UMassAmherst

WCNN

Wireless Camera Node Network

Midway Design Review

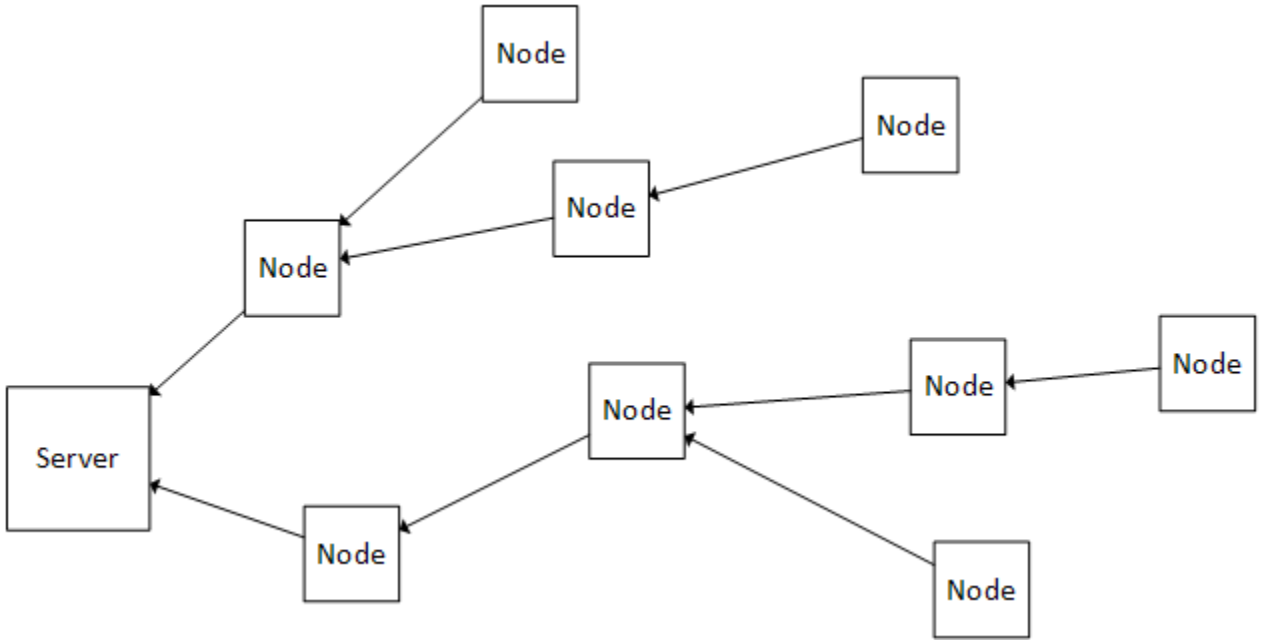
December 1, 2014

PDR Recap: What is the problem?

- Many wildlife species are becoming endangered
- Need to study their behaviors to help them better cope with their surroundings.
- Need to monitor wildlife to determine how population sizes change over time.

PDR Recap: Our Proposed Solution

Low cost, low power, and low maintenance wireless network of sensors and motion activated cameras.

