Angle Based Static Routing in WSN using Triangular method

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Abstract:

The nature of the path constructed is very important in the routing process. If we are able to construct the path between sensor node and base station in a straight line or near to straight line, then the efficiency of data transfer will be very high. The nodes appear in the straight line can be found using the angle measurement technique using cosine of the angle between current node,probable next node and base station. If this angle is maximum among the probable next node candidates; then the maximum cosine angle will form path which is approaching to a straight line.

The current work prepares the routing table based on this angle measurement approach, which is constructed statically particular time duration. The path will be constructed statically using these RT entries. The data will later use this path to take the data towards base station. The simulation compares two different RT search criteria. In the first approach is entry in the RT is used. while in the 2nd approach, maximum angular entry is found out and used as the next forwarding node. In the path construction process which is static as far as current work is considered. The simulation result is compared against the normal next node selection, where the first entry in the routing table is selected in the path construction process.

1 Introduction

The sensors are deployed in a geographical area, where data is sensed and needs to transfer to base station. Here the packets are forwarded towards base station in a multi-hop fashion. Angle based approach is a most suitable since it considers the angle formulation in the next hop node selection which makes straight line path.

2 Related work

Data collected from sensors required to reach base station, Here the constructed path takes critical role in the process. Angle based routing is one of the best approach to do so.[2] This method is based on the direction of source to destination. This scheme calculates the inclination angle formed between the transmitter and the receiver [1]. The candidate set is formed in the process to select the best node to forward the packet. Angle based energy aware routing algorithm is used to transfer data that achieves the goal of less energy consumption and hence the network lifetime is extended The nodes deployed at the indoor location cannot access satellite GPS signals. These devices will use Received Signal Strength (RSS); to identify the target location [3] and hence to calculate the angle. Localization information of sensor nodes is critical to many WSN applications not either sensors are deployed indoor or outdoor. The localization algorithm based on angle and distance information can successfully localize all the nodes in the network. [4] Using these techniques a routing scheme is developed where each intermediate node in a multihop route selects the nearest node within a sector of angle (0) toward the direction of the destination as the next hop. [5] In this

paper,scenario of a source node and the potential relaynodes in channel aware informed forwarding protocol is reviewed ,where the source node will calculate angle of deviation towards destination node.Based on this angle,the packet will be forwarded to the next hop node having minimum deviation. This paper [6] also describes angle based multicast routing algorithm,which will reduce the number of hops while multicasting in a wireless mesh network. The paper [7] describes the role of a threshold angle in which the nodes locating within the angle is considered to select the next forwarding node

