Enhanced perimeter routing under greedy approach for energy efficiency

Neha  
Research Scholar  
I.K. Gujral Punjab Technical University  
Kapurthala, India

Dr. Jogishwar Singh Sohal  
Director  
Ludhiana College of Engineering & Technology  
Ludhiana, India

Abstract: Parameter based routing is becoming an advantageous technique over topological based routing due to enhancement in energy constraint. This paper has focus on reliable positioning of nodes based on grid network architecture to handle the traffic congestion with the help of energy model. This enhanced greedy approach take decisions regarding route forwarding through perimeter region. This work has aim to evaluate the performance with high mobility quality in the network. Our work has focused on the varying effects of network parameters set at different conditions such as packet throughput ratio, speed, average throughput in kbps, delay tolerance, data load in packets per second and region coverage. The simulation results indicate that the packet throughput ratio of enhanced greedy approach has improved by 10% over greedy approach in the presence of 40% of malicious nodes in the wireless network. Our aim is also to make the enhanced perimeter routing more balance to prolong the network life time.

Keywords: routing; energy model; mobility; throughput; wireless network

I. INTRODUCTION

The ground of wireless sensing network is composed of nodes with mobility through infrastructure-less building. Now-a-days flexible computing is an on-demand issue in the battle-field situations. This really requires the vision of highly connected networking in terms of routing on the field to handle the immediate current situations for military purposes. So time demands to do work on routing because of flexible scenario on battlefield [1]. It makes routing a challenging as well as on demand task. This is the reason for routing techniques to move towards the positioning based rather than topological based scenario [2]. As topological based routing consumes more power and take enough time to proceed on geographic area. To make the network flexible, it is highly required to control the flow of packets overhead.

II. PERIMETER ROUTING

In this routing technique, a forwarding node finds out the set of all other neighboring nodes. The nodes that are in selective mode should be closer to the destination than itself. The next neighbor node having maximum weight value will select the next hop mode towards the receiver [5]. This process is continuously repeated at each hop under greedy forwarding approach.
Figure 2 shows that the path following selection on the basis of topological selection (red), greedy mode (green) and perimeter mode (blue). This routing is mainly based on location and distance of neighboring nodes. Next, one hop information data is saved before taking decision to the next hop count. The main advantage of using greedy approach is the removal of dead nodes in the network. To forward the packets in the network, right hand propagation rule is applied under protocol configuration. To minimize the crossings among communication lines, planarization graph technique is adopted. The table1 declares the perimeter header that contain the fields

\[
D_p \quad L \quad N_f \quad E^f \quad M_{G/IP} .
\]

<table>
<thead>
<tr>
<th>Field</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>(D_p)</td>
<td>Destination point</td>
</tr>
<tr>
<td>(L)</td>
<td>Location perimeter mode</td>
</tr>
<tr>
<td>(N_f)</td>
<td>First node position</td>
</tr>
<tr>
<td>(E^f)</td>
<td>First edge traversed</td>
</tr>
<tr>
<td>(M_{G/IP})</td>
<td>Mode (greedy/perimeter)</td>
</tr>
</tbody>
</table>

### III. ENERGY MODEL

#### A. Analytical Equations

Energy model proposed the energy components used in the direction of total power consumption at a node. Here we use the single-hop sampling time.

a. On-Listen energy: This energy is defined as when the active transition mode of radio is on but there is no transmission and reception of any packets.

\[
E_L = \frac{I_L}{C_k} \cdot T_c \cdot I_f \cdot V
\]

Under this, \(S_p\) is the sampling period taken between the nodes, \(T_c\) is time period during awaking mode, \(I_f\) is the current drawn during listen period, \(C_k\) is the clock time period, \(V\) is the total voltage drawn.

b. Switch on-off energy: This energy is calculated in between the states of normal, power off and idle condition.

\[
E_S = \frac{(I_f - I_s) \cdot T_{S\alpha} \cdot V}{2}
\]

In this, \(I_f\) is the current drawn in active mode, \(I_s\) is the current drawn during sleep mode and \(T_{S\alpha}\) is the time gap between sleep mode and active mode.

c. Transmit energy: It compute the total number of data packets sent inside the radio.

\[
E_{Tr} = P_{bt} \cdot P_s \cdot T_{byte} \cdot I_f \cdot V
\]

