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# GOAFR: An Optimal Algorithm for Geographic Routing In Wireless Sensor Networks

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***Abstract*—Geographic Routing is the most widely used technique for Scalable Wireless Routing. It can be considered as a lean version of source routing appropriate for dynamic networks. In this paper we propose an algorithm based on Greedy routing and face routing Techniques. GOAFR Algorithm is used in both average case and Worst case environments. This Algorithm provides good enough result for routing and it outperforms other routing algorithm such as AFR. GOAFR does guarantees the source to destination delivery of data. More over we improve this Algorithm using early fall Back Technique so that we can reduce the delay in Routing.**

***Index Terms-Face Routing, Wireless Communication, routing.***

## 1. INTRODUCTION

### Wireless Sensor Networks

Wireless sensor networks (WSN) are an increasingly attractive means to monitor environmental conditions and to bridge the gap between the physical and the virtual world. A WSN consists of large numbers of cooperating small-scale nodes capable of limited wireless communication, and sensing. By correlating sensor output of multiple nodes, the WSN as a whole can provide functionality that an individual node cannot. Application Areas for WSNs include geophysical monitoring (seismic activity), precision agriculture (soil management), habitat monitoring (tracking of animal herds), and transportation (traffic monitoring), Military systems, business processes (supply chain management), and in the future, possibly cooperating smart everyday things. The basic mode of operation of WSNs is significantly different from traditional computer networks, due to their tight integration with the physical world. Additionally, sensor networks have some unique characteristics that make the development of applications non-trivial. Routing in a communication network is the process of forwarding a message from a source host to a destination host via intermediate nodes. In wired networks, routing is commonly a task performed by routers, special fail-safe network hosts particularly designed for the purpose of forwarding messages with high performance. In ideal wireless sensor networks, in contrast, every network node may act as a router, as a relay node forwarding a message on its way from its source node to its destination node. This process is particularly important in ad hoc networks, as network nodes are assumed to have restricted power resources and therefore try to transmit messages at low transmission power, leading to the effect that the destination of a message can typically not be reached directly from the source. The importance of this task also becomes manifest in the popular term *multi hop routing*, expressing the essential role of network nodes as relay stations. Geographic routing, sometimes also called directional, geometric, location-based, or position-based routing, is based on two principal assumptions. First, it is assumed that every node knows its own and its network neighbors' positions. Second, the source of a message is assumed to be informed about destination. The former assumption is currently becoming more and more realistic with the advent of inexpensive and miniaturized positioning systems.

