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Base Station Placement Strategy in WSN Systems

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Abstract: We are primarily zeroing in on the issues connected with the base station situation in a remote sensor organization (WSN) field. The WSN model have multi bunches approach has been examined. The goal is to limit the general energy utilization in a WSN during the information transmission over hubs by sorting out the usage of group head and covering head hubs. We demonstrate that the general energy utilization is limited at the centroid of the hubs and proposed point of the hub as the think about of the base encasing circle of the focal point of the hubs. We know that the majority of the hubs are near the base station, though a couple of hubs are a long way from it. In this way these far away sensors hubs utilize more energy than closer ones. We have involved a centroid strategy for observing the group head hub area and researching how to observe the base station area related information transmission to lessen energy utilization and thus to increment network lifetime.

Keywords: Base Station, Localization, Leach, and WSN.

1. Introduction:

Wireless sensor Network (WSN) is a thickly sent assortment of countless self-coordinating remote sensor hubs with restricted energy asset, and typically a base station to gather and handle the information from sensor hubs. A sensor hub consumes energy for occasion detecting, coding, tweak, transmission, gathering and total of information. Information transmission has the most noteworthy offer in complete energy utilization. The necessary transmission force of a remote radio is relative to square or a much higher request example of distance within the sight of obstructions. Along these lines, the distance among transmitter and recipient is the fundamental measurement for energy utilization in a WSN.

Base station area influences the lifetime of the sensor network as every one of the information are at last communicated to the base station for handling and decision making for different applications. We can lessen transmission energy by diminishing the distance between the sensor hubs and the base station. This can be accomplished by setting the base station at an ideal area. We can lessen transmission energy by diminishing the distance between the sensor hubs and the base station. This can be accomplished by putting the base station at an ideal area. In the writing up until this point, numerous heuristic calculations have been proposed to observe less than ideal arrangements of the ideal base station situating in two-layered WSN. Albeit these heuristics are demonstrated to be powerful, their calculations rely upon the geography and depend on underlying measurements.

Remote sensor hubs are miniature electronic gadgets and have an exceptionally restricted wellspring of force. They are usually controlled utilizing batteries, yet for applications where the framework is relied upon to work for an extensive stretch, energy turns into a bottleneck. In sensor organizations, ordinarily every sensor can transfer traffic to different sensors utilizing multi-jump directing calculations until this information arrives at its objective.

2. Framework Evaluation Metrics

Since we have laid out the arrangement of use situations that we are tending to, we investigate the assessment measurements that will be utilized to assess a remote sensor organization. To do this we remember the undeniable level targets of the organization sending, the planned utilization of the organization, and the critical benefits of remote sensor networks over existing advancements. The key assessment measurements for remote sensor networks are lifetime, inclusion, cost and simplicity of sending, reaction time, fleeting exactness, security, and successful example rate. Their significance is examined beneath

One outcome is that a large number of these assessment measurements are interrelated. Frequently it very well might be important to diminish execution in one measurement, for example, test rate, to expand another, like lifetime. Taken together, this arrangement of measurements structure a complex space that can be utilized to depict the abilities of a remote sensor organization. The capacities of a stage are addressed by a volume in this multi-faceted space that contains the legitimate working focuses as a whole. Thus, a particular application organization is addressed by a solitary point. A framework stage can effectively play out the application if and provided that the application necessities point lies inside the ability hyperspace.

3. Radio Model

We want a radio model to appraise energy utilization during the time spent base station area improvement. We have considered a similar radio model as utilized by [18].

The transmitter scatters energy to run the transmitter radio gadgets and the power enhancer, and the beneficiary disseminates energy to run the collector radio hardware. Assuming the distance between the transmitter and the beneficiary is under an edge (d_0), the 'free space (fs) misfortune's model is utilized; in any case, the 'multipath (mp) misfortune's model is utilized. Here, we are expecting that an appropriate power control instrument exists to manage communicate power contingent upon the distance to the recipient. In a transmission intensifier .we utilized way misfortune type, n= 2, with the expectation of complimentary space misfortune model and n = 4 for multi-way misfortune model. The consumed enhancer energy E_amp, of a sensor hub is $E_{fs}.d^2$ or $E_{mp}.d^4$ depending on the distance d between node and base station[18].