In this, \(P_{bt}\) includes the total packet data length, \(P_s\) is the total number of packets sent, \(T_{byte}\) is the byte time data, \(I_f\) is the current drawn at transmission mode.

d. Receive energy: It is used to calculate the overall energy received at the end of the network.

\[
E_R = P_{br} \cdot P_{bt} \cdot T_{byte} \cdot I_R \cdot V
\]

In this, \(P_{br}\) is the total power received and \(I_R\) is the current drawn at receiving mode.

e. Sleep energy: This energy is computed at low power mode.

\[
E_S = T_{off} \cdot I_s \cdot V
\]

In this, \(T_{off}\) is the off time period at sleep mode and \(I_s\) is the current drawn at sleep condition.

f. Total energy drawn: The total energy includes the all energy factors described above as:

\[
E_T = E_L \cdot E_S \cdot E_{Tr} \cdot E_R \cdot E_S
\]

So the energy model is used to evaluate the energy consumption in an efficient way to control the wastage and to enhance the energy saving.

#### B. Greedy approach algorithm

Here, in this algorithm we assume that \((N_d:K_d)\) are the regions of the destination point node ‘d’ and the forward region node ‘f’ that have the responsibility to take data to the destination point ‘d’. Figure3 elaborates the code algorithm for greedy approach.

The forwarding region node ‘f’ computes the distance area between and destination node ‘d’ and itself. It also calculates the distance between destination node and its neighboring nodes [6]. In the formulation accepted, for example, is ‘L’ node of forwarding region is closer to the destination point then the difference between ‘f’ and ‘d’ and distance between ‘L’ and ‘d’ is computed and then divided by the distance between ‘f’ and ‘d’. If the closer proximity formulation is not fulfilled then the algorithm will need to move towards the perimeter mode.

The above algorithm elaborates as:

| Input; f: Forward region node, d: Destination point, (N): Neighbor-listing |
| Variables: Route (f, L) where L ε neighbor list (N) |
| Output: Next-Hop-count-node: if greedy approach accepted successfully |
| NULL: if Greedy approach is not adopted and need of perimeter mode. |
| Initial / Next-Hop-count-node= NULL |
| Progress \(\rightarrow 0.00\) |
| Begin Greedy algorithm |
| D1: Distance between ‘f’ and ‘d’=

\[
\sqrt{(N_f - N_d)^2 - (K_f - K_d)^2}
\]

D2: Distance between ‘L’ and ‘d’=

\[
\sqrt{(N_L - N_d)^2 - (K_L - K_d)^2}
\]

If (D2 <D1) then

Route (f, L) = \(\frac{D1 - D2}{D1}\)

If (Destination progress < Progress (f: L))

Then

Destination progress = Progress (f: L)

Next-Hop\(\leftarrow\) L

Count node

End if

End if

End for

If (Required destination progress > 0.0) then

Return Next-Hop count node /

Greedy approach is adopted

Else

Return Null /

perimeter mode is adopted

End if

End; Greedy approach algorithm

![Fig.3 Pseudo code: Greedy approach](image-url)

#### C. Enhanced greedy approach algorithm

In this, we illustrate a number of sets of candidates among neighboring nodes. Figure 4 elaborates the code algorithm for enhanced greedy approach.
Candidate-list (N): A subset of neighbor listing (N)
For each neighbor L ∈ neighbor-listing (N)
Here is a variable weight (w) is computed as the summation of initial energy at L known as ‘residual energy factor’ (w).
The region covered with the appropriate selection of ‘w’ is known as progress (f, w), which resembles the difference between ‘f’ and ‘d’ and distance between ‘w’ and ‘d’
divided by the difference between ‘f’ and ‘d’. Under this selection, the node with the maximum weight value is selected for the next-hop-count under routing. If ‘f’ will not
be able to get any neighbor node then candidate list is having value ‘0’ and the route will go under perimeter mode.

With the above description in comparison with the greedy approach, the selection of next-neighbor-node among listing depends upon the larger residual energy with the near-far effect. So, it will have the advantage to decrease the failure time of first node hop and will relatively give help in the enhancement of life-time of the network.

In further, the computation needs that the speed of the node must matches with the direction of route adopted in the enhanced greedy approach.