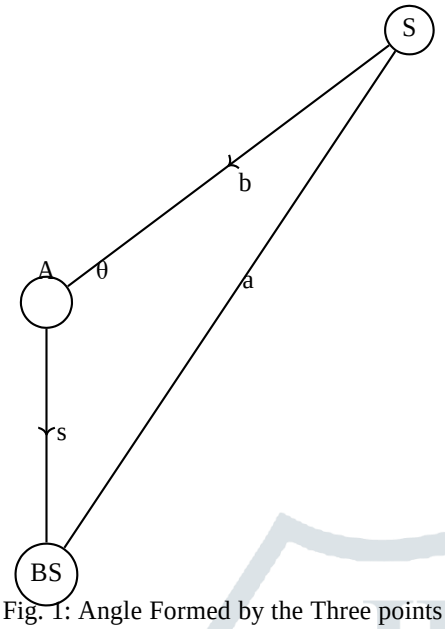

Fig. 1: Angle Formed by the Three points

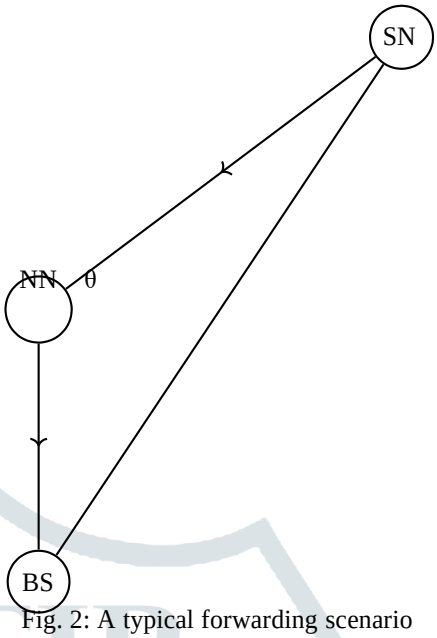

Fig. 2: A typical forwarding scenario

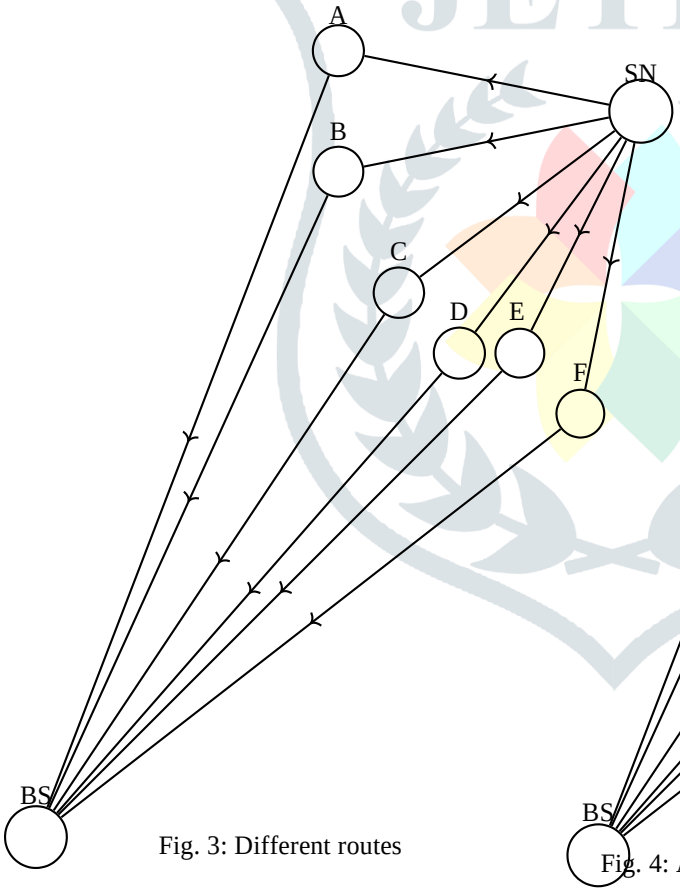

Fig. 3: Different routes

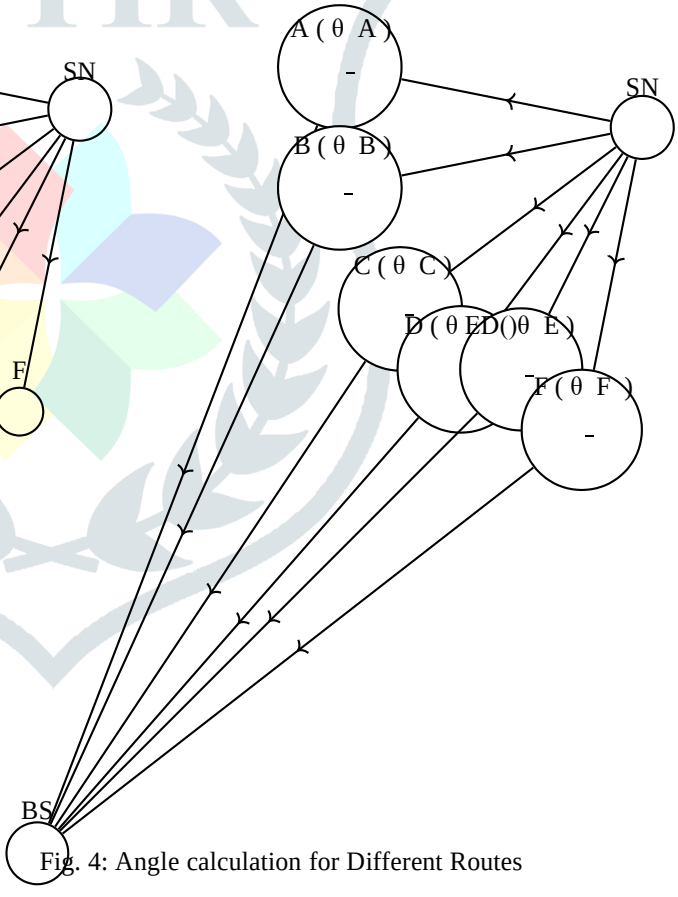

Fig. 4: Angle calculation for Different Routes

3 Mathematical Formula / The Triangular method

Sending node, destination node and next candidate neighbor node forms triangular arrangement, forming an angle at next candidate neighborer .this strategy will make straight line path towards destination node

Node s (source/sender) , intermediate node A and Base station (BS) will form a triangle making angle θ at node A. When the routing table creation processes the angle at node A needs to be measured. The measurement is done using mathematical formula :

cosA = (b*b + s*s - a*a) / 2bs where b =len(AS) a=len(S-BS) S=len(A-BS)

A=inv_cos (S)

angle in degrees is calculated by using inverse of cos. in fig A is replaced as NN (next node) and that node entry is made in the routing table.

