After 12 years of a “traditional” approach to team projects (building simulated ATMs, Mars Landers, human resource programs and such), we attempted to get teams out into the community and build systems that might actually be used. Our target client base tends toward the handicapped, medically frail and technologically dependent. In the Fall of 2002, students were asked to build an augmentative communications device for a 42 year old stroke patient who had limited motor skills with no cognitive impairment, but an inability to speak. The best of the project results were given to the patient and he uses it today as his main means of communications. In the Spring of 2003, we reassigned the project and added new requirements to meet the needs of children with cerebral palsy, with and without reading skills. Special requirements were written to include children with visual impairment.

In the Fall of 2003, the DISCO system was envisioned – so named because of its use of stage lighting, sound, video, and music to enhance the impact of choice-making therapy and education in severely handicapped students. Much thought had been given to the “switches and lights” that are the integral hardware to such a system, but little had been designed in the structuring of lessons and sessions controlled by therapists. In the Spring of 2003, requirements were added to better utilize DISCO for use in instruction and evaluation of skills.

**Intentionally Vague System Specification:**

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

**Background**

Simple choice-making and the realization of cause-and-effect are often a central goal of early education for the physically handicapped and developmentally delayed, especially children. The relationship between physical action and ultimate effect, and the ability to select between alternatives of increasing number is part of a student’s Individual Education Program (IEP) from early-on. The mechanism used usually presents large colored switches which respond with different noises or spoken words: first a single switch, then two, then four, until sufficient cause-and-effect is established to graduate the student to a more powerful augmentative communications device such as a touch-screen talker. See [http://www.tecsol.com.au/ComAidsAugment2.htm](http://www.tecsol.com.au/ComAidsAugment2.htm) for an example of the technology that is currently available.

Children can not progress to the use of augmentative communications devices until the concepts of choice-making, cause and effect, and menus-to-sound (or speech) is solidified. This DISCO station will be a staple in early intervention and education for those who will eventually depend upon technology to speak and make their needs known.

The various designs that result from this effort in CSE 442/542, will be built and delivered by students in CSE 453 in the Spring of 2004.

**Objective**
The objective of his effort, is to use technology to provide a programmable light and sound station, for therapists and teachers to use to enhance choice-making and cause-and-effect related physical, speech, and occupational therapy sessions with physically and developmentally impaired children. Utilizing light, music, and sound (including music and spoken-word), 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 experiences.

The clients and customers are the teachers and therapists. The users, are the handicapped students.

The station is envisioned to be a row of augmentative switches of all types: contact, large-button, proximity, cushioned, colored, levers, anything that can gauge intent (see http://www.adaptive-technologies.com/Products/MnSwitch.html and http://www.rjcooper.com/big-button for some examples).

The switches will be connected via yet to be determined interfaces to a personal computer. The computer will control light and sound, through these interfaces. The output selection will include common stage lighting (see http://www.carvin.com under “DJ and lighting” for some examples), fog machines, music, sound, and voice through amplified speakers, and video on the computer screen.

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. Thus the system must be programmable for therapy and teaching sessions individualized to meet the needs of specific students.

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.

Requirements

Each team must complete the design and implementation of a therapeutic sensory light and sound station, which will have the following components:

1. Lights – a stage lighting frame with color spotlights, rotating lights, brightness controls, traveling/sequence-able lights, color wheels, disco balls, lasers, fiber-optic ropes, and fog (as a light transfer medium). The various lights and changeable properties will be under computer control.


3. 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.
4. 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.

5. The scripting/programming language – you must develop an easy, graphical, drag-and-drop means of connecting input sequences to output sequences, to individualize the experience for each student. The system will be a tool for teachers and therapists to configure a lesson, to be integrated with speech, physical, and occupational therapies, and special education.

6. A single cause-and-effect, stimulus-to-response, input(s)-to-outputs(s) item will be called a puzzle. e.g. “Hit the green switch, then the blue switch, and the disco ball will turn with your favorite song playing”, is one puzzle.

7. Many puzzles comprise a lesson for a student. The puzzles can be presented serially – in increasing difficulty – or in parallel (all at once), or the same puzzle presented repeatedly, giving the student many cause-and-effect possibilities to experience at once.

8. Session control – a means must be designed to structure lessons into a session, including session start, finish, and assessment that a right or wrong answer was given, either automatically determined or manually input by the therapist. A session is time-based; for example, a therapist might structure a session for Wednesday, at 1 PM, to include Lessons 1, 2, and 8, and repeat Lesson 6 twice.

