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Adaptive priority-based sensors during the critical conditions in agriculture

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Abstract---Monitoring and controlling the agriculture field is sometimes very difficult to farmers, especially during the natural calamities like flood, unexpected fire due to the excessive of methane, famine and etc. Though various smart technologies implemented in smart farming but still there are some issues occurs during the aforesaid critical conditions. In this paper, we propose to handle the critical condition by selecting the high priority nodes by using the modified Dijikstra algorithm. So the particular node only executed and maximum amount of energy will be consumed and also the priority based sensors will be activated during the critical conditions and transfer the real time data on time.

***Keywords*---**Priority based sensors, Cluster Head, Wireless Sensor networks.

Introduction

Wireless sensor networks (WSNs) are a new type of precise technology in precision agriculture. This article discusses a routine that should be followed on a regular basis. Hybrid routing protocol with threshold sensitivity for Precision farming is a term used to describe farming that is done. The protocol that has been proposed for deployment, region-based static clustering techniques are used. Sensor nodes that give comprehensive coverage of the entire area Agri-environment using several sorts of nodes in network different places based on the work they are undertaking and the amount of energy they have for the coverage-hole problem, level is a preferable option. The sensor nodes in the network detect the presence of the despite the fact that the ambient parameter changes over time, the detected data does not learned about the agricultural industry's environmental factor Only

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when the area is relayed to the base station (BS) value of a user-defined periodic timer (PT) or value of sensed attributes surpasses the predetermined limit.

Background and Utilizations

Precision agriculture has benefited greatly from the use of WSNs. As a result, new WSN technologies must be implemented in agriculture to improve crop output quality. Farmers do not need to continuously monitor the agriculture field to obtain information in the modern automatic irrigation system because monitoring can be done automatically by collecting real-time data on soil temperature and soil moisture content of the field in a more accurate manner using sensors. The major goal of this essay is to propose an energy-efficient irrigation routing strategy for an automated system. Because users need information from all parts of the field for optimal irrigation, the routing protocol must ensure that the entire agricultural area is covered. As a result, sensors must monitor every aspect of the field. The region-based static-clustering approach is used to provide efficient coverage over the entire network field, in which the entire area is divided into various fixed regions and different types of heterogeneous sensor nodes are deployed within the fixed regions according to their task and energy level. Some applications (such as military, health care, and traffic management) require constant information from the network field, whilst others (such as precision agriculture and industrial applications) only require information from the network when it is required. The field is continuously monitored for optimal irrigation; however information about the field is only conveyed to the BS when there is a specific water requirement in the field.

Periodic threshold sensitive routing is provided for this aim, and the deployed sensors continually sense the agricultural field's soil temperature and soil moisture content. A sensor node broadcasts a data packet to the BS once the temperature or moisture level of the field or PT reaches the defined threshold limit. For data transmission to BS, hybrid routing is used. Periodic threshold sensitive routing is provided for this aim, and the deployed sensors continually sense the agricultural field's soil temperature and soil moisture content. A sensor node broadcasts a data packet to the BS once the temperature or moisture level of the field or PT reaches the defined threshold limit. For data transmission to BS, hybrid routing is used.

Related Work

Wireless technologies are increasing in interest in the precision agriculture domain. The major challenges of the sensor network are in developing low-cost energy-efficient routing protocols with simple operation and high reliability.

Sudha et al.[17] provided two different data-transmission methods based on time-division multiple access (TDMA) scheduling for an automatic irrigation system. Different data-aggregation methods are used to increase energy efficiency. Zhou et al. [20] designed a star-based intelligent irrigation system using ZigBee technology. The microcontroller used in the system was to be powered by external power supply and nodes are mostly in sleep mode.

Li et al. [9] presented an energy-efficient WSN system for monitoring black-pepper crop. The authors used the symmetrical double-chain technology to improve sensor network lifetime, but the protocol consumes more energy in continuous data transmission. They optimized the antenna height of the BS for providing reliable communication among the sensor nodes.

