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Features of Using the Energy-Saving LEACH Protocol to Control the Temperature of Stored Cotton Piles via a Wireless Network of Sensors

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ABSTRACT:

Scientific research, wireless touch control in production design, correct energy distribution in data transmission and energy saving are the main criteria for the efficiency of the system. This article examines the sensor nodes of a wireless sensor network using the LEACH energy-saving protocol as an example of controlling the temperature of cotton piles while maintaining performance.

KEYWORDS: Wireless sensor network, ZigBee technology, LEACH protocol, sensor nodes, temperature, cotton piles, synchronous, asynchronous

I. INTRODUCTION

Today, in the development of the agro-industrial complex, an important sector of the world economy, including in the Republic of Uzbekistan, an important role is played by the processing of industrial enterprises, especially the production of raw cotton, storage in good condition. Raw cotton can be stored for 6-8 months in special bundles of 350-400 tons. However, during long-term storage of raw cotton, microorganisms develop on the surface of seeds and fibers. As a result, self-heating due to the accumulation of heat generated by the seeds causes the fiber to lose its hardness, acquire a yellow color and cause rotting of the seeds [1]. To prevent self-heating during storage of raw cotton, it is necessary to prevent the growth of microorganisms and create conditions for the timely removal of heat from the gin. For this, tunnels are dug in cotton fields, which are ventilated with atmospheric air. However, this method has a serious drawback because the cotton in the bales becomes too dense when blown with hot air. Condensation is difficult to destroy, and if the sources of self-heating reappear, it will be impossible to remove them by ventilation [2]. The temperature of the ginners should be monitored constantly. In this case, we select the temperature from 8 points of the cotton piles, and the temperature can be monitored using wireless sensor networks based on ZigBee technology. Wireless sensor networks are a group of conductors that have a communication infrastructure to monitor and record conditions at different locations. A network of wireless sensors used to monitor the environment and record data. According to the ZigBee wireless standard, devices based on this technology are inexpensive, and their ability to create networks with a network topology results in significant energy savings. A standard ZigBee solution package can be implemented by any manufacturer[3].

Wireless Sensor Networks (WSNs) detect events using small nodes. These nodes are required to power the battery in order to recognize the event and perform other actions. Battery charge is an issue on the WSN. WSN has many protocols used for battery saving and event detection[4]. Of these protocols, LEACH (Low Power Adaptive Clustering Hierarchy) is one of the WSN protocols used to improve energy efficiency. LEACH is a routing protocol that has been used on the WSN for a long time.We can use LEACH to control sensor systems and detect temperature rise while monitoring temperature and aggregating data in cotton piles. When operating with wireless sensor systems, it is recommended to save energy. The energy efficiency found on ZigBee and Wi-Fi networks and the recommended sleep

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method were compared using the LEACH protocol. The LEACH protocol has two phases of operation: cluster formation and steady state.

