PosiTrack Systems

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Progress Report

In the recent two weeks, PosiTrack Systems has completed all hardware development. On the software side of things, the system's measurement and communication functions are nearly complete. Development is now focused on the implementation of software algorithms, testing, and optimization.

Budget

PosiTrack Systems has completed the purchasing of all hardware components for a grand total of $581.90. This is just under the initial estimate of $612.54 that was provided in the project proposal. Only $450.00 of these expenses can be covered by the funding received from the ESSEF, so the remaining $131.90 in expenses will be distributed evenly to each team member. The high shipping costs were unexpected and the chosen board containing the accelerometers/gyroscopes was fairly expensive. However, by locating free wireless access points from family and friends we were able to reduce the costs and remain under our initial estimate.

The total cost for the Gumstix Overo Fire, Gumstix Tobi Expansion Board, 5V Wall Adapter, Wireless Antenna, and 2GB Micro SD card was $401.52. The total cost for the Sparkfun 6 Degrees of Freedom Inertial Measurement Unit, Sparkfun Li-Ion Charger, and two 1000mAh Li-Ion batteries was $180.38. Both of these totals include shipping.

Hardware — Diagnostic Tool

The assembly of the Diagnostic Tool is complete and the device is fully functional. It can create a wireless link to access points, measure wireless signal strength, and measure the analog values provided by the 3-axis accelerometer/gyroscope. It has a battery life of approximately 2.5 hours and can also charge the 1000mAh Li-Ion battery. The assembly of the device mainly consisted of connecting the Tobi Expansion board to the 6-DOF IMU and Li-Ion Battery. Conveniently, the casing that the Tobi expansion board was shipped in was also ideal for the casing of the prototype. All of the hardware design and assembly for the diagnostic tool is completed and it works as a self contained module.

Hardware — Access Points

Since our system only requires standard wireless access points, we were able to acquire 3 free D-Link routes from family and friends. These routers have a beacon resolution of 20ms allowing for a theoretical maximum of 50 wireless signal strength measurements per second. These routers suit the needs of our prototype system.

Software — Graphical User Interface (GUI)

The Graphical User Interface consists of a Game Analysis (*GA*) module, a Tactical Analysis (*TA*) module and a Physical Training (*PT*) module. The TA and the PT modules are part of the nice-to-have features of the GUI for a final marketable product; however, they are not necessary for our proof of concept. The GA is part of the prototype deliverables, and is currently 70% done. Most functions for the GA module have been implemented; however we still have to establish connectivity with the rest of the system. Also, we need to find a proper way to display the athlete position within the GUI.

The connection with the Diagnostic Tool (DT) will be done via the GUI Dynamic-Linked Library (DLL) interface, currently 90% complete. The DLL functions have been implemented, tested, and are currently operational. These functions will be called inside the Visual Basic (VB) code that makes up the GUI. Currently the functions are called by a terminal program. The next step to complete this section is to define these functions in the VB code and test their operation, thus establishing connectivity between the GUI and the Gumstix.

As for the graphical display (displaying the athlete position in real time), there are several possibilities: using OCX controls (Object Linking and Embedding (OLE) custom control), or updating the image and refreshing the screen. However, we are still looking into other possible solutions.

Software — Dynamic-linked Library (DLL)

The Dynamic-Linked Library (DLL) consists of three software modules: the GUI DLL interface, described earlier, the Communication module, and the Algorithm module. These modules have access to data classes called the Athlete class and the Sample class.

The Communication module is 100% complete. This module is able to generate a connection from the GUI to the DT, allows the GUI to send and receive TCP messages to and from the DT, and facilitates the disconnection from the socket. The software block is also able to package and un-package the data packets that are sent and received over the communication link.

The Algorithm module has been delayed in progress due to its inherent dependence on the whole system in order to gather the data to be processed. The algorithms have been designed and now need to be implemented and tested. The project has reached a point of completion that this work can now commence. This section is approximately 20% complete.

The data classes Athlete and Sample are done. The Athlete class stores information about the athlete and holds the list of samples that the DT generates. This list is a collection of the Sample class which contains all of the sampled information. These classes are used by all of the above modules.

Software — Diagnostic Tool Executable

The Diagnostic Tool (DT) executable contains the Main Program module, the Measurement module and the Communication module, described in the section above. The Main Program module facilitates the start up, shut down and general operation of the program. This section of code is 90% done.

The Measurement module is 70% complete. It contains the functions to receive the measured Wi-Fi signal strengths and the measured inertial data from the hardware. Currently the DT can measure both signal strength and inertial data, but separate threads need to be created in order simultaneously control the resolution of each data type.

Testing

Basic functionality of hardware and software testing is occurring continuously through development of each task. Full system testing is performed after each software integration to ensure proper operation.

After completion and implementation of measurement calculation algorithms, we will be performing thorough iterative testing on the Diagnostic Tool in order to be able receive peak accuracy for Received Signal Strength (RSS) and acceleration values. Figure 1 in the appendix shows data from one type of RSS test.

Action Items

We are now entering the 12th week of the progress timeline and we are currently on schedule and entering the final stages of software development. Refer to Figure 2 in the appendix for our planned time line. Figure 3 in the appendix also shows the assembled hardware that will be used for the final prototype. We expect to be able to complete our proof of concept system by our demo date, April 14th 2010.

