

# Programmable Light and Sound Sensory Experience for Physically and Developmentally Impaired Children

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## Objective

The objective of his effort, is to use students and technology to provide a programmable light and sound station, for therapists and teachers to use to enhance physical, speech, and occupational therapy sessions with physically and developmentally impaired children. Utilizing light, music, and sound, the station will help therapists and teachers create a choice-making, positive feedback, or a calming environment for students who react positively to enhanced sensory experience.

A positive, cooperative association will be developed with local service agencies for handicapped children. The Center for Handicapped Children in Cheektowaga, NY has agreed to serve as a client base, and a source of knowledgeable therapists, teachers, and nurses. The Center for Handicapped Children will be the recipient of the first completed system.

The system will be a tool for teachers and therapists to configure a sensory experience, to be integrated with speech, physical, and occupational therapies, and special education.

## Pilot Program:

- A group of six students design a programmable station utilizing light, music, and sound technology to help therapists create a choice-making, positive feedback, or a calming environment for students who react positively to enhanced sensory experience
  - ✓ Results in a drag-and-drop scripting language as a means of programming lights and midi-music devices, using a personal computer and commercial grade equipment.
- Serves as both a tremendous learning and a very gratifying experience for the students.
- Students receive academic credit for their efforts
  - ✓ 4 credit hours per semester
  - ✓ 3 credit hours over summer
- Interdisciplinary teams are encouraged
  - ✓ Computer Engineering (hardware design)
  - ✓ Music (midi design and programming)
  - ✓ Computer Science (software design)
  - ✓ Industrial Engineering (ergonomics)
  - ✓ Informatics (communication)
  - ✓ Health Sciences (therapeutic aspects)

## Course:

- Pilot program expanded to a new project based course, or an applications lab in current courses (CSE 442/542, CSE 380, CSE 341), or n proposed courses (CSE 405, Programming for embedded systems).
- Student groups address the local community to solve special problems

- ✓ Positive relationship between UB & community
- Course enrollment 30 – 50 students
- ✓ Groups of five or six students
- Provides students with real world problem solving experience

## **Introduction**

Throughout their educational experience here at the university, many students have an opportunity to get hands-on experience in their field of study. For example, many science majors have labs in which they conduct experiments which reinforce the material they have learned in the classroom. In the computer science and engineering curriculum, students gain experience by applying their skills on projects developed by their professors. It is important that the students not only learn the fundamentals of computing, but also learn how their knowledge can be applied to solve real-world problems. To help the students obtain this valuable experience, we are proposing the development of a course in which the students are given a problem outside of the classroom which they must investigate, address the problem with engineering analysis and design, and implement the solution. This would provide students with an excellent opportunity to, not only apply their knowledge in the fields of computer science and engineering, but also start to develop many other skills that they will have to rely on throughout their career. Such skills include the ability to clearly define a problem, interdisciplinary skills which allow them to interact with other disciplines when solving a problem, economic skills, such as how to budget and fund a project, and the social skills needed to interact with people on many different levels, such as customers, peers, and managers. It is the goal of this course to provide the students with a sense of pride in their work, by affording them the opportunity to work on a problem which directly helps someone. The client benefits from the project results, and also acts as a customer to enhance the practical application aspects of the project. As a second objective of the project, we would like the effort to positively impact the local community. For potential projects, we'll be looking for clients with disabilities and special needs, which the students could address to increase the client's life experience and quality of life. As an example, the following project has been identified as a potential pilot for this program:

The students will complete the design and implementation of a therapeutic sensory light and sound station, which will have the following components:

Lights – a stage lighting frame with color spotlights, rotating lights, traveling/sequence-able lights, brightness controls, color wheels, lasers, and fog. The various lights and changeable properties will be under computer control.

Music – a midi-compatible keyboard with programmable sounds and intonation, able to mimic a host of instruments, and capable of producing a variety of sounds under computer control.

Various means of actuation and input so that choices can be made by the physically and developmentally impaired, to select sound, noise, music, and lighting programs. The switches are commercially available and as diverse as the disabilities of the children who use them: head switches, large buttons, squeezable pads, foot switches, etc. The various actuators will drive the lights, noise, and music under computer control.

The control/programming computer – a desktop PC with digital I/O, midi, and sound capability. Based on the pre-programmed interpretation of the actuators, or merely under the control of a therapist or teacher who selects programs, the PC will control the lights, noise, sound, and music.

The programming language – the students will develop an easy, graphical, drag-and-drop means of individualizing the experience for each client. The system will be a tool for teachers and therapists to configure a sensory experience to be integrated with speech, physical, and occupational therapies, and special education.

## **Target Population**

### Pilot Project

- Five or six students (juniors)
- Interdisciplinary participation encouraged
  - ✓ Potential Majors
    - Computer Science
    - Computer Engineering
    - Industrial Engineering
    - Music
    - Health Science
    - Informatics

### Project Based Course

- Multiple groups of five or six students
- Enrollment: 30-50 students
- Interdisciplinary participation encouraged (see above)

Students in the Computer Science and Computer Engineering Department have expressed interest in applying their knowledge to solve real world problems in the community.

## **Deliverables**

- Development and implementation of a prototype system to the Center for Handicapped Children, to provide sensory, noise, music, and light stimulation in response to programmed actuation, for students with physical and cognitive handicaps. The system will be a tool for teachers and therapists to configure a sensory experience to be integrated with speech, physical, and occupational therapies, and special education.
- Project based course where students solve real world problems in the community
  - ✓ Our investigation indicates no shortage of potential projects very much like this one, to engage students for many semesters.

## **Evaluation**

The program will be evaluated by setting up an independent study with approximately five to six students who:

- Meet the thereapists in a school setting to address their needs, and the needs of their students.
- Investigate options for funding the cost of the deliverables.
- Develop a system which will fully service the needs outlined in the Deliverables section above.
- Implement the system, using suitable hardware.
- Deliver the system and train therapists on its use.

As in important part of the evaluation, feedback will also be obtained from the therapists and students, as well as staff members and family with whom they interact, to assess their experiences.

## Feasibility

Preliminary investigation into the feasibility of this project has been very promising.

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## Budget

Equipment/Personnel	Justification	Cost
Desktop Computer	A desktop PC with digital I/O, midi, and sound capability.	\$1250
Midi-compatible Keyboard	To provide programmable sound and music	\$500
Stage Lighting	To provide light-based sensory feedback	\$3000
Sound System (portable, amplified speakers)	To format the sound to acceptable levels, spectrum distribution and equalization, and spatial characteristics	\$500
Activation Switches	For choice making	\$1000
Microphone and Stand	To add human-voice content	\$120
Miscellaneous Equipment	DiskS, cables, etc.	\$500
Lighting Frame and brackets	To support the speakers, lights, and surround the user	\$400
Faculty Support	Two faculty members for 1 month	\$0
<b>Total</b>		<b>\$7270.00</b>

## Timetable

End of spring 2003 semester

- Form group of five or six interested, highly motivated students

Summer 2003

- Define problem
- Meet with client
- Evaluate solutions

Fall 2003

- Design, implement & test prototype

Spring 2004

- Deliver device to client
- Training
- Follow-up & support to insure device is working properly
- Evaluate entire process

Fall 2004 onward

- Implement course with multiple groups working on projects in the local community

- Aligns well with project based component in proposed MS/IT program