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Smart Campus Energy Laboratory

Team Bumblebee Final Presentation

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Overview

- Background and Motivation
- Project Goal
- Block Diagram
- Problems we Encountered
- Final Status
- Remaining Problems
- Future improvements
- Questions



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Background and Motivation

The Bumblebee Weatherbox is a second generation communications module designed to relay meteorological data collected by the other weatherboxes. Its purpose is to increase the effective range of the weatherboxes.



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Project Goals

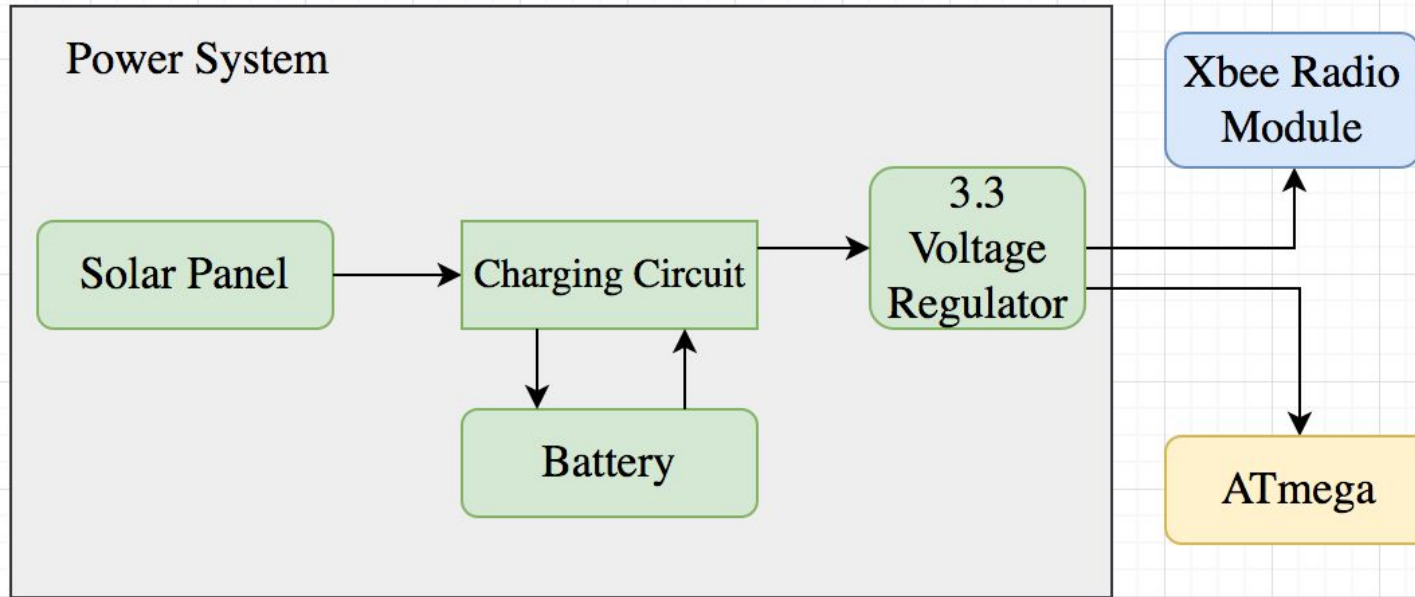
- Reimagine Ant to be compatible with Cranberry
- Design and fabricate a circuit board
- Do Xbee field tests
- Create a working relay module



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Block Diagram (Power)

