Design and Development of a Wireless Sensor Mote for Laboratory Usage

Outline

- Introduction
- Motivation
- Commercial Mote Reviews
- Proposed Mote Design
- Prototype and Specification
- Conclusion and Future work

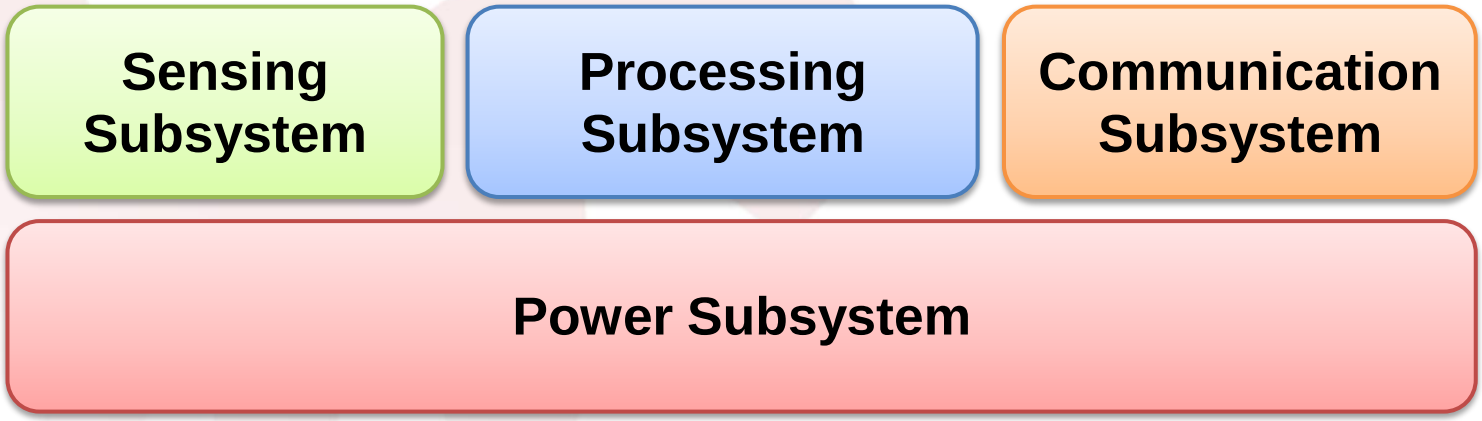
Introduction

- Wireless Sensor Network (WSN) become popular and more widely-used.
- The network consisting of distributed autonomous devices.
- Sensor node or “motes” are tiny device which has capabilities to sense physical phenomenon.

  Ex. Temperature, Humidity and Pressure.
- Sensor nodes can communicate with each others or base station.

Introduction (cont.)

- Small size and highly resource-constraint. Ex. power, processing speed or bandwidth availability.
- Mote has typically 4 principle components



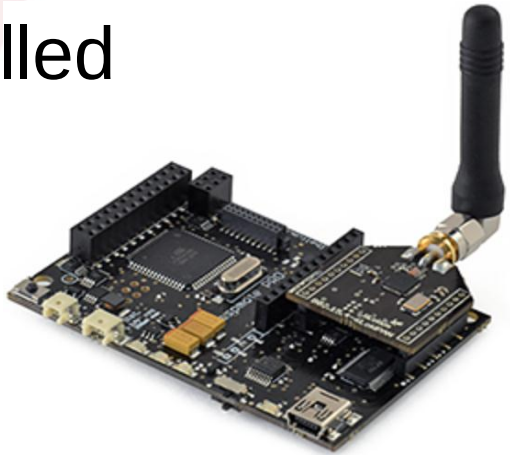
Motivation

- Design and simulation can done by using computer but in practical network is different.
- Researchers lack of real hardware to prove the simulation result.
- Commercially available motes have some hardware limitation.
- Cost and inconvenient ordering process.

