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*Research Paper*

# LOCALISATION ALGORITHM BASED EFFICIENT CONTROLLED SINK MOBILITY FOR WIRELESS SENSOR NETWORK

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A wireless sensor network consists of many sensor nodes organised in a ad hoc manner to achieve a predefined goal. Although WSN's have limitations in terms of memory and processors, the main constraint is battery problem which limits the lifetime of a network. In this paper describes using of controlled sink mobility sensor node to increase the lifetime of the sensor node with the support of triangulation localisation techniques in Wireless Sensor Network (WSN) the results show that our localisation algorithm are efficient in improving network life time and providing significantly better lifetime to fixed sink case and random movement strategy.

Keywords: WSN, Unknown sensor node, Control mobility device, Triangulation, Circle formation

## INTRODUCTION

The emergence of tiny sensor nodes as a result of advances in microelectromechanical systems has enabled Wireless Sensor Networks (WSNs). A typical sensor node has generally an irreplaceable limited-capacity battery and therefore consuming the least amount of energy is the most critical criterion when designing any sensor network-related protocol. Since energy is the most precious resource, and in most of the applications replacing the batteries is very hard or impractical efficiently utilizing both node's and the total energy of the network is very important for a given task.

Several approaches are used in literature to minimize energy consumption in wireless sensor networks and improve network lifetime. Some of these approaches are adjusting transmit power, developing energy-efficient MAC or routing protocols, minimizing the number of messages travelling in the network, and putting some sensor nodes into sleep mode and using only a necessary set of nodes for sensing and communication.

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Making the sink node mobile is another approach for improving the lifetime of WSNs. Sink node collects the incoming data from sensor nodes and when data aggregation is not used; each sensor node not only transmits its own packet to the sink, but also relays the packets of its children. Since most of the time a tree topology rooted at the sink is used to collect data, all packets are delivered to the sink node via its first-hop neighbours. Therefore, the main motivation behind sink mobility is to change these neighbouring nodes periodically by moving the sink to different locations. A node that was a neighbour of the sink in a round and therefore had a large packet load should have a smaller packet load in the next round. This way the neighbour role is delegated fairly among all sensor nodes.

## RELATED WORK

Since energy is the most precious resource in a sensor network, it should be carefully taken into consideration in any algorithm or approach related to sensor network design and operation. The studies targeting energy efficiency and network lifetime improvement in WSNs generally attack the problem in physical layer (power control (Akyildiz *et al.*, 2005; and Yick *et al.*, 2008)), in data link layer (MAC protocols (Ganesan *et al.*, 2004; and Gowrishankar *et al.*, 2008)), in network layer (routing (Akyildiz and Kasimoglu, 2004; and Sundararaman *et al.*, 2005)), or in application layer (topology control (Stankovic, 2004; and Mao *et al.*, 2007)), data gathering and aggregation (Savvides *et al.*, 2003; Hu and Cao, 2010; and Manzoor, 2010)), clustering (Perillo and Heinzelman, 2004; and Youssef and Youssef, 2007)), and sleep scheduling). Most of the papers deal with one of the aspects that lie only in one layer, whereas some other works (Langendoen and Reijers, 2003; and Youssef and Youssef, 2007) use cross-layer design where different issues related to more than one layer are taken into consideration in order to maximize network lifetime.

Sink mobility approaches can be classified into two categories according to the moving strategy used: uncontrolled (random) and controlled (Moore *et al.*, 2004). In uncontrolled mobility, a third tier is used in the network, in which mobile agents (MULEs: mobile ubiquitous LAN extensions) are deployed between access points (base stations) and sensor nodes in order to collect data from sensor nodes when they get in contact, buffer the data, and finally transmit the data to the sink. It is called uncontrolled, since movement is random and MULEs (for instance vehicles) move according to their needs and only exchange data if they encounter any node as a result of their movement.

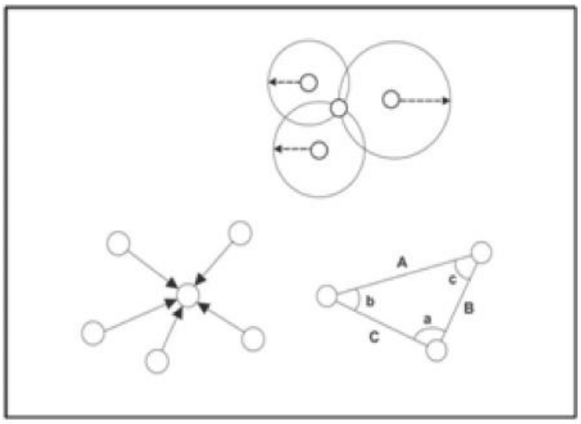
In controlled mobility, sink is moved depending on network conditions (like current energy map, node density in the regions, etc.). Currently, there are three main approaches used in controlled mobility (Liu *et al.*, 2006). In first and mostly used one, the sink moves among the nodes and collects data without any additional entity (which is also the case in this work). In the second approach, mobile relays are used as forwarding agents, like MULEs but in a controlled manner, for communication between sensor nodes and the base station (Qureshi *et al.*, 2011). In the third approach, sensor nodes themselves are mobile. Generally, sink node or relay nodes are assumed to have abundant energy resources so they do not deplete their energy during the network lifetime. Therefore it is expected that mobility of these types of nodes does not adversely affect the network lifetime. However, for sensor nodes this is not the case. As it was mentioned before, sensor nodes have very limited energy resources, which should not be wasted for mobility, topology reconstruction, and so forth, unless it is certainly necessary. That is why the first two approaches appear to be more promising for energy efficiency and longer network lifetime (Liu *et al.*, 2006).

