Commuter Tracking Sensor Network

Weekly Report - November 16, 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	11/25/2014	10/27/2014	Pushed back. Not a priority at this time.
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	11/17/2014	6/9/2014	Will be completed Monday or Wednesday. Snowed out, and pushed back.
2.3 Small-scale trail deployment	Seth, Jared	11/19/2014	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	11/21/2014	6/1/2014	Breadboard prototyping is almost complete. A secondary boost converter has been identified that will meet our power needs for the CMUCam (TPS61032EVM-208). The EVM has been ordered for prototyping, and should arrive within the week. The due date has been adjusted to allow for shipping and test time. The boost converter in series with the buck-converter is now adequately supporting a 222mA load. Stress tests also show that it can handle a sequence of 1000 Tx bursts separated in 10 minute intervals. Equivalent load resistance has been added in parallel with the radio to simulate the CMUCam.

3.2 PCB design	Alex	11/26/2014	6/10/2014	COMPLETE (for now). Jeff Lonneville in SIMS has agreed to assist with the PCB reflow soldering through use of RIT facilities. He will be returning from a trip to Washington the week of the 23rd, and will be able to assist either Monday or Tuesday of that week. In the meantime, the 3x PCBs are scheduled to arrive on the 18th, and all SMT parts have been ordered.
3.3 Ship design for stamping	Alex	11/5/2014	6/18/2014	COMPLETE First iteration of design is ordered. Parts for the board are known, and will be ordered within the weekend. Future iterations of design will merge the EVM functionality to the custom design.
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	11/26/2014	6/29/2014	Components are ordered and the custom PCB is in arrival.
4.2 Continuity tests	Alex	11/26/2014	6/30/2014	Dependent on 4.1.
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	COMPLETE Are able to Tx and Rx with the XBees between two pis.
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 off 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	Seth	11/14/2014	6/22/2014	Now that the "algorithm" is figured out after doing 5.2, this shouldn't take too long to plug into the Pixy Cam's firmware

7.3 Integrate with existing power module	Jared, Alex	11/21/2014	7/11/2014	Secondary boost converter will be in this week, and will most likely work when plugged in, allowing for completion of this task.
8. Sensor Enclosure Design / Testing		11/14/2014	8/7/2014	
8.1 Use CAD tools to design sensor enclosure	Jared	11/21/2014	7/1/2014	Pushed back due to prioritizing of tasks. CV algorithm is taking precedence, but printing of enclosure should be complete by end of week per Jared.
8.2 Use 3D printer to print the enclosures	Jared	11/21/2014	7/15/2014	8.1 Must be done first
8.3 Test (See Gantt Chart)	Jared	11/25/2014	8/7/2014	Dependent on 8.2
9. Windbelt Testing (See Gantt Chart)	Alex	11/21/2014	5/27/2014	This is almost complete. The only thing that remains is to test both the secondary boost and buck converters with a load attached with and without the sustainable source and the battery connected.
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	11/24/2014	8/1/2014	The PixyCam does not currently have enough on-board memory to store the CV program, and manipulate incoming data. To remedy this, raw data will be sent through the network to the main hub, and then offloaded to a connected desktop computer where the CV algorithm will be performed. In this manner, we will be able to utilize the OS for certain CV dependencies rather than attempting to circumvent these dependencies.

10.4 Train camera to figure out what direction the target is going	Jared	11/24/2014	9/1/2014	The PixyCam does not currently have enough on-board memory to store the CV program, and manipulate incoming data. To remedy this, raw data will be sent through the network to the main hub, and then offloaded to a connected desktop computer where the CV algorithm will be performed. In this manner, we will be able to utilize the OS for certain CV dependencies rather than attempting to circumvent these dependencies.
11. Database Creation		9/23/2014	9/14/2014	COMPLETE
11.1 Create mysql or mariadb database so data from trail can be saved to it	Seth	11/5/2014	9/5/2014	COMPLETE
12. Website Creation		9/26/2014	9/28/2014	COMPLETE. Final website is located at https://ctsn.student.rit.edu
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	11/5/2014	9/21/2014	COMPLETE Website now no longer uses hardcoded values to display results.
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		11/21/2014	10/5/2014	
14.1 Sensors communicate target data with each other	Seth, Alex	11/21/2014	10/4/2014	Dependent on 7.2
14.2 Sensors can communicate and write target data to database	Seth	11/21/2014	10/5/2014	Gateway side is done. Only need to do the Pixy Cam side.
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	12/2/2014	11/5/2014	Adjusted to meet new hard deadline of the Tuesday after Thanksgiving break.
16.2 Activate website	Team	9/27/2014	11/9/2014	Complete. Website is located at http://ctsn.student.rit.edu (login required)
17.Integration Testing		11/13/2014		
17.1 Advanced II integration testing with focus on single node in controlled environment	Team	11/21/2014		Some of the integration testing will need to be completed with the prototype in place due to time constraints. Date adjusted due to change in prototyping timeframe.
17.2 Advanced II integration testing with focus on single node in an outdoor environment	Team	11/24/2014		Some of the integration testing will need to be completed with the prototype in place due to time constraints. Date adjusted due to change in prototyping timeframe.
17.3 Advanced II testing with focus on operation in outdoor environment for multiple nodes	Team	11/25/2014		Some of the integration testing will need to be completed with the prototype in place due to time constraints. Date adjusted due to change in prototyping timeframe.

