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PI/PD Name: Geoffrey C Fox

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 ☒

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PI/PD Name: Sheryl Burgstahler

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

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PI/PD Name: Corinna E Lathan

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

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PI/PD Name: Edward D Lipson

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)
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PI/PD Name: Gregg C Vanderheiden

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

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- ☐ Visual Impairment
- ☐ Mobility/Orthopedic Impairment
- ☐ Other _____
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List of Suggested Reviewers or Reviewers Not To Include (optional)

SUGGESTED REVIEWERS:

Ronald R. Mourant, Ph.D
Professor, Industrial Engineering
Northeastern University
334 Snell Engineering Center
Boston, MA 02115
Tel: 617-373-3931
Fax: 617-373-2921
Email: mourant@meceng.coe.neu.edu

Daniel L. Welch, Ph.D., CPE
Human Factors Engineering and Ergonomics Consulting
4307 Harvard Street
Silver Spring, MD 20906
Tel: 301-946-2905
Email: DLWelch@carlow.com

Kay Marie Stanney, Ph.D.
Associate Professor, Ind. and Mgmt Systems Dept.
University of Central Florida
P.O. Box 162450
Orlando, FL 32816-2450
Tel: 407-823-5582
Fax: 407-823-3413
Email: stanney@iems.engr.ucf.edu

Dava J. Newman, Ph.D
Assistant Professor of Aeronautics and Astronautics
Massachusetts Institute of Technology
Room 33-119
Cambridge, MA 02139
Tel: 617-258-8799
Fax: 617-253-4196
Email: DNEWMAN@MIT.EDU
space human factors, biomechanics

Mike Rosen, Ph.D.
Director, Rehabilitation Engineering
National Rehabilitation Hospital
102 Irving Street
Washington, DC 20010-2949
Tel: 202-877-1932
Fax: 202-723-0628

List of Suggested Reviewers or Reviewers Not To Include (optional)

Suggested Reviewers contd...

mjr2@mhg.edu

Frank Tendick, Ph.D.
Assistant Professor in Residence, Dept. of Surgery
University of California
513 Parnassus Avenue, S-550
San Francisco, CA 94143-0475
Tel: 415-476-0495
Fax: 415-476-9557

Tel: 415-476-0495
Fax: 415-476-9557
Email: frank@robotics.eecs.berkeley.edu

REVIEWERS NOT TO INCLUDE:

Not Listed

COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE/if not in response to a program announcement/solicitation enter NSF 99-2

nsf99-29 **05/17/99**

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.)

FOR NSF USE ONLY

NSF PROPOSAL NUMBER

9980034

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	DUNS# (Data Universal Numbering System)	FILE LOCATION
				002257350	

EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)

150532081

SHOW PREVIOUS AWARD NO. IF THIS IS
☐ A RENEWAL
☐ AN ACCOMPLISHMENT-BASED RENEWAL

IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES ☐ NO ☒ IF YES, LIST ACRONYMS(S)

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE

Syracuse University

AWARDEE ORGANIZATION CODE (IF KNOWN)

0028829000

ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE

Syracuse University
113 Bowne Hall
Syracuse, NY. 132441200

NAME OF PERFORMING ORGANIZATION, IF DIFFERENT FROM ABOVE

PERFORMING ORGANIZATION CODE (IF KNOWN)

ADDRESS OF PERFORMING ORGANIZATION, IF DIFFERENT, INCLUDING 9 DIGIT ZIP CODE

IS AWARDEE ORGANIZATION (Check All That Apply)
(See GPG II.D.1 For Definitions) ☐ FOR-PROFIT ORGANIZATION ☐ SMALL BUSINESS ☐ MINORITY BUSINESS ☐ WOMAN-OWNED BUSINESS

TITLE OF PROPOSED PROJECT **A Cross-Disability-Accessible Knowledge Network for Education and Collaboration in Science and Technology**

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PREPROPOSAL NO., IF APPLICABLE
$ **2,649,237**	**36** months	**10/01/99**	**9976583**

CHECK APPROPRIATE BOX(ES) IF THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

☐ BEGINNING INVESTIGATOR (GPG 1.A.3)
☐ DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.D.1)
☐ PROPRIETARY & PRIVILEGED INFORMATION (GPG II.D.10)
☐ NATIONAL ENVIRONMENTAL POLICY ACT (GPG II.D.10)
☐ HISTORIC PLACES (GPG II.D.10)
☐ SMALL GRANT FOR EXPLOR. RESEARCH (SGER) (GPG II.D.12)
☐ GROUP PROPOSAL (GPG II.D.12)
☐ VERTEBRATE ANIMALS (GPG II.D.12) IACUC App. Date _____
☐ HUMAN SUBJECTS (GPG II.D.12)
Exemption Subsection _____ or IRB App. Date _____
☐ INTERNATIONAL COOPERATIVE ACTIVITIES: COUNTRY/COUNTRIES _____
☐ FACILITATION FOR SCIENTISTS/ENGINEERS WITH DISABILITIES (GPG V.G.)
☐ RESEARCH OPPORTUNITY AWARD (GPG V.H)

PI/PD DEPARTMENT
Department of Computer Science

PI/PD FAX NUMBER
315-443-4741

PI/PD POSTAL ADDRESS
Northeast Parallel Architectures Center
3-217 Center for Science and Technology
Syracuse, NY 132444100
United States

NAMES (TYPED)	High Degree	Yr of Degree	Telephone Number	Electronic Mail Address
PI/PD NAME **Geoffrey C Fox**	**Ph.D.**	**1967**	**315-443-2163**	**gcf@cs.fsu.edu**
CO-PI/PD **Sheryl Burgstahler**	**Ph.D.**	**1992**	**205-543-0622**	**sherylb@cac.washington.edu**
CO-PI/PD **Corinna E Lathan**	**PhD**	**1994**	**202-319-5095**	**lathan@cua.edu**
CO-PI/PD **Edward D Lipson**	**Ph.D.**	**1971**	**315-443-9107**	**edlipson@syr.edu**
CO-PI/PD **Gregg C Vanderheiden**	**PhD**	**1984**	**608-262-6966**	**gv@trace.wisc.edu**

CERTIFICATION PAGE

Certification for Principal Investigators and Co-Principal Investigators:

I certify to the best of my knowledge that:

(1) the statements herein (excluding scientific hypotheses and scientific opinions) are true and complete, and
(2) the text and graphics herein as well as any accompanying publications or other documents, unless otherwise indicated, are the original work of the signatories or individuals working under their supervision. I agree to accept responsibility for the scientific conduct of the project and to provide the required progress reports if an award is made as a result of this application.

I understand that the willful provision of false information or concealing a material fact in this proposal or any other communication submitted to NSF is a criminal offense (U.S.Code, Title 18, Section 1001).

Name (Typed)	Signature	Social Security No.*	Date
PI/PD **Geoffrey C Fox**		**SSN's are confidential and are not displayed *ON FASTLANE SUBMISSIONS***	
Co-PI/PD **Sheryl Burgstahler**			
Co-PI/PD **Corinna E Lathan**			
Co-PI/PD **Edward D Lipson**			
Co-PI/PD **Gregg C Vanderheiden**			

Certification for Authorized Organizational Representative or Individual Applicant:

By signing and submitting this proposal, the individual applicant or the authorized official of the applicant institution is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding Federal debt status, debarment and suspension, drug-free workplace, and lobbying activities (see below), as set forth in Grant Proposal Guide (GPG), NSF 99-2. Willful provision of false information in this application and its supporting documents or in reports required under an ensuring award is a criminal offense (U. S. Code, Title 18, Section 1001).

In addition, if the applicant institution employs more than fifty persons, the authorized official of the applicant institution is certifying that the institution has implemented a written and enforced conflict of interest policy that is consistent with the provisions of Grant Policy Manual Section 510; that to the best of his/her knowledge, all financial disclosures required by that conflict of interest policy have been made; and that all identified conflicts of interest will have been satisfactorily managed, reduced or eliminated prior to the institution's expenditure of any funds under the award, in accordance with the institution's conflict of interest policy. Conflict which cannot be satisfactorily managed, reduced or eliminated must be disclosed to NSF.

Debt and Debarment Certifications

(If answer "yes" to either, please provide explanation.)

Is the organization delinquent on any Federal debt? Yes ☐ No ☒

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency? Yes ☐ No ☒

Certification Regarding Lobbying

This certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding $100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding $150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, ''Disclosure Form to Report Lobbying,'' in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME/TITLE (TYPED) **Matthew Clark**		**05/17/99**

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A Cross-Disability-Accessible Knowledge Network for Education and Collaboration in Science and Technology

Summary

This multidisciplinary collaboration will develop and research a knowledge network that is accessible to individuals with a wide range of disabilities. We combine expertise in collaboration, object Web, human computer interfaces, education and cross disability access. Our team includes researchers in the fundamental building blocks as well as groups capable of deploying novel technology to the targeted user community. Our knowledge network is built on principles developed on the study of successful learning environments. This network is organized in terms of distributed information objects built with a Cross-Disability-Accessible Document Object Model (DOM) compatible with proposals of the Web Consortium W3C. Further our approach will involve building an operational CDAKN (Cross-Disability-Accessible Knowledge Network) testbed based pragmatically on iterative improvement of existing technologies for collaboration and interfaces. This KN will initially be used by the project team as a collaboratory to both build the KN itself and to design and prepare cross disability versions of existing successful web based training material. The same testbed will be used to deliver distance education with both computer and the natural sciences curricula and so extend the testing and assessment of the KN and develop further important capabilities.

The research issues addressed in this project include the architecture of CDAKN and implications for a CDA DOM; the integration of knowledge agents with collaboration and human-interface technology; and the design of customizable interfaces. The major outcome of the proposed research will be knowledge on how easy or difficult it is to create CDAKNs, how to build knowledge by integrating distributed informational objects, how to identify barriers, and how to overcome them. This will be quantified through the CDADOM design principles that we will share and evolve with the international research and standards organizations. The main practical outcome of this project will be the creation of a prototype CDAKN, which could serve as a model for further research and be ready for widespread deployment and further testing.

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A Cross-Disability-Accessible Knowledge Network for Education and Collaboration in Science and Technology
Project Description

1. Goals and Guiding Principles

The basic goal of the proposed work is to build a Cross-Disability-Accessible Knowledge Network (CDAKN) and then evaluate and advance its effectiveness in both distance education in science and technology curricula and for scientific collaboration. This goal and the project are based on the following principles:

1. People need to be integrated into society and its activities irrespective of physical disabilities.
2. Web technologies and pervasive communication infrastructure provide a universal backbone for which one can build more effective cross-disability access (CDA) with specialized perception and expression capabilities optimized for individuals.
3. The 'anyplace' characteristic of the Internet is particularly attractive for individuals with disabilities, who may find their geographical location limited. Thus Internet collaboration is especially important for building knowledge networks involving individuals with disabilities.
4. Best practice in information system standards, especially the work of the W3C including their document object model (DOM http://www.w3.org/DOM/), provide an organizing framework on which to build towards cross disability access.
5. The Trace Research and Development Center (http://trace.wisc.edu) in Wisconsin has pioneered the principles of universal design for computer interfaces and brings a broad national knowledge network. Their contacts with the Web Consortium W3C allow us to both influence and to be influenced by key national standards.
6. Syracuse University has developed a state-of-the-art collaboration (TangoInteractive http://www.npac.syr.edu/tango) system with an architecture supporting customized cross disability delivery.
7. Science, mathematics, engineering and technology (SMET) education is a national priority, for which cross disability universal participation is highly desirable.
8. DO-IT (Disabilities, Opportunities, Internetworking, and Technology at University of Washington http://weber.u.washington.edu/~doit/) and CAST (Center for Applied Special Technology http://www.cast.org) are recognized for their pioneering work for applying and evaluating technology to help those with disabilities both in educational and job training areas. Their contacts will give team appropriate testbeds for our CDAKN's.
9. The best practice interface technology for sensory and physically disabled individuals is available through the team with Syracuse's low cost technology and deployment projects (http://www.pulsar.org/ TNG/NeatTools) allowing us to extend the KN to those with severe muscular disabilities.
10. Distance education, including both teachers and students with disabilities, exemplifies the general goal of implementing societal functions in a way that allows universal participation.
11. There is natural synergy with telemedicine applications including education as part of rehabilitation and here the Rehabilitation Engineering Research Center at Catholic University (http://www.hctr.be.cua.edu/RERC/) brings innovative interfaces and broader testbed activities.
12. Distance education provides an attractive early testbed for new technology, because it has

more structure than spontaneous collaboration and so puts less stress on base hardware and software technologies. We have shown this in Syracuse's successful distance education experiments including those between Syracuse and Jackson State (historically black college in Jackson, Mississippi) using TangoInteractive.

13. Scientific research collaborations increasingly depend on electronic communication. A CDAKN can advance science by inclusion of team members regardless of geographical location or (dis)ability.

Bringing these themes together, this project proposes to explore the proposition that multisensory interactive collaborative environments can be created, which allow participation by individuals who have different types of physical and sensory limitations, acquired either at birth, through adventure or as a result of aging. Specifically, we propose to create a knowledge network to both explore this issue and to act as a test bed for the topic.

In implementing this project we will actually create two knowledge networks. One will be based around the topic of science education. This area is chosen because it represents an already existing base of knowledge, which can be used as a test bed early in the project to explore these issues. A second knowledge area and network will be established over the course of the project, and will be focused on the topic of cross-disability access to collaborative environments and collaboratories. Using these two test beds, we will proceed to explore both the issues surrounding access to multimodal environments (visual, auditory, and interactive) by individuals who have visual, auditory and manipulative limitations, and, research into strategies for addressing access by these groups.

Although, it is a common assumption that systems cannot be designed, which are simultaneously useable by individuals with multiple disabilities, the Trace center has found that this is not necessarily the case. They have, for example, developed multimedia touchscreen kiosks, which are simultaneously useable by individuals with low vision, who are blind, who are hard of hearing, who are deaf, who have reading problems, who cannot read, and who have physical disabilities involving both weakness and severe thetosis. Moreover, the technologies have been transferred to commercial production and currently are in airports, libraries, and will soon be distributed nationwide in voting booths. These production systems demonstrate that it is both practical and valuable to research systems that cover a broad range of disabilities.

The challenges posed by interactive collaborative environments are much more severe, but we have high expectations that this project will lead to both pragmatic solutions and a series of very interesting research questions and technology challenges. Moreover, we expect more people without disabilities to benefit from this research than people with disabilities, even though people with disabilities are the primary target of the research. This is a natural consequence of providing more flexible interfaces and cross-modality translation capabilities. For example, the beneficiaries will include all mobile computing users, any users wanting to interact with systems verbally, anyone using artificial agents (which are inherently deaf and blind), and anyone wishing to access information in hostile or constrained environments.

In the following sections we describe the proposed projects in detail, while sec. 3 contains technical background. In accordance with NSF regulations, separate parts of the proposal contain a discussion of appropriateness of proposal for KDI & roles of project personnel, results from prior NSF support, a plan for dissemination of results and institutional commitment, performance goals, and the management plan. These follow the project description while a separate proposal section contains references.

2. Cross Disability Access Knowledge Network

2.1: Project Methodology and Activities

We propose to research the issues underlying CDAKN's by building such as a system and evaluating two distinct types of testbed. Firstly the scientific collaboration testbed formed by this proposal team itself. Secondly and more broadly, we will establish a KN aimed at science and mathematics education with cross disability access.

The project can be divided into three phases, which correspond roughly to the each year of the three-year proposal. Firstly we build the scientific collaboration KN using existing technology and experiment with different approaches to cross disability interfaces aimed at two particular user classes -- the blind and those with severe physically disabilities. Note that it is understood in the universal access field to be important to target all disabilities and so although it is defocusing, we will where possible target the full population as only this can verify that our approach is sound. In the second year we will use a natural extension of our existing collaborative system to deliver a set of science and mathematics courses around the country. In the third year we will deploy a more sophisticated knowledge integration framework incorporating new base infrastructure and build cross disability access for it. Throughout the project we will do extensive evaluation and iteratively feed results of this process into our technology and testbed activities. We will follow and incorporate national standards including those from W3C (Web Consortium), IMS (Educause) and ADL (Dept. of Defense). We will follow relevant leading edge technology research by ongoing interaction with the Center for Innovative Learning Technologies (CILT) and the EOT (Education Outreach and Training) group of the NSF Partnerships in Advanced Computational Infrastructure. We will test the generality of our ideas by investigating relevance to related knowledge networks such as telemedicine and to emerging interfaces including virtual reality. Section 3 has many technical details and in this section we just try to describe the broad principle and activities.

We make one important assumption. Namely our KN will be built by the integration of people and information. We assume that the information is all web-based and that the knowledge network is built around the Web. There are many important forms of web-based information but we will focus on that which can be organized in terms of the W3C document object model. This roughly says we assume that we will use web pages built in terms of (advanced) HTML. This allows us to a quantitative framework for our CDAKN in terms of the sophisticated albeit not yet complete W3C document object model. Note that the Web gives us a successful model for retained knowledge that is ready to be shared at a distance and the DOM in some sense quantifies this information model. However the Web does not yet have a consolidated, successful, process model for computer supported collaborative work or more specifically for teaching and learning. We intend to build on the current courses being successfully taught at a distance via TangoInteractive as another technical building block.

The W3C DOM specifies hierarchical dynamic organization of document fragments with an event model and a defined interface to scripting languages enabling browsing and interpretation of user interactions. Scriptable style sheets allow one to customize dynamically cross disability rendering of information. Systematic use of XML with domain specific ontology is a key concept as it allows one to give a more precise expression of knowledge and its cross disability rendering. Formally a major deliverable of our project will be enhancements of the W3C DOM to support cross disability access and this product will be disseminated and discussed through the W3C working groups. The Web Content Accessibility Guidelines that will be released soon by the W3C are an important contribution and we want to build on them and

address their limitations. The W3C work provides a good guide for cross-disability success in learning resources, which are to be used asynchronously in self-directed learning. Building on the lessons from successful Tango courses, this project will be able to extend the scope of cross-disability-access technology to more dynamic (including synchronous) cases.

Note that although the key information and knowledge representation underpinnings, W3C DOM and XML, are still evolving, they are implemented well enough in existing version 4 and 5 browsers with dynamic HTML and JavaScript, that we can build our testbeds. Note we emphasize information represented in XML and HTML as these have a unifying DOM -- our approach can be generalized to Java applets and other sophisticated web environments but this will not be our major emphasis. We will however use authoring system such as PowerPoint, which have only modest web export although this is improving. This allows us to reuse investment in teachers knowledge of existing tools.

Initially, we will form the initial collaborative network using TangoInteractive with the cross disability knowledge domain being the material defining this project. We will identify prototypes of the educational material to be used in the later testbed deployment phases of the project. As described in sec. 3.1, we have tentatively chosen course modules from computer science and physics as the basis of our CDAKN for the testbeds. We need to develop methodologies to allow web technologies work across disabilities particularly in an interactive environment. We will analyze our initial information resource and rendering devices from three points of view:

1. *Are the "documents" themselves flex-modal?* -- in particular can they be viewed visually or auditorially and have all of the information presented? Further can all of the manipulations necessary be done across disability via text commands i.e., from the keyboard or assistive device used by the physically disabled - this would also make them operable by voice.
2. *Are the players that are used to present the information cross-disability accessible?* Can they be controlled via text (i.e., from the keyboard)? Further do they have a way of visually representing any captions, which are built into the material to accompany any auditory presentation? Do they provide self-voicing for those who cannot see (best) and are they compatible with screen reading technologies so that they can be read if viewed on a platform that has screen readers?
3. *Are the interaction channels cross-disability accessible?* In distance education and collaborative environments such as TangoInteractive, there are audio and visual channels that allow direct communication and interaction between the parties. We need to make provision for all of the audio channels to be translated into visual form by translating speech to text, identifying speakers and support translation of multiple people speaking at the same time by having multiple text blocks appearing on the screen. Other non-speech sounds must also be translated and presented. Finally visual information is described and if possible and appropriate presented tactilely. Generalizing, this implies making basic collaborative functions of TangoInteractive cross disability. Initial work has been done by ATRC from Toronto on WebCT Chat and whiteboard tools. Special tools such as the "raised-hands" applet of TangoInteractive would of course also need to be modified to be universally accessible. We also expect to develop tools that allow participants in the CDAKN to better support universal rendering by imposing more formal structure and by asking participants to present key material in multi-modal form.
   The essential technical idea is that TangoInteractive shares the XML (initially HTML)

specification of information and this is mapped using the web scripting API of Tango separately on each client workstation to modify the style sheets used. In the first year we will focus on the existing DOM using the conventional JavaScript API to meet the goals described above. We will use the Syracuse's NeatTools software to build appropriate device interfaces. We will of course have to evaluate and chose from existing or modify interface devices that can support the desired cross-disability rendering. Trace will lead this in the sensory impaired area while for the physically disabled, Catholic University will co-develop interface technology with Syracuse team, and will develop assessment 'instruments' for formative evaluation.

