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# creation of a Sensor Network and Mobile Agent-based System for Monitoring the Condition of Equipment Rooms

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## Abstract

***Historically, environmental monitoring systems have relied on cable transmission, despite the fact that this method is notoriously difficult to set up, expensive, and inaccurate. These issues are amenable to technological fixes, particularly those based on Wireless Sensor Networks (WSN) and Mobile Agents (MA). In this study, we outline a novel approach to ecological surveillance. Our system is able to automatically monitor interior settings and sound alarms in the event of any abnormalities. A corporation has implemented the recommended approach, which has resulted in significant gains in managerial effectiveness. Elsevier Ltd. published in 2011.***

## Keywords:

***Mobile agent; wireless sensor network; environment monitoring***

## Introduction

As the world's reliance on information technology grows, so does the significance of computer networks. Computers, servers, uninterruptible power supplies (UPS), air conditioners, and other equipment in an equipment room have stringent environmental requirements for optimal operation, including the ideal temperature, humidity, and electrical current. Conventional methods of maintaining equipment rooms are inefficient, and their managing staffs almost never spot deficiencies in equipment quickly enough to prevent a network outage. Therefore, a contemporary equipment room system must be built to meet both general and specialized requirements. The protection of equipment, the generation of alerts, and the identification of malfunctions all need an environmental monitoring system. Timely issue solving to maintain good environmental management in the equipment room. The efficiency of the network has a direct bearing on the dependability of the systems in the equipment room. Most current environment monitoring systems rely on cable transmission, which has a number of drawbacks including high cost, problematic disposition, poor stability, and difficult fault detection. When it comes to wireless communication, Wireless Sensor Networks (WSNs) are a trendy topic. It incorporates embedded computing, contemporary networks, and wireless communications with sensor technologies. Microsensor nodes with wireless transition and computation capabilities are deployed in large numbers to form a WSN. Its network architectures often exhibit properties of self-organization. A Mobile Agent (MA) is a software that can carry out instructions on its own and move from one location to another. In order to interact with an item, MA may go to a system that houses it and then take advantage of being on the same host or in the same network as the object. In this study, we used WSN and MA technologies to develop a comprehensive framework for an intelligent environment monitoring system in a data center's mechanical room. The sensor nodes in the framework gather equipment environmental characteristics and transmit them over wireless networks. Managing the streaming data from the sensor nodes is a task for the mobile agent technology. Equipment rooms may be monitored remotely, allowing for rapid issue detection, less reliance on labour-intensive manual processes, and enhanced overall management efficacy.

## Works Cited

Using Wireless Sensor Network (WSN) Technology In a WSN, multiple inexpensive sensor nodes are dispersed around the monitored region to collect data. Sensor nodes with integrated processing and communication capabilities may examine, collect, process, and transfer data on observable objects in the monitored area. Various environmental conditions, such as temperature, humidity, electrical current, pressure, etc., may be tracked by these nodes. The sensor nodes have numerous unique characteristics, such as their capacity to randomly distribute themselves around the working area and to self-organize, to analyse data acquired from the real environment locally, and to work together adaptively with other nodes to route and transmit that data. Because of these benefits, wireless sensor networks are increasingly

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being used for surveillance [1] and civil applications [2-4], such as in the medical, environmental, military, and domestic spheres.

Each of the dispersed sensor nodes, as described in Ref [5,6], gathers data and transmits it back to the end users through the sink node using a multi-hop infrastructure-free design. The nodes' protocol stack combines power and routing awareness, integrates data with networking protocols, transmits power effectively via wireless media, and encourages the collaborative efforts of sensor nodes. The application layer, the transport layer, the network layer, the data link layer, the physical layer, the power management plane, the mobility management plane, and the task management plane are all parts of the protocol stack. Some research initiatives that are working on building the necessary technologies from various levels are also included in ref [6].