9. Individualized experience – therapists and teachers must be able to save the developed sessions (comprised of lessons) and the lessons (comprised of puzzles) into student profiles, to be reloaded for an individual student later.

10. Progress statistics – the results of each session must be saved as an accumulation of right and wrong choices, so that teachers can chart the student’s progress over many weeks and months. A good idea might be to save session statistics under a student name, the data and time the session was given, and the lessons that comprised the session.

11. Progress assessment – the therapists who use this system must be able to judge the progress of a handicapped student’s learning:
   - Are they capable of following verbal instructions?
   - Do they need visual cues?
   - Do they require hand-over-hand help?
   - Are the results repeatable from session to session?
   - Is progress being demonstrated?

12. Note the following progression:
   a. inputs and outputs combine to form a puzzle.
   b. puzzles are grouped into lessons
   c. lessons are grouped into sessions, presented to a student at a particular date and time
   d. sessions are saved under a student profile
e. statistics are compiled for each occurrence of a session
f. session statistics are saved

Simulation

In the absence of purchased hardware, inputs and outputs must be simulated via software on the control PC. Graphics which simulate the selection of switches using mouse-selection and corresponding actuation of lights and sound, will be required. The simulation must be sufficiently de-coupled from the core software, so that it can be removed and replaced with software drivers when the hardware becomes available.
**Phase 1: Deriving Customer Requirements**

1. List 10 questions about the system that are left unanswered in the brief system specification above.

2. Send at least one team member, preferably the entire team, to the Center for Handicapped Children and meet with Nancy Godson, Tim Sember, or Dale O’Toole, to discuss the needs of teachers and therapists, and to see choice-making in action. Call 204-0355 for an appointment. The school is located at 80 Lawrence Bell Drive, Williamsville (near ECC North). Dress nice. Please wait until we talk about the center’s students in class.

3. Find at least 10 web sites that offer information or products dealing with augmentative input devices and sensory, light, and sound outputs, including commercial stage lighting. Pay particular attention to the mounting and construction of the hardware.

4. The document that a potential customer presents to you, the software system designer, requesting a system design is called the System Specification, and it contains much more information than the one included above. Design a Table of Contents for such a document. Hint: its intent is usually to request help solving a problem. It has a fixed budget and schedule. The allocation of hardware and software is usually specified. Your table of contents is meant to satisfy deficiencies in the intentionally-vague system specification above.

5. The last item in your table of contents (above) should be the “Summary Table” of requirements. This is a simple list of the individual capabilities of the end system, nicely numbered for reference later. Construct the table. This table, will serve you later in the design phase, to assure that all items that need to be designed and coded are included.

6. The document that you would submit in response to the customer’s System Specification is called a Software Requirements Specification (the “SRS”) and tells a potential customer how you intend to solve his problem. It must be approved before specific design begins, but will give in general terms enough details to get a customer to agree to a contract. Write the Table of Contents for the SRS.

7. Central to the finished SRS is a block diagram of the hardware / software architecture. Draw a block diagram of your architecture as you see it today (although it will likely change), in any format (UML, Visio, anything).

8. Knowing that the customer may change his requirements as the project progresses, and that new operations may need to be added, suggest an integration thread, or first-pass partial design, containing a subset of the requirements. Explain why your integration thread can serve as a foundation for the remainder of the system to be built upon. For an explanation of what, exactly, constitutes an integration thread, read the essay on Objects and Modeling on the web site.
Phase 2: Design - In this phase of the project, you will produce detailed design sufficient to code.

Document 1 (for the customer and your engineering implementation team) – the Top Level Design Document - TLDD – Write and illustrate a short (3-4 pages) document that outlines the system architecture, and explains the functions of each module, their interfaces to each other, and their interfaces to the hardware of the system. Produce a drawing of some kind (block diagram, cloud chart, UML, or invent one) that illustrates the relationships between modules. This exercise is to get your team to appreciate the difficulty of getting a design across to customers and (eventually) the coders. This document is often reviewed at a Top-Level or Preliminary Design Review, and results in permission to continue to the detailed design phase.

Document 2 – your team’s coding standards, no more than 2 pages.

