Commuter Tracking Sensor Network

Weekly Report - October 26th, 2014

Team Members:

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Project Website:

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Updated Milestone Chart

Milestone	Team Member in Charge	Modified Completion Date	Original Completion Date	Comments
1. Contact Monroe County Discuss deployment options for sensor nodes.	Jared	10/28/2014	10/27/2014	Not a priority until we complete more of the technical requirements.
2. Networking Architecture Configuration and Testing		10/13/2014	6/15/2014	
2.1 Configure XBees for DigiMesh and have them communicating in close proximity	Seth, Jared	10/16/2014	6/1/2014	Done for now. Some additional configuration changes might need to be updated as more testing is done.
2.2 Range Test	Seth, Jared	10/29/2014	6/9/2014	Outdoor testing was pushed back a few days due to rain. We don't want our electronics to get wet. However an indoor test was conducted between RIT and Seth's apartment 4 miles away. Unsurprisingly, 4 miles is a tad too far for the XBees to communicate with each other,
2.3 Small-scale trail deployment	Seth, Jared	11/1/2014	6/15/2014	Dependent on 2.1 and 2.2 and 5.2
3. Windbelt power module design		10/2/2014	6/18/2014	

3.1 Breadboard prototyping	Alex, Jared	11/1/2014	6/1/2014	Battery management is now working to spec. Next step is power with a Windbelt source, and observe effects. Then attach a battery to the converter and test charge and discharge rates. TI Design Competition entry is complete. Waiting on TI rep to accept the registration so that we can order EVMs for the secondary boost and buck converters. Configuration on the EVMs is such that we can establish proof of concept without having to make permanent modifications to the boards, so the EVM approach was chosen since it will cut development time by a significant amount. There is still some concern as to whether the secondary boost converter will work for our application, as it is specced to put out smaller amounts of current than needed.
3.2 PCB design	Alex	11/5/2014	6/10/2014	Implementation issues with the BQ device coupled with waiting on TI for confirmation has made this push back a bit. Once we can confirm that the EVMs produce adequate values at the output for current, this can be completed. In the meantime, Alex can complete the portion of the schematic and layout that deal with the battery management system.
3.3 Ship design for stamping	Alex	11/5/2014	6/18/2014	3.2 Must be completed first

3.4 Spice Transient Analysis	Alex, Jared	10/20/2014	9/22/2014	COMPLETE Transient analysis is complete for both the buck and secondary boost converter. Levels are attainable for both the 6-10V unregulated (Pixy) and 3-3.3V regulated (XBee) ranges per transient simulations produced by TI's WEBDESIGN application.
4. Windbelt power module construction and testing		10/22/2014	6/30/2014	
4.1 Solder on components	Alex	11/21/2014	6/29/2014	These got pushed back since they require a 2 week shipment turnaround time. 3.3 Must be completed first.
4.2 Continuity tests	Alex	11/24/2014	6/30/2014	These got pushed back since they require a 2 week shipment turnaround time. Will probably need just the weekend to test this.
5. Server/Gateway setup	Seth	10/10/2014	7/1/2014	The server is a Raspberry Pi located at ctsn.student.rit.edu.
5.1 Install software (Django, Apache, etc.)	Seth	6/21/2014	6/17/2014	COMPLETE Apache, Django, MariaDB are installed and ready to go.
5.2 Interface XBee with Pi	Seth	10/31/2014	7/1/2014	In Progress. Due to unforeseen circumstances, this had to be pushed back. The XBees are able to receive messages from each other, and are able to transmit to all other XBees on the network. However, they can not as of yet transmit to a specific XBee. The XBees addresses can not be changed, and some of the addresses happen to have the "new packet" character in their