Concurrently with this technical activity, another thrust will study the organization of the educational material into knowledge domains. A focus of this project is the process by which knowledge evolves as a topic (unit knowledge domain) and flows through a life cycle from research to teaching to textbook and heap of recombinant courseware modules, which we view technically as forming a shareable object space described in section 3.3.6. To make them accessible to people with disabilities, course modules need certain minimum information content (redundancy). To make them easy to share at commodity prices, we layer the object spaces as much as possible on current Web data formats and the emerging document object model interoperation norm of the W3C. A key to having recombinant modules is that the modules have a powerful summary, so that planning can be done which integrates modules with both coverage of the desired instructional domain and continuity in terms of meeting prerequisites. Each of the knowledge refinement stages produces a more tightly integrated set of information units, which are technically easier to express in XML and allow a more precise universal rendering. The articulation of what it takes to comprehend the domain is progressively more thorough and expressed in more widely accessible terms as one systematically abstracts and organizes the material in hierarchical fashion.

As an example take the case of blind students and/or teachers. Here, as described in section 3.3 we will add support to TangoInteractive for an automated "orientation view" (who's there, what's happening) comparable to the role of the "table of navigation" in the DAISY/NISO digital talking book. Here there was substantial participation from blind people and people expert in serving the blind so that the process was effective. We hope our project can replicate this success and extend it to a shared cross disability abstraction of knowledge. Articulating the relationships among the discourse fragments provides a higher level of knowledge consolidation and makes the course experience more ready to re-use and re-combine.

As part of this integration thrust, we will extend the archiving capability of TangoInteractive to be cross disability so we capture material in multiple renderings and in the original XML form. This capture will be non-invasive and capable of immediate review. It is well known (c.f. the general accessibility of information in Usenet FAQ documents) that questions people actually ask before they know are the key to making knowledge accessible.

These activities will start in the first year and will be ongoing with continual gathering of requirements from user, content and technology points of view. In year 2, there will be a limited deployment with education sessions organized by CAST and DO-IT using the approach described in sec. 2.2. At this stage we will start to formalize our work in terms of new design principles for such a DOM which will provide important extensions to the current World Wide Web Consortium model which does not have cross disability built into it. For instance, currently terms such as "onclick" or "onkeydown specify event handlers but as these reference user capability-specific and not universal devices, this is clearly not in CDA form. TangoInteractive traps all DOM events for sharing with its JavaScript interface and we will define a more abstract

syntax, which defines user events structurally rather than in terms of an explicit I/O device. This will lead to a CDADOM where content and events are specified abstractly with mappings on conventional machines leading to familiar handlers. Although we will use the concept of a CDADOM to guide the project, it would be too ambitious to fully implement such an extended DOM. Our research and testbed experience will, however, help in the future revision of current W3C document object models in order to become truly CDA.

As always in such projects, there will be ongoing experimentation motivated by the research objectives which imply hypotheses concerning CDA, KN (functionality, effectiveness, usability) and formative evaluation with consequent refinement. For example, can users who are abled, blind, deaf, or quadriplegic access the CDAKN and keep up with one another in interactive sessions? We will identify problems and take corrective design actions in an iterative fashion. The project will include quantitative performance assessment in Tango and in NeatTools interface programs (event tracking, database recording, data analysis). In this way we can strive toward developing a CDA-multimedia-interactive KN.

We will emphasize evaluation of both our concepts and separately of the particular realization in terms of TangoInteractive. The primary criteria to be used in evaluating the success of the techniques are twofold. Firstly there is the ability of the individuals with functional limitations to participate side-by-side with their peers who do not have disabilities. This would include the ability of these individuals to get similar information from the experiences, and to score similarly on tests of comprehension of materials or interactions. Secondly we will examine the reported benefit of the techniques to individuals who do not have any type of functional limitations. This criterion is very important as if the techniques and strategies do not have inherent benefit for everyone, than their promulgation is likely to be slow and limited.

It should be noted that this project does not propose to fully solve these issues. It does propose to have a significant impact on defining the key issues and identifying all of the "low-hanging fruit". This, in itself, can be of tremendous benefit to the two user groups (both with and without disabilities), as the more difficult issues are addressed.

Note that our approach making material universally accessible implies a model for information specification, which allows us to deliver material at a distance. This has obvious value to the disabled and will be an ongoing theme of the testbed activity. In the final year of the work, the major initial thrusts (cross disability representation and knowledge integration) will be firmly linked and we will deploy and evaluate the cross disability knowledge synthesis and archiving capabilities described above and in section 3.

We will of course, continue to experiment and plan for further work, which seems likely to be attractive in this important emerging area. In such a rapid moving field, we cannot predict well even a year or so in the future but areas in which we will experiment include more general (than W3C) object models such as those implied by Java applets and sophisticated multimedia authoring systems.

2.2 Deployment and Assessment

Essential to our project is an iterative process of deployment, formative evaluation, revision and re-deployment. To accomplish that research cycle efficiently, our project includes two organizations whose primary purposes are educational research and development with individuals who have disabilities. Both CAST and DO-IT have access to an active, diverse community of learners to test, customize, and apply knowledge networks that are accessible to individuals with a wide range of disabilities. They also have ongoing research projects which are

intimately related to this project and which will allow us to leverage their methodological expertise and their research sites. DO-IT will make a unique contribution to the proposed project because of its ongoing work with a large group of high school, college, and professional individuals with disabilities who are interested in science, engineering, technology, and mathematics. In addition, DO-IT has developed an extensive network of contacts in K-12 schools throughout the Washington State. CAST has recently completed two projects, which have investigated accessibility of a commercially available web-based course delivery system. Conducted at several colleges and universities in New England (University of Southern Maine, University of Southern Connecticut, and Northeastern University), that research involved essentially identical subjects and methodologies as will be involved in this research. Having developed good research relationships with those institutions and with individuals who have disabilities within them (as well as their disability offices) CAST will repeat the process for this research. CAST also has two Department of Education research grants which are investigating access issues to web-based learning environments for students at the high school level who have various high-incidence learning disabilities (e.g. dyslexia, attention deficit disorder). Another related NSF project is investigating desktop captioning in science classes for students who are deaf.

The basic process will involve training CAST and DO-IT staff on the base technologies to be used in this project. They will then collaborate with the developers of the course material to develop appropriate training material. DO-IT and CAST will be responsible for identifying the participants, offering the workshops, and then providing on-line and on-site support to the participants. They will conduct evaluations described below, which will be fed back into both the technology development and curriculum development project components. This iterative process will be repeated and drive the project forward.

CAST has found that it is sometimes difficult to obtain an adequately diverse sample of disabled students in a single institution and in this case, we will fill out the sample across several institutions. In previous research they have found that close observation and follow-up with a small number of students is more informative than cursory or summative evaluation with a larger number. Therefore, through contacts at offices of academic support for students with disabilities, they will identify a minimum of 6-10 students who span all three categories of disability identified above. Because of the individualized nature of the disabilities involved and the assistive technologies that will be used by these students, testing will be conducted at the student's local optimal setting. Where additional technologies are warranted for evaluation purposes, the CAST laboratory will be used. Note that TangoInteractive can deliver to very many different sites simultaneously and this deployment strategy fits our technology design. We will also involve abled participants so that we properly test our assertion that our approach will also generate better learning environments for all participants.

Students in this sample will thus test the evolving system by engaging in realistic assignments as determined by the course material and in a setting where the individual is comfortable, well-supported, and private. CAST and DO-IT staff will introduce the system, train the student in its use, and conduct the on-site evaluation through structured observation of the example lessons, survey questionnaires, and extended interviews (see proposed CAST methodology in table below). Each evaluation may consist of multiple sessions so as to obtain optimal results. In the final year, data collection for the evaluation collection will be embedded within actual course trials rather than in isolation.

The qualitative data will be analyzed to identify system compatibility with conventional

assistive technologies, to evaluate within-system features and functions, and to ascertain user satisfaction with individual components and with the aggregate system. This information will be used to provide a report for modifications in development and for evaluation of the overall system in realistic settings

Research Goal	**Specific information sought**	**Instrument**	**Sample Size**
General sample characteristics and preferred adaptive device information.	Demographics of the sample; particular assistive technologies utilized	Survey questionnaire and checklist developed for this project from previous CAST and DO-IT work.	6-10 individuals.
Qualitative measure: customary use of adaptive technologies and learning supports.	Information about students' customary use of assistive technologies and software in study settings.	Structured observations of student work (nature of assignments, tools and system supports used, difficulties, advantages, comments).	10-20 observations, 1-2 of each individual student in the investigation.
Qualitative measure: enhanced use of experimental CDAKN system	Information about students' capacity to learn and use the system under design and to learn from it.	Structured observations of student work while using the system (including compatibility estimates with existing technologies, usage of specific features, difficulties, advantages, etc.	10-20 observations, 1-2 of each individual student in the investigation
Qualitative measure: usability and desirability of experimental CDAKN system	Information about students perceptions of usability and advantages/disadvantages of system.	Individual Interviews with students conducted by staff.	Interviews with all 6-10 students who participate conducted early and late in the year.

2.3 Project Outcomes and Research Issues

The fundamental outcome of the proposed research will be *knowledge* on how easy or difficult it is to create CDAKNs, how to identify barriers, and how to overcome them. The main practical outcome will be the creation of the CDAKN itself – the first of its kind. This will serve

as a model for further research and for widespread application of CDAKNs. We intend careful evaluation of its effectiveness and continual improvement of it during and beyond the proposed work. . We intend to sustain the project and its results for the long term, and will seek continued funding from NSF and other sources, while bringing in additional partners for broader implementation and testing. For instance, as we continue to stress truly universal access, we can mention the area of accessibility by people with learning disabilities and non-readers. We expect that the practical experience of CAST will allow techniques developed in this project, to be extended to these groups.

Another substantial outcome will be the research generated by the technology and knowledge integration thrusts needed to build the CDAKN. Computer science research issues addressed in this project, include: a) architecture of CDAKN and implications for a CDADOM, b) Knowledge synthesis and its universal specification, c) Linkage of collaborative systems to knowledge and information resources and d) abstract specification of customizable interfaces and modular interface hardware.

In the companion research area of universal access, we can also identify important research issues, which will be addressed in this project. These include a) How can interactions, which are heavily speech laden, be presented so that individuals who are deaf can interact on equal footing? b) What strategies can be used to offset the inherent delays in any translation process produced, when such delays inherently destroy interaction patterns in active discussions? c) How can the fact, that the audio tracks from individuals are available as discreet audio signals, be capitalized on to provide multiple-parallel conversational tracks, especially when people are speaking simultaneously? These need to be perceivable not only by individuals who were deaf or hard of hearing, but also helpful for all members of the interaction? d) How can visual props and presentational materials be made accessible in real time to individuals who are blind? What are the gestural and real time visual events which accompany typical collaborative interactions, and can be done to prevent them from breaking down the ability of individuals who have low vision or blindness to participate in interactive collaborations or educational endeavors? e) How can pre-scripted pseudo real time interactions be capitalized on, to enhance accessibility of collaborative instructional materials? (E.g., instead of being an actual live interaction, the student is interacting with an intelligent agent which acts out scripts or responds along with pre-recorded or pre-programmed schemas.) TangoInteractive already allows instant replay of all sessions and we need to provide an intelligent cross disability interface to this.

We will make extensive use of the Web for dissemination of project information and free software (TangoInteractive and NeatTools). Information on how to obtain low-cost modular interface hardware will also be provided. This would include computer interface boxes and sensor kits and other commercial components listed in the Trace Resource Book, as appropriate. DO-IT has a long history of developing accessible Web pages and will help assure that all Web-based project materials follow the guidelines of the Web Accessibility Initiative (WAI) of the World Wide Web Consortium. Traditional-style presentations, publications including the DO-IT newsletter and workshops will also disseminate project results using the developed CDAKN methodology to make our knowledge truly universal.

A final major outcome of this CDAKN research and development project will be that users with disabilities will have far greater opportunities for SMET education (active learning in constructivist paradigm, lab participation, lifelong learning) and SMET careers.

3: Technical Background

3.1: Knowledge Domains of the CDAKN

As described above, the CDAKN will be used in two distinct roles. Firstly the team of content and technology developers (Syracuse/CUA/NRH), designers (Trace) and outreach sites (CAST, DO-IT) will use it to define the project itself and to develop initial CDA educational modules. Secondly as described in sec 2.2, the outreach sites will use the CDAKN to deliver material of increasing sophistication in both education and literacy modes. We have chosen to use material already developed, but not universally accessible at present. Our first area is Internetics at http://www.webwisdom.org , which is a curriculum developed by PI Fox that combines computational science and modern information /communication technologies. This is a popular course and easiest test case as all the material is already prepared in XML and stored in a database with the architecture described in the following section. Another major focus is *Science for 21st Century*, a large- enrollment course at Syracuse developed by co-PI Lipson and others with modular approach to teaching science in an integrated way to non-science majors. Two current NSF grants, associated with this course, support development of interactive Web-based educational modules; see http://www.simscience.org and www.phy.syr.edu/courses/CCD_NEW/. We will stress the *Science for 21st Century* modules, as these are broadly useable at both high school, undergraduate and general science literacy levels. It will also give us examples of a knowledge domain making extensive use of web links not developed internally and so requiring special cross disability attention.

3.2: TangoInteractive Background

TangoInteractive (or Tango; http://www.npac.syr.edu/tango) is an advanced, powerful, and extensible Web collaboratory, and is perhaps the most flexible of systems of its type. It is not aimed at exploring research issues in collaborative system design, but rather at exploring applications such as those proposed here. In this regard, great effort has been put into making the base infrastructure quite robust, so that it can be used outside a tolerant research environment.

Tango is written in Java, but supports collaborative applications in any language. Further Tango is fully integrated with Web browsers, and this provides the basis of convenient, familiar interfaces. To run Tango, one starts the system from a browser and connects to a Tango server. Both the client and server code for Tango are freely available on CD-ROM or from our Web site, which also contains the well documented API's for C++, Java, Java Beans, and JavaScript. Currently some 40 separate downloads are made of TangoInteractive software each week.

Once in the system, the user can select from over 25 collaboratory applications to work on projects with partners. One play a game of Bridge or Chess, take a class at a virtual university, create and use a public or private chat room, conduct a videoconference, view a movie, or surf with friends using the powerful shared browser. It is possible to do all this at the same time, in any combination, and multiple copies of applications such as chat rooms can be launched. Further, Tango can provide shared sessions for either client- or server-side applications. The latter include both shared (Web-linked) databases (as in Oracle-based WebWisdom curriculum management system described below) and shared CGI scripts (as in our integration of NCSA's Biology Workbench with Tango). We believe that no other collaboratory system, public domain or commercial gives you so many applications under such consistent and simple session and floor control.

Besides running Java applets under Tango, one can run JavaScript-based client-side Web

applications. Moreover, in Tango the user can take an arbitrary HTML page and automatically turn it into a shared entity. To build a 3D VRML world, populate it with avatars, and let them interact, Tango provides support via two integration modes: VRML JavaScript nodes and External Authoring Interface. Applications written in C or C++ (e.g. PowerPoint) can also be readily adapted to run collaboratively under the Tango API. In this proposal, we will use the C++ interface of Tango to link the NeatTools specialized interfaces. Note that the shared event collaboration model of Tango allows each client to have different views of the same shared application, and this is essential for cross disability access. Shared display systems such as Microsoft's NetMeeting are less flexible.

3.3: Systems Architecture and Software Infrastructure

3.3.1 Overall Design Principles

As discussed in sec. 2, we intend to build and deploy a CDAKN, which means that we must make particular choices in today's rich and evolving technology world. We do this in the context of a knowledge model described in sec. 3.1 with technology choices based especially on the open standards of organizations like W3C. However limitations in commercial systems (e.g. bugs and unimplemented features in web browsers) means that these lofty principles must be leavened with practical and sometimes ugly implementation choices. Further although we will articulate and test general architecture principles in this project, we must build on existing software to develop systems which are appropriately robust and functional. Thus we intend to build on two key NPAC technologies, TangoInteractive and WebWisdom, developed to support distance training but with no delivered cross disability support. We believe this is justified not only because of our familiarity with them but because they exhibit two key capabilities. WebWisdom supports the managed integration of distributed educational objects while TangoInteractive's (unique?) collaborative JavaScript API naturally allows cross disability interfaces to Web documents. Where it is necessary to reference the resultant system, we will term it *CDAWebWisdom*. NPAC and the Trace Center have produced the preliminary design (http://www.npac.syr.edu/users/gcf/webwisdomrefs/) of this cross disability extension of the WebWisdom/TangoInteractive technologies and will continue their partnership in this proposal.

Our proposed software will be built around an emerging architecture for distributed systems that builds on ongoing convergence of web and distributed object technologies (from COM, CORBA, Java and W3C) to form what is usually called the object web.

Both the hardware and software infrastructure of the object web is changing with remarkable speed and so our plans are necessarily tentative especially in out years. However we believe that the activities discussed below illustrate our approach and in some sense represent a lower bound to our goals for they do not require any major new object web base technology developments. Of course, we will take advantage of any significant new relevant technologies that become available during the performance period and modify our plans accordingly.

3.3.2: Architecture of *CDAWebWisdom*

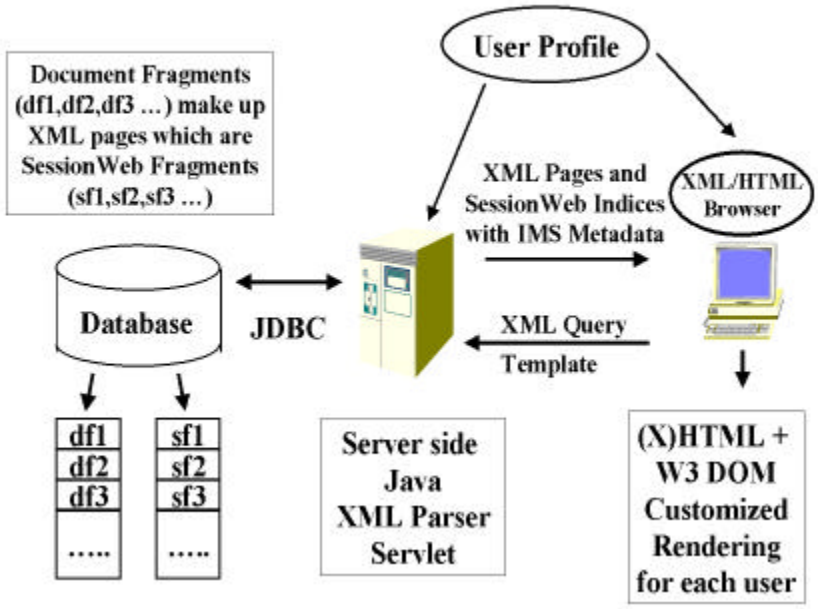

fig.1: Architecture of Cross Disability Rendering

This proposal aims to help and accelerate the development of common information structures that can both express the application in a general fashion and support well cross disability interfaces. In this fashion, our project will help the development of both cross disability access and the ongoing activities defining key object web standards. The Trace center is already a participant in the key W3C object model discussions. Our CDAKN is built on the concept that knowledge is formed iteratively by successive organizations of base information “nuggets”. These are viewed technically as “distributed educational objects" with a four level navigation scheme described below. Cross disability access is needed for both the unit information objects and perhaps even more importantly for their synopsis and indices describing their integration into knowledge. We support the knowledge management by using conventional databases (in our case Oracle) to store persistent information objects and their dynamic organization. Java servers using JDBC map the stored object model into the user view, which is accessed (as in modern web-linked databases) through XML templates. XML is converted into HTML either on the server or (increasingly in the future) browser. The XML/HTML Web documents are shared through TangoInteractive, which allows client profiles to optimize the rendering of both the information nuggets and their synopsis. This pragmatic mix of conventional databases, Java Servers, and XML specification of knowledge and information objects illustrate *CDAWebWisdom*’s technical choices. JavaScript is used to capture interactive events and allow cross disability rendering of dynamic information objects, which respect the web document model (DOM). Currently this DOM is rather erratically designed and implemented by Netscape and Microsoft but we expect the recent W3C proposals to bring more power and uniformity during the time period of this project.

TangoInteractive can share essentially any distributed object with its defined API’s to multiple languages but we stress web pages here as these are natural realization of shared information for the activities in this project. However this is more general than appears at first sight, because web pages can be the user interface to general server or client side objects –

databases (as above), CORBA object brokers, CGI Scripts (as in TangoInteractive's shared web form interface to NCSA's Biology workbench), etc.

3.3.3: Collaborative Knowledge and Cross Disability Rendering

TangoInteractive manages the sharing of educational objects and allows each client to optimize its view of the information based on user preferences and capabilities of the client machine and network connection. This capability is available in any system using a shared event collaboration model, which allows separation of display and shared object specification. As a simple example, a client with a low bandwidth network connection would request the low resolution version of an image and one serving a user with impaired vision, the audio augmentation of this image. As shown in fig. 1, we encapsulate this optimized choice of document fragment rendering in terms of a user profile, which can be implemented as a knowledge agent. Collaborative systems like TangoInteractive can be used to share distributed objects between different users or between different display devices for a given user. This replication of object between different display modalities can be implemented within a single machine or between multiple machines serving a single user.

