

International Journal of Advance Research in Computer Science and Management Studies

Research Paper

Available online at: www.ijarcsms.com

Significance of Mobile Agent in Wireless Sensor Network

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Abstract: Mobile agents have been proposed for collecting and processing network management information in the internet and other networks. This paper describes the concept of mobile agent in the wireless sensor network. Wireless sensor network works on three major steps: Sensing, processing and communicating with other nodes. Each device on the wireless sensor network able to sensing, processing of data and transmitting data to the sink node. In this paper, the major role of mobile agent is identified in the wireless sensor network. Mobile agent helps the sensor nodes in communication by providing single traffic flow. Mobile agent provides dynamic reprogramming features to the sensor nodes in the wireless sensor network by removing died nodes and injecting new nodes into the sensors.

Keywords: wireless sensor network; mobile agent; real world; virtual world; sink node.

I. INTRODUCTION

A. Wireless Sensor network (WSN)

A wireless sensor network is composed of large number of sensor nodes to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure or motion [10]. The concept for the development of wireless sensor networks was motivated by military application. Nowadays they are used for much industrial and civilian application.

A sensor node is a combination of three technologies that are sensing, processing and communication. In these technologies, the first sensing unit senses the change of parameters. After that the signal conditioning circuitry prepares electrical signal conversion into digital domain. Then the sensed electrical signals are converted into digital signal with the help of ADC (Analog to Digital Converter) convertor. The second processing unit takes the converted analog signals as input. There memory helps processing of tasks and the third communication unit uses the transceiver for communication between sensors or base stations or sinks in wireless sensor network.

Wireless sensor networks consist of electronics devices which form the network in which all information sensed and gathered is transmitted to the sink node [1]. Each device in the sensors network is capable of sensing, processing and transmitting of sensed data. In the WSN, data is transmitted on the network to sink in two ways, first it can be directly sent to sink node, and secondly it can be transmitted by gateway.

Wireless sensor networks will consist of hundred of nodes that operate on small batteries [2]. When sensor runs out of energy, it stops its working and then the wireless sensor network structurally damaged if many sensor exhaust their onboard energy supply.

A sensor network is composed of a large number of sensor nodes, which are densely deployed either inside the phenomenon or very close to it [5]. In WSN, it not necessary that the position of sensor node is predetermined. Due to the lack of proper identification of node position, there is random deployment in inaccessible terrains or disaster relief operations. Wireless sensor network is used for rehabilitation. In rehabilitation, the WSN is used to capture movements and postures of patients for monitoring his motor activities during rehabilitation therapy [6]. Fig.1 shows the wireless sensor network:

