

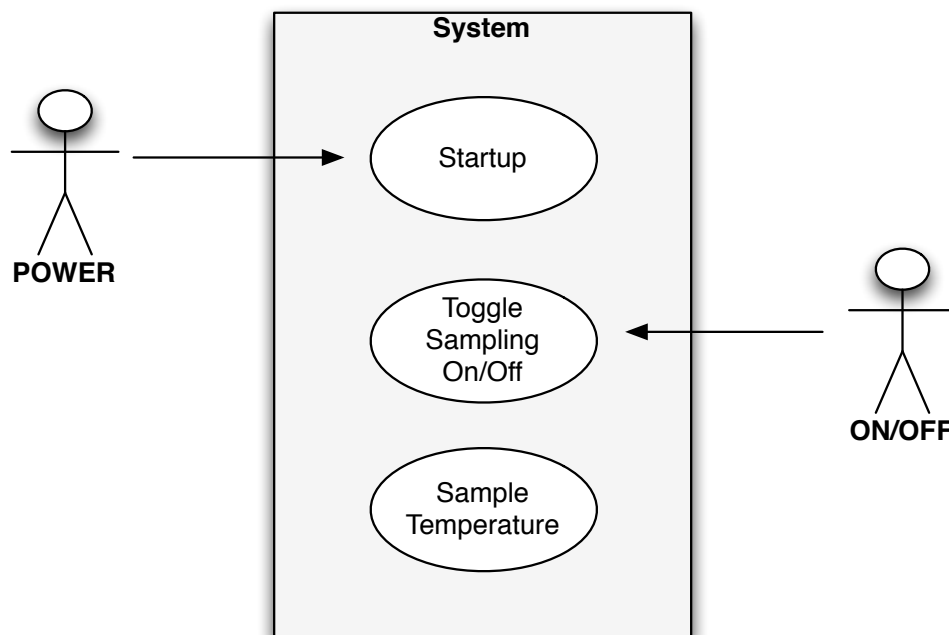
SYSTEM DESCRIPTION

This specification describes and defines the advanced requirements of the CE3200 ZigBee temperature sensor mote. The ZigBee temperature sensor mote awakens from power-down idle every two minutes, takes a temperature sample, sends the sample using a ZigBee radio to a coordinator device, displays the temperature on its LCD panel for five seconds, and then returns to idle. The remainder of this document outlines the requirements, use cases, and system design specifications for the **final project week**.

REQUIREMENTS

1. The system must be powered from standard U.S. 60Hz AC line power.
2. The system does not need power-failure or system failure recovery.
3. The system must operate in standard room temperature.
4. The system must sample temperature every two minutes.
5. The system must package the temperature data into a transmission packet.
6. The system must send the transmission packet as USART data.
7. The system must display temperatures in Fahrenheit and Celsius on the LCD.
8. The system must display a power-on heartbeat on the LCD panel when not idle.
9. The system must power-down to idle between samples.

USE CASE DIAGRAM



**USE CASE EVENTS**

1. Startup
 - A. The user starts up the system.
 - B. The system initializes.

2. Toggle Sampling On/Off
 - A. The user presses the sample on/off button.
 - B. The system toggles sampling on or off.
 - C. The system powers down to idle after 5 seconds.
 - D. If sampling is turned off then the system saves power by sleeping at idle until the user enables sampling again. All timer interrupts are disabled during idle.

3. Sample Temperature
 - A. The sample temperature timer event awakens the system.
 - B. The system samples the temperature.
 - C. The system packages the data into a transmission packet.
 - D. The system sends the transmission packet as ZigBEE radio USART data.
 - E. The system updates the LCD panel with Fahrenheit and Celsius.
 - F. The system powers-down to idle after 5 seconds.

**SPECIFICATION OF SYSTEM INPUTS AND OUTPUTS**

1. System Inputs
 - A. The system uses a LM34 analog temperature sensor.
 - i. The LM34 is powered by the Atmega32 power supply rails.
 - ii. The LM34 output is valid for 0°F to 300°F.
 - iii. The LM34 output is connected to an Atmega32 ADC pin for conversion using the full 10-bit ADC resolution.
 - B. The system uses a debounced pushbutton.
2. System Outputs
 - A. The system uses a standard LCD panel as a status display.
 - B. The system uses the USART transmit signal connected to a Parallax XBee™ ZigBee radio. The radio defaults in point-to-point mode with the destination address set to the coordinator. You will transmit only and the coordinator will receive. You do not need to configure any advanced functionality using the Xbee configuration software.

**SYSTEM FUNCTIONAL SPECIFICATION**

The system uses control software written in either Atmega32 assembly language or C.

1. The system initializes at power-on reset.
 - A. System variables are initialized.
 - B. A half-second timer interrupt is initialized for the power-on heartbeat.
 - C. A welcome message is displayed on the LCD panel.
 - D. Temperature sampling is disabled.
 - E. The system powers-down to idle mode after 5 seconds.

2. The power-on heartbeat timer interrupt event occurs.
 - A. The global volatile **heartbeat** variable is set.
 - B. The interrupt service routine exits.

3. The USART receive interrupt event occurs.
 - A. The interrupt service routine retrieves the data byte.
 - B. The global volatile **data-byte-ready** variable is set.
 - C. The interrupt service routine exits.

3. The main program identifies a set volatile variable.
 - A. Appropriate updates are made based on the set volatile variable.
 - B. The volatile variable is cleared.
 - C. If the sample on/off event occurs then temperature sampling is toggled between on and off. The two minute timer is reset.
 - D, If two minutes have passed and temperature sampling is enabled then a temperature sample is taken, packaged as a transmission packet, sent through the USART, and displayed for five seconds on the LCD panel in both degrees Fahrenheit and degrees Celsius.
 - D. The main program powers-down to idle mode.



SUPPORTING DIAGRAMS

The required transmission packet is:

FIRST BYTE SENT	SECOND BYTE SENT	LAST BYTE SENT
SOURCE ADDRESS BYTE	TEMPERATURE UPPER BYTE	TEMPERATURE LOWER BYTE

The required source addresses are:

TEAM	ADDRESS
Evan Zimmerman and Kevin Duer	12
Adam Stonehocker	5
Cyril Pyfferoen	2
Josh Adams and Casey Stark	42
Isabella Sanfelipo and Josh Reyes	1
Tony Kaczkowski and Matt Barnett	7
David Anderson	10

DELIVERABLES

1. Laboratory testing and demonstration will be completed during the laboratory period in week 10. The instructor will implement the coordinator software. This will successfully clear the ZigBee Project demo from the incomplete laboratories listed for you in the grading spreadsheet.
2. Email well-commented source code in PDF format to the instructor after you successfully demonstrate your system. **Source code submission is required.**

EXTEND YOUR WORK

1. The instructor will create the central computer for the sensor network. **No student team is required to write the central computer software.**



2. Interested groups could write their own software for a central computer that:
 - A. Initializes the system.
 - B. Waits for USART receive interrupts from the XBee™ module.
 - C. Collects the entire data packet from the USART.
 - D. Displays the source of the temperature data and the temperature values on the LCD panel for 5 seconds.
 - E. Returns to power-down idle mode.