3.3.4: Integration of Asynchronous and Synchronous Learning Models

We note that our model for information includes both asynchronous and synchronous modes supported in a common fashion for cross disability access. We assume that in each case, students and teachers access curriculum material stored as web pages or more generally distributed objects on web servers, object brokers or equivalent. Asynchronous or self-paced learning occurs when each participant accesses this material in his or her own time. Synchronous learning occurs when this same material is replicated among a class and discussed interactively. This model allows a single approach to cross disability access, which is independent of learning model.

3.3.5: Two Level Navigation Model for Distributed Objects

We start with a conventional hybrid information object model and define a distributed information object by a tuple (*Page_URL*, *Component_DOM*). This approach views information as a collection of document fragments (labeled by *Component_DOM*) arranged in pages labeled by *Page_URL*. When one uses a backend database, this conventional label is mapped into a reference to a database cell and distributed objects can be constructed at any level of granularity as a collection of the contents of multiple cells. Each cell corresponds to a document fragment specified in XML at the client side and converted in a Java servlet to a JDBC access to the database. Pages are accessed through web address, file location, CORBA or Java naming service or whatever hierarchical naming scheme evolves on the object web. A "*Page*" is, for information underlying traditional education, the basic curriculum unit. It is a "screenfull" or "foil" which is discussed by the lecturer or studied by the student as a single unit with cross referencing between concepts not requiring tiresome browsing and reloading of the browser page. The conventional hierarchical labeling of *Page_URL* seems quite natural for future web education and training with, some name like university/ college/ department/ program/ course/ lecture. However the information within a given page is much less structured and consists of some often-haphazard arrangement of multimedia information nuggets. Further fragments within the page can be repositioned dynamically using dynamic HTML as evolved in the W3C DOM.

This two level model will be used in our initial work in this project as it essentially

represents current practice. We will support a limited view of knowledge integration at this stage with all participants allowed to browse the hierarchical page structure and to dynamically arrange pages into new information streams. The XML templates that define the interface to document fragments in the database will be extended to support customized rendering as shown in fig. 1.

3.3.6: Four Level Navigation Model Supporting Knowledge Integration

As part of this project, we will investigate a new approach to document object models, which is designed to support both an easier definition of the overall structure of the document and the dynamic linkage of input-output devices to components. We return to the hierarchical structure labeled by the tuple (*Page_URL, Component_DOM*). We wish to support the hierarchical grouping of information described in section 3.1. In this regard we consider a four way grouping of information – namely the Internet or *World Wide Web*, the *SessionWeb*, the *Page* and the *document fragment*. As emphasized earlier, we will follow the market place in the area of resource discovery and coupling to the hierarchical URL namespace defining the *World Wide Web*. We will use appropriate metadata such as those proposed by Educause's IMS project to integrate educational objects to the topology of the resource-discovery world. Here however, we focus on the natural organization of knowledge in a “session” such as is found in a lecture or a single self study activity. We now discuss this limited fine grain or local *Session Wide Web*, which we abbreviate to *SessionWeb*. This is a subset of the object web whose transactions are the natural units of learning and whose contents are persistent objects whose methods support such transactions. For instance for a lecturer, the *SessionWeb* consists of all pages relevant to a particular lecture as well as all their subcomponents. This local *SessionWeb* is of course likely to be dynamically updated with outside links as topics come up during the lecture. We include in this concept all local navigation both within pages and within the document space of a given learning session. In particular this definition allows the lecturer to pick and choose between presentation material with an order that is determined in real-time. This contrasts with clumsy frameset technology and the static sequential order convenient in most systems (e.g. PowerPoint) today. In a more general browsing activity, a student learner's *SessionWeb* would be less structured and roughly consist of all pages and components stored in the browser cache. In this way, we can customize the display to accommodate different learning styles for each student. Technically the *SessionWeb* is quite small and so able to support richer linkage and access models using very fast client side technologies such as Java and JavaScript with the data structures stored in memory. One approach to the *SessionWeb* that is attractive today is based on Sun Microsystems JavaSpaces and Jini technologies but these are of course only illustrative of appropriate technologies and better choices may become available.

We will build a prototype of such a rich *SessionWeb* object model linked to TangoInteractive. This will be in last half of the project after we have further experience from using the existing W3C DOM. We expect this *SessionWeb* model to give considerable insight to future designs of object models with richer navigation models supporting the knowledge structure discussed in sec. 3.1, with definition of document components and their dynamic linkage as well as their interface to input-output devices.

3.3.7: Range of Authoring Strategies

We will look at cross disability access for the following types of educational pages which show increasing sophistication in terms of authoring tools and hence internal W3C DOM structure.

Each authoring method supports either synchronous or asynchronous views of curricula as described in sec. 3.3.4.

1) Conventional and dynamic HTML Pages.
2) PowerPoint exported to the web using Microsoft's Internet Assistant and modest restructuring to better define object components (labeled by *Component_DOM*).
3) PowerPoint accessed via COM components stored in the backend database, which allows one to properly define a base object model. Web export uses XML templates, which allows support of the multi-resolution images and cross disability access discussed earlier.
4) We will elaborate the object structure seen in pages of the types 1) through 3) in various ways, such as through the addition of pointers, glossaries, notes and quizzes in fashions popularized by tools like WebCT.
5) Java applets are used in some of the best interactive educational curricula and these are well supported with our existing collaborative technology -- especially if they are constructed according to the Javabean design frameworks.

3.4 Assistive Devices and Cross Disability Interfaces

NeatTools Background. We have been developing NeatTools, a visual programming and runtime environment, for interfacing humans and computers. It enables users to input information to a computer through various kinds of sensors and devices and, among other things, displays the information in the form of text, graphics, audio, video, or other methods. One constructs a dataflow network (visual program) in this environment by dragging and dropping objects (modules) from an on-screen toolbox to the desktop workspace and then connecting these with input or output controls and control of parametric lines. Editing and execution of programs occur simultaneously, so that no compilation is necessary. NeatTools is written in C++ on top of a Java-like cross-platform application programming interface (API) so that it can run on multiple platforms including Windows 95/98/NT, Unix, Irix, and Linux. It can interface with serial, parallel, and joystick devices and other significant features include Internet connectivity; display of time signals; mathematical and logic functions; character generation; multimedia; Musical Instrument Device Interface (MIDI) controls; and a visual relational database with multimedia functions. A developer's kit, for writing new external modules, is also available online for those proficient in object-oriented programming in C++.

Devices Background. We have also developed the palm-sized TNG-3 hardware interface box, which detects signals from sensors and switches. Both TNG-3 and the latest version, TNG-3B, have 8 analog and 8 digital input channels and stream data to the serial port of a personal computer at 19200 baud. We also have a working bench prototype of TNG-4, which has more capacity and versatility, with 8 analog and 22 digital lines that are dynamically bi-directional. In other words, each digital line can serve as an input or an output, and this can be dynamically reconfigured at any time within NeatTools by manual or automatic control. We have used *NeatTools* to interface various types of hardware devices to TNG-3, including displacement potentiometers, photocells, magnetic sensors (Hall Effect transducers), pressure transducers, and bend sensors. The customizable and extensible features of these modular hardware and software systems are important for the project goal of extending such technology to accommodate users with a broad range of disabilities.

A Cross-Disability-Accessible Knowledge Network for Education and Collaboration in Science and Technology

Appropriateness for KDI and Roles of Project Personnel

This project is inherently cross disciplinary involving central themes of computer science and universal access and having importance in the areas of learning environments, interface physics and telemedicine. The project directly addresses the goals of the KDI program as it researches the issues involved in building cross disability collaborative and learning networks. It will build testbeds that instantiate such knowledge networks.

The P.I. Fox will naturally be responsible for overall coordination of the project. NPAC , directed by Fox, will be responsible for the software systems needed for the prototype testbeds developed in this project and this effort will be led by Podgorny. This work includes continual enhancement of TangoInteractive to support cross disability rendering of web documents respecting the evolving W3C document object model. The database backend, XML/HTML views of it and archiving learning sessions will be supported by NPAC.

The Trace Center will address the issues that arise in creating CDA multi-modal interactive environments and ensure the project is integrated with the standards development at W3C and IMS. They will actively work with NPAC on overall design of system which is responsibility of Gilman and Fox.

Lipson at Syracuse will lead the identification and development of the special assistive interfaces and their needed device drivers. Catholic University will co-develop interface technology with this Syracuse team, and will develop assessment ‘instruments’ for formative evaluation. Their work will provide alternative rendering of the knowledge network and so enable more quantitative assessment of the chosen human computer interfaces.

CAST (Boston) and DO-IT (U Washington) will be responsible for identifying appropriate users and deploying and evaluating with necessary assessment infrastructure the testbed developed by the collaboration.

Note that Vanderheiden from the Trace center and Fox are team leaders in the joint Alliance/NPACI EOT (Education, Outreach and Training) activity in areas of universal access, learning technologies and graduate education. We expect to use the EOT teams as an informal resource throughout the project.

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Results from Prior NSF Support

Geoffrey Fox and Edward Lipson

NSF award number: ASC-9523481 Dates: 11/1/95–10/31/99 Amount: $927,935 (total costs for three years, plus current no-cost extension; not including two supplements discussed below); "Integration of Information Age Networking and Parallel Supercomputing Simulations into University General Science and K–12 Curricula"

This Metacenter Regional Alliances grant is concerned with developing Web-based educational modules based on four supercomputing simulations projects: a) membrane fluctuations, b) fluid dynamics, c) crackling noise and associated hysteresis, and d) crack propagation in societal structures, such as dams. The former two projects are conducted at Syracuse University, respectively in the physics department and in aeronautics. The latter two take place at Cornell under a subcontract. Additional information on all four modules is available via our grant project Web site (www.simscience.org). We have created Java applet versions of both our fluid- and crystalline-membrane simulations (which arise from representations of "string" theories in particle physics and cosmology). We have also written several other Java applets to illustrate other ideas in physics and principles behind the main simulations. For example, we have written an applet that simulates a simple spring—how the force and stored energy change with extension—to illustrate how the springs used in our crystalline membrane applet work. In addition to Java applets and digital video we have used virtual reality modeling language (VRML) to visualize the output of off-line membrane simulations. We are using examples from everyday life and biology in particular to motivate explanation of the concepts underlying membrane physics. We have also demonstrated collaborative versions of some applets using NPAC's TangoInteractive collaboratory system. This project drove the design of the TangoInteractive interface to Java and Javabean modules. The cross product, spring, planetary motion and computational fluid dynamics collaborative applets have been shown in numerous talks and exhibits to demonstrate the principles behind the use of shared Java in Education. This project also drove research by Fox into new approaches to integrating physics and computer science into education as part of the concept of Internetics. These ideas were described in a book chapter cited in the publications and will be tested this fall in a new undergraduate course PHY 300 aimed at non-science majors interested in communicating ideas using the physics and computer science ideas developed in this and other grants. The MRA project is carried out with the participation of two postdoctoral research associates at Syracuse (one in physics and one at NPAC) and several graduate and undergraduate (REU) students at both institutions. We were awarded a $25,000 REU supplement in the summer of 1997. In addition, we have been awarded a $350,000 supplement for integration of this project with vBNS/Internet II.

Publications

- Beca L., Fox G., Podgorny M. 1999. Component Architecture for Building Web-based Synchronous Collaboration Systems, to appear in proceedings of WETICE'99 workshop

Stanford, June 99.

- Catterall, S., Goldberg, M., Lipson, E., Middleton, A., and Vidali, G. Implementation of information technologies in the teaching of “Science for the 21st Century” *Int. J. Mod. Phys. C* 8:49-66, 1997.

- Fox, G., "Internetics: Technologies, Applications and Academic Fields", Invited Chapter in Book: "Feynman and Computation", edited by A.J.G. Hey, Perseus Books (1999).

- Warner, S., Catterall, S., and Lipson E.D. Java simulations for physics education. *Concurrency: Practice and Experience*, 9:477-484, 1997.

Gregg Vanderheiden Ongoing NSF Support from NSF Partnership in Advanced Computational Science PACI Program

The Universal Design/Disability Access Program (UD/DA) for Advanced Computational Infrastructure project contributes to PACI progress by assisting the PACI partners in applying Universal Design practices by facilitating the inclusion of people with disabilities in all aspects of the PACI program.

The program advances these two goals by five kinds of activities: Education and Awareness, Resources, Tools, Assistance and New Techniques through Synergy. This five-fold strategy persists over the five year life of the program and is developed in more detail in the project home page at http://trace.wisc.edu/world/paci/.

All five of these strategies have produced results in GFY '99:

Education and Awareness: UD/DA also conducted research demonstrations in the EOT-PACI Booth at SC'98. The Trace center also presented PACI and other NSF-funded accessible educational technology to the assistive technology and disability access community in it CurbCuts Room at the CSUN Conference. Additional educational opportunities were found through participation in a conference on reacing senior citizens with health information via the WWW and a workshop on future Home Care Technologies sponsored by the NIDRR RERC on TeleRehabilitation, among others. Collaboration with the TeleRehabilitation researchers promises to be a productive strategy for the achievement of robust and educational Interaction Environments.

Resources: The UD/DA team contributed to the development by the EOT-PACI Team of the "Touch the Future" outreach volume for the SC'98 Conference and an overhaul of the team website at that time. The Web Content Accessibility Guidelines (from the W3C have gained a great deal in both comprehensibility and authority during this period. As of April 30, 1999 they have achieved the status of a Proposed Recommendation and are under review by the W3C member companies.

Tools: A module that prompts accessible practices for inclusion in Web editors, and a tool to speed the creation of captions and related access aids for multimedia are under development and have demonstrable prototype versions.

Assistance: The UD/DA team has helped NPACI articulate "common application needs for Interaction Environments" and approaches to the use of XML in client/server communication. This is just begun and is to be continuted. Contact has been made with the Instructional Management System project of EDUCAUSE and accessibility approaches for that Learning Technologies standards project are under discussion. It was helpful to the Home Care Technologies workshop that we were able to inform them of the developments underway in Immersive Environments and Interaction Environments in PACI.

New Techniques through Synergy: Combining the EOT activities from both the Alliance and NPACI into one team has allowed a critical mass to form around the topic of Learning Technologies. This is a positive development because the projection of Advanced Computational Infrastructure into learning and teaching situations has a lot of the same flexibility and scalability requirements as universal design and disability access. Through the formation of this focus area in the EOT-PACI the UD/DA team has been able to form strategic alliances such as that with this KDI team.

Currently there are no publications from this activity

Sheryl Burgstahler Summary of Prior NSF Support

NSF Award: #HRD-9550003, amount: $1,5000,000, period: 10/1/95-9/30/99.

Title: DO-IT Extension

Summary of Results: summer programs and Internet activities for students with disabilities, printed publications, videotapes, World Wide Web site, workshops, mentoring, conference presentations, participant tracking. This project also produced summaries of survey data from participants including high school students with disabilities, mentors, parents, and instructors.

Publications from Project:

Burgstahler, S. E. (1998). Making Web pages universally accessible. Computer-Mediated Communications Magazine, 5(1).

Burgstahler, S. E., & Comden D. (1998). World wide web. Creating a level playing field. Ability, 98(2), 56-59.

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Burgstahler, S. E. (1997). Students with disabilities and the online classroom. In Z. Berg and M. Collins (Eds.), Wired Together: The Online Classroom in K-12, Volume I. Cresskill, NJ: M. Hampton Press, Inc.

Burgstahler, S. E., Baker, L. M., & Cronheim, D. (1997). Peer-to-peer relationships on the Internet: Advancing the academic goals of students with disabilities. National Educational Computing Conference Proceedings.

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Burgstahler, S. E. (1996). Creating an electronic community on the Internet. National Educational Computing Conference Proceedings.

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Burgstahler, S.E. (1995). Distance learning and the information highway. Journal of Rehabilitation Administration, 19(4), 271-278.

Burgstahler, S.E. (1995). Faculty facilitate research for students with disabilities. Council on Undergraduate Research Quarterly, 8-11.

Burgstahler, S.E. (1995). Cooperative education and students with disabilities. Journal of Studies in Technical Careers, 15(2), 81-87.

Burgstahler, S.E. (1995). Technology eases the transition to college for students with disabilities. Learning and Leading with Technology, 23(1), 39-41.

Corinna E. Lathan Summary of Prior NSF Support

PI on Current NSF Small Grant for Exploratory Research

IIS-9813548, $75,000, Oct. 1, 1998-Oct 1. 1999

Title: Personal Augmentation Devices (PADs): Exploratory Agents To Enable Tele-Interaction, Evaluation, And Development Of Abilities In Persons With Severe Disabilities

The scope of this grant is the initial exploration and development of prototype personal devices, controlled by physiological signals, for the purpose of augmenting human function. The objective is to provide children, who have severe motor disabilities, a device that can navigate and manipulate the external environment under their control.

Number of Students Supported: 2 Graduate Students, 2 Undergraduate Students

Number of Papers Generated: 3 Conference Paper, 1 Journal in Progress, 1 Patent Pending

PI on Previous planning grant

IRI-9712526, $18,000, Aug 15, 1997-December, 1998

Title: Quantitative assessment in complex multisensory human-interface environments

This is a planning grant to identify and assess advanced input and output devices associated with complex multisensory interfaces from a human computer interface design perspective and explore potential methods for measuring performance in environments that use these interfaces in the rehabilitation community.

Number of Students Supported: 1

Number of Papers Generated: 2 Conference Papers

A Cross-Disability-Accessible Knowledge Network for Education and Collaboration in Science and Technology

Dissemination of Results, and Institutional Commitment

We have summarized our plan for dissemination in section 2.3 of the project description. As our proposal is built around novel web-based approaches to communication in a cross disability fashion, we must surely put our results into practice using them where appropriate in the dissemination process. We have already started to use Tango Interactive to support remote lectures as a natural extension of its application to education and training. We will extend this as part of the dissemination plan of this project. Note that our methods are carefully designed to allow the same material to be cross-disability whether used asynchronously as a conventional web site or delivered interactively using Tango. We will also use electronic and traditional newsletters and exploit the existing outreach channels of the participants. These will include the NSF Partnerships in Advanced Computational Infrastructure where we collaborate through Trace and NPAC in the EOT (Education Outreach and Training) program. An important activity we identified in the main text is integration of our results into the activities of relevant standards bodies. These will include Educause's IMS (Instructional Management System) where we are already planning the use of Tango Interactive to demonstrate their messaging standards as well as working with them on integrating accessibility issues into their instructional technology specifications. Equally important is the work of the Trace center with W3C on cross disability issues in their user interface (HTML, DOM) standards for web documents.

The facilities needed by this project include the normal institutional resources, which will be available, as all partners have well established activities and support mechanisms that we will be leveraging in this proposal. Operationally our project needs significant network and computer resources. We have substantial experience from numerous Tango Interactive events as to the requirements in this area. The good news is that high bandwidth is not needed as a single Tango Client needs about 100 kilobits per second to support video and audio. In cases where one drops the video component of digital audio-video conferencing, ordinary dial up modem performance is sufficient. However the bad news is that one does need excellent quality of service (QoS) and current technology and network deployment plans emphasis high bandwidth and not QoS in the near term. We will use the vBNS (as installed at major project sites and giving QoS as a byproduct of bandwidth) to enable this project and NPAC staff will help identification of network issues in our deployment testbeds managed by CAST and DO-IT. Conventional Windows 98 and NT clients with cheap peripherals ($200) will be needed at deployment sites. The Java Tango Interactive servers do not require large servers and modest UNIX or NT boxes are sufficient. However the Web and database servers will see high traffic and here we will use major Sun resources just installed at NPAC through a hardware donation from Sun Microsystems. This will be supplemented with an appropriate network of proxy servers and if necessary mirror sites in the deployment testbeds.

For the work of co-PI Lathan, we note that the Rehabilitation Engineering Research Center (RERC) on Telerehabilitation's headquarters is in Catholic University's Biomedical Engineering's Home Care and Telerehabilitation Technologies Center

(http://www.hctr.be.cua.edu/). The RERC will provide support in the form of laboratory space for hardware and software integration as well as access to clinical expertise through ties with the National Rehabilitation Hospital in DC and Sister Kenny Institute in Minnesota.

A Cross-Disability-Accessible Knowledge Network for Education and Collaboration in Science and Technology

Performance Goals

1. Baseline Plan (Month 3)

We will meet and summarize our current capabilities and establish an initial strategy to meet broad goals of proposal. This will use evolution of existing technologies and strategies. It will establish process for establishing testbeds, appropriate initial curricula, and driving development of novel strategies and technologies for Cross-Disability information access. We will start using TangoInteractive for the project knowledge network.

2. Initial CDAWebWisdom 1.0 Release (Month 10 or earlier)

This software will be aimed at supporting distance training of visually impaired users and will drive activities at CAST DO-IT and Trace on establishing testbeds and setting up an evaluation plan.

