Title
Solar Energy Collection and Management for Networked Infomechanical Systems (NIMS)

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Authors
Rachel Scollans
Lisa Shirachi
Kris Porter
et al.

Publication Date
2003
Problem Description: Remote Energy Aware Articulated Sensor Networks

Introduction: Networked Infomechanical Systems (NIMS)

What is NIMS?
• NIMS is a sensor node which explores and monitors the surrounding environment
• The NIMS architecture consists of static sensors, mobile nodes, and smart infrastructure which is completely integrated into one cooperative system
• The NIMS node will sense, sample and be adaptive

Sensing:
1. Light
2. Humidity
3. Temperature
4. Pictures

Sampling:
1. Water
2. Eddie Flux (CO2)
3. Soil

Adaptive:
• Nodes that adjust operations to respond to events
• Horizontal and Vertical Movement
• Some Applications are natural environment, remote locations, public health, biomedical, homeland security

NIMS Node

System Requirements
• NIMS nodes must be autonomous sensing systems that can be placed in remote locations
• The remote location of the node requires the system to be independent of an utility grid and therefore, an alternative energy source must be considered
• The Node consumes 30W of Power

Design Challenges
• Limited Energy
• Ability to run the node and store excess energy for 24-hour periods
• Remote location
• Environmental factors
• Mounting issues

Why is Solar Harvesting is Necessary?
• The remote location does not allow a utility grid to power the node
• Batteries only have a finite lifetime without being recharged
• Solar energy harvesting and storage allow the node to be run on a 24 hour basis

Stand-Alone Photovoltaic System
• A stand-alone photovoltaic system allows the node to be powered in a remote location for extended periods of time.
• The system does not have to be connected to a utility grid. Using solar cells as an alternative energy also helps the sensing nodes to remain autonomous.
• Excess energy from the system can be stored in a battery bank, which can be sized to meet the nodes requirements
• The panels can be fixed at an angle to maximize the day light resources
  • Angle of inclination = latitude – 15 degrees (Summer)
  • Angle of inclination = latitude + 15 degrees (Winter)

Mounting of Solar Panels
• The Solar Array is placed above the tree canopy so it can receive the most sunlight
• The solar panels are hung below the NIMS node main support cable
• The solar panels then can be fixed at any angle by adjusting the length of the support wires
• The power cabling then can be lowered to the forest floor where the battery bank is located

Energy Harvested
• Measured energy harvested in a day was found to be 509 Watt-hrs (1,832,400J)
• Assuming there are 5 peak hours of sunlight in day, the maximum theoretical amount of energy collected would be 750 Watt-hours (2,700,000J) using the Siemens SP75 solar panels
• Summer peak hours range from 5 – 7 hours in day [at Wind River]
• Winter peak hours range from 3 – 4 hours in a day [at Wind River].

Acknowledgements: Richard Pon, Ashutosh Verma, Winston Wu, Steve Liu, Anita Chan, Bryan Ribaya, Jamie Burke, Iman Ahmadi, Dr. Sara Terheggen