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Environmental Energy Management in Sensor Networks

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Publication Date

2003

Environmental Energy Management in Sensor Networks

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NESL – <http://nesl.ee.ucla.edu>

Introduction: Exploit Environmental Energy to Increase System Lifetime or Performance

Energy Harvesting

- Battery life and performance can improve with extra energy
- Ample opportunity in real deployments



Managing Environmental Energy

- In Distributed Systems: Performance improves if tasks are intelligently shared
 - Richer nodes take more load
- Learn the energy environment
 - Looking at the battery status is **not** enough

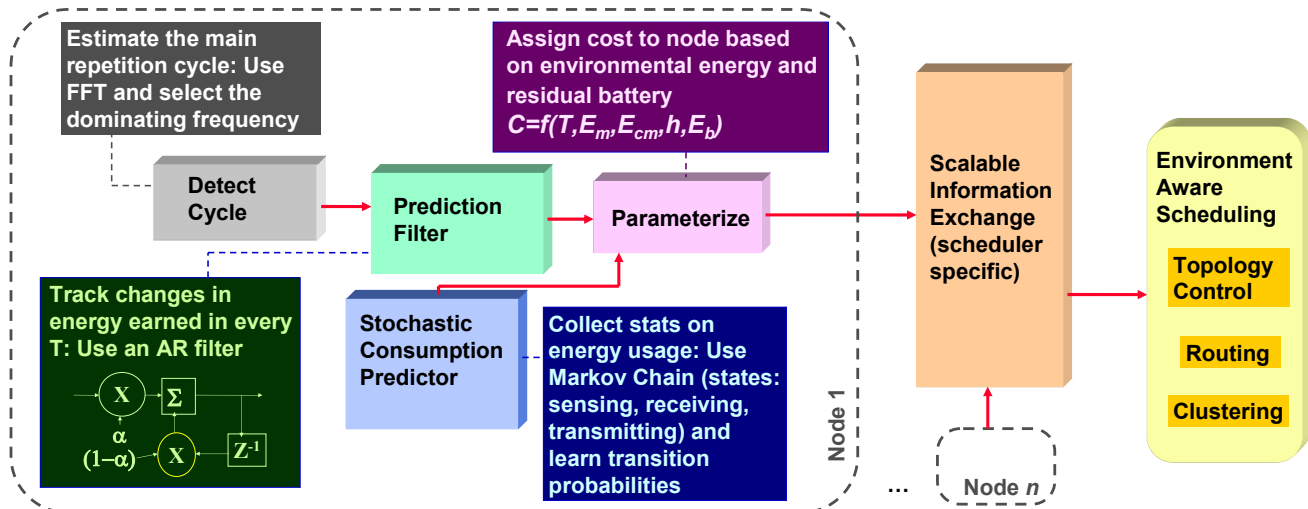


Problem Description: Get maximum work from the available energy

- Need distributed method to learn the environmental energy opportunity at all nodes
- Global task sharing among the nodes to optimize performance in locally learnt environment

Proposed Solution: Locally measurable cost metric with distributed scheduling algorithm

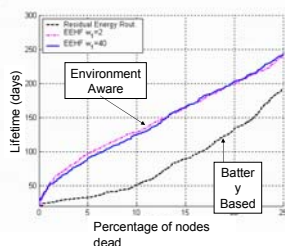
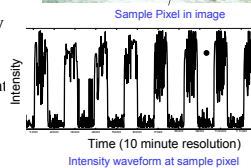
Overall Framework



Simulation Studies

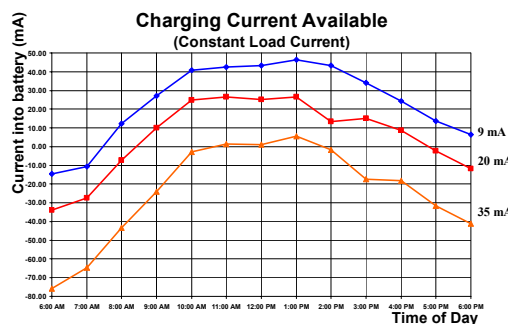
James Reserve Data:

- Pixel intensity used to approximate the light intensity at a node
 - Solar cell current varies approximately linearly with light intensity while voltage stays constant
- Data collected at 10 minute resolution for 40 days



Hardware Implementation

- HelioMote test-bed
 - Recharge batteries from solar energy
 - Track energy received from sun
 - Provide residual battery status
 - Provide constant voltage to load as battery voltage degrades



- Routing and distributed environment aware scheduling being tested on hardware
- Developing theoretical bounds on the performance for a given environment