3. Cross Disability DOM Study (Month 14 or earlier)
Using initial results from CDAWebWisdom 1.0 and general experiences, we will establish the requirements and approach for a version of the W3C DOM supporting the CDAKN.

4. Initial Testbeds and early Evaluation (Month 14 or earlier)

We will have conducted initial training sessions and completed informal evaluation to allow immediate feedback to CDAWebWisdom system.

5. Release of CDAWebWisdom 1.1 supporting range of disabilities (Month 18 or earlier)
This will support users with hearing or physical disabilities and the latter will be integrated with the interface work at Catholic University and Syracuse. This system will also support cross disability knowledge summaries as a prototype of SessionWeb concept described in Sec 3.3 of project description.

6. Major Mid Term outside Review (Month 21 or earlier)

At this stage we will have performed initial deployment across a range of disabilities and obtained initial formal evaluations. We will discuss progress and next steps with a group of outside experts.

7. Release of CDAWebWisdom 2.0 supporting range of disabilities and an improved architecture built around concept of CDADOM and SessionWeb(Month 26 or earlier)
This will enable the last round of testbed deployment and evaluation activities. Throughout the technology evolution there will be a corresponding activity to prepare curricula in CDA form and by this date, all material from both physics and comoputer science will be available.

8. Final Report and Public Workshop (Month 36 or earlier)

This will be a consolidated description of recommended practices for knowledge capture and

access, to ensure seamless integration of people with different disabilities in collaborative work and learning/teaching activities employing both retained knowledge and real-time interaction. We will summarize our experiences and either hold a separate open workshop or bootstrap such an activity as a part of a national meeting.

A Cross-Disability-Accessible Knowledge Network for Education and Collaboration in Science and Technology

Management Plan

The PI and co-PIs will together constitute an executive committee that will jointly coordinate the project. They will meet at least monthly using TangoInteractive in a multimedia videoconferencing mode with as developed the cross disability support to be designed and built in this project; the meeting agendas will be posted in advance on the Web. When appropriate, other team members at the various sites—including those with disabilities—will participate during part of these meetings to present results and raise any issues of general concern. In any case general meetings will be conducted online at least bimonthly. Continual communications among all participants will take place by e-mail, telephone, and Web page postings (with e-mail alerts). An enlarged technical committee will also be formed and will communicate similarly.

In addition, the results, and plans of the project will be maintained on cross disability Web sites at all participating institutions to compare notes and progress at our various sites. As stated in the project description, the mode of collaboration itself will constitute part of our study of cross disability knowledge networks.

The main project will be divided into subprojects in the following areas:

- Knowledge Integration and Network Design
- Software and Systems Infrastructure (Tango Interactive and NeatTools)
- Assistive Devices and Cross Disability Interfaces
- Science Education
- Deployment
- Assessment

As summarized in discussion of senior personnel roles, individual members of the executive committee will be assigned to be in charge of one or two of these respective areas. Overall management will be organized and tracked using a program like Microsoft Project to establish goals, targets and assigned roles to the team members. The Trace center will be responsible for supporting this management structure as the lead editor of a set of documents and online resources systematically produced during the project and capturing requirements, technologies, lessons and evaluations keyed to the performance goals summarized in the previous section.

Both the Trace Center and Syracuse University are familiar with large multidisciplinary projects, as they are both part of the NCSA Alliance while Fox has been part of the NSF Center for Science and Technology CRPC since its inception. This experience will be used in setting up and implementing the management for this project.

A Cross-Disability-Accessible Knowledge Network for Education and Collaboration in Science and Technology
References

Web Sites for Project Participants

http://www.npac.syr.edu/tango TangoInteractive Web Site at NPAC
http://www.npac.syr.edu NPAC Web Site at Syracuse University
http://www.pulsar.org/ Web Site for work on NeatTools at Syracuse University
http://trace.wisc.edu Trace Center Web Site
http://trace.wisc.edu/world/kiosks/ Trace project designing more usable kiosks, ATMs & Information Transaction Machines.
http://www.hctr.be.cua.edu/RERC/ Rehabilitation Engineering Research Center at Catholic University
http://weber.u.washington.edu/~doit/) DOIT Web Site
http://www.cast.org CAST Web Site

Key References

- Abdel-Wahab, H., Kvande, B., Nanjangud, S., "*Using Java for Multimedia Collaborative Applications*", Proceedings of PROMS'96: Third International Workshop On Protocols for Multimedia Systems, 1996, Madrid, October 1996, pp. 49-62.
- ADL or Advanced Distributed Learning network of the Dept. of Defense and the White House OSTP, http://www.adlnet.org/
- Alliance for Technology Access. 1996. *Computer resources for people with disabilities: a guide to exploring today's assistive technology*. Alameda: Hunter House Publishers.
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- Beca L., Fox G.C., Podgorny M. 1999. *Component Architecture for Building Web-based Synchronous Collaboration Systems*, to appear in proceedings of WETICE'99 workshop Stanford, June 99. http://www.npac.syr.edu/users/beca/papers/components/components.ps
- Bernholdt D.E., Fox G.C., Markowski R., McCracken N.J., Podgorny M., Scavo T.R., Mitra D., Malluhi Q. 1998. *Synchronous Learning at a Distance: Experiences*

with TANGO, published in proceedings of SC98, Orlando. http://www.npac.syr.edu/users/njm/jsuspring98/
- Biology Workbench developed by NCSA, http://biology.ncsa.uiuc.edu/
- Burgstahler, S. E. (1999, in press). *Web access for students with disabilities*. Journal of Science Education for Students with Disabilities.
- Burgstahler, S. E., Comden, D., & Fraser, B. (1997). *Universal design for universal access: Making the Internet accessible for people with disabilities*. ALKI, 13 (3),8-9.
- Burgstahler, S. E., Baker, L. M., & Cronheim, D. (1997). *Peer-to-peer relationships on the Internet: Advancing the academic goals of students with disabilities*. In National Educational Computing '97 Conference Proceedings. Washington, D. C.: T. H. E. Journal and NECA, Inc.
- Burgstahler, S. E. (1995). *Faculty facilitate research for students with disabilities*. Council on Undergraduate Research Quarterly, 8-11.
- Burgstahler, S. E. (1994). *Increasing the representation of people with disabilities in science, engineering, and mathematics*. Journal of Information Technology and Disability, 1(4).
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- Educause Instructional Management System (IMS) http://www.imsproject.org/
- Habanero Collaborative Systems Project at NCSA. http://www.ncsa.uiuc.edu/SDG/Software/Habanero/
- Jini technology from Sun Microsystems, http://www.jini.org/, and http://www.sun.com/jini/
- Kautzman, A.M. (1998). *Virtuous, virtual access: Making Web pages accessible to people with disabilities*. SEARCHER: The Magazine for Database Professionals. 6 (6), 42-45, 48-49.
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- Orpwood, R.D. (1990). *Design methodology for aids for the disabled*, Journal of Medical Engineering, 14(1), 2-10.
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- Rogers, W.A., & Fisk, A.D. (1997, January). *ATM Design and training issues*. Ergonomics in Design, 5, 4-9.
- Salvendy, G. (1997). *Handbook of human factors and ergonomics*. New York: John Wiley and Sons.
- Schneiderman, B. (1997). *Designing the user interface: Strategies for effective human-computer interaction* (3rd Edition). Reading, MA: Addison-Wesley.
- Sheridan, T.B., & Mann, R.W. (1978). *Design of control devices for people with severe motor impairment*. Human Factors, 20(3), 321-328.
- "Science for the 21st Century" Syracuse Courses: http://suhep.phy.syr.edu/courses/PHY106, http://suhep.phy.syr.edu/courses/PHY105, and see also http://www.phy.syr.edu/courses/CCD_NEW/
- SimScience web site for interactive Physics and Engineering learning modules, http://www.simscience.org/
- Vanderheiden, G.C. (1990). *Thirty-something million: Should they be exceptions?* Human Factors, 32(4), 383-396.
- Vanderheiden, G.C. (1997). *Design for people with functional limitations resulting from disability, aging, or circumstance*. In G. Salvendy (Ed.), Handbook of human factors and ergonomics (pp. 2010-2052). New York: John Wiley and Sons.
- Vanderheiden, G.C. (1997). *Input/output technologies: Current recommendations and research needs*. In National Research Council, More than Screen Deep (pp. 71-120). Washington, DC: National Academy Press.
- Vanderheiden, G.C. (1998). *Cross-modal access to current and next-generation internet: Fundamental and advanced topics in internet accessibility*. Technology and Disability, 8(3), 115-126.
- Vanderheiden, G.C. (1998). *Universal design and assistive technology: Alternatives or complements?* Assistive Technology, 10(1), 29-36.
- Virtual University Site http://www.webwisdom.org, including computer science courses (http://www.webwisdom.org/sept1998/WebWisdomCertDescription.html) to be delivered in cross disability fashion in this proposal.
- Web Consortium Document Object Model http://www.w3.org/DOM/
- Web Consortium http://www.w3.org/WAI/
- WebWisdom web-linked database and TangoInteractive integration, http://www.npac.syr.edu/users/gcf/webwisdomrefs/

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Education:

B.A. in Mathematics from Cambridge Univ., Cambridge, England (1961-1964)
Ph.D. in Theoretical Physics from Cambridge University (1964-1967)
M.A. from Cambridge University (1968)

Professional Experience:

1990- Professor of Computer Science, Syracuse University
1990- Professor of Physics, Syracuse University
1990- Director of Northeast Parallel Architectures Center
1979-1990 Professor of Physics, California Inst. of Tech.
1986-1988 Associate Provost for Computing, California Inst. of Tech.
1983-1985 Dean for Educational Computing, California Inst. of Tech.
1981-1983 Executive Officer of Physics, California Inst. of Tech.
1974-1979 Associate Professor of Physics, California Inst. of Tech.
1971-1974 Assistant Professor of Physics, California Inst. of Tech.
1970-1971 Millikan Research Fellow in Theoretical Physics, Caltech
1970 Visiting Scientist (April-May), Brookhaven National Laboratory
1969-1970 Research Fellow at Peterhouse College, Cavendish Lab.,Cambridge
1968-1969 Research Scientist, Lawrence Berkeley Lab., Berkeley, Calif.
1967-1968 Member of School of Natural Science, Inst. for Advanced Study, Princeton, New Jersey

Awards and Honors

Senior Wrangler, Part III Mathematics, Cambridge (1964)
Alfred P. Sloan Foundation Fellowship (1973-75)
Fellow of the American Physical Society (1990)
Journal Editor: Concurrency: Practice and Experience (John Wiley, Inc.)

Selected List of Publications - 5 general ones preceeded by 5 specific to proposal 1 Fox, G "Internetics: Technologies, Applications and Academic Fields" Invited Chapter in Book :Feynman and Computation", edited by A.J.G. Hey, Perseus Books (1999)

2. Fox, G., Scavo T., Bernholdt D.,Markowski R.,McCracken N.,Podgorny M., Mitra D. and Malluhi Q., "Synchronous Learning at a Distance: Experiences with TangoInteractive", in Proceedings of SC98, Orlando, November 1998. 3. Fox, G. C. "Parallel Computing and Education," Daedalus, Journal of the American Academy of Arts and Sciences, Vol. 121, No. 1, pps 111-118, Winter 1992. C3P-958, CRPC-TR91123. 4. Fox G.C., Furmanski W., "Computing on the Web,New Approaches to Parallel Processing,Petaop and Exaop Performance in the Year 2007 IEEE Internet Computing 1:2,38-46, 1997 5. Fox G.C., and Podgorny M, "Real Time Training and Integration of Simulation and Planning using the TangoInteractive Collaborative System", in Proceedings of International Test and Evaluation Workshop on High performance Computing, July 1998, Aberdeen Maryland.

6. Fox, G.C.,Akarsu E., Furmanski W., Haupt T., "WebFlow—High-level Programming environment and Visual Authoring Toolkit for High Performance Distributed Computing" in Proceedings of SC98, Orlando, November 1998. 7. Fox, G.C., Johnson, M.A., Lyzenga, G.A.,

Otto, S.W., Salmon, J.K., Walker, D.W., Solving Problems on Concurrent Processors, Vol. 1, Prentice-Hall, Inc. 1988; Vol. 2, 1990.

8. Fox, G. C., Messina, P., Williams, R., Parallel Computing Works!, Morgan Kaufmann, San Mateo Ca, 1994.

9. Fox, G. C. "Approaches to Physical Optimization," in

Proceedings of 5th SIAM Conference on Parallel Processes for Scientific Computation, pp 153-162, March 25-27, 1991, Houston, TX, J. Dongarra, K. Kennedy, P. Messina, D. Sorensen, R. Voigt, editors, SIAM, 1992.

C3P-959, CRPC-TR91124

10 Fox, G, Bozkus, Z., Choudhary, A., Haupt, T., and Ranka, S. "A compilation approach for Fortran 90D/HPF compilers on distributed memory MIMD computers," in Proceedings of the Sixth Annual Workshop on Languages and Compilers for Parallel Computing. Lecture Notes in Computer Science, Springer-Verlag, pp. 200--215. U. Banerjee, D. Gelernter, A. Nicolau, and D. Padua (editors).

Summary of Interests
See: http://www.npac.syr.edu/DC
Java based Computation: http://www.npac.syr.edu/projects/javaforcse
For education: http://www.webwisdom.org

Fox has worked in a variety of applied computer science fields with his work on computational physics evolving into well known contributions to parallel computing initially involving the hypercube architecture. Over the last three years, his major activity has been the use of Object Web technologies to build collaboration systems and their application in an integrated approach to synchronous and asynchronous distance education. He has led activities to develop prototype high performance Java and Fortran compilers and their runtime support. His research group has pioneered use of CORBA and Java for both collaboration and distributed computing. He helped set up the Java Grande forum to encourage use of Java in large scale computations. Fox is a proponent for the development of computational science and its follow on "Internetics" as an academic discipline and a scientific method. He has established at Syracuse University both graduate and undergraduate programs in these areas. All course have been made available on the Web and his research includes HPCC technology to support education at both K-12 and University level. His research on parallel computing has focused on development and use of this technology to solve large scale computational problems—such as numerical relativity and earthquake prediction. Fox directs InfoMall, which is focused on accelerating the introduction of high speed communications and parallel computing into New York State industry and developing the corresponding software and systems industry

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Education

Ph.D., Policy, Governance and Administration of Higher Education, 1992, University of Washington, Seattle, WA (Dissertation: Computing Services for Disabled Students in Institutions of Higher Education)
Masters' Degree, Mathematics, 1975, University of Washington
Bachelors' Degree, Mathematics, 1970, University of Washington, Summa Cum Laude

Administrative Experiences

Director, DO-IT, 1992-present.
Assistant Director, Information Systems, Computing & Communications, University of Washington, 1991-present.
Director, DO-IT (Disabilities, Opportunities, Internetworking, and Technology, 1992 - present.
Manager, Desktop Computing Services, Computing & Communications, University of Washington, 1988-91.
Manager, Micro Support Group, Academic Computing Services, University of Washington, 1984-88.
Chairman, Department of Mathematics and Computer Science, Saint Martin's College, 1980-84.
Director, Summer Session**,** 1980-84, Saint Martin's College.
Director, Computer In-service, Saint Martin's College, Lacey, WA, 1982-84.
Associate Director, Microcomputer Resource Center, Saint Martin's College, 1981-84.
Project Director, Computers and the Physically Disabled, Saint Martin's College, 1982-84.
Education Center Administrator, Department of Defense (DOD) PREP School, Osan Air Base, South Korea, 1975-76.

Post-secondary Mathematics, Computer Science, Internet, Teacher Education Teaching Experiences

University of Washington, 1984-present.
Saint Martin's College, 1978-84.
Seattle Pacific University, Seattle, WA, 1981.
University of Puget Sound, Tacoma, WA, 1978-79.
Fort Steilacoom Community College, Tacoma, WA, 1977-79.
University of Maryland, Los Angeles City College, South Korea, 1976.
University of Washington, Seattle, WA, 1974-75.

Pre-college Teaching Experiences
Bethel Junior High School, Tacoma, WA, 1977-78.
Department of Defense Prep School, Osan Air Base, South Korea, 1975-76.
Showalter Junior High School, Seattle, WA, 1971-74.

Selected Publications Closely Related to Proposal

Burgstahler, S. E. (1998). Making web pages universally accessible. Computer-Mediated Communications Magazine, 5 (1).

Burgstahler, S. E. (1997). Peer support: What role can the Internet play? Journal of Information Technology and Disability, 4 (4).

Burgstahler, S. E. (1995). Faculty facilitate research for students with disabilities. Council on Undergraduate Research Quarterly, 8-11.

Burgstahler, S. E. (1995). Technology eases the transition to college for students with disabilities. Learning and Leading with Technology, 23 (1), 39-41.

Burgstahler, S. E. (1994). Increasing the representation of people with disabilities in science, engineering, and mathematics. Journal of Information Technology and Disability, 1(4).

Other Selected Publications

Burgstahler, S. E., & Murakami, C. (1998). New kids on the net: Internet activities for secondary mathematics. MA: Allyn and Bacon.

Burgstahler, S. E., & Sahl, K. (1998). New kids on the net: Internet activities for secondary science. MA: Allyn and Bacon.

Burgstahler, S. E. (1995). Cooperative education and students with disabilities. Journal of Studies in Technical Careers, 15 (2), 81-87.

Burgstahler, S. E. (1995). Distance learning and the information highway. The Journal of Rehabilitation Administration, 19(4), 271-276.

Burgstahler, S. E. (1992). Computing services for disabled students in institutions of higher education. Dissertation Abstracts International, 54 (1), 102-A. Ph. D. dissertation, University of Washington.

Present Involvement in Professional Organizations

Equal Access to Software and Information (EASI), American Association for Higher Education
Association for Higher Education ad Disability (AHEAD)
National Science Teachers Association (NSTA)
International Society of Technology Educators (ISTE)

Collaborations

Dr. Ray Bowen, Professor, College of Engineering, University of Washington, collaborate on DO-IT

Dr. Norman Coombs, Professor, RIT, collaborate on EASI

Dr. Denice Denton, Dean, College of Engineering, University of Washington, collaborate on DO-IT

Ron Johnson, Associate Vice President, Computing and Communications, and Associate Provost, University of Washington, collaborate on DO-IT and K-12 Internet outreach activities

Dr. Richard Ladner, Professor of Computer Science and Engineering, University of Washington, collaborate on DO-T

Virginia Stern, Director of Project on Science, Technology and Disability, collaborate on DO-IT

Graduate Students

None

Graduate Advisors
Drs. Steven Olswang, Stephen Kerr, Richard Yalch, University of Washington

BIOGRAPHICAL SKETCH

DO NOT EXCEED 2 PAGES PER PERSON

A. Vitae, listing professional and academic essentials and mailing address.
B. List up to 5 publications most closely related to the proposed project and up to 5 other significant publications, including those being printed. Patents, copyrights or software systems developed may be substituted for publications. Do not include additional lists of publications, invited lectures, etc. Only the list of up to 10 will be used in merit review.
C. A list of persons, other than those cited in the publication list, who have collaborated on a project or a book, article, report or paper within the last 48 months, including collaborators on this proposal. If there are no other collaborators, please indicate so.
D. A list of the names of graduate students with whom this individual has had an association as thesis advisor and postdoctoral scholars sponsored by this individual over the past five years, with a summary of the total numbers of graduate students advised and postdoctoral scholars sponsored.
E. The names of this individual's own graduate and postdoctoral advisors.

The information in C, D, and E is used to help identify potential conflicts or bias in the selection of reviewers.

A. Vitae

Corinna E. Lathan, Ph.D.
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Department of Mechanical Engineering
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PhD, Neuroscience, Massachusetts Institute of Technology, 1994
MS, Aeronautics and Astronautics, Massachusetts Institute of Technology, 1995
BS, Biopsychology and Mathematics, Swarthmore College, 1988

1995-Present Assistant Professor of Biomedical Engineering, **The Catholic University Of America**, Washington, D.C.
1995-Present Consultant to the Medical Staff, **National Rehabilitation Hospital**, Washington, D.C.
1996-Present Adjunct Assistant Professor, Department of Radiology, Imaging Science and Information Systems Center **Georgetown University School of Medicine**, Washington, D.C.
1993-Present Founder, **Keys to Empowering Youth**, http://www.ee.cua.edu/~lathan/keys.htm
1996 Design Project Faculty, **International Space University**, Vienna, Austria.
1996 Consultant, National Photographic Interpretation Center (NPIC) Human Computer Interface Guidelines Project.
1995 Visiting Scientist, Laboratory of Perception and Action Physiology**, Centre Nationale De Recherche Scientifique/Collège de France**, Paris, France.
1994-1995 Research Assistant, Sensory Communications Group, Research Laboratory of Electronics, Department of Electrical Engineering and Computer Science, **Massachusetts Institute Of Technology**, Cambridge, MA.
1989-1994 Man-Vehicle Laboratory, MIT Center for Space Research, Department of Aeronautics and Astronautics/Department of Brain and Cognitive Sciences, **Massachusetts Institute Of**

Technology, Cambridge, MA.

