# Routing Strategies for Smart City Applications Based On Intelligent Clubbing Of Multi Parameters

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**ABSTRACT:** The Smart City platform can play a key role by providing a fully automatic service. The platform will enable the transmission of timely and spatial information on the whereabouts of the people having requested the service through a personal device, the Internet of things based Foot Patrol service will enable tracking the location of the service user .The design and development of applications such as the aforementioned require the use of smart wireless communications. In this paper, algorithms for self organization of wireless sensor network & intelligent routing using fuzzy logic with multiple parameters are proposed. Due to this approach, the routing delay is reduced & the throughput is increased.

**KEYWORDS**: fuzzy logic, radio signal strength, number of hops, residual energy, virtual backbone scheduling

## I. INTRODUCTION

In the context of Smart City environments, wireless sensor networking is playing a major role when enabling the utilization of networked infrastructures to introduce or improve a wide variety of services to be available to the citizens. For this kind of environment, the network should be self organizing without much human intervention. The routing of packets from the sensor nodes to the base station must be based on optimization of multiple parameters. We consider path optimization based on multiple parameters like Radio Signal Strength (RSI), Number of hops, Residual Energy of Node .With all these parameters, fuzzy logic is applied to get the preference score. The spanning tree is then constructed with every node attaching to parent with bigger value of score. Along with this, a network is created using a virtual backbone scheduling, in which the optimized path is created using the dominating set.

## II. RELATED WORK

Managing the growth of our cities is one of the major challenges of this century. IoT-based platforms will support it, with the promise of better environmental monitoring, energy saving, smart grids, more efficient factories, better logistics, better healthcare and smart homes. IoT driven primarily by wireless sensor networks will require people with new skills, since the focus will be much more on software than hardware. Different companies around the world are completing interesting platforms for smart cities control. Two relevant examples of smart cities are the SmartSantander project and the futuristic GhostCity. Wireless sensor networks help to create Smart Cities, using a distributed network of intelligent sensor nodes to measure a variety of parameters, such as noise, temperature, ambient light levels, carbon monoxide concentration, and the

availability and location of parking spaces, for efficient city management. The Smart Santander project—collaboration between companies and institutions designed as a life-size laboratory for technology—is an example of a unified vision for technology to benefit the lives of city dwellers and all citizens. SmartSantander is really a city-scale experimental research facility in support of the typical applications and services required for future Smart City implementation. This facility is sufficiently large, open, and flexible to enable the SmartSantander network to associate with other experimental facilities, creating a large-scale network of real-time testing nodes in different cities within Europe or around the globe to stimulate development of new applications by a variety of users, including advanced research on Internet of Things (IoT) technologies, based on the realistic assessment of users' acceptability tests. The project envisions the deployment of 20,000 sensors in the European cities of Belgrade, Guildford, Lübeck, and Santander (12,000), incorporating a large range of technologies. In the SmartSantander project, Libelium has deployed a large number of Waspmote wireless sensor nodes (See sidebar "Introducing Waspmote" at the end of this article) to monitor a variety of parameters. One of the main challenges encountered during the project was the need to develop Over-the-Air-Programming (OTAP) so that they could program all the nodes wirelessly and remotely. Libelium collaborated with the University of Cantabria to improve the OTAP system, creating a more robust network that can be upgraded at any time from any place.

## III. PROPOSED ALGORITHM

*Design Considerations:*

1. Sensor network must be created with configurable number of nodes and a sink
2. Sensor nodes must be placed randomly in the network
3. From any sensor node events can be triggered
4. From sensor node to sink packet must be routed using Shortest Hop routing
5. From sensor node to sink packet must be routed using Fuzzy routing
6. From sensor node to sink packet must be routed using Virtual Backbone Scheduling
7. Measure QOS parameters - Packet delivery ratio, delay, energy consumed across all routing methods.

## IV. PSEUDO CODE

**1. Shortest Hop Routing**

```
// compute next shortest hop count to sink for all nodes
Start = 0; // 0 is the sink node
Q<-Null;
Node(start).hopcounttosink=0;
Q.add(Start);
while (Q.isempty ==false)
{
    NinQ = Q.poll();
   Visit(NinQ) = 1;
 for all  neighbours NX for NinQ
      if  Visit(NinQ) == 0
        Node(NX).nexthoptosink = NinQ;
        Node(NX).hopcounttosink = Node(NinQ).hopcounttosink+1;
      else
         if  Node(NX).hopcounttosink< Node(NinQ).hopcounttosink
            Node(NX).hopcounttosink = Node(NinQ).hopcounttosink + 1;
```

```
            Node(NX).nexthoptosink = NinQ;
        end
  end
// when any event is triggered at node packet is forwarded to next hop
Start = fromnode
while (Start != 0)
{
     Nexthop = Node(Start).nexthoptosink;
     forwardPacket(packet,Nexthop);
     Start = Nexthop;
 }
```

**2. Fuzzy Routing**

```
for   all node NX
    for each neighbor Ny  of node NX
        NX(NY).score = Fuzzy(Current energy, RSSI, congestion);
     end
      Node(NX).nexthoptosink =  Neighbour with higgest score  NX(neighbours) score.
End
// when any event is triggered at node packet is forwarded to next hop
Start = fromnode
while (Start != 0)
{
     Nexthop = Node(Start).nexthoptosink;
     forwardPacket(packet,Nexthop);
     Start = Nexthop;
     }
```

**3. Virtual Backbone Scheduling**

```
VBS = ComputeVBS();
 // when any event is triggered at node packet is forwarded to best node in VBS
Start = fromnode
NextHop =   Node in VBS with shortest hop & congestion
forwardPacket(Nexthop);
Start = NextHop;
while (Start != 0)
{
    Nexthop = NextNode_in_VBS();
    forwardPacket(NextHop);
   Start = Nexthop;
}
```

