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Author(s)	Seide, Germine
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Description	Supervisor:TAN Yasuo，情報科学研究科，修士

An Energy Efficient Recovery Mechanism for Tracking Systems

Seide Germine (610203)

School of Information Science,
Japan Advanced Institute of Science and Technology

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Wireless sensor networks are considered one of the promising technologies for its capability to be applied in different fields. It allows intensive monitoring in the deployed environment and provides efficient solution for applications that require real time and accurate monitoring.

Tracking is one of the suitable applications that has been recently adopted to Wireless Sensor Networks. In those networks a large number of sensor nodes are deployed randomly. Tracking applications need to scale when the number of nodes is increased, and need to ensure reliability and accuracy while reporting data through the network.

Developing strategies to manage raw data in such networks is considered a huge challenge considering that the transmission range is limited by power constraints, frequency reuse and channel effects while the position of the base station(sink node) is far way. Accordingly the data routing needs to be done in a distributed way such that the data will be forwarded among several nodes until it reaches the sink nodes.

In this thesis, we first survey the object tracking problem. We enumerate four schemes discussed in prior literature. They approach the problem of object tracking from different prospectives but their main focus is finding efficient ways to forward data from the information source to the base station. Inspite of those improvements, we showed that object tracking can still be subject to enhancements. The second part of the thesis is then about our proposed system. Inspired by pre-cited approaches, the system defines a new model to track mobile objects using wireless sensor networks. The object tracking introduced in this thesis demonstrates a system that uses a large scale wireless sensor network to track a mobile object and communicate their information. In this system we consider the architecture as the key element for our approach. We use a multi-layer architecture in which sensor nodes are clustered and connected together, forming a tree of subnets for robustness. The tracking application will then execute an algorithm that contains the following phases: detect, report, predict and locate. By taking advantage of the sleep/awake mechanism available in each sensor node we define a recovery mechanism "sleep/predict/awake" between internal and boundary nodes.

To evaluate the proposed solution we implemented in C language, an event-driven simulation, built on top of Embedded Computers AR2000 series. We conducted many simulations by testing parameters related to the large scale deployment; miss prediction and energy saving issue. The obtained results showed that:

1. The architecture handles the mobile object location and prediction with a negligible margin of error.
2. The clustering algorithm scale well in case of adding more nodes and inactive nodes.
3. The recovery mechanism reduces the number of data transfers between nodes, regulate the transmission frequency and therefore save energy.

In conclusion, comparison based on energy saving with prior cited work has been conducted. In the case of the prediction our results showed the same improvement. In the case of scalability, the recovery mechanism showed an excellent performance in terms of accuracy and energy efficiency.