1990-1994 Research Assistant, Massachusetts Eye and Ear Infirmary, Boston, MA**.**

1989-1990 Consultant, Department of Biomedical Sciences, **Universities Space Research Association**, Houston, TX.

1987 Staff, Ashton Graybiel Spatial Orientation Laboratory, Department of Psychology, **Brandeis University**, Waltham, MA.

Reviewer. International Journal of Human Computer Interaction, American Journal of Public Health, IEEE, Systems, Man and Cybernetics; Presence, Teleoperators and Virtual Environments.

Grant Reviewer. National Institute on Disability and Rehabilitation Research (NIDRR) (Panel Chair); National Science Foundation (Multiple Panels); National Institute of Mental Health, IRG: MHSB.

B. Selected Publications

Lathan, C.E., K. Cleary, and L. Traynor******, "Human-centered design of a spine biopsy simulator and the effects of visual and force feedback on performance," ***Presence: Teleoperators and Virtual Environments,*** MIT Press, Accepted.

Lathan, C.E. A. Kinsella, M. Rosen, J. Winters,***** and C. Trepagnier, "Human Factors Engineering of Hor Telemedicine and Telerehabilitation Systems," ***Telemedicine Journal,*** In Press, June, 1999.

Lathan, C.E., M. Sebrechts*****, D. J. Newman, and C. Doarn, "Heuristic Evaluation of a Web-Based Interface For Internet Telemedicine," ***Telemedicine Journal***, In Press, June, 1999.

Lathan, C.E., D. Hamilton, M.S. Bogner, and A. Blanarovich.****** "Human-centered design of home care ***Neurorehabilitation,*** 3:19-26, April, 1999.

Newman, D.J., and C.E. Lathan, "Memory processes and motor control in extreme environments," ***IEEE Systems, man, and Cybernetics,*** 29:3, August, 1999, In Press.

Clément, G. and C.E. Lathan, "Postural reactions induced by vertical motion of visual scenes and the effects of weightlessness," *Acta Otol.*118:466-473. (1998)

Clément, G. and C.E. Lathan, "Effects of hypergravity on optokinetic afternystagmus and perceived direction of optokinetic stimulation," *Aviat. Space, & Env. Med.* 69: 583-589. (1998)

Clément, G., S.J. Wood, C.E. Lathan, R.J. Peterka, and M.F. Reschke, "Effects of gravity on visual-vestibular interaction. 1. Comparison between pitch motions around Earth horizontal axis and Earth vertical axis," *J. Vestib. Res*. 8:4:1-13. (1998)

Lathan, C.E., C.Wall III, and L.R. Harris, "Human eye movement response to z-axis linear acceleration: The effect of varying the phase relationships between visual and vestibular inputs," *Exp. Brain Res.* 103(2):256-266. (1995)

Edward Lipson, Professor of Physics, Syracuse University

EDUCATION

Ph.D. Physics, California Institute of Technology, Pasadena, CA (1971)
B.Sc.(Hons.) Physics and Mathematics, University of Manitoba, Winnipeg, Canada (1966)

ACADEMIC EMPLOYMENT

1999-	Adjunct Professor of Radiology, SUNY Health Science Center, Syracuse
1996-97	Interim Chair, Department of Physics, Syracuse University
1995-96	Acting Chair, Department of Physics, Syracuse University
1994-	Faculty Associate, Northeast Parallel Architectures Center, Syracuse University
1990	Compton Visiting Professor, Department of Biology, Technion (Haifa, Israel; January-May)
1989-1995	Associate Chair, Department of Physics, Syracuse University
1985-	**Professor of Physics, Syracuse University**
1983-89	Director, Graduate Biophysics Program, Syracuse University
1980-85	Associate Professor of Physics, Syracuse University
1976-80	Assistant Professor of Physics, Syracuse University
1974-76	Senior Research Fellow, Caltech
1971-74	Research Fellow, Caltech

HONORS

1979-83	Alfred P. Sloan Foundation Fellow
1972-74	NIH Postdoctoral Research Fellow
1966-69	NSF Predoctoral Fellow
1966-67	Woodrow Wilson Fellow (Honorary)

PUBLICATIONS

Five publications most closely related to the proposed project

Lipson, E., Warner, D., Chang, Y.-J. 1999. Universal Interfacing System for Interactive Technologies in Telemedicine, Disabilities, Rehabilitation, and Education. In: Medicine Meets Virtual Reality — The Convergence of Physical and Informational Technologies: Options for a New Era in Healthcare, Westwood, J., Hoffman, H., Robb, R. and Stredney, D., editors, IOS Press, Amsterdam, pp. 205-211.

Warner, S., Catterall, S., and Lipson E.D. 1997. Java simulations for physics education. Concurrency: Practice and Experience, 9:477-484.

Catterall, S., Goldberg, M., Middleton, A., and Vidali, G. 1997. Implementation of information technologies in the teaching of “Science for the 21st Century” Int. J. Mod. Phys. C 8:49-66.

Pratap, P., Palit, A., and Lipson, E. D. 1986. System analysis of *Phycomyces* light-growth response with sum-of-sinusoids test stimuli. Biophys. J. 50:645-651.

Lipson, E. D. 1995. Action Spectroscopy. In: Handbook of Organic Photochemistry and Photobiology (Horspool, W. and Song, P.-S., editors), CRC Press, Boca Raton, pp. 1257-1266.

Chen, X., Xiong, Y., and Lipson, E. D. 1993. Action spectrum for subliminal light control of adaptation in *Phycomyces* phototropism. Photochem. Photobiol. 58:425-431.

Five other significant publications

Lipson, E. D. and Horwitz, B. A. 1991. Photosensory reception and transduction. In: Sensory Receptors and Signal Transduction. (J. Spudich and B. Satir, editors), (Modern Cell Biology, Vol. 7, B. Satir, series ed.) Wiley-Liss, New York, pp. 1-64.

Sineshchekov, A. V. and Lipson, E. D. 1992. Effect of calcium on dark adaptation in *Phycomyces* phototropism. Photochem. Photobiol. 56:667-675.

Palit, A. and Lipson, E. D. 1989. System analysis of Phycomyces light-growth response in single and double night-blind mutants. Biol. Cybern. 60:385-393.

Palit, A., Galland, P., and Lipson, E. D. 1989. High- and low-intensity photosystems in Phycomyces phototropism: effects of mutations in genes *madA*, *madB*, and *madC*. Planta 177:547-553.

Cerdá-Olmedo, E. and Lipson, E. D., eds. 1987. *Phycomyces*. Cold Spring Harbor Laboratory, New York (430 pages).

GREGG C. VANDERHEIDEN

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RESEARCH INTERESTS

Research and development in the area of universal design and "everyone interfaces," particularly in the area of information systems, to allow their use by people with the broadest possible range of abilities and disabilities.

EDUCATION

B.S. Electrical Engineering (1972), University of Wisconsin-Madison
M.S. Biomedical Engineering (1974), University of Wisconsin-Madison
Ph.D. Technology in Communication Rehabilitation and Child Development (1984), University of Wisconsin-Madison

PROFESSIONAL EXPERIENCE

1986-Present: Faculty, Human Factors Program, Department of Industrial Engineering, University of Wisconsin-Madison.

1972-Present: Director, Trace R&D Center; a rehabilitation engineering center with a focus on design of communication control and computer access systems. The center currently operates under a 5-year core grant of $3.5 million from the National Institute of Disability and Rehabilitation Research, plus other funding, with a project agenda of 33 projects & programs (affiliated Clinic not included).

1971-Present: Principal investigator on 140+ grants and projects, totaling $15+ million, in the area of Rehabilitation Engineering, Access to National Information Infrastructure and Next-Generation Information Systems, Computer Access Systems, and Augmentative Communication & Writing, Systems for children and adults with disabilities Activities included research, development, commercial facilitation, information summary, and training (pre-service and in-service). Funding sources included, among others:
National Institute of Disability and Rehabilitation Research (US DOE), National Science Foundation, Rehabilitation Services Administration, National Institutes of Health, IBM, Apple Computer, Pacific Telesys, AT&T, American Association for the Advancement of Science, US Government Accounting Office, US General Services Administration, Office of Special Education (US DOE).

SELECTED PUBLICATIONS

SELECTED PUBLICATIONS (More than 150 books, book chapters, journal papers, conference publications, and other articles)

- Vanderheiden, G. (1997) Position Paper: Nomadicity, disability access and the every-citizen interface. In *More than Screen Deep: Every Citizen Interfaces to the National Information Infrastructure. Science and Telecommunication Board*, pp. 297-306. National Research Council, National Academy of Science. Washington, DC. 1997.
- Vanderheiden, G. (1997) Design for people with functional limitations due to disability, aging, or circumstances. In Gavriel Salvendy, Ed., *Handbook of Human Factors and Ergonomics*, pp. 2010-2052. John Wiley & Sons.

- Vanderheiden, G. (1996) Development of a multisensory visual interface to computers for blind users. In *Human Factors Perspectives on Human-Computer Interactions: Selections from Human Factors and Ergonomics Society Annual Meeting Proceedings, 1983-1994*. Santa Monica, California: Human Factors and Ergonomics Society.
- Vanderheiden, G. (1997) Design for people with functional limitations due to disability, aging, or circumstances. In Gavriel Salvendy, Ed., *Handbook of Human Factors and Ergonomics*. John Wiley & Sons.
- Making information systems accessible. *Universal Design*, Volume 2, No. 4, October 1995.
- Access to the global information infrastructure (GII) and next-generation information system. *Proceedings of the 18th International Congress on Education of the Deaf*, Tel Aviv, July 1995. Tel Aviv, Israel: International Congress on Education of the Deaf.
- Symposium on High Resolution Tactile Graphics: Invited presentation, "Dynamic and static strategies for nonvisual presentation of graphic information." Los Angeles, March 1994.
- Vanderheiden, G. Use of seamless access protocol to expand the human interface of next-generation information systems and appliances. *Proceedings of 5th International Conference on Human-Computer Interaction*, August 1993, Orlando, FL.
- Vanderheiden, G. (1990). "Thirty-something million: Should they be exceptions?" *Human Factors*, 32(4), 383-396.
- Lee, S., Wiker S.F., and Vanderheiden, G. Interactive haptic interface: Two-dimensional form perception for blind access to computers. *Proceedings of 5th International Conference on Human-Computer Interaction*, August 1993, Orlando, FL.

Vita

Dan Comden
Adaptive Technology Consultant, University of Washington
Technology Coordinator, DO-IT Program
Box 354842
University of Washington
Seattle, WA 98195
206/685-6252
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Education

B.A. in Speech Communication - June, 1986 from Humboldt State University in Arcata, CA

Other training

- College coursework in BASIC, FORTRAN and database management systems from Humboldt State University
- Computer training classes from University of Washington Computing and Communications include: C Programming, Intro and Advanced X Windows, and Unix System Administration

Work Experience

Adaptive Technology Consultant
6/92-present: University of Washington

Systems Analyst/Programmer 2
4/89 to 6/92: University of Washington

Assistant Coordinator
3/86 to 6/88: Humboldt State University Disabled Student Services

Windows Software Tester
5/90 to 6/92: Self-Employed

Data Services Specialist
9/88 to 4/89: Western Energy Distributors, Seattle, Washington

Military

United States Coast Guard Reserve, 4/93 to 5/85. Honorable Discharge.

Selected Publications Closely Related to Proposal

Burgstahler, S. E. & Comden, D. (1998). Creating a level playing field for the world wide web. Ability, 98(2), 56-59.

Burgstahler, S. E., & Comden, D. (1997). World wide access: Focus on libraries. Journal of Information Technology and Disability, 4, 1-2.

Burgstahler, S. E., Comden, D., & Fraser, B. (1997). Universal access: Designing and evaluating Web sites for accessibility, CHOICE: Current Reviews for Academic Libraries, 34, 19-22.

Burgstahler, S.E., Comden, D., & Fraser, B. (1997, December). Universal design for universal access: Making the internet more accessible for people with disabilities. Journal of the Washington Library Association, 13(3).

Comden, D. (1998). Resources in the adaptive technology lab. [Brochure]. Seattle, WA: University of Washington.

Other Selected Publications

Burgstahler, S.E. & Comden, D. (1994). Disabilities, opportunities, internetworking and technology (DO-IT) on the electronic highway. In Assets '94 Conference Proceedings (1534). New York: The Association for Computing Machinery.

Collaborations

Dr. Sheryl Burgstahler, University of Washington
E.A. Draffan, University of Sussex, Brighton
Beth Fraser, Bellevue Community College
Dr. Steven Nourse, University of Washington

Graduate Students

None

Graduate Advisors

None

Alfred S. Gilman

Education:
B.S. in Mechanical Engineering, the Cooper Union, 1963
D.Sc. in Control Systems, Washington University, 1972

Employment (latest first):
Independent consultant, 1996-present.
Coordinating teams negotiating formats and protocols for sharing knowledge.

Intermetrics, Inc. 1975-1996.
Navigation algorithms, aerospace software, software development software, and software for the computer aided design and testing of electronics.

MIT Lincoln Laboratory, 1972-1975.
Systems analysis for communications, sensor, and control systems including surveillance for air traffic control, orbit planning and station-keeping for satellite communication, and spread-spectrum modulation schemes for low probability of detection and high interference resistance.

Sheng Kung Hui Middle School, Hong Kong, 1965-1967.
Mathematics and science teacher in Forms 2 and 3 (corresponds to grades 8 and 9 in U.S.)

Relationship to proposed research (earliest first):

Summary: Dr. Gilman has a distinguished history of accomplishment in aerospace and engineering design software. He is currently active in the areas of universal design of human/computer interfaces, particularly World Wide Web media. Fortuitously, Dr. Gilman's experience with aerospace navigation algorithms provided a practical introduction to networks of autonomous agents. Likewise his experience with software and languages for the design of computer chips provided a similar practical introduction to knowledge representation. His recent experience working with the World Wide Web Consortium on the accessibility of web media suggests that academic research is required to establish a better theoretical foundation for practice in this area. The evolution of the Document Object Model in this industry group will most likely not be accessible-by-design unless the industry consortium process is supported with suitable academic research on the orientation knowledge requirements of navigable information spaces.

Math/Science Teacher: Before entering graduate school, Dr. Gilman taught mathematics and science in junior high school grades for two years. Trying to coach concept-poor students through a great leap forward in abstraction put intense pressure on his own mathematical formation, and helped him obtain a fellowship for graduate study. This left him with a firm grasp of the principle that to understand knowledge one must observe those who are learning it.

Aerospace Engineer: Dr. Gilman was the lead programmer for the navigation software that operated the first user equipment to be flown in the proof-of-concept flight testing of the Global Positioning System. Based on this success he won for his company the role of defining system requirements and evaluation methods for a related function, the "relative navigation" function in the Joint Tactical Information Distribution System. JTIDS relative navigation is an example of what applied mathematicians call a relaxed algorithm. This is a network of sub-processes each of which is iterating toward a local solution and passing intermediate results to some of its neighbors. Work among applied mathematicians in the area of relaxed methods of problem solving or goal seeking has progressed and reaches a high level of mathematical refinement in the Hybrid Control theory exemplified by the work of Wolf Kohn and Anil Nerode. Their approach is based on relaxing or decomposing knowledge of the problem into a network of problem statements. This line of mathematical research gives a framework for analyzing whether knowledge can be effectively applied in an incremental fashion or must be consolidated to be effective.

Computer Scientist and Software Manager: Computer aided design software offered yet another application of network concepts. Dr. Gilman was later the deputy program manager and system engineer for the development of VHDL, the VHSIC Hardware Description Language. The specific application of VHDL is the design of logic circuits and systems. It is used to describe logic at levels ranging from small functions performed by macrocells within a chip to multi-board systems. It is a common mode of expression used by design tools from competing vendors. It has expresses how the circuits behave based on a "communicating sequential processes" execution model. Each VHDL process operates autonomously; control must be explicitly modeled by the signals that communicate the control.

VHDL logic designs can be very complex, and iterative, top-down design is often employed. VHDL includes data abstraction capability so that the overall block diagram topology can persist as a design progresses through this process of incremental refinement to more detailed designs. To support the incremental design process, it was desired to be able to not only retain but exchange intermediate states of partially known designs. This forced strong emphasis on modular description and multiple, but interoperable, levels of design abstraction.

One of Dr. Gilman's duties as deputy program manager was to coordinate the documentation of the "design library," a repository for design work in progress with a public Application Programming Interface (API) so third-party tools could participate in the design process. He also coordinated the training of third-party tool writers in this API, which was exported from a core set of tools developed by Intermetrics. Teaching others this API forced the team to deal in greater depth with the issues of data abstraction and knowledge representation in the design and test process for electronics. To help the industry capitalized on the potential of this technology he served for several years as vice-chair of the Design Automation Standards Subcommittee (now Committee) in the IEEE Computer Society. VHDL is a living, growing phenomenon in the design of digital electronics. To track ongoing progress start at <http://www.eda.org/>.

Later, DARPA funded work to extend design languages into the domain of analog electronics via the MHDL (MIMIC Hardware Description Language) project. This intensified the knowledge representation challenges. For analog circuits, the designer moves back and forth between equational descriptions of passive circuits and functional or algorithmic descriptions of active circuits. Integrating descriptions framed in these two views is a knowledge representation challenge that had to be addressed in MHDL. For recent research that extends the progress made in the VHDL and related projects see the DARPA programs "Intelligent Information Integration" and "Evolutionary Development of Complex Systems."

Accommodation Analyst and Mediator: Recently, Dr. Gilman has served as chair of a working group in the Web Accessibility Initiative of the World Wide Web Consortium which reviewed technical specifications for the basic Web hypertext and stylesheet languages (HTML 4.0 and CSS 2.0). This team was charged with reviewing these draft specifications for support of access by people with disabilities. The accessibility benefits of this review are reflected in the W3C website at <http://www.w3.org/WAI/#Resources>. He continues to serve as co-chair of the related "Protocols and Formats working group" in the WAI. As the web media migrate from HTML toward XML, some of the assurance of standard semantics is eroding, and it is not clear that accessibility can be assured without a stronger layer of knowledge requirements above and beyond the bare syntax of XML. From this experience Dr. Gilman has become an advocate in this community for knowledge engineering as a discipline that can help to extract simple but effective access accommodations and automate them in a way that makes their satisfaction affordable and sustainable.

Marek Podgorny
Research Director
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Education

Habilitation (higher doctoral degree) , '91, Theoretical Physics, Jagellonian University, Cracow, Poland.
PhD, '78, Experimental Physics, Jagellonian University, Cracow, Poland.
MSc, '73, Experimental Physics, Jagellonian University, Cracow, Poland.

Professional Employment

Research Director, NPAV, Syracuse University, ’97 - now
Associate Director for Advanced Systems, NPAC, Syracuse University, '95 - 97
Associate Director for System Engineering, NPAC, Syracuse University, '93 - '95
Sr. Researcher in NPAC, Syracuse University, '92 - '94
Visiting Professor, Ruhr University, Bochum, Germany, '90
Assistant Professor and Director of the Computer Services, Jagellonian University, Cracow, Poland, '86-'89
Senior Scientific Associate, Ruhr University, Bochum, Germany, '86
Humboldt Research Fellow, Dortmund University, Dortmund, Germany, '84 - '85
Scientific Associate, INFN Frascati, Rome, Italy, '80
Assistant Professor, Jagellonian University, Cracow, Poland, '79 - '83.
Scientific Associate, Nijmegen University, Nijmegen, Holland, '78 - '79.
Assistant, Experimental Physics, Jagellonian University, Cracow, Poland, '73 - '78

Projects supervised (last five years)

- TANGO Interactive: a Web-based collaborative framework, , ~$1.1M, ’97 - now
- Collaboration and Interactive Visualization, sponsored by DARPA via Rome Laboratory, $2M '95 - '97
- Northeast Parallel Architectures Center facility upgrade grant, sponsored by New York State, $6,5M, '93 - '96
- Video on Demand Project in NPAC, sponsored by Rome Laboratory, Griffiss Air Force Base, $400K, '94 - '96
- NYNET ATM Network Project in NPAC, in collaboration with NYNEX, Griffiss Air Force Base, CornellUniversity, Columbia University, and Brooklyn Polytechnic, '93 - '96

Current responsibilities

Technical and research management of a number of NPAC projects. Sole responsibility for project planning, staffing,
implementation, and delivery. Providing leadership and supervision for 20+ researchers and graduate students.