4 Algorithm : MASLT

Maximum Angle Straight Line Technique (MASLT)

Phase 1. Sensor node deployment

Phase 2. RT Search and path creation

1) Creating RTable for all the nodes which has probability of possible participation in the data routing process.

2) Path Construction using max angle strategy between sensor and base station. Search in the RT table is required. Path Construction (best path max angle strategy).

Phase 3. Data transmission using already created path.

Routing Table First Entry Technique(RTFET) :

5 Code for angle calculation

```
Alg. angle_determination()
double x1 , y1 , x2 , y2 , x3 , y3 ;
{
double dx21 = x2-x1; double
dx31 = x3-x1; double dx32
= x2-x3; double dy21 = y2-
y1; double dy31 = y3-y1;
double dy32 = y2-y3;
double a = sqrt( dx32∗dx32 + dy32∗dy32 ); double b =
sqrt( dx31∗dx31 + dy31∗dy31 ); double c = sqrt(
dx21∗dx21 + dy21∗dy21 );
double A = ( b∗b + c∗c - a∗a ) / (2 ∗b∗c ) ;
double cosa = acos(A);
double val = 180.0 / PI; double deg
= cosa ∗ val ; return deg;
}
```

The method of calculating angle is invoked using the function call :

double ang = funA(x1 , y1 , x2 , y2 , x3 , y3);

where

(x1 , y1) is the position of the node where angle is calculated.

(x2,y2) is intermediate sending node, which is needed to be added into RT

(x3,y3) is base station

select the maximum angled node which has minimum deviation

Criteria to make an entry into Routing table :

if (ang > 120.0) add point(x1, y1) into RT which is the candidate next node which is in the radio range of (x2,y2).

6 Simulation method

1)Deployment 2) Routing table construction using angular basis. 3)Path construction method using Choice 1: First Entry techniques(RTFET) Choice 2:Max Angle Technique.(MASLT) 4)Data transfer using already constructed path. Path construction methods: Choice 1: First entry in the RT is selected as the next hop node in the path towards base station. Choice 2: RT is searched for Max angle entry which is determines the next forwarding node in the path.

ANGLE BASED ROUTING IN WSN USING TRAINGULAR METHOD choice 1: simple routing table having just neighboring node entries. choice 2:uses RT created using angle based method. c:-sending node(SN) has 6 neighboring nodes within range(A....F) as shown in figure 5.they angles are formed base station as destination . the angles are calculated and they are represented as 0-A.....0-F as shown in the figure 7. those nodes which satisfies upper and lower angular limits will get entries into routing table . Ientry=triangle¡=0-A.....0-F<=max angle. the routing table will be searched to find next hop node.

7 Simulation Environment And Result

1. Deployment

The deployment of the node and sample path constructed is shown in 9.

Sensor nodes are deployed at an area of 1km X 1km, where base station is situated at the origin. The sensors will collect the data and they will forward the packet to the base station using already created path.

2. The Simulation Procedure: The routing table consists of next node id and its angle with respect to base station is constructed after the deployment phase of the network. When a sensor node has a sufficient data to send, it will demand a route to the base station. If it will check its routing cache where already created path entries are present. If a valid entry is already present then, no need of creating a new path and data will use that path. If a valid entry is not present or a error is reported then a new path needs to be created. The process will utilize already constructed Routing table, where maximum angle is calculated and the node which makes maximum angle is selected as the next hop node. The process is repeated till base station is reached.

The above method is compared against the path created using first entry in the routing table, without calculating the best node to forward.

