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# Enhanced The Routing Efficiency of Wireless Sensor Network Using STR Protocol and Node Reference Process

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**Abstract:** ***Utilization of energy is major issue in wireless sensor network. For the proper utilization of energy used low energy based routing protocol for the communication to source to distination node. For the low energy based protocol shortcut routing protocol cannot supported the direct routing and take more energy. For the direct communication used tree based protocol. in tree based protocol used refrence node selection process for the communication. The reference node selection procress descase the number of hop count and increase the value of packet delivey ratio and throughput of overall network.***

**Keywords:** WSN, MWSN, Hop Count, ZTR, STR.

## 1. Introduction

In this paper enhanced the alternate way tree directing convention for ZigBee remote system. The ZigBee remote system is surely understand individual zone arrange for the correspondence in street movement, healing facility administration and numerous more home machine work through this system. In ZigBee remote system fundamentally utilized ZTR directing convention[1,2,3]. The ZTR steering convention confronted an issue of different level branch situation for the preparing of data. In ZTR steering convention some fundamental issue happened amid the determination of correspondence hub. The procedure of correspondence made with numerous hubs. With the end goal of upgrade ZTR convention accompany on request remove directing convention and its called alternate way tree steering convention. The alternate way tree directing convention is essentially in light of three engineering for the choice and plan of system mode. Alternate way tree directing (STR) that altogether upgrades the way effectiveness of ZTR by just including the 1-bounce neighbor data. Though ZTR[5,6,7] just uses tree joins associating the parent and youngster hubs, STR misuses the neighbor hubs by centering that there exist the neighbor hubs shortcutting the tree steering way in the work topology. As such, in STR, a source or a middle hub chooses the following bounce hub having the littlest outstanding tree jumps to the goal paying little mind to whether it is a parent, one of youngsters, or neighboring hub. The directing way determination in STR is chosen by individual hub in a disseminated way, and STR is completely perfect with the ZigBee standard that applies the distinctive steering systems as indicated by every hub's status. Likewise, it requires neither any extra cost nor change of the ZigBee standard including the creation and support system of 1-bounce neighbor data. For the change of alternate way tree steering convention utilized reference hub choice process. The reference hub determination handle chooses the hub in given region for the procedure of on request. The procedure of on request infers the likelihood of dynamic hub determination handle.The rest of paper discuss as in section 2 discuss the STR protocol. In section 3. Refrence selction. in section 4 discuss proposed method. In section 5 discuss experimental result analysis and finally discuss conclusion & future work in section 6.

## 2. STR Protocol

The STR algorithm basically follows ZTR, but chooses one of neighbor nodes as the next hop node when the remaining tree hops to the destination can be reduced [9]. STR computes the remaining tree hops from the next hop node to the destination for all the neighbor nodes, and selects the N4 as the next hop node to transmit a packet to the destination D2.

Find_Ancestors(devAddr)
Input : devAddr – network address of the device
Output : level(devAddr)-tree level of devAddr, A(devAddr)-network addresses of the devAddr's ancestors at each tree level

A(devAddr,0) ← 0
For i=0 to -1
If(A(devAddr,i) = devAddr)
Return i , A(devAddr)
End if
rIndex ← [ (devAddr- A(devAddr,i)-1)/ ]
if (rIndex < )
A(devAddr,i+1) ← A(devAddr,i) + . rIndex + 1
Else if (rIndex ≥ )
A(devAddr,i+1) ← devAddr
End if
End for

Find_NextHopAddr(dstAddr)
Input : dstAddr – network address of the destination
Output : nextHopAddr –next hop address for the destination

Initialize minRouteCost with infinity
Level(dstAddr),A(dstAddr)←Find_Ancesstors(dstAddr)

```
For each (neighbor,s address      in neghbor table)
Level(    ),A(    ) ← Find_Ancestors(    )
Level(LCA) = 0
While (level(LCA) ≤ min(level(dstAddr),level(    ))
and
            A(dstAddr,level(LCA))=
            A(    ,level(LCA)))
++level(LCA)

End while
nbrRouteCost ← level(dstAddr) + level(    )-
2.level(LCA)
if(nbrRouteCost < minRouteCost)
nextHopAddr ←
minRouteCost ← nbrRouteCost

end if

end for each

Transmit packet to nextHopAddr
```

The main idea of STR is that we can compute the remaining tree hops from an arbitrary source to a destination using ZigBee address hierarchy and tree structure as discussed in previous section. In other words, the remaining tree hops can be calculated using tree levels of source node, destination, and their common ancestor node, because the packet from the source node goes up to the common ancestor, which contains an address of the destination, and goes down to the destination in ZTR.