Document 3 – Project Plan – Schedule and Budget

You must plan the entire project, as if you are a commercial software development team. For the purposes of planning the project in its entirety, imagine that your team has unlimited resources.

1. List all the tasks to be completed, in a table
   • Rows are to be the tasks
   • Three columns:
     - the man-hour estimate for each task
     - the number of people who can work effectively and simultaneously on the task
     - the precedent tasks - task(s) that must be completed prior to performing this task

2. Do a Critical Path (Pert) Chart

3. Using a rate of $85/hr., calculate the total job cost.

4. Using the Critical Path chart, calculate the calendar time of the complete job.

5. Using the Critical Path chart, calculate maximum effective team size.

6. Prepare to defend your estimates in a competition in class.

Phase 3: Demo

Implement your system using the graphical simulation as outlined in the System Specification. Each team will demonstrate their project in class.
Advice:

Team Building

Hopes and Fears

Purpose: To identify initial apprehension about this course and the idea of using teams as a major component of the course.

Think about the course. Take out a piece of paper. On one-half of the sheet of paper, make a list of your "hopes" for the course: what you hope to learn and/or what you hope to achieved. The focus is optimistic, and participants should respond as if considering the ideal circumstances.

On the second half of the sheet you are asked to write down your "fears": concerns, apprehensions, misgivings, etc., about the anticipated group/class sessions.

After a few minutes, we will create a class list of hopes and fears. Each person will take a turn, introduce yourself, and cite one hope and fear. The next person can either repeat or offer an additional item from their list.

TRUST

Trust is a powerful and essential educational tool; it is the key to personal involvement.

Learning involves risk. People are at risk when they learn. This risk may be physical, social, emotional, or intellectual in nature. Learning involves personal growth.

Clarence Darrow once said: "Unless a fellow moves ahead, he's left behind."

Software Engineering frequently utilizes the concept of working together. Teams can accomplish more than individuals can working alone. "The whole is greater than the sum of it's parts."

For teams to work, each team needs to nurture the personal confidence of each team member. The establishment of trust among team members is essential. Trust means that: "I don't have to "do" everything; if I try something and fail my peers will be supportive of my efforts; I will not be laughed at or made to appear foolish; my ideas and comments will be considered without ridicule."

An individual will seldom take a physical or emotional chance if they perceive callousness and unreasonable risk as part of that risk-taking. A group surrounded with positive experiences and successes will experience trust growing quickly along with personal confidence.

Trust, within the framework of a team is gained with patience, thoughtfulness and care over a period of time, and can be damaged or lost in a second by carelessness or inconsiderate behavior. Cultivate and protect the trust that an individual offers and shares.

Some of the paragraphs above were abstracted or adapted from: Silver Bullets by Karl Rohnke
Team Resource Inventory (second week exercise)

Select a "recorder" for this exercise. The "recorder" is responsible for note taking, and typing the answers to the questions below. When typed, this material should be turned in to the instructor on the due date, and re-distributed to all team members. This is the first required Team Log.

Develop a list of team skills (and who has them) in the following areas:

I) Technical Skills: What are the technical skills possessed by the team?
   - What programming languages do team members know?
   - What/who possesses HTML skills, CGI skills etc?
   - What drawing or software packages do team members use?
   - What other technical skills do team members possess?
   - How comfortable are team members with learning new skills? (It is just as appropriate for team members to not want to learn new skills as it is to feel comfortable doing so! Honesty is the key here!)

II) Writing skills
   - What is the longest paper each team member has written?
   - What course(s) were such papers written in?
   - What are your team's feelings about writing lots of documentation?
   - How do members usually write papers? (ex. Word, TeX)
   - How comfortable are team members with written English?

III) Business and Team Experiences
   - Which team members have had team/group experiences. Have they been CSE work related experience?
   - Have members had team experiences in school or at work? Describe them in a short paragraph for each member's experience: was the experience positive or negative, best part, worst part, what did you learn? (There may be more than one paragraph per member depending on the number of team experiences they have had.)
   - Have any team worked for a CSE related corporation? Have they worked on teams? Have any team members worked on business related teams but not in a CSE related setting? Describe them in a short paragraph for each member's experience: was the experience positive or negative, best part, worst part, what did you learn? (There may be more than one paragraph per member depending on the number of team experiences they have had.)

