KT4TT Update

A Publication of the Center on Knowledge Translation for Technology Transfer Volume 2, Issue 1, 2010

KT4TT Names Its First PUSH Award Winner!

Product Utilization Support and Help (PUSH) AWARD

The Product Utilization Support and Help (PUSH) award is a peer-to-peer dissemination activity. It is based on the identification and distribution of 'best practice' approaches to the development, transfer and/or production processes by National Institute on Disability and Rehabilitation Research (NIDRR) technology grantees. The goal is to offer exemplars of research utilization that have been proven effective to the broader NIDRR community.

The PUSH program is modeled after some elements of SEDL's highly successful Research Utilization Support & Help (RUSH) Project. RUSH supported NIDRR grantees in their efforts to get their NIDRR-funded research findings used in targeted, measurable ways. The PUSH program partners the Center on Knowledge Translation for Technology Transfer (KT4TT) with NIDRR grantees by offering financial support for their efforts to describe utilization strategies that are associated with some evidence of their effectiveness.

PUSH candidates are NIDRR technology grantees identified by KT4TT staff as conducting meritorious activity in Technology Transfer (TT) or Knowledge Translation (KT) for TT. In this case, the KT4TT in conjunction with the selected NIDRR technology grantee generates a brief evidence-based description of a carrier used to successfully overcome a barrier within the technology transfer process. The supporting evidence may include research and/or practice knowledge.

The first recipient of the KT4TT's PUSH award is CreateAbility Concepts, Inc. (CCI). CreateAbility Concepts Inc. performed exemplary work in three areas related to Knowledge Translation for Technology Transfer, each of which will be referenced in the following project summary:

1) Identification of an unmet need for a technology-based solution to improve the quality of life for persons with disabilities, and differentiating between the need to generate new knowledge from research, or the need to demonstrate feasibility through a prototype device.

2) Involvement of persons representing the target beneficiary group in the articulation of needs, the translation of needs into device specifications, and the testing of prototype models for usability.

3) Collaboration with another NIDRR technology grantee. In this case a grantee with related expertise in the application area, and access to consumers with an interest in the envisioned device as a solution to an unmet need.

BACKGROUND: The HearingCompanion is a portable device capable of recognizing distinguishable sounds in the environment, and communicating this information to a user via imagery, vibration and text through their mobile communications device. What is unique about the HearingCompanion approach is that CCI combined these methodologies and techniques and packaged them in a portable electronic ear that works in concert with the user's mobile technology to automatically

convert sounds to pictures, captions and vibration patterns. CCI pursued and received Small Business Innovation Research (SBIR) funding from NIDRR to build and test the envisioned device. The goal for this SBIR project was to establish the HearingCompanion's technical merit, feasibility of its use and the efficacy of the required functional features. Project objectives were met by designing, assembling, coding and testing the hardware and software prototypes.

To accomplish these goals and objectives, CCI developed a partnership with Assistive Technology Partners (ATP) in Colorado and worked in collaboration with its director, Cathy Bodine. ATP is located in Denver Colorado and is a unit within the University of Colorado Denver (UCD) School of Medicine, Department of Physical Medicine and Rehabilitation. As a NIDRR grantee, Cathy Bodine directs the RERC on Technologies for Cognition, among other research, demonstration and training projects. The ATP is nationally recognized for services that include assistive technology assessment and training for individuals with a broad range of communication impairments including hearing impairment. In addition to their large database of contacts of individuals who are deaf or hard-of-hearing, ATP also has extensive experience with small businesses in this area of application, and has previously assisted CCI perform product testing on five other technology-based projects.

A project funded by the NATIONAL INSTITUTE ON DISABILITY AND REHABILITATION RESEARCH NIDRR

METHODOLOGY

SBIR Phase 1

The SBIR Phase 1 project involved three major tasks:

1) Requirements Identification;
2) Prototype Design, Construction and Testing;
3) Usability Evaluation.