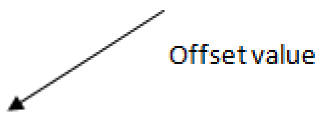
## 3. Reerence Node Selection

In this method, master send by the node is called reference node. And those node accept the join query from reference node, generate token with the help of request node [12].

1) The receivers will compare their clocks to one another to calculate their relative phase offsets. The timing is based on when the node receives the reference beacon.
2) The timing packet will be broadcasted to the receivers. The receivers will record when the packet was received according to their local clocks. Then, the receivers will exchange their timing information and be able to calculate the offset.
3) If the measured time interval is within the range of offset value, the next hop node is considered as a legitimate node. In case the time interval exceeds the value of the offset value, the next hop node is set aside as malicious.
4) Each token have offset value, clock and neighbors.

**Table 1:** Token Generation

| S No. | Token | Clock | Neighbors |
|---|---|---|---|
| 1 | T1 | 3.4 | 1m |
| 2 | T2 | 4.5 | 2m |
| 3 | T3 | 3.5 | 1m |
| 4 | T4 | 7.9 | 3m |




**Method for selection**

```
Void  outgoing packet(Input: e) {
R= (source IP, destination IP)
if e is a request/reply packet then
   for  (i=0; i<k; i++ ) do
    j= Quee_i (e)
    Increment_j ++
   end for
end if
Void Incoming_Packet (Input: e) {
if e request/reply packet then
  R= (destination IP, source IP)
for (i=0; i<k; i++ ) do
   j= Quee_i (e)
    if increment ==0  then
route  Alarm (RA) is reported
    end if
 end for
end if
for  (i=0; i<k; i++ ) do
    j= Quee_i (P)
    Increment--
   end for
end if
Return}
```

## 4. Proposed Algorithm

In this paper improved the shortcut tree routing protocol for ZigBee wireless network. The ZigBee wireless network is well know personal area network for the communication in road traffic, hospital management and many more home appliance function through this network. In ZigBee wireless network basically used ZTR routing protocol[1]. The ZTR routing protocol faced a problem of multiple flat branch scenario for the processing of information. In ZTR routing protocol some basic problem occurred during the selection of communication node. The process of communication composed with multiple nodes. For the purpose of enhancement ZTR protocol come with on demand distance routing protocol and its called shortcut tree routing protocol. The shortcut tree routing protocol is basically based on three architecture for the selection and design of network mode. Shortcut tree routing (STR) that significantly enhances the path efficiency of ZTR by only adding the 1-hop neighbor information. Whereas ZTR only uses tree links connecting the parent and child nodes, STR exploits the neighbor nodes by focusing that there exist the neighbor nodes shortcutting the tree routing path in the mesh topology.