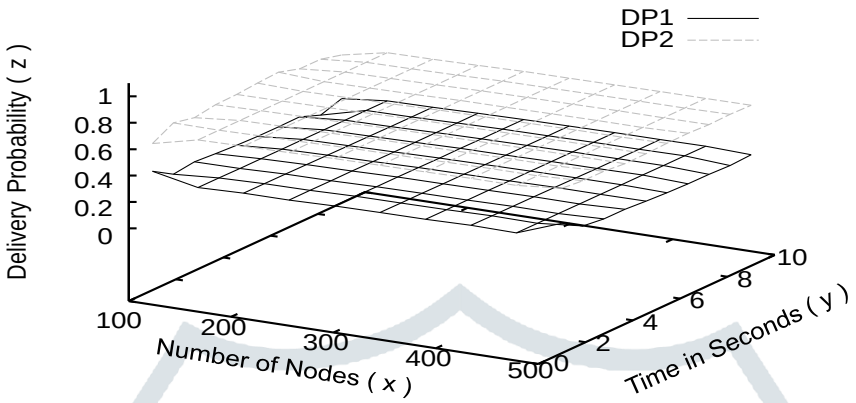

Fig. 5: Delivery Probability

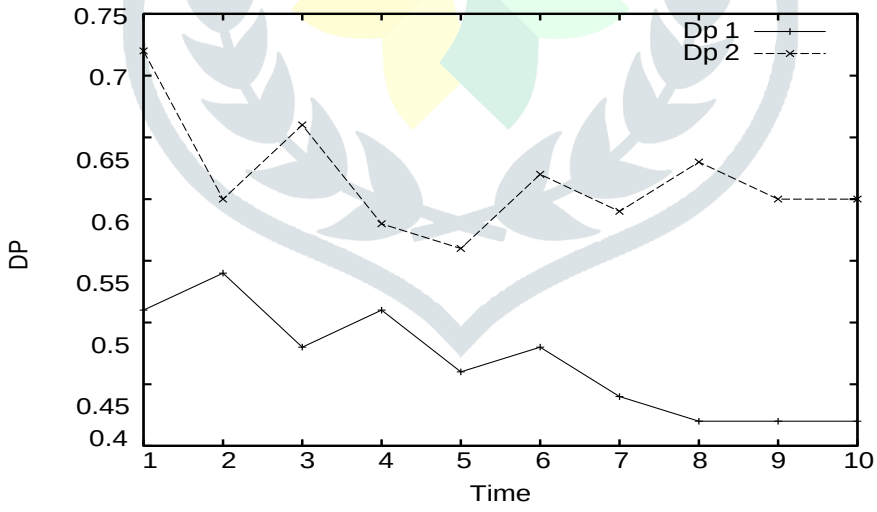

Fig. 6: Delivery Probability

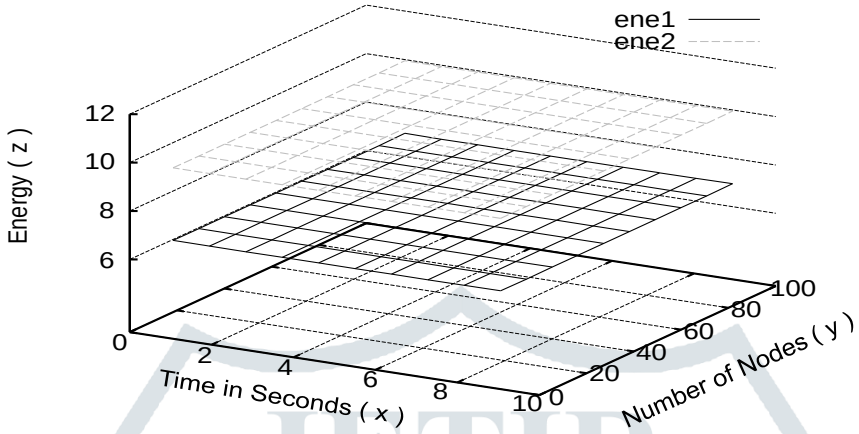

Fig. 7: Energy Distribution

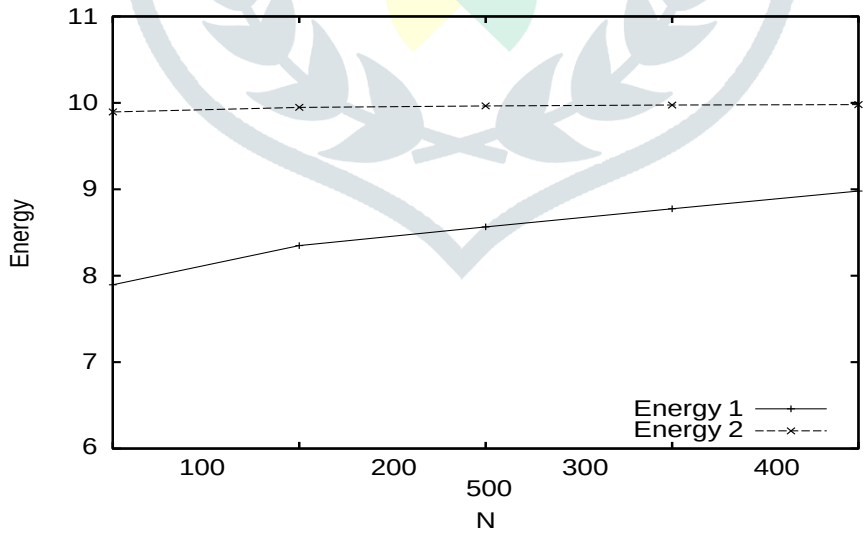

Fig. 8: Residual energy at the end of the simulation

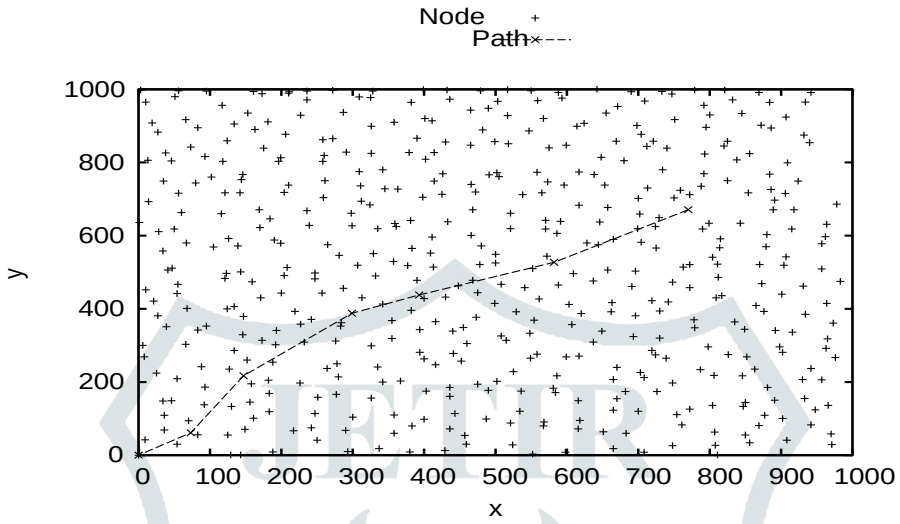

Fig. 9: Deployment and Sample path created for 100 nodes

8 RESULTS

BS base station SN sensor node(source) A .. F intermediate node 0 A .. 0 F angle formed wrt BS and SN Fig 5 dhows delivery probability Of the simulation wrt simulation time.the 3D graph is drawn. For different network density. Fig 6 shows the variation of delivery probability wrt simulation of time.fig 7 shows energy of nodes along Z- axis ,considering number of nodes deployed along y-axis. Fig 8 shows residential energy of the end of the simulation for different nodes density. Fig 9 shows deployment and sample path created for 100 nodes

9 Conclusion

Two path construction or Route establishment techniques are presented in the paper. The algorithm which uses maximum angle technique gives better result compared to first entry technique because the maximum angle technique,tries constructs straight line path towards base station.

References

[1] Spachos, Petros, Dimitris Toumpakaris, and Dimitrios Hatzinakos. ”Angle-based dynamic routing scheme for source location privacy in wireless sensor networks.” Vehicular Technology Conference (VTC Spring), 2014 IEEE 79th. IEEE, 2014.