				address. Therefore while processing the packet, it will prematurely think there's a new packet coming across the Uart. The fix is to use escape characters, but this hasn't been started yet.
5.3 Install and configure fail2ban	Seth	9/1/2014	6/21/2014	COMPLETE
6. Server/Gateway testing		10/12/2014	7/1/2014	COMPLETE
6.1 Disable root login test	Seth	6/21/2014	6/16/2014	COMPLETE Done automatically when Raspbian was updated
6.2 Set the SSH port to a non-standard port test	Seth	6/21/2014	6/17/2014	COMPLETE SSH Port is set to 1315, not the default port of 22
6.3 Disable password login test - must log in with SSH key	Alex, Jared, Seth	9/5/2014	6/21/2014	COMPLETE SSH Keys are required to login to the server via SSH
6.4 White Hat Hacker Test	Seth	10/12/2014	6/21/2014	COMPLETE. They could not access the server via ssh, get a root shell, or access the database directly. Jared (security major) will be providing a formal report of the pen test results. We will be able to fortify security based on the results.
6.5 Ping disabled test	Seth, Security Majors	10/31/2014	6/21/2014	DEFERRED While the server is on the RIT campus, this is completed since outsiders can not ping rit.edu. If the server moves of campus for whatever reason, this will need to be revisited

7. Sensor hardware testing and integration		10/31/2014	7/11/2014	
7.1 Begin playing with Pixy Cam in USB tethered mode	Jared, Alex, Seth	7/11/2014	5/1/2014	COMPLETE We've all experimented and interfaced with the PixyCam now, and familiarized ourselves with its basic operation.
7.2 Interface Pixy Cam with an XBee	Jared, Alex	10/31/2014	6/22/2014	Antennas are in. Dependent on 2.2.
7.3 Integrate with existing power module	Jared, Alex	11/7/2014	7/11/2014	Will be done upon completion of 3.1. Pushed back due to power module dependency, and implementation issues/ordering wait time for power modules.
8. Sensor Enclosure Design / Testing		10/31/2014	8/7/2014	
8.1 Use CAD tools to design sensor enclosure	Jared	10/31/2014	7/1/2014	This is no longer blocked. This process can continue taking into account the largest board size available through the evaluation version of EAGLE. Jared currently working on CV, which is higher priority task.
8.2 Use 3D printer to print the enclosures	Jared	11/3/2014	7/15/2014	8.1 Must be done first
8.3 Test (See Gantt Chart)	Jared	11/5/2014	8/7/2014	Dependent on 8.2
9. Windbelt Testing (See Gantt Chart)	Alex	11/5/2014	5/27/2014	BQ device is to be connected to windbelt and tested for output levels and consistency. Further testing will involve connecting a battery and testing charge and discharge rates along with outdoor testing with natural wind sources.

10. Sensor Software - Identify targets		10/24/2014	9/1/2014	
10.1 Code Review for Pixy Software	Alex, Seth, Jared	9/8/2014	9/8/2014	COMPLETE Code review was completed. Information was documented regarding each file's contents.
10.2 Compile GCC version of Pixy software and note differences			9/8/2014	No longer a requirement. Keil will work just fine.
10.3 Train camera for identifying walkers, bikers, and horses	Jared	10/31/2014	8/1/2014	After creating a Visual Studio Project so parsing through the Pixy Firmware code is easier, we found the spot where the code is to be plugged in. The best part is we can plug in multiple algorithms and select which one we want to run, therefore allowing us to test multiple algorithms. The one we are leaning towards right now is the FREAK algorithm.
10.4 Train camera to figure out what direction the target is going	Jared	10/31/2014	9/1/2014	10.3 and 10.4 are not dependent on one another. These two tasks should be completed in parallel.
11. Database Creation		9/23/2014	9/14/2014	
11.1 Create mysql or mariadb database so data from trail can be saved to it	Seth	10/31/2014	9/5/2014	The rest of this can be completed in parallel with the CV algorihms. Need to know what data needs to be saved to the database resultant of the CV algorithms.
12. Website Creation		9/26/2014	9/28/2014	Front end is complete, but there may need to be some work done on the backend down-the-road