## Technology for mobile agents

By combining AI with object-oriented distributed computing, a new software technology known as agent-based systems [7] has evolved. In [8], Franklin and Graesser give a formal definition of agent and explain how it differs from a regular computer program. In Ref [9], Lange enumerated seven benefits of using mobile agents, such as lowering network traffic, avoiding network delays, providing reliable and fault-tolerant service, and more. Several references [10–16] detail uses for mobile agents and their advantages. 3. Organizational structure Here we show how to plan and build an environmental monitoring system for an equipment room. As can be seen in Fig. 1, the system is split into three distinct layers: the wireless sensor network layer, the control layer, and the application layer. When it comes to gathering data on things like temperature, water leaks, and electricity use, the Wireless sensor network layer is where it's at. The data are collected at the sink node and sent to the command layer. An application server and a data server make up the control layer. The control software is executed on the application server and may get data from the sink node. The application then saves the data to the database server after processing and evaluating it. The system also offers a number of services to its customers, including the display of real-time data and the transmission of historical data to the management through a wired local area network. If anything goes awry, like the temperature being too high, the control application will quickly send an alert message to the phone of the management team. The application layer serves as a user interface. In this layer, administration may do things like request services and keep tabs on

environmental conditions in real time. The administration team will be alerted immediately if an alarm is received from the control software. In this layer, users may issue commands to the wireless sensor network, such as asking for the temperature inside a cabinet.

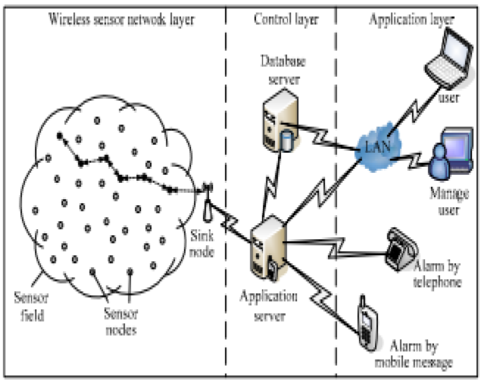


***Fig.1. The scheme of environment monitoring system for equipment room;***

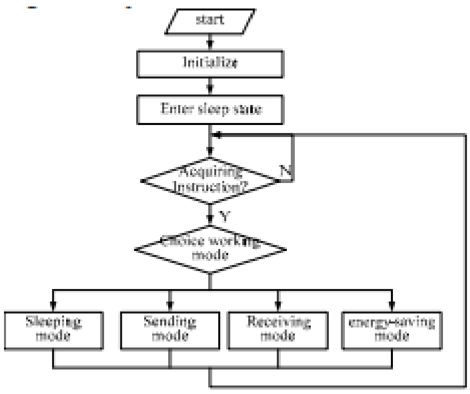


***Fig.2 The operation process on Unicells***

## Design and Implementation

### The design and implementation of wireless sensor node

According to Fig. 1, the wireless sensor network layer is the foundation of this architecture. The corners of rooms are outfitted with sensor nodes. Using its built-in sensors, each node collects and relays environmental data via radio. In this deployment, we use the UbiCell node, a sensor node developed by researchers at Nanjing University of Posts and Telecommunications. The Atmega128L is a stable and reliable CPU used by the UbiCell platform. The maximum time between instructions is 135.6ns at a clock rate of 7.3728MHz. The chip's dependable 76.8KBaud/s

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data rate is made possible by the CC1000 transceiver. The UbiCell node's operational procedure is shown in Fig. 2.Protocol creation and implementation (4.2) Each sensor node may act as a data collector and relay information to the hub. Thus, the protocols govern the process of synchronization and communication. Section 2's analysis reveals that there are a small number of crucial algorithms for the protocol stack. ZigBee (IEEE 802.15.4 standard) was selected as the communication protocol for the UbiCell nodes because of its suitability for the environment. We then choose a routing method that is data driven. As a method of acquiring information, "directed diffusion" [17] has been suggested. It aims to keep tabs on happenings that are usually detected by a small network of nodes. In a sensor network, a sensing job is broadcast as a point of interest. Informational nodes that respond with useful data are generated.

## The development and deployment of a mobile agent design

Using the protocol and algorithm presented in subsection 4.2, the sensor nodes in this system may send their data to the network administration team. Sensor nodes keep a constant eye on the surroundings and relay the data back instantly to ensure a seamless flow of information. But as the number of sensor nodes expands, so does the volume of data flowing across the network. The end consequence is a substantially quicker death for a single node. The overall impact on the wireless sensor network is increased data transfer rates. However, the issue could not be fixed by decreasing the rate at which data was sent; otherwise, the network manager would not be alerted to environmental issues in a timely fashion. Mobile agent technology is used here to help with dispute resolution. In the context of WSN, as stated in the introductory section, mobile agents may be given permission to access not only their own data, but also the data stored in the sensor nodes. They can read sensor information, communicate amongst nodes, and move around on their own. The mobile agents will be sent from the sink node to the sensors. And the dispatch routing protocol is the directed diffusion routing protocol described in subsection 4.2. The steps taken by the mobile agent and its connection to the dispatcher are shown in Fig. 3.

