

# Application of Wireless Sensor Network in Forest Fire Detection

Zeenat Rehena, Krishanu Kumar  
 Sarbani Roy, Prof. Nandini Mukherjee  
 Computer Science & Engineering  
 Jadavpur University

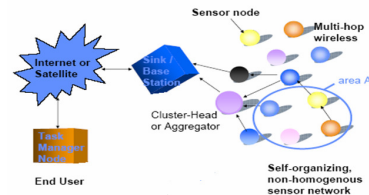
## Outlines

- Introduction
- Wireless Sensor Network (WSN)
- Applications of WSN
- Algorithm – SPIN
- Proposed System
- Component Overview
- Results
- Future Work and Conclusion

## Introduction

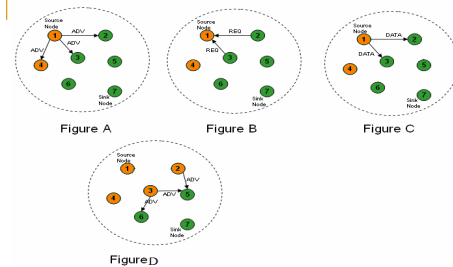
- Forest fire causes a massive loss of vegetation and animal life in that region
- Detection of such fire before it spreads over a large region is important to avoid the huge losses and disaster
- Wireless Sensor networks can be effectively used for this purpose
- Fire at any place can be considered as an *event*
- As SPIN protocol is negotiation-based, energy and resources are saved as no unnecessary data is forwarded through the network

## Wireless Sensor Network



## Other Applications

- Home application
- Environment monitoring
- Health monitoring
- Military application
- Battle Field
- Traffic surveillance



### SPIN - Protocol

- Node with data
- Node without data

## Algorithm – SPIN

- The SPIN algorithm is basically divided in three parts:
  - an *initialization* phase
  - a *data collection* phase and
  - a *negotiation* phase
- All nodes are synchronized to global time in initialization phase
- DATA packets obtain from its own application or from its neighbors
- A DATA packet contains the source node number, sequence number and a payload containing timestamp and temperature reading
- In the negotiation phase, ADV is sent before sending actual DATA packet.
- The neighbors nodes which have not that data sends REQ packets to the advertiser.
- Finally the DATA is sent in response to the REQ

## Assumptions

- Homogenous sensor nodes
- Sensor nodes may be immobile in the application
- Both broadcast and point to point communication are used
- At least one of its neighbor nodes is always within the broadcast range and interested for the data

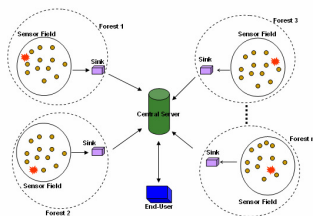
## How SPIN works on the proposed System

- The proposed system based on SPIN algorithm
- Sensor nodes are distributed randomly
- Sense temperature periodically
- Each node runs an application program to sense the environmental data periodically
- Stores the current sensor reading in the node
- If sense temperature is above a *predefined threshold value*, the nodes initiate ADV packets

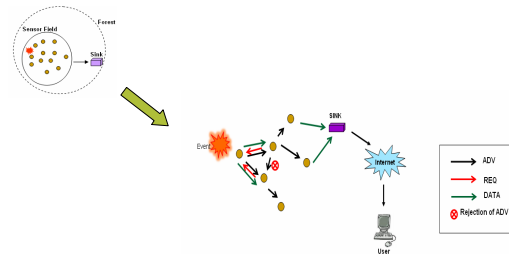
## How SPIN works on the proposed System (cont'd)

- Using the negotiation mechanism, the relevant temperature data is forwarded to the sink node
- The DATA packet contains the node id and a sequence number alongwith the last sensor reading and a timestamp
- Timestamp gives the global time as known by the node when the packet was sent
- The control terminal is connected with the base node through Internet or satellite connection
- When the extraordinarily high values for temperature reach the control terminal, they provide an indication of forest fire

## Structure of Proposed System



## Structure of Proposed System (cont'd)



## Component Overview

The Component below required for the forest fire application-

- **MHEngineM**
  - main component of the multi-hop messaging layer and provides the packet movement logic
  - modified version of an existing component MultiHopEngineM from the TinyOS multi-hop routing component library
- **MHSpinPSM**
  - provides the route selection logic for the SPIN protocol
- **MHSpinRouter**
  - This module wires all the components together
- **MHSpinAdvM**
  - This module provides the metadata advertisement mechanism
- **MHSpinReqM**
  - contains the mechanism for sending a request for data upon receiving an advertisement packet.

## Component Overview (cont'd)

- **MyMsgM** –
  - module provides the codes for Forest Fire detection application by sending packets containing sensor data i.e. current temperature
- **TimeSyncM** –
  - module provides a basic time synchronization service for the network

## Results

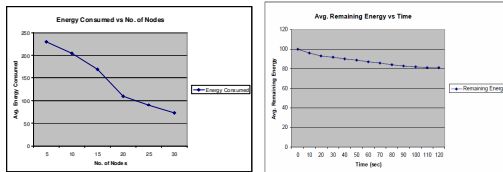


Figure 1: Avg. Energy consumed under different topology scale

Figure 2: Avg. Energy remaining with time

## Results (cont'd)

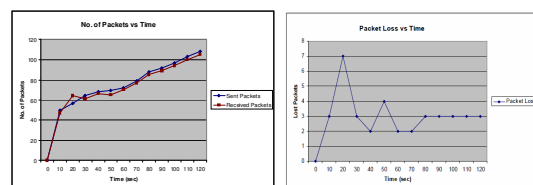


Figure 3: No. of sent and received packets with time

Figure 4: Data Packet Loss in Time

## Future Work & Conclusion

- Several obstacles need to be overcome – like energy, computational power and communication resources
- Due to time & resource constraints only a basic evaluation has been carried out
- reducing unnecessary data forwarding and storage at different nodes, energy and other resources are saved within the sensor network
- Reliable data transmission – if one node is failed to transmit the data, other node can transmit the missing data

## Reference

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- D. Janakiram, A V U Phani Kumar, A. Mallikarjuna Reddy V. Component Oriented Middleware for Distributed Collaboration Event Detection in Wireless Sensor Networks.
- W. Heinzelman, J. Kulik, and H. Balakrishnan, "Adaptive Protocols for Information Dissemination in Wireless Sensor Networks," Proc. 5th ACM/IEEE Mobicom Conference (MobiCom '99), Seattle, WA, August, 1999. pp. 174-85.

Thanks

## Hardware - crossbow

Mica suite, Transceiver



Programming board



Crossbow Cricket Mote