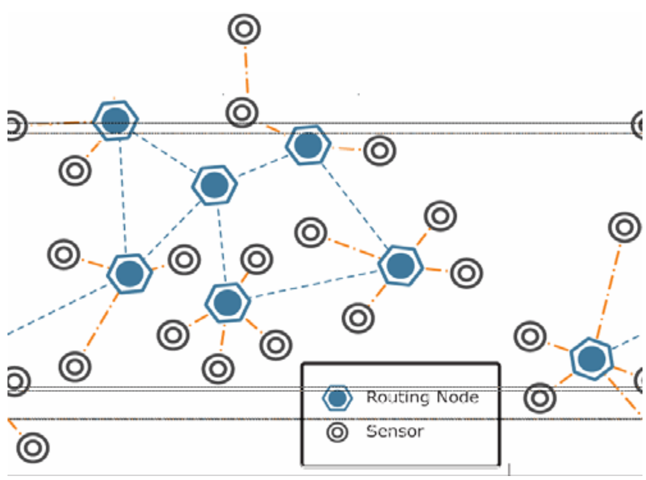



***Figure (1) routing nodes find the next node using sensor***

Sensor networks are the key to gathering the information needed by smart environments, whether in buildings, utilities, industrial, home, shipboard, transportation systems automation, or elsewhere. Recent terrorist and guerilla warfare Counter measures require distributed networks of sensors that can be deployed using, e.g. aircraft, and have self-organizing capabilities. In such applications, running wires or cabling is usually impractical. A sensor network is required that is fast and easy to install and maintain. Smart environments represent the next evolutionary development step in building, utilities, industrial, home, shipboard, and transportation systems automation. Like any sentient organism, the smart environment relies first and foremost on sensory data from the real world. Sensory data comes from multiple sensors of different modalities in distributed locations. The smart environment needs information about its surroundings as well as about its internal workings; this is captured in biological systems by the distinction between interceptors and proprioceptors. The main characteristics are WSN middleware should support the implementation and basic operation of a sensor network as outlined above. However, this is a non-trivial task, as WSNs have some unique characteristics: First, sensor nodes are small-scale devices with volumes approaching a cubic millimeter in the near future. Such small devices are very limited in the amount of energy they can store or harvest from the environment. Furthermore, nodes are subject to failures due to depleted batteries or, more generally, due to environmental influences. Limited size and energy also typically means restricted resources (CPU performance, memory, wireless communication bandwidth and range). Node mobility, node failures, and environmental obstructions cause a high degree of dynamics in WSN. This includes frequent network topology changes and network partitions. Despite partitions, however, mobile nodes can transport information across partitions by physically moving between them. However, the resulting paths of information flow might have unbounded delays and are potentially unidirectional. Communication failures are also a typical problem of WSN. Another issue is heterogeneity. WSN may consist of a large number of rather different nodes in terms of sensors, computing power, and memory. The large number raises scalability issues on the one hand, but provides a high level of redundancy on the other hand. Also, nodes have to operate unattended, since it is impossible to service a large number of nodes in remote, possibly inaccessible locations.

**Routing Protocols:**

**1.1 Geographic Routing**

Geographic routing is particularly interesting, as it operates without any routing tables whatsoever. Furthermore, once the position of the destination is known, all operations are strictly local, that is, every node is required to keep track only of its direct neighbors. These two factors—absence of necessity to keep routing tables up to date and independence of remotely occurring topology changes—are among the foremost reasons why geographic routing is exceptionally suitable for operation in ad hoc networks. Furthermore, in a sense, geographic routing can be considered a lean version of source routing appropriate for dynamic networks: While in source routing the complete hop-by-hop route to be followed by the message is specified by the source, in geographic routing the source simply addresses the message with the position of the destination. As the destination can generally be expected to move slowly compared to the frequency of topology changes between the source and the destination, it makes sense to keep track of the position of the destination instead of maintaining network topology information up to date; if the destination does not move too fast, the message is delivered regardless of possible topology changes among intermediate nodes. Finally, from a less technical perspective, it can be hoped that by studying geographic routing it is possible to gain insights into routing in ad hoc networks in general, without availability of position information. We will start our analysis of geographic routing by describing a simple greedy routing approach. The main drawback of this approach is that it cannot guarantee to always reach the destination. Geographic routing algorithms that, in contrast, always reach the destination, are based on faces, contiguous regions separated by the edges of planar network sub graphs. It may, however, happen that these algorithms take steps before arriving at the destination, where is the number of network nodes. In other words, they basically do not perform better than an algorithm visiting every node in the network. We will describe the concept of face routing and describe algorithms that not only always find the destination, but are also guaranteed to do so with cost at most, where is the cost of a shortest path connecting the source and the destination.

**2. Existing Methods:**

In the existing system they were used so many types of algorithms to broadcast the packets to the destination. They are

2.1 Greedy Routing Algorithm (GR)
2.2 Face Routing Algorithm (FR).
2.3 Adaptive Face Routing (AFR)
2.4 GOAFR Algorithm

**2.1 Greedy Routing Algorithm (GR)**

Greedy Routing Algorithm finds the shortest path between the nodes. Each node forwards the message to the best neighbor. However, fail if the message reaches a local minimum with respect to the distance to the destination that is a node without any “better” neighbors. Also a “least deviation angle” approach (*Compass Routing*) cannot guarantee message delivery in all cases.

