

Project Summary

Intellectual Merits

This Small Business Innovation Research Phase II project chooses to aid learning at the higher education level. This project specifically targets the problem modern colleges have with successfully educating students in entry level mathematics. In a sampling of colleges, more than half of the students attempting College Algebra failed to pass it (Miami-Dade Community College) (Austin Community). This project will improve the learning process by specifically improving the students personal study time... It was determined that teachers communicate at over 180 words per minute, whereas students are able to record notes only at approximately 20 words per minute. Furthermore, these incomplete notes suffer from their static nature, and cannot repeat the step-by-step processes fundamental to mathematics. The objective of this project is to develop a working integrated multimedia recording and distribution system based around commercially available digital whiteboard technology. The entirety of the instructor's oral lecture and written notes will be stored in a compact, real-time format that will be distributed to students. Phase I of this project has proven the viability of recording and synchronizing the audio and graphical data. The exploratory research has proven the feasibility of gathering the data, synchronizing it, and storing it in a readily distributable format.

Broader Impacts

This project will offer several broad advancements to modern digital presentation technology. Foremost, this project will offer distribution methodology for presentations superior to current options. This will be achieved by storing all graphical information in a vector-based format which is much smaller and much more accurate than bitmap or raster graphics. Additionally, storing graphics as vector-based strokes with timestamps will allow the real-time replay of the presenter's written notation in such a way that it directly replicates the timing and order of the original writing. This will give a lossless repeat of the presenter's performance in a visual style equivalent to a movie, but with file sizes several orders of magnitude less, while also escaping the compression and lossy data storage that plague modern digital movie formats. This project's achievements can not only be used in university mathematics instruction but also across all subjects in a university setting, especially ones featuring step-by-step processes such as physics, chemistry, and other technical subjects. Beyond the university level, this project would be a superior solution to most applications used by digital whiteboards in the business world. The ease of recording and distribution would allow businesses to integrate the product into their daily communication.

Keywords

Digital presentations, vector graphics, digital communication, multimedia, mathematics instruction, educational, media synchronization

Topic

Information-Based Technologies (IT)
F. Education Applications
2. Applications in Support of Learning
c. Content authoring systems

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NSF Form 1359 (10/99)



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Project Description

1. Results of the Phase I Project

The Student Audio Visual E-tool required several innovative advancements to be made before it could be taken from the conceptual phase to the laboratory prototype phase. These technological improvements required our team to analyze the existing hardware and software algorithms, make decisions on which to use, and develop in-house those pieces which had no viable solution in the current industry. In Phase I of this project, we demonstrated that all of the necessary criteria were met for the project to be feasible, and that further research and development would be met with success.

The most significant technical hurdle researched by our team was the conversion of the input from pixel-based raster graphics to line-based vector graphics. Using vector graphics is critical to our solution because of the significant advantages it offers us. Vector graphics are by definition smaller than raster graphics because they only store the pen strokes as drawn by the presenter. Vector graphics are also better at capturing critical data, and offer the ability to zoom in on a smaller subset of the display area without losing definition or resolution of the drawn material. All current digital whiteboard presentation software current operates off of raster graphics and fails to offer any of the advantages of vector graphics. Current technology would only provide a small, grainy video file that is over 275 megabytes for three hours worth of presentation.

We decided the best course of action for this problem was to develop our own solution using custom algorithms. Our first attempt was to use a simple intermittent snapshot of the graphical input. Using this, we would determine where a new line segment was being drawn by comparing the differences between the new snapshot and the previous one. While this approximated the presentation, it ended up capturing too much data when the lines were being drawn slowly and too little data when the lines were being drawn quickly. Our next solution involved sampling the points as they were being drawn. Instead of having a time based snapshot five times per second, we were capturing one out of every 5 points being drawn, and using those to drawn lines. This gave much more even performance over all drawn lines but had a lot of problems with jagged edges where curves were missed. Our final solution used point sampling with the addition of Bezier curves. Bezier curves allow the computationally fast drawing of a curve. Using these we were able to smooth out the worst jagged edges with little performance loss. This solution finally met all of our needs

Past the vector graphics problem, we were still faced with synchronizing the graphical data with the audio data. Luckily, current state-of-the-art audio compression algorithms were found to be sufficient for our needs. Upon researching and refining our choices, we determined that modern compression schemes had sufficient time encoding and low enough latency that we could efficiently timestamp the vector strokes with the current point in the recording timeline and be able to quickly and imperceptibly seek to the

appropriate position within the audio data. Once this was done, the synchronization of the playback was kept within tolerable limits.

These two main research areas comprised the bulk of our research and development efforts within Phase I of this project. All of our major questions were answered, and all of our main concerns were satisfied. With this, we believe we are prepared to succeed in Phase II of the project.

Once this project is completed, we will be able to deploy this system to solve the needs of educators in multiple subjects on multiple levels. Specifically, we will initially target the mathematics courses of colleges and universities. These courses are most direly in need of support, because mathematics represents the area of greatest difficulty for today's student. By allowing the student to easily replay and study the presentation in their own time as many times as they want, we offer them a way to study in the most effective manner for themselves. We feel educational institutions will see the profound benefit this system will offer to their students, and accept it into their classroom environment.

2. Phase II Technical Objectives and Work Plan

2.1 PROBLEM DESCRIPTION:

SAVE will aid students in their personal study time by facilitating the availability of recorded lectures as a reference that can be viewed on demand. Current options are insufficient for fulfilling the needs of the students who seek a reliable reference to repeat and reinforce the study material in order to overcome short term memory and digest the subject based on actual classroom lectures.

Textbooks offer only one perspective on the material being learned and risk ignoring the teacher's input or the course's specific which may leave the student in a state of uncertainty about the classroom material versus the Textbook material. Another option is private tutoring which is generally expensive and unviable to most students. Furthermore, private tutoring offers help with only those specific classes being tutored. The most prevalent option for students currently is studying from lecture notes taken by the student personally during lectures. However, It is near impossible to transcribe all the material given by the instructor. Handwriting can not effectively keep up with the speed of spoken words let alone any drawn or written material the instructor offers. Additionally, lecture notes offer only a static view of the content. In curriculums such as history, this may be acceptable since the majority of the facts can be understood independent of each other. In curriculums such as mathematics, this is not the case since techniques are based around several related steps that can not be comprehended without comprehending how they relate to each other. It is necessary to grasp each of the progressive and iterative steps of a given problem solving technique. This is the main reason why SAVE aims at aiding mathematics curriculums specifically more than any other class subject.

Current solutions for classroom technology are insufficient to properly meet these needs. The widespread use of digital projectors and slide show presentations across most academic subjects only offer static, inflexible views of information. This allows no iterative explanations of problems, no dynamic changes done by the professor, and no interaction with the class. This is completely insufficient for problem solving and is why this solution is rarely used for algebra, calculus, and other beginning college level math courses. Video cameras are another classroom technology option that has been available for some time, but yet to find a place in the mathematics classroom. The need to be operated by a technician, the poor reproduction of the board contents due to light and angle, the psychological effect on students' classroom participation and the difficulty of distributing the tapes are all factors that play against using the video camera as a solution. A relatively new classroom technology is the use of satellite and Internet-based courses to record and distribute the content to students remotely. The huge overhead cost for establishing such a service renders this option to be exclusive to educational institutions with high budgets.

2.2 SOLUTION DESCRIPTION:

We choose to solve this problem by recording the professor's narrative lecture using a wireless microphone and the professor's written notation using a digital pressure sensitive whiteboard. This content will then be synchronized together, stored in an efficient format, and distributed via the internet to students for playback on their own computer of use. We term this solution Student Audio/Visual E-tool or SAVE.

Vector-based recording will allow us to have a high quality graphical reproduction and also be able to store the graphical data in a format that will be one hundredth to one fifth the size of other graphical storage formats. Synchronization is integral to being able to replicate the presentation in a coherent format on the students' own home computer. Drawn gestures are a very significant innovation and will allow the teacher to send commands and instructions to the recording software for purposes of content control and authoring without interrupting the flow of their instruction. Developing gesture recognition technology will allow us to seamlessly integrate this with our product. Storing all this data in an appropriate format is necessary to be able to distribute this file over the internet to the students for their own personal study time.

SAVE will be composed of COTS hardware elements and newly written software. The system will allow the complete recording of any classroom lecture, including both Audio and Video. The major functional components of SAVE are:

- a. Classroom computer.
- b. Digital whiteboard
- c. Wireless microphone
- d. Student computer
- e. The Internet
- f. SAVE's software

Functionality Diagram



The digital whiteboard will be connected to the classroom PC and all written contents on the board will be captured and converted into vector based graphics. The wireless microphone will capture the instructor's speech and SAVE will synchronize audio and video to produce a single output file. The file can then be distributed to students via the Internet as a download.

2.3 RESEARCH GOALS:

A prototype SAVE has been built to demonstrate basic functionality and to allow an assessment of performance to reveal any design or construction shortcomings. Based on our prototype testing, the system as originally designed and intended is viable and the majority of the planned features are possible. The prototype demonstrated successful capture and conversion of drawn images into digital vector format, audio capture, audio/video synchronization, file saving and playback. Future research goals will include implementation of other features which include gesture control and audio compression.