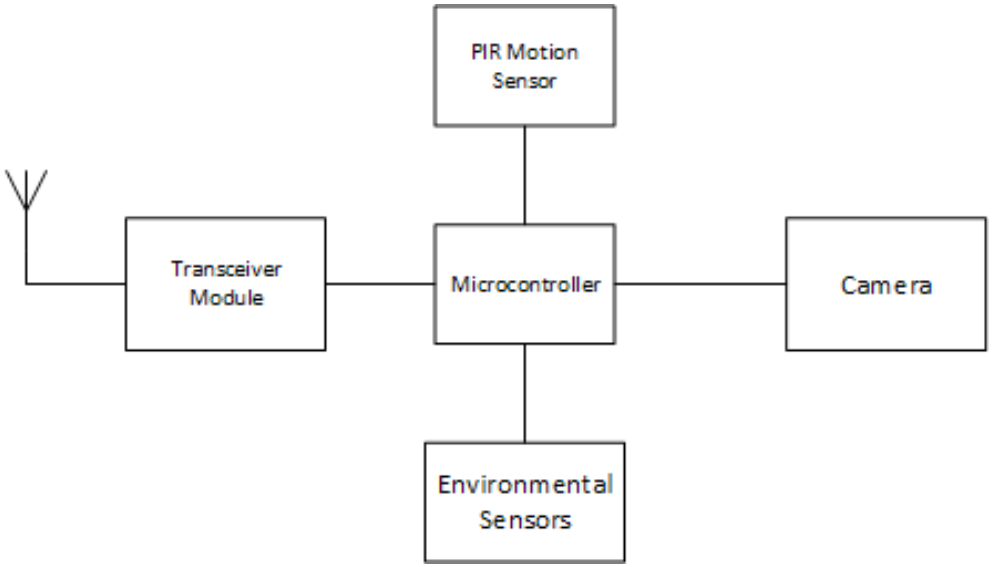


PDR Recap: Requirements

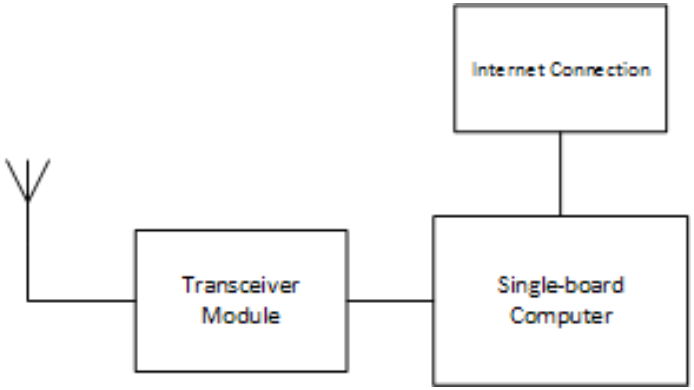
- Weatherproof
- Long battery life (at least 2 weeks)
- Network is easy to expand
- Approximately ¼ mile range between nodes
- Pictures: 320 x 240 pixels (qVGA)
- Network should work with at least 32 nodes
- The system should not interfere with wildlife.

PDR Recap: Block Diagram

Node:



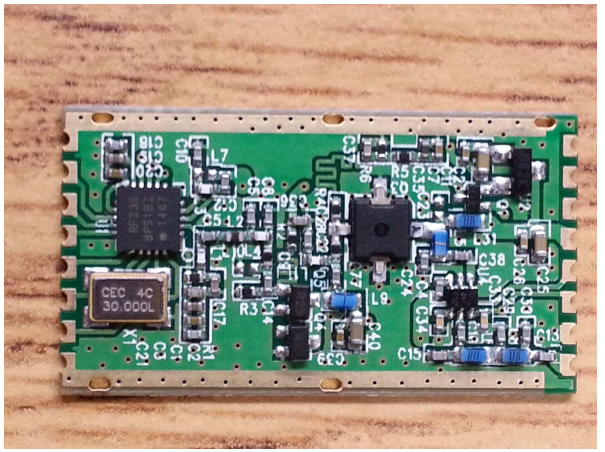
Server:



MDR Deliverables – Wireless communication

Transceiver Module: HopeRF RFM23BP

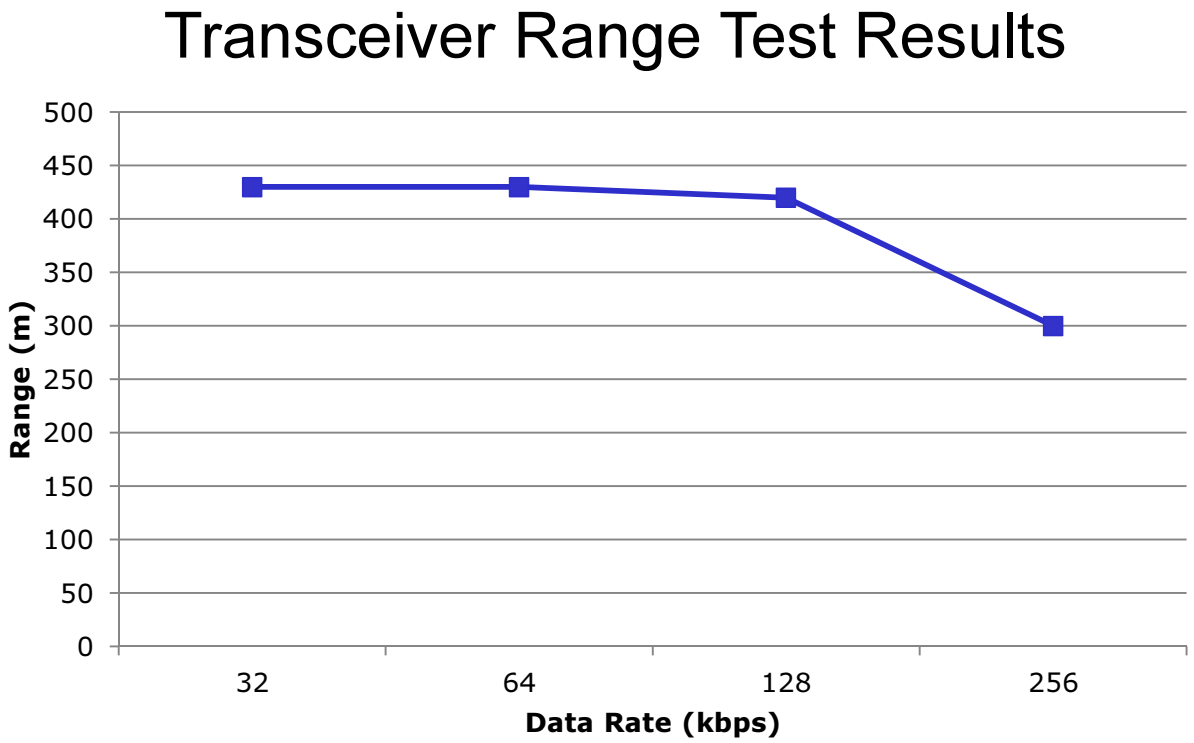
- Frequency: 915MHz (ISM band)
- Data Rate: up to 256 kbps
- Transmit power: up to 30dbm (1 Watt)
- Modulation: GFSK, FSK, or OOK
  - We used GFSK
- Uses SPI
- Cost: $8.80



MDR Deliverables – Wireless communication

- Proposed Deliverable: Demonstration of communication between transceiver modules connected to microcontroller ~~and server~~.
- Person Responsible: Alan
- Point-to-point communication between nodes works.

MDR Deliverables – Wireless communication

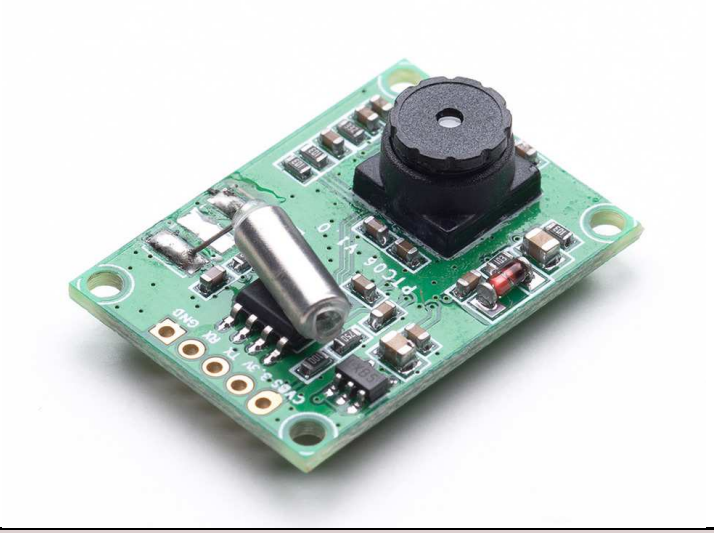


Tested with 4.5v power supply and quarter-wavelength wire antennas

MDR Deliverables - Camera

Camera: Miniature TTL Serial JPEG Camera

- Maximum resolution: 640x480
  - We will use 320x240
- Features: JPEG Compression, auto-white-balance, auto-brightness, auto-contrast
- Uses 38400 baud UART
- Cost: $35.95

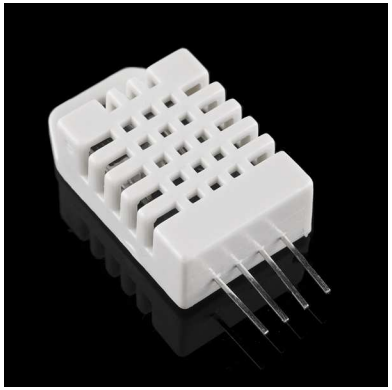


MDR Deliverables - Camera

- Proposed Deliverable: Demonstration of capturing and storing images with camera.
- Person Responsible: Andrew
- We are able to capture and save images from the camera on a computer using a microcontroller.

