station. The LEACH protocol has a bug where periodic transmissions are unnecessary, which results in unnecessary s. energy consumption. Cluster leader selection is based on priority, so weaker nodes can be purged as they are elected as often as nodes stronger than cluster leaders. Additionally, the protocol is based on the assumption that all nodes begin each round of elections with the same power output, and all nodes can broadcast with enough power to reach the base station in the event of a power failure. need. In many cases, however, these assumptions are simply unrealistic. The base station must also track sensor nodes to determine which node has the highest remaining energy. Therefore, unnecessary transmissions will occur between the base station and the cluster nodes, resulting in increased power consumption. The proposed work proposes a new idea to replace the existing technology. With the existing technology (Figure 2),

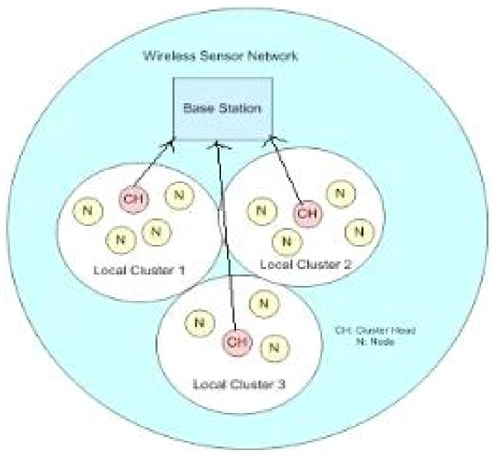

Figure 2: Assessment of LEACH algorithm

The CH sends aggregated data directly to the base option , which results in additional power consumption of them . In the proposed algorithm, total data is only transmitted to the cluster head of the next layer (FIG. 3), which reduces the communication distance between CH and BS. Two thresholds are combined, a hard threshold and a soft threshold. A hard threshold is the lowest possible value of a attribute that triggers a wireless sensor node to transmit out its transmitter and to a cluster leader .

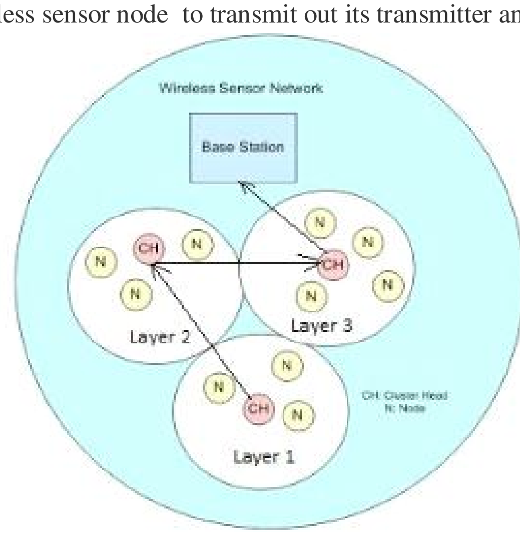

Figure 3: Assessment of the proposed algorithm.

A soft threshold is a moderate change in the value of detected characteristic that triggers node to turn on the transmitter and send data. A strict threshold attempts to reduce the number of transmissions by only allowing nodes to transmit s when the detected occurrence exceeds the threshold. Likewise, the soft threshold further reduces the number of transmissions that may have occurred, or have occurred if little or no change in the observed characteristic has occurred. With each switch in the cluster, the thresholds of both s can be changed, allowing users to control the trade-off between power efficiency and data accuracy. This technology reduces unnecessary transfers and lowers power consumption. of energy. The main operations of the deployment phase are the selection of the candidate node , the selection of the cluster leader, the planning in each cluster and the discovery of the cluster leader for the CH-CH communication .During the configuration phase, each node first decides whether it can be a candidate node in each region for the current round. The selection is based on the threshold value T(n) used in the LEACH protocol . It can be seen from equation 1 that p must be given a larger value in order to select multiple candidate nodes . Cluster points are selected from the centers of candidate nodes. cluster heads are selected with advertising messages. For this, the candidate nodes use the CSMA MAC protocol. Each candidate node broadcasts advertisements in its coverage area and depends on the maximum distance between these layers. In the proposed system, ad regions are given twice the maximum distance to cover another layers. If candidate node is in the ×Advertisement interval, where the value of is predetermined between 0 and 1, then the candidate node's opportunity should be dropped and rejoined the competition. However, a normal node ends the group with the number , suitable for this round. This parameter is , which is determined based on the signal strength of the notification message. Once each node has decided which cluster it belongs to, the node must send its own information to the corresponding cluster leader. After the group leader has received all messages from nodes that wish to join the group, the group leader creates a TDMA schedule based on the number of nodes and allocates a time slot if each node can transmit. Each cluster head sends its respective program to the nodes of the cluster. After generating the program, each cluster head performs a cluster head discovery to identify uplink cluster heads to reach the sink. To do this, each cluster leader uses a two-way handshake technique with REQ and ACK messages. Each cluster leader sends a REQ message in the advertising area. Upon receipt of the REQ message, the upstream CH sends back an ACK message to the CH that sent the REQ message. The steady-state phase of the design system is similar to other cluster-based protocols . The main function of this stage is to identify and send the detected data.Each node detects and sends detected data to the cluster leader according to its own schedule . After receiving all the data, the cluster leader performs data aggregation to reduce the amount of data. Finally, each cluster head sends data to the sink along the CH-CH routing path established in configuration step . When all data is sent or the specified timeout expires, the network returns to configuration step and begins the next candidate node selection cycle .