Sink mobility differs from other approaches to save energy in the way it considers the resulting energy consumption behaviour in the network. Most strategies other than sink mobility aim to minimize either average or maximum energy consumption by using an appropriate technique; however, neither average nor maximum energy consumption based strategies consider current energy status of a node (He *et al.*, 2003). That is why they cannot avoid the nodes whose batteries are close to depletion. Unlike these approaches, in (controlled) sink mobility, current remaining energy values of sensor nodes are taken into consideration, and this helps to extend the lifetime of nodes as much as possible. This brings a serious advantage in the case where network lifetime is defined as the time passed until the first node depletes all its energy, which is commonly used definition in the literature.

## RELATED WORK

The localization problem consists in finding the geographic location of nodes in a WSN. The location of a node can be computed by a central unit (the sink node) or in a distributed manner, which is frequently used. Essentially, the location discovery problem can be split into two stages: distance estimation and position computation (Patwari *et al.*, 2003). Usually, the distance between two nodes is estimated based on methods such as Received Signal Strength Indicator (RSSI), Time of Arrival (ToA), and Time Difference of Arrival (TDoA) (Niculescu and Nath, 2003). Once the distance is estimated, at least three methods can be used to compute the node location: Triangulation, Trilateration, and Multilateration (Liu *et al.*, 2005). Triangulation is used when we have the directional information instead of the distance information, which is the case of Angle of Arrival (AoA) systems in which the angle of arrival of the received signal is estimated and the node position is computed through trigonometrically relations (Figure 1a). Trilateration is the most basic and intuitive method that locates a node by computing the intersection of three circles (Figure 1b); in this case, the location is found by solving a simple linear system. In Multilateration, the node position is estimated by minimizing the

Figure 1: "Position Estimation Methods: (a) Triangulation, (b) Trilateration, and (c) Multilateration"



differences between the measured distances and estimated distances (Figure 1c); in this case, the location is found by solving an over determined linear system. A node that has at least three reference neighbours can estimate its own location through trilateration. Then, this node becomes a reference by broadcasting its location and helping other nodes to estimate their own locations.

Node localization has been the topic of active research and a number of systems have been proposed over the past few years. Many of those systems fall into one of three classes or a combination of them. The first class includes range free algorithms, which assume that there is no distance/angle information available at each node (Bachrach and Taylor, 2004; and Tanvir, 2010). In general, range-free techniques provide the lowest level of accuracy among the three classes. The second class employs a number of specialized, anchor, nodes that know their positions usually using GPS (Decuir, 2004; Hach, 2005; and Xing *et al.*, 2007). The rest of the nodes try to estimate their positions relative to these anchors. For example, in the iterative multilateration method, an unknown node that is connected to at least three anchors estimates its position by solving a system of equations. Once a node estimates its position it becomes an anchor and assists other unknown nodes in estimating their positions by propagating its own location estimate through the network.

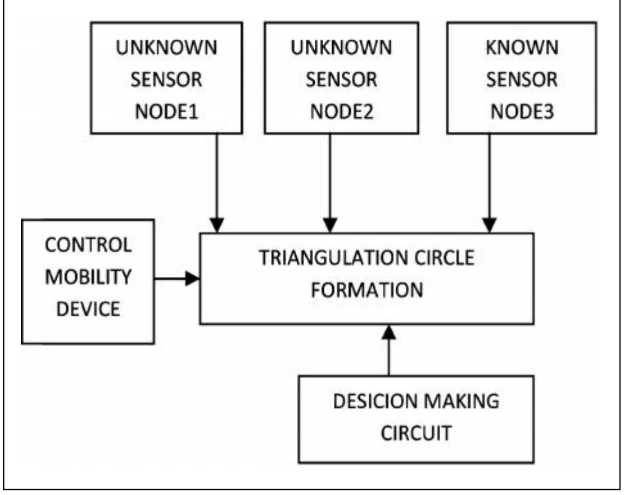
## PROPOSED ALGORITHM

### Localization Overview

Localization is estimated through communication between localized node and unlocalized node for determining their geometrical placement or position. Location is determined by means of distance and angle between nodes. There are many concepts used in localization such as the following.

