The real HOGTHROB

The Hogthrob Project (2004 –2007)

Philippe Bonnet

DIKU

Hogthrob consortium: DIKU, DTU, KVL,
IO Technologies
Danish Commitee for Pig Production

The Project

Developing a Sensor Network Infrastructure for Sow Monitoring

- Sensor Nodes on a chip
- Sensor Network Model
- Monitoring Application

Goals:

- Functionalities
  - Tracking
  - Detecting Heat Period
  - …
- Low Cost (~1 €)
- Low Energy (2 years lifetime)

Sow Monitoring

Initial application model (state machine):

- Sleep (8h / 2h)
- Awake
- Active
- Heat

Some issues:

- State transitions managed by timer + sensing
  - Different duty cycles (processing / sending)
  - Refined model based on observations of pig behavior
- Trade-offs:
  - Sleeping vs. (Sensing and Networking)
  - In-channel wakeup vs. Additional, low power radio
  - Embedded detection model vs. Feed to a server-based detection model

The Nodes (V0)

- FPGA (Xilinx Spartan3)
  - Co-design Hardware/Software
    - Hardware accelerators (radio, sensors)
  - Different MCUs
    - Clock-based (open core) vs. Asynchronous
  - Also Spec mote, Picoradio at UC Berkeley, Galore project at UCLA
- AVR Core
  - To ease start-up
  - As timer module (counter of limited size, cannot sleep for hours) and AD converter
- Add-on radio board
  - 2,4 GHz radio (NVLSI)
  - Transmit quickly to avoid interferences
- Add-on sensor board
  - Motion detector, possibly microphones

<u>Some issues:</u>

- Explore the design space for a sensor node on a chip
  - Calibrate energy consumption
  - Analog-digital design
  - Modelling
- 2,4 Ghz single channel is a new point on the design space
  - Trade-off store vs. Send

A First Lesson

Component-based design:

- Commodity electronics
  - Designing a board is not that hard
    - Careful about radio characteristics
  - Layout and production left to the digital design specialists next door
- Component Based Programming (TinyOS)
  - Modified baseband, MAC
  - Signal Processing