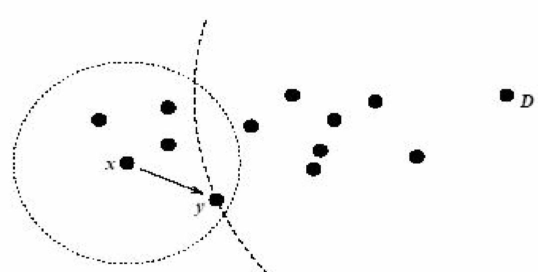



***Figure (2) x and y finds the shortest path to reach the destination using greedy routing technique***.

**2.2 Face Routing Algorithm (FR)**

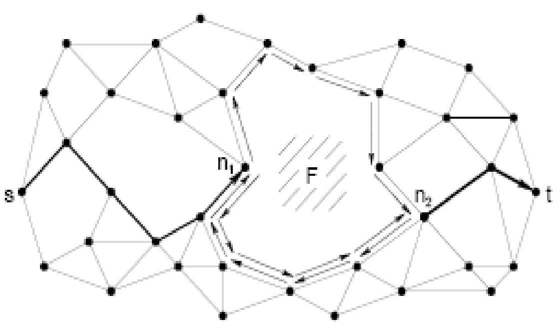
Face routing technique guarantees the source to destination delivery of data . Face Routing walks along faces of planar graphs and proceeds along the line connecting the source and the destination. Besides guaranteeing to reach the destination, it does so with messages, where is the number of network nodes. However, this is unsatisfactory, since also a simple flooding algorithm will reach the destination with messages. Additionally, it would be desirable to see the algorithm cost depend on the distance between the source and the destination.

### 2.3 Adaptive Face Routing (AFR)

Adaptive Face Routing algorithm (AFR) is formed on the basis of face routing technique. AFR will predict the length of a path .If s and t is connected at all, AFR will eventually find a path to. This iteration is asymptotically dominated by the cost of the algorithm steps performed in the last ellipse, whose area is at most proportional to the squared cost of an optimal path.

### 2.4 GOAFR Algorithm

The GOAFR algorithm combining greedy and face routing. GOAFR is a combination of greedy routing and face routing in the following sense: Whenever possible, the algorithm tries to route in a greedy manner; in order to overcome local minima with respect to the distance from the destination, face routing is employed. In face routing mode, GOAFR restricts the searchable area and improves the performance of both average case and worst case networks. More importantly, for average-case considerations, the algorithm should fall back to greedy routing as soon as possible after escaping the local minimum.




***Figure(3) GOAFR proceeds in greedy mode until reaching the local minimum n1. The algorithm switches to face routing mode and explores the boundary of face F to _nd n2, the node closest to t on F's boundary. GOAFR falls back to greedy mode and finally reaches t.***

### 2.5 Disadvantages of Existing System

- Does not guarantee source to destination delivery of data.
- Takes more number of time reach the destination.
- The cost of AFR is greater than the squared cost of the optimal route.
- GOAFR Algorithm takes more number of loops during face routing process.

## 3 Proposed Method:

### Improved GOAFR Algorithm

In this paper we improve the performance of GOAFR Algorithm using Early Fall Back Technique. This Technique will reduce the searchable area during face routing process. Improved GOAFR Algorithm does not necessarily explore the complete face boundary in face routing mode. The algorithm employs two counters p and q to keep track of how many of the nodes visited during the current face routing phase are located closer (p) and how many are not closer (q) to the destination than the starting Point of the current face routing phase; as soon as a certain fallback condition holds, this algorithm directly falls back to greedy mode. While face routing process the algorithm uses a bounding circle ***C*** centered at ***t*** to restrict itself to a searchable area after hitting the Bounding circle ***C*** the algorithm turn back to continue the exploration of F's Boundary in opposite direction. Soon after completing the face routing process the algorithm will fall back to greedy routing process and continue to move towards the destination.

