A STUDY ON OBJECT OBSERVATION BY LARGE-SCALE WIRELESS SENSOR NETWORK AND AUTONOMOUS MOBILE ROBOT

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Abstract. *This paper proposes a new system for object observation by a large-scale wireless sensor network and an autonomous mobile robot, named the Network-Robot system (N-R system) for object observation. In the proposed N-R system, a large-scale wireless sensor network composed of sensor nodes limited resources learns the appearance points of objects and appearance frequency at each point. An autonomous mobile robot with a highly efficient camera obtains learning results from the wireless sensor network and moves to a high point of appearance frequency of objects. In the proposed N-R system, an autonomous mobile robot measures the status of objects in detail at the appearance point. We evaluate the proposed N-R system by computer simulations and discuss its development potential. In simulation experiments, the performance of the proposed N-R system is investigated in detail to verify its effectiveness.*

Keywords: Wireless sensor nodes, Autonomous mobile robot, Large-scale sensor network, Object observation

1. Introduction

Wireless sensor networks have attracted a significant amount of interest from many researchers because they have great potential as a means of obtaining information of various environments remotely[1],[2]. Wireless sensor networks have a wide range of applications, such as environmental monitoring, environmental control, and object tracking[3],[4]. In large-scale wireless sensor networks, hundreds or thousands of sensor nodes are deployed in an observation area and used to monitor and gather information of environments. Each sensor node consists of a simplified sensing function to perceive the appearance of objects, a limited information processing function, and a limited wireless communication function, and operates on a resource of a limited power-supply capacity such as a battery. This paper proposes a new system for object observation by a large-scale wireless sensor network and an autonomous mobile robot, named the Network-Robot system (N-R system). In the proposed N-R system, a large-scale wireless sensor network composed of sensor nodes limited resources learns the appearance points of objects and appearance frequency at each point. An autonomous mobile robot with a highly efficient camera obtains learning results from the wireless sensor network and moves to a high point of appearance frequency of objects. In the proposed N-R system, an autonomous mobile robot measures the status of objects in detail at the appearance point. We evaluate the proposed N-R system by computer simulations and discuss its development potential. In simulation experiments, the performance of the proposed N-R system is investigated in detail to verify its effectiveness.

2. Network-Robot System and Experimental Results

The proposed N-R system consists of the following Phase I and Phase II. In Phase I, a large-scale wireless sensor network composed of sensor nodes limited resources learns the appearance points of objects and appearance frequency at each point. The learning algorithm is based on the Advanced Ant-based Routing (AAR) algorithm[5]. In Phase II, an autonomous mobile robot with a highly efficient camera obtains learning results from the large-scale wireless sensor network and moves to a high point of appearance frequency of objects. As Phase II, we show the results of the pattern that an autonomous mobile robot moves to the highest point of appearance frequency of objects after each learning result from all sensor nodes was gathered.

The conditions of simulation, which were used in the experiments performed, are shown in Table 1. The simulation configuration is illustrated in Fig.1. Experimental results on average successful ratio of object observation and total energy consumption through a large-scale wireless sensor network are reported in Fig.2. By using the proposed N-R system, the object observation was achieved with acceptable accuracy and stable energy consumption.

Table 1 Conditions of simulation

Simulation size	*400m ✕ 400m*
The number of sensor nodes	*1000*
Sensing Range	*10m*
Range of radio wave	*25m*
Packet size	*10byte*

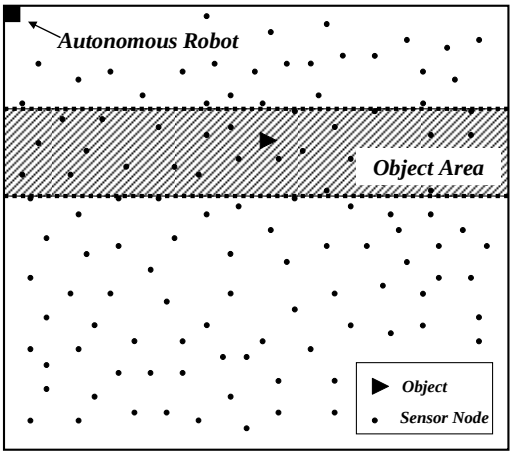

Fig.1 Simulation configuration

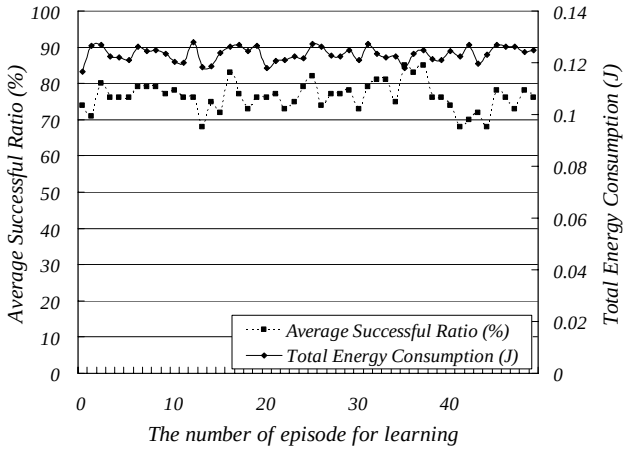

Fig.2 Experimental results

3. Conclusions

In this paper, a new system for object observation by a large-scale wireless sensor network and an autonomous mobile robot, named the Network-Robot system (N-R system), has been proposed. Through experimental results, it has been confirmed that the proposed N-R system has the development potential as a promising system for object observation. Future works include proposal of a more efficient method on Phase II and verification of the effectiveness to various situations.

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