- Lateration occurs when distance between nodes is measured to estimate location.
- Angulations occur when angle between nodes is measured to estimate location.
- Trilateration. Location of node is estimated through distance measurement from three nodes. In this concept, intersection of three circles is calculated, which gives a single point which is a position of unlocalized node.
- Multilateration. In this concept, more than three nodes are used in location estimation.
- Triangulation. In this mechanism, at least two angles of an unlocalized node from two localized nodes are measured to estimate its position. Trigonometric laws, law of sines and cosines are used to estimate node position (Manzoor, 2010). Localization schemes are classified as anchor based or anchor free, centralized or distributed,

Figure 2: Block Diagram



GPS based or GPS free, fine grained or coarse grained, stationary or mobile sensor nodes, and range based or range free. Here we describe our related work for the proposed localisation algorithm.

## ALGORITHM

- Step 1: Assumption: Assume a sensor node say 'N' wants to calculate its location L.
- Step 2: Random Deployment of Sensor Nodes: The transmitted Sensor Nodes are randomly deployed and their corresponding coordinates are found.
- Step 3: Collection of RSSI: Received Signal Strength from all the sensor nodes collected at unknown node 'S'.

Figure 2: Triangularization Flow Chart

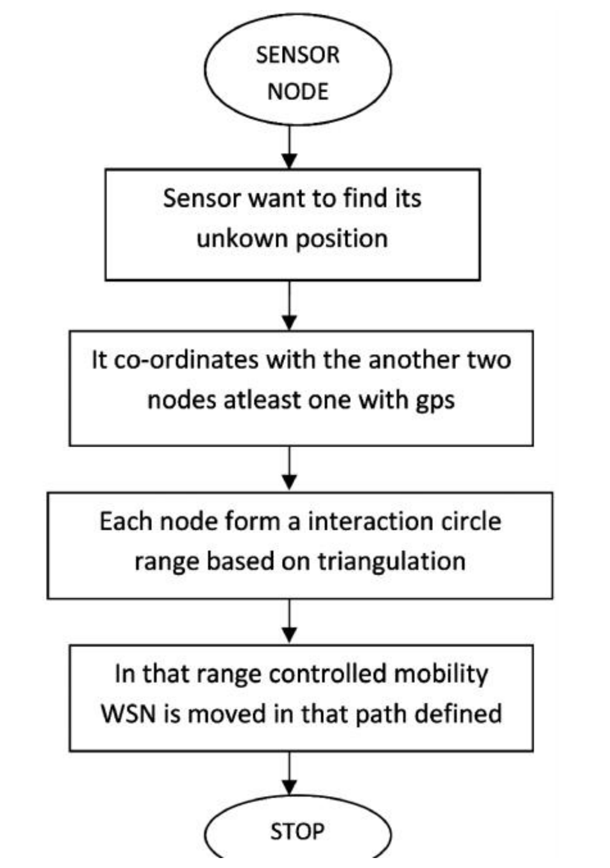



Figure 3

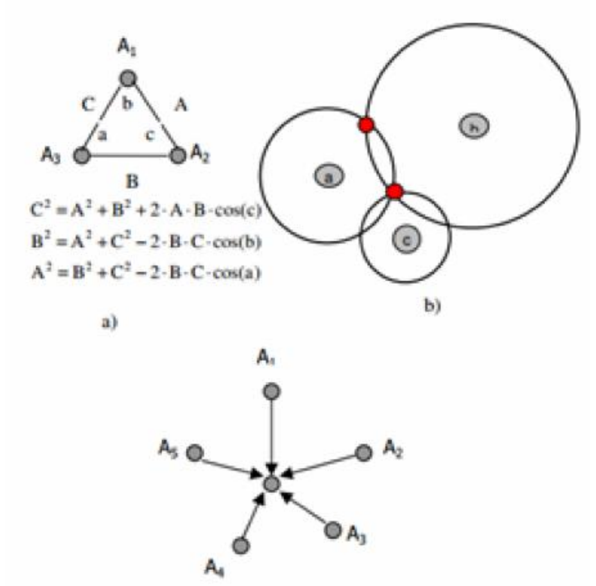
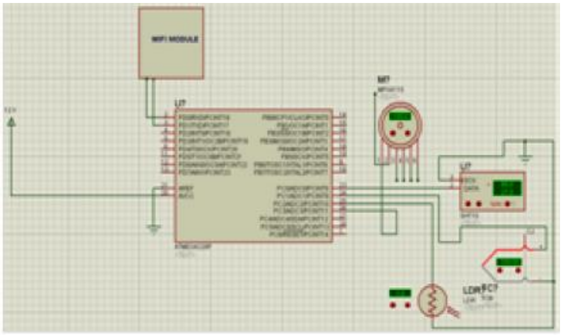



Figure 4: Circiut Diagram



- Step 4: Mapping of Signals: The Strongest signals from the collected signals are found and circles are mapped.
- Step 5: Location computing: From step 4 only 3 values are taken to compute the location of the sensor 'S'.
- Step 6: Estimation of node position: Finally the Euclidean distance from the reported location vector of the mobile device is generally regarded as being the correct estimate of the position of the sensor node.

## CONCLUSION

In this paper we presented localization algorithm method to support controlled mobility sink with the unknown nodes, also reduces the estimation error in finding location with time complexity in computation reduces as the mapping of strongest signals is taken into consideration.

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