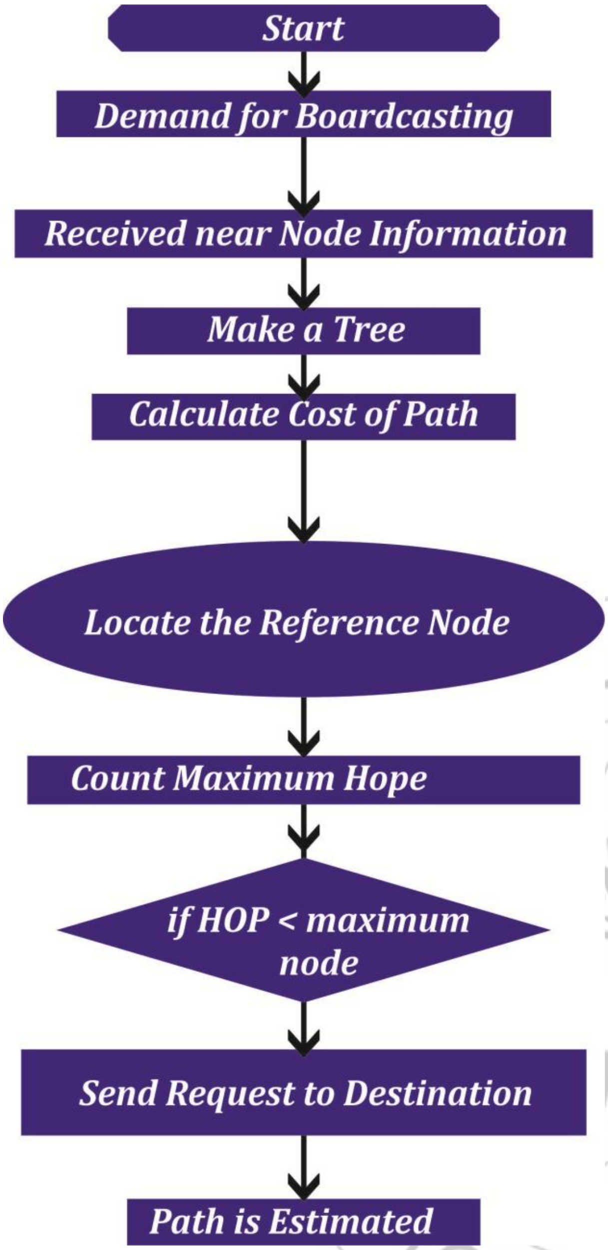



**Figure 1:** Show the improved proposed model of STR protocol.

## 5. Working Process of Model

In this section discuss the working process of proposed model in terms of on demand request and path establishment. The path establishment is final destination of proposed algorithm

1) Start: - in this process established the network and propagation model of signal for the purpose of broadcasting
2) Demand for broadcasting:- in STR protocol basically node broadcast the information for neighbors node.
3) Make tree:- in this section on the basis of information broadcast make all tree node for communication
4) Cost:- measure the cost of open free tree node
5) Reference node:- in reference node selection make node as reference node for the master node for the broadcasting of request
6) Hop:- count the maximum hop of tree node along with reference node and total tree node if hop is minimum then send request packet
7) Path: - finally path is established for the communication.

## 6. Experimental Result

Simulation is an experimental process in that process proposed a simulated model for wireless sensor network and put some standard parameter for valuation of result. In our research work perform energy minimization in wireless sensor network. The proposed model of ISTR written in MATLABscript language and scenario of network generated by TCL (tool command language), both function and script command provided by MATLAB simulator. MATLAB well knows research software of wireless network. The evaluation of performance of our proposed methodology in two parameter throughput of network and packet dropping of network.

**Throughput**

Throughput is the average number of successfully delivered data packets on a communication network or network node. In other words, throughput describes as the total number of received packets at the destination out of total transmitted packets [1]. Throughput is calculated in bytes/sec or data packets per second. The simulation result for throughput in ns-2 shows the total received packets at destination in KB/Sec, mathematically throughput is shown as follows:

$$\text{Throughput}\left(\frac{\text{bytes}}{\text{sec}}\right) = \frac{\text{Total number of received packets at destination} * \text{packet size}}{\text{Total simulation time}}$$

**PACKET DROP**

Packet drop shows total number of data packets that could not reach destination successfully. The reason for packet drop may arise due to congestion, faulty hardware and queue overflow etc. Packet drop affects the network performance by consuming time and more bandwidth to resend a packet. Lower packet drop rate shows higher protocol performance.

Average PDR (%) =

$$\sum_{i=1}^{m} \frac{\text{by each destination data packets received Addition}}{m}$$

Where,

i, symbol of the number of output file

m, symbol of the total number of output files

**Average End-to-End Delay**

This includes all doable delays caused by buffering throughout route discovery latency, queuing at the interface queue, retransmission delays at the macintosh, and propagation and transfer times [7][8][9]. This is the common time concerned in delivery of knowledge packets from the supply node to the destination node [23]. To calculate the common end-to-end delay, add each delay for every flourishing knowledge packet delivery and divide that add by the quantity of with success received knowledge packets.

In different word the common finish to finish delay of the route will be determined by finding the overall delay and dividing it by hop count [24].

$$\text{Average End to End Delay} = \frac{\sum \text{Total Data Packets Received}}{(\text{Time Received} - \text{Time Sent})}$$

$$\text{Normalized Routing Load} = \frac{\text{Total Routing Packets Sent}}{\text{Total Data Packets Received}}$$

$$\text{Route Request's Energy} = \frac{\text{total Route Discoveries Number}}{\text{Seconds.}}$$

**Simulation Topology**

The topology considered is similar to the one used traditionally to depict a typical mobile node in wireless sensor network. Scenario is used 30 nodes and 50 nodes for different location one are used for different group. In both scenarios 2 base node nodes are used and all communication transferred in single destination source in fashion of STR protocol. The legitimate nodes are TCP agents that request files of size 1 Mbps each. The rate of attack is kept very high which is very typical of an attack flow. Each of the links is a duplex link of 5 Mbps bandwidth, with the exception of the high bandwidth bottleneck link which is modeled by a combination of two simplex links of 20 Mbps bandwidth each. The Flow Monitor tailored for the purpose of Characterization is attached to the bottleneck link.