Marketing will be a significant research goal on the agenda. As the project evolves into a product, marketing will become one of the most important tasks, covering customer research, market analysis and competition assessment.

2.4 WORK PLAN:

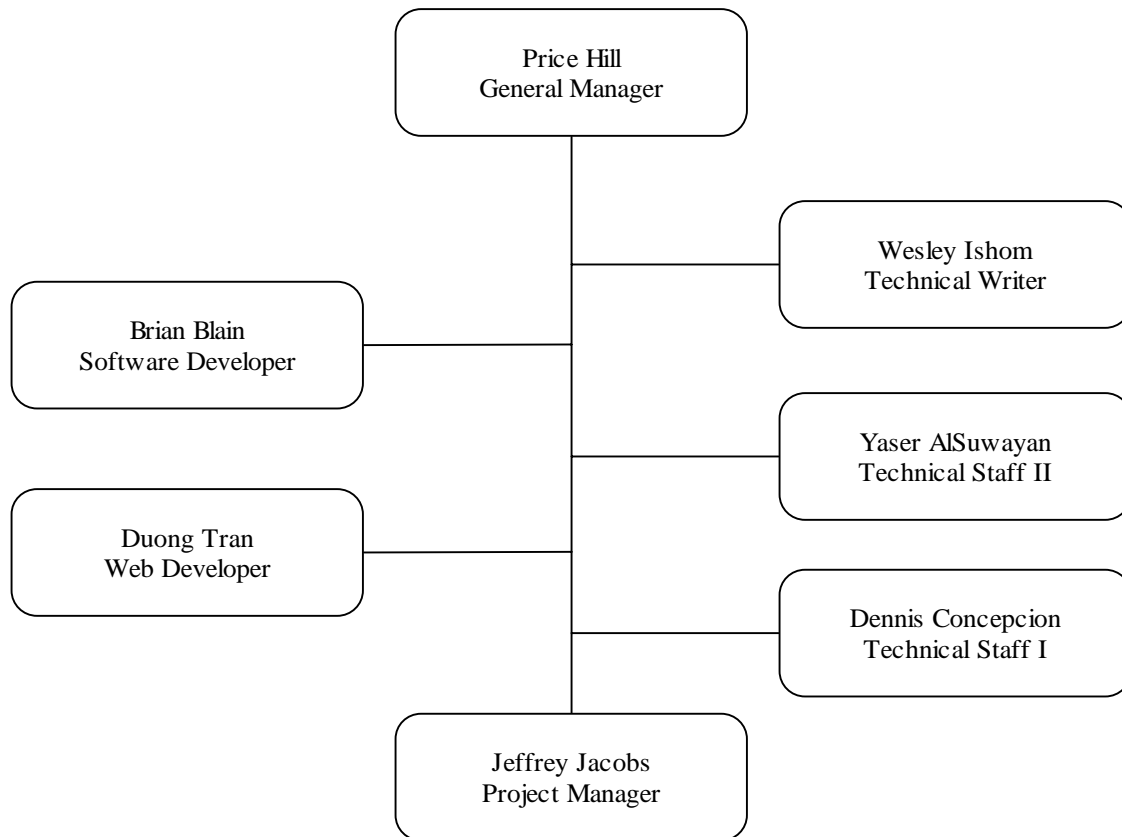
The milestones for Phase II include documentation, product development, marketing, acquiring funding and website implementation.

Task	Duration	Start	Finish	SBIR funded
SAVE phase II	730 days	Fri 6/10/05	Sun 6/10/07	N/A
Documentation	130	Fri 6/10/05	Tue 10/18/05	No
SAVE Development	330	Wed 10/19/05	Thu 9/14/06	Yes
Research website	180	Sun 12/11/05	Fri 6/9/06	Yes
Funding	181	Mon 12/11/06	Sun 6/10/07	No
Marketing research	152	Mon 12/11/06	Sat 5/12/07	No
Commercial website	180	Mon 12/11/06	Sat 6/9/2007	No

NOTE: SOME TASKS OVERLAP IN DURATION.

Note: Weekends are considered as workdays. Actual dates may change once weekends were factored in.

3. Organizational Information



General Manager: General Manager is a professional who assigns the project to project manager. General Manager makes contracts with businesses. General Manager chooses the right project manager to reassign the project.

Project Manager: Project manager plans and executes the project. Project manager organizes the team to complete the project. Project manager knows each member and each member's knowledge. Project manager has a great communication and management skills. Project manager identifies risks and reduce risks. A great project manager makes a great project.

Software Developer: Software developer designs, creates, tests, debugs, and updates software. Software developer writes partial or complete code using programming languages such as C, C++, and cSharp. Software developer has good programming background.

- Web Developer:** Web developer is responsible for the web site. Web developer creates and maintains the web site. Web developer tests the web site to make sure all links are valid. Web developer uses web tools and programs to create the web site.
- Technical Writer:** Technical writer creates documents for software and hardware. Technical writer is responsible for creating, editing, writing, and organizing technical papers. A user manual is a part of technical writer's work. Technical writer understands the customer and has good knowledge of technology.
- Technical Staffs:** Technical staffs deal with customers. Technical staffs are responsible for answering customers' questions. Technical staffs understand the product and have excellent communications. Technical staffs answer customers via email, phone, and in person.

4. Consultant and Subaward Agreements

A. Consultants

Educational Consultant

The educational consultant is utilized in the understanding of educational methodologies that will support the development of the project. The consultant will assist in the development of a product that will positively affect student's learning ability by emphasizing repetition of step by step problems. By attaining an outside source with explicit studies involving educational methods, the hope is to clearly determine areas of teaching that can make the most of technology to improve educational practices.

During phase two of the intended grant proposal the educational consultant will be acquired as a resource in analyzing the problematic areas of study. Advice on these problematic areas will aid in the design and production of the product as well as suggestion and critiquing of features and components of the product.

The educational consultant will be on hand for a limited period of time during each of the four parts of phase two which is comprised of two development phases and two testing phases. The consultant will be representing the opinions of the consensus in the locations (universities, schools, etc.) that will be used during this phase. The consensus will include evaluations from teachers and students that will be presented in the way desired by the consultant (survey, poll, etc.). Being present in the classrooms during testing phases will assure accurate data and reactions for and against the product. The consultant will have

sole responsibility of these forms and will provide a complete analysis of the results in a useful and understanding fashion.

Desired Educational Consultant

Richard C. Overbaugh, Ed.D.
Darden College of Education
Department of Education Curriculum & Instruction
Old Dominion University
Norfolk, VA 23529-0161
roverbau@odu.edu
<http://www.odu.edu/educ/roverbau/vita/vitae.htm> as of December 15, 2004

Mr. Overbaugh is a program coordinator and professor for instructional design and technology. He has implemented technology into the classroom and curricula in order to promote learning.

Technical Consultant

The technical consultant desired will be projected as an expert in the field of audio and visual elements. The consultant will collaborate primarily on the hardware aspects of the product as well as make suggestions towards the interaction between these components and the software used to capture the data of the components. The expert attained will have experience in developing new hardware and possibly experience in the audio or visual components suggested.

For the duration of phases two the technical consultant will be scheduled to provide guidance during the development sub phases of the product. The consultant will have knowledge of the latest technologies to be employed in the development and provide options in hardware alongside each advantage and disadvantage to the technology. Researching and approving the best and most cost efficient solution to the businesses hardware and software needs will be a prime responsibility of the technical consultant. Assistance in the design of the hardware's operation will relieve possible time constraints due to any lack of unspecialized operational employees of the business.

Desired Technical Consultant

Garry Musgrave
Conceptron Associates: Independent Audio-Visual Design Consultants
1195 Durant Dr.
Coquitlam, BC Canada V3B 6R3
gmusgrave@conceptron.com
http://www.conceptron.com/profile/tech_resume.html as of December 15, 2004
Mr. Musgrave is an independent audio and visual consultant with over 20 years of experience. He is a member of many authorized professional associations as well as a certified technology specialist – design (CTS-D).

B. Subaward Agreements: CS250 and CS300 Subcontracts

Notice: This non-copyrighted contract form is taken from FindLaw for Small Business. This contract defined below is for educational use only.