Morais et al. [13] created a ZigBee-based, multi-powered wireless power management subsystem that recharges sensor-node batteries with energy gathered from the environment. As a result, most precision agricultural routing protocols are primarily focused with good dependability and do not examine how to save energy in sensor nodes. In the literature, there are numerous energy-efficient hierarchical and non-hierarchical routing techniques [15].

Most hierarchical or non-hierarchical routing protocols, on the other hand, are unsuitable for precision agriculture because they do not provide adequate coverage across the full agricultural area. Sensor nodes are distributed randomly across the entire network region in these routing methods, and if more sensor nodes are placed far away from BS, then there will be more sensor nodes.

Proposed Algorithm

To monitor two environmental parameters, the proposed model employs a periodic threshold sensitive RBHR technique. One is the soil temperature, while the other is the agricultural field's soil moisture content. The temperature and moisture-threshold data can be used to determine when irrigation should be started in the field. Before delving into the specifics of the proposed protocol, consider the following network assumptions: After deployment, all sensor nodes and the BS are stationary, sensor nodes are aware of their own locations using any of the proposed localization methods for WSNs [5], and the BS is in the middle of the sensing field.

Region-Based Sensor Deployment

For sensing and transferring information about the agricultural field, three types of heterogeneous sensor nodes (type-1, type-2, and type-3 nodes) are deployed in a (A A) unit2 network region. The complete agricultural land is divided into nine fixed areas, as indicated in Figure 1, to ensure efficient coverage throughout the entire field. Because we're dealing with specific land locations, all of the regions can be simply divided using field measurements. Because the further a node is from the BS, the more energy it consumes in data transmission, region segmentation can be done based on the availability of different types of heterogeneous nodes in the network and their sensing range.

As a result, nodes in the outermost region (REG-1, REG-2, REG-3, and REG-4) that are far from the BS use more energy to transfer data to the BS than nodes in the middle region (REG-5) and the innermost region (REG-6) that are closer to the BS. Type-3 nodes, which have more energy than type-1 and type-2 nodes, should be deployed in the outermost regions, type-2 nodes, which have less energy than type-3 nodes but more than type-1 nodes, should be deployed in the middle regions, and type-1 nodes, which have much less energy, should be deployed in the innermost region. However, we have placed type-3 nodes in the intermediate regions, type-2 nodes in the outermost regions, and type-1 nodes in the innermost region in the suggested network model.

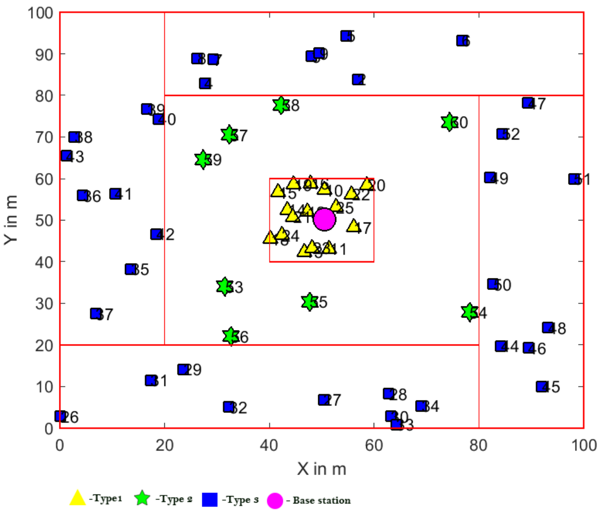

Figure 1: Region Division Network architecture

Region Division ---- Reg 1 Reg2….Reg6
Base station ----Circle (color Magenta)

Continuous data (field information) transfer to the BS is not necessary for irrigation because irrigation takes place only when there is a high demand for water in the field. The proposed protocol is a threshold-sensitive protocol in which nodes continually sense environmental parameters but only send data to the BS when the sensed value is within the range established by the users.

This aids the farmer in making irrigation decisions. Threshold sensitivity has a limit; if the sensed value never reaches the established thresholds, nodes never communicate with the BS, and the farmer is unaware of field conditions.