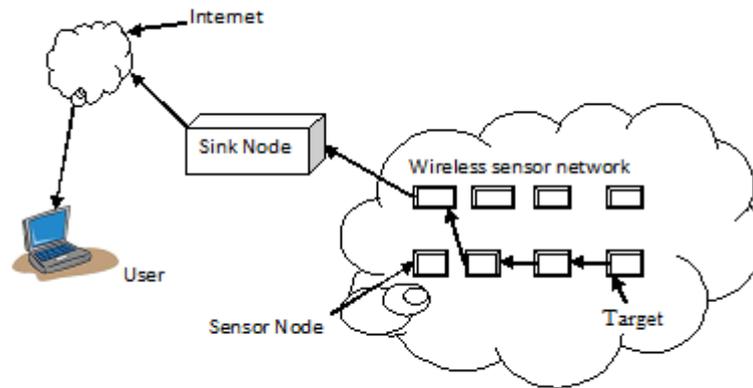


Fig. 1 Wireless Sensor Network

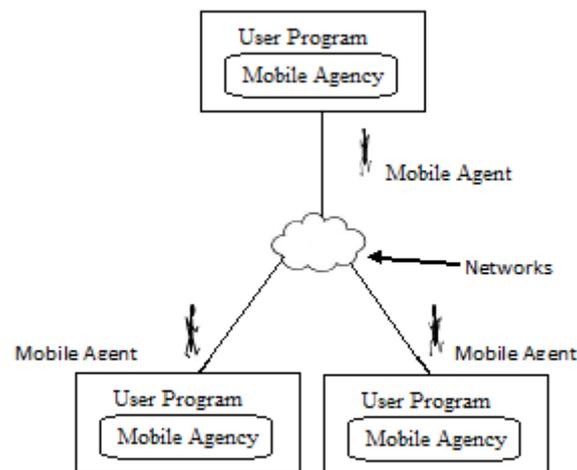


Fig. 2 Mobile Agent

B. Mobile Agent (MA)

Mobile agent in wireless sensor network is an entity which can represent the desire of the sink node. The mobile agent can move to the target are autonomously and carry out application- specific task intelligently. Wireless sensor network is competent for a flexible maintenance system. Client/Server model adopted in traditional intelligent maintenance which requires transmitting vast data via network is unsuitable in wireless sensor network with limited bandwidth and unstable connection. Emerging mobile agent technology can reduce the network traffic and overcome the network latency, and is an eligible substitute for Client/Server model. Fig. 2 shows the mobile agent.

A mobile agent is basically a special kind of software and computer program that migrates between the node of a network to perform a task autonomously and intelligently [7]. Sometime Mobile agents have been found to be particularly useful in facilitating data fusion.

A software agent is totally different from the regular computer program. A software agent has the feature to observe and estimate the current state of the environment where it executes and decides what actions are performed on it. As compare to

software agents, the regular programs do not have any feedback mechanism when making a decision and they don't possess the mobility features.

Mobile agents are self-executable programs that travel around a network doing work [9]. Wireless sensor networks are unable to adapt the changes in the environment or these are difficult to program. So the MA middleware promises to address both concerns by providing higher-level programming abstractions and the ability to inject new agents into a pre-existing network [8].

II. IMPORTANCE OF MOBILE AGENT

In client-server system, when an event is sensed by the individual wireless sensor network node it initiates the corresponding client-server interactions to send raw data to the wireless sensor network gateway or sink for subsequent analysis. In this approach, when the data is transferred from source to destination, it leads to high bandwidth utilization. By using this method, higher burden produced on the nodes that are closed to the WSN gateway. Such type of processing of data creates heavy data traffic as compared to the wireless links located further away from the gateway. Fig.3 shows such type of client-server paradigm. To eliminate such type of problem, we can use mobile agent system. Mobile agent system provides single traffic flow to reduce the traffic problem that produced in client-server system. Mobile agent reduces the bandwidth consumption by moving the data processing elements to the location of sensed data [3]. Fig. 4 shows the mobile-agent based paradigm.