CS250 and CS300 Subcontract

SUBCONTRACTOR WORK ORDER AGREEMENT TERMS AND CONDITIONS

1. INDEPENDENT CONTRACTORS CS250, CS300 and AZUL Business Corporation is independent contractors. Neither party is an employee, agent or representative of the other party. Neither party shall have any right, power, or authority to enter into any agreement for or on behalf of the other party, or to incur any obligation or liability or otherwise bind the other party. This Agreement does not create an association, joint venture, or partnership between the parties nor imposes any partnership liability upon either party.
2. WARRANTIES Subcontractor warrants that Subcontractor has the right to enter into this Agreement and further warrants that:
 - a. The service shall be performed in a good and professional manner
 - b. The Subcontractor shall at all times comply with AZUL Business Corporation or its client's security provisions and other educational and governmental policies and procedures made known to Subcontractor
 - c. The Subcontractor shall not violate or infringe upon any their party rights, including but not limited to property, contract, employment, trade secret, confidential and proprietary information, or any trademark, copyright or patent rights; and
 - c. The Subcontractor shall not violate any applicable federal, state, or local laws, rules or regulations in the performance of services under this Agreement.
3. OWNERSHIP All work or materials developed or provided by Subcontractor under this Agreement, shall be deemed work made for hire and owned exclusively by AZUL Business Corporation. Such work or materials shall include and is not limited to data, notes, plans, documentation, specifications, designs, files, software (in source and object code form), upgrades, revisions, modification, or enhancements. In the event such work or materials may not, by operation of law, is work made for hire.

Subcontractor hereby assigns to AZUL Business Corporation all rights in such work and materials and all copyrights and patents rights therein. Subcontractor shall also disclose to AZUL Business Corporation all discoveries, inventions, ideas or techniques (inventions) made by Subcontractor in the performance of services under this Agreement. All such Inventions shall also be owned exclusively by AZUL Business Corporation.

4. INDEMNIFICATION Subcontractor shall indemnify and hold AZUL Business Corporation, its officers, employees and agents harmless from all claims, liability damages, losses and expenses arising from:
 - a. Any personal injury (or death) or damage of any property arising out of or in any way connected with any act or omission by Subcontractor in the provision of services under this Agreement;
 - b. Any taxes or other payments owned by Subcontractor to any governmental agency as a result of any services provided hereunder, any compensation owned to any employee or subcontractor of Subcontractor for services provided hereunder, or any determination that Subcontractor is not an independent contractor; and
 - c. Any claim by a third party that the work or materials provided hereunder infringes a copyright, patent, trade secret or other intellectual property right of such third party.
5. CONFIDENTIALITY In the course of providing services hereunder, Subcontractor may have access to confidential and proprietary information and materials of AZUL Business Corporation or its clients (Confidential Information). Confidential Information includes and is not limited to, information related to past, present or future research, development or business affairs, any proprietary products, materials or methodologies, or any other information which provides AZUL Business Corporation or its clients with a competitive advantage. Confidential Information shall be used by Subcontractor only in conjunction with the provision of services hereunder and shall not be disclosed to any third party. No rights or licenses under patents, trademarks or copyrights are granted or implied by any disclosure of Confidential Information.

Upon AZUL Business Corporation's request, completion, or termination of this Agreement, Subcontractor shall return all Confidential Information to AZUL Business Corporation. This Section 5 shall survive the expiration or termination of this Agreement.

6. TERMINATION

- a. AZUL Business Corporation has the right to immediately terminate this Agreement without cause upon ten (10) days prior written notice to Subcontractor.
 - b. Either party may terminate this Agreement upon ten (10) days prior written notice to the other party if the other party is in default of any provision of this Agreement and such default is not cured within the ten (10) day period.
 - c. Upon termination of this Agreement, Subcontractor shall cease all work and shall promptly provide AZUL Business Corporation, without additional cost to AZUL Business Corporation, all work and materials developed by Subcontractor under this Agreement. Subcontractor shall also return to AZUL Business Corporation all materials and Confidential Information provided to Subcontractor in connection with this Agreement.
7. NONCOMPETITION AND SOLICITATION AZUL Business Corporation may, in connection with this Agreement, disclose to Subcontractor Confidential Information regarding AZUL Business Corporation's clients and the products and services to be provided to such clients by AZUL Business Corporation. In consideration of the fees to be paid hereunder, Subcontractor agrees not to solicit such clients directly or indirectly, for any similar products and services during the term of this Agreement and for a period of one (1) year thereafter.

Subcontractor further agrees not to solicit or approach for employment, either directly or indirectly, any AZUL Business Corporation personnel during the term of this Agreement and for a period of one (1) year thereafter.
8. PUBLICITY AND TRADEMARKS Neither party shall publicize or use the name or trademarks of the other party in any manner, or those of AZUL Business Corporation's clients, without the prior written consent of the other party.
9. LIMITATION OF LIABILITY EXCEPT FOR DAMAGES ARISING FROM ANY NONCOMPLIANCE WITH SECTIONS 2, 3, 4, AND 5 IN NO EVENT SHALL EITHER PARTY BE LIABLE FOR LOSS OF PROFITS, REVENUE, DATA OR USE OR FOR ANY INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, HOWEVER CAUSED, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.
10. NONEXCLUSIVITY This Agreement is nonexclusive and the parties may enter into similar agreements with other parties without restriction as to number, location and application.
11. NOTICES Any notice, request, authorization, direction, or other communication under this Agreement shall be given in writing and delivered in person or by certified or first-class United States mail, properly addressed and stamped with the required postage to the intended recipient.

12. NONWAIVER The failure of either party to insist upon or enforce strict conformance by the other party of any provision of this Agreement or to exercise any right under this Agreement shall not be construed as a waiver or relinquishment of such party's right unless made in writing and shall not constitute any subsequent waiver or relinquishment.
13. INVALID PROVISION The invalidity or unenforceability of any provision of this Agreement shall not affect the other provisions hereof, and this Agreement shall be construed in all respects as if such invalid or unenforceable provisions were omitted.
14. CUMULATIVE REMEDIES The rights and remedies afforded to either party pursuant to any provision of this Agreement are in addition to and do not in any way limit any other rights or remedies afforded to either party by any other provision of this Agreement or by law. All such rights and remedies are cumulative and may be exercised singularly or concurrently.
15. SUCCESSORS AND ASSIGNS Neither party may assign any rights hereunder without the prior written consent of the other party, which consent shall not be unreasonably withheld. Any assignment of rights shall not work as a novation of obligations hereunder without written agreement.

Any attempt to assign any rights, duties, or obligations hereunder without the other party's written consent will be void. Notwithstanding the above, either party may assign this Agreement to a surviving entity in connection with any merger, acquisition or consolidation.
16. SURVIVAL Sections 3, 4, 5, 6.3, 7 and 9 shall survive any termination of this Agreement.
17. ENTIRE AGREEMENT This Agreement and its attachment(s) set forth the entire agreement between the parties and supersedes any and all prior or contemporaneous agreements of the parties with respect to the subject matter contained herein. AZUL Business Corporation shall not be bound by, and specifically objects to, any term, condition, or other provision inconsistent with or in addition to any provision of this Agreement that is submitted by Subcontractor in any correspondence or any other document, unless AZUL Business Corporation specifically agrees to such provision in a written instrument signed by an authorized representative of AZUL Business Corporation. No change, amendment, or modification of any provision of this Agreement shall be valid unless set forth in a written instrument signed by both parties.
18. APPLICABLE LAW This Agreement shall be governed by the laws of the Old Dominion University.

SUBCONTRACTOR AGREEMENT

SCHEDULE A BETWEEN

CS250

AND
AZUL Business Corporation

PROJECT CODE NO. SAVE

Following the successful delivery of services, AZUL Business Corporation will pay CS250 in accordance with the following fee schedule and payment terms. This Schedule A shall be subject to the terms and conditions of the Subcontractor Work Order Agreement between CS250 and AZUL Business Corporation.

1. STATEMENT OF WORK: AZUL Business Corporation agrees to provide the necessary resources to CS250 to research and develop the following six categories described below, using the website and prototype developed by AZUL Business Corporation:
 - a. The class will be divided into groups of 5 or 6 and each group will address 3 or more possible test cases to cover all the possible events that may occur during the use of the program.
 - b. The programming module has to strictly conform to the programming guidelines and specifications. In addition, each module has to be debugged and tested for easier integration with other modules. Each team in the class will only be responsible for that particular programming module.
 - c. AZUL Business Corporation's software engineering team will create the programming specifications for every function that is needed for the program. The CS250 class will write the underlying code that is needed based on the programming specifications provided to them by the software engineering team.
 - d. Their written programs must compile and with no warning.
 - e. The compiled program must perform and pass all the test cases and must pass all the test cases.
 - f. The output of the program must be readable and logically correct.

g. Below is the software programming outline:

- 1) Recording Software – develop an application to record and synchronize the information written on a digital whiteboard along with the vocal oration spoken synchronously
 - a. Hardware Interface - create an interface for receiving communication from a digital pressure sensitive whiteboard
 - i. Use applicable existing APIs to communicate with the third party digital whiteboard
 - ii. Ensure all necessary and relevant data is captured from the hardware device
 - b. Vector Conversion - convert the capture information from the hardware device into a vector based data storage format
 - i. Use efficient algorithms to ensure real time processing
 - ii. Record all collinear and synchronous data points as a single vector stroke
 - iii. Attach a timestamp to each vector stroke to determine the time from the start of the recording that it was received
 - iv. Ensure that the conversion algorithms offer the most minimal size of recorded data
 - c. Gesture Recognition – Parse the recorded vector information to determine if the user has drawn a manufacturer-defined symbol or “gesture”
 - i. Determine if drawn vectors occur within a user-defined area on the board, the “Command Square”
 - ii. Determine if the drawn set of vectors matches any of the manufacturer-defined symbols
 - iii. Enact the corresponding action if a match is found. Actions will include but are not limited to:
 1. Pausing the presentation
 2. Beginning a new problem or subject within the presentation
 3. Beginning a new step within the presentation
 4. Stopping the presentation
 5. Resuming the presentation
 6. Clearing the entire currently drawn screen
 - d. Audio Interface – create an interface to record the audio input from a classroom computers sound card
 - i. Compress the audio using modern compression algorithms and formats to use the least amount of storage space possible while still maintaining an understandable vocal recording
 - ii. Ensure that all recorded audio data can be synchronized at playback
 - e. File Storage - store the audio and graphical data in a single synchronized file format

- i. Process from both written gesture commands and directly computer initiated commands the segmentation of the file
 - 1. Segment the presentation into problems or subjects
 - 2. Segment the problems into steps
 - f. Real-time Playback – reproduce the drawn whiteboard presentation on the computer screen in real time during recording
 - g. User Interface – Develop a user interface to handle all user actions
 - i. New Presentation Dialog – offer the user options and actions to start recording a new presentation. Automatically fill in fields where possible
 - 1. User Input: Course/Title
 - 2. User Input: Subtitle
 - 3. User Input: Author
 - 4. User Input: Date
 - 5. User Action: Record Presentation – Moves to recording presentation dialog and begins recording
 - ii. Recording Presentation Dialog – display the currently recording presentation, and allow user to take certain actions
 - 1. User Action: Pause Recording – Stops the flow of time within the presentation
 - 2. User Action: Resume Recording – Resumes the flow of time within the presentation
 - 3. User Action: End Recording – Ends the recording and moves to the Save Presentation Dialog
 - 4. User Action: Move to next problem/subject – Inserts a segmentation marker within the recorded presentation
 - 5. User Action: Move to next step – Inserts a segmentation marker within the recorded presentation
 - iii. Save Presentation Dialog – Allows the user to finalize the presentation
 - 1. Allow the user to add additional meta data
 - a. User Input: Title each problem/subject
 - b. User Input: Title each step
 - 2. Save the file
 - 3. Distribute the file
 - h. Presentation Distribution - the stored file of the presentation should be distributable in a variety of ways
 - i. Stored on a local disk drive
 - ii. Stored on a LAN file server
 - iii. Transmitted over the internet to the central server
- 2) Playback Software – develop an application that can play back a previously recorded presentation
 - a. File Input

- i. Read the file recorded by the Recording Software
 - ii. Maintain proper synchronization of the presentations audio and graphical data
 - b. Presentation Playback
 - i. Playback the presentation on the user's computer screen.
 - ii. Maintain proper synchronization
 - iii. Utilize the vector format to allow lossless zooming in on user selected portions of the presentations graphics
 - c. Presentation Seeking – Allow the user to seek to specific times and events within the presentation
 - i. Display all problems and steps in a hierarchy
 - ii. Allow the user to seek between individual problems and steps
 - iii. Display a timeline seek bar to allow the user to seek to a specific time within the presentation
 - 3) Server Software – develop server software to receive, store, secure, and transmit previously recorded and finalized presentations
 - a. Build a component to receive the presentation file via a connected network
 - b. Store the files on a local or attached storage space
 - c. Create a database to track the stored files, and the associated user accounts
 - d. Allow web access to the stored presentation to authorized users
2. FEE SCHEDULE AND PAYMENT TERMS: AZUL Business Corporation will pay the subcontractor in kind instead and of monetary. This subcontracting work will serve as internship that the CS250 students can use towards satisfying the requirements of Computer Science Undergraduate Degree. The estimated duration of this effort is expected to be fifteen (15) weeks. This effort is scheduled to begin Fall Semester 2005.

Any work that may be required outside the scope of the above described services must be in the form of a written request by the AZUL Business Corporation Manager and processed as an addendum to this Schedule A.

AZUL Business Corporation will issue recommendations and certificate of internship completion to CS250 students upon the successful completion of the above described services, and the acceptance of those services by CS250.



AZUL Business Corporation
Old Dominion University
Computer Science Dept
Norfolk VA, 23529

AZUL Business Corporation

CS250

By: _____
Authorized Representative

by: _____
Authorized Representative

Name: _____

Name: _____

Title: _____

Title: _____

Date: _____

Date: _____

SUBCONTRACTOR AGREEMENT

SCHEDULE A BETWEEN

CS300

AND
AZUL Business Corporation

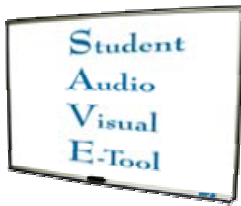
PROJECT CODE NO. SAVE

Following the successful delivery of services, AZUL Business Corporation will pay CS300 in accordance with the following fee schedule and payment terms. This Schedule A shall be subject to the terms and conditions of the Subcontractor Work Order Agreement between CS300 and AZUL Business Corporation.

1. **STATEMENT OF WORK:** AZUL Business Corporation agrees to provide the necessary resources to CS300 to research and develop the following six reports, using the website and prototype developed by AZUL Business Corporation
 - a. They are to research on the societal issues that might arise with the customer's purchase and use of the product.
 - b. They are to research on the physical issues that might arise with the customer's purchase and use of the product.
 - c. They are to research on the mental issues that might arise with the customer's purchase and use of the product.
 - d. They will write the user's manual in a user-friendly language. They will only use simple and easy to understand language constructs.
 - e. The user's manual will address all the societal, physical, and mental issues and concerns that may arise with the development, purchase and use of the product.
 - f. The user's manual will describe the process on how to install, use and take care of the product.
2. **FEE SCHEDULE AND PAYMENT TERMS:** AZUL Business Corporation will pay the subcontractor in kind instead of monetary. This subcontracting work will serve as internship that the CS300 students can use towards satisfying the requirements of Computer Science Undergraduate Degree. The estimated duration of this effort is expected to be fifteen (15) weeks. This effort is scheduled to begin Fall Semester 2005.

Any work that may be required outside the scope of the above described services must be in the form of a written request by the AZUL Business Corporation Manager and processed as an addendum to this Schedule A.

AZUL Business Corporation will issue recommendations and certificate of internship completion to CS300 students upon the successful completion of the above described services, and the acceptance of those services by CS300.



AZUL Business Corporation
Old Dominion University
Computer Science Dept
Norfolk VA, 23529

AZUL Business Corporation

CS300

By: _____
Authorized Representative

by: _____
Authorized Representative

Name: _____

Name: _____

Title: _____

Title: _____

Date: _____

Date: _____

5. Equivalent or Overlapping Proposals to Other Federal Agency.

NONE

References

Mathematic Resources

Baumslag, B. *Fundamentals of Teaching Mathematics at University Level*. London: Imperial College Press, 2000.

Mitchell, Richard. *College Algebra: Traditional Instruction Versus Instruction via Video Tape*. Ed. Mohammed H. Ahmadi. Lanham: University Press of America, 2002

Owens, Philip. (February 10, 2003). "Managing Attrition and Improving Instruction in College Algebra: A Radical (?) Approach" Online. Available: <http://www.austincc.edu/powens/attrition/attrition.htm> 2004, October 16.

National Council of Teachers of Mathematics.
<http://www.nctm.org/about/met/index.htm>

Simon, Beth *Five Questions* Online. Available:
<http://www.signonsandiego.com/news/computing/personaltech/20041115-9999-lz1b15five.html> 2004, November 15.

Equipment Resources

"Digital Whiteboards Buyer's Guide". 3M Meeting Network Product Solutions Product Buyer's Guide.
http://www.3m.com/meetingnetwork/products/product_guide_digital.html

eBeam - Interactive Whiteboard Technology <http://www.e-beam.com>

MicroTouch Ibid Systems, Inc. Review by American Institutes for Research: Human Factors and Design.
http://www.air.org/usability/case_studies/microtouch.html

Mimio by Virtual Ink. <http://www.mimio.com>

SmartTech www.smarttech.com

System Requirements <http://www.new-technologies.org/ECT/Internet/mimio.htm>

How to Build a Whiteboard. <http://www.ebibleteacher.com/howtomarkm.html>

PC Whiteboards FAQ http://www.gbcoffice.com/register_support/ibid/faq.htm

Educational Resources

Hodgdon, Linda A. *Visual Strategies for Improving Communication: Practical Supports for School and Home*. Troy: QuirkRoberts Publishing, 1998.

Kaplan, Howard. (1992). "Multimedia in Lecture Halls: Science & Math Visualizations". *THE Journal (Technological Horizons in Education)* Online. (3pp.). Available: InfoTrac OneFile. 2004, October 14.

Kiplinger.com. (no date). "How to Use the College Survey Data." Online. Available: www.kiplinger.com/tools/colleges/glossary.html 2004, October 18.