				when nodes need to send data to the database
12.1 Create status webpage, hosted somewhere else	Seth	9/5/2014	9/5/2014	COMPLETE Status webpage that pings the gateway is functional. Its currently hosted on one of Seth's pis, located at http://people.rit.edu/~srh7240/ctsn_status .
12.2 Create web front end	Seth, Alex	10/31/2014	9/14/2014	Front end is COMPLETE. Data results from the CV algorithms must be identified and linked to the database to render on the webpage.
12.3 Link website to database	Seth	10/31/2014	9/21/2014	Done for now. There will need to be some work done once the nodes need to save data to the database.
13. Website Testing (See Gantt Chart)	Team	10/12/2014	10/4/2014	COMPLETE. Jared (security major) will be providing a formal report of the pen test results. We will be able to fortify security based on the results.
14. Target Data Communication		10/28/2014	10/5/2014	
14.1 Sensors communicate target data with each other	Seth, Alex		10/4/2014	Dependent on 7.2
14.2 Sensors can communicate and write target data to database	Seth	11/7/2014	10/5/2014	Dependent on 7.2
15. Computer Vision Testing (See Gantt Chart)	Alex, Seth	11/1/2014	10/28/2014	Dependent on 10.3 and 10.4
16. Deployment		11/17/2014	11/9/2014	

16.1 Deploy nodes on trail	Team	11/17/2014	11/5/2014	
16.2 Activate website	Team	9/27/2014	11/9/2014	Complete. Website is located at http://ctsn.student.rit.edu:1415 (login required)
17.Integration Testing		11/13/2014		
17.1 Advanced II integration testing with focus on single node in controlled environment	Team	11/5/2014		Some of the integration testing will need to be completed with the prototype in place due to time constraints.
17.2 Advanced II integration testing with focus on single node in an outdoor environment	Team	11/10/2014		Some of the integration testing will need to be completed with the prototype in place due to time constraints.
17.3 Advanced II testing with focus on operation in outdoor environment for multiple nodes	Team	11/13/2014		Some of the integration testing will need to be completed with the prototype in place due to time constraints.

Current Milestones

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2.2 Range Test	Seth, Jared	10/29/2014	6/9/2014	Outdoor testing was pushed back a few days due to rain. We don't want our electronics to get wet. However an indoor test was conducted between RIT and Seth's apartment 4 miles away. Unsupringly, 4 miles is a tad too far for the XBees to communicate with each other,
3.1 Breadboard prototyping	Alex, Jared	11/1/2014	6/1/2014	Battery management is now working to spec. Next step is power with a Windbelt source, and observe effects. Then attach a battery to the converter and test charge and discharge rates. TI Design Competition entry is complete. Waiting on TI rep to accept the registration so that we can order EVMs for the secondary boost and buck converters. Configuration on the EVMs is such that we can establish proof of concept without having to make permanent modifications to the boards, so the EVM approach was chosen since it will cut development time by a

				significant amount. There is still some concern as to whether the secondary boos converter will work for our application, as it is specced to put out smaller amounts o current than needed.
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5.2 Interface XBee with Pi	Seth	10/31/2014	7/1/2014	In Progress. Due to unforseen circumstances, this had to be pushed back. The XBees are able to receive messages from each other, and are able to transmit to all other XBees on the network. However, they can not as of yet transmit to a specific XBee. The XBees addresses can not be changed, and some of the addresses happen to have the "new packet" character in their address. Therefore while processing the packet, it will prematurely

				think there's a new packet coming across the Uart. The fix is to use escape characters, but this hasn't been started yet.
10.3 Train camera for identifying walkers, bikers, and horses	Jared	10/31/2014	8/1/2014	After creating a Visual Studio Project so parsing through the Pixy Firmware code is easier, we found the spot where the code is to be plugged in. The best part is we can plug in multiple algorithms and select which one we want to run, therefore allowing us to test multiple algorithms. The one we are leaninng towards right now is the FREAK algorithmn.
10.4 Train camera to figure out what direction the target is going	Jared	10/31/2014	9/1/2014	10.3 and 10.4 are not dependent on one another. These two tasks should be completed in parallel.