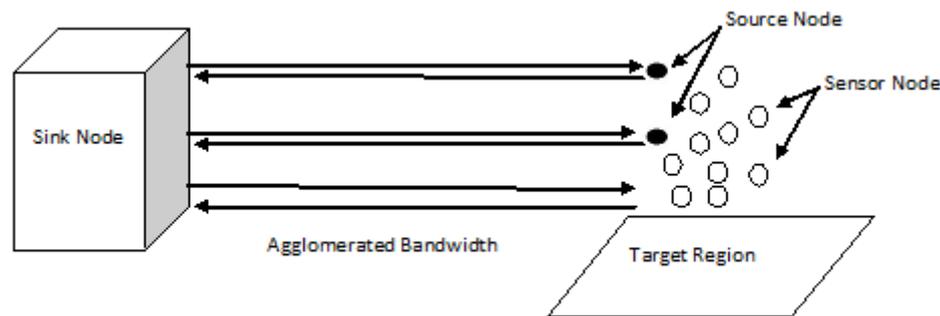


Fig. 3 Client-Server Paradigm

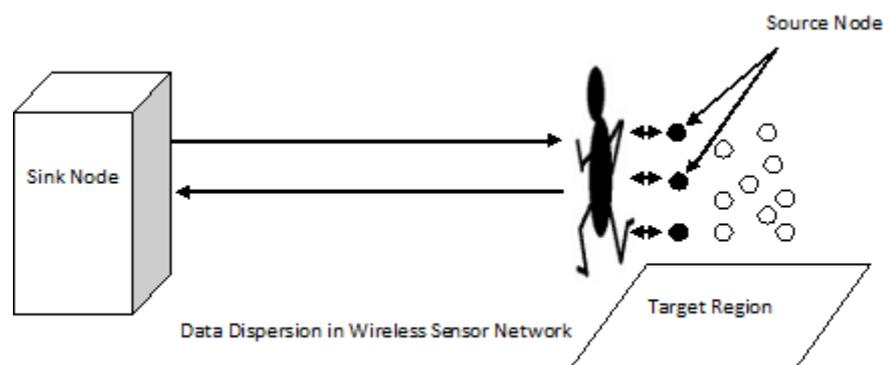


Fig. 4 Mobile-Agent Based Paradigm

Mobile agent system provides a higher degree of WSN re-tasking flexibility and facilitates collaborative information processing. Other good reasons to use mobile agents are:

- They are heterogeneous.
- They are dynamically adapted.
- They are fault-tolerant and they overcome network latency.

III. FRAMEWORK OF MOBILE AGENT FOR WIRELESS SENSOR NETWORK

Framework basically provides the platform where sensor nodes delegate software agents to collect valuable data about the neighbouring sensors and the spatial characteristics of their surrounding environments [4]. Fig.5 contains the general framework of the mobile agent. Such framework contained two main factors that are parallel to each other.

A. Real world

Here wireless sensor network is used to monitor real resources or to manage the deployed resources. When a sensor node wants to provide services to its neighbours, a sensor node has to take more information about the environment, the requirements and constraints of its neighbours, as well as its restrictions or its goals. Real world environment cannot help to get such type of information's due to following four reasons:

- 1) *Due to energy factor:* When several sensor nodes work together with a high volume of exchanged messages, a large amount of energy is consumed by the sensor nodes.
- 2) *Due to limited memory and CPU:* Offering a personalized service to the other nodes may require from a given sensor more processing [10]. But due to limited memory or CPU no such more processing is provided to the other nodes.
- 3) *Due to space and resources information:* Each sensor decision may depend upon the spatial characteristics of the space and the location of resources/sensors. So these data are available for a single node in the real world [4].
- 4) *Due to network information:* In real world, an individual sensor node is only aware of its neighbourhood, it does not have overall information's about its network. So the actions taken by the sensor node is not positive to all over the network.

B. Virtual world

Basically software agents are used in the virtual world. The software agents can behave/act on behalf of the real sensors [4]. Virtual world provide platform where software agents exchange local messages about their original sensor nodes. Virtual world provide options to the mobile agents to use virtual world as super node or as remote host. When the mobile agent want to exchange data between them, then the virtual world is used as super node with extended memory and CPU capacities. Fig. 6 shows the virtual world as super node.