Commercial Motes Review

Waspmote

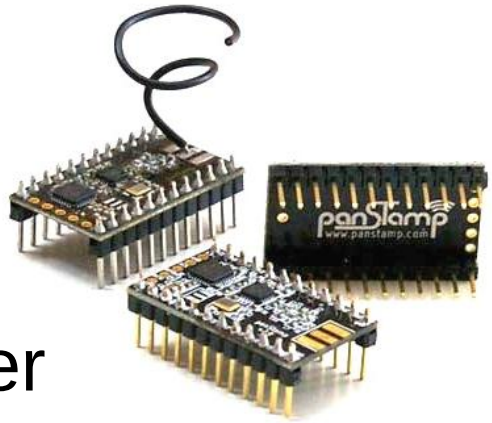
- Different sensor boards are designed for various application can be installed on Waspmote.
- Communication module can be selected from Xbee module.



- ***Cannot use other radio transceiver, sockets are designed for specific footprint.***
- ***Missing Serial Peripheral Interface (SPI)***

Commercial Motes Review

PanStamp AVR

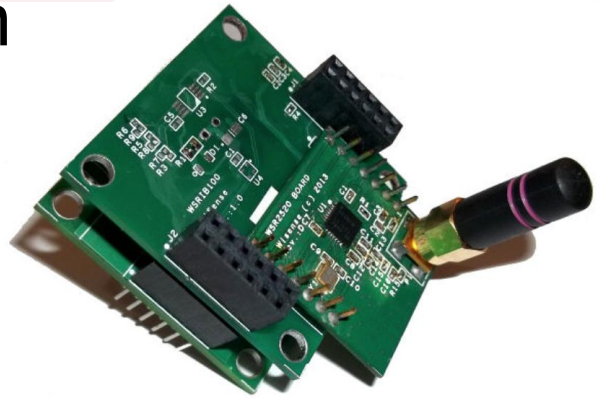


- Open source project for remote control and low-power wireless comm
- Small device contains microcontroller (Arduino based) and radio transceiver
- ***Required additional circuits to operate.***
  Ex. power supply, sensor board and USB-to-serial converter
- ***Radio transceiver is soldered on circuit board***

Commercial Motes Review

WiSense

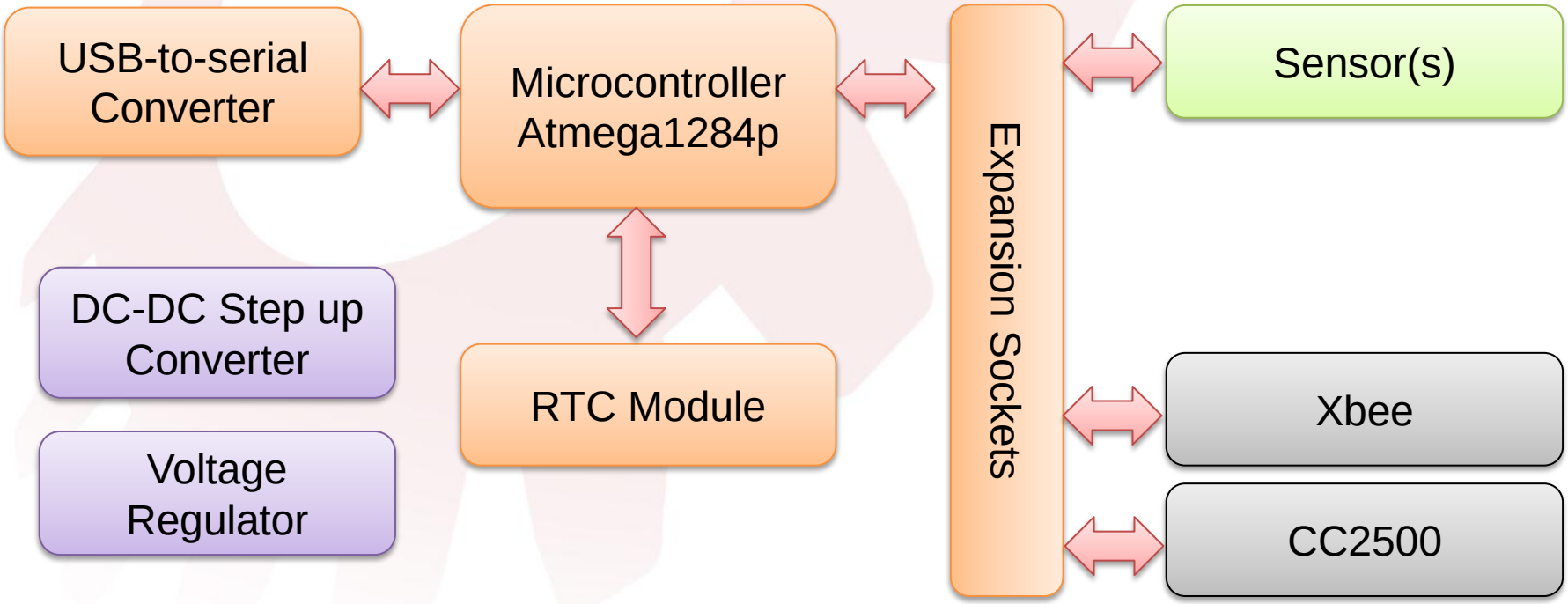
- Each subsystem is assembled on separate board.
- These circuit board are stacked together to make a mote