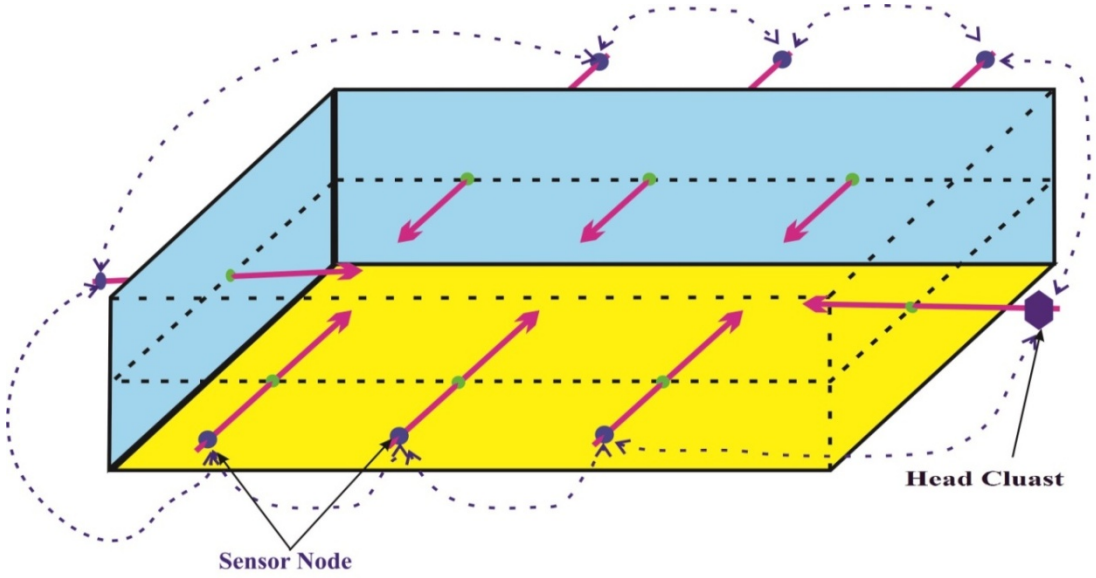

Figure 1. Organize control of cotton piles temperature using wireless sensor networks.

When forming a cluster, a random access protocol is used, in which nodes are selected as cluster heads depending on whether they previously assumed this role or not. Once clusters are formed, the nodes transmit their data using a multi-input structure that is split over time without conflicts[5].

II. THE MAIN PART

We analyze efficiency indicators that directly affect energy consumption, such as durability, energy saving methods. Although Wi-Fi sensors consume more power than ZigBee, it should be noted that ZigBee protocols do not have connectivity. There are no links between nodes in the same hierarchy, and they allow a single parent to a single node[6]. Although Wi-Fi sensors create a network with redundant network topology, this difference makes the number of dropped packets for ZigBee more than for Wi-Fi. Thus, the number of attempts to play and listen to the channel increases, and this increases the power consumption. Therefore, the difference between the power model values for Wi-Fi and ZigBee (in favor of ZigBee) is compensated for by packet loss due to the lack of ZigBee sensor routes[7].

The best way to save energy is to use a sleep technique that allows the touch nodes to switch to a low power mode, thereby saving energy when essential tasks are not being performed. Waiting methods can be divided into two main typologies: MAC (middle access control) waiting methods and directed layer methods. The MAC layer allows sensor nodes to quickly access the appropriate environment. In addition, several protocols at this level employ sleep techniques. This method can be divided into two categories: synchronous and asynchronous[8].

Synchronous - nodes are synchronized, i.e. when a wakeup is planned, the sleeping nodes wake up at the same time. When the nodes are active, the MAC approach can be used. However, the main disadvantage of this method is the need for control messages to synchronize the time of the nodes. As an example, as we said, sync error in sleep / wake mode shows that carelessness and the use of conservative time wastes energy.

Asynchronous - each node has its own wake-up time. Here the nodes are equipped with simple equipment and the network is easily expanded. Each node periodically connects to the channel, and if not given a task, it goes back to sleep. The disadvantages of this method are that the transmitter must stay awake for a long time to keep the receiver awake, resulting in excess energy, the study analyzes asynchronous sleep power consumption and wake time scheduling, and the authors propose a methodology that determines the recovery rate and wake-up period. They offer two input sampling methods that combine the best characteristics of standard low power listening and strobe preambles to achieve low power characteristics at the MAC level without the need for any synchronization between nodes[9]. The main purpose of using the protocol is to extend the life of the WSN by reducing power consumption. In a cluster system, they must be cluster head (CH) and cluster members (CM) that are members of the sensor node cluster. The CH collects other CM data and sends it to the base station. CH distributes energy to nodes in the network to regulate energy, but CH itself receives more energy than the nodes. The LEACH-based cluster works as follows. The data in the CH cluster is sent to the CM. CM then sends it to the next cluster members Fig. 2.

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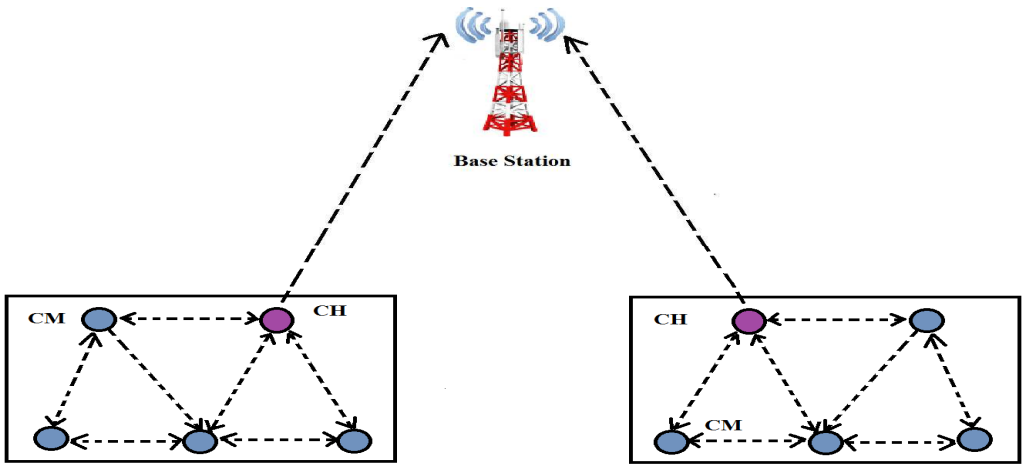