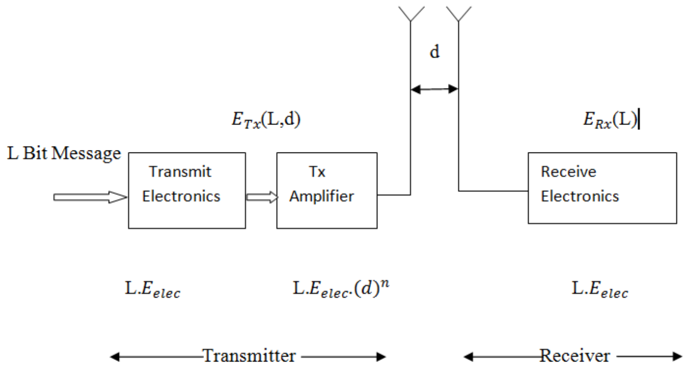

Fig. 1 : Radio Model

$$E_{amp} = \begin{cases} E_{fs}.d^2 & d < d_0 \\ E_{mp}.d^4 & d \geq d_0 \end{cases}$$

(1)

Here, threshold distance d0 for swapping amplification model is calculated by equating E_{amp} (fs) to E_{amp} (mp).

$$E_{fs}.d^2 = E_{mp}.d^4 = d_0 = \sqrt{\frac{E_{fs}}{E_{mp}}}$$

(2)

where E_{fs} is free space loss constant measured in J/bit/m2 and E_{mp} is multi-path loss constant measured in J/bit/m4. If a node transmits L number of bits, the energy used in transmission will be

$$E_{TX}(L,d) = E_{TX-ele}(L) + E_{amp}(L,d)$$

$$= \begin{cases} LE_{ele} + LE_{fs}.d^2 & d < d_0 \\ LE_{ele} + LE_{mp}.d^4 & d \geq d_0 \end{cases} \quad (3)$$

To receive L message bits, the radio spend

$$E_{RX}(L) = E_{RX-ele}(L) = LE_{elc}$$

(4)

Here, E_{ele} is the energy, in J/bit in transmission and reception electronics. Most of the earlier work had considered only free space loss (n = 2) as the model of radio communication. We are not aware of any work that considers multi-path loss (n =4) in their radio model or multi-path radio models for analysing optimal base station positioning.

4. Optimal Location Of Base Station Analysis With An Example

Let us consider a homogeneous network in which the position of the nodes are known and these three nodes which are placed at positions (0, 150), (0, 0) and (150, 150) in a 150× 150 square metre area. We have assumed the values of E_{mp} = 1.3 × 10^{-15}J/bit/m^4as multi-path loss constant and E_{fs} = 10^{-11} J/bit/m^2 as free space loss constant.

Step 1:-define the x and y co-ordinates of three nodes
x=[0, 0 ,150]
y=[150, 0, 150]
n=3(number of nodes)

Step 2:- $d_0 = \sqrt{\frac{E_{fs}}{E_{mp}}} = 87.7058$

Step 3:-calculate the cetroid of three points and these are C_x and C_y from equation 18 and 19 and the location is shown in figure 3.
C_x=50
C_y=100

Step 4:-calculate the distances from the centroid
dc = [70.7107 111.8034 111.8034]

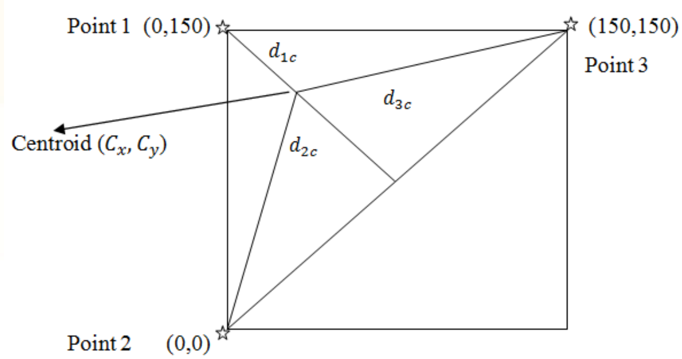

Fig. 2: Energy expenditure from the centroid

Step 5:- Now we calculate the average amplifier energy consumption in J/bit node for three nodes at the centroid with the help of equation (2).