Next Milestones

Milestone	Team Member in Charge	Modified Completion Date	Original Completion Date	Comments
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2.3 Small-scale trail deployment	Seth, Jared	11/1/2014	6/15/2014	Dependent on 2.1 and 2.2 and 5.2
3.1 Breadboard prototyping	Alex, Jared	11/1/2014	6/1/2014	Battery management is now working to spec. Next step is power with a Windbelt source, and observe effects. Then attach a battery to the converter and test charge and discharge rates. TI Design Competition entry is complete. Waiting on TI rep to accept the registration so that we can order EVMs for the secondary boost and buck converters. Configuration on the EVMs is such that we can establish proof of concept without having to make permanent

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9. Windbelt Testing (See Gantt Chart)	Alex	11/5/2014	5/27/2014	BQ device is to be connected to windbelt and tested for output levels and consistency. Further testing will involve connecting a battery and testing charge and discharge rates along with outdoor testing with natural wind sources.
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10.4 Train camera to figure out what direction the target is going	Jared	10/31/2014	9/1/2014	10.3 and 10.4 are not dependent on one another. These two tasks should be completed in parallel.

Status

Difficulties

The battery management device required that one of the pins attached to ground be connected to signal ground versus a general ground like the rest of the chip. Once this problem was isolated, the fix was simple. The input source was isolated from the rest of the circuit, and a line from its ground was connected to the pin as required.

Surprises

The XBee's address can not be changed. Although this is not a roadblock, it does slow progress down. Some of the XBee's have the start character of a packet (0x7E) in their address. This means that while parsing through the packet, its possible to mistake an address number with a new packet. There is a workaround to do this by adding escape characters, but this will push the completion of the XBees back a few days.

Successes

The battery management boost converter is working per specifications provided from the transient analysis simulation in Spice. It is providing $4.1V_{DC}$ at the output of the boost converter and at the battery's positive terminal for a V_{IN} as low at $550mV_{RMS}$ of pulsating DC. The overvoltage and undervoltage thresholds limit the voltage levels to a little over 4.1V for both pins, regardless of what voltage is at the input. When the voltage limit is undershot, MPPT works to drive the voltage up to an acceptable limit based on what input is being sampled at the V_{samp} pin.

The XBees can now transmit and receive packets. However, they can only transmit packets to all XBees on the network, not to a specific address. Packet parsing with escape characters needs to be completed first before the XBees can transmit to a specific address.

After creating a Visual Studio project for the Pixy Cam firmware, the code was considerably easier to parse through. The firmware acts like a state machine, and can run several "programs" or algorithms on it. Plugging in the CV algorithms should be relatively easy, we just need to write a new program. The FREAK algorithm seems like the best choice.

Open Questions and Concerns

There is still some concern as to whether the secondary boost converter will work for our application, as it is specced to put out smaller amounts of current than needed, but the TI web-based design simulation app provided transient analysis data that says otherwise.

Alex will try as hard as he can to get the custom PCB implemented before demonstration. This will most likely be completed for just the BQ25504 portion of the system, and any peripherals that may need a connection to power, which is still considered less than ideal. All efforts will be made to stick to original plans.

