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Managing the Assistive Technology Resource Center

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2012 Assistive Technology Resource Center- Laboratory Operations Digital Archive Project

A Project Proposal Submitted in Partial Fulfillment of the Requirements for Completion of the Interactive Qualifying Project

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ABSTRACT

The 2012- 2013 ATRC Lab Operations IQP project pursued the goal of collecting the previous 5 years of development research conducted by previous IQP projects and, in conjunction with newly developed plans, implement a system to organize the lab's facilities, streamline the reuse of existing research, and nourish the development of new projects via in-lab courses, IQP's, MQP's, and Ph.D. programs. Following initial efforts to establish a firm operating foundation within the ATRC, our IQP worked to reestablish the assistive technology community at WPI through promotion of the Engineering Projects in Community Service (EPICS) club. Through development of the on campus community, the project worked to form an organization that will maintain a consistent and reliable outreach program which will both promote the ATRC and assistive technology program at WPI and provide students with service oriented outreach opportunities where they may gain relevant experience while contributing to individuals in the community.

ACKNOWLEDGEMENT

The team would like to thank several individuals for their advices in making this project a success. The project would not get this far without the thoughtful guidance of Professor Allan Hoffman whose thoughtful guidance provided served as the map by which we found a path to our goals. The assistance from other knowledgeable individuals, particularly Librarians Jessica Colati and Christine Drew, Mechanical Engineering Administrative Assistant Statia Canning, Computer Operations Manger Randolph Robinson and EPICS officers made it possible to extend the reach of our projects efforts well beyond what we might have achieved on our own.

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1 INTRODUCTION

Assistive technology (AT) is technology whose purpose to create assistive, adaptive and rehabilitative devices for people with disabilities. Assistive technology has applications to disabilities in mobility, cognition, hearing and seeing. Some of the assistive technology devices which are most familiar to the general public are mobility devices such as wheelchairs, walkers, and prosthesis that provide assistance for amputees. Additionally, accessibility software and electronic systems are frequently used to aid individuals with disabilities that create challenges to using computers or other information technologies. These electronic aids include text telephone (TTY) for individuals with hearing impairments and "text to speech" software that converts literary material to audiobook format automatically.

Over the past years, many organizations, laws and services have arisen due to society's understanding of the need to assist people with disabilities. In 1988, the Technology-Related Assistance for Individuals with Disabilities Act (The Tech Act) legalized the definitions of assistive technology. The act has been amended and modified in the following years but the original definitions of assistive technology as developed in 1988 has been consistent throughout. The definition of an assistive technology device is

"…any item, piece of equipment or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities." (United States House of Congress, 1988)

There are many organizations, services and foundations dedicated to the field of assistive technology in Massachusetts. Generally, AT focused organizations and service providers strive for the inclusion of people with disabilities in society through various means such as directing public resources, providing commercial products or developing novel AT programs on their own. Many foundations also strive to give monetary support not only to people with disabilities but also centers that specialize in design and manufacturing assistive technology. However, very few of them focus on the technical aspect of creating customized AT devices. Realistically, not every AT device available on the

market will fit the individual's specific needs. Therefore, the best way to address this problem is to have a specialized regional center with an interdisciplinary team from the engineering, information technology and medical fields that are able to take on specialized assignments.

Understanding such needs, Professor Hoffman and Ault from the Mechanical Engineering Department at Worcester Polytechnic Institute (WPI) founded the Assistive Technology Resource Center (ATRC) in 1999 when the Fairlawn Foundation of Worcester awarded funding to the Rehabilitation Engineering Laboratory at WPI. Ever since then, the ATRC has been working to fulfill the technological needs of individuals within WPI and throughout the central Massachusetts with a particular focus on those needs related to physical handicaps.

Starting in 2008, ten years after the establishment of the ATRC, a series of Interactive Qualifying Projects have taken place focusing on the re-evaluation and improvement of ATRC lab operations. The goal of these projects has been to implement and recommend solutions to keep the ATRC open for many years to come.

This project is the fifth to participate in the maintenance of the operational abilities of the ATRC. While there have been many recommendations and dedicated efforts by previous IQP's, this team's goal was to expand on previous work by investigating problem areas that were in need of continuing attention, refining previous solutions if needed, and ultimately suggesting and implementing additional solutions to improve the lab's operation. The overall goal of this project was to structure a system that would be capable of fulfilling the lab's long term needs.

2 BACKGROUND

2.1 History of the ATRC

Professor Hoffman and Ault proposed founding the Assistive Technology Resource Center at WPI in 1998 to address the need for a centralized location that could provide the customized assistive technology products and development services for the Worcester community while at the same time delivering hands on experience to WPI students developing prototypes for projects related to assistive technology. Even before the center

was fully established, WPI students closely collaborated with Massachusetts Hospital School and other Worcester public schools to fulfill the specific needs of many unique clients. Therefore, the founding of the WPI ATRC served to further expand campus community networks to be able to better serve AT needs in the region and consequently, expose WPI students to practical engineering problems on a more frequent basis.

Since 1999, with the help of funding from the Fairlawn Foundation, the ATRC has operated within the Rehabilitation Engineering Laboratory at WPI. (Hoffman & Ault, Implementation of Best Practices in the ATRC, 2007)The mission of the center as described in the ATRC website is as follows:

"*The mission of the ATRC is to foster the use of assistive technology through collaboration with professionals associated with local and regional clinical, educational, governmental and social service organizations that serve persons with disabilities. The ATRC disseminates technical information regarding the availability and use of assistive devices. When an appropriate commercial device is not available, the ATRC will collaborate with cooperating organizations in developing modifications to existing devices or the design of a custom device. The ATRC focuses on mechanical and electromechanical devices.*"

WPI ATRC

Aiming for this mission, the ATRC strives to accomplish the two main objectives as follows:

1. *To provide a centralized information resource for rehabilitation professionals within the region.*
2. *To provide a technically based resource for either the modification, or the design and development of customized assistive devices.*

(Hoffman, Ault, & Catricala, 2001)

2.2 Overview of the ATRC

The ATRC is located in the Rehabilitation Engineering Laboratory (HL 129) on the first floor of Higgins Laboratories of WPI Mechanical Engineering Department. It has an area of 700 square feet. Higgins Laboratories is one of the oldest buildings on campus and

is the home to courses lectures, laboratories and research centers related to Mechanical Engineering with an additional focus on Biomedical Engineering.

The ATRC supports projects and research by undergraduates as well as graduates in the area of AT. The three undergraduate courses associated with the ATRC are Introduction to Engineering (ES 1020), Introduction to Engineering Design (ME 2300) and Rehabilitation Engineering (ME 3506). The first two courses introduce freshmen and sophomores to engineering design process through engineering projects which encompass activities from the definition of design concepts, to development and evaluation of a prototype at the Rehabilitation Engineering Laboratory. The last course, ME 3506, particularly emphasizes the design of devices for individuals with mobility challenges, perfectly aligning with the ATRC's core mission. All projects from these undergraduate courses are not more than 7 weeks long and are therefore relatively small and less refined than Major Qualifying Projects MQPs which generally span 3 terms. Many of the outstanding projects built within the ATRC come from externally sponsored MQPs and can be seen on display there regularly.

Frequent users of the ATRC lab include undergraduate students from IQPs, MQPs and lower level courses. Students use many ATRC services and equipment including metal and wood working hand tools to design, assembly, and prototype testing devices. Prior to the start of the ATRC management IQP's, students had been responsible for self-managing necessary lab logistics and standard operations to conduct projects in an organized manner. With the start of the Operations IQP's, the lab has grown to allow project staff to look after the donated AT devices such as wheelchairs and walkers as well as increase lab availability for students.

Under the direction of Professor Hoffman and Ault the ATRC has also developed an active Community Outreach program and extracurricular activity program. Students of the ATRC aim to increase the awareness of issues faced by individuals with disabilities and the availability of assistive technology services in the Worcester region by giving presentations, and demonstrations to public schools, youth groups, adult organizations and senior centers. Annually in the summer, the ATRC holds a one-day Disability Awareness workshop for middle school girls as part of WPI's Camp REACH. In order to

keep the networks of the ATRC updated, ATRC sends out newsletter once par academic semester to students, lab partners and organizations which have signed up for the mailing list. (see 8.10.3 ATRC 2013 Spring Newsletter)

Another program the ATRC strongly supports is Engineering Projects in Community Service (EPICS). The EPICS organization was originally founded at Purdue University in 1995 to develop student skills while fulfilling the role of a local community service organization. This goal is strongly connected with that of the WPI undergraduate courses ES 1020, ME 2300 and ME 3506. Students from these vertically integrated classes continually build on earlier skills when participating in EPICS projects. EPICS also encourages participation from students in different majors who want to pursue something beyond academic coursework and make an engineering difference in the society through accessibility and assistive technology design.

WPI EPICS has associated with the ATRC and collaborated with other central Massachusetts service organizations such as Glavin Regional Center. WPI EPICS is also an international consortium member of EPICS along with other universities including Penn State University, Princeton University, and Dartmouth College. Due to its outstanding commitment to community service, WPI EPICS was recognized with a second place award in a national video contest sponsored by the American Society of Civil Engineers (ASCE) in 2010. The video included images of college students engaged in fun and meaningful engineering activities that really connected to the society and it inspired judges and many middle-school students. (Herzog & Oo, ATRC Flash Drive Digital Archive, 2013)

The partner with which the ATRC has most frequently collaborated is the Massachusetts Hospital School. Being in close proximity to WPI, Massachusetts Hospital School focusses on technology development for individuals with Cerebral Palsy, Muscular Dystrophy, Spinal Cord Injury, amongst others. Other organizations working with WPI to serve similar communities include Seven Hills Pediatric Center at Groton and Glavin Regional Center. Assistive technology developed for these facilities range from wheelchair modification and add-ons to therapeutic devices. Finally, the ATRC hopes to renew work with Worcester Public Schools so that it can connect to the community through youth and parents by presenting information sessions and holding engineering demonstrations.

Beyond review of established connections, an investigation was made of new national institutions and foundations focused on assistive technology. Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) has defined a set of "Standards of Practice" as a code of conduct to be promoted in AT practices, which the ATRC has been consistently following. (United States House of Congress, 1988) Federal organizations such as Disability.gov, the U.S Department of Education and the National Institute on Disability and Rehabilitation Research (NIDRR) maximizes inclusion of and development for individuals through a collection of internet resources and research materials as well as through grants to AT organizations and individuals with disabilities. (Herzog & Oo, ATRC Flash Drive Digital Archive, 2013)

Lastly, it is important to assess AT centers in colleges and universities. The University of Massachusetts, Lowell is one of the few nearby collegiate AT centers which have similar goals to the ATRC. Many other university programs focus on providing disability services in the area of cognitive development as well as hearing and visual learning assistance to students on campus rather than AT development as a whole. The common focus of most university AT centers is to supply custom solutions specifically to members of its student body. While WPI has a well-established division in charge of managing services for students with special needs, interaction with this department, the ATRC, and similar offices on other college campuses remains an unexplored area for growth. (Trimby & Lyons, 2008)

2.3 Previous Studies

The operation of the ATRC has evolved since its inception in 2004 as the number of student users passing through the lab has grown and the field of assistive technology has rapidly transformed. At the outset of this project a review of previous work was conducted in order to establish a foundation for the new work that was to be done. This included a re-evaluated list of goals based on the criteria for progress laid out in 2007 by Professors Hoffman and Ault. This specification was created along with the initiation of an IQP whose participants would maintain the operational state of the lab. (Thamilavel, 1999) Since then, there have been four IQPs associated with the ATRC operations. Each one was reviewed extensively and provided a high quality reference for understanding the past work which had been completed in the ATRC.

2.3.1 Lyons and Trimby Study (2008)

Lyons and Trimby were the first IQP students review the operations of the Assistive Technology Resource Center (ATRC). As the first IQP group, they created a 5 year plan to keep the ATRC operating in accordance with its founding objectives. The 5-year plan was developed based on information collected from surveys sent out to clinical, educational, government and social service organizations. Although the 5 year plan was not strictly followed, it did serve as a guide to the following IQP's. In the 5 year plan, the focus on internal operations is paramount and is recognized as a critical precursor to any work that might be done developing off campus contacts. The proposed internal ATRC operations guide included a cash flow projection, defined discrete roles for the ATRC staff, as well as outlining a website, contacts database and a guide for future use of the ATRC lab space. (Lyons, Trimby, 2008)

The small list of the ATRC contacts were categorized into schools, university AT centers, AT relevant organizations and previous students and clients. One useful insight provided along with their database guide was that of cross referencing the ATRC's mission and activities goals with those of the contacts as well as prioritizing off campus contacts by their geographic distance from WPI. For the website development, Lyons and Trimby used Web Development for Firefox and set the website in accordance with W3C guidelines. Lastly, to improve the visual appearance of the laboratory space, they suggested activities such as re-arranging the tools, storing the completed projects so as to be observable by visitors and performing a weekly walk-through for campus guests.

Their IQP was analyzed to pin point ideas which could be integrated into the current IQP as well as to be learned through their experience. The main challenge to the Lyons and Trimby IQP was their intention to make large-scale changes to the lab which was ultimately not possible within the time constraints of their IQP. Little work was done in the actual implementation of their proposed solutions and therefore the following IQP's did not have the stepping stones expected during their own consideration of requirements for completing the five year plan.

2.3.2 Hristov, Mawhiney and Wilson Study (2009)

As a continuation of the Lyons and Trimby study, Hristov, Mawhiney and Wilson were able to execute many of the recommendations from the Lyons and Trimby study. The three main improvements coming out from their IQP were reorganization of the lab, the development of a Microsoft Access project database, and the compilation of a list including around 50 potential local affiliates.

This group physically reorganized the lab by generally following the suggestions from the previous IQP group. The countertops were all cleared and similar items and tools were all organized in the drawers. The whole facility was labeled in a manner that was intended to be maintainable in the future. Additionally, a floor plan of the active lab space was produced along with recommendations for an optimized floor plan works towards goals of efficiency and safety inside the working environment.

This group went through the hardcopies of IQPs and MQPs pursued within the ATRC dating from 1989 to 2009. They set up a new index system and categorized the projects in Microsoft Access to allow the users to be able to find a certain topic area in a given category. This was meant to stimulate interest and ideas in students and clients and give an overview of the accomplished projects. The categories in Microsoft Access project database include; Date (mm/ yyyy), Project Name, Status, Student(s), Advisor(s), Abstract, Awards, Online, Web Page Name, Primary Disability, Assistive Technology, Context and Client Age. In the hope of handing over the database to the next IQP group, they also provided instructions on how to create categories and store information in the Microsoft Access file making the Microsoft Access database and CAD floor plan two major accomplishments for the 2009 team.

2.3.3 George and Kalluri Study (2010)

George and Kalluri made up the third IQP to work in the ATRC and focused on optimizations particularly in the areas of marketing and documentation. George and Kalluri expanded the ATRC project database by the Hristov, Mawhiney & Wilson study through comprehensive documentation of all projects completed within the ATRC. George and Kalluri developed a general format for the summary of each project in order to include a

problem statement, description and result of the final design when documenting every project. They also assigned keywords for each of the projects. Their database is comprised of 61 projects in total - nine outstanding class projects from undergraduate courses, one independent study project and seven MS thesis in addition to IQPs and MQPs. Their database was compiled in a Microsoft word document.

George and Kalluri also created a marketing document which is a collection of selected projects that represent an informative overview of devices developed with the ATRC. They proposed that these marketing documents shall be distributed to potential clients and sponsors.