Current Milestones

Milestone	Team Member in Charge	Modified Completion Date	Original Completion Date	Comments
3.1 Breadboard prototyping	Alex, Jared	11/21/2014	6/1/2014	Breadboard prototyping is almost complete. A secondary boost converter has been identified that will meet our power needs for the CMUCam (TPS61032EVM-208). The EVM has been ordered for prototyping, and should arrive within the week. The due date has been adjusted to allow for shipping and test time. The boost converter in series with the buck-converter is now adequately supporting a 222mA load. Stress tests also show that it can handle a sequence of 1000 Tx bursts separated in 10 minute intervals. Equivalent load resistance has been added in parallel with the radio to simulate the CMUCam.

10.3 Train camera for identifying walkers, bikers, and horses	Jared	11/24/2014	8/1/2014	The PixyCam does not currently have enough on-board memory to store the CV program, and manipulate incoming data. To remedy this, raw data will be sent through the network to the main hub, and then offloaded to a connected desktop computer where the CV algorithm will be performed. In this manner, we will be able to utilize the OS for certain CV dependencies rather than attempting to circumvent these dependencies.
10.4 Train camera to figure out what direction the target is going	Jared	11/24/2014	9/1/2014	The PixyCam does not currently have enough on-board memory to store the CV program, and manipulate incoming data. To remedy this, raw data will be sent through the network to the main hub, and then offloaded to a connected desktop computer where the CV algorithm will be performed. In this manner, we will be able to utilize the OS for certain CV dependencies rather than attempting to circumvent these dependencies.

Next Milestones

2.2 Range Test	Seth, Jared	11/17/2014	6/9/2014	Will be completed Monday or Wednesday. Snowed out, and pushed back.
2.3 Small-scale trail deployment	Seth, Jared	11/19/2014	6/15/2014	Dependent on 2.1 and 2.2 and 5.2
7.2 Interface Pixy Cam with an XBee	Seth	11/14/2014	6/22/2014	Now that the "algorithm" is figured out after doing 5.2, this shouldn't take too long to plug into the Pixy Cam's firmware
7.3 Integrate with existing power module	Jared, Alex	11/21/2014	7/11/2014	Secondary boost converter will be in this week, and will most likely work when plugged in, allowing for completion of this task.
10.3 Train camera for identifying walkers, bikers, and horses	Jared	11/24/2014	8/1/2014	The PixyCam does not currently have enough on-board memory to store the CV program, and manipulate incoming data. To remedy this, raw data will be sent through the network to the main hub, and then offloaded to a connected desktop computer where the CV algorithm will be performed. In this manner, we will be able to utilize the OS for certain CV dependencies rather than attempting to circumvent these dependencies.

10.4 Train camera to figure out what direction the target is going	Jared	11/24/2014	9/1/2014	The PixyCam does not currently have enough on-board memory to store the CV program, and manipulate incoming data. To remedy this, raw data will be sent through the network to the main hub, and then offloaded to a connected desktop computer where the CV algorithm will be performed. In this manner, we will be able to utilize the OS for certain CV dependencies rather than attempting to circumvent these dependencies.

Status

Difficulties

The waveform generators caused a difficulty with powering the battery management system properly. They have a ‘sweep’ mode which caused a bit of confusion related to proper chip configuration. Once this issue was sorted out, the BQ25504 was once again operating correctly.

The Pixy Cam does not have enough on-board memory for the CV algorithm we want to use. We have decided to change the plan from doing the CV on board to having the Pixy Cams send the images encrypted over the network to the Gateway Node. The Gateway Node will then send the image to a desktop on the same network which will do the processing for us. Privacy is still not an issue since the XBees are encrypted.

Surprises

The step-down converter has a connection for both load and a microcontroller. This may be useful in later stages of the project.

Successes

The step-down converter can handle a consistent 222 mA (18 ohm load). When the XBee is connected, it can transmit 1000 successive bursts over 10 minute intervals with about a 5% error rate.

Parts for the PCB have been ordered, and Jeff Lonneville has agreed to work Alex to solder them to the board. The board is due to arrive by the 18th, and the parts shortly thereafter. Jeff will be available to help solder the following week (the 24th), so there will be time for testing through break week.

The gateway node can now receive status updates from the trail nodes, and update the database accordingly. If a trail node does not notify the gateway node of its status within an hour, the gateway node will notify all admins that the node has an

unknown status. Meanwhile, if a node has a low battery, it can notify the gateway node, and the gateway node will notify the admins, and update the database as needed.

Open Questions and Concerns

None at this time.