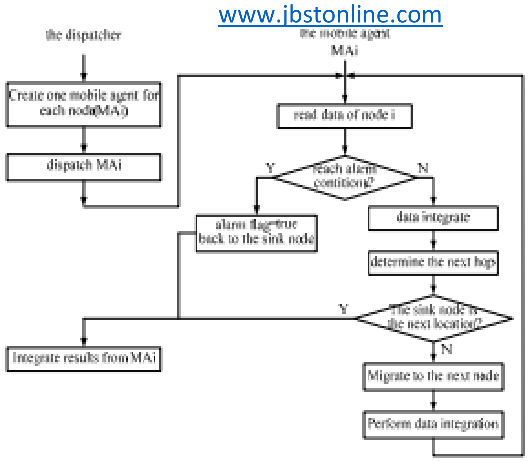


***Fig.3 the process of the mobile agent and its relationship with its dispatcher***

Consider the sink node to be a stand-in for the processing unit in charge of the monitoring service. Let's call the n mobile agents sent out by the sink node "MA1,...,MAi,...,MAn." Once MAi receives a job assignment, it immediately begins gathering information from sensor node i. MAi instantly route this alert if the monitoring data reaches the alarm criteria and send it back to the sink node. If not, MAi will carry the integrated data and information with it as it moves on to the next step. The MAi itinerary has been completed successfully if the next hop is the sink node. After then, sensor node data is incorporated on purpose in accordance with the MAi. Agilla, which offered a mobile-agent-based programming paradigm for use in wireless sensor networks, serves as the platform upon which we deploy our method.

## Developing an App for Service and Putting It to Use

The monitoring data is collected by the sink node based on the deployment of the wireless sensor network layer and then sent to the end user over the intranet. The service application software then saves those records to the database server. User inquiries may be broken down into three categories: historical, snapshot, and long-running. The program's features should include the following, among others: the ability to query and analyze historical data and visualize it in a chart; the ability to examine important or abnormal measure acquisition; the ability to review real-time environmental information of the room; the ability to establish alert thresholds; etc. When an abnormal condition arises, the system actively feeds back the alert information, in this case the abnormal temperature, to the management team and asks them to deal with it. The software was developed using an object-oriented approach. The schematic for the packaging is shown in Fig. 4. Sequence

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diagram layout is shown in Fig. 5. Aspect of the user interface devoted to monitoring systems data acquisition subsystem WSN information monitoring and management system for communicating with the outside world wireless Network of sensors

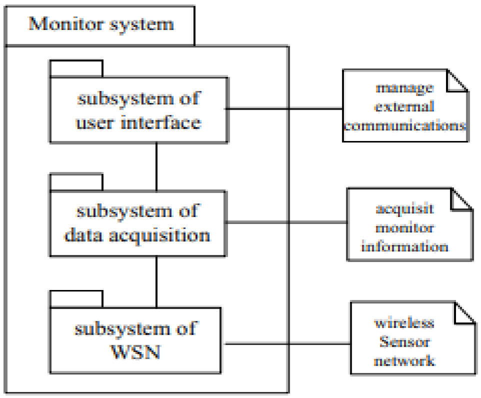


*Fig.4 the design of package diagram;*

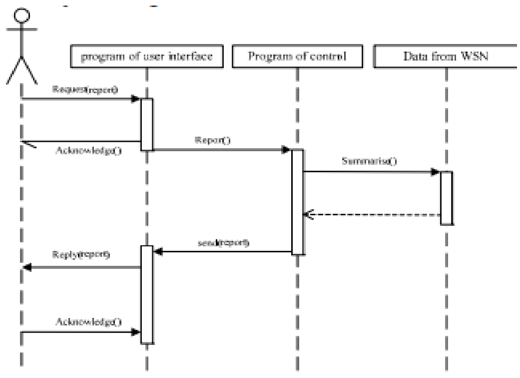


*Fig.5 the design of sequence structure*

## Conclusion

This study successfully develops a WSN- and MA-based environmental monitoring system. A firm has been using and testing the technique for months. There has been a noticeable rise in managerial effectiveness. The following are some specific advantages of the suggested system architecture: First, the challenges of costly and time-consuming deployment may be overcome and unmanned monitoring can be achieved by using WSN technology for environmental monitoring. (2) Networks with mobile agents have improved reliability and fault tolerance by decreasing data flow and latency. Thirdly, including mobile agents in WSN helps increase node longevity and load balancing without increasing network latency. The security flaws in this system will be the focus of future development.

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