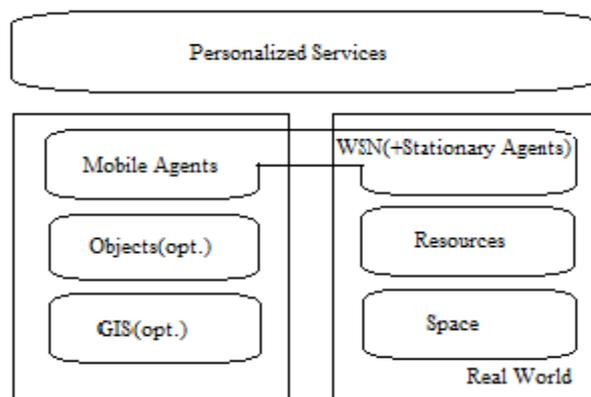


Fig. 5 Agent based framework

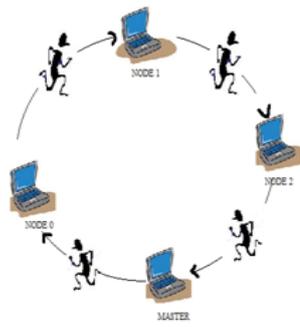


Fig. 6 Virtual world as super node

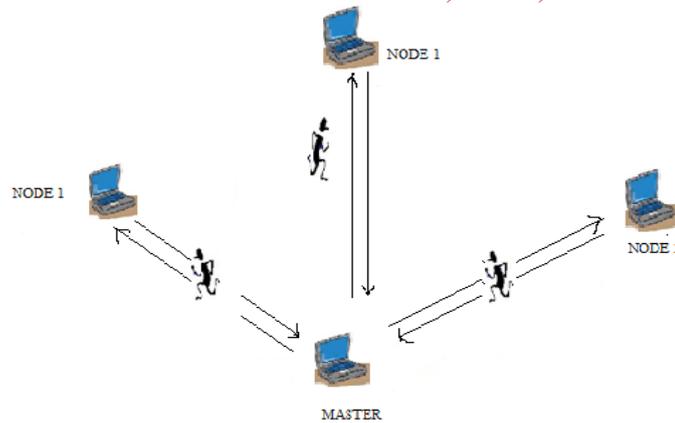


Fig.7 Virtual world as remote host

When the mobile agent want to access GIS (Global Information System) data then the virtual world is used as remote host with extended memory and processing capacities. Fig. 7 shows the virtual world as remote host.

Advantages of the virtual world:

- 1). In the virtual world, the inter-agent messages are local. So the high traffic of messages will not affect the wireless sensor network performance.
- 2). All agents in the virtual world can have extended memory or extended CPU. So at the time of personalization, it avoids the problem of limited memory/CPU.

IV. CHARACTERISTIC FEATURES OF MOBILE AGENTS IN WIRELESS SENSOR NETWORK

A. Programmability

It allows the mobile-agents based system to change its operations on demands depend upon the particular environment and the circumstances that are produced by the environment.

B. Mobility

It provide better bandwidth usage by moving the processing element to the location where the data to be analysed resides [3].

C. Agent itinerary planning

Wireless sensor network itinerary planning includes both the selection of the set of wireless sensor network nodes to be visited by the mobile agents of these applications and the determination of the node visiting sequence in an energy-efficient manner [4].

D. Dynamic reprogramming/services

Mobile agents allows wireless sensor network dynamic reprogramming characteristics by enabling users to inject new agents into the network and allowing old ones to dies [8].

E. Optimal path

Mobile agent provide optimal path characteristics by redirecting traffic if a mobile agent find a problem based on the information collected or by collecting network information.

V. APPLICATIONS OF MOBILE AGENTS

The mobile agents contained various applications. Some applications are as followed:

- Mobile agents are used in internet or telecommunication network services. A mobile agent can be dispatched to problematic network nodes to investigate node status, statistics and configuration information to a network control centre [9].
- Mobile agent is used in E-commerce, parallel processing applications.
- Mobile agent is used in workflow applications and groupware applications.
- Mobile agent is used in distributed information retrieval applications.
- Mobile agent is used in information dissemination.
- Mobile agents are used for personal assistance.

VI. MERITS OF MOBILE AGENTS IN WIRELESS SENSOR NETWORK

A. Active network routing

In active network routing, mobile agents are targeted at specific tasks with well known outcomes [3].

B. Bandwidth saving

Mobile agents provides bandwidth saving. It can be achieved if efficient migration policy is employed.

C. Programming

Mobile agents provide programming facility in which mobile agents programmed to perform a complex brokering task.

D. Single traffic flow

Mobile agents provide the single traffic flow facility in which mobile agent system dispatches an agent into wireless sensor networks region of interest where the event was observed.

E. Reduce processing delay

During migration process, mobile agent incurs less delay than consecutively forwarding raw data segments.

F. Resilience

It is other most important advantage of wireless sensor network with MA where mobile agent based solution can incorporate in environments whose behaviour is unstable or highly uncertain.

VII. DEMERITS OF MOBILE AGENTS IN WIRELESS SENSOR NETWORK

A. Security

In such case, an attacker could inject a malicious agent in the form of computer virus into the network to disturb its normal operations.

B. Size of mobile agent

In such case, bandwidth saving is done only if the size of one or more mobile agents performing a task is sufficiently compact to offset the bandwidth.