- ***Required additional circuit board to operation.***
- ***Lack of Real time clock (RTC) and missing SPI interface***

Proposed Mote Design

The propose mote architecture is divided into 4 subsystems.



Proposed Mote Design

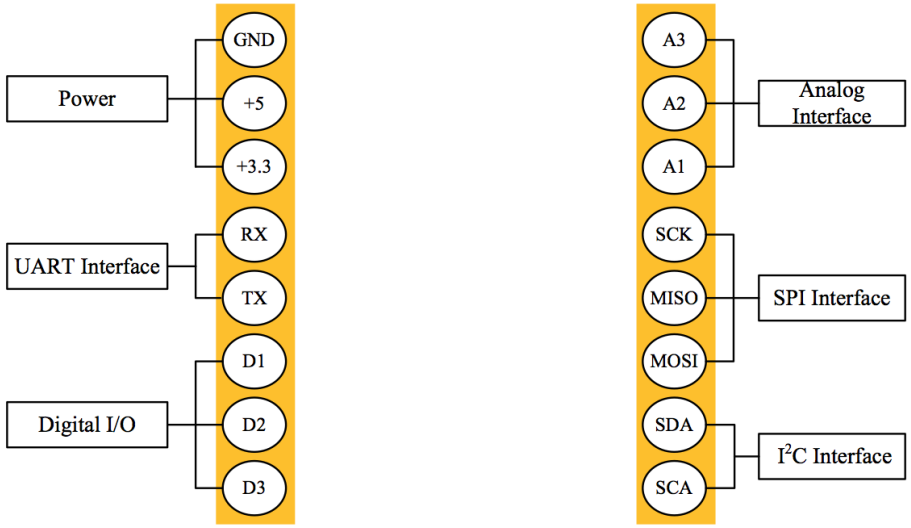
1. Processing Subsystem

- Atmel Atmega 1284p 8bit microcontroller (128KB Flash, 16KB RAM, 4KB EEPROM)
- DS3231 Real time clock module (High-precision, low-power and on-chip temperature sensor)
- USB-to-serial Converter for burning software and testing purpose.

Proposed Mote Design

1. Processing Subsystem (cont.)

- Two expansion sockets are provided for communication and sensor interfaces



Proposed Mote Design

2. Communication Subsystem

- Support 2 types of radio transceiver modules (CC2500 and Xbee module)
- CC2500 module, user can design and implement own MAC and routing protocol
- Xbee module, user can take advantage of Xbee protocol and compatibility with existing network

Xbee

CC2500

Proposed Mote Design

3. Sensor Subsystem

- Provide fully interface such as SPI, I^2C, UART, digital and analog interfaces
- External sensors can be attached with a sensor board

