Proceedings of the ASME 2011 Summer Bioengineering Conference
SBC2011
June 22-25, Nemacolin Woodlands Resort, Famington, Pennsylvania, USA

SBC2011-XXXXXX

Morpheus: Portable Assistive Technology

Stephen Berus, Alexandra Johnson, Erin Litts, Athena Turner

I. Need and Market Potential

A missed alert for a deaf or hard of hearing person may have lethal consequences. Even if outcomes are not fatal, missing vital information negatively affects quality of life for deaf and hard of hearing people, as it restricts their independence and self-reliability. Most homes and hotel alert systems are audible thus neither convenient nor practical for deaf or hard of hearing persons.

Businesses are required by the Americans with Disabilities Act (ADA) to provide reasonable accommodations to customers and employees. While the act has made strides in protecting the civil rights of disabled Americans, ongoing problems still exist. In hotels, management personnel are either ignorant of provisions such as providing strobed door knockers or alarm clocks for deaf or hard of hearing customers, or choose to ignore requirements and only implement them when legal action is applied.[1]

Products exist on the market that include non-audible functions but are cumbersome for travel or may require permanent installation. One benchmark product, the Sonic Boom™ alarm clock, requires three large components and is better suited for home usage rather than travel. Additional assistive technologies include use of installed strobe lights to indicate incoming phone calls in deaf/hard of hearing homes. Some of these systems require permanent installation and can be inconvenient for both user and employers required by the ADA to provide them[1]. A lightweight, inexpensive and portable alert device is needed. Our prototype, Morpheus, fills that need.

It is estimated that there are as many as 20 to 36 million Americans with hearing losses ranging from mild to profound.[2,3] Over the course of 75 years, half of adults will eventually lose their hearing through natural aging, excessive noise levels, and other causes. In addition two to four babies out of every thousand born are afflicted with some degree of hearing loss.[2] While getting specific statistics is speculative, there is potentially over 20 million prospective consumers for our device.[2]In addition, the device could potentially be useful to hearing consumers as well, such as those who have a hard time waking up to a conventional sound alarm.

Figure 1: Morpheus CAD Assembly

II. Novelty

The first phase of this alert product, Morpheus, is an alarm clock. Given its Bluetooth® interface, it has the potential for increased functionality through smartphone applications. The customer plans to share Morpheus' design with Google with a proposal to design and implement applications specific to it. Possible applications that could be designed include not just an alarm clock function, but also important incoming alerts. Additionally, the application can be used to indicate calls or e-mails from important people in an office setting.

To activate Morpheus, the user sets an alarm through an application installed on their smartphone or PDA and sets Morpheus' internal alarm via the Bluetooth connection. When Morpheus connects via Bluetooth, an indicator LED turns blue. When the alarm is set,

[1]Christopher Reynolds. "ADA get mixed results 5 years later : *San Antonio Express-News* 21 Sep. 1997,ProQuest National Newspapers Premier, ProQuest. Web. 20 Jan. 2011.
[2]Holt, Judith et al. "Demographic Aspects of Hearing Impairment: Questions and Answers." *Center for Assessment and Demographic Studies Gallaudet University* 3rd Edition, 1994. <http://research.gallaudet.edu/Demographics/factsheet.php#Q1>. Web. 20 Jan 2011.
[3] Establishing a Realtime Captioning Program: Designed to Meet the Needs of 28 Million Deaf and Hearing Impaired Americans

the LED turns green. When the alarm activates, Morpheus flashes the LED lights installed on the sides and activates the bedshaker, which is placed either under the user's pillow or mattress.

Morpheus is novel as it is an assistive device that uses Bluetooth to capitalize on the convenience that smartphones and PDAs offer. In addition, due to its small size, it is easily portable and can be easily set up in a number of settings, such as the home, office, or a hotel room. Finally, through the use of Bluetooth technology, it is easy to add new uses through designing new applications with little or no hardware changes.

III. Feasibility of Design

One major challenge was finding a Bluetooth RF transceiver. Toothpick® designed and built by FlexiPanel Ltd was specifically selected given its documentation and files that could be built upon, shortening the learning curve for this project.

The design of the plastic housing required expertise outside the scope of the group's background. Different forms of production were considered, including 3D printing, injection molding and thermoforming. 3D printing was selected because it could be done in-house, therefore minimizing the team budget while also decreasing production time. This method of manufacture also has few limitations, allowing the team to explore the aesthetics of the design.

Minimizing the overall device size was accomplished by integrating the alert scheme into the housing, LEDS, versus including a power supply and 115 VAC power receptacles needed for a conventional table lamp to plug in. Customer feedback indicated that a device with a receptacle for a plug-in lab would be acceptable, similar to the Sonic Boom ™ alarm clock. This receptacle became the limiting factor on the size of the device, so the team proposed an integrated lighting scheme using high powered LEDs. Through communication and careful documentation, the team was able to reconcile an innovative idea with customer needs to accomplish one of the major goals of the design: minimizing size.

IV. Budget and Economic Plan

For Morpheus' current design, cost of single build quantity is $186.44. To be economically viable the future cost will fall into the range of twenty to forty dollars in large manufacturing quantities. When Morpheus goes to market, it will face varied competition. Companies, such as Sonic Alert make a product that sells for forty to fifty dollars. However, their products only include a bedshaker. Bellman manufactures a $160 alarm clock that provides both a bedshaker and flashing light. Based on these benchmark products, if the desired price range for Morpheus is met, it would be very competitive with available assistive technologies in addition to offering a superior user interface.

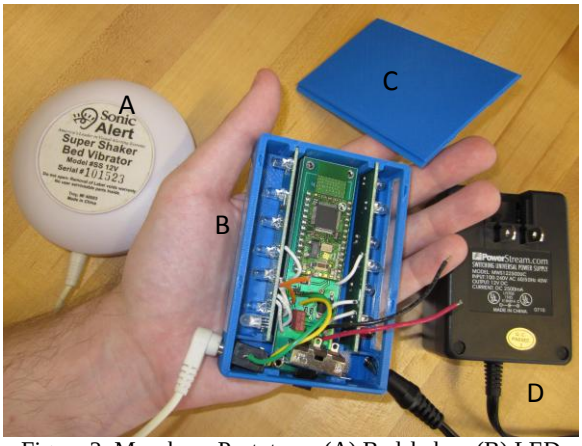

Figure 2: Morpheus Prototype: (A) Bedshaker, (B) LED lights, (C) Morpheus cover, (D) Power source

V. Acknowledgements

This material is based upon work supported by the National Science Foundation under Award No. BES-0527358. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.