Expertise

- Experimental Physics: optical properties of semiconductors, spectroscopy in the energy range form IR to
  synchrotron radiation, computer on-line experiment control and data acquisition.
- Theoretical Physics: solid state theory, specialty: optical properties of materials and theory of magnetism; advanced mathematical skills.
- Computational Physics: electronic structure calculations, Monte Carlo simulations.
- High Performance Computing and Communication:
  - computer architectures: PCs, workstations, vector machines, massively parallel machines
  - networking technology: hardware infrastructure and software layers, including SONET and ATM; internetworking, ISDN, integrated services, Internet protocols, quality of service
  - storage technology: hierarchical and network storage systems
  - software: web technology; client - server system architectures spanning PC UNIX and supercomputer systems; multi-tier architectures, distributed collaborative systems, database technology including parallel databases, multimedia including video server technologies, digital audio and video codecs and transports, multimedia protocols
  - active programming skills Fortran, C, Visual Basic, SQL ; active system and DBA administration
  - distributed computing and system integration

Relevant Publications

- Fox G.C., and Podgorny M, "Real Time Training and Integration of Simulation and Planning using the TangoInteractive Collaborative System", in Proceedings of International Test and Evaluation Workshop on High performance Computing, July 1998, Aberdeen Maryland.
- Fox, G., Scavo T., Bernholdt D.,Markowski R.,McCracken N.,Podgorny M., Mitra D. and Malluhi Q., "Synchronous Learning at a Distance: Experiences with TangoInteractive", in Proceedings of SC98, Orlando, November 1998.

CURRICULUM VITAE

DAVID H. ROSE
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(617) 391-9584

EDUCATION

1976	Harvard University, Graduate School of Education, Cambridge, Massachusetts Ed.D.
1968	Reed College, Portland, Oregon M.A.
1967	Harvard College, Cambridge, Massachusetts B.A.

PROFESSIONAL EXPERIENCE

1993 -Present	CAST, Inc., Peabody, Massachusetts Co-Executive Director
1987 - 1993	CAST, Inc., Peabody, Massachusetts Executive Director
1985 - Present	Harvard University, Cambridge, Massachusetts Graduate School of Education Lecturer (Neuropsychology)
1983-1987	North Shore Children's Hospital, Salem, Massachusetts Director, Medical Educational Evaluation Center Director, Diagnostic Evaluation Center
1981-1983	Children's Hospital Medical Center, Boston, Massachusetts Psychologist, Department of Pediatrics Developmental Evaluation Clinic
1978-1980	Children's Hospital Medical Center, Boston, Massachusetts NIMH Post-Doctoral Fellowship, Dept. of Psychiatry
1973-1979	Tufts University, Medford, Massachusetts Assist. Professor, Elliot-Pearson Department of Child Study
1973-1976	Tufts University, Medford, Massachusetts Instructor, Elliot-Pearson Department of Child Study
1971-1973	Harvard University, Cambridge, Massachusetts Research Assistant, Graduate School of Education

CERTIFICATIONS

Licensure in Clinical Psychology, Commonwealth of Massachusetts

SELECTED PUBLICATIONS

Meyer, A., & Rose, D. H. (1998). Learning to read in the computer age. In J. Chall (Series Ed.) & J. Onofrey (Ed.), *What research and practice say to the teacher of reading*. Cambridge, MA: Brookline Books.

Rose, D. & Meyer, A. (1996). Expanding the literacy toolbox: New media in the classroom, *Literacy Research Paper*, New York, NY: Scholastic Inc.

Rose, D. (1995). *Apprenticeship and exploration: A new approach to literacy instruction* (Literacy Research Paper 6). New York: Scholastic.

Rose, D. & Meyer, A. (1994). The role of technology in language arts instruction. *Language Arts, 71* (4), 290-294.

Rose, D., Meyer, A., & Pisha, B., (1994). Out of print: Literacy in the electronic age. In N.J. Ellsworth, C. N. Hedley, A. N. Baratta (Eds.), *Literacy. A redefinition* (pp. 55-59). Hillsdale, NJ: Lawrence Erlbaum Associates.

COMPUTER SOFTWARE DEVELOPMENT

CAST, Inc., (1995) *Interfaces* (accessible newsletter), Peabody, Massachusetts: CAST, Inc.

CAST, Inc. & Annenberg Washington Program (1994). *Communications Technology for Everyone: Implications for the Classroom and Beyond*, (Accessible CD-ROM), Washington, D.C.: The Annenberg Washington Program.

CAST, Inc. & Scholastic, Inc. (1994). *Wiggleworks: Scholastic Beginning Literacy System*, New York, New York: Scholastic, Inc.

PUBLIC POLICY INITIATIVES

February 26, 1996: member of Texas Task Force on Electronic Textbook Accessibility that prepared a report for the Texas Legislature explicating the advantages of electronic textbooks for people with disabilities.

September, 1995, advisor to the Council of Exceptional Children (CEC) in its efforts to adopt and disseminate principles and national guidelines of universal design in education for educators, publishers and policy makers.

PAPERS AND SYMPOSIA DELIVERED AT RECENT PROFESSIONAL CONFERENCES

Literacy unbound: intelligent text books for intelligent teaching. *SkyLight Fifth International Teaching for Intelligence Conference*. San Francisco, CA. April 18, 1999.

Learning to read in the computer age. *Michigan Reading Association Conference*. Grand Rapids, Michigan. March 15, 1999.

Keynote address. learning to read in the electronic age. *Annual West Coast Reading Recovery Conference*. Anaheim, California. March 7, 1999.

Plenary address. Learning to read in the electronic age. *National Reading Conference 48th Annual Meeting*. Austin, Texas. December 2-5, 1998.

Is the literacy express on the right track? Learning to read in the digital age. *California Reading Association 32nd Annual Conference*. Sacramento, CA. November 5-7, 1998.

Learning disorders: Can we create a synthesis? *Brain Bases of learning disorders: The case of reading. Mind/Brain/Behavior Interfaculty Initiative*. Harvard University. Cambridge, MA. October 15-16, 1998.

Making the possibilities possible for everyone. *Harvard Graduate School of Education's summer insitute on leadership and the new technologies: Strategies for the schools of tomorrow*. Cambridge, MA July 19-25, 1998

David Jay Warner, M.D.

EDUCATION

Doctor of Medicine: Loma Linda University, Spring 1995.
Bachelor of Arts: Physical Science, San Diego State University 1986.

CURRENT POSITIONS

Professional:

Director/CEO of the Institute for Interventional Informatics, 94-Present.
Director of the "Technology Task Force" for the American Telemedicine Association, 96-98
Director of Medical Intelligence for International Telemedicine Associates Inc., 96-Present.

Academic:

Nason Fellow at the Northeast Parallel Architectures Center-Syracuse Univ., 95-present
Adjunct Professor of Pathology and Clinical Informatics-SUNY HSC-Syracuse, 96-present.
Visiting Scholar for the Human Interface Technology Lab-Univ. of Washington, 96-present (Physiologically based Interface Design).
Adjunct Professor of Plastic Surgery-UCSD San Diego 97-present (Medical interfacing for assessing task performance).

PUBLICATIONS

Publications most closely related to the proposed project

Lipson, E., Warner, D., Chang, Y.-J. (1999) Universal Interfacing System for Interactive Technologies in Telemedicine, Disabilities, Rehabilitation, and Education. In: Medicine Meets Virtual Reality — The Convergence of Physical and Informational Technologies: Options for a New Era in Healthcare, Westwood, J., Hoffman, H., Robb, R. and Stredney, D., editors, IOS Press, Amsterdam, pp. 205-211.

Warner D, Tichenor J.M, Balch D.C. (1996) Telemedicine and Distributed Medical Intelligence. *Telemedicine Journal* 2: 295-301.

Warner, D., Sale, J., (1995) Interventional Informatics: Healing with Information. In Proceedings of Medicine Meets Virtual Reality III. San Diego, CA: Aligned Management Associates.

Warner, D., Anderson, T., and Johanson, J. (1994). Bio-Cybernetics: A Biologically Responsive Interactive Interface. In Medicine Meets Virtual Reality II: Interactive Technology & Healthcare: Visionary Applications for Simulation Visualization Robotics. (pp. 237-241). San Diego, CA, USA: Aligned Management Associates.

Warner, D., Sale, J., Price, S. and Will, D. (1992). Re-enabling Technologies: Immediate Medical Applications for Virtual Reality Interfaces. In Proceedings of Medicine Meets Virtual Reality. San Diego, CA: Aligned Management Associates.

Warner, D., Sale, J., Price, S. and Will, D. (1992). Remapping the Human-Computer Interface for Optimized Perceptualization of Medical Information. In Proceedings of Medicine Meets Virtual Reality. San Diego, CA: Aligned Management Associates.

Other significant publications

Warner, D., Sale, J. and Price, S. (1991). The Neurorehabilitation Workstation: A Clinical Application for Machine-Resident Intelligence. In Proceedings of the 13th Annual International Conference of the IEEE Engineering in Medicine and Biology Society. (pp. 1266-1267). Los Alamitos, CA: IEEE Computer Society Press.

Viirre E, Warner D, Balch D, Nelson J.R. (1997) Remote Medical Consultation for Vestibular Disorders: Technological Solutions and Case Report. *Telemedicine Journal* 3:53-57.

COLLABORATORS

Jay Sanders MD, American Telemedicine Association
Erik Viirre, Human Interface Technology Lab, University of Washington, and UC San Diego
Corinna Lathan, Catholic University of America
David Balch, East Carolina University School of Medicine
Jeff Sale, San Diego State University
Edward Lipson, Syracuse University
Yuh-Jye Chang, Syracuse University and Bell Laboratories

ADVISEES

I have not advised nor sponsored any graduate students or postdoctoral fellows.

ADVISOR

Nason Postdoctoral Fellowship advisor: Geoffrey Fox, Syracuse University

SUMMARY PROPOSAL BUDGET

YEAR 1

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **Syracuse University**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **Geoffrey C Fox**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Geoffrey C Fox - none**	**0.00**	**0.00**	**2.00**	$ **16,997**	$
2. **Sheryl Burgstahler - none**	**0.00**	**0.00**	**0.00**	**0**	
3. **Corinna E Lathan - none**	**0.00**	**0.00**	**0.00**	**0**	
4. **Edward D Lipson - none**	**0.00**	**0.00**	**1.50**	**13,950**	
5. **Marek Podgorny**	**5.00**	**0.00**	**0.00**	**42,608**	
6. (**2**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**1.00**	**0.00**	**0.00**	**6,000**	
7. (**7**) TOTAL SENIOR PERSONNEL (1 - 6)	**6.00**	**0.00**	**3.50**	**79,555**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**1**) POST DOCTORAL ASSOCIATES	**12.00**	**0.00**	**0.00**	**45,000**	
2. (**0**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**0.00**	**0.00**	**0.00**	**0**	
3. (**3**) GRADUATE STUDENTS				**40,263**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**164,818**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**42,481**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**207,299**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				**10,000**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
(**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**15,000**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**10,000**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**447,653**	
6. OTHER				**34,980**	
TOTAL OTHER DIRECT COSTS				**507,633**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**724,932**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **% of MTDC (Rate: 51.0000, Base: 242298) (Cont. on Comments Page)**					
TOTAL INDIRECT COSTS (F&A)				**174,571**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**899,503**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **899,503**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*: **Geoffrey C Fox** DATE

ORG. REP. TYPED NAME & SIGNATURE* DATE

FOR NSF USE ONLY

INDIRECT COST RATE VERIFICATION

Date Checked	Date Of Rate Sheet	Initials - ORG

SUMMARY PROPOSAL BUDGET COMMENTS - Year 1

Other Senior Personnel

Name - Title	Cal	Acad	Sumr	Funds Requested
Vanderheiden, Gregg C - none	0.00	0.00	0.00	0
Warner, Dave -	1.00	0.00	0.00	6000

**** I- Indirect Costs**
subawards (Rate: 51.0000, Base 100000)
Subawards for CAST Budget year 1
Not in the institution selector total for year 1 = $49,918 which is included in year 1 subaward total

SUMMARY PROPOSAL BUDGET YEAR 2

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **Syracuse University**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **Geoffrey C Fox**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Geoffrey C Fox - none**	**0.00**	**0.00**	**2.00**	$ **17,677**	$
2. **Sheryl Burgstahler - none**	**0.00**	**0.00**	**0.00**	**0**	
3. **Corinna E Lathan - none**	**0.00**	**0.00**	**0.00**	**0**	
4. **Edward D Lipson - none**	**0.00**	**0.00**	**1.50**	**14,508**	
5. **Marek Podgorny**	**5.00**	**0.00**	**0.00**	**44,312**	
6. (**2**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**1.00**	**0.00**	**0.00**	**6,240**	
7. (**7**) TOTAL SENIOR PERSONNEL (1 - 6)	**6.00**	**0.00**	**3.50**	**82,737**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**1**) POST DOCTORAL ASSOCIATES	**12.00**	**0.00**	**0.00**	**46,800**	
2. (**0**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**0.00**	**0.00**	**0.00**	**0**	
3. (**3**) GRADUATE STUDENTS				**41,874**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**171,411**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**44,180**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**215,591**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				**10,400**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
(**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**15,600**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**10,400**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**450,150**	
6. OTHER				**36,720**	
TOTAL OTHER DIRECT COSTS				**512,870**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**738,861**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **% of MTDC (Rate: 51.0000, Base: 251997)**					
TOTAL INDIRECT COSTS (F&A)				**128,518**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**867,379**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **867,379**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY
Geoffrey C Fox		INDIRECT COST RATE VERIFICATION
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked / Date Of Rate Sheet / Initials - ORG

SUMMARY PROPOSAL BUDGET COMMENTS - Year 2

Other Senior Personnel

Name - Title	Cal	Acad	Sumr	Funds Requested
Vanderheiden, Gregg C - none	**0.00**	**0.00**	**0.00**	**0**
Warner, Dave -	**1.00**	**0.00**	**0.00**	**6240**

**** I- Indirect Costs**
Subaward for David Rose for year 2 = $49,461 which is included in total year 2 subaward amount.

SUMMARY PROPOSAL BUDGET YEAR 3

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **Syracuse University**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **Geoffrey C Fox**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Geoffrey C Fox - none**	**0.00**	**0.00**	**2.00**	$ **18,384**	$
2. **Sheryl Burgstahler - none**	**0.00**	**0.00**	**0.00**	**0**	
3. **Corinna E Lathan - none**	**0.00**	**0.00**	**0.00**	**0**	
4. **Edward D Lipson - none**	**0.00**	**0.00**	**1.50**	**15,088**	
5. **Marek Podgorny**	**5.00**	**0.00**	**0.00**	**46,084**	
6. (**2**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**1.00**	**0.00**	**0.00**	**6,490**	
7. (**7**) TOTAL SENIOR PERSONNEL (1 - 6)	**6.00**	**0.00**	**3.50**	**86,046**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**1**) POST DOCTORAL ASSOCIATES	**12.00**	**0.00**	**0.00**	**48,672**	
2. (**0**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**0.00**	**0.00**	**0.00**	**0**	
3. (**3**) GRADUATE STUDENTS				**43,548**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**178,266**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**45,947**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**224,213**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				**10,816**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
(**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**16,224**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**10,816**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**448,049**	
6. OTHER				**38,580**	
TOTAL OTHER DIRECT COSTS				**513,669**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**748,698**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **% of MTDC (Rate: 51.0000, Base: 262070)**					
TOTAL INDIRECT COSTS (F&A)				**133,655**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**882,353**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **882,353**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*: **Geoffrey C Fox** DATE

ORG. REP. TYPED NAME & SIGNATURE* DATE

FOR NSF USE ONLY

INDIRECT COST RATE VERIFICATION

Date Checked	Date Of Rate Sheet	Initials - ORG

SUMMARY PROPOSAL BUDGET COMMENTS - Year 3

Other Senior Personnel

Name - Title	Cal	Acad	Sumr	Funds Requested
Vanderheiden, Gregg C - none	0.00	0.00	0.00	0
Warner, Dave -	1.00	0.00	0.00	6490

**** I- Indirect Costs**
Subaward for David Rose (CAST) = $49,593 which is included in total year 3 subaward amount

SUMMARY PROPOSAL BUDGET

Cumulative

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **Syracuse University**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **Geoffrey C Fox**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Geoffrey C Fox - none**	**0.00**	**0.00**	**6.00**	$ **53,058**	$
2. **Sheryl Burgstahler - none**	**0.00**	**0.00**	**0.00**	**0**	
3. **Corinna E Lathan - none**	**0.00**	**0.00**	**0.00**	**0**	
4. **Edward D Lipson - none**	**0.00**	**0.00**	**4.50**	**43,546**	
5. **Marek Podgorny**	**15.00**	**0.00**	**0.00**	**133,004**	
6. (**2**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**3.00**	**0.00**	**0.00**	**18,730**	
7. (**7**) TOTAL SENIOR PERSONNEL (1 - 6)	**18.00**	**0.00**	**10.50**	**248,338**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**3**) POST DOCTORAL ASSOCIATES	**36.00**	**0.00**	**0.00**	**140,472**	
2. (**0**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**0.00**	**0.00**	**0.00**	**0**	
3. (**9**) GRADUATE STUDENTS				**125,685**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**514,495**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**132,608**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**647,103**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				**31,216**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
(**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**46,824**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**31,216**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**1,345,852**	
6. OTHER				**110,280**	
TOTAL OTHER DIRECT COSTS				**1,534,172**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**2,212,491**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				**436,746**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**2,649,237**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **2,649,237**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*: **Geoffrey C Fox** DATE

ORG. REP. TYPED NAME & SIGNATURE* DATE

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

NSF Form 1030 (10/98) Supersedes all previous editions

C***SIGNATURES REQUIRED ONLY FOR REVISED BUDGET (GPG III.B)**

Budget Justification

Personnel: Rates are based on actual costs where there are incumbents and Syracuse University approved rates for unfilled positions. The academic year is 8.5 months and the summer is 3.5 months. With this each year has a 4% increase in salaries.

Fringe Benefits: Varied Rates (negotiated effective 7/1/99)
Full-time employees and faculty academic year rate is 34.2%
Graduate Research Assistants rate is 12.7%
Faculty rate is 17.3%

Travel: Funds requested are for attending annual conferences to help keep abreast of latest technology in this field. Since destinations have not been determined estimates are based on previous conference attending costs.

Materials and Supplies: This is an average monthly cost based on historical and current rates charged to upgrade the software and maintain the state of the art computer equipment, and the materials associated with the research for the project. All items are let for bid through the University's Purchasing Department.

Publication: This is an average monthly cost based on historical and current rates to charge documentation and publication supplies associated with the research of the project. All items are let for bid through the University's Purchasing Department.

Remitted tuition is a part of a graduate research assistant's appointment to Syracuse University. They receive up to 24 hours per year/per student based on a 20 hour per week work load. Tuition rates were provided by the university's Budget Office.
Academic year rates: ($583)/per credit 99-00, ($612)/per credit 00-01, ($643)/per credit 01-02

Indirect Costs: Syracuse University's indirect cost rate is negotiated with the NIH. University's rate effective 7/1/98 is 51.00 x MTDC. (Total direct costs minus tuition).

SUMMARY PROPOSAL BUDGET YEAR 1

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
Catholic University of America

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Corinna E Lathan

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Corinna E Lathan**	**0.00**	**0.00**	**1.00**	$ **6,470**	$
2.					
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**0.00**	**0.00**	**0.00**	**0**	
7. (**1**) TOTAL SENIOR PERSONNEL (1 - 6)	**0.00**	**0.00**	**1.00**	**6,470**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL ASSOCIATES	**0.00**	**0.00**	**0.00**	**0**	
2. (**1**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**4.00**	**0.00**	**0.00**	**10,000**	
3. (**1**) GRADUATE STUDENTS				**16,000**	
4. (**1**) UNDERGRADUATE STUDENTS				**3,000**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**35,470**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**4,715**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**40,185**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				**3,000**	
2. FOREIGN				**1,500**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
(**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**8,000**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**500**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**8,500**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**53,185**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **% of MTDC (Rate: 62.0000, Base: 35470)**					
TOTAL INDIRECT COSTS (F&A)				**21,991**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**75,176**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **75,176**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY
Corinna E Lathan		INDIRECT COST RATE VERIFICATION
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked / Date Of Rate Sheet / Initials - ORG

SUMMARY PROPOSAL BUDGET COMMENTS - Year 1

SUMMARY PROPOSAL BUDGET YEAR 2

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
Catholic University of America

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Corinna E Lathan

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Corinna E Lathan**	**0.00**	**0.00**	**1.00**	$ **6,470**	$
2.					
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**0.00**	**0.00**	**0.00**	**0**	
7. (**1**) TOTAL SENIOR PERSONNEL (1 - 6)	**0.00**	**0.00**	**1.00**	**6,470**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL ASSOCIATES	**0.00**	**0.00**	**0.00**	**0**	
2. (**1**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**4.00**	**0.00**	**0.00**	**10,000**	
3. (**1**) GRADUATE STUDENTS				**16,000**	
4. (**1**) UNDERGRADUATE STUDENTS				**3,000**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**35,470**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**4,715**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**40,185**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				**3,000**	
2. FOREIGN				**1,500**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
(**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**8,000**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**500**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**8,500**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**53,185**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **% of MTDC (Rate: 62.0000, Base: 35470)**					
TOTAL INDIRECT COSTS (F&A)				**21,991**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**75,176**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **75,176**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*
Corinna E Lathan

DATE

ORG. REP. TYPED NAME & SIGNATURE*

DATE

FOR NSF USE ONLY INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

SUMMARY PROPOSAL BUDGET YEAR 3

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
Catholic University of America

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Corinna E Lathan

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Corinna E Lathan**	**0.00**	**0.00**	**1.00**	$ **6,470**	$
2.					
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**0.00**	**0.00**	**0.00**	**0**	
7. (**1**) TOTAL SENIOR PERSONNEL (1 - 6)	**0.00**	**0.00**	**1.00**	**6,470**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL ASSOCIATES	**0.00**	**0.00**	**0.00**	**0**	
2. (**1**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**4.00**	**0.00**	**0.00**	**10,000**	
3. (**1**) GRADUATE STUDENTS				**16,000**	
4. (**1**) UNDERGRADUATE STUDENTS				**3,000**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**35,470**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**4,715**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**40,185**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				**3,000**	
2. FOREIGN				**1,500**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
(**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**8,000**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**500**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**8,500**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**53,185**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **% of MTDC (Rate: 62.0000, Base: 35470)**					
TOTAL INDIRECT COSTS (F&A)				**21,991**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**75,176**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **75,176**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY
Corinna E Lathan		INDIRECT COST RATE VERIFICATION
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked / Date Of Rate Sheet / Initials - ORG

SUMMARY PROPOSAL BUDGET

Cumulative

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
Catholic University of America

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Corinna E Lathan

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Corinna E Lathan**	**0.00**	**0.00**	**3.00**	$ **19,410**	$
2.					
3.					
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**0.00**	**0.00**	**0.00**	**0**	
7. (**1**) TOTAL SENIOR PERSONNEL (1 - 6)	**0.00**	**0.00**	**3.00**	**19,410**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL ASSOCIATES	**0.00**	**0.00**	**0.00**	**0**	
2. (**3**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**12.00**	**0.00**	**0.00**	**30,000**	
3. (**3**) GRADUATE STUDENTS				**48,000**	
4. (**3**) UNDERGRADUATE STUDENTS				**9,000**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**106,410**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**14,145**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**120,555**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				**9,000**	
2. FOREIGN				**4,500**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
(**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**24,000**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**1,500**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**25,500**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**159,555**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				**65,974**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**225,529**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **225,529**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*
Corinna E Lathan

DATE

ORG. REP. TYPED NAME & SIGNATURE*

DATE

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

NSF Form 1030 (10/98) Supersedes all previous editions

C***SIGNATURES REQUIRED ONLY FOR REVISED BUDGET (GPG III.B)**

Subawardee's Scope of Work
Alfred S. Gilman, D.Sc.