Figure 2. Request LEACH Protocols and Extended LEACH Protocols in Wireless Sensor Network

Operation of the LEACH protocol consists of two phases: a tuning phase and a stability phase. The setup phase is a one-cycle LEACH cycle. The time at this stage is less than in the steady-state phase. To complete the step, three sequences are performed: information about the cluster head; Cluster configuration; Creation of a schedule of transfers. Sends packets about the cluster head to the CM, indicating that they can also be converted to CH. CH data is sent using the MAC protocol. All CMs in the loop hold the receivers so that they can receive data from the beginning of the cluster.Upon receipt of the information, a join request is sent to the CM to indicate that CH is a member of the cluster. At the end of one round, the next channel is determined based on the high signal level, if there is equality between the two CMs, it selects a random channel. All CH CMs must hold receivers to receive. Data transfer is determined by the number of nodes in the cluster [10]. Each node sends data to CH within the time allotted to that node. In other cases, the node shuts down the receiver to conserve power to keep the network running smoothly.

Stable phase. The stable leach phase is longer than the setup phase. In the stable phase, it sends all CM data to CH and CH data, and reduces the amount of data to minimize the load and save power on the grid [11].

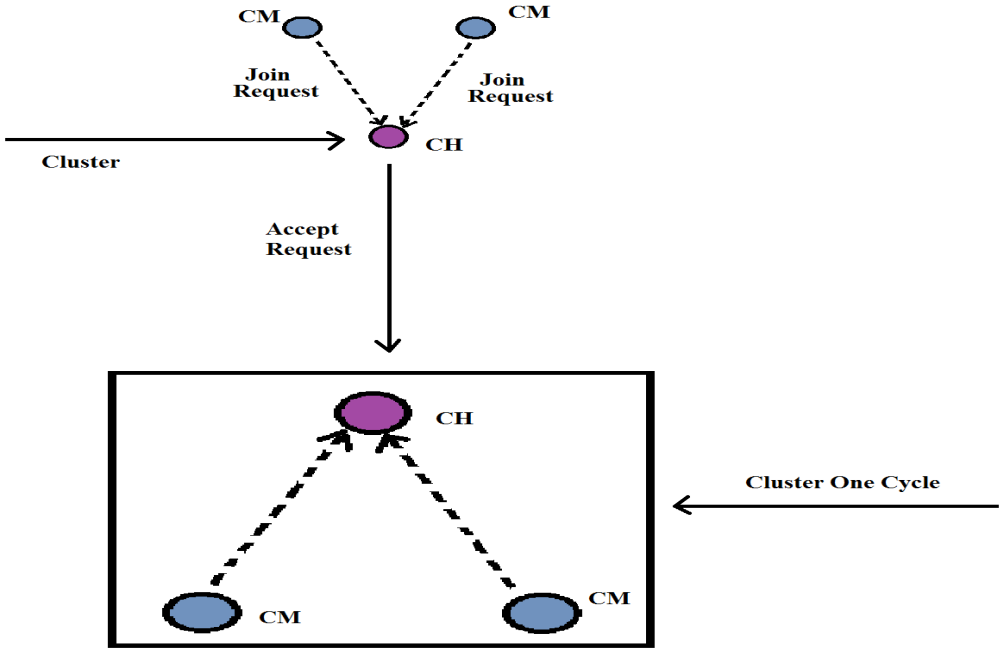

Figure 3. CM sends a request to CH to join the cluster

CM sends data in one hop. After receiving data and reducing the volume, the CH channel sends the data directly to the base station or via an adjacent channel. The purpose of transmitting data over the adjacent channel is to find the

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shortest path to the base station to save energy. After the specified time, the network will return to active mode for the new cluster CH and CM [12].