Our team extracted the data about in-class, EPICs and MS theses from George and Kallur Study so they could be integrated into the format of the Microsoft Access database by Hristov, Mawhiney and Wilson. Unfortunately, neither of the databases created by these two studies saw a great deal of use by either the students or the clients in the ATRC due to access not being available in a manner that was convenient to the intended audience.

2.3.4 Begins and Zeveska Study (2012)

Begins and Zeveska's IQP on ATRC Communications was the most recent preceding IQP. The group put forth a significant effort to make the lab self-sustainable and operate efficiently without close supervision. Deciding that the ATRC project and client database were advanced enough to provide an adequate framework for communicating with potential clients and WPI students, Begins and Zeveska concentrated on improving the lab operation, procedures and outreach activities. The overall goals they pursued were most highly aligned with those pursued by this IQP team.

Begins and Zeveska, in addition to cleaning the ATRC, went a step further than Hristov, Mawhiney & Wilson by developing a schematic of the lab which shows the layout of the room and accurately depicts what each drawer and cabinet contains. They also documented tool inventory and supply inventory. These inventories were intended to allow the lab users and the project supervisor to keep track of the existing tools and to reorder consumable supplies when they became low. In addition, they encouraged the lab users to return the tools to the right location when they have used them.

The team drafted Standard Operating Procedures (SOP) to entirely restructure administration of the ATRC. First, they defined roles and responsibilities of a lab manger, a position which has been unoccupied since 2010, and those of other students/ staff. The SOP also contains templates for the ATRC brochures, newsletter and tool and supply inventory. Second, they emphasized the need to release an updated newsletter twice a year to the entire WPI community as well as to the ATRC networks. Overall, the team made significant improvement in optimizing the lab's efficiency and communications.

To promote communications within WPI and outside contacts, the group launched websites for the ATRC as well as EPICS at WPI. While the website was first proposed by Lyons and Trimby in 2008, this was the first instance of the site actually being put online. They made an attempt to recruit students, particularly from ES 1020, ME 2300 and ME 3506 that had a desire to continue projects from the design classes. Although there were a reasonable number of interested students, availability was not consistent for the extended length of time required causing updates to the projects remained incomplete. Even so, Begins and Zevesaka's study offered great insights as to the strategies and priorities for the current IQP.

3 IMPLEMENTATION

The objective of the 2012 - 2013 ATRC Operations IQP was to improve the capability of the lab to support student projects on a continuing basis while developing lasting relationships between WPI, other educational facilities, assistive technology users and professional industry. A major component of this year's project included implementation of ideas from previous teams as well as our own newly developed ones. Based on the large number of unknown variables, the team's strategy was to conduct sufficient background research so as to be confident of a successful outcome and then documenting the work so that future groups may pick up work where it was left off. It is also understood from the outset that in case of an obstacle being encountered that new objectives would be set based on the activities that were possible.

The team's activities for the 2012-2013 year are outlined as follows.

1. Database and Archive Construction:

a. To create internal ATRC databases allowing for field searchable archival of three primary information sources:
    i. Past "Best of Class" course term project papers, IQP papers and MQP papers.
    ii. Organizational contact records listing the personal information of individuals working with the lab as well as potential sponsors.
    iii. Online Assistive Technology resources assisting ATRC projects with innovation technology and AT devices.
b. To work with the WPI Gordon Library in developing its system for creating a digital library for the campus and integrating an institutional digital repository for grouping materials discussing specific topics or pertaining to specific research. Due to the fact that the university's program is in its infancy, the IQP group's secondary goal was to act as a "Use Case" supporting the school's program as well as the ATRC's effort to develop a readily searchable reference for the largest audience possible.

2. ATRC Organization and Operation
    a. To implement an ATRC wide organizational system to maintain a clean, safe and functional educational workspace.
    b. To lend past project experience toward developing the most appropriate and affordable equipment inventory possible.
    c. To provide students using the lab with instructional materials and research assistance working towards the goal of eliminating work interruptions for information retrieval and training.
    d. To compile a tool inventory database with wall mounted printout and associated graphical storage map to allow lab staff simplified facility upkeep and a consistent list of the equipment available within the lab. In contrast to previous efforts as well as initial activities this year, this system is not intended as a tool checkout system. A "high value" item list is provided incase future administrations consider its use justified given new demands placed on the lab.

e. To construct a robust archive of past ATRC operational and instructional material as well as the resources that were developed over the course of this project with the goal of supporting future IQP groups.

3. Outreach Activities
    a. To integrate the EPICS and ATRC websites and incorporate whatever functional updates are possible in addition to correction of outdated information.
    b. To produce one organization newsletter for the close of two terms.
    c. To develop an outreach program that promotes bringing together WPI students with local and national organizations associated with assistive technology, as well as other colleges and youth education entities.

3.1 Archival

The first approach taken by the team was to further extend the existing IQP database produced by the proceeding five years of research from Operations IQP groups. The ATRC database is not only limited to IQPs & MQPs, but other academic work as well. Additionally, a private contacts database was created incorporating past and present ATRC contacts. To make the databases' format familiar to as wide an audience as possible, the IQP team compiled then in Microsoft Access. These databases include files for Projects, Contacts, Resources, and the Digital Commons. The Digital Commons archive includes research and other information being developed in conjunction with the WPI Gordon Library. All of these files are also backed up on the ATRC flash drive.

3.1.1 ATRC Internal Databases

As stated in the background of the project, previous IQPs have recorded almost a complete archive of projects associated with the ATRC from 1989 to 2010. The most up to date database is that developed by the George and Kalluri study, consisting of 61 projects in total including IQPs, MQPs, nine outstanding course projects and seven M.S. theses. The database by the Hristov, Mawhiney and Wilson study has a total of 69 projects including only IQPs and MQPs. In addition, Hristov, Mawhiney & Wilson developed a list of 50 local

potential affiliates in a PDF. Our goal has been to compile the databases created by the previous IQPs and bring them current with correct information for the 2012 year, and to build a system where the project database is stored and readily accessible for all WPI students and faculty.

It was found that all of the above mentioned databases and resources have remained unused in the office computer or on the project reports server since the time they were first created. It is believed that because most of the ATRC users rely on the project database search tool provided by the Gordon Library to retrieve the projects, and that such in depth information is not searchable, it becomes highly difficult to locate. Research indicated that the database maintained by the Gordon Library has several such limitations. Firstly, it only houses electronic copies of IQPs and MQPs from 1999 to the present. Secondly, because of the massive volume of information that is required to be stored, the library system only indexes (and thus limits searches) to the abstract of a paper and certain keywords that might have been added to the index when a now disabled keyword inclusion system was running. Thus, while users may find reports associated with the lab, extracting specific project details is not possible without going through individual project by project searches. The new database compiled by the IQP team was intended to solve this problem and create a path to providing such a tool as a WPI community resource. It was during this process that the upgrade plans for the Gordon Library's collection were discovered, in which case the goal of the archive project became first, to create private resources for use only within the ATRC by administrative staff such as the contacts list and second, to collect as much information as possible to prepare the lab for becoming an early adopter of the Digital Commons system being rolled out by the Gordon library.

The system chosen to house the internal database was Microsoft Access because it is not only readily available to students in the WPI community for free, but because it is also easily updatable and user-friendly. In addition, there were already Microsoft Access files created by Lyons and Trimby making data import and update much simpler.

The new Access databases improve search capability, navigation and attractiveness of the users' interface to the program, in contrast to the standard interfaces from previous

efforts. The purpose is to encourage students and faculty to frequently use the program and to ensure minimal technical difficulty during searches and updates.

3.1.1.1 Microsoft Access Project Database Features

The new Access project database makes use of fields similar to those of the earlier databases and was heavily influenced by earlier contributions by Lyons, Trimby, George, Kalluri and Professor Hoffman. It does exclude two categories; "Status of the Project" and "Available Online?" and adds a new category "Project Type." Several other fields of category which were not populated in the Lyons and Trimby version were also filled. In addition, the group made extensive study of the George and Kalluri database to modify and add fields for the two categories "Primary Disability and "Assistive Technology". The following table shows the outline of the ATRC Projects Database.

1. Project Name
2. Date
3. Project Type
    a. Graduate Thesis
    b. IQP
    c. MQP
    d. ISP
4. Advisor(s)
5. Sponsor(s)
6. Student(s)
7. Abstract
8. Awards
9. Client's Age
    a. Less than 6
    b. Child (6-12)
    c. Teen (3-19)
    d. Elderly (>65)
    e. Multiple Ages
10. Primary disability
    a. Mobility
    b. Cognitive
    c. Vision
    d. Hearing
    e. Speech
    f. Muscular Dystrophy
    g. Traumatic Brain Injury
    h. Spinal cord Injury
    i. Cerebral Palsy
    j. Arthrogryposis
    k. Dystonia
11. Assistive Technology
    a. Wheelchair Adaptations
    b. Computer Access
    c. Prostheses and Orthoses
    d. Everyday Living Aids
    e. Wheelchair Add-ons
    f. Communication
    g. Safety
12. Context
    a. Home
    b. School
    c. Workplace
    d. Institution
    e. Group Home
    f. Community
    g. Nursing Home
    h. Gymnasium/ Outdoors
    i. Useful in all contexts

Figure 3-1: Project Database Data Field Options

As shown in the next figure, the users' interface for data import and storage in Access is a form called "Projects". It is where search terms and descriptions will be entered or selected from the drop down menu. Clicking the next button will display the search results or a new black form if no search hits are found.

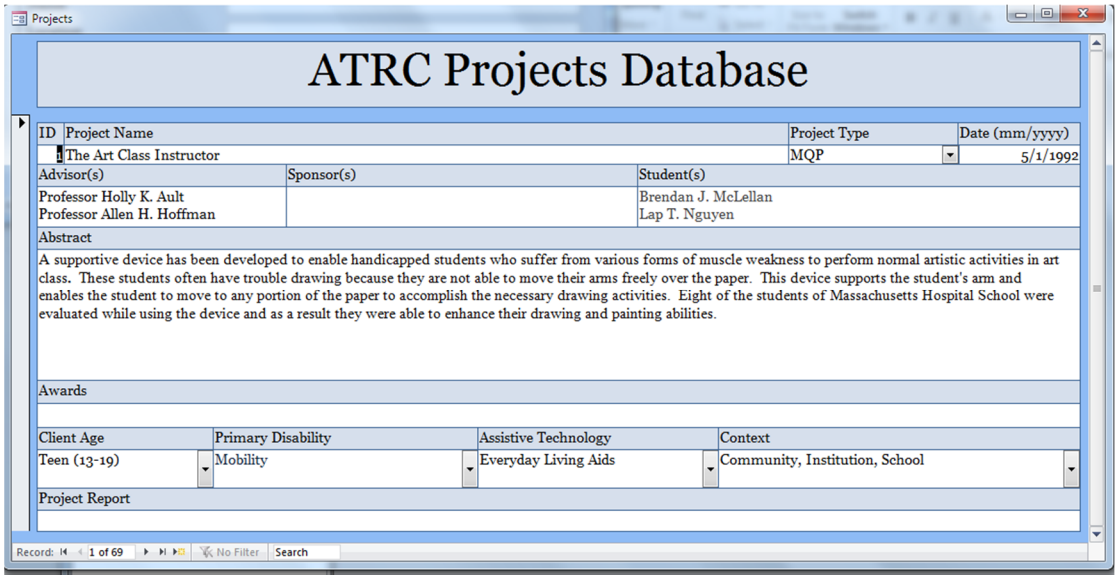

Figure 3-2: Project Database Add in/Look up Interface

In order to make the "Projects" archive more user friendly, the group developed another form called "SearchProjects" which differentiates this database significantly from the Gordon Library services as well as those from previous IQPs in that is provides a full text search through all documents in the database. Additionally, database was programmed to index new materials added to the archive, there by automating the update process. The window below shows the simplicity of this program. Once the user has typed in the keywords in the desired fields and clicked the "Search" button, the table of related results will show up.

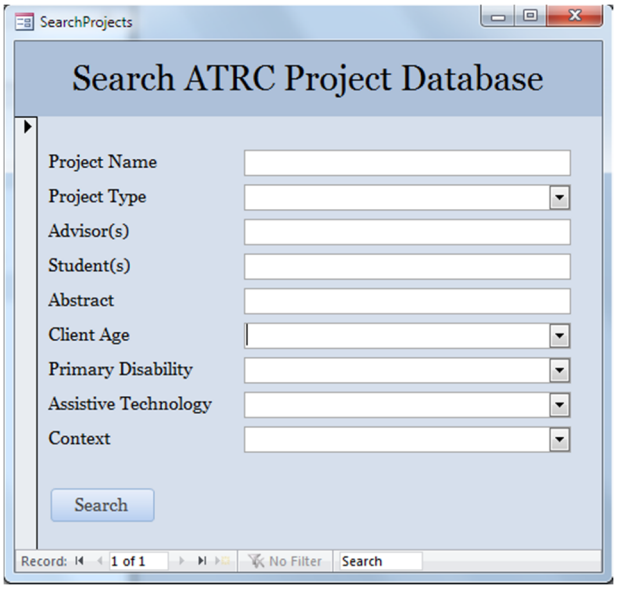

Figure 3-3: Project Database Search Interface

The Projects database is updated to include MQPs and IQPs submitted through spring of 2013. This database is made available electronically from the ATRC flash drive for any future group associated with the ATRC. (Herzog & Oo, ATRC Flash Drive Digital Archive, 2013)

3.1.1.2 Microsoft Access Contacts and AT Resources Database

Successful operation of the ATRC has always demanded the ability to compile and maintain an effective contacts list, not to mention that maintaining such information is one of the ATRC's main objectives. These two requirements encourage the group to come up with the ATRC Contacts and AT Resources database. The content of the database encompasses past and potential clients, internet resources, search engines indexing current AT practices and devices, foundations and national organizations offering grants to AT related efforts.

Many students working on AT related projects will find this database valuable since they need to do background research while developing design concepts for a device. This database will only be made available electronically on the flash drive at the ATRC office due the presence of confidential contact information. (Herzog & Oo, ATRC Flash Drive Digital Archive, 2013)

To confirm the value of an entry in the resources database, the team checked two main criteria, whether it shares the ATRC's goal of improving the lives of individuals with disabilities, and whether it is within 50 miles of the city of Worcester. Search engines capable of targeting this area, such as AbleData, DisabilityInfo.org and AssistiveTech.net are great tools to search related AT products, services and organizations. They include search filters sorting results by vendor, provider, organization or location. Using these resources the team added approximately 40 entries to the database. The rest of the database was expanded by filtering a list of fifty potential clients created by Hristov, Mawhiney and Wilson in accordance with the two criteria mentioned above.

This database follows the same format as the projects database. The following shows the outline of the contacts and resources databases.

1. Name
2. Location
3. Phone Number
4. Database Type
    a. Potential Client
    b. AT resources
5. Categories
    a. University AT centers
    b. Hospitals
    c. Public Schools
    d. Nursing Home
    e. Company
    f. AT relevant organizations
    g. Exchange/browse AT stuff
    h. Search engine
    i. Funding

Figure 3-4: Client and Resource Data Field Options

Forms for "ClientsResources" and "SearchClientsResources" are provided below.