Gantt Chart

	Name	% Complete	Finish
1	**⊟Commuter Tracking Sensor Network Project**	**65%**	**12/16/2014**
2	**⊟Contact Monroe County**	**0%**	**11/25/2014**
3	Discuss deployment options for sensor nodes	0%	11/25/2014
4	**⊟Networking Architecture Configuration and Testing**	**56%**	**11/19/2014**
5	Configure XBees for DigiMesh and have them communicating in close proximit	100%	10/16/2014
6	Range Test	50%	11/17/2014
7	Small-scale trail deployment	0%	11/19/2014
8	**⊟Windlbelt power module design**	**95%**	**11/21/2014**
9	Breadboard prototyping	85%	11/21/2014
10	PCB design	100%	11/12/2014
11	Ship design for stamping	100%	11/05/2014
12	Spice Transient Analysis	100%	10/20/2014
13	**⊟Windbelt power module construction and testing**	**7%**	**11/26/2014**
14	Solder on components	10%	11/26/2014
15	Continuity tests	0%	11/26/2014
16	**⊟Server/Gateway setup**	**100%**	**10/31/2014**
17	Install software (Django, Apache, etc.)	100%	06/17/2014
18	Interface XBee with Pi	100%	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 test	100%	06/17/2014
23	Disable password login test - must login with SHH key	100%	06/18/2014
24	Ping disabled test - looking into other options	100%	10/31/2014
25	White Hat Hacker Test	100%	10/13/2014
26	**⊟Sensor Hardware testing and integration**	**21%**	**11/25/2014**
27	Begin playing with Pixy cam in USB tethered mode	100%	09/15/2014
28	Interface Pixy Cam with an XBee	20%	11/25/2014
29	Integrate with existing power module	3%	11/21/2014
30	**⊟Sensor Enclosure Design / Testing**	**60%**	**11/28/2014**
31	Use cad tools to design sensor enclosure	75%	11/21/2014
32	Use 3D printer to etch out enclosure	0%	11/24/2014
33	Temperature test	0%	11/25/2014
34	Rain Test	0%	11/26/2014
35	Execute drop test	0%	11/27/2014
36	Fire test	0%	11/28/2014
37	**⊟Windbelt Testing**	**98%**	**12/03/2014**
38	Early testing with focus on size	100%	09/05/2014
39	Early testing with focus on maximizing current production for varied fan speeds	100%	09/08/2014
40	Early testing with focus on maxmizing current production for varied wind angles	100%	09/09/2014
41	Intermediate I testing with focus on smoothing levels for a half-wave rectifier	100%	09/24/2014
42	Intermediate II testing with focus on providing safe levels at the output of the bo	100%	11/24/2014
43	Intermediate II testing with focus on battery discharge time and voltage levels	100%	11/25/2014
44	Intermediate II testing with focus on safe output levels from voltage regulation c	90%	11/26/2014
45	Intermediate II testing with focus on providing safe voltage levels from seconda	100%	11/27/2014
46	Advanced I testing with focus on duration and level of charge on battery without	100%	11/28/2014
47	Advanced I testing with MPPT enabled for a solar energy application with focus	100%	12/01/2014
48	Advanced I testing with boost converter configured for MPPT with focus on safe	75%	12/02/2014
49	Advanced II testing with focus on configuring the boost converter for use with M(	100%	12/03/2014
50	**⊟Integration Testing**	**0%**	**12/12/2014**
51	Advanced II integration testing with focus on single node in controlled environm	0%	12/04/2014
52	Advanced II integration testing with focus on deploying a single node in an outd	0%	12/09/2014
53	Advanced II testing with focus on operation in outdoor environment for multiple	0%	12/12/2014
54	**⊟Sensor Software - Identify Targets**	**52%**	**11/24/2014**
55	Code review for Pixy software	100%	09/08/2014
56	Train camera for identifying walkers, bikers, and horses	40%	11/24/2014
57	Train camera to figure out what direction the target is going	40%	11/24/2014
58	**⊟Database Creation**	**90%**	**11/05/2014**
59	Create mysql or mariadb database so data from trail can be saved to it	90%	11/05/2014
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 somewhere else	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%**	**11/21/2014**
70	Sensors communciate target data with each other	0%	11/21/2014
71	Sensors can communicate and write data to database	0%	11/21/2014
72	**⊟Computer Vision Testing**	**0%**	**12/04/2014**
73	Early - Image Sensor Component Testing	0%	11/25/2014
74	Early - Image Sensor Component Testing	0%	11/25/2014
75	Intermediate - Infrared Component Testing	0%	11/26/2014
76	Intermediate - CV Algorithm Component Testing	0%	11/26/2014
77	Intermediate - CV Algorithm Component Testing	0%	11/27/2014
78	Advanced- CV Algorithm Component Testing	0%	11/28/2014
79	Advanced - CV Algorithm and Infrared Integration Testing	0%	12/01/2014
80	Advanced - Computer Vision and Networking System Integration	0%	12/02/2014
81	Advanced - Computer Vision and Power Management System Integration Testi	0%	12/03/2014
82	Advanced - Computer Vision Acceptance Testing	0%	12/04/2014
83	**⊟Deployment**	**33%**	**12/16/2014**
84	Deploy Nodes	0%	12/16/2014
85	Activate Website	100%	11/03/2014