[2] Suresh , Maria Navin J , Venkatagiri , Hemanth Kumar .”Angle based Routing Protocol for MANET”.International Journal of Scientific Engineering and Research (IJSER) ISSN (Online): 2347-3878 Volume 2 Issue 2, February 2014 .

[3] Pietro Cassar‘, Francesco Potort‘, Paolo Barsocchi, Michele Girolami, Paolo Nepa.”Lessons Learned on Device Free Localization with Single and Multi Channel Mode”.IEEE conference Banff, AB, Canada,13-16 Oct. 2015 .

[4] Weitao Hu, Jianxin Wang, Shigeng Zhang .”Component-Based Localization for Wireless Sensor Networks Combining Angle and Distance Information ”.2013 IEEE International Conference on High Performance Computing and Communications & 2013 IEEE International Conference on Embedded and Ubiquitous Computing.

[5] Uma Datta, Sumit Kundu. ”Comparative performance of forwarding protocols based on detection probability and search angle in a Multi-hop CDMA wireless sensor networks ”. International Journal of Sensors and Sensor Networks , June 30, 2014.

[6] B. Thenral and K. Thirunadana Sikamani. ”AMRA: Angle based Multicast Routing Algorithm for Wireless Mesh Networks” .Indian Journal of Science and Technology, Vol 8(13), DOI: 10.17485/ijst/2015/v8i13/59451, July 2015.

[7] Kwangcheol Shin, Kyungjun Kim, and Soontae Kim . ”ADSR: Angle-based Multi-Hop Routing Strategy for Mobile Wireless Sensor Networks ” .2011 IEEE Asia -Pacific Services Computing Conference.

[8] Li Yaman,Huang Min,Wang Xingwei. ”Space Angle Based Energy-Aware Routing Algorithm in Three Dimensional Wireless Sensor Networks ”.2013 12th International Symposium on Distributed Computing and Applications to Business, Engineering & Science.