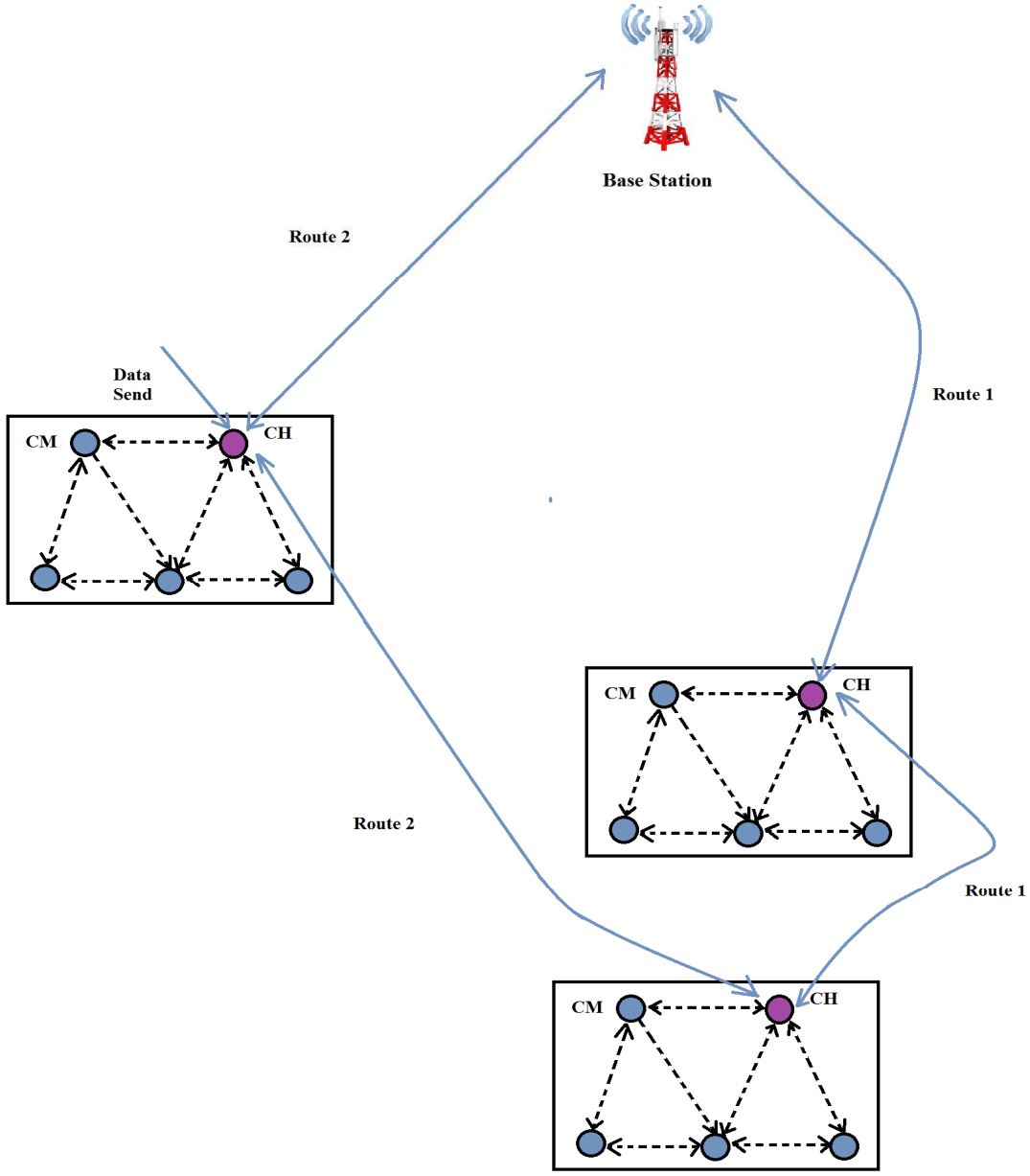

Figure 4. To save energy, cotton clusters transmit data to one cluster channel through an adjacent channel.

Figure 4 explains that one CH data cluster is transmitted over an adjacent channel to save power. As shown in the diagram, the CH has 1 routing station and two routes for sending data to Route 2. The CH should indicate the shortest path and save energy. CH takes time to determine the shortest path and location of its neighboring CH so that the CH can send the information correctly[13].

