CREU Research

Multi-hop Wireless Electricity Charging in Protocol in Wireless Sensor Networks

Presented by Chloe Norris, Nancy White, Bretny Khamphavong and Catherine Greene

Introduction/ About the Project

Presented by Nancy White

Source: www.witricity.com

About the Research

- The title is Multi-hop Wireless Electricity Charging Protocol in Wireless Sensor Networks
- We are researching how to integrate witricity charging into wireless sensor networks.
  - This would eliminate the need for batteries which are expensive and have limited power.
- We are also researching how multi-hop power transmission can be used in wireless sensor networks to eliminate the energy constraint.

Source: www.witricity.com

Significance of Research

- If successfully completed this research would help to integrate witricity technology into wireless sensor networks while minimizing energy leakage and maximizing the life of the network.
- Therefore, further research can focus on improving wireless sensor networks performance

Source: www.witricity.com

Questions to be Addressed

- 1. What kinds of wireless electricity charging technologies have been suggested and investigated by other researchers?
- 2. What are advantages and disadvantages of the existing wireless electricity charging technologies?
- 3. Is there any other wireless electricity charging algorithm for wireless sensor networks?
- 4. What is the wireless electricity charging protocol for wireless sensor networks to minimize an electricity leakage for various wireless sensor network models?
- 5. How can we simulate and justify the proposed idea?
- 6. What kinds of applications can use the result of the proposed research?

Source: www.witricity.com

Ideas for Practical Use

- Charging electronics without having to be plugged in such as:
  - Cell phones
  - Controllers for gaming systems
  - Ipods
- Possibly being used with hybrid or solar powered cars with wireless sensor networks integrated into the cars with charging stations similar to gas stations.

Source: www.witricity.com

The Facts

Presented by Chloe Norris

Witricity. What is it?

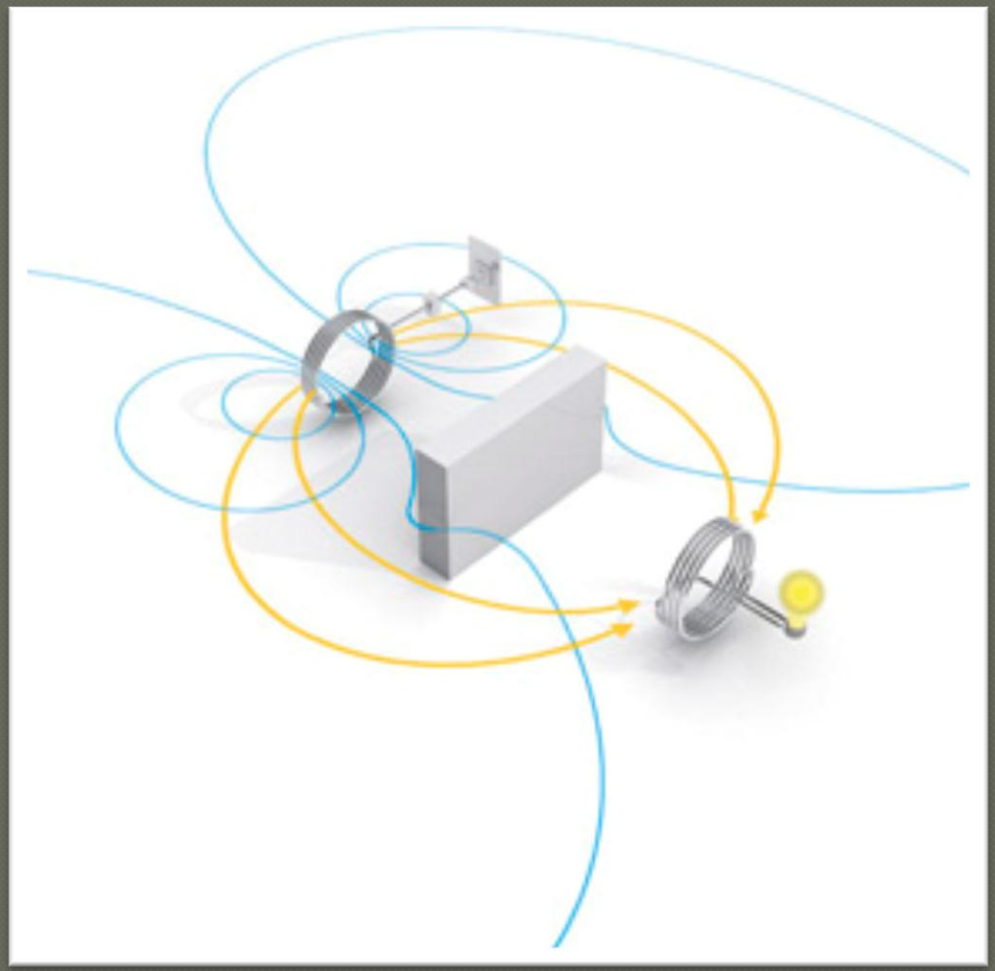
- Wireless electricity
- non-radiative
- Relies on the magnetic near field
- Not harmful to the environment
- Invented by a team of MIT scientists
  - MIT Professor Marin Soljačić