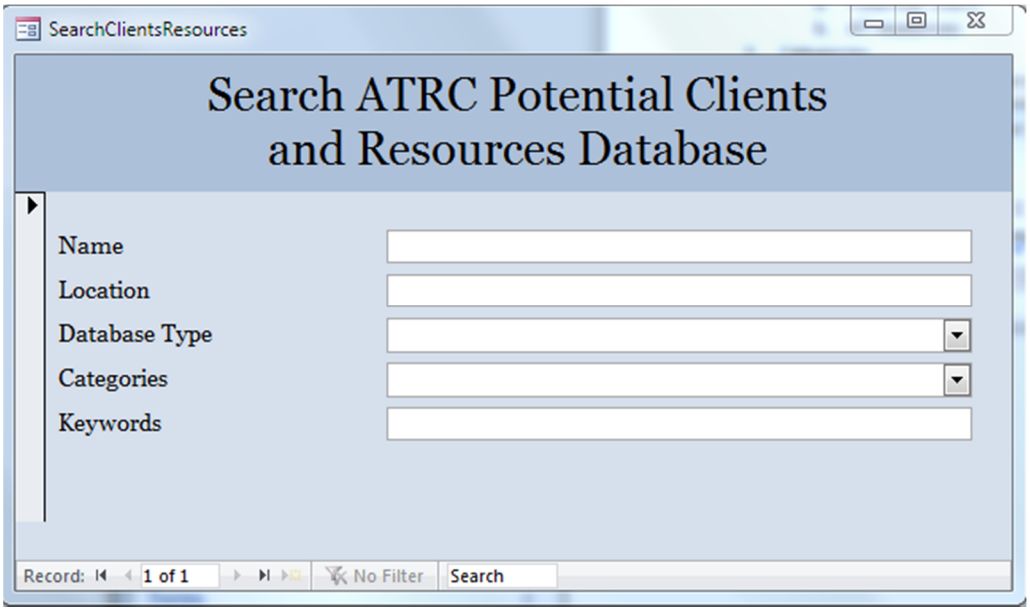

Figure 3-5: Outreach Database Search Interface

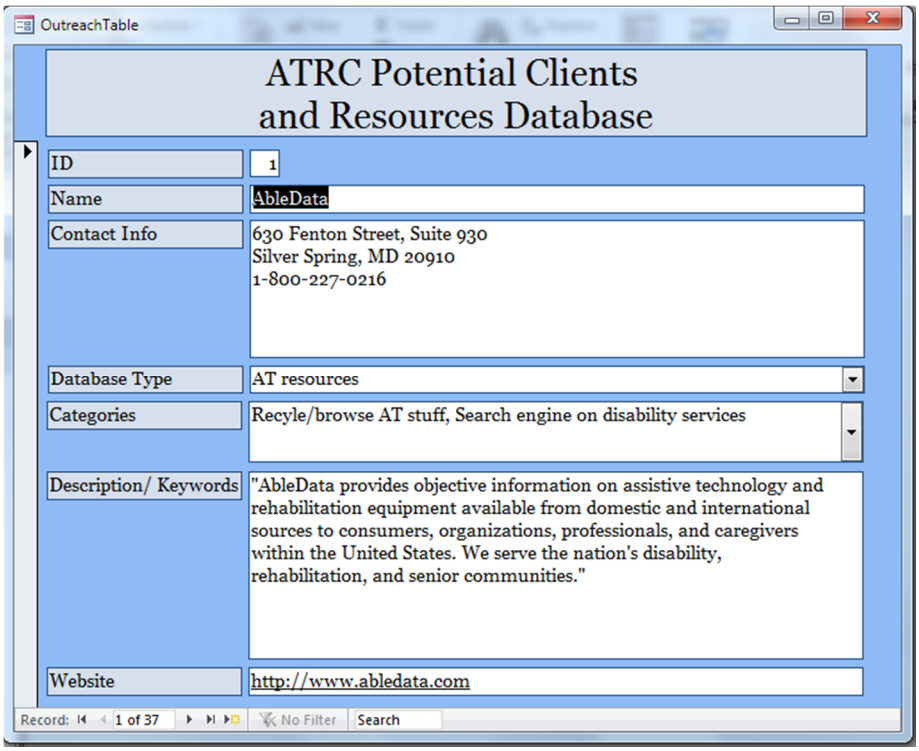

Figure 3-6: Outreach Database Add in/ Look up Interface

The group also discovered hardcopies of old contact lists compiled in 2005 in the ATRC office. The contacts included information for 50 to70 individuals in AT related organizations however, because of the age of the information, was not incorporated into

the new Contacts database. It was recognized that there still might be valuable information contained in that list so the hardcopies were scanned and made available on the backup flash drive in the ATRC office.

3.1.2 Collaboration with Gordon Library

3.1.2.1 Initial Motivations

While the internal Projects database is effective for organizing all ATRC information for the limited audience who understands how to use it, for public information sharing purposes there are many benefits to a professionally managed resource administrated by the Gordon Library staff in conjunction with future IQP teams.

The product being implemented to accomplish this goal on a campus wide scale is a digital repository system called the Digital Commons which was purchased from the company Bepress for the project which started in early October 2012. The repository itself is a service maintained by the Gordon Library that has the ability to include specifically selected materials as organized by individual departments within the institute, creating what can be seen as a Google style resource with "deep web" full text search capabilities as decided by the rights administrators. The team found Digital Commons to also be a resource for conveniently sharing materials and research work not associated with IQPs and MQPs such as outstanding class projects, independent studies, or EPICS activities, allowing it to function as a fully configurable research tool as well as a marketing & outreach tool for both internal and off campus target groups.

Since the Digital Commons project is just getting started, it was decided to focus the immediate efforts of collecting information for future groups, developing a fully featured version of the Access database files, and providing as much information as possible to the following teams who will have the opportunity to fully take advantage of the new system. During the course of this year's IQP, the team had the opportunity to act as use case group for the Gordon Library Digital Initiatives team which included the opportunity to provide feedback regarding system needs from the students' perspective as well as input regarding the various ways that our team envisioned such a system being utilized. The hand off point for this part of the team's project will be to define a problem statement and provide a set of

guidelines for the future IQP group to work from while building the ATRC Digital Commons site. (see 2.c.i Project proposal to WPI Gordon Library.)

3.1.2.2 Preparation for ATRC Digital Commons site

The team submitted its use case report to the Gordon Library in early November and conducted follow up meetings with the Digital Initiatives Librarian, Jessica Colati, and other Gordon Library personnel. (see 8.3: Database Proposal to Gordon Library) During these follow up meetings demonstrations of the Digital Commons product were seen to allow uploads of video, images, Office documents and PDFs. Research materials and publications can be contributed by faculty members as well as students in the WPI community and can easily accommodate "limited time," content such as conference and special event postings as well as upload links for submissions on a focus research topic. Just like the existing MQP and IQP database served through the Gordon Library, the Digital Commons pages can be indexed by search engines such as Google and moderated through settings which allow varied levels of viewing rights. Depending on the type of access the individual has to a Digital Commons site, community contribution areas can be established, allowing for certain areas to function along the lines of a Wiki. Changes to this and other content can also be followed by interested users through news feeds (RSS) allowing activity updates and improved communication between research contributors and their various audiences.

From a management standpoint, the main advantage of the Digital Commons system is the ability to allow distributed administration with various responsibilities delegated to the students, staff or faculty most appropriate. Future IQP groups will be responsible for constructing a user friendly layout that allows easy navigation of ATRC content and deciding how to merge new content opportunities with the organizations existing web presence.

The four main content areas outlined by the team are as follows:

1. Publication
2. Projects
3. EPICS

4. ATRC Resources

The materials in Projects, EPICS and ATRC Resources should be linked with the existing Gordon Library project database and ATRC website. Much of the content for the ATRC Digital Commons page can be extracted from the Microsoft Access database developed by the team however, because material beyond that intended for release on the reports server is now stored on the flash drive, all major content upload plans should be approved by the appropriate instructor to insure private information is not disclosed.

As the next step, the future team should take advantage of features that can strengthen communication between the audience and the writers such as posting videos and updated news in EPICS and ATRC resources. Regular updates can now easily be integrated within the curriculum of courses utilizing the ATRC, however adoption of this technology will be the responsibility of future IQP teams who will need to coordinate with the Gordon Library's Digital Initiatives staff and gain an appropriate understanding of web development tools. As was seen in the last team meeting with library staff, early adopter sites have already provided campus divisions the ability to integrate normal web content with searchable scholarly research articles. Considering the power of this resource for delivering information to the individuals searching for it, future groups are highly encouraged to explore this avenue as a means of creating a single, unified digital resource for all ATRC and EPICS digital content needs.

3.1.3 Archival of Project Report CD's to Flash Drive Backup

Over the course of the term the IQP team located many CD's as well as several "ZIP" magnetic disks in addition to a large archive of paper documents. While the team's immediate efforts revolved around creating the Projects database and Gordon Library Use Case, the degrading state of the digital materials prompted an immediate backup strategy to allow future groups to easily find information. It should be noted that none of the materials found were compared to those uploaded to the WPI report servers, though it is expected that these disks are the only record for much of the material as the library standards exclude files over a set size limit, thus excluding many valuable raw data and

imagery archives. Archival of CD materials was immediately accomplished through a full backup of all disks to the EPICS office computer and later to the ATRC Dropbox.

A more permanent solution was decided to be the purchase of a USB flash drive. The purpose of the drive is to provide a central repository for documents found by the IQP team to have been compiled during the preceding five years of work and to allow future IQP groups access to the data and provide access to data that will have to be reviewed as it is loaded to the Digital Commons site. First and foremost, the IQP team attempted to store a softcopy of every useful file and record created throughout the IQP project. In addition, the flash drive will store all EPICS digital media backup, the Microsoft Access databases.

3.2 ATRC Organization and Operation

3.2.1 Methodology

A primary focus of the IQP group was to create a streamlined process for the flow of projects through the lab. One of the biggest challenges in the lab was coordinating the different activities of the diverse user base. At the outset of the project it was recognized that any system implemented would require both identification of the typical user workflow and intervention at the points which had resulted in earlier systems breaking down, causing the lab to not only become unsightly, but contain a great deal of underutilized space.

Early inspection of the lab revealed disorganization as well as some missing equipment. It was observed, however, that in addition to items not being put away, many items were grouped inconsistently, or simply returned to a random location.

The conclusion drawn from these observations was rather than the lab suffering from frequent theft or an unwillingness of students to clean, that students were likely unable to identify where items had come from once off the shelf. Additionally, because no protected group storage existed, at the end of a work period groups would simply rush out the door and in the process collect anything they had been working with in the boxes they were taking home with them. Because groups frequently don't come back to the lab after the final work is submitted, wherever materials and tools were last located became their new home.

Providing a new structure for work within the lab therefore was broken up into providing students with a personal project storage space and creating an equipment management system that provided anyone who works with a piece of equipment a quick, efficient way to fetch and return an item to its proper location. Based on this strategy it is hoped that users will be encouraged to organize their own belongings and cooperate with classmates to maintain a system that will benefit everyone.

Throughout the B-term, the Op's team dedicated significant time and effort toward getting the contents of the lab cleaned, sorted, and repaired. Past projects that weren't actively being used as display pieces were collected in a location where they would not interfere with day to day operations and equipment in the workspaces was put into a state where groups did not have to displace it or one-another's materials to continue their own projects.

One of the first efforts made was to check the tool inventory in the ATRC to identify and fill any gaps as well as provide students with necessary cleaning supplies so as to avoid undue expectations being placed on campus Facilities staff. (see 8.6: Operations Resources)

While evaluating different options to implement a tools inventory system, initial efforts considered using the QR code and the barcode scanner to speed up check in & checkout of lab tools as well as to organize them better. However, the needs of the lab make this level of control unnecessary and thus a less complicated, minimal oversight strategy for the organization of tools was designed.

3.2.2 Supporting Project Teams

One of the goals that developed throughout the project was pursuit of the idea that the majority of teams follow a fairly similar pattern of activities within the lab and if that pattern could be characterized, then the points resulting in disorganization could be addressed.

This effort theorized the several logical activity types that students engage in while interacting with the lab environment, specifically:

- Identifying the piece of equipment or tool that was necessary to complete a task.

- Finding that tool in the lab and retrieving it for use on the project with individuals who may not be familiar with such identification and retrieval.
- Intermittently using the tool or switching between tools used by multiple group members.
- Repeating the first two steps in reverse order during cleanup times that are usually as rushed as possible.

Staff input to these activities is generally limited based on practical availability however, development of a new system would also imply that the administrative constraints to be met would include:

- Moderate to minimal capital replacement demands as well as essentially zero maintenance requirements.
- "Easy as breathing" implementation procedures.
    - Users should be able to walk into the lab, approach a workstation and intuitively be able to help themselves without having to retrieve a staff member or randomly search for an item.
- "Zero Reference" cleanup capable.
    - An individual should be able to have simple intuitive guides to allow them to return items to their correct location without consulting lab references as much as possible.
- System tolerance for new items as well as items removed from service without having to constantly update labels and maps.

This general theory of activities led to the formation of a revised method for maintaining the lab state.

- Update the cabinet labels with clear holders that can be easily replaced with simple printed or written paper labels.
- Color coded tag stickers or "paint pen" stripes on tool items which match color coded indicators on storage locations allowing individuals to identify general storage locations for items from most locations within the lab space.

- Compilation of a more generalized inventory list with the associated location of items to be posted in the lab.

3.2.3 Tool Use and Workflow

3.2.3.1 Tubs

A primary focus of the IQP team has been to organize the lab and provide groups working within the facility convenient means to operate in an organized fashion. This goal was accomplished through the implementation of a group tub storage system wherein each MQP and class project group was provided the option of using at least one 18 gallon plastic storage tub as well as a smaller four quart clear tote for more fragile items. The transparent label holders developed to display the lists of cabinet contents were reused as team ID label holders. The immediate effect of this procedure was that the lab's appearance stayed in the condition that it was restored to following the initial cleaning that was conducted at the project's outset.

3.2.3.2 Signs

In addition to reorganization of the lab projects and equipment, it was recognized as a critical management point to create signs throughout the lab that fulfilled four basic goals.

a. Gain the reader's attention without sounding offensive, condescending or patronizing.
b. Effectively communicate the message as briefly as possible.
c. Build a sense of cooperation between students and staff to keep the lab orderly.

3.2.3.3 Heavy Lab Assets

In addition to filling any immediate need for tools, the larger issue of adapting to the evolving real estate constraints was considered. While use of larger pieces of movable furniture such as Akrobin™ racks has become unfeasible, smaller bins within fixed furniture pieces are more attractive. Specific vendors already leveraged by the Electronics & Computing Engineering and Robotics Engineering departments have been evaluated to

provide both fixed and floating storage. While such options are not cost or space effective considering the superior availability of bins & totes from local vendors, in the event that a full fixed asset reorganization becomes possible, such options might be considered. (see 8.6:Operations Resources)

In addition to open storage, the possibility of locking furniture was considered to support both internal operations and student projects which might demand a higher level of security. While such issues are currently handled by means outside of the ATRC, the ability to secure higher value equipment such as power tools or data acquisition equipment is considered to be appealing.

3.2.3.4 Tool Inventory

In order to have tools organized at all times, a simple "storage map," system was developed. The main purpose was to be able to better locate and replace tools, saving time for restructuring by future teams. The lab space was redefined in that all existing cabinets, drawers and shelves have been assigned an alpha-numeric location. Consequently, every tool will have its own location defined. While itemized checkout is not needed it is hoped that such a system will allow the lab to achieve a more self-sustaining state.

The team made an approximately scaled 3D SolidWorks model of the lab layout. (see 8.6.2: SolidWorks Model of ATRC Floor Plan) Having numbers assigned in the lab layout makes it easier to cross check with the tools inventory sheet and quickly identify a storage area. The tool inventory sheet consists of a layout of drawers, cabinets and shelves in blocks. The blocks are again identified alphanumerically. (see 8.6.4: Drawer Contents Map). Alpha-numeric locations of tools and expensive hardware were obtained by matching numbers of lab space from SolidWorks model with alphabets from drawers, cabinets and shelves.