We present a new routing protocol that sends data after a predetermined amount of time. As a result, data transmission to the BS is influenced not only by the rigid or mild thresholds, but also by the PT. The farmer/user collects temperature and moisture content information after each fixed time interval by utilizing a PT. Hybrid routing is employed to transfer data to the BS, with all type-1 nodes deployed in REG-6 sending data directly to the BS. In the centre and outermost zones, type-3 and type-2 nodes are deployed.

Using the CH node indicated in Figure 2, they transfer their data to each other.
Because they conduct additional data-aggregation duties from the outermost region's CH node and execute data aggregation from their own members, type-3 nodes with the highest energy are installed in middle regions rather than outermost regions. When compared to sensing or transmitting energy, data

aggregation consumes more energy [8]. (as described in Table 1). Because type-2 nodes have less energy and undertake additional data aggregation activities, if we deploy type-2 nodes in midway regions, all of the type-2 nodes will die before the type-3 nodes.

After the type-2 nodes die, a coverage hole in the centre areas is established, and the sensor nodes in the outermost regions, despite being alive, are unable to communicate with the BS because of the coverage hole in the middle regions. As a result, coverage holes appear in the far reaches of the map. As a result, type-3 nodes are installed in the middle regions to eliminate the coverage-hole problem. Only one CH is chosen from each outermost and centre region in the suggested concept.

Every round, a total of eight CHs are chosen for data transmission. The number of CH nodes can be determined based on the presence of type-2 and type-3 nodes. Because a node takes more energy in data transmission than in sensing the environment, the network spends more energy in data aggregation if there are more CHs in the network. As a result, the number of CH nodes in each cluster should be chosen carefully to achieve effective load balancing in each outer/middle zone. Because the number of type-2 and type-3 nodes in the outer and middle regions, respectively, is substantially lower than the number of nodes in the innermost region, the suggested protocol uses them. As a result, we chose only one CH from each outer and middle area to preserve a CH node's data-aggregation energy. However, if there are more type-2 and type-3 nodes placed when sensing a big field, Multiple CH nodes might be found in an outermost or middle region nodes can be chosen to balance the energy of data aggregation The ideal number of CHs can be calculated using the [6] proposes a method. After the CH has been determined in a round, the data from other cluster member (CM) nodes is sent to their own. After the aggregate, CH nodes (as shown in Figure 2), and then after the aggregation, these data are forwarded to the CH node. The data-transmission thresholds (BS) are defined in the following way: The hard threshold (T1) is the value beyond which nodes perceiving perceived attributes must transmit data to BS. The moderate threshold (T2) is the value that triggers the sensor nodes to transmit data to the BS when there is a modest change in the observed attributes, and the PT is the period between two consecutive data transmissions at the BS. These two thresholds (T1 and T2), as well as PT, are used for data transmission and can be selected based on weather conditions and crop water needs. These thresholds (T1, T2, and PT) can be configured to receive information based on the user's needs, and they can be selected based on weather conditions and water use for the purpose of a crop [4]. As a result, the user can adjust these levels based on the weather and crop water requirements. All sensor nodes in the field sense the soil temperature and moisture content in each round. The measured temperature and moisture readings are saved in internal variables termed sensed temperature value (STV) and sensed moisture value (SMV) in the node (SMV). STV and SMV are set to current temperature value (CTV) and current moisture value (CMV) whenever a node transmits data. Only one of the following conditions must be met for the nodes to send data in the current round: The absolute difference values (CTVSTV) or (CMVSMV) are greater than or equal to mild thresholds [i.e., T2 (T) and T2 (M)], the CTV is greater than the rigid threshold 6T1 (T) or the CMV is less than the rigid threshold 6T1 (M), the absolute difference values (CTVSTV) or (CMVSMV) are greater than or equal to mild thresholds [i.e., T2 (T) and T2 (M)] or PT expires.