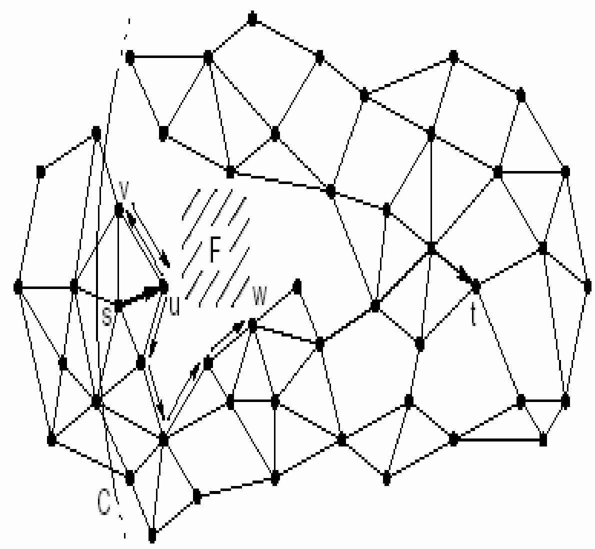
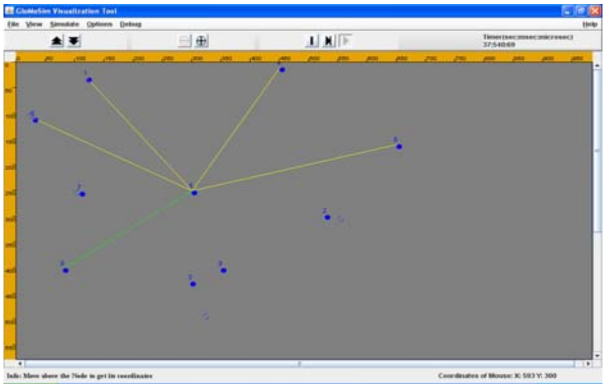
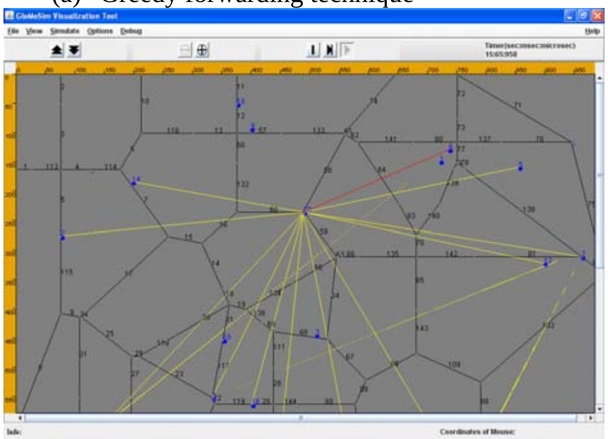



***Figure (4) Improved GOAFR+ algorithm starts from in s in greedy mode at node u it reaches a local minimum, a node without any neighbors closer to t. the algorithm the algorithm switches to face routing mode and begins to explore the boundary of face F(in clockwise direction). At node v the algorithm hits the bounding circle C and a turn back to continue the exploration of F's boundary in the opposite direction and fall back to greedy mode and continues to finally reach t***

## Simulation Results

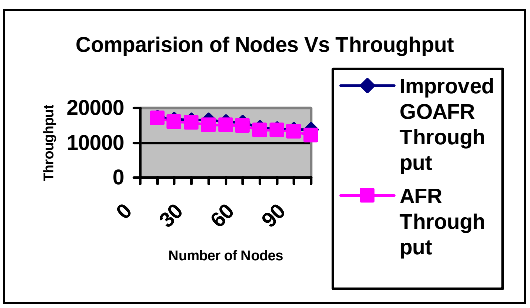


(a) Greedy forwarding technique



(b) GOAFR Technique

**Performance Evaluation:**




**Conclusion:**

In this paper we Improved GOAFR Geographic Routing Algorithm with Early Fall Back Technique. GOAFR is the Combination of Greedy routing and Face Routing approaches. In most cases GOAFR Routing Algorithm uses Greedy forwarding Techniques. If there is no possibility of going forward with the Greedy Forwarding Technique then we should go for Face Routing Technique. But this Algorithm will Fall back to Greedy forwarding Technique as early as possible since Greedy technique finds the path easier than the Face routing Technique. Main Advantage of using GOAFR Routing Algorithm is that it can be employed in both Average case and Worst case Sensor Network Environment.

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