Source: www.witricity.com

How does it work?

- Magnetic resonators that efficiently transfer via the magnetic near-field
  - Electricity
  - Magnetism
  - Electromagnetism
  - Magnetic Induction
  - Energy/Power Coupling
  - Resonance
  - Resonant Magnetic Coupling

Source: www.witricity.com



Source: www.witricity.com

FAQ

- Highly efficient over distances
- Energy only transferred when needed
  - Idle listening
- Not harmful to environment
- "The body really responds strongly to *electric* fields, which is why you can cook a chicken in a microwave. But it doesn't respond to *magnetic* fields. As far as we know the body has almost zero response to magnetic fields in terms of the amount of power it absorbs." (Professor Sir John Pendry of Imperial College London)

Source: www.witricity.com

FAQ Continued

- Can fairly transmit energy through most obstructions
- Variety of uses
- Convenient, reliable, eco-friendly

Source: www.witricity.com

Sensors and Wireless Sensor Networks

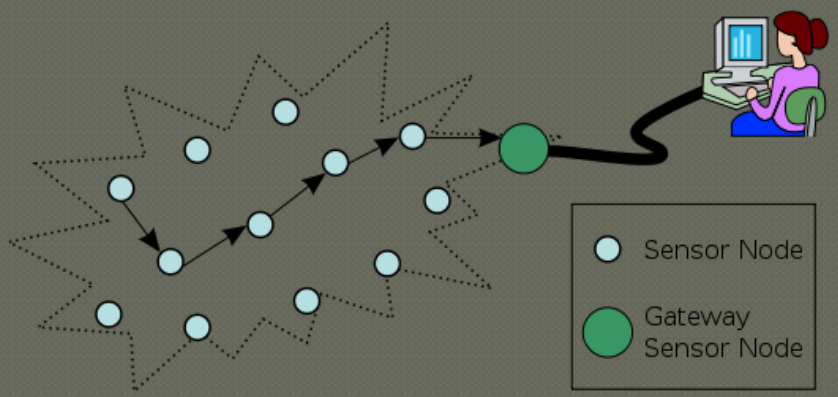
What does a sensor do?

- A device that reads/senses a physical quantity.
- Several different types of sensors:
  - Light, thermal, motion, pressure, electrical fields, and many more
- Come in all shapesand sizes

Source: http://en.wikipedia.org/wiki/Sensor

Wireless Sensor Networks

- A group of sensors in an environment
- Energy source in sensors typically a battery
- Each sensor equipped with a radio-transceiver
  - Communication device



Source: http://en.wikipedia.org/wiki/Wireless_sensor_network

FAQ

- Communication via one-hop or multi-hop
- Several different types of operating systems within wireless sensor networks (WSN)
- Our team will be using TinyOS

Source: http://en.wikipedia.org/wiki/Wireless_sensor_network

Energy efficiency

- All sensors have different pros, cons, and real world applications
- Power efficiency
  - In most cases, extremely limited
  - Issue of replacing battery/re-charging
- Numerous scenarios where recharging can't be easily accomplished
- How can we charge these sensors?