Adaptive Priority and Event Based Energy Efficient Cluster Selection Algorithm

The sink node's duty scheduling and packet planning are critical for managing the utilization of Wireless Sensor Networks (WSNs). For starters, continuing programming will be more important than one-time events. In any event, the majority of the company's current scheduling plans employ First-Come-First-Served (FCFS) scheduling algorithms, which deal with data packets as they arrive. The use of vitality by sensors is not considered as efficient to the extent that waits continue to end. Healthy nodes now require a change in the information transmission requirement in their prepared line, taking into account needs and transmitting cutoff time. The traffic components are frequently ignored by existing WSN business scheduling calculations. An ongoing need scheduler, for example, is utilized forever for persistent needs. It introduces three groups of the need plot for packet planning, with each node holding three rates on its line for three different knowledge categories. This is due to the fact that data is classed as follows:

- Non-continuous wireless packets, i.e. lower-level parcels arriving from sensor nodes,
- Continuing (most noticeable or priority1) wireless packets (priority2), and
- Non-continuous surrounding packages, i.e. packets seen at the current sensor node (least priority3).

Dijkstra's Algorithm

As the system evolves, identify the primary node, and a node's partition is the time it takes to get from the root node or source node to u. Dijkstra’s believes that a lot of individual confidence in the differentiation is exaggerated.

1. In network isolation, reverence is assigned to each node, the fundamental or root network's separation is zero, and vastness is assigned to specific nodes.
2. The uncertified nodes are separated until the start node is set to be the current node. Uncertified clusters or groups are formed by grouping together all of these nodes.
3. In evaluating each current node neighbor, this is set aside as an evaluated node, and it is removed from the uninspected community.
4. The measurement is disallowed if the objective or goal node is tested in the collection or the least node path in the uninspected area on the opposite side is infinite.
5. The uncertified batch with the least differential is then browsed by another current node, which rehashes from stage 3 onward.

Mark the displacement from the fundamental or important node to the full another node on the 62 constant partnerships to get Dijkstra's computation straight away from the root and goal node. This does not imply an unlimited or unbounded division, but it does imply that these nodes should be tested. At that point, each circle selects a current node. The schematic representation is picked as the starting point for the essential sequence, and the difference between it and it is set to nil. After the beginning, the current node will be the closest uncertified node to a rough guide for gradual repeats. For any uninspected node legibly connected to it from the present node, the differentiation is renewed. It is accomplished by calculating the total gap between the existing node's estimate and the uninspected nodes' forecast, and if that sum is not equal to the actual value, the uncertified node is re-labeled with complete estimation.

Effective Event-Based and Priority Algorithm

The effective event-based and priority algorithm has been introduced for energy-intensive routing. Cluster routing protocol typically comprises three steps: cluster head generation, cluster construction, and cluster communication. As a result, the approach includes these three steps, with the first two stages combined into the cluster institution and cluster correspondence. As a result, effective event-based and priority algorithm incorporates cluster topologies as well as secure data transport. In terms of cluster member preference, the effective event-based and priority algorithm uses an equal-chance technique, selecting cluster heads in an excessively circular and random manner and evenly allocating the network's energy to each node.

As a result, the effective event-based and priority algorithm reduces energy usage while increasing the lifetime of the network. The management strategy used by the effective event-based and priority algorithm is intermittent. Because each quantity necessitates clusters and data transfer, we set the amount too approximately to save resources; the period for trustworthy data transfer is substantially longer than the time required for the outcomes. The correct method is as follows:
Nodes can generate a number between 0 and 1 at random during the cluster setup step (including 0 and 1). The node in this round will be a member of the cluster if the random number is smaller than the T(n) criterion. The T(n) approximation procedure is based on the following equation:

$$\mathrm{T(n)} = \begin{cases} \dfrac{p}{1 - p\left[r mod\left(\frac{1}{p}\right)\right]}, & \mathrm{N} \in \mathrm{G} \\ 0, & \text{Otherwise} \end{cases}$$

In the above equation, p denotes the proportion of cluster nodes that account for the overall number of nodes, indicating the likelihood that nodes will become cluster heads; r denotes the number of rounds currently in use, and N denotes the total number of nodes; and G denotes the set of nodes that did not qualify as cluster heads in the 1/p round. Nodes chosen as cluster leaders will then inform all nearby nodes that they have been chosen as cluster heads.