IV. CONCLUSION

Compared to the existing cluster mechanism (LEACH), the main feature of this algorithm is that the cluster leader forwards the next upper layer through the cluster leader to send all the aggregated data to the base station. The concepts of soft threshold and hard threshold are also used to further reduce the number of transmissions from the end of the group to the base station. In this way, the energy waste for the remote transmission of the is avoided and the power consumption of the is greatly reduced. The node death rate is lower than the current LEACH algorithm.

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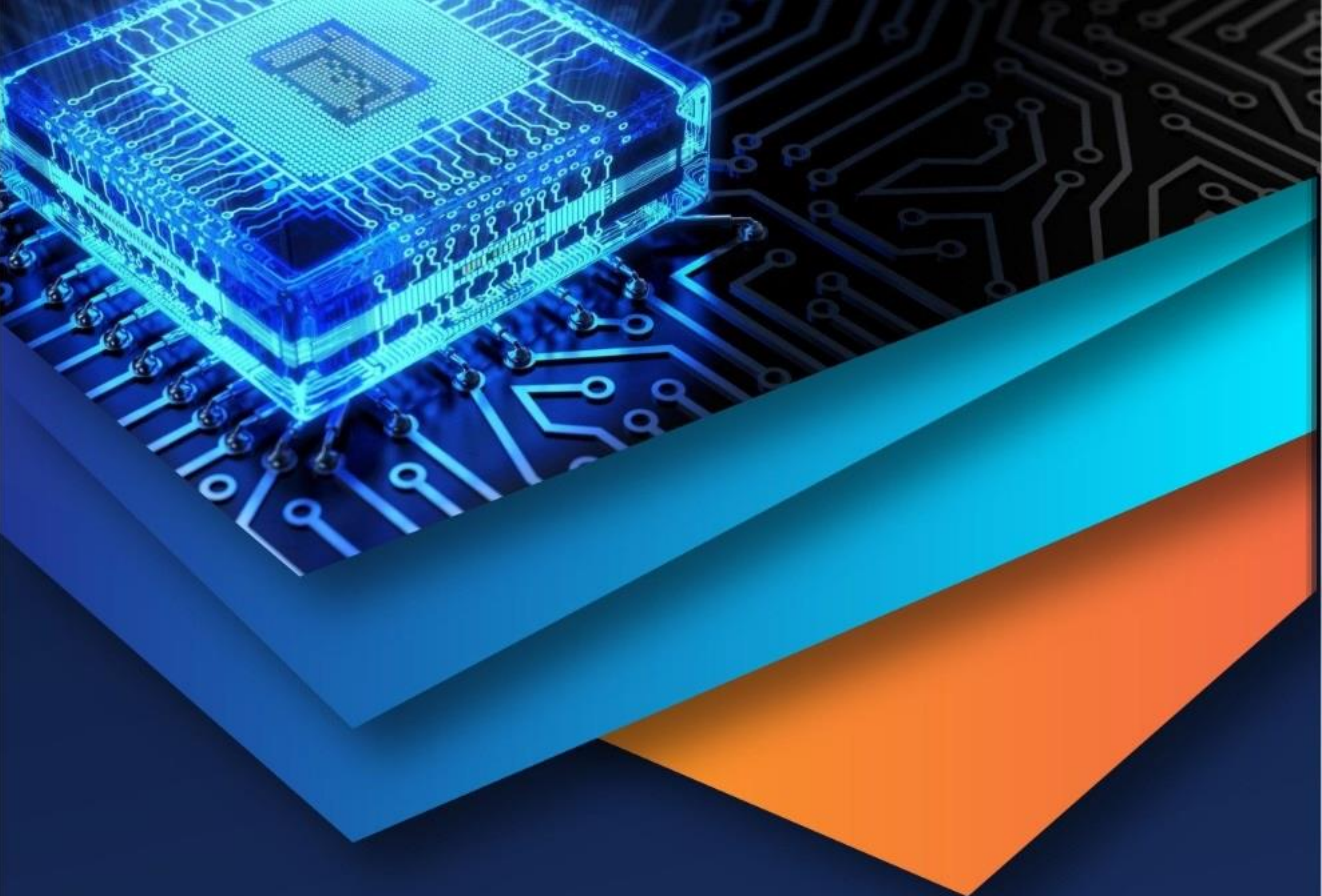

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