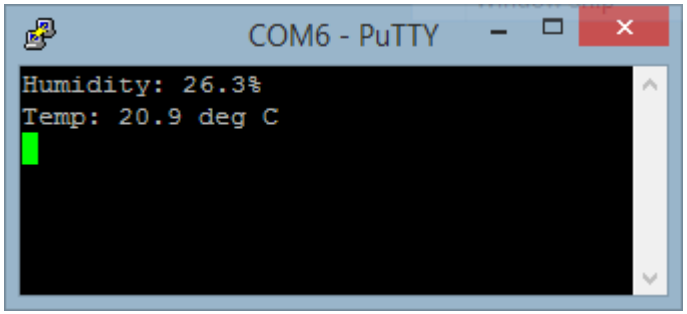
MDR Deliverables - Sensors

- PIR sensor: Parallax PIR Sensor
  - Output pin generates pulse when motion is detected
- Environmental Sensors: MaxDetect RHT03 humidity and temperature sensor
  - Uses proprietary single wire digital communication similar to PWM



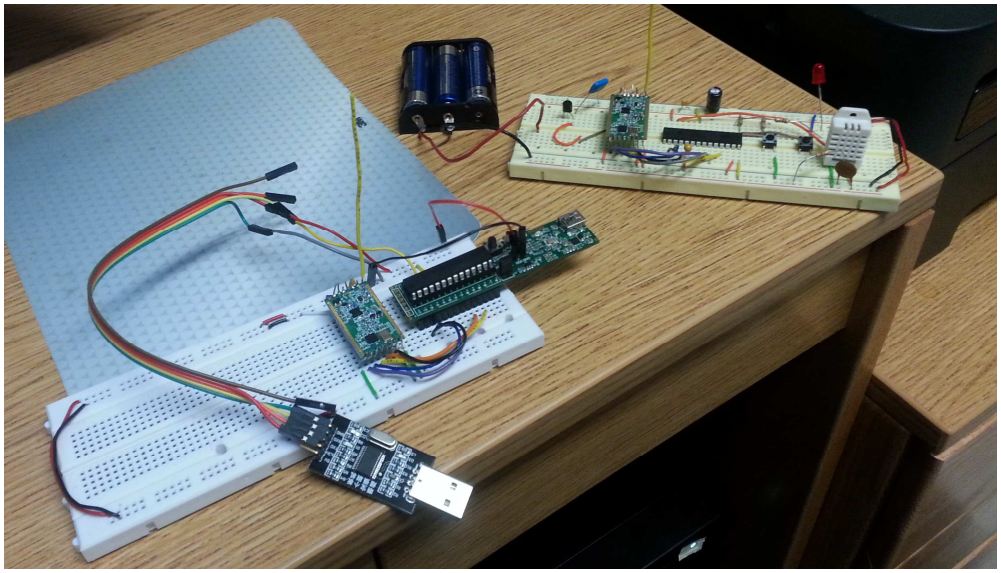
MDR Deliverables - Sensors

- Proposed Deliverable: Demonstration of reading data from sensors.
- Person Responsible: Ping
- We are able to detect motion with the PIR sensor and read environmental data from the temperature/humidity sensor.