3.3 Website Management

The new ATRC website was established in 2012 by the Begins and Zeveska IQP group. This IQP group decided to keep the same format but extended the content provided to WPI students and the general public about the ATRC. The purpose of the website is to promote the ATRC project center to Assistive Technology institutions and other

organizations in need of assistive technology so that the ATRC can develop its community network and potentially develop new avenues for fund raising. The other purpose is to motivate students to be a part of projects related to assistive technology as well as some of the basic information resources needed to do so.

The ATRC "About Us" session has subtitles titled "Personnel", "Recent News" and "Courses". "Personnel" has been updated to include the current IQP team. "Recent News" includes all news updates for the ATRC along with archives of newsletters which have been released since 2012. The "Courses" session is a completely new addition to the site and lists all course descriptions for instruction taking place within the ATRC.

In addition to the updates to "About Us" section, the "Projects" tab was added to the website. This lists what specific MQPs, IQPs and ISPs are currently underway or have recently finished in the ATRC as well as those future projects that the ATRC might host. Having been incorporated from a previously dedicated site, the "EPICS" club tab is now part of the ATRC website. During the 2012-2013 academic year EPICS regained full recognition as a campus student organization.

Last, but not least, under the "Resources" tab, the website links to excerpts from the ATRC Operations Binder. Since the excerpt is simply a document file, the future updates can easily be updated by anyone familiar MS Word. Furthermore, that document already contains a description on how to access the flash drive where the full version of the Operations Binder and all the ATRC related information is stored. This is a huge advantage for all the students associated with the ATRC because they can acquire the most up to date information at any time.

The team hopes that the above additions provide more insights into the activities and projects the ATRC holds while inspiring WPI students to get involved with the lab. The html files of the updated ATRC website are available in the flash drive as well. (see 8.10.1: Website Updates)

3.4 Publications

Early in the project, the IQP team made some updates to the lab's promotional brochure and later provided a simple holder outside the office door. This idea turned out

to be extremely popular with groups touring the campus and at the time of publication it is estimated that approximately 100 brochures a month are distributed.

Larger publications providing more in depth coverage of laboratory activities was planned however did not materialize due to time constraints and a focus on the large reorganization activities being undertaken.

The basic format for articles as well as past examples are present in the digital archive and future teams are encouraged to continue this valuable method of communicating with the community that the ATRC and EPICS groups are most interested in interacting with. (Herzog & Oo, ATRC Flash Drive Digital Archive, 2013)

3.5 Engineering Projects in Community Services (EPICS)

3.5.1 Introduction

Aiming for the long term goal of lab management sustained by students themselves, the team decided to reestablish the student group focused on activities within the ATRC, EPICS. EPICS has been a part of the ATRC since it was first founded but did not have formal leadership, instead being maintained by students who wanted to conduct further work on projects started in courses related to assistive technology. Having EPICS as an official students club allowed election of officers as well as obtaining school funding which are two main resources required to keep the club running.

During the course of the term, the revival of EPICS was initiated with the intent of reaching two main audiences, students who have some degree of mechanical background who would like to develop a project or skill related to assistive technology devices and students outside of mechanically focused majors where experience with an assistive technology development project would be a valuable asset. General project idea sources for the club included projects that were brought to the group as a new or continuing introduced by non-students and similar project ideas that would originate from within the student group. While many of the externally introduced projects were from previously developed student coursework, the availability of projects founded by Professor Hoffman with external sponsors was promoted with the specific goal of demonstrating to the team members the opportunity to benefit individuals with an immediate need.

The recruitment of this group was accomplished through four primary means; word of mouth advertisement by the IQP team, on campus flyer posting, EPICS Facebook page postings and lastly through contact with interested members reached through in-service presentations made by Dr. Hoffman in non-major classes. Future strategies include submitting the meeting notice to several campus wide email notification newsletters as well as the Mechanical Engineering and Office of Student Life newsletters.

Following informal discussions with several prospective club members it was decided to conduct general club meetings consistently in the evenings around the dinner hour, after most classes had concluded for the day. Additionally, a tentative calendar for the first month of the term was assembled that indicate a consistent gathering time on Friday's at 5:30 PM for all official club business to be handled as well as any project work that might be agreed upon by the members.

As C term arrived, the IQP team started to proceed with the establishment of EPICS as an official student organization. At the beginning of the term, officer elections were held for six positions; president, vice president, treasurer, secretary, public relations officer and the technical project leader. With the help of the IQP team, EPICS officers drafted the constitution that set EPICS goals, mission statement, values, target activities, budget, officers' roles and membership requirements.

The mission statement of EPICS is as shown below:

The goal of EPICS is to develop a robust team of students working together to design, build, and deploy real systems that solve engineering-based problems for local community service and educational organizations. To achieve this goal, EPICS strives to provide its members with valuable hands on project experience they might not otherwise gain.

3.5.2 Off-Road Tire Wheelchair Adapter

Following with the larger purpose of the ATRC itself, the IQP team made its primary goal to encourage EPICS club members to work through the entire development process with an idea and to the greatest degree possible, help its members to become familiar with resources for managing the various aspects of their project. Beyond basic logistical planning and organization, initial club meetings focused on initiating discussions between

members about both broad ideas that they would be interested in developing and brainstorming about the potential hard deliverables that could be produced while fulfilling member interests.

Club activities were encouraged to focus on short term projects that could be completed before the close of the year, reserving longer term project support for team members who demonstrate an ability to be self-motivated during the unsupervised summer terms as well as competency for maintaining the lab facility with minimal supervision.

Among many potential projects that came out of discussion, the group showed strong interest in designing a beach friendly wheelchair which allowed the user to drive on sand and potentially snow during a New England winter. The idea was proposed by an individual within the group who had a family requiring an electric wheelchair to travel and was experiencing such problems. It was hoped that the application of the wheelchair could be further extended to driving on rough terrain without giving up indoor accessibility. The project got even more exciting when a wheelchair for the testing purpose was donated by that same person who initiated the project. This allowed the group to effectively evaluate several design solutions against the actual structure of a wheelchair and then produce drawings around measurements from that vehicle.

The first two weeks of the project were spent studying the design specification sheets of the donated Jaguar electric wheelchair. Based on the exploded views showing how parts were assembled as well as the power rating of the motor, the group was able to narrow down their design solutions to two main areas. One was to modify the wheel hub to enable a different type of wheel such as bubble tire to be attached, extending the contact surface area. The other option was to design a 3D printed tire chain that could be attached in a manner similar to snow chains on a car. In order to assure that the group was making progress and keeping the project going, the group met weekly to discuss progress that had been made and come up with solutions to problems that were encountered along the way.

3.5.3 Community Outreach

To align with the ATRC missions, EPICS will also strive to collaborate with similar constituencies and university AT centers to offer AT solutions for people with disabilities. The two main goals EPICS strives to achieve are to connect with AT groups around the country and to serve the AT needs in regions around Worcester, particularly in collaboration with Worcester Public Schools and Massachusetts Hospital School which have built connections with the ATRC since its establishment. These two goals will be pursued by EPICS group members in the future and are hoped to include attendance at regional and national design conferences.

EPICS officers identified some university AT centers within the Worcester region and concluded that the goals of the University of Massachusetts, Lowell most closely matched with those of the ATRC. Through contact with U-Mass Lowell, the EPICS group will explore active AT projects, activities and events each college is pursuing and will offer to co-organize or collaborate in one of the projects or the events during the coming year. In addition to U-Mass Lowell, EPICS will also contact the main EPICS institution at Purdue University to update the status record of EPICS organization at WPI. Records show that there had been EPICS conferences hosted different university divisions annually since 2009. By helping EPICS institutions at different universities connect to each other, EPICS at WPI hopes to host this annual EPICS conference in the future.

3.5.4 Campus Events

As a newly founded student organization, EPICS needed to make outreach efforts not only to get its name promoted and become recognized on campus, but also to recruit more interested students into the club. As discussed in the previous section, future outreach events will be of two types- on campus events targeted towards students interested in rehabilitation engineering and assistive technology, and community outreach activities, with the goal of allowing members to attend regional and national conferences.

EPICS will also plan to arrange some on campus events in order to raise funding for the club's activities and pay for project supplies. The club's funding with regards to the supply of general lab equipment within a range of $100 to $200 will be sponsored by

Professor Hoffman. Any other club social activities such as expenses in printing and refreshments for general body meetings will be obtained through the Student Government Association. Additional expenses not enough to be covered by the first resources will come from EPICS fundraising events.

One of the ideas proposed for fundraising includes a 3D printed "toy" sale. 3D printing has become popular among engineering students at WPI for easy prototyping. By applying that idea to making things people can easily enjoy or use such as phone cases, hipster glasses and so on, EPICS hopes to gain the attention of the campus community while financially providing for its activities.

Some other campus events solely intended to raise the awareness of disabilities and assistive technology is to debut an annual "Assistive Technology fair". This is the long term goal of the club and is something to be built upon year after year. The fair in general will have posters and presentation sessions along with networking and welcome sessions for potential undergraduates, graduates and students form other universities, as well as interested individuals from the local community. For the academic year 2013-2014, EPICS plans to start off with holding a speaker's presentation on the topic of disabilities and assistive technology. The club will try to attain the support from Mechanical Engineering and Biomedical Engineering Departments.

In addition to introducing new events on campus, EPICS will still continue to participate in activities where it has collaborated with other WPI groups over the past couple of years. Touch Tomorrow and Camp REACH are summer activities hosted by WPI to inspire young kids in engineering by introducing them to projects and research accomplished at WPI as well as explaining how science and the humanities are tied together. During special events like this, the ATRC will give people a tour around the lab and give a demonstration of original assistive devices that ATRC students have created. In the future, the ATRC should extend its activities to small engineering workshops for middle and high school students, either through hosting a design competition, presentations or lectures in coordination with WPI.

Open house is also a great opportunity for the ATRC to recruit interested prospective students. There are three open house events through the C and D terms of an

academic year. In the past ATRC IQP students have prepared informational brochures, and member interest flyers for classes offered at WPI in the area of assistive technology. (see 8.6.8:

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
8:00							
:30							
9:00							
:30							
10:00							
:30							
11:00							
:30							
12:00							
:30							
1:00							
:30							
2:00							
:30							
3:00							
:30							
4:00							
:30							
5:00							
:30							
6:00							
:30							

EPICS Recruiting Sign) This preparation can effectively seek for attention and interest from visiting students to WPI. It is important to continue this tradition in the future because the ATRC can definitely showcase great engineering talents of WPI students, particularly in assistive mechanical and electromechanical devices.

4 DISCUSSION

4.1 Lab Modernization and Organization Philosophy

The overlying objective of the project was not only to organize the lab, but to try and ameliorate the underlying factors that caused it to fall into its early state of disorganization. The success of these strategies can be summarized by three goals.

- Successfully increasing the simplicity of identifying responsibility for any activity in the lab by all individuals present.
- Minimizing the "non-value" added work necessary for students to keep themselves organized within the spaces for which they are responsible.
- Simplifying process of navigating the laboratory workspace as much as possible.

4.2 Operations

4.2.1 Capital Investment Evaluation

The critical purchase items for the project were made during the initial Harbor Freight tool update and the WalMart tub and tote setup purchase. One critical aspect that will remain under construction through the close of this year's final report will be the print capabilities within the lab.

While print capabilities were not considered a mandatory item, plans to replace the aging multifunction system connected to the office staff computer were made.

If this purchase is reviewed the system should be considered to have:

1. A B&W laser printer for small office needs.
2. Double sided (duplex) printing.
3. Double sided (duplex) scanning.
4. Cost of cartridge replacement.

The IQP team evaluated several other laboratory investments including:

1. A Tablet Computer Research System
    a. An integrated design and construction workflow incorporating wall mounted tablets that allow for quick access to designs and research materials.
2. Wheelchair Rack Replacement
3. Swipe Card Replacement for key safes and all lab access
4. Stock materials rack reinforcement
    a. The rack needs backing to prevent materials from falling behind dividers.

The primary factor of time, caused these projects to not be pursued, however future teams are encouraged to reevaluate them as their own project constraints allow.

4.2.2 Project Organization: Google Sites, Google Drives, DropBox & SkyDrive

Throughout the course of the course of the 2012-2013 project, the team experimented with the major free project management tools and compared them with basic evaluations of the WPI SharePoint services. While it was found to be a well-supported and extremely powerful tool, the team preferred the capabilities of free services to those of the SharePoint mainly for reasons of administrative convenience. Such free sites allow the sharing and compilation of information with new users regardless of their relation to the institute. Because these logistical challenges are typically the kinds of things that individuals have difficulty with or are most prone to put off until the last minute, the ability to have a single experienced team member be able to make any administrative change necessary, 24 hours a day, was extremely useful. As the sheer volume of materials created through the course of the project increased, the need to move beyond the basic capabilities of a free Google Site became clear, leading the team to further experimentation with programs like MS Project. The team found that it was helpful to use Google Docs for creation of documents and Dropbox for storage, though the evolution of MS SkyDrive appears to hold the most promise for the simple reason that it allows multi-user work natively in Microsoft Word, combining many of the features of Google Drive and Dropbox.

While no complete solution for the team appears to be on the market at this time, several of the key missing organizational and shared user development components appear to be included in the 2013 version of Microsoft Project and Project Server. It is hoped that the technical specifications of these products are matched with a shared administration strategy allowing WPI to increase the credential access management provided to students in real time without the oversight of on campus staff by relying on the account structure created by the free version tools. Gantter, on the other hand, is a free, web based tool to plan project task distribution amongst team members. Gantter is able to get in sync with Google Drive, and therefore it can be easily shared and opened, however as with most tools investigated, cross communication with Microsoft based content is perfect and problems between vendors are more likely to be abandoned or avoided than actually resolved.

Another web tool that became frequently used was the group's Facebook group's page, Google drive and drop box are also found to be useful. For instance, if the project takes longer than expected and is to be continued next year, then there is a high chance of losing current team members. By having everything related to project documented electronically, the future team members can build on the existing work instead of starting from scratch.

Hence, building a strong project team requires not only technical understanding and hands-on prototyping skills but also project management skills and most importantly commitment. While freshmen are able to give more time and effort compared to upperclassman, they have relatively little experiences which can be counterbalanced by the upperclassmen that can provide technical assistance. Therefore, equal age distribution across the range class years is a beneficial goal for maintaining a well-rounded group.

4.3 Student Resource Development

Some of the most informative work done over the course of the entire year was the research and development of the administrative and student resource manuals. Past personal experience of team members allowed these issues to have only been tangentially addressed and thus investigating the manner in which project teams organize their

activities provided an extremely valuable experience that should be repeated by future IQP groups. (see 8.6.1: ATRC Student Resource Handbook- Project Management Outline.)

4.4 Engineering Projects In Community Service EPICS

During the first two terms little activity was pursued relating to EPICS as efforts were focused on getting started with lab improvement projects and laying out organizational plans. During the second half of the year that plan allowed more time for club development, ultimately leading to EPICS having nine active members including five juniors, three sophomores and one a freshman. Most of the members have little or no hands-on experience in open-ended engineering design projects. Especially during this time when the club is new, it was found that guidance from the IQP team helped to maintain direction.