Proposed Mote Design

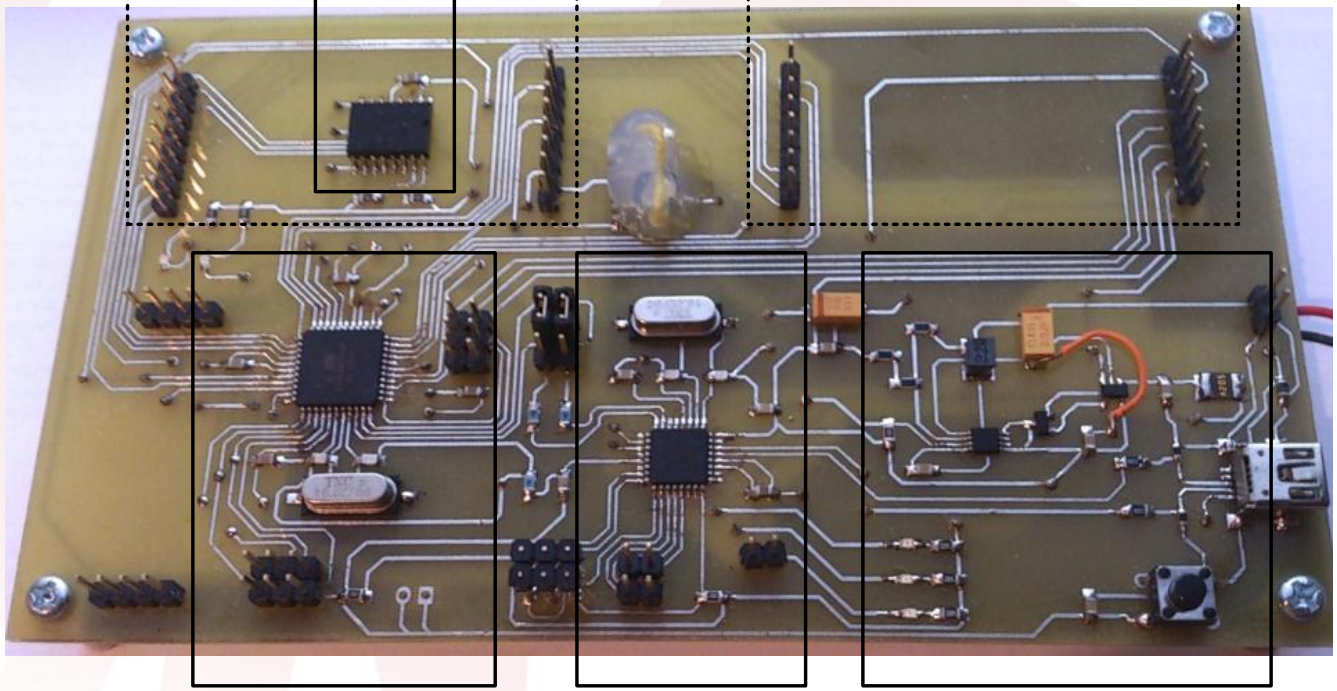
4. Power Subsystem

- Powered by USB port or Alkaline battery of the range 1.8-5.5V
- MAX1674 is used as DC-DC Step up voltage to maintain working voltage level at 5V
- Build on single board with processing subsystem

Prototype and Specification

- The first prototype has dimension of 8.5cm x 15cm.
- Electronic components are surface mount device (SMD)
- Sensor and radio module are quite flexible for laboratory usage
- No need additional circuits board to operate

Prototype and Specification



Prototype and Specification

	Proposed Mote	Waspmote	PanStamp AVR
Microcontroller	Atmega 1284p	Atmega1281	Atmega 328p
Flash/RAM	128 KB/16 KB	128 KB/8 KB	32 KB/2 KB
Speed	16 MHz	8 MHz	8 MHz
Communication	Xbee	Xbee	CC1100
	CC2500		
Sensor and Interface	Digital & Analog Port		
	SPI, I^2C, UART	I2C, UART	SPI, I2C, UART
	RTC Module	RTC Module	-
Active Mode	16.5 mA	9 mA	2 mA
Sleep Mode	95 uA	62 uA	1 uA
Programming	USB or AVR ISP	USB	UART or AVR ISP

Conclusion and Future work

- We propose a new prototype of mote with has flexibilities and capabilities for laboratory usage.
- Fully I/O interfaces and replaceable radio module, The proposed mote can be used for multi-purpose.
- Real time clock, USB-to-Serial and power supply make it superior to commercial mote.
- ***Our Future work will develop application programming interface (API) for users who have difficulty to work with low-level hardware.***