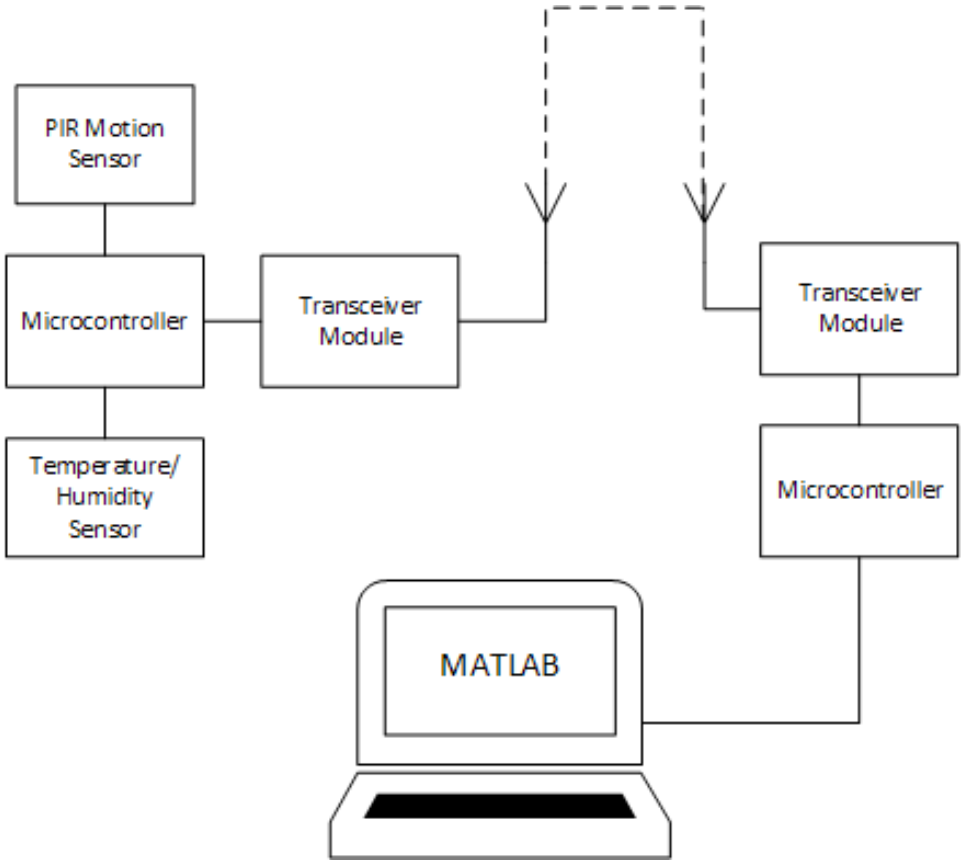


Demo

- Send image and sensor data wirelessly from one node to another node
- View the received image and data using Matlab

