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AN APPROACH FOR OPTIMAL ENERGY CONSERVATION IN WSN UTILIZING SPLINE

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ABSTRACT

Coverage is a key issue that guarantees that fundamental functions are accessible in Wireless Sensor Networks (WSNs). These functions give correspondences during emergency rescue or in war situations. Sensor nodes must be scattered and survive in place for a long time to precisely monitor all occasions. Then again, sensor nodes depend on restricted battery energy confined to the lifetime of the whole network. At the point when few sensor nodes are conscious during an epoch, the whole network lifetime gets to be longer. This suggests that the coverage issue must be solved based on the energy proficiency issue. In order to strengthen the coverage ratio with a set number of sensor nodes, in the existing method just explored in a 2-D plane, which is not suitable for a reasonable area. In this paper, consider the field of Interest as a complex surface additionally utilize the Adaptive spline function to acquire genuine data around a complex surface. Also enlarge the coverage area capacityand power conservation by dynamicallyvarying the spline function.

***Index Terms*—Wireless sensor network, Optimal energy Conservation Technique, Adaptive B-Splinefunction, Coverage Hole problem,dynamic programming.**

I INTRODUCTION

The rising field of wireless sensor networks joins sensing, calculation, and communication into a single small device. WSN is a hot research topic that can be applied to novel research fields. It not only detects the new environment and monitors any situation including dynamic variations, widely applied in medical treatment, health care, military applications and resources exploration. For instance, the sensor nodes can be deployed in many places such as hospitals, battlefields or volcano. The sensor nodes should be deployed in the target space for a long time, with the required datachecked precisely. However, sensor nodes only contain limited battery vitality that restricts the lifetime of the whole network. Specific sensors must be chosen and scheduled to be conscious or asleep. The ultimate goal is to decrease the sensor awake epoch and solve the coverage problem based on the energy proficiency issue. Sensing coverage with a finite number of sensor nodes is other problem to Sustained. There are three application classes: Environmental data collections, Security monitoring, and Sensor node tracking. Environmental data collection is one where a research scientist wants to collect a few sensor readings from a set of focusesin an environment over a time with a specific end goal to recognize to detect trends and interdependence.Security monitoring networks are composed of hubs that are set at settled areas throughout an environment that persistently screen one or more sensors to distinguish an inconsistency. A key contrast between security observing and environmental monitoring is that security networks are not actually collecting any data. The tracking of a labeled object through a district of space monitored by a sensor network. Coverage problem is the fundamental issue in sensor network, which reflects how well a sensor system is observed or followed by sensors .Full coverage means that every point on the surface is covered by at least one sensor. The typical coverage problem satisfies the specific service necessitieswith a limited number of sensor nodes. Especially in rugged terrain it is more difficult to gratify such service necessities, such as coverage ratio, network connectivity and steadiness.

Spline is a mathematical function, defined piecewise by polynomials .Transportation is getting better, such as cars and ships. Because these shapes are complex engineers derived a mathematically accurate representation for freeform surfaces known as the Spline curve. It flexibly adjusts the curvature of an object so that we can obtain an approximate curve from the original object. In other words, the Spline function is able to make a smooth abstraction of the object's surface. By using this Spline function characteristic to produce similar curves for the desirable FoI. Currently, there are three familiar Spline curves, which are Bezier curve, B-Spline curve and Non Uniform Rational B-Spline (NURBS) curve. The Bezier curve is widely used in the computer graphics field to achieve a smooth curve. Each curve has many control points that can be graphically displayed and used to intuitively deal with the curve. Sensor nodes can be deployed on an entity but the surface of FoI is a complex surface. Normally spline function are used to creating ship hulls and car bodies. Coverage Hole is the one of the main problem. Coverage Holes are nothing but the clients cannot

Receive the signals through the wireless network. Coverage Holes are caused by physical obstructions.

II EXISTING METHODOLOGY

Non-Uniform Rational B-Spline (NURBS) is used to depict the topography. NURBS are the mathematical representation of 2D or 3D objects which can be standard shapes or free form shapes Spline function characteristic to find the closest target FoI curve. To further reduce redundant coverage we use the variable sensing radius to adapt any different network topology. We have two major contributions:

1) Use the NURBS to find the target FoI information which approaches the original terrain.

2) Adjust the sensing radius based on dynamic programming and decrease the redundant power consumption as much as possible. These methods were dedicated to improve the drawbacks in the 2 D coverage method and obtained the correct and precise position between sensor nodes to prevent coverage holes. It implies that the coverage problem must be reformed from 2D plane to 3D space. However, the unembellished 2D k-coverage algorithm is applied to the 3 D environment directly, hence some coverage holes are unavoidable. Connectivity-based Boundary Extraction (CABET) scheme which including the following five phases.

1) Boundary node identification: Every sensor makes a decision to be a boundary node or not.

2) Critical node identification: The first two elements are named convex critical node and concave critical nodes. Both of them not only determine the block edge, but also identify the topology shape.

3) Landmark selection: The subset of boundary nodes is selected in this phase, and the absolute network topology position is also determined.