The remaining node will choose the cluster to join based on the frequency of the broadcast signal it receives and notify the relevant cluster head. Cluster heads then create a TDMA for each node in the cluster and broadcast it to the remainder of the cluster. And each node will transmit data in its own timing gap, with the other timing gap being utilized to conserve resources by enabling the node to go to sleep.

During the secure data transfer period, non-cluster nodes that are member nodes in the cluster must transfer the tracked data to the applicable cluster head in the time allotted. The stable transmitting phrase can be divided into numerous frames, with the length of each frame determined by the number of nodes in the cluster. Each node receives only a portion of the frame, each with its own time duration. At the end of each round, cluster heads and clusters will be re-elected, and certain resources will be required.

The stable stage length in-round is substantially longer than the cluster establishment stage length to reduce the method's overhead. The connectivity state of the cluster's head is still kept in order to collect data from the cluster's nodes at any moment. When the cluster head has received all of the data from its member nodes, it will process it using data fusion to reduce redundant data. Finally, the cluster head transmits the fused data to its own cluster head or base node; the data is transmitted in a separate time period than non-cluster nodes, and they turn off their wireless communication module during the rest of the time to save energy.

Experiments and Results

The result of the proposed and Dijkstra's algorithms after Cluster Head Selection is presented in Figure 2.

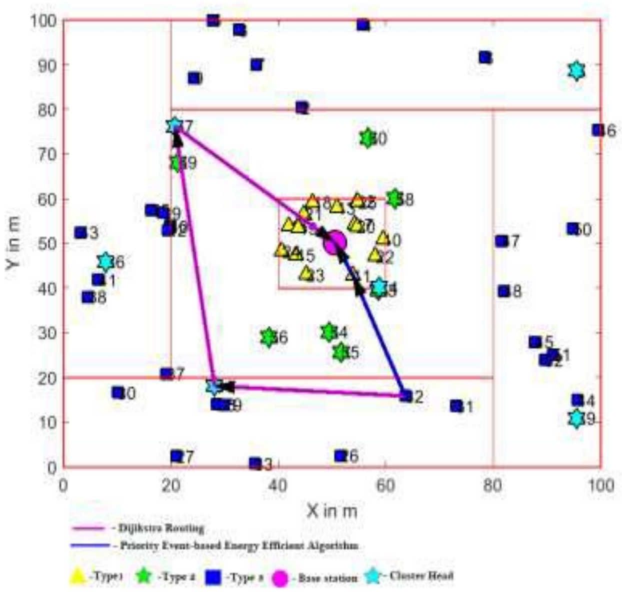

Figure 2: After Cluster Head Selection

The LEACH protocol uses the same radio transmission energy consumption concept as the effective event-based and priority algorithm. This configuration is made up of two parts: an energy-saving transmit module and an energy-saving receive module. Nodes consume energy when transporting data and their amplifiers consume energy as well; hence, nodes consume energy when processing data. As a result, the total energy spent is calculated as follows:

$$E_{total} = E_{send} + E_{received}$$

According to the radio communication energy consumption model, those sensor nodes need the amount of energy stated in the equation above to send kbit data.

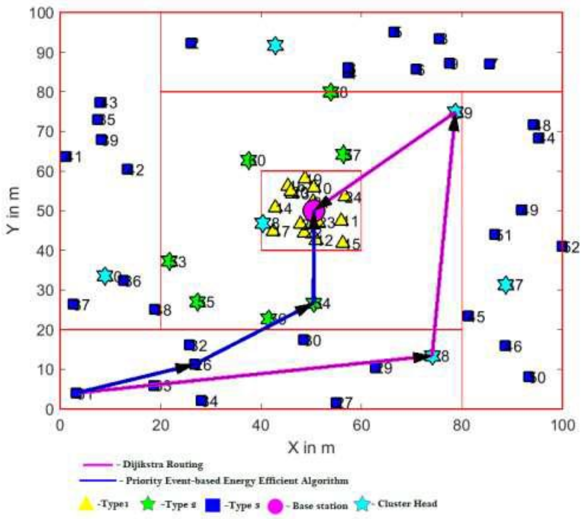

Figure 3: Hybrid Routing: Node Type 3 and CH Node

A comparison of the energy consumption between the existing Dijkstra's algorithm and the proposed effective event-based and priority algorithm for different samples are provided in Figure 4.