Ec=(Efs*(dc(1)^2)+Emp*(dc(2)^4)+Emp*(dc(3)^4))/n

E_c= 1.5208× 10^{-7}

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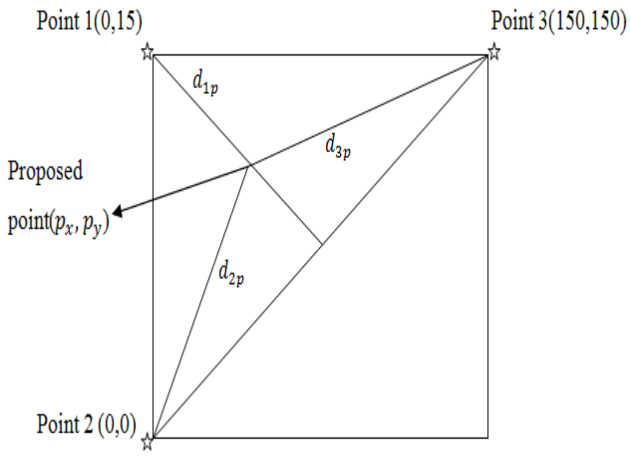

Fig. 3: Energy expenditure from the proposed point

Step 6:- calculate the proposed point with the help of weight from equation 21. We take weight w as 1 for the nodes which are less than d_0 distance and $\frac{d_{ic}^2}{d_0^2}$ for the other nodes which are at equal or higher distance than d_0. The points p_x and p_y are calculated from the equation 23 and 24 and the location is shown in figure 4.

p_x =57.3529

p_y =92.6470

Step 7:- calculate the distances from the proposed point

$$d_p = [81.1093 \;\; 108.9626 \;\; 108.9626]$$

Step 8:- Now we calculate the average amplifier energy consumption in J/bit node for three nodes at the proposed point with the help of equation

Ep=(Efs*(dp(1)^2)+Emp*(dp(2)^4)+Emp*(dp(3)^4))/n

$$E_p = 1.4410 \times 10^{-7}$$

Step 9:- We also calculate the amplifier energy by considering the centre of a minimum enclosing circle as the base station location. The points at the minimum enclosing circle is m_x and m_y and the location is shown in figure 5.

$$m_x = 75$$

$$m_y = 75$$

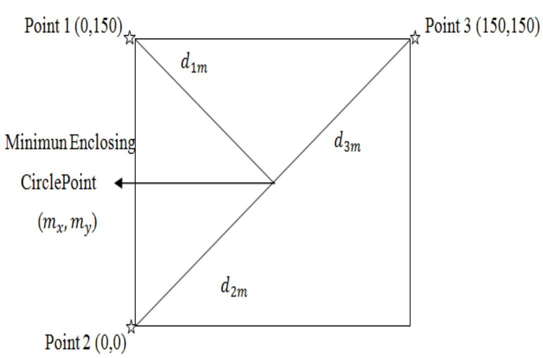

Fig. 4: Energy expenditure from the centre of the minimum enclosing circle

Step 10:- calculate the distances from the centre of the minimum enclosing circle

$$d_m = [106.0660 \;\; ,106.0660, \;\; 106.0660]$$

Step 11:- The average amplifier energy consumption E_m in J/bit-node for three nodes at the minimum enclosing circle.

Em=(Emp*(dm(1)^4)+Emp*(dm(2)^4)+Emp*(dm(3)^4))/n

$$E_m = 1.6453 \times 10^{-7}$$

5. Result and Discussion:

In this section we have described above WSN model design using the MATLAB. Using this model we have determined the energy consume by sensors during the force of data transmission from WSN sensor to base station. We have analysed three different scheme of determining the location of base station with respect to minimum energy expenditure of a sensors network.

5.1 Design Of WSN Model:-

We have design WSN model having large number of wireless sensor nodes with limited energy resources model having a base station that can collect and process the data obtained from sensor nodes. For this purpose an algorithm using MATLAB 10 software. In this algorithm we have generated randomly distributed sensor node in a given field having square area M×M meter square. The number of nodes are varied from 5 to 200 nodes for a given area .We have also considered field area of different dimensions having length of square area 30 to 500 meters. Every time we have increment of 10 and nodes are increment of 10 also. In this way we have generated about 48×20 random distributed WSN cluster with different areas and different number of nodes. Let we have N sensor nodes randomly distributed in a rectangular field at a location(Px, Py) where ;

Px=X1,X2,X3................Xn

Py=Y1,Y2,Y3................Yn

After that we have calculated the location of centroid for given randomly distributed wireless sensor nodes.

