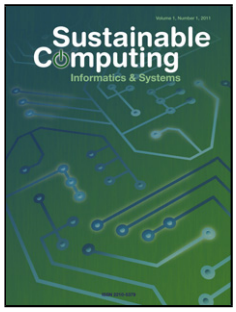


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# Non-invasive Cyber-Physical System For Data Center Management

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**Abstract**

We present a Cyber-Physical System (CPS) designed to improve the efficiency of Cloud Data Centers. The hardware part of the system consists of a number of dual functionality devices powered with scavenged thermal energy. The devices can perform two different functions: i) act as wireless sensing nodes to monitor environmental parameters inside the server room that are important for system reliability and security; ii) provide active cooling to the CPUs of the data center as *smart heat-sinks*. Starting from the empirical characterization of the energy harvesting module, we determine the amount of energy that can be harvested from a CPU heat dissipation while performing different tasks. We then analyze the amount of energy required to supply the low power sensors or to actuate the cooling fan. The CPS exploits a software simulator of the network of smart heat-sinks to predict the status of the devices. The simulator works in conjuction with a management algorithm used to administrate the cloud infrastructure and the network of *smart heat-sinks* for pursuing global objectives, i.e., maximizing the power efficiency of the data center, while keeping the wireless sensing network alive. Experimental data and simulation results of the framework validate the effectiveness of the proposed method.

*Key words:* Internet of Things, Cyber-Physical Systems, Thermoelectric

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