1. Tetradores

Vanderbilt University

SNAP Technology in the Vanderbilt University NICU to increase operational efficiency and patient safety

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2. Abstract:

The importance of process efficiency in hospitals is overstated but often under researched. Vanderbilt's Neonatal Intensive Care Unit (NICU) houses 105 beds spread over a quarter of a mile and three stories of the medical campus. With this comes the need for excessive organization on part of the charge nurse to manage the movement of babies throughout the hospital. This is managed by two meetings per day to relay patient information to the five teams and to ensure the location of each patient is known. The later part can take up to thirty minutes causing safety and efficiency concerns. Ultimately, the purpose of this design scheme is the following:

- To install SNAP technology in the NICU in order to track the movement of babies and physicians between the NICU pods
- To develop a prototype design that will display the locations of patients in real-time and allow clinicians to make informed decisions about transferring patients
- To create a Systems Requirement Document detailing the functional and performance requirements for the large scale implementation of the display throughout the NICU.

Through the accomplishment of these goals, we will equip our partner, Synapse, with adequate information to develop our prototype into a working device and to aid the NICU in delivering the highest quality of care for patients.

3.1 Introduction:

As one of the largest neonatal intensive care units in the country, Vanderbilt NICU is experiencing difficulties maintaining premium levels of organization within the hospital. The 105 beds that make up the Vanderbilt NICU are spread across five teams and various pods in three different buildings. The current standard of care relies upon the memory and organization of the teams making coordinating activities and equipment difficult. The charge nurse and representatives of each team meet twice daily to coordinate activities and negotiate the location of the babies. Up to 30 minutes of each meeting is often spent just trying to determine the exact locations of certain babies, which is both a safety and efficiency concern. The purpose of this project is to integrate a system of SNAP sensors to track both babies and physicians throughout the network of pods throughout the Vanderbilt University Hospital campus as well as formulate a design to aid the clinician teams in making decisions about the movement and locations of the babies.

3.2 History and context:

Thus far, Synpase Wireless has developed SNAP technology sensors to collect real-time data on the locations of tagged objects. The SNAP technology uses IR to send out signals and the receiving tags send RF signals back to the sensors. This technology already has proven applications in healthcare, lighting, solar, and food services industries. Synapse is currently involved in projects in several other southeastern hospitals. They have had success in several asset tracking and optimization projects that help employees identify the current location of mobile medical equipment in the facility as soon as the equipment is needed. Our early customers are hospitals with a large number of patient beds. This market can then be expanded to any nursing unit to aid in inpatient capacity management.

3.3 Team

Our team members are Kristin Barth, Megan Madonna, Houston Massey, and Trenton Piepergerdes. This specific team was selected based on a dynamic set of skills. Since every team member has the same background in Biomedical Engineering, each team member was distinguished based upon his/her other skills such as communications, organization, leadership, and previous experience. Kristin Barth will serve as the Project Manager because of her experience taking classes such as Project Management for her Engineering Management Minor. She also interned at a healthcare IT company focusing on hospital efficiency, which gives her knowledge in this domain. Megan Madonna will serve as the Research and Development Correspondent because of her extensive research background in various laboratories throughout her college experience. This has equipped her with proficient programming abilities as well. Houston Massey will serve as the Recording Secretary because of his experience as a secretary for the Honor Council. His attention to detail is invaluable in keeping our team organized. Trenton Piepergerdes will serve as the Communications Lead because of his ability to communicate concisely to a varied audience. This will allow him to effectively communicate between the student group, hospital leaders, and Synapse employees. Our primary advisors are Kevin Orndorff, President of Healthcare at Synapse; Chip Bagwell, Software Engineer at Synapse; Dr. Dan France, Research Associate Professor of Anesthesiology and Medicine at Vanderbilt, Center for Research and Innovation in Systems Safety; and Dr. Peter Grubb, Associate Professor of Clinical Pediatrics at Vanderbilt, Medical Director at Stahlman NICU. Our secondary points of contact are Russ Dickerson, Hardware Engineer of Synapse; and Dr. William Walsh, Professor of Pediatrics and Chief of Nurseries at Vanderbilt.

3.4 Work plan and outcomes:

Using Synapse's SNAP technology, we hope to track the movement of babies and physicians from one pod to another. In order to capture this data, the sensors must first be installed and tuned to ensure that accurate and precise tracking occurs. Successful installation and data capture will prove that real time locating systems (RLTS) technology can be implemented into an environment with many moving parts, such as a hospital. With the data collected from the sensors, we will develop a prototype that will allow for this information to be available to physician and nurse teams so informed decisions can be made about transferring patients. This prototype and a Systems Requirement Document will be used to inform Synapse of the functional and performance requirements for the creation of a large-scale display for real-time tracking within the NICU. After the Senior Design competition, this project will be taken over by Synapse to implement the finished program into the hospital. The charge nurse will be able to physically manipulate the display in order to decide where a baby should be located and to convey this information visually during the planning period. Considering that the ideology behind these devices is not entirely novel, a distinction must be made between Synapse RTLS technology and RTLS technology of other competitive companies. Other existing companies which have developed similar RTLS technology include Ekahau, Aeroscout, TeleTracking, and Centrak. These companies are simply a sampling of many companies pursuing implementation of this technology, and specific companies such as Centrak and TeleTracking have already proven applications within hospital environments. Specific aspects of Synpase technology that differentiates them from their competition includes their installation of
LED lighting in conjunction with the installation of their tracking devices, which requires minimal infrastructure, increased energy savings, and increased hard dollar savings.