Figure 5 (a), (b), (c) and (d) are shown below where x and y axis represents the length of square field and stars shown the location of wireless sensor and a circle shown the location of centroid.

Figure 5(a) shows the cluster of nodes (blue stars), centroid (mageta diamond) and proposed position of base station (red circle) for area field of length=120 and number of nodes=175 in this Figure. Here area is small hence centroid and proposed position are approximately same with centroid and proposed base station location.

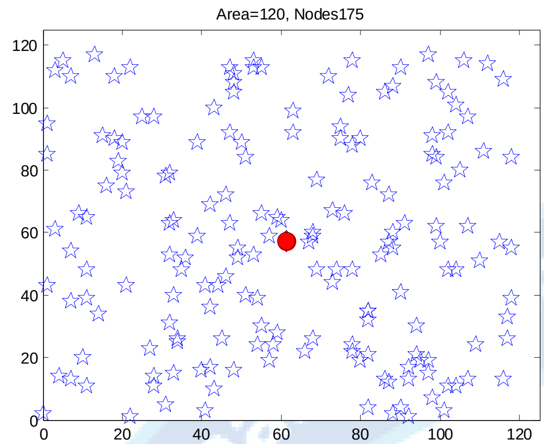

Fig. 5a: WSN sensor node cluster for area =120 and node=175

Similarly Figure 5(b),(c) ,(d) shows the randomly picked WSN cluster field map for different areas and nodes. In these figures we can see that our proposed base station location and centroid location are different.