Gantt Chart

	Name	% Complete	Finish
1	**Commuter Tracking Sensor Network Project**	**62%**	**11/25/2014**
2	**Contact Monroe County**	**0%**	**10/28/2014**
3	Discuss deployment options for sensor r	0%	10/28/2014
4	**Networking Architecture Configuration and**	**53%**	**10/31/2014**
5	Configure XBees for DigiMesh and have	100%	10/16/2014
6	Range Test	10%	10/29/2014
7	Small-scale trail deployment	0%	10/31/2014
8	**Windibelt power module design**	**74%**	**11/05/2014**
9	Breadboard prototyping	60%	10/31/2014
10	PCB design	50%	11/05/2014
11	Ship design for stamping	20%	11/05/2014
12	Spice Transient Analysis	100%	10/20/2014
13	**Windbelt power module construction and t**	**0%**	**11/24/2014**
14	Solder on components	0%	11/21/2014
15	Continuity tests	0%	11/24/2014
16	**Server/Gateway setup**	**90%**	**10/31/2014**
17	Install software (Django, Apache, etc.)	100%	06/17/2014
18	Interface XBee with Pi	85%	10/31/2014
19	Install and configure fail2ban	100%	09/01/2014
20	**Server/Gateway testing**	**100%**	**10/31/2014**
21	Disable root login test	100%	06/16/2014
22	Set the SSH port to a non-standard port t	100%	06/17/2014
23	Disable password login test - must login	100%	06/18/2014
24	Ping disabled test - looking into other op	100%	10/31/2014
25	White Hat Hacker Test	100%	10/13/2014
26	**Sensor Hardware testing and integration**	**27%**	**11/07/2014**
27	Begin playing with Pixy cam in USB tethe	100%	09/15/2014
28	Interface Pixy Cam with an XBee	20%	11/06/2014
29	Integrate with existing power module	5%	11/07/2014
30	**Sensor Enclosure Design / Testing**	**60%**	**11/07/2014**
31	Use cad tools to design sensor enclosu	75%	10/31/2014
32	Use 3D printer to etch out enclosure	0%	11/03/2014
33	Temperature test	0%	11/04/2014
34	Rain Test	0%	11/05/2014
35	Execute drop test	0%	11/06/2014
36	Fire test	0%	11/07/2014
37	**Windbelt Testing**	**69%**	**11/12/2014**
38	Early testing with focus on size	100%	09/05/2014
39	Early testing with focus on maximizing cu	100%	09/08/2014
40	Early testing with focus on maxmizing cu	100%	09/09/2014
41	Intermediate I testing with focus on smo	100%	09/24/2014
42	Intermediate II testing with focus on prov	100%	11/03/2014
43	Intermediate II testing with focus on batte	50%	11/04/2014
44	Intermediate II testing with focus on safe	0%	11/05/2014
45	Intermediate II testing with focus on provi	0%	11/06/2014
46	Advanced I testing with focus on duration	0%	11/07/2014
47	Advanced I testing with MPPT enabled fo	0%	11/10/2014
48	Advanced I testing with boost converter c	0%	11/11/2014
49	Advanced II testing with focus on configu	0%	11/12/2014
50	**Integration Testing**	**0%**	**11/21/2014**
51	Advanced II integration testing with focus	0%	11/13/2014
52	Advanced II integration testing with focus	0%	11/18/2014
53	Advanced II testing with focus on operati	0%	11/21/2014
54	**Sensor Software - Identify Targets**	**40%**	**10/31/2014**
55	Code review for Pixy software	100%	09/08/2014
56	Train camera for identifying walkers, bike	25%	10/31/2014
57	Train camera to figure out what direction	25%	10/31/2014
58	**Database Creation**	**90%**	**10/31/2014**
59	Create mysql or mariadb database so d	90%	10/31/2014
60	**Website Creation**	**100%**	**10/31/2014**
61	Create front end	100%	10/31/2014
62	Link to database	100%	10/31/2014
63	Create status webpage, hosted somewh	100%	09/05/2014
64	**Website Testing**	**100%**	**11/04/2014**
65	Sanitation Test	100%	11/04/2014
66	Password Protection Test	100%	11/04/2014
67	User Login Test	100%	11/04/2014
68	White-hat hacker test	100%	11/04/2014
69	**Target Data Communication**	**0%**	**11/07/2014**
70	Sensors communciate target data with e	0%	11/07/2014
71	Sensors can communicate and write dat	0%	11/07/2014
72	**Computer Vision Testing**	**0%**	**11/12/2014**
73	Early - Image Sensor Component Testin	0%	11/03/2014
74	Early - Image Sensor Component Testin	0%	11/03/2014
75	Intermediate - Infrared Component Testi	0%	11/04/2014
76	Intermediate - CV Algorithm Component	0%	11/04/2014
77	Intermediate - CV Algorithm Component	0%	11/05/2014
78	Advanced- CV Algorithm Component Tes	0%	11/06/2014
79	Advanced - CV Algorithm and Infrared Int	0%	11/07/2014
80	Advanced - Computer Vision and Networ	0%	11/10/2014
81	Advanced - Computer Vision and Power	0%	11/11/2014
82	Advanced - Computer Vision Acceptance	0%	11/12/2014
83	**Deployment**	**33%**	**11/25/2014**