Neighboring data path Figure 5 explains how the CH allocates the time slot between CMs in the cluster to send data. Time and energy are evenly distributed among the CMs in the cluster. The CH collects data from the CM and then sends it to the base station[14].Some typical protocols have been highlighted for comparing the energy efficiency found in ZigBee and Wi-Fi networks, as well as the recommended sleep technique. The LEACH protocol has two phases of operation: cluster formation and steady state

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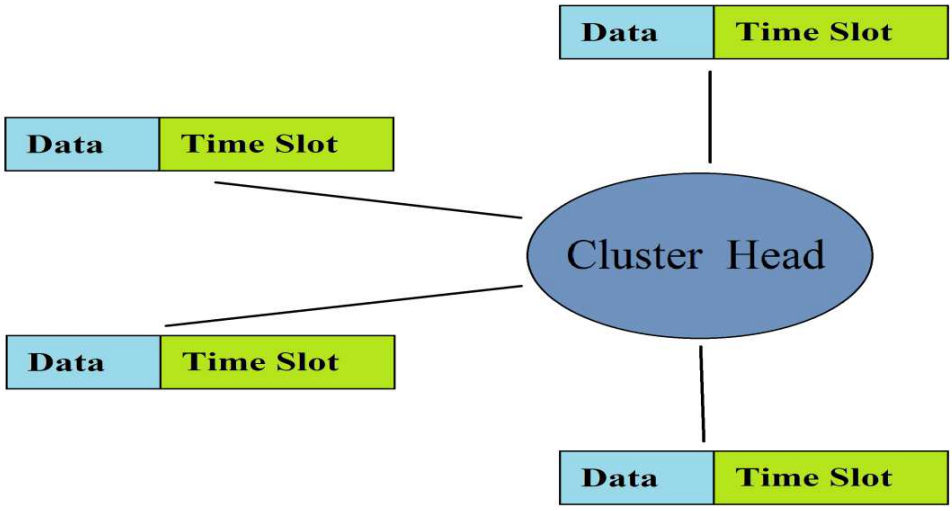

Figure 5. A cluster member sends data in the allotted time interval.

When forming a cluster, a random access protocol is used, in which nodes are selected as the head of the cluster, depending on whether they have previously assumed this role. Once clusters are formed, the nodes transmit their data using a multi-input structure that is split over time without conflicts[15].

III. CONCLUSION

Considering the amount of energy that will be purchased in wireless sensor networks in the near future, the choice of communication technology is very important. Networks have the advantages of energy savings and significant data security because they allow multilateral routes to be established in the event of node blocking or failure. One of the unique features of ZigBee technology. In fact, they have the same performance as wired Ethernet. Topology reconfiguration is performed using routing protocols, which are responsible for routing packets and optimizing node functions appropriately for the network[16]. In addition, these protocols also ensure that nodes are sending, receiving, and delivering packets, and that communication channels are constantly monitored. In fact, these protocols strive to optimize the power consumption of wireless networks based on the number and size of devices. For example, there are sleep methods in which nodes fall asleep if they have no network functionality, their main advantages are low power consumption and easy integration across nodes[17]. Here, each sensor only needs to be turned on when data is to be sent to another device, and routers and coordinators need to be turned on every time. Data transmission is carried out in three ways: continuously at a given time interval, event-oriented, and request-oriented[18]. This article uses mixed LEACH systems. Hybrid systems also use a combination of data transmission methods such as shortening the communication distance. The LEACH protocol has its advantages and disadvantages.

The disadvantage is that when monitoring large areas, errors occur in the real-time system. This shows that the LEACH protocol based on wireless sensor networks cannot be applied in all areas. In this article, the real-time process is not critical to remotely monitoring the temperature of selected cotton piles, so the leach protocol has been shown to be highly effective in this area. We can use the LEACH protocol in the following areas:

- Modification of the protocol with high sensitivity and distribution of energy and time with data transmission nodes in the cluster;
- Distribution of time and energy to remove nodes in the cluster;
- The location of other nodes in the network is communicated to the CM (nodes), so if any node has to find the shortest path, it will be easy to find and used to save energy;
- The architecture of the LEACH protocol can be changed for a wide area, so it is used in many systems with great capabilities.

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