**Simulation Parameters**

Table 5.1 lists the simulation parameters, their values and description of these parameters used in the simulation.

**Table:** Simulation Parameters

| Parameter | Value | Description |
|---|---|---|
| Environment size | 100 * 100 ms | Area of simulation |
| Base station location (x, y) | 50,170 | |
| Node types | Mobile node | Relative load due to traffic. |
| Node speed | 30m/s,40m/s, 50m/s | Mobility time of node |
| Packet type | TCP/UDP | Application load |
| Packet size | 500 bytes | load |
| Base node | 2 | |
| Simulation time | 200 | Total time |
| Receiver node | One | Single destination |

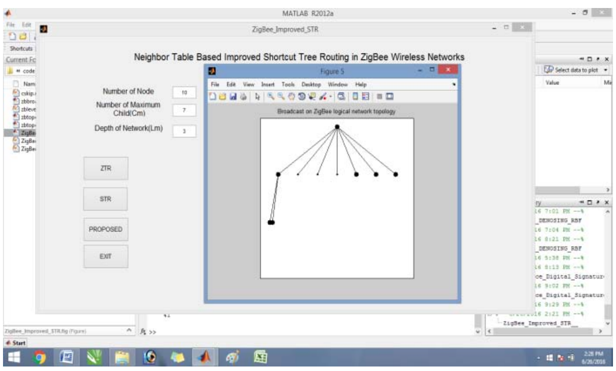



**Figure 2:** Shows that simulation scenario of 10 nodes for the performance evaluation of ZTR, STR and Proposed.

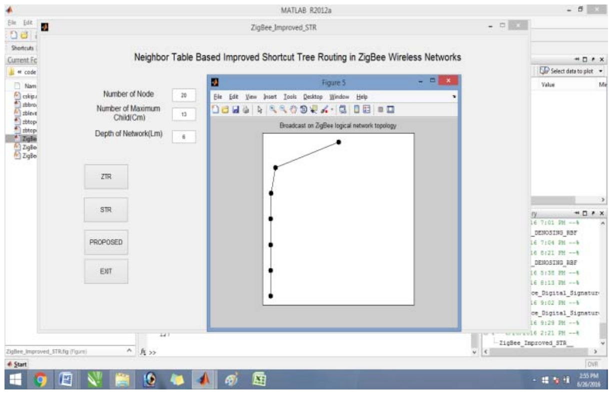



**Figure 3:** Shows that simulation scenario of 20 nodes for the performance evaluation of ZTR, STR and Proposed.

## 7. Comparative Result Table for Performance Evaluation

**Table 2:** Shows the comparative evaluation of ZTR method and Node Value

| Node Value | PDR | Routing Overhead | End To End Delay | HOP-Count |
|---|---|---|---|---|
| 10 | 0.0137 | 300 | 0.6678 | 41 |
| 20 | 0.0635 | 200 | 0.4852 | 127 |
| 40 | 0.1900 | 200 | 0.6694 | 380 |
| 70 | 0.6310 | 200 | 0.0105 | 1262 |
| 90 | 1.9260 | 100 | 0.5472 | 1926 |
| 100 | 2.5040 | 100 | 1.1851 | 2504 |

**Table 3:** Shows the comparative evaluation of STR method and Node Value

| Node Value | PDR | Routing Overhead | End To End Delay | HOP-Count |
|---|---|---|---|---|
| 10 | 0.1137 | 280 | 0.2678 | 31 |
| 20 | 0.1635 | 180 | 0.0852 | 117 |
| 40 | 0.2900 | 180 | 0.2694 | 370 |
| 70 | 0.7310 | 180 | -0.3895 | 1252 |
| 90 | 2.0260 | 80 | 0.1472 | 1916 |
| 100 | 2.6040 | 80 | 0.7851 | 2494 |

**Table 4:** Shows the comparative evaluation of Proposed method and Node Value

| Node Value | PDR | Routing Overhead | End To End Delay | HOP-Count |
|---|---|---|---|---|
| 10 | 0.2137 | 270 | 0.0678 | 26 |
| 20 | 0.2635 | 170 | -0.1148 | 112 |
| 40 | 0.3900 | 170 | 0.0694 | 365 |
| 70 | 0.8310 | 170 | -0.5895 | 1247 |
| 90 | 2.1260 | 70 | -0.0528 | 1911 |
| 100 | 2.7040 | 70 | 0.5851 | 2489 |

