Design of a moderate cost therapeutic cross-body movement and sensorial therapy system for adults with special needs

Anned Vargas González and Claudia Pagán Guadalupe
Advisor: Dra. María Irizarry
Department of Industrial Engineering

Sponsors: University of Puerto Rico, Mayaguez Campus and National Science Foundation contract CBET-1403753

Introduction

This is a research and design project funded by a GARDE-NSF project, *Award No. CBET-1403753.* The project goal is the design of a therapeutic device for adults with disabilities to provide visual, auditory, smell, and tactile stimulation prompting a response therefore, improving the patient's sensory system. The experimental population is adults with disabilities attending the *Asociación Mayagüezana para Personas con Impedimentos* (AMPI). This is a non-profit organization where adults with disabilities receive therapy to improve their quality of life and independence. This is one of the few centers on the island of Puerto Rico dedicated exclusively to adults with disabilities, a population usually being forgotten after they reach a certain age. Currently, sensorial therapy is provided through different non-integrated means such as a pool full of balls, home products with different odors, game and garden areas with different textures, etc. The objective is to create a transportable integrated device to provide multi-sensory therapy at a low cost.

Problem Background

Sensorial integration therapy is used to treat people who have functional disorders in their sensory processing system. Conditions such as autism, or other developmental disabilities makes difficult processing sensory information such as those provided by textures, sounds, odors, light and movement of objects. Through sensorial integration therapy, these patients can improve their responses to social situations, and common daily tasks. For example, a parent of a child who wakes during the night due to extreme sensitivity to sounds might set a goal of improving tolerance of ordinary noises and sleeping through the night. For a child who hates touching food, the goal might be to decrease touch sensitivity to the point that the child can comfortably eat a meal.

Throughout the literature review it was found that a multi-sensorial cross-body therapy system called Makoto is available, which provides benefits in aspects such as reaction time motor skills and execution of some body functions. However, its cost ranges between $12,000 and $15,000, which is extremely expensive to non-profit organizations and most therapists. This Makoto system provides stimulation using only a lighting system.

Objectives

1. Identify subjects who can benefit from a multi-sensorial therapy system. Perform a literature review to identify which aspects of the therapy do the subjects need the most, which ones the market offers and how to include more in the new design.

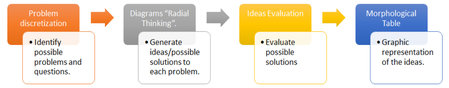
2. Design a therapy system with a selling price of at most 50% that of the Makoto system to make it more affordable to therapeutic centers or individuals.

3. Design a small modular therapy system in order to reduce the space required to install it. This will help the individual with the disability and attendants to include the therapy system in any place without major concerns of space.

4. Validate the design's functionality with specialists in order to integrate features for different disabilities and include their recommendations. This will guarantee that the design proposed satisfy the individual with the disability and the professional needs.

5. Develop a design with adaptability for individuals in a wheelchair.

Methodology



Through interviews with physical therapists and visits to AMPI's facilities in Mayagüez we gathered data on the therapies provided by them.

Through an extensive literature review and brainstorming of ideas we developed how to incorporate new functionalities into a cross-body movement stimulation system.

The consultation throughout the process with different experts as Occupational Therapists and Physical Therapists allowed us to develop a design that would be functional by known standards.

Experts in electrical engineering and manufacturing were consulted on the viability of materials.

Results

SenSe it! **Design Overview**

SenSe it! includes the following features in order to stimulate the senses. All these features will be controlled through a computer application.

Visual Stimulation

Lights**:** The lights will stimulate the individual visually and at the same time should motivate him to move to touch them. This also helps with balance and muscular activity.

Tv/Tablet: A tablet or a small television is in one of the columns to stimulate the user visually. It can be used to pair sounds with images or odors with images.

Bubble machine: The bubble machine will be activated at the therapist's request in order to stimulate vision and make the individual follow the bubbles by moving the neck.

Auditory Stimulation

Speakers: The structure will have speakers that will be used to stimulate the individual's audition. The system will provide different options of sounds and music that will be controlled through the computer application.

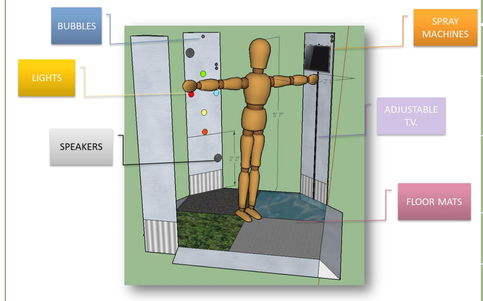
Olfactory Stimulation

Odor Spray machine: The system will have 6 different odor spray machines. The machines should be loaded with different odors. The therapist will active the outburst of odors with the computer application.

Tactile Stimulation

Floor mats: The design includes different floor mats that are used to stimulate the tactile system. The therapist can select the textures than are suitable for each patient.

Design



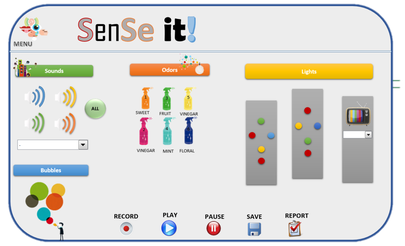
Anthropometry

Measure	Anthropometric measure consider	Justification
Column height	Average man height (5'7")	Percentile 95 for man was 6.08' that will require higher ceilings and will make the transportation more difficult.
Floor Dimension and distance between columns	Broad shoulder and arm reach. (Longest) (2'1")	If the longer person fits the shorter will too.
Lights Range	Knee height of the tallest and arm reach of the smaller. (2'2")	The lowest light can be placed at the knee of the tallest or higher to avoid an extreme bending. The higher light can't exceed the sum from ankle to shoulder and arm reach.
Bubble Machine	On the top of the structure	Bubbles' path should be seen fby everyone to promote neck movements and attention.
T.V./ Tablet	Adjustable	The T.V should be placed at the eyes level in order to fit all the population, including wheelchairs. An adjustable stand should be integrated in the design.

Safety & Materials

Material analysis

Application



Conclusions

Our original goal was to create a system which was 50% less than Makoto. According to our estimates, the proposed system would cost between $ 1,154 and $3,815 **to built, a difference of 68.21%. Not only will it be less expensive, but it has additional features to stimulate additional senses, which Makoto lacks, making it a more versatile tool.**

Functionalities/ Characteristic	Makoto	SenSe it!
Visual Stimulation	✓	✓
Auditory Stimulation		✓
Olfactory Stimulation		✓
Tactile Stimulation		✓
Cost (Approximately)	$12,000	From $1,154 to $3,815

References

- Alta tasa de autismo. (2012, March 12). Retrieved July 26, 2015, from http://www.elnuevodia.com/noticias/locales/nota/altatasadeautismo-1210510/
- València, C. (Ed.). (n.d.). Terapia de Integración Sensorial - CEI Valencia. Retrieved July 27, 2015, from http://ceivalencia.com/servicios/terapia-de-integracion-sensorial/
- Miller, L. (n.d.). Autism & SPD Therapy. Retrieved July 26, 2015, from http://www.makoto-usa.com/uploads/4/5/3/7/45379317/miller-spd-quotes.pdf
- Comparison of Makoto Training to other Training Conditions: A Preliminary study of Makoto Benefits. (n.d.). Retrieved July 26, 2015, from http://www.makoto-usa.com/uploads/4/5/3/7/45379317/calvin-college-final-w-graph.pdf