

Intelligent Platform for Autonomous Environmental Monitoring

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Over the years, Wireless sensor networks (WSN) have gained a lot of attention in both public and research communities. This technology has been applied to a wide range of application domains that have a need to monitor phenomena, process sensed data, and take actions accordingly. As of today, most middleware platforms for sensor networks offer basic measurement services, but fall short to offer accompanying processing facilities. We have developed and evaluated a framework combining both the data collection and processing functions. In order to enable intelligent monitoring and data management, we have adopted a multi-agent approach. Apart from performing simple tasks, agents can realize the required level of flexibility, robustness and autonomy to the system.

The developed monitoring platform has a layered architecture providing functionalities such the sensing, transmitting, storage and processing of sensor data. In order to maintain the autonomy and scalability of the data processing functions we implemented and evaluated load-balancing algorithms that balance the task load across machines. This logic was incorporated agents. By using principles such as agent cloning, migration, task passing and reallocation, a scalability processing infrastructure can be achieved with respect to the number of sensors. Our system is able to handle sudden task load increases by lowering the priority of those tasks, resulting in a fairer resource sharing.

Our agent-based monitoring approach has been successfully applied to a use case aimed at measuring noise and air quality in urban environments. In contrast to classical monitoring systems, a cost-efficient measuring network is achieved by using consumer hardware to deploy urban environmental monitoring networks. This approach allows relaxing the strict quality and reliability requirements since cross referencing between nodes and high performance signal processing allows eliminating errors efficiently. The load-balancing algorithms were evaluated in this use case on simple tasks such as updating the diurnal noise patterns.

In this paper we have presented the results of our research and developments into a middleware platform capable of large-scale autonomous monitoring. The platform enables autonomous, scalable data processing in the sensor network itself by using mobile software agents.