Miller, David and Derek Glover. (2002) "The Interactive Whiteboard as a Force for Pedagogic Change: The Experience of Five Elementary Schools in an English Education Authority." *Information Technology in Childhood Education Annual* Online. Available: <http://www.aace.org/dl/files/ITCE/ITCE200215.pdf> 2004, October 18.

National Center for Education Statistics. (2002) "Number of degree-granting institutions that enrolled freshmen, and the percentage of those institutions that offered remedial reading, writing, or mathematics courses, by institution type: Fall 1995 and 2000" *Quick Table and Figures* (2000) Online. Available: <http://nces.ed.gov/quicktables/Detail.asp?Key=1123> 2004, October 18.

"Visual & Auditory Learners." (no date). *ReadingInstructions.com: Superlinks Accelerated Learning & Reading Instruction Center*. Online. Available: <http://www.readinginstruction.com/readinginstruction/visuallearners.html> 2004, October 17.

"Will Changes in This Course Have a High Impact on the Curriculum?" (no date) *Center for Academic Transformations*. Online. Available: <http://www.center.rpi.edu/PewGrRdi/CRC1.html> 2004, October 16.

Blackboard <http://www.blackboard.com>

Lotus Learning Space
<http://www.lotus.com/lotus/offering3.nsf/wdocs/learningspacehome>

Anderson, Richard "Beyond PowerPoint: Building a New Classroom Presenter" *Campus Technology*, (2004) Online. Available: <http://www.campus-technology.com/article.asp?id=9537> 2004, November 6.

Miscellaneous Resources

National Science Foundation <http://www.eng.nsf.gov/sbirspeccs/IT/it.htm>

Nation Science Foundation Proposal Guidelines
http://www.nsf.gov/pubs/gpg/nsf04_23/nsf04_23.pdf

How Your Learning Style Affects Your Use of Mnemonics
<http://www.mindtools.com/mneme1sty.html>

Williams, J. R. (1998). *Guidelines for the use of multimedia in instruction*, Proceedings of the Human Factors and Ergonomics Society 42nd Annual Meeting, 1447-1451.

Brown, Bettina Lankard. "Learning Styles and Vocational Education Practice."
1998. <http://www.cete.org/acve/docs/pab00007.pdf>

**INFORMATION ABOUT PRINCIPAL INVESTIGATORS/PROJECT DIRECTORS (PI/PD) and
co-PRINCIPAL INVESTIGATORS/co-PROJECT DIRECTORS**

Submit ONE copy of this form **for each PI/PD and co-PI/PD** identified on the proposal. The form(s) should be attached to the original proposal as specified in GPG Section II.B. Submission of this information is voluntary and is not a precondition of award. The information will not be disclosed to external peer reviewers. **DO NOT INCLUDE THIS FORM WITH ANY OF THE OTHER COPIES OF YOUR PROPOSAL AS THIS MAY COMPROMISE THE CONFIDENTIALITY OF THE INFORMATION.**

PI/PD Name: Hill G. Price

Gender: ☒ Male ☐ Female

Ethnicity: (Choose one response) ☐ Hispanic or Latino ☒ Not Hispanic or Latino

Race:
(Select one or more) ☐ American Indian or Alaska Native
☐ Asian
☐ Black or African American
☐ Native Hawaiian or Other Pacific Islander
☒ White

Disability Status:
(Select one or more) ☐ Hearing Impairment
☐ Visual Impairment
☐ Mobility/Orthopedic Impairment
☐ Other
☐ None

Citizenship: (Choose one) ☒ U.S. Citizen ☐ Permanent Resident ☐ Other non-U.S. Citizen

Check here if you do not wish to provide any or all of the above information (excluding PI/PD name): ☐

REQUIRED: Check here if you are currently serving (or have previously served) as a PI, co-PI or PD on any federally funded project. ☐

Ethnicity Definition:

Hispanic or Latino. A person of Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture or origin, regardless of race.

Race Definitions:

American Indian or Alaska Native. A person having origins in any of the original peoples of North and South America (including Central America), and who maintains tribal affiliation or community attachment.

Asian. A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.

Black or African American. A person having origins in any of the black racial groups of Africa.

Native Hawaiian or Other Pacific Islander. A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.

White. A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.

WHY THIS INFORMATION IS BEING REQUESTED:

The Federal Government has a continuing commitment to monitor the operation of its review and award processes to identify and address any inequities based on gender, race, ethnicity, or disability of its proposed PIs/PDs. To gather information needed for this important task, the proposer should submit a single copy of this form for each identified PI/PD with each proposal. Submission of the requested information is voluntary and will not affect the organization's eligibility for an award. However, information not submitted will seriously undermine the statistical validity, and therefore the usefulness, of information received from others. Any individual not wishing to submit some or all the information should check the box provided for this purpose. (The exceptions are the PI/PD name and the information about prior Federal support, the last question above.)

Collection of this information is authorized by the NSF Act of 1950, as amended, 42 U.S.C. 1861, et seq. Demographic data allows NSF to gauge whether our programs and other opportunities in science and technology are fairly reaching and benefiting everyone regardless of demographic category; to ensure that those in under-represented groups have the same knowledge of and access to programs and other research and educational opportunities; and to assess involvement of international investigators in work supported by NSF. The information may be disclosed to government contractors, experts, volunteers and researchers to complete assigned work; and to other government agencies in order to coordinate and assess programs. The information may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records," 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records," 63 Federal Register 268 (January 5, 1998).

NSF Form 1225 (10/99)



Hill Price

Old Dominion University
Department of Computer Science
Norfolk, VA 23529-0162

Principle Investigator**Education**

Hill Price is a senior lecturer in the Computer Science Department at Old Dominion University. His education status includes a M.S. from ODU in 1984 as well as a B.S. from USNA in 1969.

Relevant Experience

Hill Price is proficient in teaching about eleven courses for Old Dominion University including many studies in the areas of Computer Graphics, Data Communications and Networks, and Object Oriented Design.

Co-Principle Investigators Listed Beyond This Point

Name: Yaser AlSuwayyan

Education: Old Dominion University
2001 - 2005
Computer Science Undergraduate

Experience: Ministry of Labor and Social Affairs - Kuwait
1993-1998
Managed and supervised educational activities for youth.

Public Authority for Applied Science and Technology - Kuwait
1994-1997
Computer Junior College program Graduate.

Kuwait Financial House - National Bank.
1999-2001
Technical Support - Help Desk representative

Name: Brian Blain

Education: Old Dominion University
Norfolk, VA
2001 – 2005
B.S. in Computer Science
Minor in Information Technology

Experience: Old Dominion University
Computer Science Tutor
February 2005 – Present

As a tutor I guide students in freshman and sophomore classes to solving programming assignments so they may gain a better understanding of the theories and content associated with C++.

NetTek
Programmer
October 2004 – January 2005

Through employment at NetTek I have learned to code asp as well as set up database structured web applications. My responsibilities include creating web pages that may incorporate admin screens or any other features requested by the client(s).

Kmart
Electronics Associate
June 2003 – February 2004

My responsibilities as an Electronics Associate were to answer customer questions, stock shelves, create shelf layouts, checkout customers, and maintain the electronics department as a clean and welcoming place for customers to shop.

Name: Dennis Concepcion

Education: Old Dominion University
2002-2005
BS in Computer Science
Minor in Geography

University of Maryland at College Park
1997-1999
Major: Computer Science
Minor: Music and Arts

Experience: UMCP, Bursars Office
1997-1999
Web Developer

Freelance MIDI
2002-current
XG Accompaniment Arranger for Yamaha Electone Organ

Name: Wesley J. Ishom

Education: Old Dominion University
Norfolk, VA
2001 - 2005
B.S. in Computer Science

Experience: Jefferson Lab
Internship
March 2004 – September 2004

Worked independently to develop two customized databases. The first one was for the Policies and Manuals Group's Environmental Health and Safety Manual Revisions. The other was for the tracking of processes, incidents, and environmental aspects dubbed the Environmental Management System to meet new governmental regulations.

Tidewater Council, BSA
Summer Camp Staff
June 2002 – August 2002

Old Dominion University Bookstore
August 2001 – September 2001

Western Branch High School
Computer Lab Assistant
June 1998 – July 1998, January 2000 – June 2000

Hannaford Food and Drug Superstore
July 1999 – October 1999

Name: Jeffrey Jacobs

Education: Old Dominion University
Norfolk, VA
2001 - 2005
B.S. in Computer Science
Minor in Computer Engineering

Ocean Lakes High School
Virginia Beach, VA
1997 – 2001
Math and Science Magnet Program

Experience: Visualzen Inc.
Senior Software Engineer
January 2004 – Present
Responsible for software development, web application development, and database design.

Visualzen Inc.
Web Developer
February 2003 – December 2003
Responsible for web development

Old Dominion University
System Consultant
January 2003 – July 2003
Responsible for system administration of departmental computers

Name: Duong Tran

Education: 75 credits at Tidewater Community College
18 credits at Virginia Wesleyan College
Old Dominion University
Fall 2002 – Fall 2005 or Spring 2006
B.S. in Computer Science
Duong plans to take IT as my minor major.