Scope of Work

Background

The work to be carried out under this subaward is part of an overall effort to extend a Cross-Disability Accessible Knowledge Network (CDAKN) based on extensions to the TangoInteractive Collaboratory. The resulting architecture will be closely linked to potential enhancements for the Document Object Model under development by the World Wide Web Consortium (W3C). The project draws on past collaboration between Dr. Gilman and Trace Center staff in various areas of the Web Accessibility Initiative, where Dr. Vanderheiden in cochair of the Author Guidlines Working Group and Dr. Gilman is cochair of the Protocols and Formats Working Group.

In carrying out these activities, Dr. Gilman will be acting as a member of the program team. He will also be preparing specific analysis and recommendation reports in this regard, including:

1. Compare and contrast the access challenges and strategies presented by the TangoInteractive and NeatTools classes with the lessons learned in providing accessibility in
   - HTML 4.0 and CSS 2
   - the W3C Dynamic Object Model (DOM)
2. Serve as lead author or editor of the series of reports addressing "Knowledge Opportunities in Cross-Disability Access to Distance Collaboration." This will be a series of three releases. The first will focus on the needs of cross-disability access, the second on knowledge sources and how they can be applied in telecollaboration, and the third will capture the answers to questions that had to be answered over and over to get the necessary knowledge for cross-disability access captured and connected in the Tango collaboration infrastructure and World Wide Web Document Object Model architecture.

As a part of the team, Dr. Gilman will also participate in:

1. Support to the Syracuse University researchers maintaing the object model reference for TangoInteractive collaboration. This will be explanation of

how various access strategies depend on the knowledge represented in the documents. For example, although smileys look like text to a graphical rendering engine, for presentation by text-to-speech it must be recognized that these character strings do not follow the pronunciation rules of the surrounding language and they must be set off from the natural language text e.g. by the HTML 'span' element and given a pronounceable equivalent e.g. by the HTML 'title' attribute. Normally the author does not consider the pronounceability of word-like tokens that she types; but for universal accessibility the pronounceability of these tokens is necessary knowledge. Helping the text originator know that pronounceability of smileys is an issue is part of the necessary knowledge networking. It is getting the knowledge of the problem to the agent with capability to solve the problem. The fix can be partially automated by changing the rule base used in on-the-fly spell checking as the originator types. The vision-impaired user is using text-to-speech pronunciation rules. Synchronizing the spell-checking rules at the point of text origin with the pronunciation rules at the point of text use is the kind of knowledge networking which will make cross-disability real-time telecollaboration work. Work under this subaward will address this basic issue, but on a multimodal basis covering audio and visual information in the collaborating environment.

2. Support to the World Wide Web Consortium working group developing W3C Recommendations for the Document Object Model to be the industry consensus model for the World Wide Web. This is the way to inject cross-disability access capabilities into the technology base that everyone uses on the World Wide Web. For example, the Document Object Model (DOM), the eXtensible Markup Language (XML) language and the Resource Description Framework (RDF) are three technological facets that are being developed concurrently within the W3C. There is knowledge representation capability in RDF but the groups working on the other facets do not necessarily understand why or how to employ this capability. Worked examples demonstrating cross-disability access powered by just the right networking of knowledge will accelerate the evolution and use of better forms of knowledge representation in Web media. These better representations are critical to accessibility.

SUMMARY PROPOSAL BUDGET

YEAR 1

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of Washington

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Sheryl Burgstahler

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Sheryl Burgstahler**	**0.00**	**0.00**	**0.00**	$ **0**	$
2. **Dan Comden**	**0.25**	**0.00**	**0.00**	**14,000**	
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**0.00**	**0.00**	**0.00**	**0**	
7. (**2**) TOTAL SENIOR PERSONNEL (1 - 6)	**0.25**	**0.00**	**0.00**	**14,000**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL ASSOCIATES	**0.00**	**0.00**	**0.00**	**0**	
2. (**1**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**0.50**	**0.00**	**0.00**	**17,500**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**20**) OTHER				**3,000**	
TOTAL SALARIES AND WAGES (A + B)				**34,500**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**7,890**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**42,390**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				**4,000**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
(**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**2,500**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**2,500**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**48,890**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **% of MTDC (Rate: 52.0000, Base: 48890)**					
TOTAL INDIRECT COSTS (F&A)				**25,422**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**74,312**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **74,312**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY
Sheryl Burgstahler		INDIRECT COST RATE VERIFICATION
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked / Date Of Rate Sheet / Initials - ORG

SUMMARY PROPOSAL BUDGET COMMENTS - Year 1

SUMMARY PROPOSAL BUDGET YEAR 2

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **University of Washington**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **Sheryl Burgstahler**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Sheryl Burgstahler**	**0.00**	**0.00**	**0.00**	$ **0**	$
2. **Dan Comden**	**0.25**	**0.00**	**0.00**	**14,560**	
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**0.00**	**0.00**	**0.00**	**0**	
7. (**2**) TOTAL SENIOR PERSONNEL (1 - 6)	**0.25**	**0.00**	**0.00**	**14,560**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL ASSOCIATES	**0.00**	**0.00**	**0.00**	**0**	
2. (**1**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**0.50**	**0.00**	**0.00**	**18,200**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**20**) OTHER				**3,120**	
TOTAL SALARIES AND WAGES (A + B)				**35,880**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**8,205**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**44,085**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				**3,000**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
(**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**2,000**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**2,000**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**49,085**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **% of MTDC (Rate: 52.0000, Base: 49086)**					
TOTAL INDIRECT COSTS (F&A)				**25,524**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**74,609**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **74,609**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*: **Sheryl Burgstahler** DATE

ORG. REP. TYPED NAME & SIGNATURE* DATE

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INDIRECT COST RATE VERIFICATION

Date Checked	Date Of Rate Sheet	Initials - ORG

SUMMARY PROPOSAL BUDGET YEAR 3

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **University of Washington**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **Sheryl Burgstahler**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Sheryl Burgstahler**	**0.00**	**0.00**	**0.00**	$ **0**	$
2. **Dan Comden**	**0.25**	**0.00**	**0.00**	**15,142**	
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**0.00**	**0.00**	**0.00**	**0**	
7. (**2**) TOTAL SENIOR PERSONNEL (1 - 6)	**0.25**	**0.00**	**0.00**	**15,142**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL ASSOCIATES	**0.00**	**0.00**	**0.00**	**0**	
2. (**1**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**0.50**	**0.00**	**0.00**	**18,928**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**20**) OTHER				**3,245**	
TOTAL SALARIES AND WAGES (A + B)				**37,315**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**8,534**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**45,849**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				**2,000**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
(**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**1,500**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**1,500**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**49,349**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **% of MTDC (Rate: 52.0000, Base: 49349)**					
TOTAL INDIRECT COSTS (F&A)				**25,661**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**75,010**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **75,010**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*: **Sheryl Burgstahler** DATE

ORG. REP. TYPED NAME & SIGNATURE* DATE

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

SUMMARY PROPOSAL BUDGET

Cumulative

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of Washington

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Sheryl Burgstahler

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Sheryl Burgstahler**	**0.00**	**0.00**	**0.00**	$ **0**	$
2. **Dan Comden**	**0.75**	**0.00**	**0.00**	**43,702**	
3.					
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**0.00**	**0.00**	**0.00**	**0**	
7. (**2**) TOTAL SENIOR PERSONNEL (1 - 6)	**0.75**	**0.00**	**0.00**	**43,702**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL ASSOCIATES	**0.00**	**0.00**	**0.00**	**0**	
2. (**3**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**1.50**	**0.00**	**0.00**	**54,628**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**60**) OTHER				**9,365**	
TOTAL SALARIES AND WAGES (A + B)				**107,695**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**24,629**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**132,324**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				**9,000**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
(**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**6,000**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**6,000**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**147,324**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				**76,609**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**223,933**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **223,933**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*
Sheryl Burgstahler
DATE

ORG. REP. TYPED NAME & SIGNATURE*
DATE

FOR NSF USE ONLY
INDIRECT COST RATE VERIFICATION

Date Checked	Date Of Rate Sheet	Initials - ORG

NSF Form 1030 (10/98) Supersedes all previous editions

C***SIGNATURES REQUIRED ONLY FOR REVISED BUDGET (GPG III.B)**

Budget Narrative

Salaries

The costs for personnel are primarily for the Technology Specialist/UW Site Coordinator at 25%, and the Technology assistant at 50% to develop and implement training sessions for using cross-disability-accessible knowledge networks. Individuals with disabilities will also be hired on an hourly basis ($10/hr.) to test products and provide initial and ongoing product input.

Fringe Benefits

Fringe benefits are based on University of Washington requirements for staff: professional staff at 24% and hourly staff at 11%.

Travel

Travel will be for the Technology Specialist/ UW Site Coordinator to visit Syracuse University for training, to visit participating individuals with disabilities, to attend conferences as part of the project activities, and to deliver presentations on project processes and outcomes.

Supplies

This category includes the cost of duplication of project handouts and purchase of special supplies for this project (e.g., nametags, folders for meetings). All written materials will be offered in alternate format (enlarged print, tape, Braille, disk).

Indirect Costs

Indirect costs for the University of Washington are 52% of the total direct costs.

SUMMARY PROPOSAL BUDGET YEAR 1

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of Wisconsin-Madison

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Gregg C Vanderheiden

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Gregg C Vanderheiden**	**0.90**	**0.00**	**0.00**	$ **10,890**	$
2.					
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**0.00**	**0.00**	**0.00**	**0**	
7. (**1**) TOTAL SENIOR PERSONNEL (1 - 6)	**0.90**	**0.00**	**0.00**	**10,890**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**1**) POST DOCTORAL ASSOCIATES	**6.00**	**0.00**	**0.00**	**27,560**	
2. (**5**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**18.00**	**0.00**	**0.00**	**40,450**	
3. (**1**) GRADUATE STUDENTS				**10,801**	
4. (**1**) UNDERGRADUATE STUDENTS				**1,357**	
5. (**1**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**2,680**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**93,738**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**24,584**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**118,322**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				**7,100**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
(**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**13,000**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**30,000**	
6. OTHER				**5,500**	
TOTAL OTHER DIRECT COSTS				**48,500**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**173,922**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **% of MTDC (Rate: 44.0000, Base: 168922)**					
TOTAL INDIRECT COSTS (F&A)				**74,325**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**248,247**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **248,247**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY
Gregg C Vanderheiden		INDIRECT COST RATE VERIFICATION
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked / Date Of Rate Sheet / Initials - ORG

SUMMARY PROPOSAL BUDGET COMMENTS - Year 1

SUMMARY PROPOSAL BUDGET YEAR 2

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of Wisconsin-Madison

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Gregg C Vanderheiden

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Gregg C Vanderheiden**	**0.90**	**0.00**	**0.00**	$ **11,326**	$
2.					
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**0.00**	**0.00**	**0.00**	**0**	
7. (**1**) TOTAL SENIOR PERSONNEL (1 - 6)	**0.90**	**0.00**	**0.00**	**11,326**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**1**) POST DOCTORAL ASSOCIATES	**6.00**	**0.00**	**0.00**	**28,662**	
2. (**5**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**18.60**	**0.00**	**0.00**	**44,950**	
3. (**1**) GRADUATE STUDENTS				**11,233**	
4. (**1**) UNDERGRADUATE STUDENTS				**1,466**	
5. (**1**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**2,788**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**100,425**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**27,526**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**127,951**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				**7,455**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
(**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**12,000**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**30,000**	
6. OTHER				**6,000**	
TOTAL OTHER DIRECT COSTS				**48,000**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**183,406**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **% of MTDC (Rate: 44.0000, Base: 153406)**					
TOTAL INDIRECT COSTS (F&A)				**67,498**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**250,904**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **250,904**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY
Gregg C Vanderheiden		INDIRECT COST RATE VERIFICATION
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked / Date Of Rate Sheet / Initials - ORG

SUMMARY PROPOSAL BUDGET YEAR 3

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **University of Wisconsin-Madison**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **Gregg C Vanderheiden**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Gregg C Vanderheiden**	**0.90**	**0.00**	**0.00**	$ **11,779**	$
2.					
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**0.00**	**0.00**	**0.00**	**0**	
7. (**1**) TOTAL SENIOR PERSONNEL (1 - 6)	**0.90**	**0.00**	**0.00**	**11,779**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**1**) POST DOCTORAL ASSOCIATES	**6.00**	**0.00**	**0.00**	**29,809**	
2. (**5**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**18.00**	**0.00**	**0.00**	**45,736**	
3. (**1**) GRADUATE STUDENTS				**11,683**	
4. (**1**) UNDERGRADUATE STUDENTS				**1,520**	
5. (**1**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**2,899**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**103,426**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**29,323**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**132,749**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				**7,828**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
(**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**5,000**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**30,000**	
6. OTHER				**6,000**	
TOTAL OTHER DIRECT COSTS				**41,000**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**181,577**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **% of MTDC (Rate: 44.0000, Base: 151577)**					
TOTAL INDIRECT COSTS (F&A)				**66,693**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**248,270**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **248,270**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY
Gregg C Vanderheiden		INDIRECT COST RATE VERIFICATION
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked / Date Of Rate Sheet / Initials - ORG

SUMMARY PROPOSAL BUDGET

Cumulative

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of Wisconsin-Madison

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Gregg C Vanderheiden

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Gregg C Vanderheiden**	**2.70**	**0.00**	**0.00**	$ **33,995**	$
2.					
3.					
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	**0.00**	**0.00**	**0.00**	**0**	
7. (**1**) TOTAL SENIOR PERSONNEL (1 - 6)	**2.70**	**0.00**	**0.00**	**33,995**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**3**) POST DOCTORAL ASSOCIATES	**18.00**	**0.00**	**0.00**	**86,031**	
2. (**15**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	**54.60**	**0.00**	**0.00**	**131,136**	
3. (**3**) GRADUATE STUDENTS				**33,717**	
4. (**3**) UNDERGRADUATE STUDENTS				**4,343**	
5. (**3**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**8,367**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**297,589**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**81,433**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**379,022**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				**22,383**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
(**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**30,000**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**90,000**	
6. OTHER				**17,500**	
TOTAL OTHER DIRECT COSTS				**137,500**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**538,905**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				**208,518**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**747,423**	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **747,423**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*
Gregg C Vanderheiden

DATE

ORG. REP. TYPED NAME & SIGNATURE*

DATE

FOR NSF USE ONLY

INDIRECT COST RATE VERIFICATION

Date Checked	Date Of Rate Sheet	Initials - ORG

NSF Form 1030 (10/98) Supersedes all previous editions

C***SIGNATURES REQUIRED ONLY FOR REVISED BUDGET (GPG III.B)**

Budget Notes: KDI SubAward to University of Wisconsin-Madison (Gregg C. Vanderheiden)

Personnel:

B-2: Includes specialists in human factors/ergonomics, web accessibility, usability testing, computer programming, and blind access.

B-3: Graduate Students, totalling 50% FTE (6 person-months)

B-4: Undergraduate student aide to blind team member (10% FTE)

B-5: Program assistant (10% FTE)

Other Direct Costs:

E. Travel – Includes travel expenses for team members to meet with other teams, attend disability conferences for usability testing, and attend professional conferences to present and coordinate work.

G-1: Materials and Supplies – Includes computers, software, disability access aids, and office supplies.

G-5: Subaward to Alfred S. Gilman, D.Sc. (See attached scope of work and budget.)

G-6: Other – Includes mailing and shipping, telephone, copying, and subject fees (for usability testing)

CURRENT AND PENDING SUPPORT

CURRENT AND PENDING SUPPORT

Investigator: Geoffrey C. Fox

Support:	Current		
Project/Proposal Title:	Programming CRPC		
Source of Support:	Rice University (NSF)		
Total Award Amount:	$210,000	Total Award Period Covered:	02/01/99-01/31/00
Location of Project:	Syracuse University		
Person-Months Per Year Committed to the Project:	0.5 Cal.		

Support:	Current		
Project/Proposal Title:	Education Technology		
Source of Support:	University of Illinois (NCSA)		
Total Award Amount:	$335,000	Total Award Period Covered:	10/01/98-09/30/99
Location of Project:	Syracuse University		
Person-Months Per Year Committed to the Project:	0.25 Cal.		

Support:	Current		
Project/Proposal Title:	Black Hole Binaries Coalescence and Gravitational Radiation		
Source of Support:	University of Texas/Austin		
Total Award Amount:	$714,000	Total Award Period Covered:	10/01/94-08/31/99
Location of Project:	Syracuse University		
Person-Months Per Year Committed to the Project:	0.25 Cal.		

Support:	Current		
Project/Proposal Title:	Performance Estimation for Large Scale Applications		
Source of Support:	University of Maryland		
Total Award Amount:	$477,312	Total Award Period Covered:	10/01/93-05/27/00
Location of Project:	Syracuse University		
Person-Months Per Year Committed to the Project:	0.25 Cal.		

Support:	Current		
Project/Proposal Title:	Programming Models from Fortran to JAVA		
Source of Support:	National Science Foundation		
Total Award Amount:	$346,827	Total Award Period Covered:	09/01/98-08/31/01
Location of Project:	Syracuse University		
Person-Months Per Year Committed to the Project:	0.25 Cal.		

Support:	Current		
Project/Proposal Title:	CEWES Computing Modernization		
Source of Support:	Nichols Research Corporation		
Total Award Amount:	$1,735,073	Total Award Period Covered:	04/01/96-03/17/01
Location of Project:	Syracuse University		
Person-Months Per Year Committed to the Project:	.50 Cal.		

CURRENT AND PENDING SUPPORT

CURRENT AND PENDING SUPPORT

Investigator: Geoffrey C. Fox
Other agencies (including NSF) to which this proposal has been/will be submitted: None

Support:	Current		
Project/Proposal Title:	DOD/HPC Modernization		
Source of Support:	Nichols Research Corporation		
Total Award Amount:	$565,734	Total Award Period Covered:	07/08/96-05/12/01
Location of Project:	Syracuse University		
Person-Months Per Year Committed to the Project:	0.5 Cal.		

Support:	Current		
Project/Proposal Title:	E-Systems		
Source of Support:	Raytheon E-Systems		
Total Award Amount:	$736,253	Total Award Period Covered:	08/20/98-08/19/01
Location of Project:	Syracuse University		
Person-Months Per Year Committed to the Project:	0.25 Cal.		

Support:	Pending		
Project/Proposal Title:	General Earthquake Model Computational Challenge		
Source of Support:	University of Colorado		
Total Award Amount:	$450,000	Total Award Period Covered:	10/01/98-09/30/01
Location of Project:	Syracuse University		
Person-Months Per Year Committed to the Project:	0.25 Cal.		