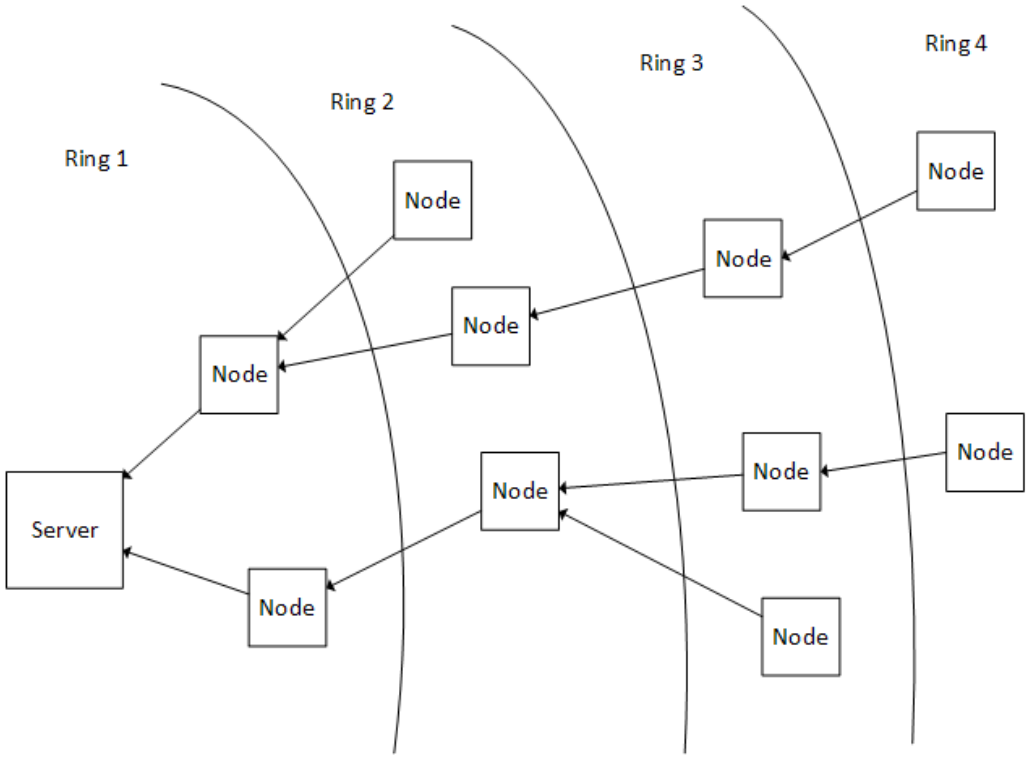


Demo block diagram

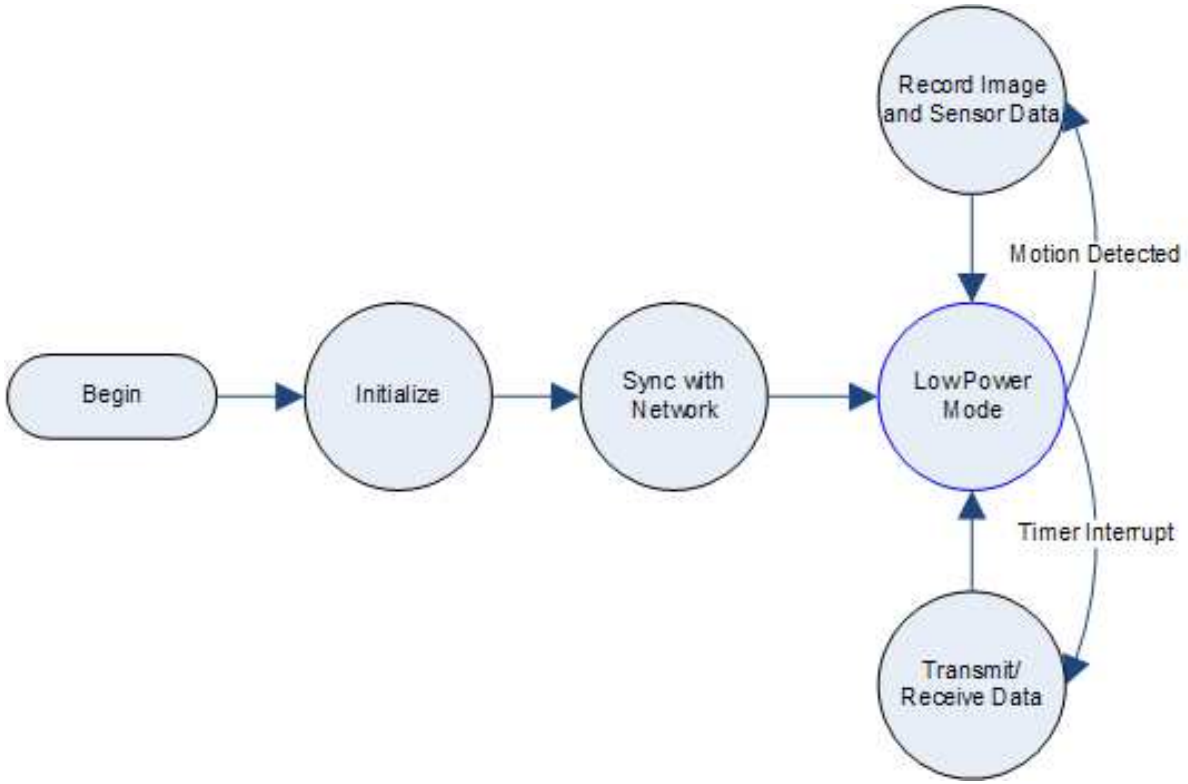


Proposed Network Layout

- Nodes will divided into "rings".
- A nodes ring determines the number of nodes data will have to pass through to get to the server.
- For now, we will assign each node to a ring



Proposed Node Program Flow



Power Consumption Estimation

	Low Power	Transmit	Receive	Image Capture
Microcontroller (4 MHz clock) (3.3v)	145.2 µW	6.6 mW	6.6 mW	6.6 mW
Tranceiver (4.5v)	4.5 µW	2.475 W	112.5 mW	4.5 µW
Camera (3.3v)	0W*	0W*	0W*	231 mW
PIR Sensor (3.3v)	165 µW	165 µW	165 µW	165 µW
Temp/Humidity Sensor (3.3v)	165 µW	165 µW	165 µW	4.95 mW
Total:	479.7 µW	2.482 W	119.43 mW	242.72 mW
Estimated time per minute	58 sec	1 sec	1 sec	0 sec
Adjusted Total	463.7 µW	41.37 mW	1.99 mW	0 W
Average Power:	43.82 mW			