Experience: Duong had about 5 years of experience in software testing from 1996 – 2001 and about 2 years as a computer consultant. Now, Duong is interesting in Unix and Linux systems. Duong is learning to build a Linux cluster in his cs495.

Tidewater Community College
Computer Assistant
2001 - 2003

His job was to assist students and patrons to use computers and software.

Biographical Sketches of Consultants

Educational Consultant

Richard C. Overbaugh, Ed.D.

Darden College of Education
Department of Education Curriculum & Instruction
Old Dominion University
Norfolk, VA 23529-0161

roverbau@odu.edu

<http://www.odu.edu/educ/roverbau/vita/vitae.htm> as of December 15, 2004

Mr. Overbaugh is a program coordinator and professor for instructional design and technology. He has implemented technology into the classroom and curricula in order to promote learning.

Technical Consultant

Garry Musgrave

Conceptron Associates: Independent Audio-Visual Design Consultants
1195 Durant Dr.
Coquitlam, BC Canada V3B 6R3

gmusgrave@conceptron.com

http://www.conceptron.com/profile/tech_resume.html as of December 15, 2004

Mr. Musgrave is an independent audio and visual consultant with over 20 years of experience. He is a member of many authorized professional associations as well as a certified technology specialist – design (CTS-D).

Biographical Sketches of Subcontractors

CS 250 Problem Solving and Programming

This is the second semester level of Problem Solving and Programming class. It is a 4 credit class with prerequisites for cs148 or cs150 and Math 162M

Students gain knowledge on topics that include the software life cycle, methods of functional decomposition, design documentation, abstract data types and classes, common data structures, dynamic data structures, and algorithmic patterns, and testing and debugging techniques. Students use C++ as the main programming language and C++ standard library and templates are introduced.

<http://www.cs.odu.edu/~advisor/program/catalog2004/cscurdesc2004.html>

CS 300U Computers in Society

This is the junior level intensive writing class. It is a 3 credit class with prerequisites for ENGL 110C, and COMM 101R

Students develop a sense of awareness of changes in world's society due to continuing implementation of computing technologies. They get to evaluate technological expansions in areas of governments, business/industry, education, medicine, transportation, communication, and entertainment. The topics that can be covered include but not limited to: intellectual property, software piracy, computer crimes and ethics. Students are required to research societal topics, and present results in written and oral formats.

<http://www.cs.odu.edu/~advisor/program/catalog2004/cscurdesc2004.html>

Glossary:

CS 149D Elements of Computer Science
CS 150 Introduction to Programming
ENG110. Explore Engineering and Technology I
COMM 101R Public Speaking
MTH162M Precalculus



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					FOR NSF USE ONLY				
ORGANIZATION Azul Business Corporation					PROPOSAL NO.		DURATION (MONTHS)		
							Proposed	Granted	
PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR Hill G Price					AWARD NO.				
A. SENIOR PERSONNEL: PI/PD, Co-PIs, Faculty and Other Senior Associates List each separately with name and title. (A.7. Show number in brackets)					NSF-Funded Person-months			Funds Requested By Proposer	Funds Granted by NSF (If Different)
					CAL	ACAD	SUMR		
1. Yaser Al Suwayyan – Hardware Developer					12			\$50,000	\$
2. Brian Blain- Software Developer					12			\$50,000	
3. Dennis Concepcion – Software Developer					12			\$50,000	
4. Wesley J. Ishom- Software Developer					12			\$50,000	
5. Jeffrey Jacobs – Project Manager					18			\$120,000	
6. Duong Tran – Web Developer					6			\$18,750	
7. () OTHERS (LIST INDIVIDUALLY ON BUDGET EXPLANATION PAGE)									
8. () TOTAL SENIOR PERSONNEL (1-6)									
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)									
1. () POSTDOCTORAL ASSOCIATES									
2. (4) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)									
3. () GRADUATE STUDENTS									
4. () UNDERGRADUATE STUDENTS									
5. () SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)									
6. () OTHER									
TOTAL SALARIES AND WAGES (A + B)								\$346,250	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)								138,500	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)									
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.) Development Server									
TOTAL EQUIPMENT									
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)									
2. FOREIGN									
F. PARTICIPANT SUPPORT									
1. STIPENDS \$ _____									
2. TRAVEL _____									
3. SUBSISTENCE _____									
4. OTHER _____									
TOTAL NUMBER OF PARTICIPANTS ()					TOTAL PARTICIPANT COSTS				
G. OTHER DIRECT COSTS									
1. MATERIALS AND SUPPLIES								27,500	
2. PUBLICATION/DOCUMENTATION/DISSEMINATION									
3. CONSULTANT SERVICES								54,000	
4. COMPUTER SERVICES									
5. SUBAWARDS								0	
6. OTHER Miscellaneous Expenses								0	
TOTAL OTHER DIRECT COSTS								81,500	
H. TOTAL DIRECT COSTS (A THROUGH G)								\$566,250	
I. INDIRECT COSTS (F&A) (SPECIFY RATE AND BASE)									
TOTAL INDIRECT COSTS (F&A)									
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)								\$566,250	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECT SEE GPG II.D.7.j.)									
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)								\$566,250	\$
M. COST SHARING: PROPOSED LEVEL \$					AGREED LEVEL IF DIFFERENT: \$				
PI/PD TYPED NAME AND SIGNATURE*					DATE	FOR NSF USE ONLY			
Hill Price					05/02/05	INDIRECT COST RATE VERIFICATION			
ORG. REP. TYPED NAME & SIGNATURE*					DATE	Date Checked	Date of Rate Sheet	Initials-ORG	
Jeff Jacobs					05/02/05				

Phase 1

Time 15 Weeks
Funding \$100,000

	Total #	# of hours	hourly wage	cost
Employees				
Project Manager	1	200	\$40	\$8,000
Hardware Developer	3	300	\$25	\$22,500
Software Developer	3	300	\$25	\$22,500
Total for Employees				\$53,000
Consultants				
Educational Consultant	1	80	\$100	\$8,000
Technical Consultant	1	160	\$100	\$16,000
Total for Consultants				\$24,000
Total Employees				\$53,000
Total Overhead (40%)				\$21,200
Employees				\$53,000
Consultants				\$24,000
Overhead				\$21,200
Total				\$98,200

Phase 2

Time 2 Years
Funding \$750,000

	Total #	# of hours	hourly wage	Cost
Employees				
Project Manager	1	3000	\$40	\$120,000
Software Developers	3	2000	\$25	\$150,000
Hardware Developers	2	2000	\$25	\$100,000
Web Developer	1	750	\$25	\$18,750
Technical Staff	2	150	\$25	\$7,500
Total for Employees				\$346,250
Consultants				
Educational Consultant	1	360	\$100	\$36,000
Technical Consultant	1	180	\$100	\$18,000
Total for Consultants				\$54,000
Software				
Flash	2	500		\$1,000
Microsoft Visual C#				
.NET	7	109		\$763
Photoshop CS	3			\$1,947

Microsoft Office	9	\$630
Total for Software		\$4,340

Hardware

Development Server	1	\$6,000
Desktops	9	\$10,800
Whiteboard	3	\$6,000
Microphone	3	\$300
Total for Hardware		\$23,100

Total Employees		\$346,250
Overhead (40%)		\$138,500

Employees		\$346,250
Consultants		\$54,000
Software		\$4,400
Hardware		\$23,100
Overhead		\$138,500
Total		\$566,250

Phase 3

Time Continual

	Total #	# of hours	hourly wage	cost
Employees				
General Manager	1	2000	\$40	\$80,000
Software Developers	1	1000	\$25	\$25,000
Web Programmer	1	1000	\$25	\$25,000
Tech Support	2	2000	\$20	\$80,000
Account Representative	1	2000	\$15	\$30,000
Total for Employees				\$240,000

Outside Staff

Contract Attorney	1	40	\$150	\$6,000
Patent Attorney	1	100	\$150	\$15,000
Accountant	1	500	\$20	\$10,000
Total for Outside Staff				\$31,000

Total Employees		\$240,000
Overhead (40%)		\$96,000

Employees		\$240,000
Consultants		\$31,000
Overhead		\$96,000
Total		\$367,000

(See GPG Section II.D.8 for guidance on information to include on this form.)

	Other agencies (including NSF) to which this proposal has been/will be submitted.
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FACILITIES, EQUIPMENT & OTHER RESOURCES

FACILITIES: Identify the facilities to be used at each performance site listed and, as appropriate, indicate their capacities, pertinent capabilities, relative proximity, and extent of availability to the project. Use "Other" to describe the facilities at any other performance sites listed and at sites for field studies. Use additional pages if necessary.

Laboratory:

Clinical:

Animal:

Computer: Nine computer workstations, Microsoft Project (1), Microsoft Office (9), Visual C#.NET (6) and printing capability. These will be located in the Open Research Lab in the Engineering & Computational Sciences building at Old Dominion University.

Office: Open Research Lab in the Engineering & Computational Sciences building at Old Dominion University.