Over the last two terms, the team closely worked together with the EPICS club. This gave the EPICS team a chance to gain some exposure to a typical engineering design process. Since the project is not supervised by a faculty member, it was recognized as an important responsibility to have individuals available who might lead the project discussion and encourage task delegation to the appropriate project members in order to keep all individuals working. Frequently the EPICS group struggled with breaking down the problem and defining the steps to be accomplished along a timeline. Although the group had come up with many potential solutions for the beach friendly wheelchair project, the group struggled to settle on one solution and actually implement it. Therefore, the task breakdown, procedure development and timeline of goals are very important to avoid frustration amongst members. Frequently, the diverse experience of the members leads to a single individual being able to complete all tasks before less experienced members are able to even become familiar with the necessary steps to be taken. It is for this reason that the ambition of any project must take into account the abilities of its members and those more experienced members must be explicit in defining the necessary steps for project completion, even at the expense of project features, if such an activity is to be a true group activity.

Likewise, an emphasis must be made that individuals who are not familiar with the work being done must speak up and not allow themselves to become isolated from the

work by taking on assignments which they are completely unprepared for. These guidelines are easily overlooked, but are critical to avoid 'boom and bust' years where the club becomes completely dependent on one person for all work and then collapses when that individual graduates.

While there are many ways to recruit new members on campus through events, club fairs and flyers in general, it is also important to not lose the current interested members. Therefore, EPICS club officers should make sure that all members are on the same page and encourage cooperative work amongst members to provide everyone experience.

5 RECOMMENDATIONS

5.1 Project Accomplishments

At the close of the 2012-2013 IQP, the list of successfully implemented projects include Microsoft Access database, the Tub Management System, the Inventory List and Cabinet Labeling System, the restoration of the EPICS club with accompanying Off Road Wheelchair Project, and update of the "Play Therapy Biome" project to interact with campus tour groups via optical interface.

5.2 Recommendations to Future IQP teams

5.2.1 Data archival

A central goal of previous teams has been to make full use of work that has been done by earlier groups. That goal was continued by the current team and the larger goal of providing a more complete archival resource was initiated. While several tools were found that accomplished the goal and a database of current materials created, the implementation of the ATRC Digital Commons site is believed to be the best long term solution for creating a searchable archive of reference materials specifically relating to the activities within the ATRC. While full implementation of this site was not possible within the current projects time constraints, creation of the ATRC Digital Commons page should ultimately allow for a continuously updatable archive of materials derived for future groups. Upon first

availability of the site, creation of an organizational structure is critical. Recommendations for the outline of such a structure might include:

1. IQP/ MQP/PHD Paper Submissions
    a. Gordon Library Synchronized copy of official submission
    b. Automated generation of a page associated with each paper where supplemental materials can be uploaded. This resource is meant to include materials that currently reside on the lab flash drive, however it is important to remember to review release rights for each project with Professor Hoffman.
    c. A full text accessible search tool.
        i. The Gordon Library is currently providing search access to the legacy keywords associated with each paper as well as the digitized text of the abstract. A primary benefit to using the Digital Commons tool is that full text searching within all site documents can be accomplished. While integration of this tool is still in progress, future IQP teams should strongly consider attending an in-service provided by library staff or the Digital Commons vendor to become familiar with the capabilities of the software tool as quickly as possible in order to accommodate the extensive time commitment that content creation represents.
    d. Collection of mirrored web sites presenting tutorials that provide training for common activities within the lab.

5.2.2 Project Organization

One of the most critical and most challenging aspects of maintaining integrity of the laboratory management system was the implementation and maintenance of an organizational plan. Such systems are frequently taught to be implemented through the use of Gantt charts, however, because the intermediary requirements and goals are so frequently changing, that the ability to track and document project processes is an easily overwhelming process.

While early planning of the project focused on free software solutions, subsequent experience made it clear that the demands of such a large and complicated project are nearly impossible to meet with any of the currently available free packages that were found. While several templates are available through both Google Documents and Google Apps, the ability to coordinate between team members seems to be offset by the lack of features. For our team this realization came too late to allow for the implementation of the intended management system.

Experience acquired over the course of three terms lead to the conclusion that implementation of a Microsoft Project based system showed the greatest potential for effective planning, coordination, and documentation. This conclusion, however demands that teams be committed to maintaining a well-managed strategy and are willing to commit to learning the necessary software at the outset of the project when the reliance on such a system can be constrained to the broad planning for subsequent work.

Key procedural recommendations for developing future project management systems are as follows:

1. Research and define the requirements of the project management software.
    a. Key factors to consider include:
        i. The ability to create standard Gantt charts for planning the tasks and the time commitments for all activities in a hierarchical format.
        ii. The ability to have basic "Resource" allocation associated with activities on the Gantt chart.
            1. Allows for scheduling of large groups in a single document.
            2. Allows for integration of contacts made throughout the entire project in a single location.
                a. This feature can either be used to eliminate or work in conjunction with the existing ATRC contacts database.
                b. Because this feature can tie directly in with the schools contact directory, initial setup may require assistance from WPI Tech Support.

iii. The ability to embed other documents within the MS Project file (such as PDF, Word and Excel files) and manage them with effective revision control.
    1. Allows for the tracking of project material as well as personnel using them.
        a. Again, allows for central storage and organization of documents used for accounting through the "Insert Object" Feature.
        b. This ability is probably most easily used to support more common tools for students like Google Documents or Dropbox.
iv. The ability to provide an effective equivalent to popular calendar tools like Google Calendar or the Outlook Calendar associated with all WPI students' user profiles.
    1. Microsoft Project has a "Resource Pool" and basic contact management abilities that combine many features of other tools used by students such as WhenToMeet.com and Google Calendar. (Microsoft, Inc., 2013)

The MS Project Web App, Project Server, and SharePoint programs appears to have been more effectively expanded in the 2013 release to incorporate the multi-user features that attract many students to Google Documents as well as the file sharing abilities of Dropbox.com. While this new release does seem to offer the best option from a feature based perspective, there are several critical convenience issues that must be addressed for a team to effectively use the tools that are freely available through WPI.

1. Software SharePoint setup and training through WPI support staff.
    a. While the 2013 Office update is scheduled and reasonably functionality exists with the currently available 2010 release, the tools do not appear to be frequently used and thus in person training from campus should be considered.
2. Effective self-training resources.

a. Microsoft's documentation for this and many of its other products remain challenging for many individuals as their site is frequently found to be difficult to navigate and composed of text only instructions for its graphical program interfaces.
b. Future IQP teams interested in more information on the more intuitive features of MS Project 2010 thru the advanced Web App and SharePoint capabilities provided in the MS Project 2013 are recommended to review the MS Project Files on the flash drive repository. (Microsoft Inc., Project 2010 Support, 2010), (Herzog & Oo, ATRC Flash Drive Digital Archive, 2013)

5.3 Overview of Operations Administration and Student Resource Binders

In an effort to aid in creating a documentation and review structure around the project, several lab binders were created with resources for groups working within the lab. These are intended to be a centralized location for the storage of items like sign templates and Standard Operating Procedure documents to allow future teams to have quick access to reference material that might otherwise be more difficult to find within the digital archives.

These binders should not be confused for whatever larger organizational system is created for individual team materials. By keeping the Ops binders as strict collections of finished material that can be used by future teams, it is hoped that a polished reference can be provided for material that is inherently useful in hard copy format.

Development of a standard weekly task list is a strongly recommended activity for future teams. While normal project commitments will include the typical "Accomplishments & Goals" list associates with progress reports, having a running check list will improve consistency in the care of the lab and help avoid accumulation of clutter that can bring effective use of the lab to a standstill. (Herzog & Oo, ATRC Student Resource Handbook, 2013), (Herzog, Oo, & ., ATRC Administration Handbook, 2013), (DiRoma, Levine, Mensah, Ryan, & Perry, 2012)

5.3.1 New Term Task List:

1. Insure that old projects are cleared out of the lab as soon as possible to make room for the new term's work.
2. Make sure that teams fill out tub slips with all information.
3. Make sure that there are a sufficient number of tubs for all incoming teams.
4. Make sure that lab signs are current.
5. Do a quick drawer check & cabinet check to make sure that things aren't completely out of order.
    a. This will help familiarize you with the location of things in the lab.
    b. It is also the easiest way to stop the breakdown of organization that gets exponentially worse the longer you let things go.

5.3.2 Three Term IQP Binder Sections:

It is recommended to keep a project binder with dividers for the following section:

1. IQP Guidelines: Use as Syllabus
    a. The overall project goals. (Deliverables checklist)
2. A project calendar with major event dates or equivalent integrated into the calendar tool preferred by the team members.
3. Weekly Meeting Minutes
4. Running Ops Project Activity List:
    a. Printed copy of Gantt chart where notes can be taken.
    b. Project Term Calendars
5. Business Cards/ Important Contacts
    a. Printed from student cell to avoid loss at end of term.
6. Website Notes
7. Account Records
    a. Financial
    b. Websites (Google, Dropbox, etc.)
8. A print out of the Gantt Chart that you can make notes on (Excluding those who are extremely skilled at keeping the digital copy up to date.)

9. Lab Projects Budget
10. Receipts (In a clear sheet holder)
11. EPICS project information and progress notes.
12. Report Information
    a. Brochure
    b. Newsletters
    c. Key notes for final report.

5.3.3 Weekly tasks:

1. Maintain clear counters and floor workspace.
2. Emphasize that each team is responsible for containing project materials within their tubs.
3. Make sure that tools aren't lying out. Make sure the lab is not an embarrassment when the occasional unannounced tour group shows up!
    a. Don't be afraid to address issues with a specific project to keep the lab accessible for everyone.
        i. Do they need an extra tub?
        ii. Do they need to spend more time cleaning up before leaving the lab?
        iii. If tools are not cared for let the teams know.
            1. Use sign that mentions items not properly stored will be made "Check out/ key access only"

5.4 Available Project Opportunities

5.4.1 K9 Support Harness for Users with Limited Balance

The K9 Support Harness project is already actively integrated into the life of the off campus sponsor who presented the case. The current design requires that the user provide actuation force on the pin retraction loop in the downward to allow the handle to be stored in the lowered position. This state is important because it allows the service animal to rest on the floor or travel under low furniture without a collision. Due to current limits and anticipated loss of dexterity and balance, this method of disengaging the handle lock

creates a higher than desired risk for fall with additional risk for impacting the still locked and upright handle. A future design revision would focus on redesigning the locking pin retraction mechanism to meet several requirements:

1. The actuating motion must not pose a fall risk for a free standing individual having a reduced sense of balance.
2. That the actuating mechanism must make use of some hand powered means of operation with a low force input.
3. That the actuating mechanism must be compact, lightweight, and possess sufficient durability to withstand years of use.
4. Any modifications must also not cause undue stress on the service animal.

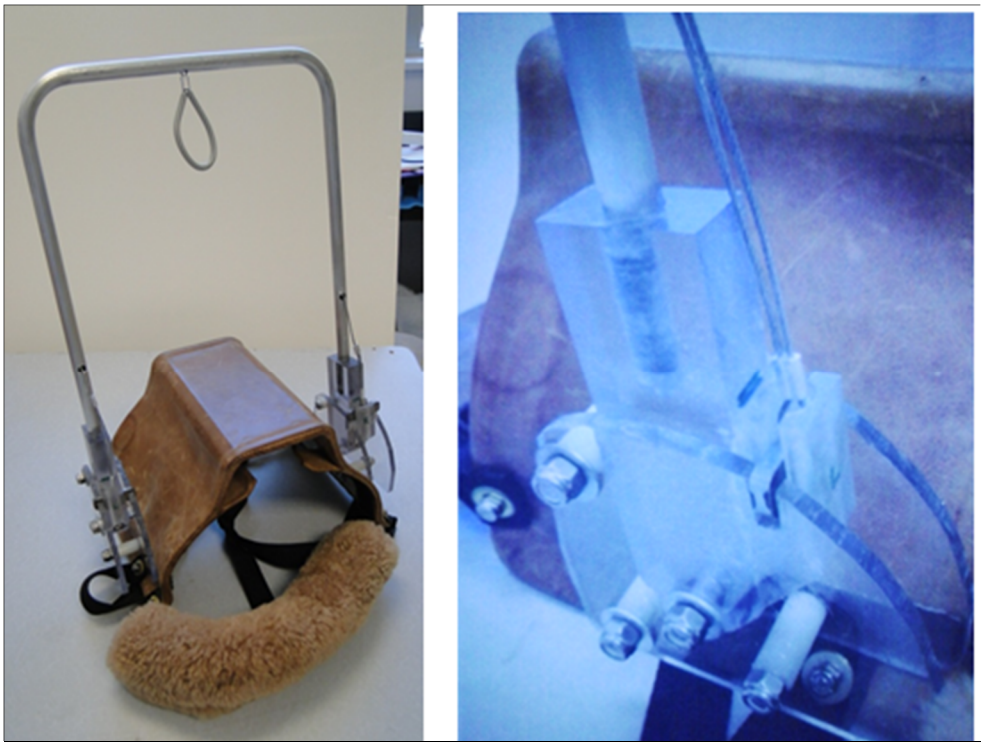

Figure 5-1: Dog Harness Device with Folding Hinge Close-up

5.4.2 Butterfly Play Therapy Biome Update

While initial plans were to pass this project on to future IQP teams, budget and time constraints encouraged initiation of the project during the 2012-2013 terms. The current implementation makes use of a standard R3 Arduino Uno microcontroller and IR Optical sensor for distance sensing of the participant. Use of a low cost photodiode and hardware

interrupt allow the IR sensor to be powered only when an actual participant is interacting with it, thus making best use of the relatively shorter lifespan of the higher value IR sensing component.

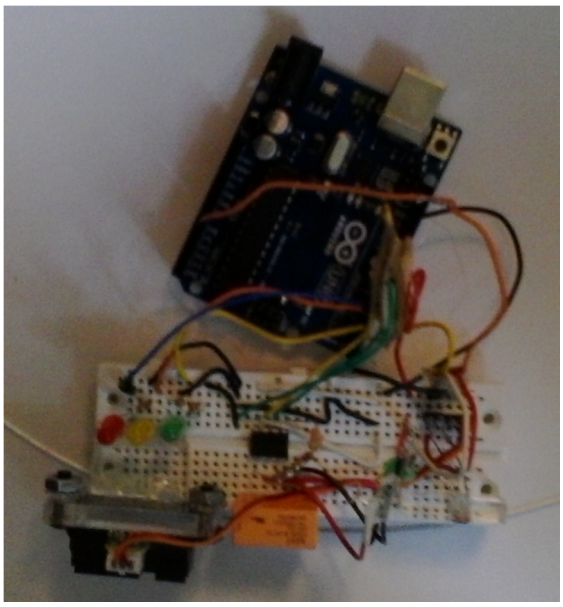

Figure 5-2: Distance Sensing Circuit and Controller

5.4.2.1 Biome Continuation and Opportunities

Both the aesthetic and technical aspects of this project make it an appealing piece for gaining the interest of campus visitors. As such, potential interest from other departments, such as robotics and electrical engineering should be explored for display opportunities during visitor events that the ATRC is not participating in. It is furthermore recognized that this basic style of using contact free user input to create a low cost, highly interactive experience should be further developed for projects focusing on enjoyable play experiences as well as those simply working to engage and inspire the WPI campus community.

5.4.3 Internal Operating Equipment

As in any lab, there are a variety of jobs that arise from unique situations where the solution, while not technically challenging, pose the need for a sufficient time commitment toward making operations within the lab clean, safe and organized.

5.4.3.1 Vacuum Hose Clamp for Drill Press

Specifically targeted for a future individual with an interest in 3D printing on campus, a vacuum hose clamp for the drill press is needed for users of the drill press to simply fix the hose to the drill press table or main support post so they can remove chips while keeping both hands free. Use of the vacuum is extremely helpful in the lab as cutting tools and computers that can ingest the dust and material chips through fans are frequently in close proximity.