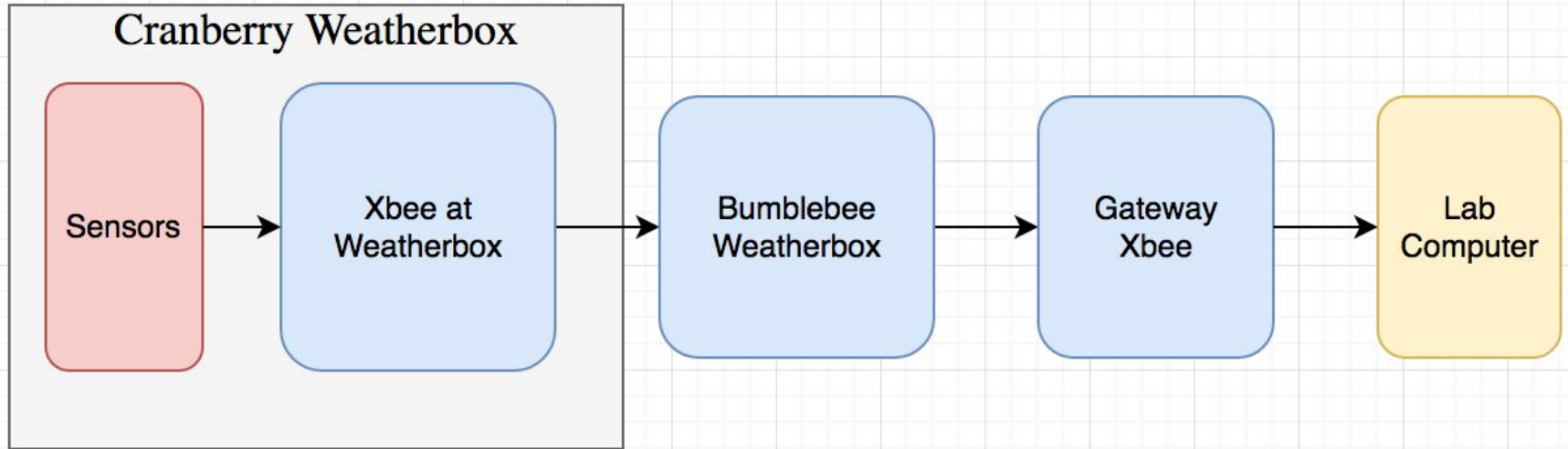




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Block Diagram (Signal/Communication)





Problems Encountered



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Problems

- Programming the atmega
- Using 3.3V
 - Wrong bootloader
 - Powering Xbee and atmega

Solutions

- Press the reset button while programming
- Reburned the bootloader
- Changed from using the LM3940 to LM1086 3.3V regulator



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Team Progress

- Got bare Arduino to work
 - Able to relay a packet
- Range Testing
 - Line of sight, non line of sight, floors
- Relaying test weatherbox packets to the gateway simulation



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Bill of Materials

Team Bumblebee's Bill of Materials

Part Name	Part Name/Vendor Number	Package Type	quantity	Unit cost	Total Cost
Xbee Breakout Board	BOB-08276	THRU	1	\$2.95	\$2.95
Microprocessor	ATMEGA328P-PU-ND	THRU	1	\$2.14	\$2.14
Xbee Pro S2B	602-1180-ND	THRU	1	\$29.00	\$29.00
Duck Antenna	730-1005-ND	EXT	1	\$10.50	\$10.50
Solar Panel	1525	EXT	1	\$59.00	\$59.00
Charging Chip	MCP73871-2CCI/ML-ND	SMD	1	\$1.84	\$1.84
Battery	3.7V 6600mAh / 353	EXT	1	\$29.50	\$29.50
LEDS	160-1415-1-ND	SMD	3	\$0.35	\$1.05
8 Mhz clock crystal	887-1263-1-ND	SMD	1	\$0.59	\$0.59
(sliding?) switch	401-2002-2-ND	SMD	1	\$0.26	\$0.26
3.3V regulator	LM1086	SMD	1	\$2.12	\$2.12
Passive Components	Various			\$30.00	\$30.00
				Total Parts Cost	\$138.95



