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Wireless Sensor Networks with Increased Network Lifetime Using Clustering and Path Selection Protocol

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ABSTRACT

The introduction of mobile charging via wireless energy transfer models has kept the use of wireless rechargeable sensor networks from becoming extinct. The current study shows that recharging sensor nodes (SNs) in a network context can significantly extend the network life time by using multiple charging vehicles (MCVs) and a multi-node charging model. Most existing methods do not account for the varied rates of SNs' energy consumption, partial charging of the SNs, and joint optimization of several network parameters like network life and payload rate efficiency; as a result, these methods do not fully benefit from expanding network lifespan.In this paper, we provide a novel hierarchical clustering and path detection (HCPD) method for energy-efficient sensor node deployments. In this case, power and path adjustment detection is done using k-means clustering. Clustering is used to calculate the required power distribution, and a fuzzy model is used to identify the charging path. The energy received from the mobile charging unit is thus better utilised by developing a charging method based on statistical measurements.After going through the information from this charging test-performance bed, its applicability is determined. In order to test the effectiveness and survival rate of the clustered and formulated routing sensor nodes in large-scale networks, the computed tour length, duration, and distance metrics are lowered.

I. INTRODUCTION

Precision agriculture is a field of study that use cutting-edge technology to control expenses, encourage crop development, and boost yields in agricultural fields. One of the main forces behind agriculture precision is the use of wireless sensor networks (WSNs), in which sensor nodes monitor physical or environmental conditions like humidity, temperature, and illumination and transmit the sensed data to the base station (BS) via single-hop or multihop coordinator nodes [1-3].This technology can also be used to improve other sectors like agriculture, healthcare, the military, transportation, and security. In the healthcare sector, sensor nodes have been utilised to collect the patient's physiological or biometric data, such as the ECG, heart rate, and blood pressure [4]. The military employs sensor nodes to keep an eye on things, find platoon placements, track soldiers on the battlefield, and safeguard the troops. Sensor nodes can offer a diligent watch to track and monitor the risky condition and stay on alert against terrorist attacks [5] in terms of security.In agricultural, sensor nodes are used to measure the wind speed, humidity, pressure, and temperature. The sensor nodes also identify variables in the environment that can be used to forecast the weather and the possibility of natural disasters. These networks' sensor nodes are separated into coordinator and standard nodes to collect data from the agricultural field [6].

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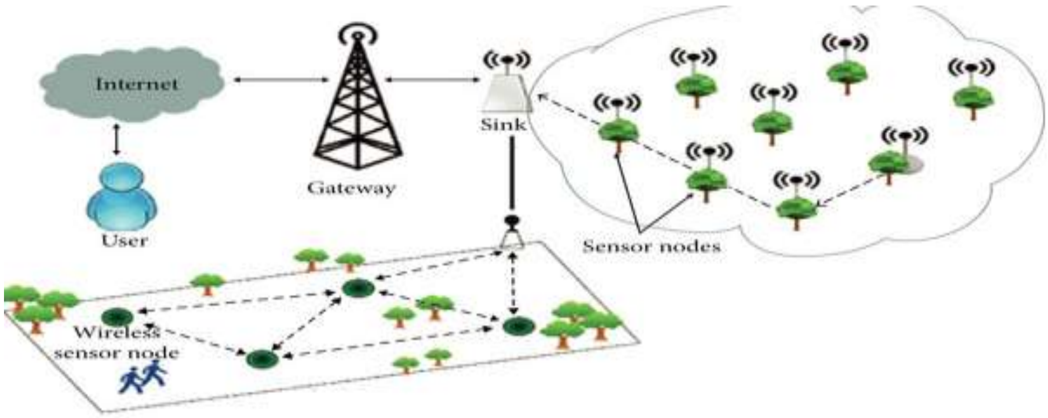

Figure 1: Architecture field with WSN deployment.

Sensor nodes are small in size and have constrained energy and processing capabilities [7]. To monitor environmental factors like crop health, sensor nodes are used. Both within and outside of the soil are suitable locations for the sensor nodes. Many technologies and standards have been established based on applications, data rate, frequency spectrum, power consumption, and distance. Many well-known technologies include Wibree, Wi-Fi, GPRS, WiMAX, Bluetooth, and ZigBee [2, 8].Wireless transmission of monitored data from the deployed sensor nodes to the BS allowed for data collection. The BS decides whether to take any further action. Users received information on crop growth or other drip irrigation-related information, and they then took further actions to improve the product's microenvironment [9].Sensor nodes monitored numerous parameters to accomplish precision control in agriculture, analysed monitored data for decision-making, and then implemented the control mechanism [10, 11]. The improvement of agricultural productivity is pursued through the use of precision farming, data collecting, and transmission [12, 13]. Environmental variables such as weather, wind speed, temperature, soil humidity, chemical and physical properties of the soil like the pH level, crop identification, leaf area index, leaf moisture content, and weed-disease detection are all included in the monitored data. Using sensor nodes to forecast soil moisture and organic content while photographing the fruit is another automated fruit picking technique[14, 15].

Using sensor nodes with mobility-based technology, crop plant mass is assessed along with the characteristics of fertilisation for maximum yield. A rough estimation of the harvest period is made using specialised sensors to evaluate the soil strength. [16, 17].the current technique To collect data from all surrounding nodes based on their distance, nodes are spread randomly among sensor nodes[18]. Using a moving car charger will maximise data rates and extend network life.