5.4.3.2 Vacuum Hose Clamp/ Holder for Bench Tops

Similar to the idea behind the drill press mount, this relatively simple model and subsequent 3D print would be a valuable tool for keeping the lab clean during use around floating projects.

5.4.3.3 Grouped Fittings Containers

Future groups ought to consider organizing the loose boxes of fittings into larger ones organized by size. While the conventional fitting catalog might not integrate immediately into the lab, grouping fittings by diameter would make working in the lab easier in addition to improving its appearance. Several extra clear cubby boxes were purchased so this project can be continued as time allows. Dividers in plastic bins should be hot glued down to prevent them from getting knocked out during use or transport.

5.4.3.4 Miscellaneous Lab Improvement Projects

I. Shelving Procurement for Storage Room Organization
    I. Organization of ATRC storage room to keep large projects from being stored in main lab work area.
II. Addition of backing beams to raw material storage rack.
    I. To stop materials from constantly falling out of slots as rack slides away from the wall through typical use.

5.5 Engineering Projects In Community Service EPICS

One of the key goals to thrive on campus is to build strong connections with the student community. One way to do is to collaborate with student clubs which have similar

or mutually beneficial goals as EPICS. The Collablab is an exemplary club for this. It has been active for two years under the management and leadership of students themselves. Within the past two years, the Collablab has been a useful resource in students' personal projects by providing necessary lab tools, workspaces and storage areas as well as serving as a resource for students to share experience.

The team urges EPICS to adapt Collablab guidelines for project and team management. For instance, EPICS needs to address the issue of having the lab monitored when people are working in the ATRC. It is impractical to allow key access to all current EPICS members since this will just cause excessive technical complications. The team recommends the procedure of selecting lab monitors and having the lab open at the hours those individuals are available. As for a club as small as EPICS, the lab monitors can be appointed to the executive board. Consequently, this will encourage the members to take leadership roles in EPICS. Another way is to set a regular lab open hours during week days when any student can have access. However, this method will be more suitable for the term period when there are students who need to the use the ATRC lab for their course projects.

The process for selecting lab monitors should be relatively simple. There will be two kinds of quizzes, a general one required for any student to get a lab access and another one specifically testing their knowledge and experience with equipment in the ATRC lab. Sample quizzes are made available on the flash drive. (8.1: Project CD to Flash Drive Backup). The most important criteria are such members' commitment progress and safety, recognizing the responsibility that comes with such a position.

To aim for continuity and long term success of the club, EPICS need to keep hardcopies of paperwork related to the club constitution as well as all the research done for projects whenever possible. The current EPICS secretary keeps them in a binder that is stored in the ATRC office. Future EPICS groups should look into the digital storage or flash drive kept in the ATRC office before they start on making a new electronic storage drive or a binder of hardcopies. Looking into these resources will give the future EPICS group helpful direction through use of material the IQP teams have cumulatively developed over the last 5 years. (see 8.1: Project CD to Flash Drive Backup)

It is also expected that EPICS will work together with the future IQP teams in promoting the ATRC and helping it to run according to the standard operation procedures. (see 8.1: Project CD to Flash Drive Backup). Some of the activities that the IQP teams should collaborate with EPICS on include, table-sitting for prospective members at activities fair in A and C term and giving a tour to the ATRC lab in open house events. If the EPICS group includes people with talents in website and layout design, they are encouraged to contribute in outreach activities such as designing and updating the website as well as helping to publish an annual newsletter.

5.5.1 Project Handoff- State

5.5.2 Hand-Off State Information

At the close of the 2012-2013 school year EPICS will have completed a fair portion of the first project since the club was reestablished. Lead by the work of project manager Sara Chamberlain, and supported by the entire EPICS organization, work on the rear adapter plates as well as a circle cutting jig for use with the plasma cutter successfully completed. The first operations done with the plasma cutter by hand resulted in parts that were considered to be less than optimal and as a result finishing were made using one of the CNC mills. Sarah has volunteered to complete the remaining work on the front wheels over the summer and so it is anticipated that the beginning of the 2013-2014 school year will see the club ready to start a new activity.

During the summer is recommended that the officers of the club accomplish the following:

- Contact existing members to build interest at least a week before the start of the new term.
- Sign up for the club fair and prepare a display with the project from the previous year.
- Set a date for the first meeting and flyer the campus to build interest in potential members.

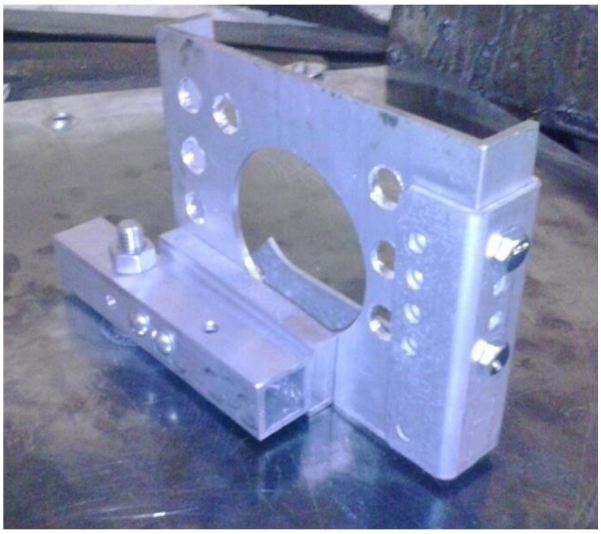

Figure 5-3: Plasma Circle Cutting Jig Mounted on Bubble Tire Adapter Stock

Figure 5-4: Wheel Hub Adapter Plate Machined by CNC

6 CONCLUSION

Over the course of what eventually became a full year at the Worcester Polytechnic Institute, this team was provided the opportunity to evaluate and experiment with some of the first ideas toward directly improving the actual work environment that other students

were required to interact with. These ideas depended on the collaboration of individuals with diverse skill sets to allow each team members to make valuable project contributions including extensive research on background content and careful time management with regards to evaluation and implementation of solutions to project goals. This IQP project was successful in that it embodies the WPI core IQP concept which is the interaction of humanities and with the sciences. Through the work done by this project is hoped that a foundation has been cast that will allow those individuals working within the Assistive Technology Resource Center to realize more ambitious goals, furthering not only their own education, but a community of individuals whose lives are improved by a student's contribution.

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8 APPENDICES

8.1 Project CD to Flash Drive Backup

An outline of the files to be included in the flash drive and how they will be arranged is listed below. It should be noted that this list is provided only as an outline of the living repository developed for backup of the ATRC's information resources.

1. Lab Operations
    a. Work space
        i. Lab Layout and Drawer Map
        ii. Tools Inventory
        iii. High Value Hardware Loan List
        iv. Signs and Instructions
        v. Label Templates
            1. Small tubs
            2. Big tubs
            3. Drawers
    b. Lab Schedule Calendar
    c. Standard Computer Software List
    d. Useful Operations Contact Info
    e. Budget Summary
2. Database
    a. Microsoft Access Database
        i. ATRC Projects
        ii. ATRC Contacts and AT Resources
    b. 2005 Contact List (exclusive)
    c. Collaboration with Digital Commons
        i. Project proposal to WPI Gordon Library
        ii. Recommendation for future IQPs (Excerpt from 2012-13 report)
    d. Project Resource Handouts for students
        i. Project Management Outline

ii. Web-based Resource
iii. Instructables Tutorial for Making Cabinet Label Holders
iv. On campus Resource
1. Excel template
2. Digital files
a. WPI rapid prototyping Guidelines
b. WPI and Versa Company Laser Cutter PDF
c. RBE 2001 Kit Information

3. External Communications and Marketing
a. ATRC brochure template
b. ATRC newsletter template
c. ATRC logo
d. ATRC website
e. Marketing Document

4. EPICS
a. EPICS Constitution
b. Collablab_SampleQuiz_MembershipRequirement
c. EPICS Budget plan for 2013-2014
d. EPICS Contact Information
e. EPICS Public Relations
i. EPICS flyer
ii. EPICS digital media back-up
f. Projects
i. Wheelchair Adapter_SponsorshipLetter_TireSpec
ii. Available Projects

8.2 EPICS Electric Beach Wheel Chair Sponsorship Letter.

To whom it may concern,

Engineering projects in Community Service (EPICS) is a club at WPI that has been recently resurrected. This club's mission is to help people with handicaps, through technology. Our club has not been officially chartered by the college, so the current year's project is being supported through looking for component donations.

We are currently working on a wheelchair that can use common ATV tires to drive on the beach. This project was started with a personal interest in Assistive Technology to help my sister. My sister has a severe physical disability called cerebral palsy. This disability strips her of many physical freedoms such as the ability to walk and talk. I then presented my idea of making a wheelchair that drives on the beach to EPICS and it was accepted as the club's yearly project.

Our current goal is to create an adapter between a wheelchair hub and a similar sized ATV tire. For that reason we would be interested in old tires and any hubs to fit that tire. Any donations to this cause will be greatly appreciated.

Thank You for Your Time,

Sarah Chamberlain
Project Manager

Figure 8-1: Existing Beach Wheelchair with Custom Tires

Figure 8-2: Project Test Chair

8.3 Database Proposal to Gordon Library

WORCESTER POLYTECHNIC INSTITUTE

2012 Assistive Technology Resource Center- Laboratory Operations Digital Archive Project

Dale Herzog & Wut Yee Oo

1/23/2013

History and Overview of ATRC

The Assistive Technology Resource Center (ATRC) was founded by Professors Allan Hoffman and Holly Ault in 1999 when funding from Fairlawn Foundation was awarded to the Rehabilitation Laboratory at WPI's Mechanical Engineering Department. The purpose of the ATRC is to connect students at WPI with disabled individuals in the Worcester

community and allow them to develop engineering skills while providing customized or modified assistive technology devices. Additionally, the lab provides facilities for WPI mechanical engineering students to pursue class projects as well as ISPs, IQPs, MQPs and PhDs related to the design, fabrication and testing of assistive and rehabilitation engineering devices.

Problem Statement

In the 13 years since its establishment there have been over 70 projects as well as hundreds of class projects which have passed through the ATRC. As the community of lab users grows, there it is necessary to update the ATRC in order to keep the facility in state where it is most able to serve WPI students and project recipients. One of the most critical problems to be addressed is the construction of a database which is to be the repository for of all completed and ongoing undergraduate projects as well as PhD thesis papers and other research related to AT. Although past IQPs have compiled a sizable volume of information to be stored in the database, none of them have been properly digitized and indexed in a manner that would allow a user to search and extract the desired information in a convenient manner.

Methodology

WPI Gordon Library has purchased new digital archive software called Digital Commons. Since information related to the ATRC needs to be updated at least twice a year with information of which much is already stored by the school, it is best to have a stable, dedicated source like the WPI Gordon Library in charge of controlling the database and associated archives. As part of this IQP project's goals, the database requirements and associated files will be used as the first use case for the library. It is therefore our goal to help the library not only by providing a searchable archive that allows ATRC students and faculty to dig as deep as technologically possible through the intellectual capital accumulated through previous work, but to provide whatever reference possible through the process of future interface design and feature development for the library.

The database demonstrated for the library will include the extensive work of previous IQP groups that have documented almost a complete list of projects and research

work up to 2011 in a combination of Microsoft database and word processing formats. Project and research work was taken from digital copies from the WPI Gordon library's Projects Database as well as the original ATRC website and hard copies from Professor Hoffman which were stored since 1989. This repository adds up to approximately 90 projects in total, each with a size of 50 to 120 pages in files ranging from 1 to 10 MB depending submission format or scan resolution. The projects included are comprised primarily of Interactive Qualifying Projects (IQP) and Major Qualifying Projects (MQPs) in addition to with seven MS Theses and nine specially selected course projects.

The draft format of the database was developed and modified from the database by the previous IQPs. The following shows the categories and subcategories under which the data will be indexed by the document creator. In addition, the database shall include a link to access the electronic project if it is available online.

Projects Database

- Project Name
- Date
- Project Type
    - Graduate Thesis
    - Interactive Qualifying Project (IQP)
    - Major Qualifying Project (MQP)
    - Independent Study Project (ISP)
    - Course project
- Advisor(s)
- Sponsor(s)
- Student(s)
- Abstract
- Awards
- Client's Age
    - Less than 6
    - Child (6-12)
    - Teen (3-19)
    - Elderly (>65)
    - Multiple Ages
- Primary disability
    - Mobility
    - Cognitive
    - Vision
    - Hearing

    - Speech
    - Muscular Dystrophy
    - Traumatic Brain Injury
    - Spinal cord Injury
    - Cerebral Palsy
    - Arthrogryposis
    - Dystonia
- Assistive Technology
    - Wheelchair Adaptations
    - Computer Access
    - Prostheses and Orthoses
    - Everyday Living Aids
    - Wheelchair Add-ons
    - Communication
    - Safety
- Context
    - Home
    - School
    - Workplace
    - Institution
    - Group Home
    - Community
    - Nursing Home
    - Gymnasium/ Outdoors
    - Useful in all contexts

Once the format is determined, a draft sample program with a feature similar to a search engine was prototyped in Microsoft Access. Microsoft Access has a user interface and the system can be easily exported to an HTML format for testing through an online interface.

There are two kinds of forms, one to import data into the database and another to search and generate query responses from the database. Figure 1 shows the former wherein a drop down menu will allow the users to select the sub-categories previously discussed and to add additional headings as allowed by administrative staff.

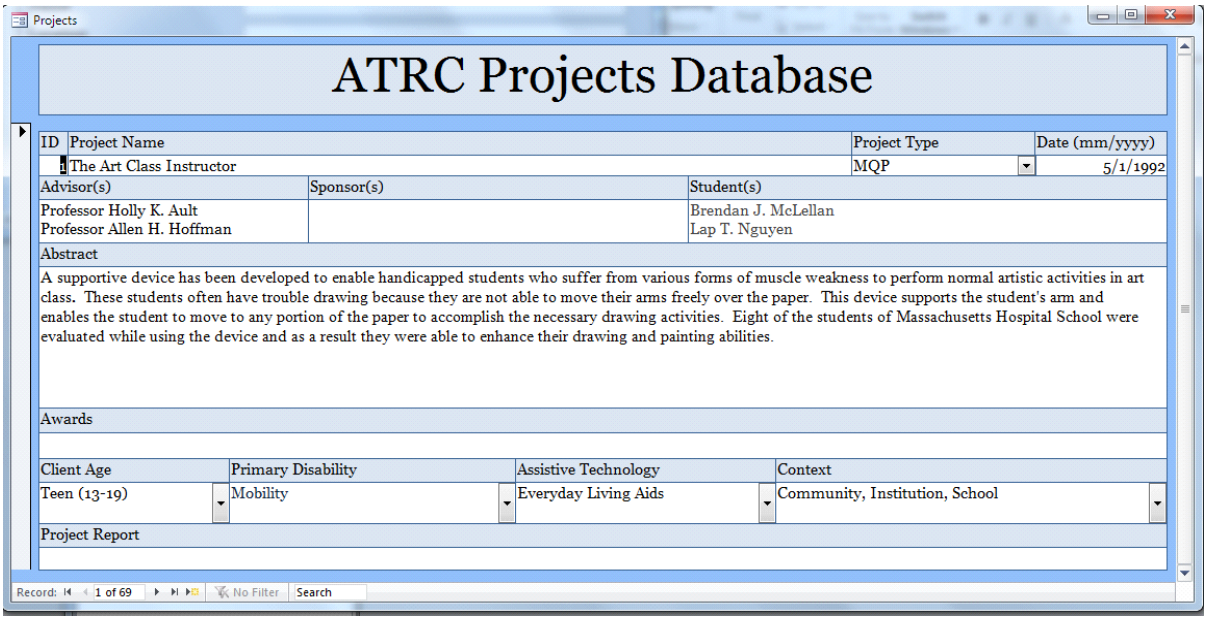


Figure 8-3: The ATRC Projects Database Form

Figure 8-4 shows the forms where the users can query the database by typing keywords into the desired fields. Clicking on the "Search" button will display the matched result which is a listing of forms compiled in Figure 8-3.