Other: Lab Prototype Items Pressure sensitive surface and sound recording device. Both devices must be able to transmit data to a computer.

MAJOR EQUIPMENT: List the most important items available for this project and, as appropriate, identify the location and pertinent capabilities of each.

OTHER RESOURCES: Provide any information describing the other resources available for the project. Identify support services such as consultant, secretarial, machine shop, and electronics shop, and the extent to which they will be available for the project. Include an explanation of any consortium/contractual/subaward arrangements with other organizations.

Education consultant for 360 hours to design real world field test, create field test student survey, create teacher test field survey, and acquire the classroom testing agreements.
Technical consultant for 180 hours to oversee and advise both hardware and software developers in choices, design, and testing.

Supplementary Documents

A. Payment Schedule and Project Milestone Chart.

Production Model Development Tasks and Milestones

Defined Tasks:

Project Management The Project Manager's job of directing the flow of work throughout the length of the development phase.

Purchasing:

Development tools, Aids the hardware and software developers

Accounting/ Budget tasks, An ongoing process to keep track of expenses

Software Licensing, Obtaining software licensing for required tools

Microphone, Whiteboard & Related Project Hardware, The system hardware components

Programming Milestones

A: *First Release Alpha Version*, First development level system package created but not tested

B: *Preliminary Alpha Test Approval by Educational Consultant*, First testing of the development package

C: *Final Version Alpha Release*, First development package released after testing

D: *Final Alpha Test Approval by Educational Consultant*, First development package released and approved by the consultant.

E: *Preliminary Beta Field Test Results*, Second round results of testing performed with a testing group

F: *Redeveloped Final Release Version*, Development package released after Beta testing results incorporated, this is the final development package

G: *Surveys and Results from Final Field Testing*, The survey results of the final development are returned and evaluated

H: *Results Analysis and Project Success Evaluation*, Full evaluation to see if development package meets or exceeds the project problem statement requirements for a feasible solution

Phase II Project Report Milestone Chart

Reporting Period:	From: 6/10/05	To: 12/10/05
Total Estimated Expenditures (this means good faith estimate of actual expenditures) this reporting period	\$151,500	
Cumulative Estimated Expenditures (this means good faith estimate of actual expenditures)	\$151,500	
Reporting Period:	From: 12/11/05	To: 6/10/06
Total Estimated Expenditures (this means good faith estimate of actual expenditures) this reporting period	\$124,750	
Cumulative Estimated Expenditures (this means good faith estimate of actual expenditures)	\$151,500 + \$124,750 \$276,250	
Reporting Period:	From: 6/11/06	To: 12/10/06
Total Estimated Expenditures (this means good faith estimate of actual expenditures) this reporting period	\$151,500	
Cumulative Estimated Expenditures (this means good faith estimate of actual expenditures)	\$276,250 + \$151,500 \$427,750	
Reporting Period:	From: 12/11/07	To: 6/10/07
Total Estimated Expenditures (this means good faith estimate of actual expenditures) this reporting period	\$0	
Cumulative Estimated Expenditures (this means good faith estimate of actual expenditures)	\$446,500 + \$0 \$427,750	

Gantt Chart Gantt chart portion must show duration and timng of tasks. Indicate a beginning and ending of each task. (See example Gantt Chart.) X = 1 month effort	Estimate Duration for eachTask	Reporting Period 0-6 months	Reporting Period 6-12 months	Reporting Period 12-18 months	Reporting Period 18-24 months
Project Management	24 months	^XXXXXX^	^XXXXXX^	^XXXXXX^	^XXXXXX^
Purchasing :	24 months	^XXXXXX^	^XXXXXX^	^XXXXXX^	^XXXXXX^
Development tools	0.5 months	^x^			
Accounting/ Budget tasks	24 months	^XXXXXX^	^XXXXXX^	^XXXXXX^	^XXXXXX^

Software Licensing	0.5 months	^x^ ^x^ ^XXXXXX^ ^XXXXXX^ ^XXXXXX^ ^XXXXXX^ ^XXXXXXx^ ^x^ ^XXXXXX^ ^x^ ^Xx^ ^XXXX^ ^XXXXX^ ^X^
Microphone, Whiteboard & Related Project Hardware	0.5 months	
Programming Milestones	24 months	
A: First Release Alpha Version	5.5 months	
B: Preliminary Alpha Test Approval by Educational Consultant	0.5 months	
C: Final Version Alpha Release	6 months	
D: Final Alpha Test Approval by Educational Consultant	0.5 months	
E: Preliminary Beta Field Test Results	1.5 months	
F: Redeveloped Final Release Version	4 months	
G: Surveys and Results from Final Field Testing	5 months	
H: Results Analysis and Project Success Evaluation	1 months	

Resources List key Personnel by Name Provide levels of effort in person-months including consultants and subawardees.	Estimate Total Months Effort for entire Project	Reporting Period 0-6 months 6/10/05 - 12/10/05	Reporting Period 6-12 months 12/11/05 - 6/10/06	Reporting Period 12-18 months 6/11/06- 12/10/06	Reporting Period 18-24 months 12/11/06 – 6/10/07	Actual for the Entire Project
Key Personnel						
Yaser AlSuwayyan	12	4	4	4	0	12
Brian Blain	12	4	4	4	0	12
Dennis Concepcion	12	4	4	4	0	12
Wesley J. Ishom	12	4	4	4	0	12
Jeffrey Jacobs	18	6	6	6	0	18
Duong Tran	6	0	0	6	0	6
Consultants						
Technical Consultant	2	2	0	0	0	2
Educational Consultant	1	0	0	1	0	1
Expenditures Provide dollar amount for: Key Personnel, Consultants, Subawardees, Permanent Equipment, & Other (List by name)	Estimate Total \$ for Entire Project	Reporting Period 0-6 months 6/10/05 - 12/10/05	Reporting Period 6-12 months 12/11/05 - 6/10/06	Reporting Period 12-18 months 6/11/06- 12/10/06	Reporting Period 18-24 months 12/11/06 – 6/10/07	Actual \$
Key Personnel						
Yaser AlSuwayyan	\$50,000	\$16,500	\$16,500	\$17,000	\$0	\$50,000
Brian Blain	\$50,000	\$16,500	\$16,500	\$17,000	\$0	\$50,000
Dennis Concepcion	\$50,000	\$16,500	\$16,500	\$17,000	\$0	\$50,000
Wesley J. Ishom	\$50,000	\$16,500	\$16,500	\$17,000	\$0	\$50,000
Jeffrey Jacobs	\$120,000	\$40,000	\$40,000	\$40,000	\$0	\$120,000
Duong Tran	\$18,750	\$0	\$18,750	\$0	\$0	\$18,750

Consultants						
Technical Consultant	\$18,000	\$18,000	\$0	\$0	\$0	\$18,000
Educational Consultant	\$36,000	\$0	\$0	\$36,000	\$0	\$36,000
Permanent equipment						
Hardware	\$23,100	\$23,100	\$0	\$0	\$0	\$23,100
Software	\$4,400	\$4,400	\$0	\$0	\$0	\$4,400
Other*	\$7,500	\$0	\$0	\$7,500	\$0	\$7,500
TOTALS	\$427,750	\$151,500	\$124,750	\$151,500	\$0	\$427,750

*Other includes non-key personnel, indirect costs, materials, travel, etc.

B. Commercialization Plan

While there are many applications for our product, we still have a specific audience in mind. We would start with this specific audience and expand to a different or modified audience in the future.

Who is the Customer?

The target market for our product is university mathematics departments. Our target market includes the more than 2100 public and private four-year colleges in the United States.¹

A search for public or private four-year colleges in Virginia offering a degree in mathematics yielded 39 matches on Peterson's Education Portal.

Averett University, Bluefield College, Bridgewater College, Christopher Newport University, Eastern Mennonite University, Emory & Henry College, Ferrum College, George Mason University, Hampden-Sydney College, Hampton University, Hollins University, James Madison University, Liberty University, Longwood University, Lynchburg College, Mary Baldwin College, Marymount University, Norfolk State University, Old Dominion University, Radford University, Randolph-Macon College, Randolph-Macon Woman's College, Roanoke College, Saint Paul's College, Shenandoah University, Sweet Briar College, University of Mary Washington, University of Richmond, University of Virginia, University of Virginia's College at Wise, Virginia Commonwealth University, Virginia Intermont College, Virginia Military Institute, Virginia Polytechnic Institute and State University, Virginia State University, Virginia Union University, Virginia Wesleyan College, Washington and Lee University, The College of William and Mary

Initial Customer

Our initial customer is the Old Dominion University (ODU) Mathematics Department. ODU offers a B.S. in mathematics, M.S. in computational and applied mathematics, M.S. in mathematics education, and a Ph.D. in computational and applied mathematics. All undergraduate students are required to complete at least three credit hours of mathematics:

- MATH 101M An introduction to mathematics for critical thinking
- MATH 102M College algebra
- MATH 162M Pre-calculus I
- STAT 130M Elementary statistics

Depending on a student's major, (ex. computer science, engineering, physics, etc.) more mathematics may be required.