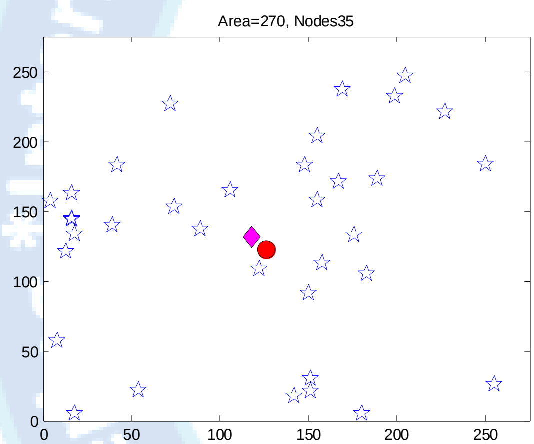

Fig. 5(b): WSN sensor node cluster for area =270 and node=35

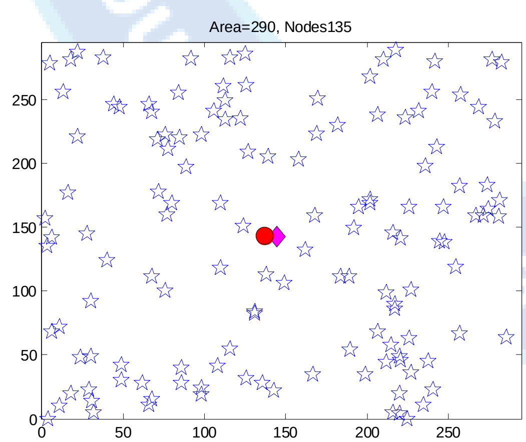

Fig. 5(c): WSN sensor node cluster for area =290 and node=135

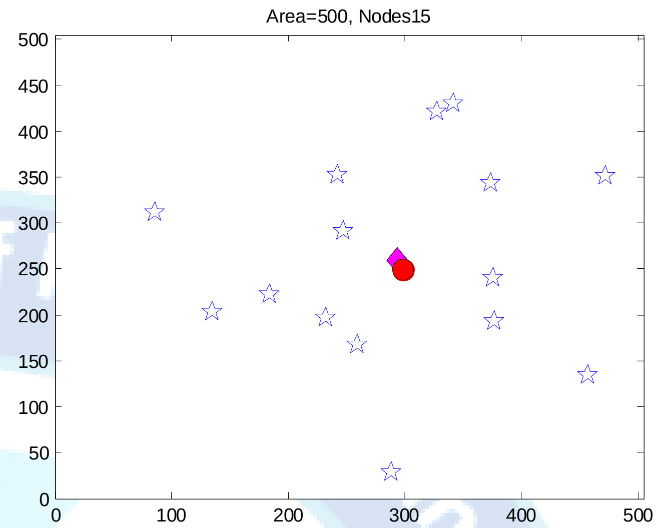

Fig. 5(d): WSN sensor node cluster for area =500 and node=15

We also compared percentage energy reduction for considering centroid and minimum enclosing circle and the surface plot is shown in Figure 6 where z-axis shows percentage energy reduction, x-axis and y-axis shows the number of nodes and area. Figure 7 shows the plot %Emp with respect to area and number of nodes. In both the plots all the surface are below zero, if Ec or Ep is greater than Em that is why %Emc or %Emp will always result in negative value shown so we can conclude that both base station location points either centroid or proposed location gives lower energy consumption compare to minimum enclosing circle for all the combination of area and number of nodes

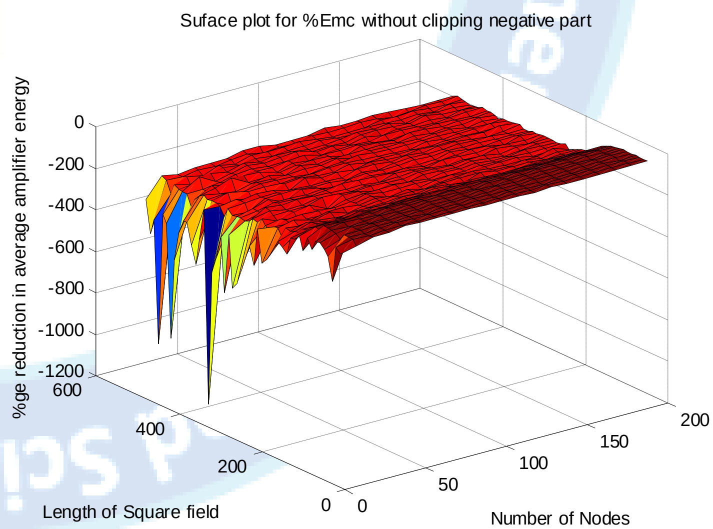

Fig. 6: Percentage reduction in average amplifier energy for the centroid compared with minimum enclosing circle without clipping negative parts

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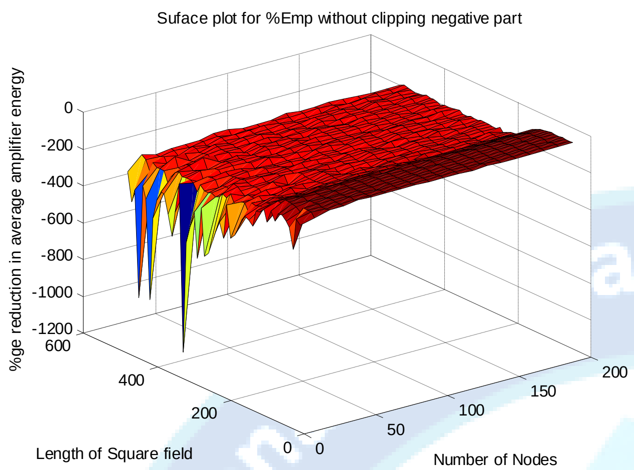

Fig. 7: Percentage reduction in average amplifier energy for proposed points compared with minimum enclosing circle without clipping negative parts

6. Conclusion:

In this paper we have worked in tracking down ideal area of base station assessment examination with saving imperatives of least energy consumption for giving greatest life time to the hubs of sensor organization. It has been see that number of hubs are builds, this hub proportion diminishes and as we expands the region this hub proportion again diminishes , and it has been seen that as assuming we take number of hubs above than 75 for region above than 210 meter length , we can get hub proportion short of what one. this shows that number of hubs experiencing multi-way misfortune decline from region 210 meter yet same perception for region length of 240 meter on account of centroid .in this way we can diminished the multi-way misfortunes for region 210 meter for the case the proposed conspires however for centroid same outcome are found from a somewhat higher region.

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