Relevance to CREU research

- Solution: WiTricity!
- Energy transmitted to WSN via WiTricity
- Relatively cheap
- Saves time, and energy

Research Operating and Software Components

Presented by Bretny Khamphavong

TinyOS

- Free and open source component based operating system
- Embedded in WSNs as a language set of cooperating tasks and processes
- Very low available memory; however it is written to allow for maximum concurrency

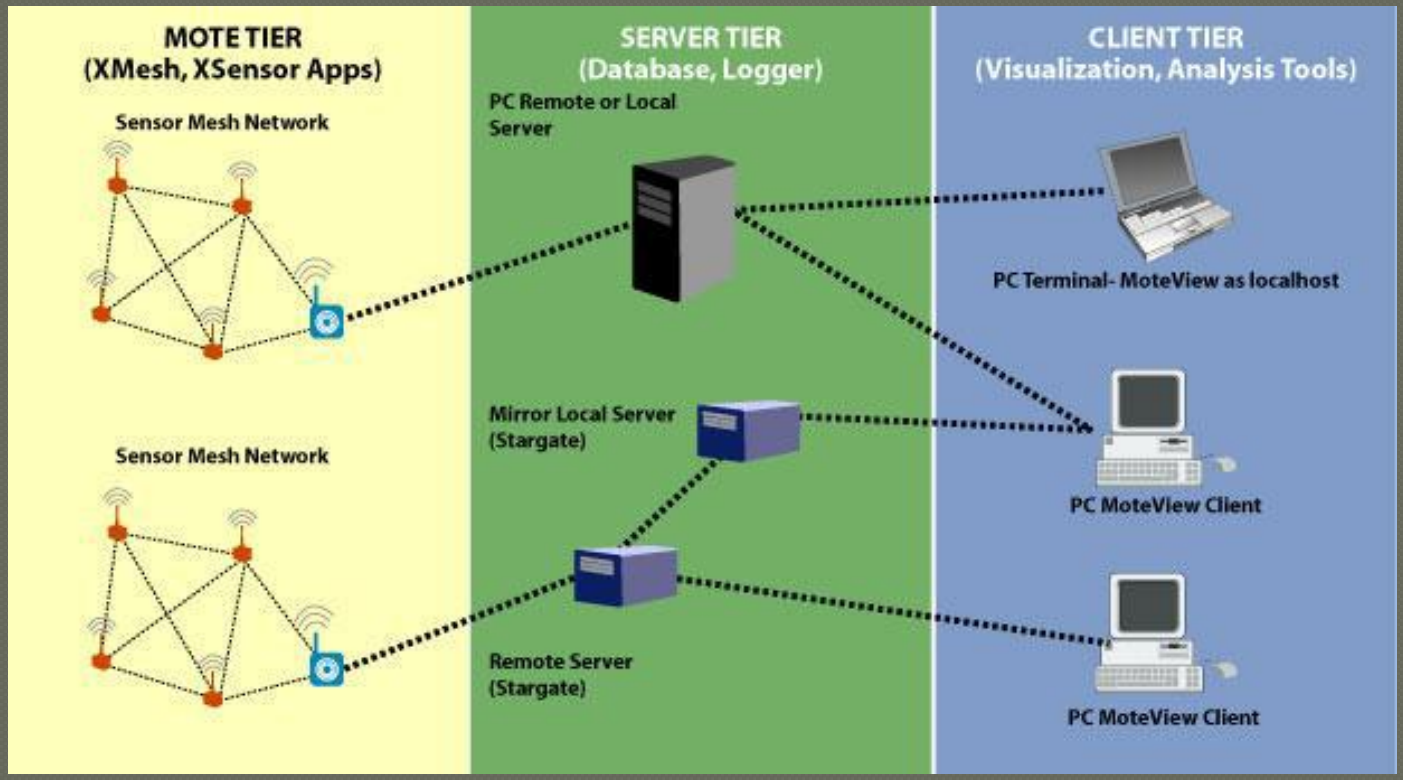
nesC

- Extension of the C programming language
- Components are the basic building block of applications
- A couple challenges:
  - Motes are highly reactive in terms of their normal operation
  - Motes have very limited hardware resources
  - Software must enable highly available applications so as to reduce mote failure due to software

Wireless Network Deployment

- Composed of three distinct software layers:
  - Client Tier = *MoteView*
  - Server Tier = *XServeand XOtap*
  - Mote Tier = *XMesh*

Deployment Framework

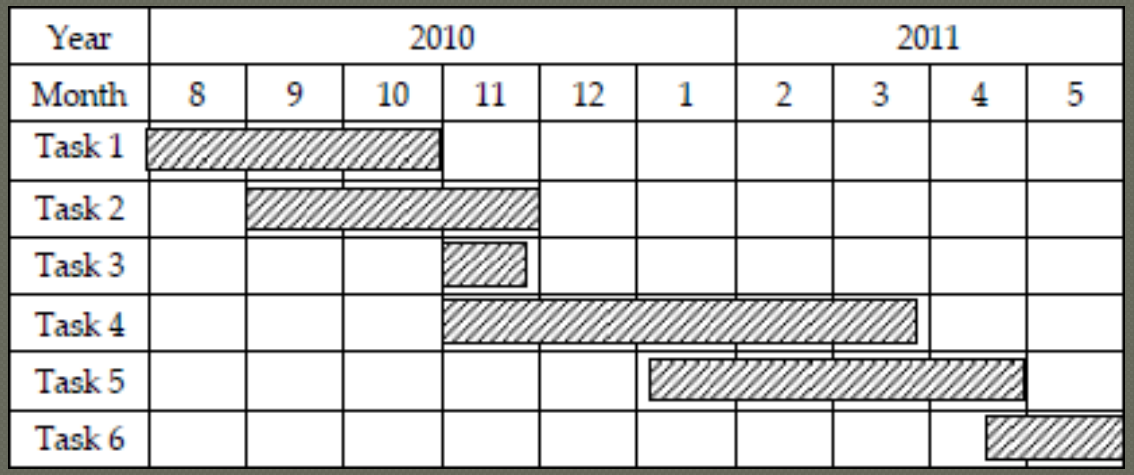


SystemImage Source: Crossbow: MoteViewUser‘‘s Manual

Timeline and Tasks

Presented by Catherine Greene

Timeline



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Task One

- What kinds of wireless electricity charging technologies have been suggested and investigated by other researchers?
  - Traditional Magnetic Induction
  - Radiative Power Transfer
  - Magnetic Resonance

Source: www.witricity.com

Task Two

- What are advantages and disadvantages of the existing wireless electricity charging technologies?

Advantages:
- Price
- Time
- Energy

Disadvantages:
- Efficiency
- Battery life
- Recharging not always possible

Task Three

- Is there any other wireless electricity charging algorithm for wireless sensor networks?
  - Scarcest resource of WSN nodes is energy
  - Algorithms need to be improved

Source: http://en.wikipedia.org/wiki/Wireless_sensor_network

Task Four

- What is the wireless electricity charging protocol for wireless sensor networks to minimize an electricity leakage for various wireless sensor network models?
  - Ex. Sleep()
  - More improvements to be developed

Source: http://en.wikipedia.org/wiki/Wireless_sensor_network

Task Five

- How can we simulate and justify the proposed idea?
  - Software Downloaded
  - Researched
  - Propose an idea
  - Develop the algorithm

Task Six

- What kinds of applications can use the result of the proposed research?
  - Last task
  - Countless applications

Source: www.witricity.com