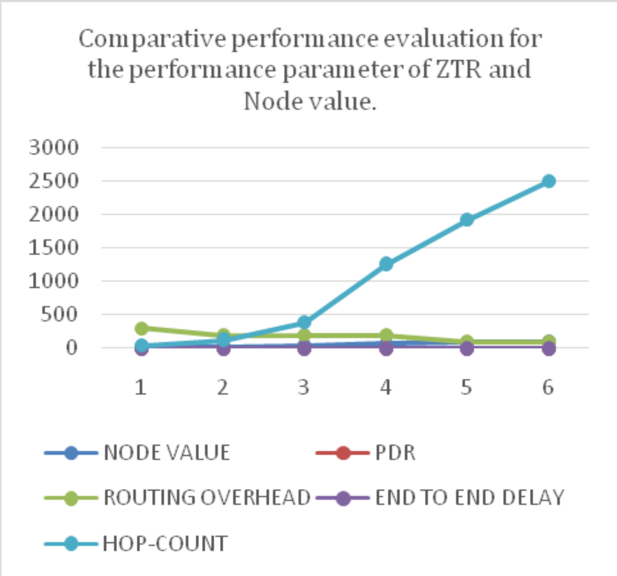



**Figure 3:** Shows the comparative performance graph of ZTR method with input of node value, number of maximum child and depth of network

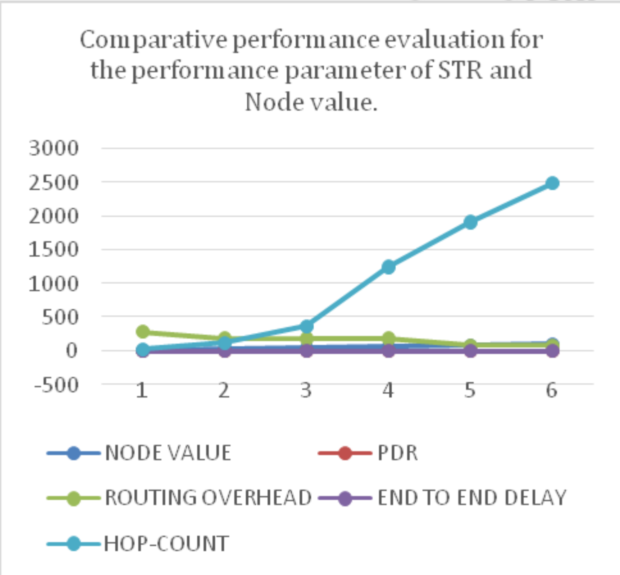



**Figure 4:** Shows the comparative performance graph of STR method with input of node value, number of maximum child and depth of network

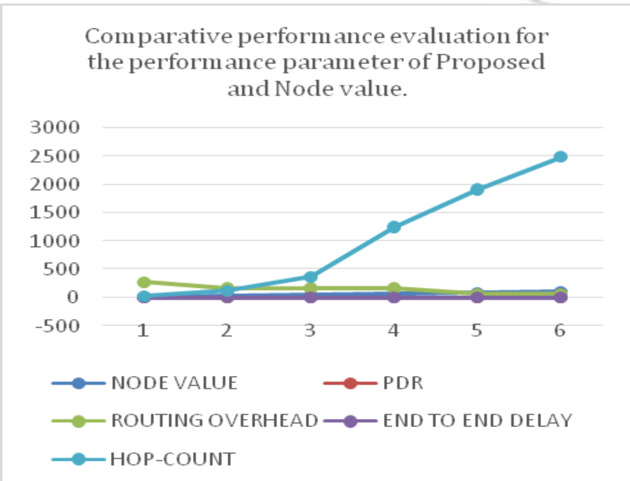



**Figure 5:** Shows the comparative performance graph of Proposed method with input of node value, number of maximum child and depth of network

## 8. Conclusion and Future Work

In this paper improved the STR protocol using reference node selection policy. The reference node selection policy select the sensor node for the direct commuinication. The direct communication of sensor node decrease the hop count and normalized load of network. The modified protocol is extension of STR protocol. the modified protocol simulated in MATLAB software and used standard parameter for the evaluation of parameter such as PDR, hope count, delay of transmission. Our modified protocol enhanced the value of routing load and packet delivery ratio. In future extend this protocol in terms of ISTR.

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