4) Coarse boundary extraction: The selected landmarks using boundary triangulation, and delineated the entire network topology

5)Boundaryrefinement*:* Since the method is still used in the 2D method to address the 3D intersection problem and need to discover these holes and correctthis error first, then assume the virtual edges connected by each edge.

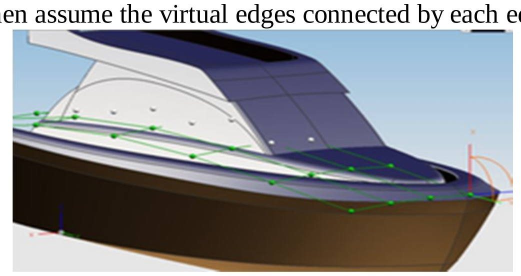

Fig 1 Model for NURBS

NURBS curves and surfaces are useful for a number of reasons. The fundamental equation of Bezier curve is

$$C(u)=\sum_{i=0}^{n} P_i f_i(u),\ 0 \le u \le 1. \qquad (1)$$

The variable P i represents the control point that dominates the Spline curve. The variable u is the location specified in the curve, f i (u) is a blending function that is also a piecewise polynomial function. The shortcoming of Bezier curve is that if any control point has been changed then the whole curve changes which means it cannot elastically control the local curve.

III. PROPOSED METHODOLOGY

Adaptive B-spline Adaptive B-Spline is defined by its order, set of weighted control points used to adapt curves and surfaces. It consists of Four directions(s,t,u,v) .Here taking u, v, s as a variable node and t as a fixed node by keeping this and Performing operations of rotation and translation.It is subdividing polygon grid lines in one or both parametric direction. The flexibility of Adaptive B-spline curves and surfaces is increased by raising the order of the basis function. An alternative to degree raising is increasing the knot values in the knot vector used. The nature of the knot vector is preserved (uniform, open) even after insertion of new knot values.

In order to achieve the higher coverage range with the lower energy consumption in complex terrain, how to accurately depict the FoI is important. The Spline function is based on WSN coverage. Derive the network model, coverage model and connection model to formalize the deployment of sensor nodes on FoI.

IV. IMPLEMENTATION

A. Network Model

A multi-hop WSN with area size A is Modelled by graphG = (V, E), where vertex V = V1, V2,...,Vn are the sensor nodes in the network, and E ={E1, E2,..., En} are the transmission ranges covered by the set of sensor nodes V.These sensor nodes are deployed on a FoI F, which is composed of a set of surfaces, with S : F ={S1, S2,..., Sk}. Since the coverage of sensor nodes may not exactly aligned each other, some redundant coverage happened. The redundant overlapping area leads to power wastage of sensor nodes. The redundant region O is defined as G–S, Let

O = ≥ 0, if the FoI is covered by sensor nodes
< 0, if the FoI is not covered by sensor nodes.

B. Coverage Model

Define the FoI composed of several surface blocks and let the set V be the sensor nodes deployed with a homogeneous Poisson process in a three-dimensional space A.

$$C\ block(u,v) = wi,jPi,jNi,k(u)Mj,l(v). \qquad (2)$$

The Spline function has convex hull characteristics which ensure full coverage and uses a control point to model the topology graphic. The control point is also used to intuitively manipulate the curve allowing the curve the approximate the terrain perimeter. The relationship between the sensor nodes including the radius R and r are show in the following Fig 2 including with their variables and co-ordinates between two sensor nodes.

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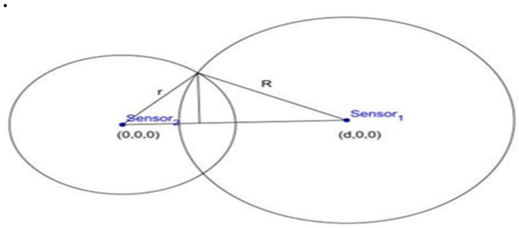

Fig. 2 The overlapping area.

The relationship between two sensor nodes, including the radius R and r, and their coordinates. The overlapping area can be calculated with these variables.

C. Connection Model

We defined the connectable sensor nodes to represent that their transmission range overlaps and covered by each other, with a transmission radius of r.

Where d =< r, the sensors are not connected
≥ 0, further determine the terrain.

Assume o(x0, y0, z0) is the coordinate of center, the sphere area equation is

$$(x - x0)2 + (y - y0)2 + (z - z0)2 = r2. \qquad (3)$$

The simultaneous equation is

$$Cblock\ (u,v) = wi,jPi,jNi,k\ (u)\ Mj, \qquad (4)$$

Let the result is divided into two cases:

1) Answerable: It represents that there is an intersection between the sphere and the FoI, hence these twosensor nodes cannot communicate with each other. In other words, there is an obstruction between any two sensor nodes.

2) Unanswerable: This means that the sensing range is full coverage on the FoI, so the sensor nodes are able to negotiate. In a word, any two sensor nodes can communicate with each other directly.

A. Variable Sensing Radius

The motivation is the longer transmission range must consume more energy, and vice versa. For saving more power, we should use the shorter radius on condition that the number of linked sensor nodes can't be decreased. There are two situations when using variable radius:

1) Outside: The sensing range exceeds or the node has left the FoI boundary.