Task 1 – Requirements Identification based on Literature and Customer Input

1.1 Requirements Analysis

- CCI conducted activities to learn more about the attitudes and strategies people with hearing aids use to detect and identify sounds at home or work. These activities included face-to-face meetings with potential consumers and phone interviews with hearing professionals and potential distributors.
- CCI completed a literature review of available wireless communication and signal processing technologies useful in meeting consumer needs. Beyond the normal search of trade journals and grant-funded research of current, new and emerging strategies and technologies, this literature review included the participation of students in the Occupational Therapy Masters program at University of Colorado.
- The results of the literature review demonstrated a sufficient foundation of technology-based research knowledge to support the planned project, so no additional time or resources needed to be allocated to a Research Phase. This decision permitted the project to move directly into the Development Phase of activity.
- CCI then developed initial system requirements.
- CCI surveyed available techniques and approaches to performing real-time digital signal processing.
- CCI identified Bluetooth as the best wireless communication approach & selected Linux for prototyping embedded environment.
- CCI conducted field interviews and planned a focus group with ATP comprised of individuals who were hard of hearing or deaf who identified adaptive strategies and preferences in regard to the interface.

1.2 Conduct Focus Groups

- ATP coordinated one mixed-group focus group and recruited 14 participants (6 with profound hearing loss, and 8 deaf) to discuss the functionality, usability issues, reliability requirements and performance of a device like HearingCompanion.
- A Nominal Group Technique approach was used to gather information. This combines approaches where participants work alone and where they interact in a group.
- Participants/Subjects were recruited by posting approved recruitment text on E-mail and list serves typically used by individuals who are deaf and hard of hearing in the Denver metro area of Colorado, e.g., Self Help for Hard of Hearing and Deaf.Net. Inclusion criteria were: age 18 years or older, having a severe hearing loss with the ability to hear only sounds louder than 70 decibels, willingness and ability to

travel to ATP, and willingness to spend 60 minutes in the focus group.
- Focus group participants validated the strategies currently used by persons who are deaf and hard of hearing for getting alerts about environmental sounds.
- Focus group participants identified the features that an alerting device would need to have in order to be acceptable.

1.3 Define System Requirements
- The input from consumers permitted CCI to identify both the desired benefits for the targeted end users, and the system requirements that would deliver these desired benefits, as shown below.

The table below contains two columns. The first column consists of a list of device benefits or features that consumers wanted for the HearingCompanion device. The second column consists of a list of the defined system requirements which corresponds to the list of consumer benefits.

Consumer Benefit:	**System Requirement:**
Ability to *detect* and *identify* sounds in the environment (advantage over or supplement to hearing dogs alone)	• Sound detection and identification functionality • Communicates with individual's mobile communication device (Blackberry, Sidekick, Palm Treo, Nokia) • Multifunctional
Enhances personal security and safety	• Identifies a wide range of potential threats to personal safety • Designed for outdoor as well as indoor use
Convenience	• HearingCompanion device can be placed in the likely location of an expected sound event and then wirelessly notify the user in a different location on their mobile device via vibration, imagery and captions
Portable	• Handheld user device • Long battery life (at least 72 hour, recharged via USB) • Operates anywhere, anytime
Easy setup and training	• Sound templates can be downloaded from CCI's website and settings adjusted via a PC utility
Richer understanding of the environment from the integration with other sensor networks	• Information on the status of non-sound events (from the SafetyNet sensors) and other sound events (from the SoundAlert sound sensors) can be presented

Task 2 – Prototype Design, Construction and Testing based on defined system requirements to achieve intended consumer benefits.

2.1 Design Prototype
- The HearingCompanion interface used vibration and visual output to communicate with hearing impaired individuals
- Usability and simplicity maximized through use of cell phone, PDA, or Pocket PC as user interface
- When device vibrates, display informs user about detected sound
- Prototype consisted of three parts:
  - Microphone
  - HearingCompanion device
  - Bluetooth-enabled mobile device

2.2 Build Hardware
- Rechargeable power supply, digital signal processing circuitry, capacity for Bluetooth communication
- Standard, commercially available Nokia

phones were selected to run our small application that notifies the consumer via vibration, imagery, and text.