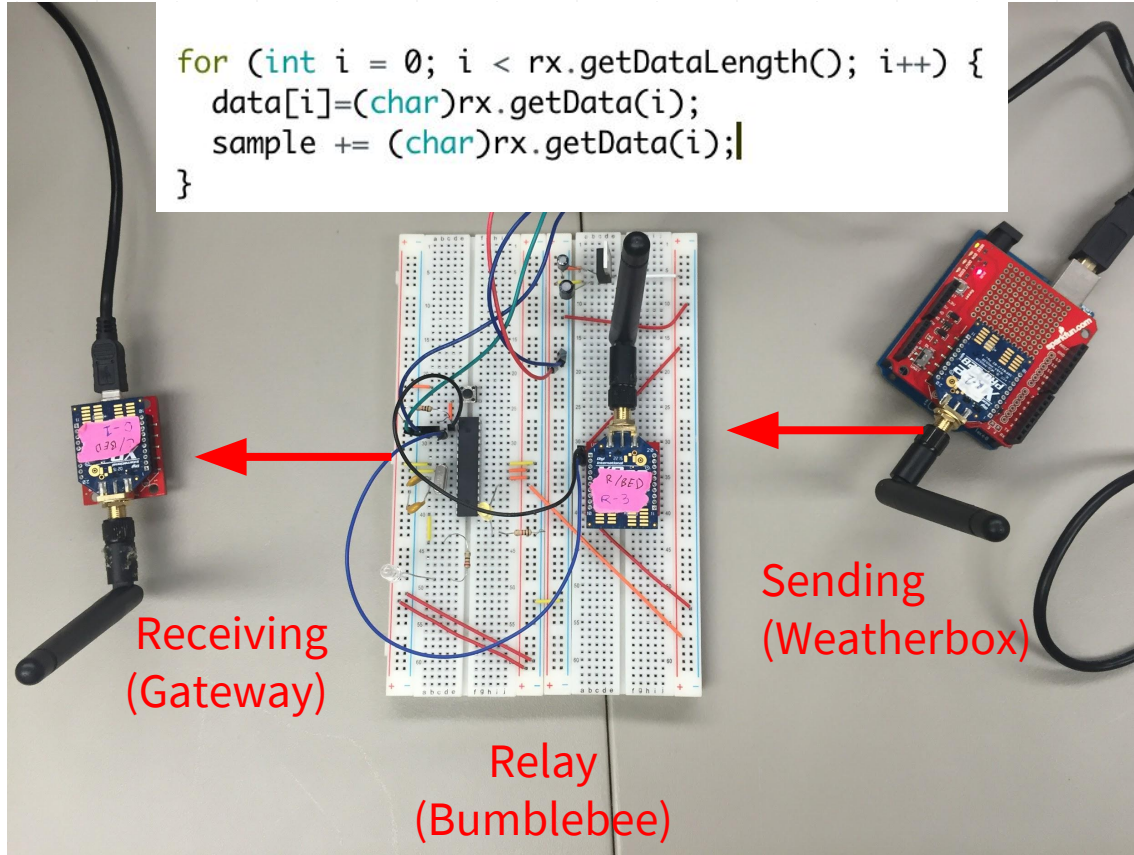
Relay Layout



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```
for (int i = 0; i < rx.getDataLength(); i++) {  
  data[i]=(char)rx.getData(i);  
  sample += (char)rx.getData(i);  
}
```



Receiving
(Gateway)

Relay
(Bumblebee)

Sending
(Weatherbox)



```
void loop() {
```

```
    struct ga_packet{  
        uint16_t schema = 1;  
        uint16_t node_addr = 1;  
        uint32_t uptime_ms = 1;  
        uint16_t batt_mv = 1;  
        uint16_t panel_mv = 1;  
        uint32_t bmp085_press_pa = 1;  
        int16_t bmp085_temp_decic = 1;  
        uint16_t humidity_centi_pct = 1;  
        uint16_t apogee_w_m2 = 1;  
    };
```

Gateway Simulation

```
apogee_w_m2: 0.25  
batt_mv: 1  
humidity_centi_pct: 1  
node_addr: 1  
panel_mv: 1  
press_pa: 1  
schema: 1  
temp_c: 1  
time_received: 2017-04-27 12:55:03.855483  
uptime_ms: 1
```