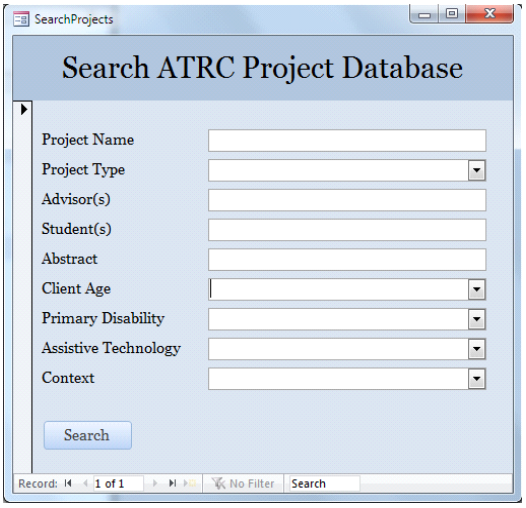


Figure 8-4: The ATRC Projects Database Search Form

Recommendations

To further extend the Access database to the DigitalCommons repository system requires several modifications. First of all, the team proposes that DigitalCommons should include a separate ATRC folder specifically referencing the database as a unique collection of materials. This collection would include the projects listed in the previously constructed database and should be linked to the corresponding e-projects in the Gordon Library Projects archive so that the user can access to it. For undigitized reports, instructions on how to obtain access through a library loan or to the appropriate professor should be included.

In addition to a content creator rights management system for public and campus community members, some system to allow users to append or comment on the existing project material might be developed. This effort would revolve around the underlying goal of having users of any resource be able to add value to the material as well as there be an opportunity for content managers to implement a "tagging" feature for collecting aggregate information on the use of any document. This information, which is commonly used on social websites, would be used to improve correlated search returns. Furthermore, the opportunity for derivative works to have a simple user based interface or even automated process for linking to referenced material would help to create a valuable network for following the progression of an idea in a style similar to that of wiki pages on the internet.

This style allows future content creators to be easily directed toward unfamiliar topics that could benefit their own ideas and allow the interactive research methods that have already made standard web resources so successful.

The existing system for inclusion of multimedia materials should be incorporated into the topic linking, tagging and indexing system so that users may more rapidly evaluate the value of a resource rather than relying on a document cross-reference or their own willingness to blindly review these possibly under-defined materials on the chance that they will be of value. In addition to Microsoft Office files, these resources are expected to include any of the common image, video, CAD, and scientific software formats not to mention code archives for a variety of languages.

Other capabilities and features that should be considered in DigitalCommons are its search depth through the files and retrieval of relevant files at a minimum. The current existing Gordon Library database only uses Adobe Reader Text Recognition OCR and the search does not go beyond abstract session. With DigitalCommons, the team proposes that the basic search option should include a simple search box as in Google homepage and it should only retrieve results which have a user's input keyword matched with those specified by a document owner. The advanced search option can have a similar format with the sample Access database mentioned earlier. A good search capability is crucial.

Conclusion

The team intends to meet with Gordon Library on a monthly to biweekly basis, and is committed to provide the complete public documentation of projects, research work, and any other guidance that might be possible in order to aid in the development of the DigitalCommons site. While it is understood that the time constraints of the IQP prevent the group from completing the DigitalCommons project, it is our greatest hope that we may act as a valuable test group during the project's development and serve to lay the groundwork for future collaboration between the Gordon Library and ATRC Operations Project groups.

8.4 Engineering Projects in Community Service (EPICS)

8.4.1 Off-road Wheelchair Adapter Project- Tire Specification

Figure 8-5: Greenball Towmaster Trailer Tire and White Wheel 16.5x6.50-8 (5 Lug)

Greenball Towmaster Trailer Tire and Wheel

Price: $43.00 each: Mounted on rim & inflated. (Ready to mount).
SKU: 08908505RW
Size: 16.5x6.50-8
Ply Rating: 6
Mounted Diameter: 16.7 Inches
Section Width: 6.6 Inches
Bolt Pattern: 5 on 4.5
Notes: White Wheel

Manufacturer: Greenball Tire
Load Range: C
Ply Rating: 6
Bolt Pattern: 5 on 4.5
Lugs: 5
Overall Diameter: 16.7 Inches
Section Width: 6.6 Inches
Tread Depth: 7 (32nds)
Max Load: 795 lbs.
Website: http://www.petestirestore.com/Trailer-Tires-and-Trailer-Wheels/Mounted-Trailer-Tires/Greenball-Towmaster-Trailer-Tire-and-White-Wheel-16-5x6-50-8-5-Lug-p3569.html

8.5 Project Resources

8.5.1 Recommended Hardware Tools

8.5.1.1 Arduino Development Kits

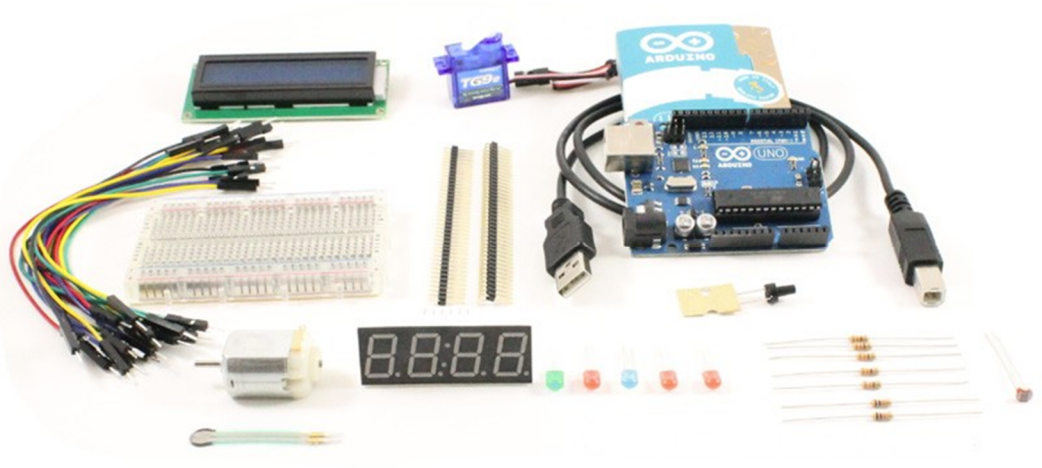


Figure 8-6: Example of a Basic Arduino Force Sensing Kit- (JS Arduino Starter kit)

8.5.2 Tutorials and Web References

Tutorial Video Links

1. **Designing with Microcontrollers: Cornel Online Courses**
    a. http://www.infocobuild.com/education/audio-video-courses/electronics/ece4760-spring2012-cornell.html
2. **Basic Shop Skills Video Series: MIT Tech TV- Machining Skills for Prototype Development:**
    a. Basic
    b. Layout Techniques
    c. Basic Tools: Drill Press, Band Saw, Belt Sander & Grinder
    d. Locating and Drilling Holes
    e. Tapping Holes
    f. http://ttv.mit.edu/videos/142-machine-shop-1
3. **Sparkfun Crash Course In Soldering:**

a. http://www.sparkfun.com/tutorials/354

4. **Sparkfun: Using the Flex Force Pressure Sensor**
    a. http://www.sparkfun.com/tutorials/389
5. **Fritzing: Software and Electronics Hardware Development:**
    a. http://fritzing.org/welcome/
    b. http://www.fabiobiondi.com/blog/2009/11/arduino-and-electronic-sensors-proximity-light-force-and-tilt/
    c. http://www.youtube.com/watch?v=jE3lhjpWTVo
6. **Online training courses on Computer Science, Electrical and Computer Engineering**
    a. www.coursea.org
7. **Basic Electronic components reading**
    a. http://www.robotshop.com/PDF/eck-10-manual.pdf
8. **A complete version of MIT video training tutorials for machine shop skills**
    a. http://www.home-machine-shop.com/links-7-books.htm
9. **Understanding motor and gearbox design**
    a. http://www.instructables.com/id/Understanding-Motor-and-Gearbox-Design/
10. **Servo motor basics**
    a. reading - http://www.robotplatform.com/knowledge/servo/servo_tutorial.html
    b. disassembly - http://www.youtube.com/watch?v=-XSXfqd1N58&feature=related
11. **Arduino and servo motor**
    a. http://www.youtube.com/watch?v=F2SYGGqxxEo
    b. http://www.youtube.com/watch?v=dTzrARIHYgE&feature=channel&list=UL
12. **Project Management tools**
    a. Microsoft Project
        i https://www.youtube.com/watch?v=sPwURRG9_Gs&feature=related
    b. Gantt Project

- i http://www.ganttproject.biz/

c. Ganter

- i www.app.ganter.com

13. **Use sheet protectors to make label holders**

a. http://www.instructables.com/id/Divide-Your-Page-Protectors/

14. **Project Brainstorming**

a. www.Kickstarter.com

b. www.instructable.com

c. www.hackaday.com

15. **Selected resources on Assistive Technology**

a. www.Abledata.com

b. www.Assistivetech.net

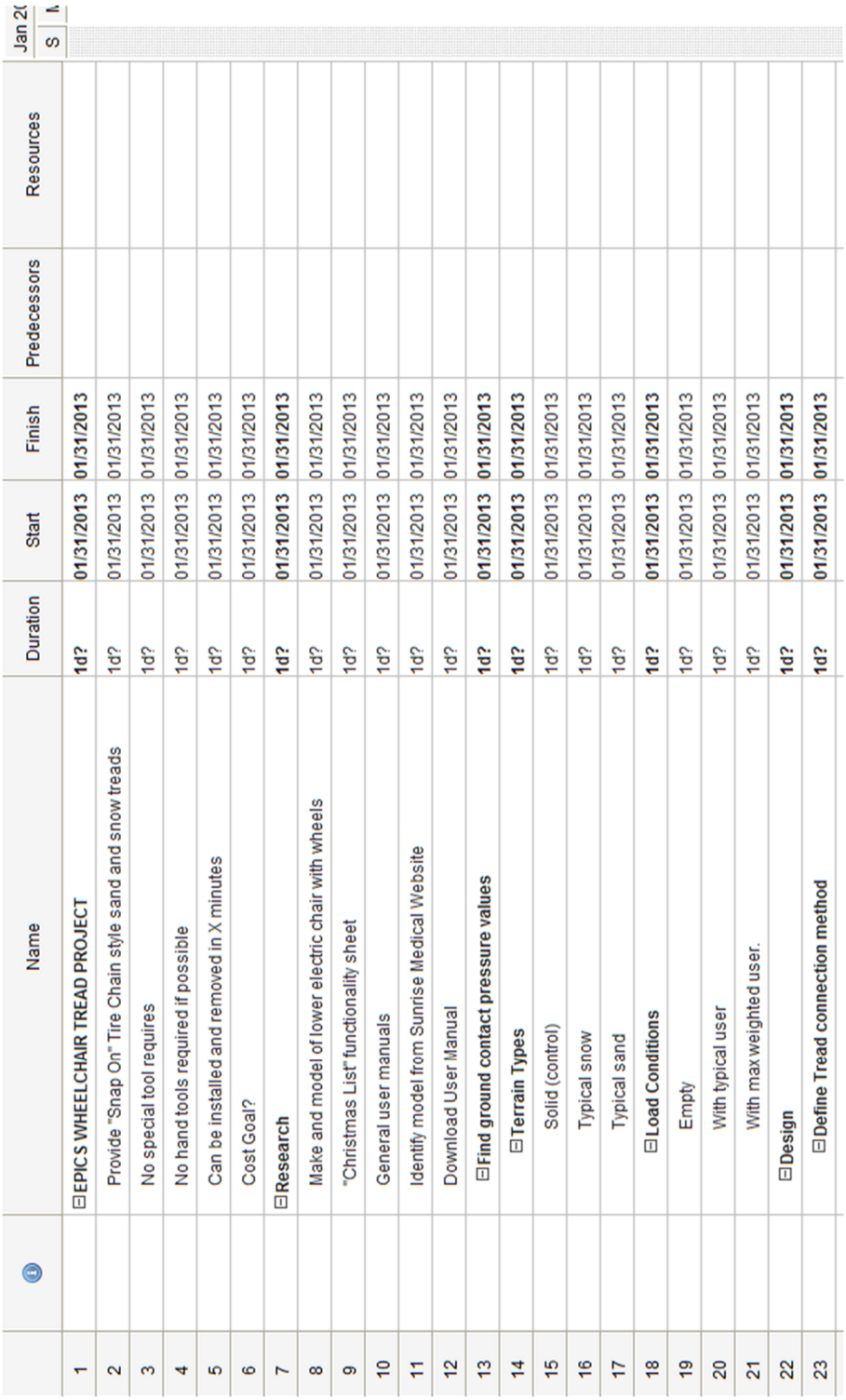
c. http://www.resna.org/

16. **Rapid Prototyping**

a. See Rapid Prototyping pptx (Herzog & Oo, ATRC Flash Drive Digital Archive, 2013)

8.5.3 Project Management Tools Examples:

8.5.3.1 Ganter.com



	Name	Duration	Start	Finish	Predecessors	Resources
1	**EPICS WHEELCHAIR TREAD PROJECT**	**1d?**	**01/31/2013**	**01/31/2013**		
2	Provide "Snap On" Tire Chain style sand and snow treads	1d?	01/31/2013	01/31/2013		
3	No special tool requires	1d?	01/31/2013	01/31/2013		
4	No hand tools required if possible	1d?	01/31/2013	01/31/2013		
5	Can be installed and removed in X minutes	1d?	01/31/2013	01/31/2013		
6	Cost Goal?	1d?	01/31/2013	01/31/2013		
7	**Research**	**1d?**	**01/31/2013**	**01/31/2013**		
8	Make and model of lower electric chair with wheels	1d?	01/31/2013	01/31/2013		
9	"Christmas List" functionality sheet	1d?	01/31/2013	01/31/2013		
10	General user manuals	1d?	01/31/2013	01/31/2013		
11	Identify model from Sunrise Medical Website	1d?	01/31/2013	01/31/2013		
12	Download User Manual	1d?	01/31/2013	01/31/2013		
13	**Find ground contact pressure values**	**1d?**	**01/31/2013**	**01/31/2013**		
14	**Terrain Types**	**1d?**	**01/31/2013**	**01/31/2013**		
15	Solid (control)	1d?	01/31/2013	01/31/2013		
16	Typical snow	1d?	01/31/2013	01/31/2013		
17	Typical sand	1d?	01/31/2013	01/31/2013		
18	**Load Conditions**	**1d?**	**01/31/2013**	**01/31/2013**		
19	Empty	1d?	01/31/2013	01/31/2013		
20	With typical user	1d?	01/31/2013	01/31/2013		
21	With max weighted user.	1d?	01/31/2013	01/31/2013		
22	**Design**	**1d?**	**01/31/2013**	**01/31/2013**		
23	**Define Tread connection method**	**1d?**	**01/31/2013**	**01/31/2013**		