C. Insufficient migration policy

Create multiple mobile agents hops to accomplish a certain task. So it is drawback to select the best migration policy.

D. Deadlock state

Mobile agents produce deadlock state. An mobile agent could remain stranded at a remote node, perhaps unable to return to the networks gateway upon encountering a situation that steered it into a deadlock state.

E. Addition of resilience

It is difficult to achieve added resilience in case of mobile agent based system where mobile agent is coded to provide added resilience.

VIII. CONCLUSION

In wireless sensor network, the mobile agents play a very important role than regular agent/program. This paper shows the significance of mobile agents in wireless sensor network by covering its importance, framework, characteristics, applications, merits and demerits. Here we conclude that the study of mobile agents in wireless sensor network help to save bandwidth that is wasted during sensor nodes communication between each other. We conclude that the overall lifetime or the performance of the sensor nodes in wireless sensor network is increased by using mobile agents.

Acknowledgement

It gives me immense pleasure to express my deepest sense of gratitude and sincere thanks to my highly respected and esteemed guide (Mrs. Sonia Jangra) for their valuable guidance, encouragement and help for completing this work. Their useful suggestions for this whole work and co-operative behavior are sincerely acknowledged. I also wish to express my gratitude to (Er. Dileep Adabala)for his kind hearted support. I am also grateful to Dr. Manish Mann for his constant support and guidance. I also wish to express my indebtedness to my parents as well as my family member whose blessings and support always helped me to face the challenges ahead. At the end I would like to express my sincere thanks to all my friends and others who helped me directly or indirectly during this project work.

References

1. Gurbhej Singh, Harneet Arora, "Design and Architectural Issues in Wireless Sensor Networks," Volume 3, Issue 1, January 2013, ISSN: 2277 128X.
2. Abdelkrim Hadjidj, Marion Souil, Abdelmadjid Bouabdallah, Yacine Challal, Henry Owen, "Wireless sensor networks for rehabilitation applications: Challenges and opportunities," Journal of Network and Computer Applications 36 2013, 1-15.
3. Nabil Sahli, Nafaa Jabeur, Mohamad Badra, "Agent-based Framework for Sensor-to-Sensor Personalization," The 4th International Conference on Ambient Systems, Networks and Technologies (ANT-2013), Procedia Computer Science 19 2013 , 197-205.
4. Estanislao Mercadal, Carlos Vidueira, Cormac J. Sreenan, Joan Borrell, "Improving the dynamism of mobile agent applications in wireless sensor networks through separate itineraries," Computer Communications 36 2013, 1011-1023.
5. Qutaiba I. Ali, " Simulation Framework of Wireless Sensor network(WSN) Using MATLAB/SIMULINK Software," INTECH open science/open mind, volume-2, 2012, Chapter 12.
6. Mohamed Younis, Kemal Akkaya, " Strategies and techniques for node placement in wireless sensor networks: A survey," Ad Hoc Networks 6 2008, 621-655.
7. MIN CHEN, SERGIO GONZALEZ, AND VICTOR C. M. LEUNG, "APPLICAIONS AND DESIGN ISSUES FOR MOBILE AGENTS IN WIRELESS SENSOR NETWORKS," IEEE Wireless Communication, December 2007, 1536-1284.
8. Daniel Massaguer, Chien-Liang Fok, Nalini Venkatasubramanian, Gruia-Catalin Roman and Chenyang Lu, " Exploring Sensor Networks using Mobile Agents," AAMAS'06 May 8-12 2006, Hakodate, Hokkaido, Japan.
9. SEONG-HWAN KIM AND T.G. ROBERTTAZZI Department of Electrical and Computer Engr. Stony Brook University Stony Brook, NY 11794, U.S.A., "Modeling Mobile Agent Behaviour," Computer and Mathematics with applications 51 2006, 951-966.
10. I.F. Akyildiz, W. Su, Y. Sankarasubramaniam, E. Cayirci, "Wireless sensor network: a survey," Computer Networks 38 2002, 393-422.

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