*Information not available

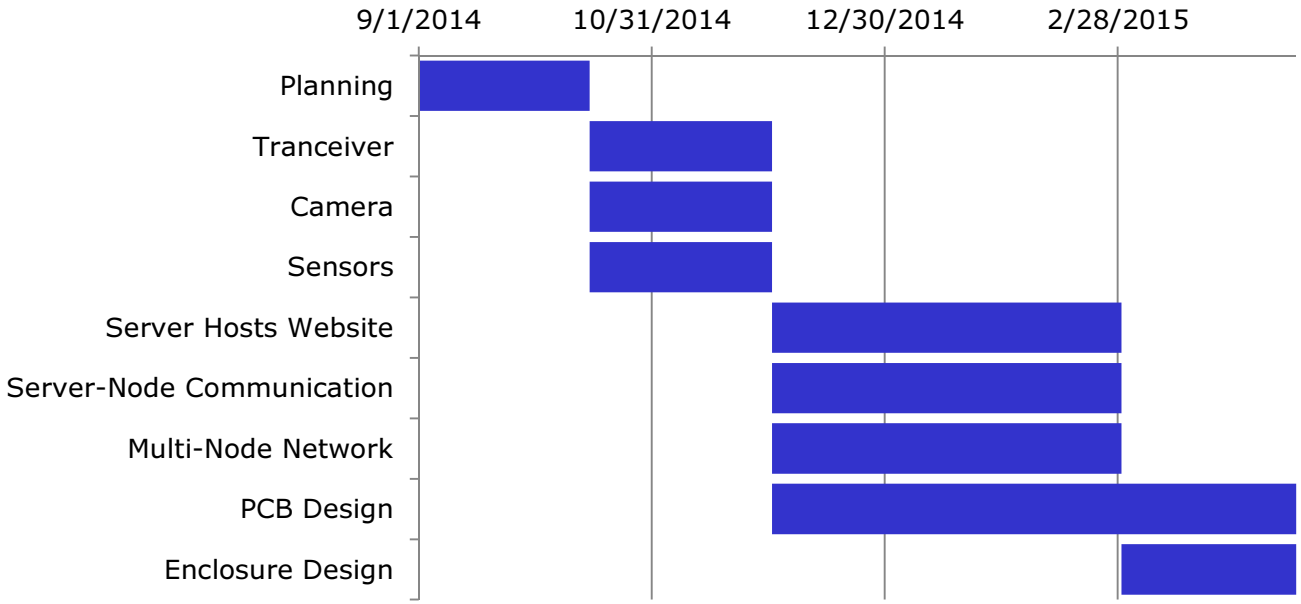
The estimated power consumption for one node is 43.82mW. 3 D-Cell alkaline batteries (15000mAh) could theoretically power a node for 64 days if no pictures are taken.

Estimated Cost

Component	Unit Price	Other info
PIC32MX170F256B	$3.10	>100 quantity from Mouser
HopeRF RFM23BP	$8.80	From Anarduino
Mini TTL Serial Camera	$28.76	>100 quiantity from Adafruit
Parallax PIR Sensor	$9.34	>5 quantity from Mouser
MaxDetect RHT03	$7.96	>100 quantity from Sparkfun
Total (per node)	$57.96	

If at least 100 nodes are produced using the components used in today's demonstration, the cost per node would be $57.96. This does not include the cost of passive components, the PCB, and the enclosure.

Gantt Chart


9/1/2014
10/31/2014
12/30/2014
2/28/2015
Planning
Tranceiver
Camera
Sensors
Server Hosts Website
Server-Node Communication
Multi-Node Network
PCB Design
Enclosure Design

Future Work

- Server (host website, communicate with nodes)
  - Use Intel Atom board
  - Alan will do this part.
- PCB design (for nodes and server)
  - Andrew will do this part
- Networking multiple nodes
  - Designing routing protocols: congestion avoidance
  - Node addressing: can use only 8 bits as opposed to the 32/64 bits in the IP
  - Ping will do this part
- Node scheduling (sleep modes and interrupts)
  - Conserve power without sacrificing functionality
  - Ping will do this part

Questions?

References

"Humidity and Temperature Sensor - RHT03." *Sparkfun*. N.p., n.d. Web 30 Nov. 2014.

"Miniature TTL Serial JPEG Camera with NTSC Video." *Adafruit Industries*. N.p., n.d. Web. 14 Oct. 2014.

"PIC32MX170F256B-I/SP." *Mouser Electronics*. N.p., n.d. Web. 14 Oct. 2014.

"RFM23BP - 915 Mhz FSK High Power Transceiver." *Anarduino*. N.p., n.d. Web. 14 Oct. 2014.