2.3 Develop Software

- Firmware was developed on the HearingCompanion device for the embedded digital signal processor to determine the sound and communicate to the cell phone via Bluetooth
- Firmware for the Nokia Phone to accept information from the HearingCompanion device, and notify the user of the sound detected via vibration, imagery and text

2.4 Integrate & Test System

- HearingCompanion device detected sound, identified it and used Bluetooth to transmit the picture and caption data to the user's Bluetooth-enabled mobile device
- Due to the modular design, each software and hardware subsystem had passed their individual tests, so that this phase could focus on the interaction and system level testing. These tests included verifying the system's functionality, usability, reliability and performance under expected and harsher environments, such as: colder and warmer temperature ranges, low battery levels, longer distances for Bluetooth, and RF interference from other Bluetooth devices. CCI constrained the ambient acoustical noise floor in Phase I to be within the sound pressure levels of typical office environments.

Task 3 – Usability Evaluation to ensure prototype device delivers expected features and achieves expected benefits for targeted customers

3.1 Finalize the Assessment Plans & Procedures

- Proposal described the use of a between groups experimental design to determine the usefulness of the HearingCompanion.
- There were modifications resulting from ATP suggestions, and a better assessment was determined to be engaging potential users in evaluating the user interface, the feature set, and the final form and function of the device.
- HearingCompanion was evaluated by presenting recorded auditory events for detection followed by quantitative and qualitative questions posed by ATP, designed to rate user satisfaction of features etc.

3.2 Administer Evaluation - Participants

- ATP recruited 14 participants by posting recruitment text on e-mail and listserves typically used by individuals who are deaf and hard of hearing in Denver, Colorado.
- Inclusion criteria: 18 years of age or older, severe hearing loss (can only hear louder than 70 decibels),willingness to remove hearing aids and have residual hearing level screened, ability to travel to assessment location and spend 30 minutes testing prototype.
- Usability testing
  - Provided device information sheet and ATP tested participant's hearing
  - Researcher produced sounds and participants were asked to indicate whether they heard it or not, and to identify it
  - Participants were given questions assessing their opinion of device

3.3 Analyze & Report Results

- The 14 participants completed testing over a two-day period
  - Sample included: four males and ten females; mean age of 51 years old with a range from 27-79; 12 Caucasians, one Asian, and one Hispanic; all residents of Colorado
- Session data was handwritten and entered into an MS Excel spreadsheet, cleaned, and imported into SPSS 16 for Windows.
  - Descriptive statistics and Chi Square analyses were performed and cross tabs were calculated
  - Qualitative data were coded for recurring themes
- Hearing scores were assessed with an audiometer
- Sound detection accuracy was assessed
- Usability ratings of 12 usability characteristics were assessed using a 5-point Likert-type scale
- The relationship between hearing level and participant opinion of usability was assessed
- The qualitative data gathered identified areas for further product development
  - Both positive and negative aspects of the HearingCompanion were identified
  - Participants offered suggestions for improvements of the HearingCompanion as far as the ability to integrate it with other devices and additional customizable features
  - Attractiveness and price was also assessed

SUMMARY: The project clearly distinguished between the presence of prior technology-based research, and the need to focus the limited SBIR Phase I funding on the development phase activity. Without this focus, the available time and funding would have fallen short of the required goals and objectives. Given the focus, the project yielded a functional and tested prototype device. This prototype device has a high probability of addressing an unmet consumer need because of the early and continuous involvement of the target audience. Including consumers in the identification and validation of functional needs, in the specification of system requirements, in the testing of prototype performance, and finally in usability analysis, ensured that the potential customers will encounter a device designed for them. The collaboration with an experienced NIDRR grantee leveraged available resources by drawing on their expertise in the technology area, and their networks with the targeted consumers.

CreateAbility Concepts, Inc. received a monetary award in the amount of $1000 for providing us detailed information on their exemplary practices and for allowing us to showcase their 'best practice' product development approaches to the broader NIDRR community. In the future, the KT4TT will be searching for, and disseminating the work of, other NIDRR grantees who have demonstrated exemplary practices in the development, transfer and production of assistive technology thus ensuring that their research and development projects truly benefit people with disabilities.

"focusing on the ability"

CREATEABILITY concepts, inc.

The authors gratefully acknowledge colleagues who contributed to the concepts expressed herein. This is a publication of the Center for Knowledge Translation on Technology Transfer, funded by the National Institute on Disability and Rehabilitation Research of the Department of Education under grant number H133A080050. The opinions contained in this publication are those of the grantee and do not necessarily reflect those of the Department of Education.

SPHHP University at Buffalo

ADVANCING RESEARCH SEDL IMPROVING EDUCATION