Furthermore, Synapse can install IR curtains to prevent cross-talk between signals and to resolve the signal to distinct locations.

Milestones

- Open website by November 4, 2014
- Schedule and interview selected nurses from the NICU by November 11, 2014
- Collect actual sensors and receivers by November 18, 2014
- Design test model for Vanderbilt NICU pod by November 25, 2014
-Implement test model into pod by December 2, 2014
- Collect some data, possibly even phantom data, before Christmas Break
- Implement all necessary sensors into the NICU by January 23, 2015
- Decide how the acquired data should be manipulated into usable information and make adjustments accordingly (i.e., iterate the design plan or programming code) by February 13, 2015
- Design a tracking display blueprint which can be directly connected to our data output by March 13, 2015
- Complete Systems Requirement Document with all necessary metrics for the display by April 10, 2015

ID	Task Mode	Task Name	Duration	Start	Finish
1		First Team Meeting	2 hrs	Thu 10/2/14	Thu 10/2/14
2		Email Sent to Sponsor	0.5 hrs	Thu 10/2/14	Thu 10/2/14
3		Review Needs Assessment	1 hr	Mon 10/13/14	Mon 10/13/14
4		Initial Meeting with Sponsor	2 hrs	Tue 10/14/14	Tue 10/14/14
5		Sponsor Meeting Prep	1 hr	Thu 10/23/14	Thu 10/23/14
6		Grant Proposal Writeup	2 hrs	Tue 10/28/14	Tue 10/28/14
7		NICU Tour	2.5 hrs	Thu 10/2/14	Thu 10/2/14
8		Grant Proposal Writeup	2 hrs	Wed 10/29/14	Wed 10/29/14
9		Grant Proposal Writeup	2 hrs	Thu 10/30/14	Thu 10/30/14
10		Launch Website	3 days	Sat 11/1/14	Tue 11/4/14
11		Schedule Interview with NICU nurses	6 days	Tue 11/4/14	Tue 11/11/14
12		Complete Citi Training	6 days	Tue 11/4/14	Tue 11/11/14
13		Ongoing NICU observation	104 days	Tue 11/11/14	Fri 4/3/15
14		Collect actual sensors and receivers	6 days	Tue 11/11/14	Tue 11/18/14
15		Design test model	6 days	Wed 11/19/14	Wed 11/26/14
16		Implement test model	6 days	Thu 11/27/14	Thu 12/4/14
17		Collect some data	10 days	Fri 12/5/14	Thu 12/18/14
18		Implement all sensors	31 days	Fri 12/19/14	Fri 1/30/15
19		Data analysis	16 days	Mon 2/2/15	Mon 2/23/15
20		Design display blueprint	21 days	Tue 2/24/15	Tue 3/24/15
21		Complete Systems Requirements Document	21 days	Wed 3/25/15	Wed 4/22/15
22		Prepare presentation	7 days	Thu 4/23/15	Fri 5/1/15

Figure 1: Gantt Chart

3.5 Evaluation and Sustainable Plan

The success of this project will be based on the quality and depth of the Systems Requirement Document needed to allow Synapse to create a large-scale display interface to accomplish the tracking and planning of movement within the NICU. The end-goal and final measure of success will be the significant decrease in length of planning meeting time required to identify the exact locations of each baby. This end-goal will come after the completion of the Senior Design project. Therefore, by Design Day, we will have all the functional and performance requirements in significant detail to allow Synapse to carry this project further. Our project will have met our goals if we have successfully implemented SNAP technology in the NICU to track the locations of babies and physicians, have developed a useful and informative prototype using this gathered data, and presented all requirements needed to move the prototype into a full-functioning display board of the NICU.

Appendices:

1. Budget:

Item	Price	Quantity	Subtotal	Justification
Sensepoint	$300	15	$4,500	Identifies zones for tracking, sends IR to tags
Smart Tag	$50	25	$1,250	Tracks locations and sends RF to Sensepoints
Tracking/Locarting SaaS	$33,000	1	$33,000	Data collection software/cost to run sensing system for 1 year
Travel	$900	2	$1,800	Two members of the team commute from Huntsville, AL to Nashville, TN for meetings
Total			40550	

2. Sketch of SNAP sensor, etc.

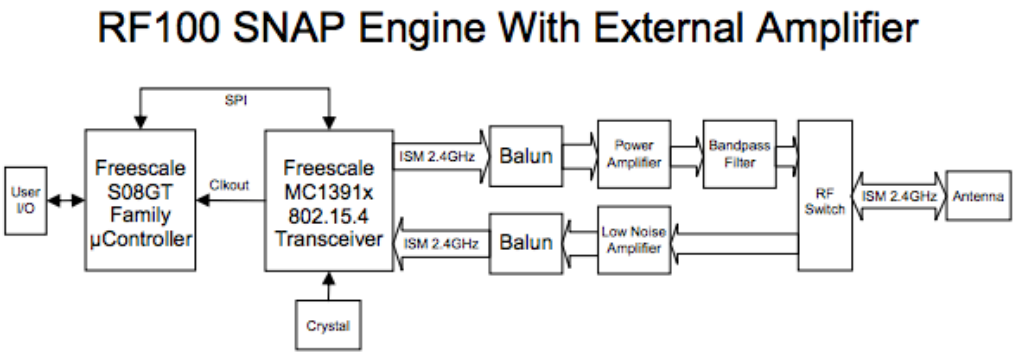

Figure 2: SNAP schematic developed by Synapse (from Synapse website)

Figure 3:

Electronic components of SNAP sensor (from Synapse website)