## V.  SIMULATION RESULTS

Simulation study shows the results of the wireless sensor network topology with 60 nodes. Proposed energy efficient algorithm is implemented with java net beans. We transmit the packets from the base station the packets are transmitted using the three different routing algorithms. In the shortest path algorithm the next shortest hop from the source node is found. In the Fuzzy Routing algorithm, parameters like current energy, RSSI, congestion are considered and based on these

values the node which suits the best or the node which is having the best combination of the three parameter is considered as the next suitable node. The last algorithm i.e VBS routing , a dominating set is created with a suitable number of nodes , when a packet has to be forwarded from the source to the sink , the nodes near to the dominating set is selected as the next best path. The figures below show the performance analysis with respect to all the three algorithms. Performance is analysed in terms of delay, success ratio, energy consumption.
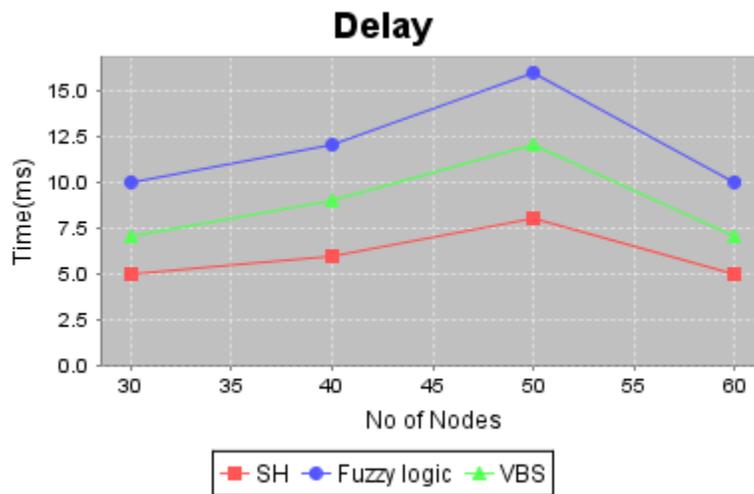


Fig.1 Delay in terms of ms with 60 nodes

Fig 1 shows the delay in the network with respect to the three algorithms with 60 nodes , the delay is measured in terms of milliseconds. According to the result fuzzy routing gives more delay compared to other routing methods.
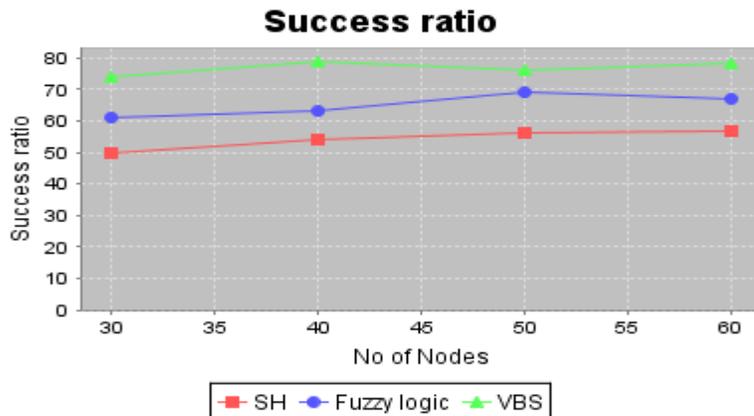


Fig.2 Success ratio with 60 nodes

Fig 2 shows the success ratio , according to the result the success ratio is higher in VBS routing

# International Journal of Innovative Research in Computer and Communication Engineering

*(An ISO 3297: 2007 Certified Organization)*

**Vol. 2, Issue 7,  July 2014**



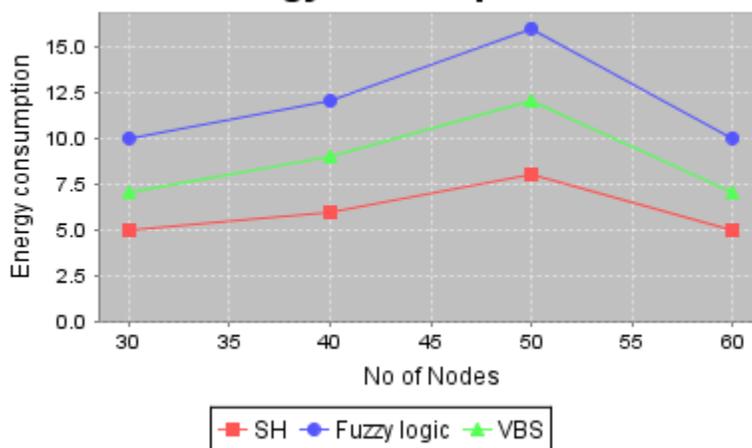Fig.3 Energy Consumption with 60 nodes

Fig 3 shows the energy consumption the result shows that the energy consumption is highest in fuzzy routing .

## VI. CONCLUSION AND FUTURE WORK

This project details with the aim of implanting a useful sensor network for the citizens in the context of smart cities. The applications in this context require the optimization of communication tasks. The work presented herein details a simple but yet efficient network discovery and tree construction protocol that can be executed using different metrics depending on the application and network requirements. A metric based on fuzzy logic has been also proposed. This metric combines several node and network parameters with the aim of constructing an efficient communication tree. These experiments have been focused on the execution of the network discovery and tree construction protocol proposed when using three different metrics for parent selection: Shortest Path Tree, Received Signal Strength Indicator and Fuzzy Logic. The fuzzy logic based metric provided the best overall results since it intelligently combines several metrics enabling efficient tree construction.

Future work will be focused on the use of mobile nodes that will have to dynamically select the attachment point to the infrastructure network. This will be the next step to the real implementation of our system in a real Smart City environment.

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