Support:	Pending		
Project/Proposal Title:	A Cross-Disability-Accessible Knowledge Network for Education and Collaboration in Science and Technology		
Source of Support:	National Science Foundation		
Total Award Amount:	$2,649,235	Total Award Period Covered:	10/1/99-9/30/02
Location of Project:	Syracuse University		
Person-Months Per Year Committed to the Project:	0.50 Cal.		

Support:	Current		
Project/Proposal Title:	Programming Models from Fortran to JAVA		
Source of Support:	National Science Foundation		
Total Award Amount:	$346,827	Total Award Period Covered:	09/01/98-08/31/01
Location of Project:	Syracuse University		
Person-Months Per Year Committed to the Project:	0.25 Cal.		

Support:	Current		
Project/Proposal Title:	CEWES Computing Modernization		
Source of Support:	Nichols Research Corporation		
Total Award Amount:	$1,735,073	Total Award Period Covered:	04/01/96-03/17/01
Location of Project:	Syracuse University		
Person-Months Per Year Committed to the Project:	.50 Cal.		

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Sheryl Burgstahler

Other agencies to which this proposal has been/willbe submitted.

Support: [X] Current [ ] Pending [ ] Submission Planned in Near Future [ ] * Transfer of Support

Project/Proposal Title: Lessons Learned: What Makes Kids with Disabilities Successful?

Source of Support: Mitsubishi Electric America Foundation

Award Amount (or Annual Rate): $ 60,000 Period Covered: 3/1/99-2/29/01

Location of Research: University of Washington, Seattle

Person-Months or % of Effort Committed to the Project. Cal.: .10 Acad: Summ.:

Support: [X] Current [ ] Pending [ ] Submission Planned in Near Future [ ] * Transfer of Support

Project/Proposal Title: DO-IT Show N Tell

Source of Support: Visio Corporation

Award Amount (or Annual Rate): $ 3,000 Period Covered: 5/15/98-4/30/00

Location of Research:

Person-Months or % of Effort Committed to the Project. Cal.: Acad: .01 Summ.:

Support: [ ] Current [X] Pending [ ] Submission Planned in Near Future [ ] * Transfer of Support

Project/Proposal Title: DO-IT CAREERS-Tech

Source of Support: U.S. Department of Education

Award Amount (or Annual Rate): $ 295,131 Period Covered:

Location of Research: University of Washington, Seattle

Person-Months or % of Effort Committed to the Project. Cal.: .10 Acad: Summ.:

Support: [ ] Current [x] Pending [ ] Submission Planned in Near Future [ ] * Transfer of Support

Project/Proposal Title: DO-IT Prof

Source of Support: U.S. Department of Education

Award Amount (or Annual Rate): $ 810,447 Period Covered:

Location of Research: University of Washington, Seattle

Person-Months or % of Effort Committed to the Project. Cal.: .15 Acad: Summ.:

Support: [ ] Current [X] Pending [ ] Submission Planned in Near Future [ ] * Transfer of Support

Project/Proposal Title: Enhanced Access to Science Education for Students with Disabilities

Source of Support: National Science Foundation

Award Amount (or Annual Rate): $ 61,881 subcontract Period Covered: 10/1/99-9/30/02

Location of Research: Syracuse, New York

Person-Months or % of Effort Committed to the Project. Cal.: .01 Acad: Summ.:

* If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Sheryl Burgstahler	Other agencies to which this proposal has been/willbe submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ * Transfer of Support

Project/Proposal Title: Institutionalization of DO-IT

Source of Support: National Science Foundation

Award Amount (or Annual Rate): $ 894,201 Period Covered: 12/1/98-11/30/01

Location of Research: University of Washington, Seattle

Person-Months or % of Effort Committed to the Project. Cal.: .25 Acad: Summ.:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ * Transfer of Support

Project/Proposal Title: DO-IT Extension

Source of Support: National Science Foundation

Award Amount (or Annual Rate): $ 1,539,282 Period Covered: 10/1/95-9/30/99

Location of Research: University of Washington, Seattle

Person-Months or % of Effort Committed to the Project. Cal.: .01 Acad: Summ.:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ * Transfer of Support

Project/Proposal Title: Transition from Community Colleges to 4-year Institutions:Supporting students with disabilities

Source of Support: US Department of Education

Award Amount (or Annual Rate): $ 199,455 Period Covered: 10/1/98 –9/30/00

Location of Research: University of Washington

Person-Months or % of Effort Committed to the Project. Cal.: .10 Acad: Summ.:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ * Transfer of Support

Project/Proposal Title: DO-IT CAREERS

Source of Support: US Department of Education

Award Amount (or Annual Rate): $ 312,967 Period Covered: 1/1/97 – 12/31/99

Location of Research: University of Washington, Seattle

Person-Months or % of Effort Committed to the Project. Cal.: .05 Acad: Summ.:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ * Transfer of Support

Project/Proposal Title: DO-IT CAREERS/K-12

Source of Support: US Department of Education

Award Amount (or Annual Rate): $ 593,880 Period Covered: 10/1/99-9/30/03

Location of Research: University of Washington, Seattle

Person-Months or % of Effort Committed to the Project. Cal.: .10 Acad: Summ.:

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* If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

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

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: **Corinna Lathan**

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: **Rehabilitation Engineering Research Center on Telerehabilitation**

Source of Support: **National Institute on Disability and Rehabilitation Research**

Total Award Amount: $ **4,500,000** Total Award Period Covered: **09/01/98 - 09/01/03**

Location of Project: **Catholic University/National Rehab. Hosp./Sister Kenny Inst.**

Person-Months Per Year Committed to the Project. Cal:**2.00** Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: **Educating biomedical engineers in home care technologies for the 21st century**

Source of Support: **The Whitaker Foundation**

Total Award Amount: $ **1,000,000** Total Award Period Covered: **05/01/98 - 05/01/01**

Location of Project: **The Catholic University of America**

Person-Months Per Year Committed to the Project. Cal:**1.50** Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: **Personal augmentation devices(PADS): exploratory agents to enable tele-interaction, evaluation, and development of abilities in persons with severe disabilities**

Source of Support: **NSF**

Total Award Amount: $ **75,000** Total Award Period Covered: **09/01/98 - 09/01/99**

Location of Project: **The Catholic University of America**

Person-Months Per Year Committed to the Project. Cal:**2.00** Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: **Assistive technology research center**

Source of Support: **U.S. Army/DOD**

Total Award Amount: $ **6,000,000** Total Award Period Covered: **09/01/98 - 09/01/02**

Location of Project: **Catholic University (640k)/National Rehabilitation Hospital**

Person-Months Per Year Committed to the Project. Cal:**1.00** Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: **Workshop on establishing technical requirements for minimally invasive therapy**

Source of Support: **NSF**

Total Award Amount: $ **50,000** Total Award Period Covered: **02/01/98 - 04/30/99**

Location of Project: **Georgetown University Medical Center**

Person-Months Per Year Committed to the Project. Cal:**0.50** Acad: Sumr:

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*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

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

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: **Corinna Lathan**

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: **Undergraduate industrial internship program in biomedical engineering at The Catholic University of America**

Source of Support: **The Whitaker Foundation**
Total Award Amount: $ **56,520** Total Award Period Covered: **09/01/97 - 09/01/00**
Location of Project: **The Catholic University of America**
Person-Months Per Year Committed to the Project. Cal: **1.50** Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: **Gateways to engineering: Workshops for high school girls**

Source of Support: **Engineering Information Foundation**
Total Award Amount: $ **85,000** Total Award Period Covered: **01/01/98 - 01/01/00**
Location of Project: **The Catholic University of America**
Person-Months Per Year Committed to the Project. Cal: **1.00** Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

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*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

CURRENT AND PENDING SUPPORT

CURRENT AND PENDING SUPPORT

Investigator: Edward D. Lipson
Other agencies (including NSF) to which this proposal has been/will be submitted: None

Support:	Pending (this proposal)		
Project/Proposal Title:	Enhanced Access to Science Education for Students with Disabilities Using Customizable Human-Computer Interface Systems		
Source of Support:	NSF		
Total Award Amount:	$597,634	Total Award Period Covered:	8/1/99-7/31/02
Location of Project:	Syracuse University (& Washington DC, Seattle, Minneapolis and Syracuse metro areas)		
Person-Months Per Year Committed to the Project:	0.5 Sumr		

Support:	Current		
Project/Proposal Title:	The Pulsar Project: Affordable Human-Computer Interfaces for the Severely Disabled		
Source of Support:	NEC Foundation		
Total Award Amount:	$40,000	Total Award Period Covered:	12/1/98-11/30/99
Location of Project:	Syracuse University		
Person-Months Per Year Committed to the Project:	0.5 Acad. (no charge to grant)		

Support:	Current		
Project/Proposal Title:	Integration of Information Age Networking and Parallel Supercomputing Simulations into University General Science and K-12 Curricula		
Source of Support:	NSF		
Total Award Amount:	$927,935	Total Award Period Covered:	11/1/95-10/31/99 (no-cost ext.)
Location of Project:	Syracuse University and Cornell University (subcontract)		
Person-Months Per Year Committed to the Project:	0.5 Acad. (no charge to grant)		

Support:	Current		
Project/Proposal Title:	Information Technology in the Service of Science Education		
Source of Support:	NSF		
Total Award Amount:	$200,000	Total Award Period Covered:	3/15/96-3/14/00 (no-cost ext.)
Location of Project:			
Person-Months Per Year Committed to the Project:	0.25 Acad. (no charge to grant)		

Support:	Current		
Project/Proposal Title:	BotMasters: An Interactive Wearable Universal Human-Computer-Interface System		
Source of Support:	DARPA		
Total Award Amount:	$1,349,720	Total Award Period Covered:	7/1/98-6/30/00
Location of Project:	Syracuse University		
Person-Months Per Year Committed to the Project:	0.5 Acad. (no charge to grant)		

Support:	Current		
Project/Proposal Title:	Improving PC Accessibility with NeatTools		
Source of Support:	Microsoft		
Total Award Amount:	$50,000	Total Award Period Covered:	4/1/99-3/31/00
Location of Project:	Syracuse University		
Person-Months Per Year Committed to the Project:	1.0 AY (no charge to grant)		

Current and Pending Support

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

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Gregg C. Vanderheiden	Other agencies (including NSF) to which this proposal has been/will be submitted. none

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Information Technology Access Rehabilitation Engineering Research Center

Source of Support: Dept. of Education (NIDRR)

Total Award Amount: $6,750,000 Total Award Period Covered: 6/12/99 through 6/11/03

Location of Project: University of Wisconsin - Madison

Person-Months Per Year Committed to the Project. Cal: 2.97 Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Universal Telecommunication Rehabilitation Engineering Research Center

Source of Support: Dept. of Education (NIDRR) – pass-through from Gallaudet Univ.

Total Award Amount: $707,396 Total Award Period Covered: 9/1/95 through 8/31/99

Location of Project: University of Wisconsin - Madison

Person-Months Per Year Committed to the Project. Cal: 1.35 Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Understanding and Increasing the Adoption of Universal Design in Product Design

Source of Support: Dept. of Education (NIDRR)

Total Award Amount: $750,000 Total Award Period Covered: 10/1/96 through 9/30/99

Location of Project: University of Wisconsin - Madison

Person-Months Per Year Committed to the Project. Cal: 2.25 Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: National Computational Science Alliance

Source of Support: National Science Foundation – pass-through from Univ. of Illinois Urbana-Champaign

Total Award Amount: $1,055,735 Total Award Period Covered: 10/1/97 through 9/30/02

Location of Project: University of Wisconsin - Madison

Person-Months Per Year Committed to the Project. Cal: .9 Acad: Sumr:

Support: ☐ Current ☐ Pending ☒ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Telecommunications Access Rehabilitation Engineering Research Center

Source of Support: Dept. of Education (NIDRR)

Total Award Amount: $3,375,000 Total Award Period Covered: 9/1/99 through 8/31/04

Location of Project: University of Wisconsin - Madison

Person-Months Per Year Committed to the Project. Cal: 2.25 Acad: Sumr:

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*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

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

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Alfred S. Gilman	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Rehabilitation Engineering Research Center
on Universal Access to Information Technology

Source of Support: U.S. Department of Education, NIDRR

Total Award Amount: $15,000 Total Award Period Covered: July 1,1998 - June 11, 1999

Location of Project: n/a

Person-Months Per Year Committed to the Project. 1.4 Cal: 1.4 Acad: Sumr:

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

NSF PACI Program

Source of Support: NSF

Total Award Amount: $60,000 Total Award Period Covered: June 1, 1998 - Sep 30, 1999

Location of Project: n/a

Person-Months Per Year Committed to the Project. 4.5 Cal: 4.5 Acad: Sumr:

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

NSF PACI Program

Source of Support: NSF

Total Award Amount: $11,203 Total Award Period Covered: Oct 1, 1998 - Sept 30, 1999

Location of Project: n/a

Person-Months Per Year Committed to the Project. 1.1 Cal: 1.1 Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

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*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

STAFF AVAILABILITY TO PROJECT

Dr. David Rose, Ed.D, Center Principal Investigator, is currently serving as Project Supervisor in 3 **currently funded** federal grants:

1) Understanding Science Through Captioning Project. NSF (Award #HRD-9712964): 0.2.5FTE
2) Engaging the Text: Reciprocal Teaching and Questioning Strategies in a Scaffolded Learning Environment. OSERS-SPED-DOE (Award #H324D980051): 0.04%FTE
3) The Strategic Reader: Textbooks Today, Web Tomorrow. OSERS-SPED-DOE (Award #H327A980024): 0.05%FTE

Dr. David Rose, Ed.D, the Center Principal Investigator, is currently serving as Project Supervisor in 3 **currently pending** federal grants:

1) Develop and Test Optimal Learning Supports for Students with Low Incidence Disability Using Bravo! SBIR (#99/0010): .05FTE
2) Develop and Test Optimal Learning Supports for Students with High Incidence Disability Using Bravo! SBIR (#99/0010): .05FTE
3) Making the Link: Technology, Family Literacy Center and Home. DOE (CFDA#84.305T): .05FTE

Dr Rose's internal commitment in time is allocated to his role as the Co-Executive Director of CAST.

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator David Warner

Other agencies to which this proposal has been/willbe submitted.

Support: [X] Current [ ] Pending [ ] Submission Planned in Near Future [ ] * Transfer of Support

Project/Proposal Title: BotMaster

Source of Support: DARPA

Award Amount (or Annual Rate): $ 1,349,720 Period Covered: 07/01/98-06/30/00

Location of Research: Syracuse University

Person-Months or % of Effort Committed to the Project. Cal.: .5 Acad: Summ

Support: [ ] Current [ ] Pending [ ] Submission Planned in Near Future [ ] * Transfer of Support

Project/Proposal Title:

Source of Support:

Award Amount (or Annual Rate): $ Period Covered:

Location of Research:

Person-Months or % of Effort Committed to the Project. Cal.: Acad: Summ

Support: [ ] Current [ ] Pending [ ] Submission Planned in Near Future [ ] * Transfer of Support

Project/Proposal Title:

Source of Support:

Award Amount (or Annual Rate): $ Period Covered:

Location of Research:

Person-Months or % of Effort Committed to the Project. Cal.: Acad: Summ

Support: [ ] Current [ ] Pending [ ] Submission Planned in Near Future [ ] * Transfer of Support

Project/Proposal Title:

Source of Support:

Award Amount (or Annual Rate): $ Period Covered:

Location of Research:

Person-Months or % of Effort Committed to the Project. Cal.: Acad: Summ

Support: [ ] Current [ ] Pending [ ] Submission Planned in Near Future [ ] * Transfer of Support

Project/Proposal Title:

Source of Support:

Award Amount (or Annual Rate): $ Period Covered:

Location of Research:

Person-Months or % of Effort Committed to the Project. Cal.: Acad: Summ

* If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

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 as necessary.

Laboratory: **Syracuse University: Over 1,500 square feet of laboratory space is available in the Physics Building in the PI's laboratories. Much of the work on campus will take place in the Northeast Parallel Architectures Center (NPAC) Interface Laboratory, which is devoted to the type of work in this proposal. This laboratory (500 square feet) is**

Clinical:

Animal:

Computer: **Syracuse University: NPAC has ample computational resources including clusters of high-performance workstations, desktop workstations for program development and data visualization, and networking infrastructure. In the NPAC Interface Lab, there are several Pentium and Pentium Pro PCs and a Silicon Graphics Indy workstations. All of**

Office: **All investigators and their staff and students have ample office space and access to departmental office machines and other facilities. The two interns at the DC site will be provided space in the School of Engineering's Outreach Program Office. This office, in conjunction with the Outreach Coordinator's office will serve as the focal point of**

Other: _____

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

University of Washington:Computers, adaptive technology, network connections are located on the University of Washington campus and in some project participants' homes.

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 to which they will be available for the project. Include an explanation of any consortium/contractual arrangements with other organizations.

Syracuse University: We have an excellent machine shop and are able to handle our own electronics in the PI's labs and at our CRNR electronics shop. There is also a basic machine shop in the CRNR basement with lathe, drill press table saw, milling machine, and welding equipment

Univerity of Washington:The DO-IT program will provide access to a large group of high school, college, and professional individuals with disabilities who are interested in

LABORATORY FACILITIES (continued):

located next door to the NPAC conference room and near the NPAC main offices. In addition, some research and development activity will take place in the so-called Center for Really Neat Research (CRNR) at 500 University Place. This 12,000 square foot structure, a former fraternity house, is located across the street from the Center for Science and Technology building (see www.pulsar.org) that houses NPAC and a number of other centers and departments with strong connections to computation. CRNR is operated by David Warner's not-for-profit Institute for Interventional Informatics with some assistance from NPAC, including a 2 megabit-per-second air-LAN connection between CRNR and the NPAC network. In addition to the computers, there are peripheral and multimedia devices at the Interface Lab and CRNR. These include ample multimedia equipment (video projector, digital cameras, slide scanner, flatbed scanners, camcorders and VCRs). Both facilities offer wheelchair access. CRNR has machine and electronics shops in the basement. Some development and application work will also take place at Nottingham High School (see below), 2 miles from campus.

The Catholic University of America (CUA): Several laboratories will be made available for the duration of this grant. Dr. Lathan directs the Computer-Human Assist Oriented Systems Laboratory and is co-director of the Human Performance and Rehabilitation Laboratory. Both labs are in biomedical engineering at CUA. In addition, The Home Care Technologies Center is a Whitaker Foundation funded center in biomedical engineering at CUA in conjunction with the School of Nursing.

Univesity of Wisconsin-Madison: Usability Testing Suite (2 testing rooms; 1 central control room); Tele/Video Conferencing Lab. Both are available to this project as needed. Both are located at the Trace R&D Center facility.

COMPUTER FACILITIES (continued):

these machines are connected to the NPAC and general university networks, and thus to the Internet in general. There are two development systems for microcontroller (as in TNG-3; see main text) design, emulation, and programming. One of these systems (worth approx. $5,000) was donated to the project by Microchip Technology, Inc. which manufactures the PIC microcontroller chips we are using.

University of Washington:
Project participants will have access to computers through the University of Washington's Adaptive Technology Lab (ATL) and DO-IT Program. The ATL has received national attention as a model for providing computing and networking access for students with disabilities. The lab includes computers equipped with a wide variety of adaptive technology including voice recognition and word prediction software, alternative keyboards and mice, screen readers and voice synthesizers, and Braille printers. Participants in the DO-IT program are loaned computers, Internet connections, and adaptive equipment for use in their homes, and have access to a special adaptive computer lab during their two-week stay at the University of Washington in the summer.

Continuation Page:

COMPUTER FACILITIES (continued):

Project staff will have access to computers and network connections.

Catholic University of America:
CUA's Department of Computer Planning and Information Technology (CPIT) provides state of the art support for all on-line projects and services.

University of Wisconsin-Madison: The Trace R&D Center LAN and multiple on-line and experimental internet servers are available to this project, as well as the Center's work stations and lab and office computer systems.

OFFICE FACILITIES (continued):

the DC site.

OTHER RESOURCES (continued):

science, engineering, technology, and mathematics. More than 130 high school students have participated in our summer programs and continue to communicate on the Internet with DO-IT Mentors (that number more than 100). More than 1000 students with disabilities ages 6 through 18 have participated online in our DO-IT Pals electronic community. In addition, DO-IT has developed an extensive network of contacts in K-12 schools throughout the State. In short, DO-IT will provide this project access to this strong, large, and growing community of learners to test, customize, apply, and provide formative feedback regarding information and communication technologies used in the project

Catholic University of America:Rehabilitation Engineering Research Center (RERC) on Telerehabilitation
The RERC on Telerehabilitation's headquarters is in CUA Biomedical Engineering's Home Care and Telerehabilitation Technologies Center (http://www.hctr.be.cua.edu/). The RERC will provide support in the form of laboratory space for hardware and software integration as well as access to clinical expertise through ties with the National Rehabilitation Hospital in DC and Sister Kenny Institute in Minnesota

Univesity of Wisconsin-Madison: 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.