

# A Hybrid Approach for Deploying Mobile Agents in Wireless Sensor Network

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## ABSTRACT

Wireless sensor network is an emerging technology that may greatly affect the human life which seems effective everywhere for high level inference and surveillance. This network is composed of hundreds and thousands of sensor nodes of small size with ubiquitous sensing and computing capabilities. Here each node individually senses the environment but collaboratively achieves complex information gathering task. Recently mobile agents have been proposed for efficient data transmission in wireless sensor networks. In the traditional client/server based computing architecture, data is collected from multiple sources and forwarded to destination for further processing whereas in the mobile agent based computing architecture only task specific executable code traverses to the relevant source for gathering data. Mobile agents can be used for reducing communication cost, for efficient energy conservation, for achieving progressive fusion accuracy etc. Deploying mobile agents in wireless sensor networks provides it extra flexibilities as well as new capabilities to network in contrast with conventional wireless sensor network operation based on client server computing architecture.

## Keywords

Mobile Agents, MAS, WSN, Information Processing, Energy Efficiency

## 1. INTRODUCTION

Wireless Sensor Network (WSN) has received much attention in the research in last few years. It is a combination of sensor technology, embedded computing, information processing, and wireless communication technology. WSN finds its

applications in many areas such as Daylight Control, landslide detection, fire detection, agriculture and medical science etc. This is a network of hundreds and thousands of tiny sized, low cost, low power devices used to perform certain tasks such as collecting data and sending them to central node for further processing. The general structure of sensor network is shown in figure 1.

Base station [BS] is the central point here for accessing the information from wide geographical area which can be further accessed by user with the help of internet. Due to flexibilities and cost effectiveness WSN have been used for numerous applications. But with all advantages, there also exist some problems in WSN:

- Path loss due to low bandwidth
- Loss of fusion accuracy
- More energy consumption

To meet the above challenges the concept of mobile agents has been proposed. Mobile agents are special computer programs that can be dispatched from base station to destination node for executing information. But mobile agents should not be confused with normal (regular) computer software since they are passed with autonomies reactive-ness thus they can sense input from environment and can act accordingly on their own [11]. It is proved that mobile agent implementation can save up to 90 percents of data transfer time due to avoiding the raw data transfer.[3]. The order and number of nodes on the route traversed by mobile agents have a significant impact on the overall performance of WSN because it determines the energy conservation, path loss and detection accuracy.

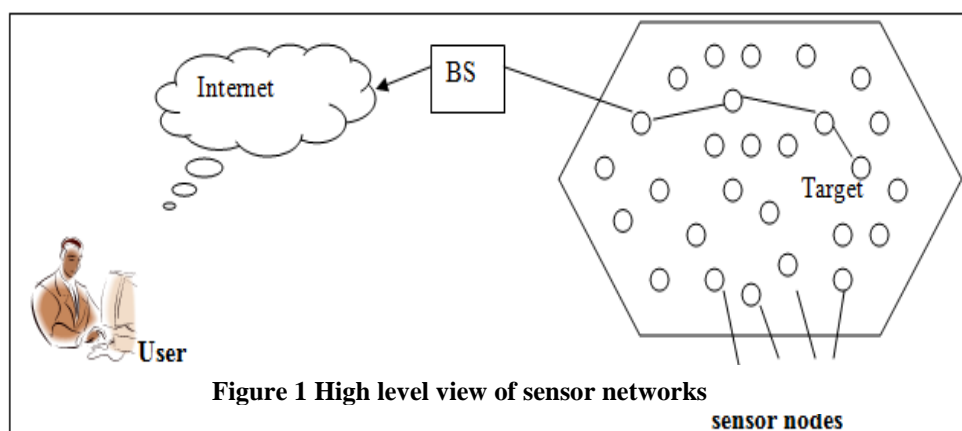


Figure 1 High level view of sensor networks

## 2. Mobile Agents

Mobile agents are programs typically written in a script language, which may be dispatched from a client computer and transport to a server computer for execution. But mobile

agents are different from regular computer programs because they have the ability to observe the environment and to estimate the current state of environment where these execute and perform the corresponding actions [11]. The mobile

agents migrate itself between nodes of a network to perform task autonomously and intelligently, in response to changing conditions in network environment .

Mobile agents provide new way to perform computation and develop various applications in distributed and wireless computing. Mobile agent is process initiated/dispatched from a source computer to accomplish the specific tasks. When the agents read the server it is delivered to agent execution environment. Then if the agents have necessary authentication credentials its execution started here. To complete its task mobile agents can transport themselves to another server, spawn new agents or interact with another agent. After completion the mobile agent deliver the result to sending client. Mobile agents have the ability to perform in an unstructured network and roam around to gather information. It is also applicable into intermittent connectivity, slow network and light weighted devices. Mobile agents have some key characteristics like dynamic execution, asynchronous computation, parallelism, and intelligent routing etc. by using mobile agents a wireless sensor network can get following advantages.