2) Inside: The overlapping area exists or the sensor cannot cover the others.

If more sensor nodes are covered, they can extend coverage to the entire network. In an outside case we consider the length of the FoI edge to any sensor nodes. Accordingly, we ascertain whether the sensing radius is greater than the length of the FoI edge to the sensor nodes or not.

B. Dynamic Programming

Since the node sensing radius is changeable, the connection between other sensor nodes may be changed and unfixed. However, only the first one is adjusted without any misgivings, the other sensing range must depend on the former sensor nodes which had adjusted before, they cannot obtain the optimal decision accurately. In order to solve this problem, we use the dynamic programming (DP) method to find the optimal sensing radius in all sensor nodes. The major concept is that the current term continues to compute the overlapping area with the previous term. DP algorithm is named to be Optimal Energy Conservation (OEC) algorithm.Before the OEC executes, first judge the connection between two sensor nodes. Secondly, evaluate the redundant power of each sensor node. If the redundant power of a node is more than that of its neighbours, the radius of this node refuses to change. In other words, only decrease its transmission radius when it has less power. After the OEC completes, the overlapping area is judged and evaluated. If there is no overlapping area, then keep the original sensing radius of all sensor nodes.

V.RESULT AND CONCLUSION

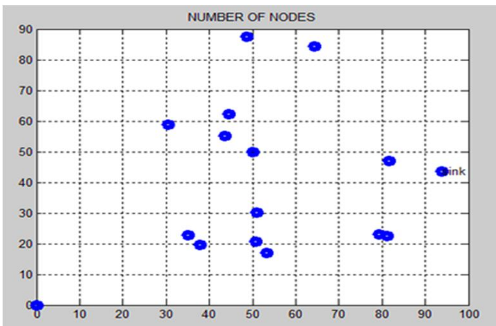

Fig 3 Implementing Number of nodes

Define the FoI as a three-dimensional space with number of sensor nodes are randomly deployed in the FoI.The OEC result is based on the power, overlapping area and distance. It adjusts itself to the length of the radius according to the control point shown in fig 3.

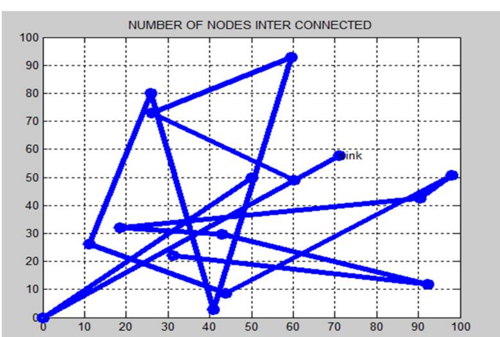

Fig 4 Interconnecting Sensor Nodes

Fig 4 shows the interconnection between the deployments of sensor nodes.It shows the interconnected nodes and the transmission of sensing radius.

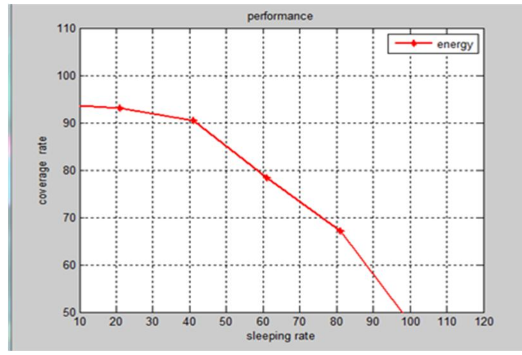

Fig 5 Coverage rate vs sleeping rate

Fig. 5shows the Performance. The sleeping rate of the system is slightly lower than the original DT from 30% to 80%.Delaunay Triangulation (DT) is a normal allocation method for the coverage problem. Because the sensing radius decreases the sensor node coverage area also decreases. If the sensor node density is increased, the coverage rate may be equivalent and can save more power.

This paper presented the Adaptive B Spline to define arbitrary terrain and obtain accurate location information for each sensor. A dynamic programming method to reduce redundant radii, achieving high energy efficiency is designed. The Adaptive B Spline sketches the terrain information smoothly and provides the characteristics of a convex hull precisely and also fully maintains network coverage. Although the method may cause a few uncovered areas, the convex hull characteristic is considered by the Adaptive B Spline. Hence the proposed system maintains high coverage range and reduces power consumption. The simulation results show that the method is always better than the original DT. The four terrain cases have been considered to show the advantages of this method and discussed what environments are suitable for this method. Also obtained lower power usage and wider coveragewith higher sensor node density, smoother terrain and fewer obstructions.

The future works will actualize this proposed technique in the realistic environment. Deploy of sensor nodes is to gauge the territory FoI. In order to monitor more accurate information, node mobility will be considered. The situation of sensor nodes onto creatures or robots can watch the node portability impact on the proposed strategy. This methodology will be a real test because of the unfixed areas, flimsy portability and erroneous estimation blunder. The current proposed system will need decency, so a flaw tolerant instrument will be included for the mobile sensor environment. Further research will give higher WSN system scope with lower power utilization, even in a mobile environment.

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