# COUGAR: The Network is the Database

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## 1. INTRODUCTION

The widespread distribution and availability of small-scale sensors, actuators, and embedded processors is transforming the physical world into a computing platform. One such example is a sensor network consisting of a large number of sensor nodes that combine physical sensing capabilities such as temperature, light, or seismic sensors with networking and computation capabilities [1]. Applications range from environmental control, warehouse inventory, health care to military environments. Existing sensor networks assume that the sensors are preprogrammed and send data to a central frontend where the data is aggregated and stored for offline querying and analysis. This approach has two major drawbacks. First, the user cannot change the behavior of the system on the fly. Second, communication in today's networks is orders of magnitude more expensive than local computation, thus in-network processing can vastly reduce resource usage and thus extend the lifetime of a sensor network.

This demo demonstrates a database approach to unite the seemingly conflicting requirements of scalability and flexibility in monitoring the physical world. We demonstrate the COUGAR System, a new distributed data management infrastructure that scales with the growth of sensor interconnectivity and computational power on the sensors over the next decades. Our system resides directly on the sensor nodes and creates the abstraction of a single processing node without centralizing data or computation.

## 2. THE COUGAR SYSTEM

The COUGAR System is a platform for testing query processing techniques over ad-hoc sensor networks. COUGAR has a three-tier architecture: The *QueryProxy*, a small database component that runs on sensor nodes to interpret and execute queries, and a *Frontend* component, which is a more powerful *QueryProxy* that permits connections to the world outside of the sensor network, and a graphical user interface through which users can pose ad-hoc and long-running queries on the sensor network. Our system forms clusters out of the sensors to allows intelligent in-network aggregation to conserve energy by reducing the amount of communication between sensor nodes. The query processing component handles queries for distributed devices in an intelligent manner.


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## 3. THE DEMO

This demonstration will utilize Sensoria WINSNG 2.0 nodes [4], running Linux on SH4 CPUs, as well as Berkeley Motes [2]. Each of the Sensoria nodes has GPS, seismic, and acoustic sensors, while each Mote has light and temperature sensors. The Sensoria nodes will run the *QueryProxy* software, while the Motes will be running a scaled down version of the *QueryProxy*. The sensor network will consist of Sensoria nodes and Motes communicating via RF radio using the Directed Diffusion routing protocol [3] with an XML message format. The GUI will communicate with a Sensoria node running the front-end over Ethernet.

The demonstration will illustrate the *QueryProxy* system's ability to interact with different sensor types and hardware, dynamically obtain available sensor types via an in-network catalog, and aggregate query responses in-network. Users will be able to create and execute their own queries over the sensor network.

## 4. ACKNOWLEDGEMENTS

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## 5. REFERENCES

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