1. Reduce the flow quality, connecting time and number of times in network.
2. Integrated with distributed structure seamlessly.
3. Pervasive computing.

### 3. INFORMATION PROCESSING IN WSN USING MOBILE AGENTS

The advancement in sensor technology and ad hoc wireless sensor networking in Distributed Sensor Network reaches at a new stage called as Wireless Sensor Network [3]. In the traditional network data is collected by the individual sensor and the transferred to sink node for performing further processing called as data fusion. So in this type of network a large amount of data travels between the networks. By using mobile agent in WSN, data stay at a local site while the integration code moves towards the data sites. It is beneficial to adopt the mobile agents in WSN is beneficial because it reduces the requirement of bandwidth since only a small sized agent is sent to sink node instead of large amount of data through several round trips. This is really advantageous for real time applications where low bandwidth is a problem. Secondly it increases the stability of data over the network because mobile agents can be sent when the network is alive and result can be obtained when the connection is re-established. These differences are shown by the figure given below.

Another important issue in the WSN is energy conservation. While the sensors senses the data from environment they just send it to sink node without checking whether it is useful or not and thus consuming their power for unnecessary data. To increase power conservation mobile agents are deployed in WSN.

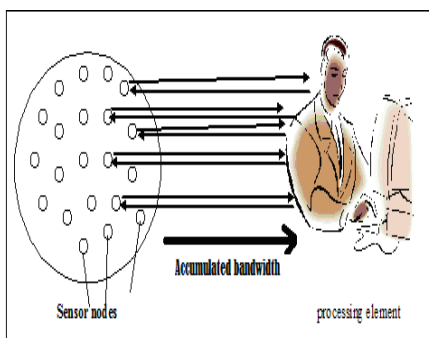


Figure 2(a) Traditional method for WSN

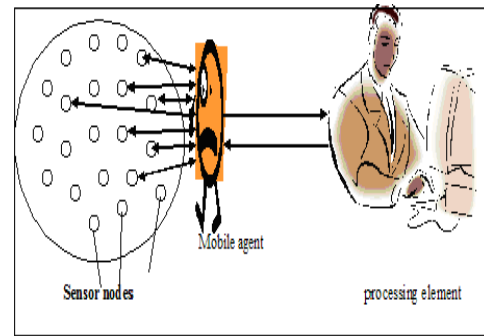


Figure 2(b) Mobile agent based WSN

### 4. PROPOSED WORK

The proposed dissemination work is based on two types of mobile agent migration strategies, which define the path when it goes through the underlying network for performing its task. The available strategies are static migration and dynamic migration. The static migration use the centralized routing method in which route is computed in advance for mobile agent's itinerary migration. Two methods were already address this problem are named as Local Closest First (LCF) and Global Closest First (GCF). The LCF first search for the node which is closest to current node whereas GCF searches for the node which is closest to the gateway. The main advantages of static migration are that it saves the computation and power. On the other hand dynamic migration determines the route locally on each hop for the next hop for migration of mobile agent among sensor nodes. These trade-offs between the nodes change the cost and may degrade the efficiency. The dynamic migration is more flexible and also applicable in real time applications. For adopting dynamic migration we must consider following three aspects.

1. Nodes must have enough battery power.
2. Require minimum energy consumption for mobile agents.
3. Yield significant information gain.

The dynamic migration is most suitable itinerary technique for the current dynamic environment in which nodes may move from one place to another place like planes, because it achieves progressive fusion accuracy without incurring excessive costs.

### 5. HYBRID APPROACH

This work proposes a hybrid approach which aims to adopt a static set of sensor nodes and the migration sequence leaves to change openly. In this approach exploratory packets are sent to WSN gateway as soon as source in certain region detects an event of interest. Then cost effective migration path is defined by the gateway as the mobile agents visit the WSN subset. This approach overcome the problem of static migration in which if one node becomes dull due to battery or any other circumstances during the execution then the processing may be stopped because itinerary is defined statically so the mobile agent can't goes anywhere. On the other hand this approach also dismissed the barrier of dynamic migration in which dynamic migration requires more battery power due to its dynamic nature. Actually the proposed approach deploys the mobile agents in traditional cluster methodology which is formed by the sensor nodes within the communication range of each other and then elects a cluster head from available

nodes with special features like additional battery life and processing power. By deploying mobile agents in such a methodology extra battery and processing power is not required. A mobile agent sequentially migrates among the sensors and the cluster head through the networks, integrate the information and finally send the desired result to the sink node. Mobile agent chooses its path arbitrarily because of its autonomous nature. In comparison to the proposed approach in the traditional approach the sink node computes the inter-cluster path consisting of non cyclic sequence of cluster heads. Each cluster head in the inter-cluster path also computes a path consisting of a non-cyclic sequence of sensor nodes within each cluster. Whereas proposed approach deploy mobile agents which aggregates individual sensed data when it visit each target source. This approach does not require any overhead to construct any cluster-head.