IV. SIMULATION METRICS

A. We have done simulation of enhanced greedy approach in network simulator-3 in comparison with the greedy approach.

Under simulation environment, the parameters taken are shown in table2 as:-

<table>
<thead>
<tr>
<th>Simulator</th>
<th>NS-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>900 * 900</td>
</tr>
<tr>
<td>Transmission range</td>
<td>300m</td>
</tr>
<tr>
<td>Number of nodes</td>
<td>150</td>
</tr>
<tr>
<td>Pause time duration</td>
<td>0.5 sec.</td>
</tr>
<tr>
<td>Simulation time</td>
<td>200 sec.</td>
</tr>
<tr>
<td>Packet size</td>
<td>560 Bytes</td>
</tr>
<tr>
<td>CBR rate flow</td>
<td>10kbps</td>
</tr>
<tr>
<td>CBR destinations</td>
<td>5</td>
</tr>
<tr>
<td>Beacon time gap</td>
<td>0.6 sec.</td>
</tr>
</tbody>
</table>

Fig.4 Pseudo code: Enhanced Greedy approach

Input: f: Forward region node, d: Destination point, (N): Neighbor listing
Variables: Route (f, L) where L ∈ neighbor listing (N), Residual energy factor (W)
L ∈ candidate list (N), corresponds to maximum-weight value ‘w’
Output: Next-hop-count-node// if Greedy approach: success
NULL: if Greedy approach: unsuccessful// Need of Perimeter mode.
Initial/ Next-hop-count-node=Null;
Maximum weight value ←0.00
Candidate list (N) ←∅
Begin
Enhanced greedy approach
Distance covered between ‘f’ and’d’ =
\[ \sqrt{(N_f - N_d)^2 - (K_f - K_d)^2} \]
For each neighbor node L ε neighbor listing (N) do
Distance between ‘L’ and ‘d’ =
\[ \sqrt{(N_f - N_d)^2 + (K_f - K_d)^2} \]
If distance between ‘L’ and’d’ is less than the distance between ‘f’ and ‘d’ then
Candidate list (N) ← Candidate list (N) U {L}
End if
End for
For each node at L ε candidate list (N) do
Residual energy factor (w) = \( \frac{\text{Energy at } (w)}{\text{Distance between 'f' & 'd'-distance between 'L' & 'd'}} \)
Route (f, L) = \( \frac{\text{Distance at initial point } (w)}{\text{Distance between 'f' & 'd'}} \)
Weight (w) ε Residual energy factor (w) + Route (f, L)
If (weight at maximum value < weight (w)) then
Maximum weight function = weight value (w)
L ← Next-hop-count
End if
End for
If (maximum value at ‘w’ > 0.00) then
Return
Next-hop-count-mode
Else
Return null
End if
End- Enhanced Greedy approach algorithm

Fig.5 Packet throughput (kbps) VS Speed (m/s)-EGPR

Fig.6 Packet throughput (kbps) VS Speed (m/s)-GPR
Under static conditions for 10 different region points, we have observed the EGPR & GPR using parameters data received ratio (%) in kbps, speed in (m/s), acceleration and routing overload. We observe from Figure 4 that at the speed of 10 m/s the data received ratio is 50 in kbps and from Figure 5 the data received ratio is 30 in kbps at the same speed. So, this is the observed enhancement of greedy perimeter approach over greedy perimeter approach.

It is also observed that as the speed increases data throughput decreases because of the overloaded data on receiver side. Still we are having improvement in enhanced mode rather than in GPR. As the data received ratio is increased in EGPR at 15m/s by 10% as in comparison with the GPR at the identical conditions.

B. Load affect during packets send:
From figure 7 and figure 8, we observed that the average throughput VS packets sent per second increases at the rate of 10%. The number of packets increases at the same region in EGPR due to minimize the overhead in path routing. By selecting the appropriate route selection in enhanced mode, maximum data is sent through EGPR than GPR.

V. CONCLUSION

In this paper, we proved that the enhancement in greedy approach through appropriate energy modeling in route selection. The results shows that technique used in our routing protocol gives better results in terms of data received ratio, throughput and packets sent per second. Our main focus is on route stability during packets sent and to minimize the congestion over head.

VI. REFERENCES