```
Checking Schema  
1:22  
apogee_w_m2: 0.25  
batt_mv: 1  
humidity_centi_pct: 1  
node_addr: 1  
panel_mv: 1  
press_pa: 1  
schema: 1  
temp_c: 1  
time_received: 2017-04-27 12:55:09.069993  
uptime_ms: 1
```



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Range Testing

Signal Strength					Packets						Other Variables:	Date
Distance (ft)	Local		Remote		Sent	Received	Tx Errors	Packets Lost	Percentage			
30	-40		-41		25	25	0	0	100%	Outside. Holmes hall 4th floor. Weather clear, windy. Not consistent sigr	4/4/17	
60	-46		-48		25	25	0	0	100%	Outside. Holmes hall 4th floor. Weather clear, windy. Line of sight	4/4/17	
90	-45		-50		25	25	0	0	100%	Outside. Holmes hall 4th floor. Weather clear, windy. Line of sight	4/4/17	
120	-51		-52		25	25	0	0	100%	Outside. Holmes hall 4th floor. Weather clear, windy. Line of sight	4/4/17	
150	-47		-50		25	25	0	0	100%	Outside. Holmes hall 4th floor. Weather clear, windy. Line of sight	4/4/17	
180	-60		-63		25	25	0	0	100%	Outside. Holmes hall 4th floor. Weather clear, windy. Line of sight	4/4/17	
210	-54		-58		25	24	0	1	96%	Outside. Holmes hall 4th floor. Weather clear, windy. Line of sight	4/4/17	
240	-65		-65		25	25	0	0	100%	Outside. Holmes hall 4th floor. Weather clear, windy. Line of sight	4/4/17	
270	-67		-71		25	25	0	0	100%	Outside. Holmes hall 4th floor. Weather clear, windy. Line of sight	4/4/17	
300	-68		-71		25	25	0	0	100%	Outside. Holmes hall 4th floor. Weather clear, windy. Line of sight	4/4/17	
330	-62		-65		25	25	0	0	100%	Outside. Holmes hall 4th floor. Weather clear, windy. Line of sight	4/4/17	
360	-65		-66		25	24	0	1	96%	Outside. Holmes hall 4th floor. Weather clear, windy. Line of sight	4/4/17	
390	-63		-65		25	25	0	0	100%	Outside. Holmes hall 4th floor. Weather clear, windy. Line of sight	4/4/17	
Signal Strength					Packets						Other Variables:	Date
Distance (ft)	Local (start)	Local (end)	Remote (start)	Reomote (end)	Sent	Received	Tx Errors	Packets Lost	Percentage			
72	-72	-76	-75	-69	25	18	1	6	72%	Not line sight. Through building	4/6/17	
151	-72	-66	-74	-69	25	13	0	12	52%			
253	-90	-91	-90	-92	25	8	17	0	32%			
332	-89	-89	-89	-89	25	2	23	0	8%			
404	0	0	0	0	25	0	25	0	0%			
Distance (ft)	Local (start)	Local (end)	Remote (start)	Reomote (end)	Sent	Received	Tx Errors	Packets Lost	Percentage	Other Variables:	Date	
64	-45	-58	-46	-60	25	25	0	0	100%	Through foliage (by IEEE)		
Distance (ft)	Local (start)	Local (end)	Remote (start)	Reomote (end)	Sent	Received	Tx Errors	Packets Lost	Percentage	Other Variables:	Date	
14	-61	-68	-63	-69	25	25	0	0	100%	4th to 3rd floor		
28	-75	-77	-76	-78	25	25	0	0	100%	4th to 2nd floor		
56	-76	-63	-77	-66	25	25	0	0	100%	4th to ground floor		

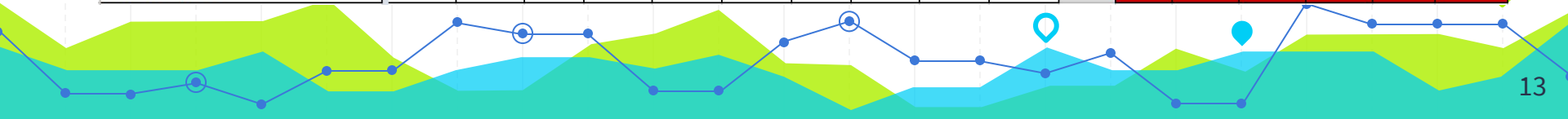


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Updated Gantt Chart

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	Jan-21	Jan-28	Feb-4	Feb-11	Feb-18	Feb-25	Mar-4	Mar-11	Mar-18	Mar-25	Apr-1	Apr-8	Apr-15	Apr-22	Apr-29	May-6	May-13
Xbee Testing																	
Distance																	
Weather																	
Networking																	
PCB Design																	
Schematic																	
Board Layout																	
Review																	
Fabrication/Assembly																	
Fabrication Time																	
Populating																	
Testing																	
Final Report																	





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Final Status

Relay Module

- Able to relay weatherbox test packets
 - Using the gateway simulator
- Working on bare arduino
- No schematic

Xbee Range Testing

- Different weather conditions
- Long range testing
-



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What Needs to Be Finished

- More range testing
 - Distance
 - Weather
 - Obstacles (buildings/walls)
- Designing PCB
- Weatherbox network



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Future Improvements

- Use the 8Mhz internal clock of the ATmega
- Add a programming switch
- Add more debugging LEDs
- Not use the reset button when programming



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QUESTIONS?