The working of purposed approach can be understood by the following figure 3.

In this figure all the source nodes or only a subset of these nodes will be chosen to be visited by mobile agents. Among the target source node to be visited, the sink will choose first and last nodes. Thus the sink generates a mobile agent with the packet format and dispatched it to the first source. At the same time the sink strengthen the path to the last source. Now first of all when the mobile agent arrived at the first node it stores its code at the first node so that it can visit this node again and again without carrying its code and sending the result to the sink node. Mobile agent also copies its processing code into the memory of each node in the first round. In addition to this mobile agent moves from source to source to collect and aggregate information. Since the processing code is already shifted at each node in the first round, mobile agent do not need to carry this in the following rounds. At the end when the whole task is completed all of nodes discards the processing code.

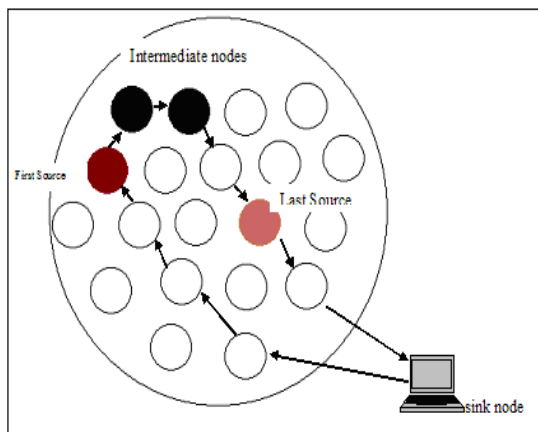


Figure 3: Hybrid approach based

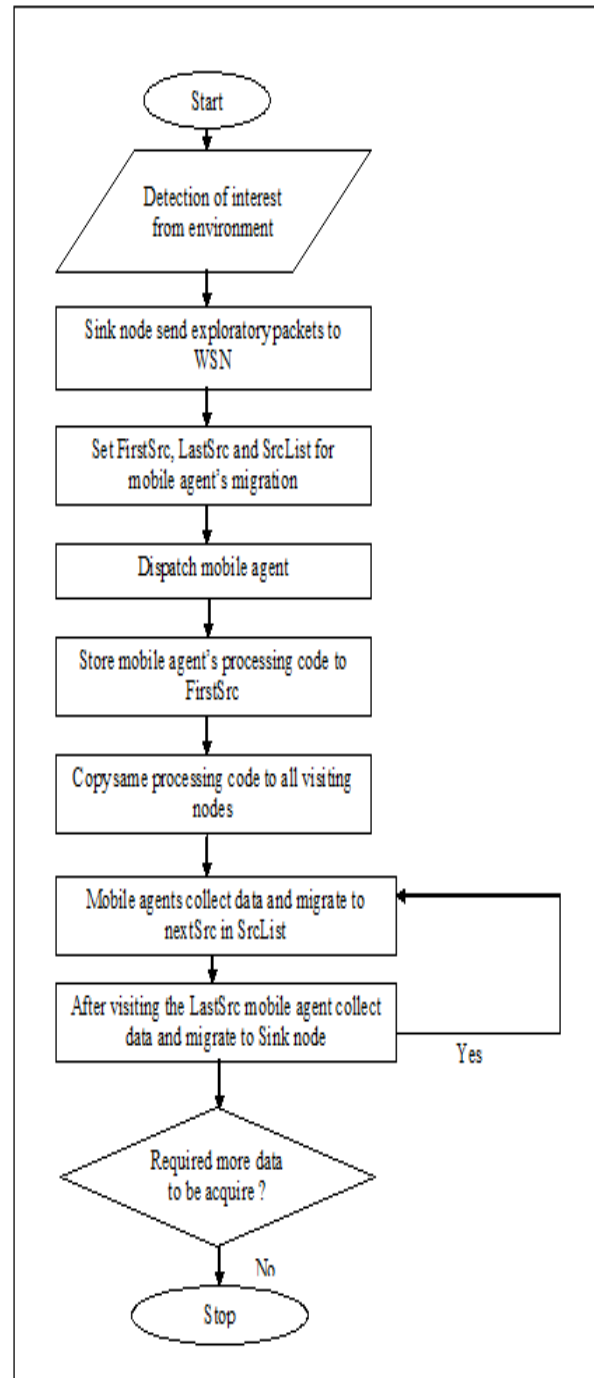


Figure 4: working of proposed work

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