¹ From Peterson's Education Portal. Available at: <http://www.petersons.com>

ODU has 20,802 total students. Among those 14,209 are undergraduate students and 6,593 are graduate students.²

Return on Investment for Customer

This solution provides an easier and better way for students to see and hear the lecture again. It does not require one or more cameras. It will allow students to resize the presentation to their preferences.

Benefits to Instructors

Instructors can conceivably cover more examples of problems in the lectures. At Old Dominion University, MATH 102M (College Algebra), 162M (Pre-Calculus I), 163 (Pre-Calculus II), 211 (Calculus I), 212 (Calculus II), and 307U (Ordinary Differential Equations), administer common exams. These means that all instructors in each course are expected to cover the same material during the semester.

Benefits to University

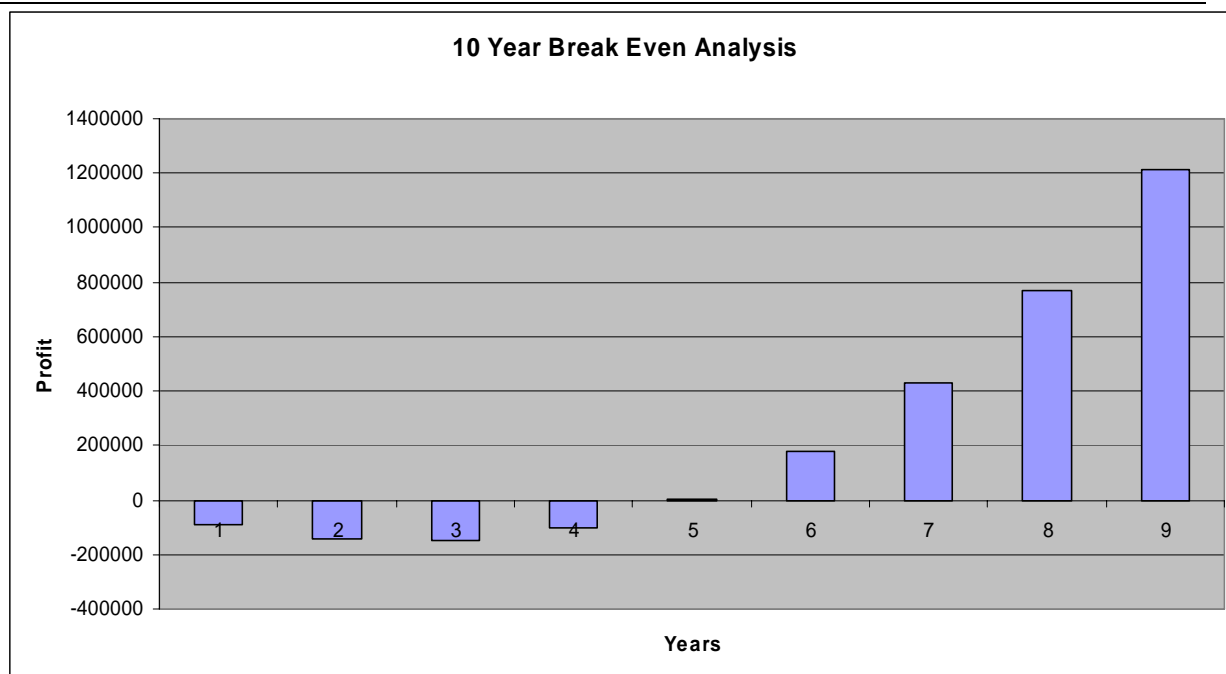
An increase is success rates in mathematics and a possibility for lower attrition rates.

Price point

\$15,000 for one board, one microphone, and the software

Return on investment for business

With the sale of 20 systems in the first year and a 15% increase in sales every year afterwards, we can expect to break even in the fifth year. We will break even with the sale of our 27th system per year.



² From ODU Campus Facts. Available at:

http://www.odu.edu/webroot/orgs/IA/university_news.nsf/campusfacts?OpenForm

Competition Matrix

	Does not require use of camera(s)	Does not require use of LCD	Does not require a full time operator	Does not require a change in teaching style	Records audio	Records visual	Scalable visual output
Student Audio Visual e-Tool	x	x	x	x	x	x	x
SmartBoard	x		x	x	x	x	
Mimio	x	x	x	x		x	
Quartet IdeaShare Board	x	x	x	x		x	
Video camera/Teletechnet		x			x	x	

There are several competing technologies, but each one has some detriments and/or missing components that our solution addresses.

Advertising

We can use direct marketing to university/college mathematics departments and consortiums.

Account representatives can attend several conferences aimed at teaching mathematics such as the following:

International Conference on Technology in Collegiate Mathematics

<http://www.aw-bc.com/ictcm/index.shtml>

National Council of Teachers of Mathematics

<http://www.nctm.org/meetings/>

Mathematics Association of America

<http://www.maa.org/>

American Mathematical Association of Two-Year Colleges

<http://www.amatyc.org/>

Funding

With a focus on adding technology that aims at increasing scholastic performance, SAVE will be the conduit to bring technology into the classroom. Key to success of this goal is the choice for the financier, and the National Science Foundation's Small Business Innovative

Research Program seeks to fund the development of innovative ideas such as ours for small businesses.

Phase II requires 2 years of intense development, and demands a much larger backing of financial support than Phase I. Here, development and refining are the primary concerns. Lasting a full 2 years (6/10/05 through 6/11/05), it is split into major programming and test stages - Alpha/Beta Development & Testing and Final Development & Field Trials. The most financially demanding part of phase 2 will be the employment of a Project Manager, Software Developers, Hardware Developers, Web Developer, Testing Programmers, a Technical Staff (3), and the 2 Consultants. Also involved in the budget is the hardware (Development Server, Desktops (14), Whiteboard (3), & Microphone (3)) and software (Flash (2), Microsoft Visual C# .NET (7), Photoshop CS or comparable photo editing program (1), and Microsoft Office (14)) and miscellaneous overhead costs. The target sum for funding for the above items is \$750,000.

As Phase II ends, the National Science Foundation will reward grantees by attempting to unite investors with our project, providing funding and support through a grounded, proven institution that meet a high standard of requirements set by the NSF. It is important that we are aligned with Universities and Colleges, in spirit and as a funding source. Our mission is to introduce a technologically advanced solution to the modern classroom that will be unobtrusive to the teacher, while aiding the student in necessary repetition. During Phase III, it will be our aim to seek financial solidarity through demonstrations and sample lectures throughout the country in various Secondary Educational Forums. As a supplement to this, we will also be taking a lesser (but important nonetheless) focus on high schools. This will help visibility of our product and potentially will open important alternate sources of revenue. In Phase III, we break even at Year 5 of production. Before that, we incur approximately \$150,000 in debt by the end of Year 3 that will be covered by small business loans secured through the Small Business Administration and through local banks.

The most important funding decision is the use of a COTS solution for our main component - the whiteboard. This includes built-in Application Programming Interface (API) calls that will be easily interfaced with in the customized application set that we will be building for our project. The whiteboards that we have chosen have already gone through rigorous testing. All of this will inevitably lead to a savings in time, manpower, and ultimately money. Other factors that have been considered in our cost analysis are reduction of redundant software or hardware where they are unnecessary. This reduction will aid in our target of meeting financial goals in the 3rd phase. Profit and momentum are key in this phase, so even these small factors can be key to the project's success.

C. Company Commercialization History.

Part 1: Company Data (Basic data about the company and the SBIR project.)

SBIR Award Number: XXX-XX-XXXX

Name of Company: Azul Business Corporation

Company Address: Engineering & Computational Sciences Bldg.
4700 Elkhorn Ave.
Suite 3300
Norfolk, VA 23529-0162

Telephone Number: 757-683-3915

Fax Number: 757-683-4900

Email: office@cs.odu.edu

Name and Title of the person preparing the report:

Part 2: Follow-On Funding Commitment(s) (FFC) (Status of the Follow-On Funding Commitment(s))

Was the original FFC exercised? No

This commercialization history only applies to any proposer who has ever received a Phase II award from any Federal agency.

Part 3: Were you awarded a Phase IIB supplement? If yes, describe the commercialization activities related to this supplement. N/A

Part 4: List any products and/or processes currently in the marketplace, or patents resulting from the SBIR project. N/A

Part 5: Please furnish the revenues received from the commercialization of this SBIR project, include: Sales, Manufacturing, Product Licensing, Royalties, Consulting, Contracts, Other. N/A

Part 6: Company Employment and Revenue Data.

	Start of SBIR Grant	Current
Number of employees	7	
Revenue (Total \$'s)	\$53,000	
Percent of Revenue from SBIR's (from all agencies)	46%	

Part 7. Briefly describe the company's efforts to commercialize technology resulting from this SBIR award. (This includes customer/potential customer base, overview of marketing and sales strategies, market readiness and/or market window of opportunity and financing strategies for product life cycle.)

Please refer to Section C, Commercialization Plan for further details.