SENIOR PROJECT ANALYSIS REPORT

BLUEBEATS

(www.BlueBeatsAudio.com)

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1. Summary of Functional Requirements

The BlueBeats product provides a wireless audio gateway between Bluetooth enabled devices (Computer, Headphones, Smartphone, etc.). The product can be used to convert a speaker system into Bluetooth enabled system. The user has multiple ways of using this product, one option being to connect the BlueBeats device with speakers, which will allow the user to wirelessly transmit audio. The other option is that the user can connect the BlueBeats device to a television with an audio cable. This option gives the television the capability of transmitting its audio to Bluetooth to Bluetooth-enabled headphones. An Android phone or Windows computer can control this whole process.

2. Primary Constraints

The BlueBeats application for Android had few limitations, which we encountered in our beginning development stages. The current Bluetooth API for Android does not support the A2DP protocol, which lead us to research and come across Android's hidden APIs. The hidden APIs resulted inefficient and obsolete, and also corrupted Eclipse's Android development environment. The solution that our team found to be most effective was the use of the RFCOMM protocol to communicate with the BlueBeats device.

The hardware aspect of our project also had challenges. The Bluegiga WT32 chip was having a hard time communicating with the microcontroller. We discovered that the baud rate on the WT32 was at 115k, which is produces a high error rate with a 16Mhz clock, so the solution

that we developed was to configure the UART to operate at twice the speed of the clock to reduce the error.

3. Economic

The original estimated cost for the BlueBeats was based on two main items for development, the Arduino Uno ($30) and Bluetooth chip WT-32 ($60), which turns out to be around $90. The final cost for our senior project was $732.74, with the hardware development cost amounting to $252.44. The most expensive part of our senior project was creating five BlueBeats devices using the 3D prototype printer and our own circuit board. At the end of our project, the cost of each BlueBeats device was cut down to $96.06.

The BlueBeats project required the use of equipment, which was not readily available to us. This consisted of using a 3D Prototype printer and the manufacturing of the circuit board. The 3D printing was done at Cal Poly Mechanical Engineering Department. As a result of our team paying for each of the enclosures with our own money, Cal Poly did not receive any intellectual property rights for our project. Due to the limited access to laboratories we also had to manufacture our circuit board outside.

BlueBeats was split up in two teams, one for software and one for hardware. This allowed our team to divide the work up equally and develop the product quickly. The development for hardware side of BlueBeats was estimated at five months, which included research on which hardware parts to use, designing the circuit board, which would fit in our enclosure, and programming the hardware. The development for BlueBeats hardware was about five and half months because we added some extra functionality. The software development side of BlueBeats was split up into a computer and mobile application. The software development

time estimated for the computer and mobile applications was about the same time, five months. The software team for BlueBeats successfully created the functional application for Android phone and Windows computer. Unfortunately, due to some problems developing the application, the software team was few days behind the schedule plan.

4. Manufactured on a commercial basis

If our device was manufactured on a commercial basis, we estimate that, during our initial year, the number of devices to be sold per year would be 240. The manufacturing cost of our prototype is $96.06 but after reducing cost and going to mass production, we estimate that each device would cost $60 to manufacture. We estimate the purchase price for each device to be $80, with an estimated profit of $4800 a year.

5. Environmental

Since the manufacturing of the device was done through a third party, we are not directly impacting the environment. However, with the having the implications of an environmental impact in mind we hold the third party to a high standard and trust that they will not pollute the environment. We entrust in them that they will dispose of any hazardous material in a safe manner that will not impact the environment in a negative way.

6. Manufacturability

The high cost of manufacturing our prototype is a concern since at the moment it is too expensive to manufacture our prototype. This cost of manufacturing our device must be reduced in order to sell our device at a competitive price. Our challenge would be to find the most cost-effective way of manufacturing our device, while still making sure that the manufacturer's values to the environment and to its employees are in line with our values.

7. Sustainability

The only sustainability concern that the user may encounter is making sure that the device's battery is charged when it is low. Since this device has a rechargeable Lithium battery, it is very portable and will not to be next to a wall outlet when in use.

8. Ethical

The main ethical implication of our project is the use of Bluetooth technology. Since most devices work in the 800 MHz to 2 GHz range, there is some concern of possible radiation from Bluetooth devices[1]. However, due to the low power signal, 1mW, that Bluetooth transmits there is no real concern of any possible radiation[2]. This low power signal won't interfere with any other devices. The design of the board was done through the Eagle software and all products that were used in the design and manufacture of our product were given their credit.

9. Health and Safety

There are no real health of safety concerns associated with design, and manufacturing of the device. The only concern, although very minimal, would be while using the device. As stated in the ethical section, Bluetooth transmits low power signals and there is concern of any possible radiation from our device. However, because of the low power signal, there is no real concern for this radiation to damage a user.

10. Social and Political

There are currently no known social and political concerns associated with design, manufacturing or use.

11. Development

After completing our BlueBeats project, our group definitely learned a lot since starting our project during winter quarter. This project helped our group receive hands-on learning experience in designing and programming an Android/Computer application, utilizing Bluetooth functionality from within an application, interfacing with a Bluetooth chip, and going through the process of creating a provisional patent application.

On the software side, our group learned how to program an Android application and use the Bluetooth APIs provided by Android in order to make a connection from the user's phone to another Bluetooth enabled device. We also learned how to use the Bluecove Bluetooth APIs in

order to create a computer application that can connect to a Bluetooth enabled device. This part of the project was interesting because it helped our group understand the process of interfacing an android/computer application with an external hardware device.

On the business side, our group learned a lot about the Business and Legal aspects of creating a product. More specifically, our group learned these aspects by experiencing the patent process, researching how to create a company, and understanding what makes a product manufacturable, sustainable, and profitable. In completing the BlueBeats project, our group went through the process of creating a provisional patent application and got a better understanding of IP and how Cal Poly San Luis Obispo views IP. Additionally, applying to the Innovation Quest competition helped our group ask important questions about BlueBeats regarding its profitability, sustainability, and marketability.

On the hardware side, our group learned a lot about using a Bluetooth chip, and designing a PCB that would be incorporated into BlueBeats. Our group got a lot of hands-on experience with using the Eagle software to create a layout for the BlueBeats board, understanding the documentation for the WT-32 chip, and the use of UART on an Arduino board to control the WT-32 chip. This valuable experience was gained through embracing Cal Poly's "Learn By Doing" motto since our group had not dealt with the WT-32 chip before.

12. Work Cited

[1] Wildstorm, Stephen H , "Bluetooth: Is Its Radiation Harmful? Is using a Bluetooth-enabled cell phone dangerous to your health? Not according to the experts", News Week, http://www.businessweek.com/technology/content/aug2006/tc20060829_289239.htm

[2] RadiationTalk.com, "Bluetooth Radiation Issues", http://www.radiationtalk.com/info/bluetooth_radiation.php