Proposed Method With Results

The WSN in question consists of sensor nodes that can be positioned in different locations. In a clustering situation, nodes that are far from the base stations are managed by a single point to accommodate a greater data relaying demand. The sensor node information is transferred through the network via a cluster head following a specified path in order to access BS points. It is an energy-efficient method of gathering data from wireless sensor networks. Together, the cluster head nodes of the network create a backbone network that sends the data gathered by each node to the base station.The more nodes in the cluster, the more data must be transmitted and energy must be consumed. To maintain a balance in the energy consumption of the cluster head nodes, the cluster size must always be controlled. It is the main technology used by every WSN. K-means clustering is used in this instance to distinguish between the different types of nodes and the sensor nodes with the highest energy level based on how the nodes appear in the group network. A fuzzy hierarchical comprehensive assessment approach is used to select the optimum path to visit the nodes.

Node through link cost(u ->v)

Rju - residual energy at node u.

Rjv - residual energy at node v.

Etx – transmission energy required.

Etr – energy required to receive.

Cuv = min ((Rju - Etx)- (Rjv - Etr)).

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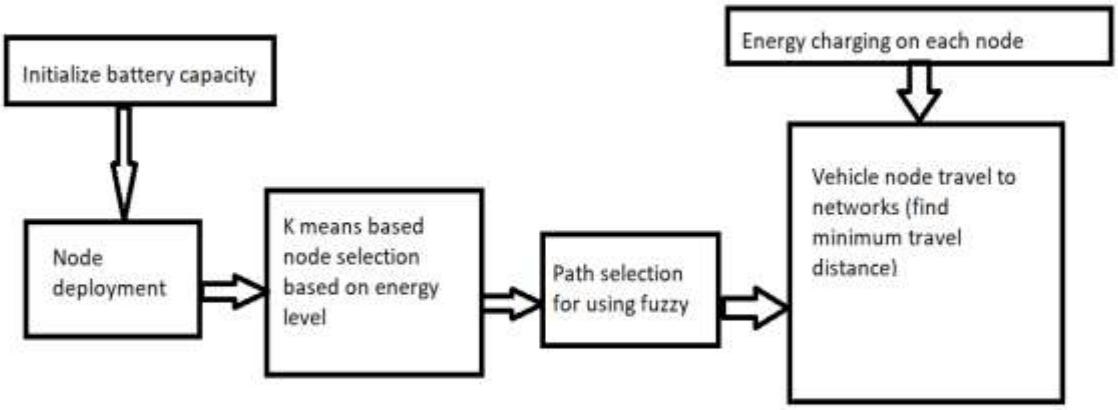

Figure 2. Routing and path selection model for mobile charging vehicle deployment and data collection.

K means clustering is a technique that can be used to manage node identification in the charging mechanism. When the number of nodes in the network increases, the delivery ratio and life duration directly alter. We also look at the trade-off between throughput rate vs. network life across the required number of nodes using balanced energy-aware routing.

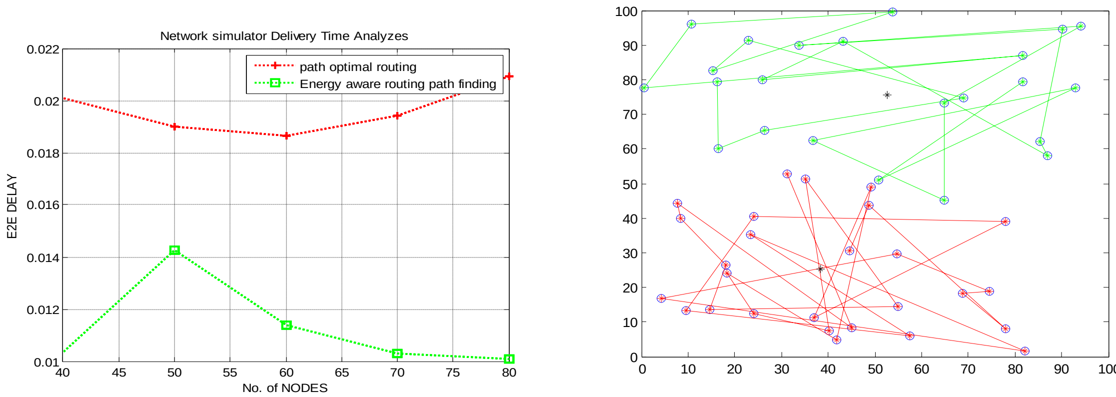

Figure 3.CH selection and optimal path routing and performance efficiency of End-to-End delay measure

II. CONCLUSION

Using sensor nodes outfitted with partial charge recharging mechanisms, we examined in this research how well energy conscious path routing performed. In this study, we assessed how well moving vehicle-based charging performed in WSN. The Fuzzy Analytic Hierarchy Process' performance indicators for the best K-means clustering and path selection in terms of increased network throughput and network life cycle are confirmed.In addition, a thorough search for the ideal path distance is conducted, using the network's overall sum energy as a benchmark, before visiting all prioritised sensor nodes that are regularly used for routing. The simulation results demonstrated the effectiveness of energy-driven sensor routing for extending the network's life. Also, it has been conclusively demonstrated that increasing network dimension has a negative influence on data rate and negatively affects network lifetime. Highly balanced energy-aware routing can be used to reduce the performance trade-off due to WSN size.

FUTURE WORK:

Here, it is acknowledged that energy efficiency is a major issue. For data transfer for delay-bound node transmission, this thesis work does not find an energy-efficient routing option. The delivery ratio is always directly impacted by the number of nodes in the network. to expand analyses of trade-offs between number of nodes needed over the course of a network's life and throughput rate with balanced energy-aware routing.

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