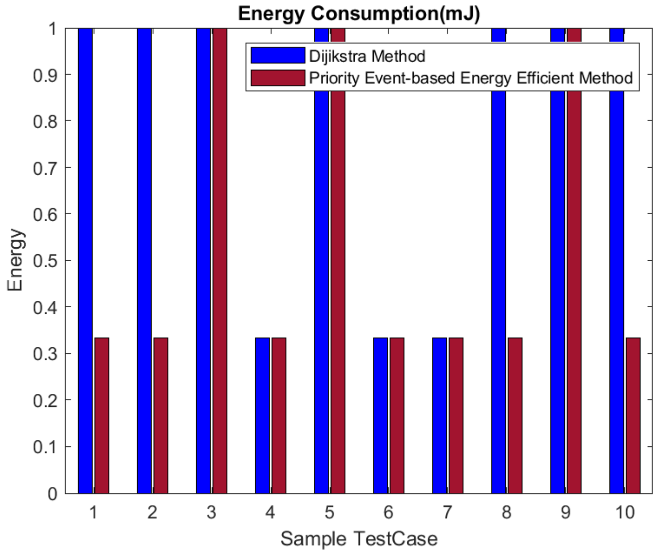

Figure 4: Test Case Vs Energy Consumption

Conclusion

The proposed algorithm's installation of different sensor nodes within the partitioned region ensures adequate coverage of the entire farm field. In comparison to current protocols, the algorithm's network lifetime is improved. Because data packets are routed straight to BS with less Cluster Head effects, the data transmission selects the suitable nodes based on the priority scenario utilizing the Energy Efficient Routing Algorithm. When transmitting essential BS data during critical conditions, energy consumption rises due to the small route gap. The IoT's MAC and routing architecture has increased storage, latency, and throughput efficiency.

When the recommended approach is used with a wireless sensor network, the delay can be significant, and end-mile communication throughput can be enhanced. The suggested cloud computing solution allows for shorter steps, which saves network bandwidth. Because the economy of a developing country is based mostly on subsistence agriculture and animals, traditional tactics are unnecessary. For low-cost and modular solutions, new technology such as IoT is crucial. The following are the main advantages of the suggested algorithm:

1. The event-based and priority algorithm accomplishes data fusion during data transmission, reducing redundant data and conserving energy.
2. The Priority Event-based Energy Efficient algorithm uses a CDMA-based MAC-layer mechanism to prevent signal interference while transmitting data within clusters; once inside the cluster, this algorithm uses a TDMA-based MAC-layer mechanism to prevent node-sending information clashes, allowing nodes to sleep when they are not in their own time gaps and thus saving resources.

At the level, the event-based and priority algorithm operates. After each cycle, the algorithm can reselect cluster nodes and construct new clusters. As a result, each network node can act as a cluster leader, and the entire network load should be distributed evenly across all nodes.

Future Work

Robotics in agriculture has been a rapidly expanding technology in recent years, with applications based on precision farming concepts. The primary goal of agricultural process automation is to reduce the time and energy required to complete normal farming chores while also increasing yields by treating each crop individually utilizing the precision farming approach. These robots' architecture is based on a specific strategy as well as other agricultural ecosystem factors in which they operate. It is possible to construct a prototype of an autonomous Agriculture Robot designed solely for seed sowing duties. It's a four-wheeled vehicle powered by the LPC2148 microcontroller. Their research would be based on precision planting, which allows for effective seed sowing at the correct depth and spacing between crops and rows, depending on the crop variety.

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