Priority tasks which will lead our project to completion:

- Compiling software on the Diagnostic tool
- Create threads to measure RSS and acceleration simultaneously
- Interface GUI with DLL
- Implement dead-reckoning and localization algorithms
- Testing to maximize accuracy

Appendix — Additional Items

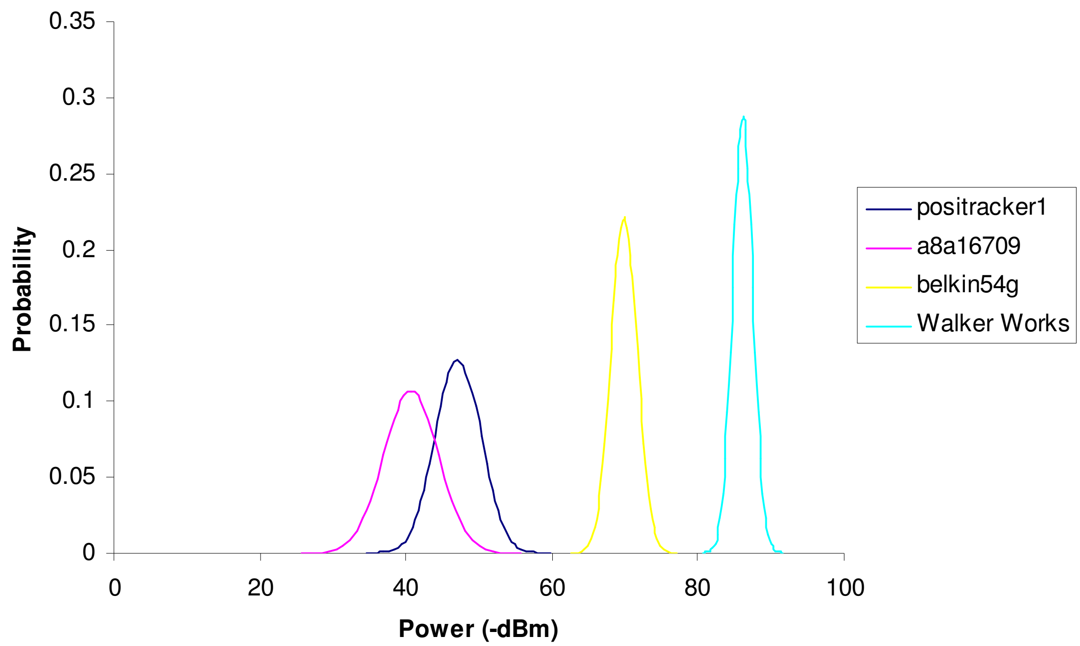

Figure 1: Power distributions of different Wi-Fi access points at various distances away from the DT.

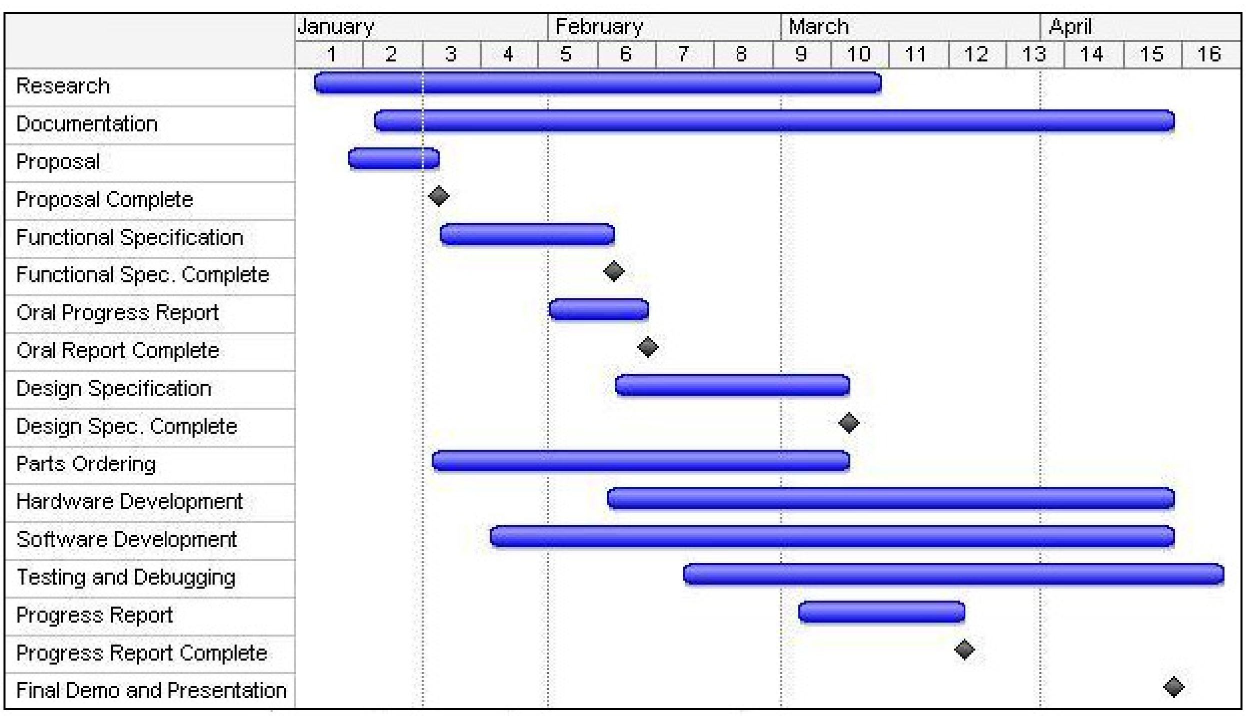

Figure 2: Gnatt Chart for the development of the PosiTrack System.

Figure 3: Assembled Diagnostic Tool (110mm x 51mm x 21mm).