IV) Personal Information
   - Who is on the team? What are their home phone numbers (and/or cell phone)? What are their login names? What classes are they taking?
   - Gather the schedules of team members, including formal TIME commitments other than classes (ex. work, day-care pickup, sports, etc).
   - Have members any "problems" that are likely to effect the team (ex. commute from far away, family/children issues, job issues, job hunting)? Formally record these and to whom do they belong.
**Dismissing (Firing) a Team Member**

In CSE4/542, faculty in a random fashion assigns Teams and their associated team members. All individuals are different and bring to relationships, including classroom team relationships, different perspectives, skills, experiences and abilities.

Teams are expected to learn to work together in a cooperative fashion, and class time is spent on team development. Trust, hard work and honesty are all key factors in all team endeavors.

Despite good intentions, and efforts, from time-to-time some individuals fail to take their roles as team members seriously. Whatever the reason, this produces anger and frustration among the rest of the team. If such an individual should be a member of your team this procedure must be followed prior to the dismissal of the team member. A dismissal removes the individual from the team. This individual is then required to attempt to complete the project on his or her own. This is equivalent to a grade of F for the dismissed student.

**Procedure for Dismissal:**

1) Active members should make significant efforts to contact the non-participating or intransigent member both by email and telephone.

2) Provide a "paper-trail" of all electronic messages between the team and the non-participating member.

3) Contact the Instructor and discuss your team's problem. The Instructor will contact the non-participating member and discuss the situation. The Instructor will attempt to develop a solution that will re-unify the team.

4) Once team members suspect that is may be necessary to dismiss a member, team members should copy the Instructor on all team communication and include copies of email messages to/from the non-participating member.

5) If after all of the above attempts, the team still decides that dismissal is appropriate, a memo identifying the non-participating member and explaining the team's reason for dismissal must be turned into the Instructor. All the members of the team (except the non-participating member) must sign this note.

A team member may not be dismissed simply because skills level does not match that of the rest of the team or because there is no social compatibility with the rest of the team. Large amounts of text are written and edited in each portion of the project and significant testing is required by the final phase. As such there is always some varied task, central to the project, that team members can successfully complete.
Academic Integrity – Computer Science & Engineering - CSE4/542

The academic degrees and the research findings produced by our Department are worth no more than the integrity of the process by which they are gained. If we do not maintain reliably high standards of ethics and integrity in our work and our relationships, we have nothing of value to offer one another or to offer the larger community outside this Department, whether potential employers or fellow scholars.

For this reason, the principles of Academic Integrity have priority over every other consideration in every aspect of our departmental life, and we will defend these principles vigorously. It is essential that every student be fully aware of these principles, what the procedures are by which possible violations are investigated and adjudicated, and what the punishments for these violations are. Wherever they are suspected, potential violations will be investigated and determinations of fact sought. In short, breaches of Academic Integrity will not be tolerated.

The university has a responsibility to promote academic honesty and integrity and to develop procedures to deal effectively with instances of academic dishonesty. Students are responsible for the honest completion and representation of their work, for the appropriate citation of sources, and for respect for others' academic endeavors. *By placing their name on academic work, students certify the originality of all work not otherwise identified by appropriate acknowledgments.*

* Adapted from the University of Wisconsin's Student Disciplinary Guidelines.

All academic work must be your own. Plagiarism, defined as copying or receiving materials from a source or sources and submitting this material as one's own without acknowledging the particular debts to the source (quotations, paraphrases, basic ideas), or otherwise representing the work of another as one's own, is never allowed.

http://www.cse.buffalo.edu/academics-academic_integrity.shtml
http://undergrad-catalog.buffalo.edu/0203/undergraduateeducation/strights.shtml

Departmental Policy on Violations of Academic Integrity

Any student accused of a violation of academic integrity will be so notified by the course director. An informal review will be conducted, including a meeting between these parties. After this review and upon determination that a violation has occurred, the following sanctions will be imposed. **It is the policy of this department that any violation of academic integrity will result in an F for the course,** that all departmental financial support including teaching assistantship, research assistantship or scholarships be terminated, that notification of this action be placed in the student's confidential departmental record, and that the student be permanently ineligible for future departmental financial support. A second violation of academic integrity will cause the department to seek permanent dismissal from the major and bar from enrollment in any departmental courses. Especially flagrant violations will be considered under formal review proceedings, which may in addition to the above sanctions result in expulsion from the University.

Text adapted from http://www.cse.buffalo.edu/academics-academic_integrity.shtml