Figure 8-7: Example Chart Created with Ganter.com Site

8.5.4 Campus Resources

Name	Facilities	Specialities	Location	Website
Collablab	RepRap 3D printer	student-run projects	HL 005	http://collablab.wpi.edu/index.php
	Band Saw	Robotics		
CNC Laboratory (manufacturing laboratories)	Haas machines (VF4, VF2SS, TL15)	CNC machining	WB 108	http://www.wpi.edu/academics/me/cnc.html
	DoAll vertical knee mill	Fabrication of CAD models		
	DoAll 13 manual lathe	Engineering research		
	Southbend tool room lathe	MQPs		
	Drill press	drilling		
	Arbor press	Laser Cutting		
	Stand grinder			
	Starrett DCC CMM			
	Starrett Manual CMM			
	O.S. Walker Machining Magnet			
	Hahn Engineering force-feedback grinder			
	Machine Shop tutorials			"Manufacturing Laboratories" under "Community" tab at mywpi.edu
Robotics Laboratory	Manual milling area	Robotic courses	WB107	https://sites.google.com/site/wpiroboticslab/
	Two largest CNC milling machines of Haas Technical Center	graduate researchers		
		CNC machining		
Rapid Prototyping	Object260 Connex	3D printing		https://sharepoint.wpi.edu/academics/ME-PROTO/default.aspx
	Dimension SST 1200 es	Fused Deposition modelling		
		MQPs, IQPs		
Software Application Instruction(SESA)	MATLAB	PPT tutorials	HL 234	http://www.wpi.edu/Academics/CCC/Instruction/Sessions/sesa.html
	MathCAD	training sessions		
	SolidWorks			Search "SESA" under "Community" tab at mywpi.edu for tutorials
	ANSYS			
	FLUENT			
	LABVIEW			
	COMSOL			
	Mathematica			
	CES EduPack			
	Data Management			
Lab Safety training	Lab Safety quizzes	Lab Safety	online	"Lab Safety Training" under Community tab at mywpi.edu
	Lab Safety tutorials			

8.6 Operations Resources

8.6.1 ATRC Student Resource Handbook- Project Management Outline

1. Phase I: Planning
    a. Project Readiness Package
    b. Background Research
    c. Decision Matrix for Critical Parameter Definition
    d. Peer Review Tool
    e. 2nd Peer Review Tool
    f. Project Plan
2. Phase II: Systems Level Design
    a. Functional Decomposition
    b. Customer Needs
    c. Engineering Specifications
    d. House of Quality
    e. Morph Analysis
    f. Concept Generation
    g. Software Architecture
    h. Motor Control Architecture
    i. Risk Analysis
    j. System Design Review Pre-Read
    k. Projector Capability Experiment
3. Phase III: Detailed Design
    a. System Overview
    b. Graphical User Interface (GUI) Design
    c. Shearing Test Protocol
    d. Motor Driver & Controller
    e. Resin Bath Design
    f. Build Platform Assembly Design
    g. CAD Drawings
    h. Bill of Materials

i. Motor Controller Communication
j. New Risks
k. MSDII Testing Outline
l. Detailed Design Review Pre-Read
m. Detailed Design Review Post-Read

4. MSDII Project Plan
    a. Integrated Bath Testing
    b. Fully Integrated Testing
    c. Testing Scenario Spreadsheet
    d. Final Presentation
    e. Technical Paper
    f. Project Poster
    g. User Manual
    h. Build Gallery

8.6.2 SolidWorks Model of ATRC Floor Plan

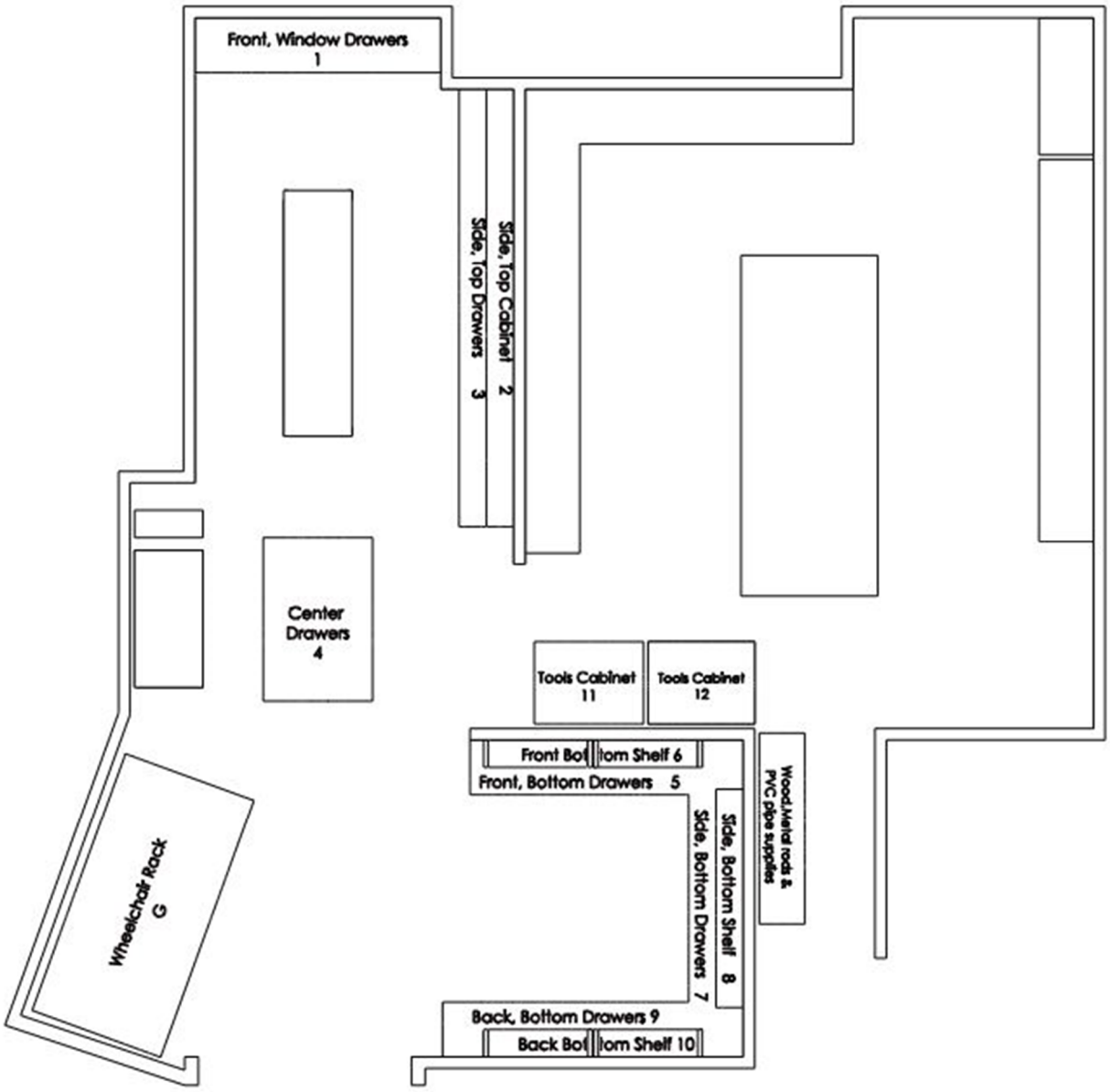


Figure 8-8: 2D Floor Plan

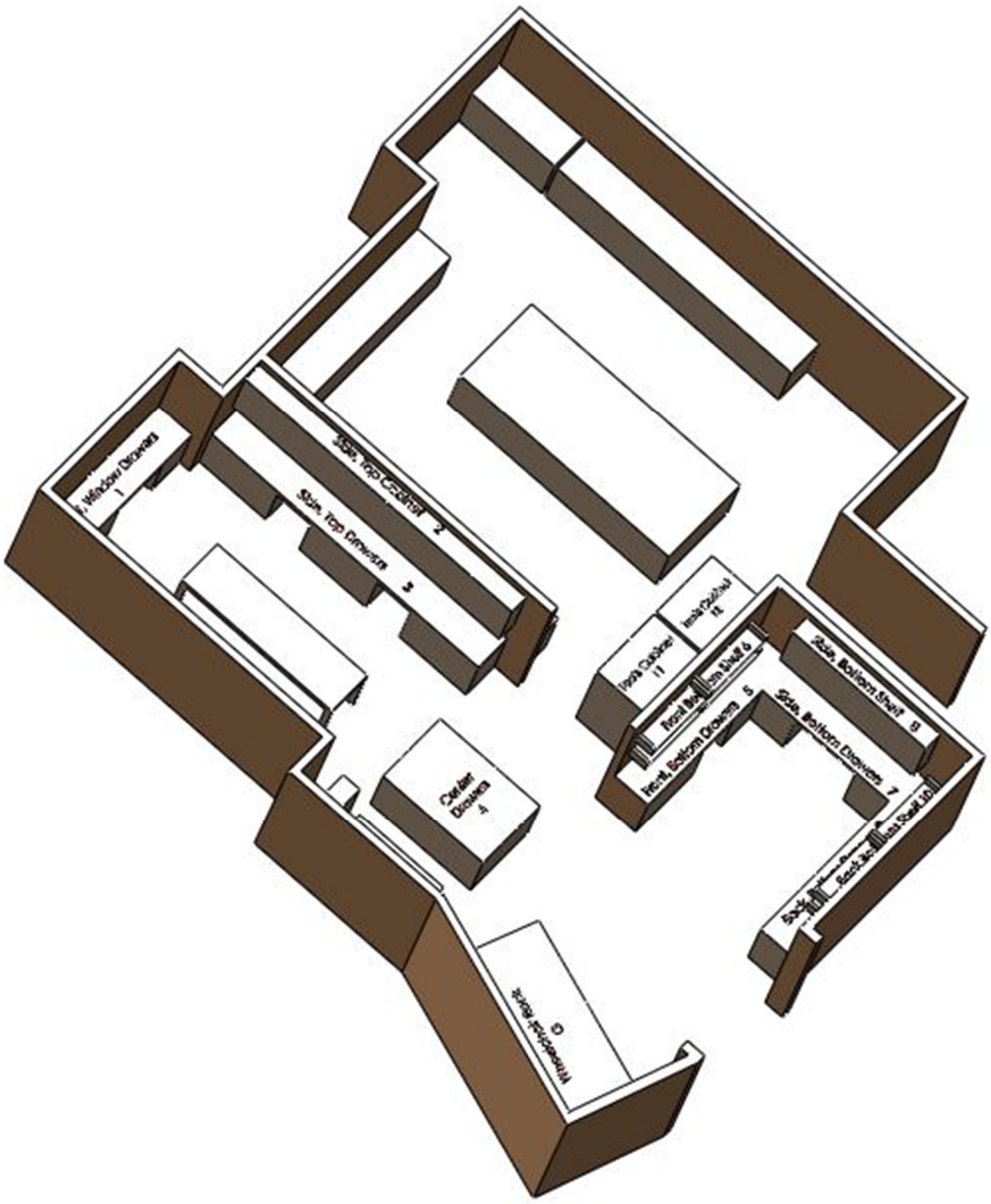


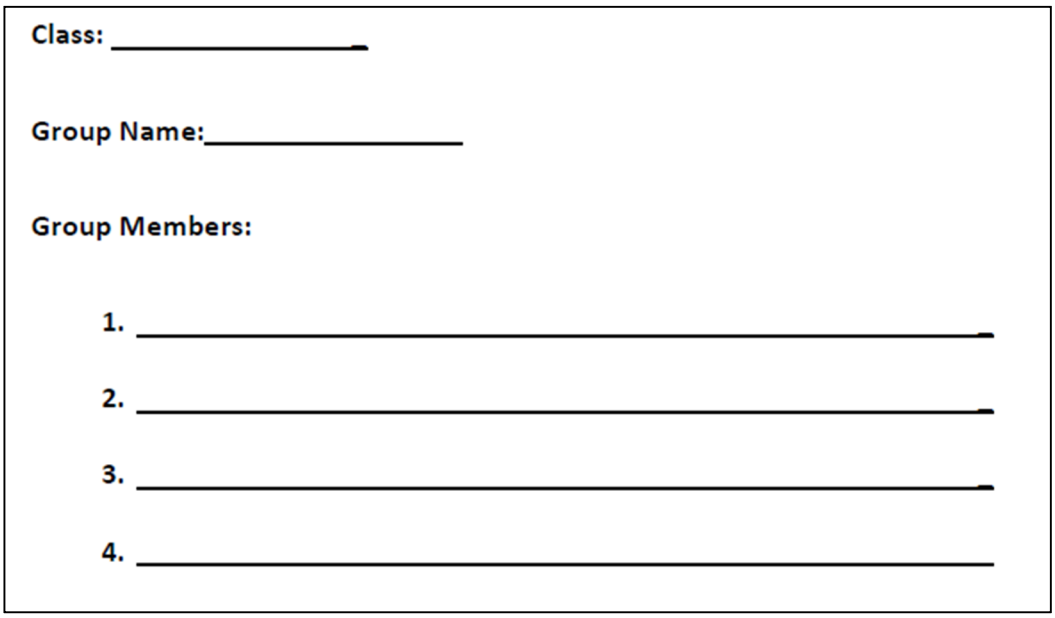
Figure 8-9: 3D Floor Plan

8.6.3 Labels

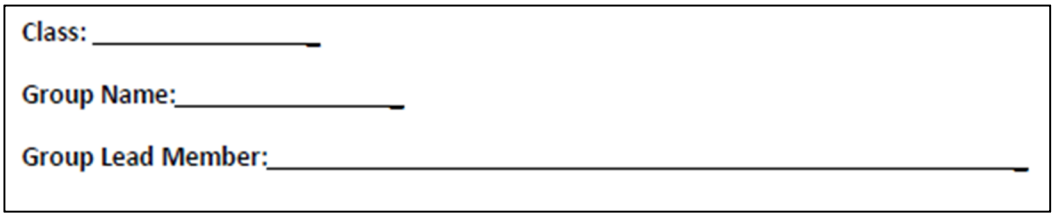
8.6.3.1 Drawer Label Samples

<table>
<tr><td>a.
BIOMECHANICS</td><td>c.
CATHETER TRANSDUCER</td></tr>
<tr><td rowspan="2">f.
PACKAGING MATERIALS
STORY BOOKS</td><td>a. WALL PAINT
Paint thinner
Craft paint
Tempra paint
Wood putty
Urethane (paint on)</td></tr>
<tr><td>a. SPRAY PAINT
PVC primer & cement
Plaster of Paris
Wall putty
Teflon spray tube</td></tr>
</table>

8.6.3.2 Large Tub Label



8.6.3.3 Clear Tote Label



8.6.4 Drawer Contents Map

Front, Window Drawers 1			
a	b c d e	Tubs	f
a. Biomechanics	b. c. Cather transducer d. e.		f.

Side, Top Cabinet 2							
a	b	c	d	e	f	g	h
a. surface finish, Paints	**b.** Painting supplies,glues	**c.** Tools	**d.** Tools	**e.** Prosthetics	**f.** Past projects	**g.**	**h.** Voltmeter, power supply

Side, Top Drawers 3									
a	b c d		e	f g h	bowling balls	i	j	k l	 m
a. Lap trays	b. PVC, wood & metal rods		e. Wood	f. Fabric		i. art cart, wheel-chair rack	j. Tubing	k.	
	c. Past Projects			g. Aluminum Stock				l.m. Cleaning supplies	
	d. PVC Stock			h. Plastic sheet&block					

Front, Bottom Drawers 5			
a	e		i
b	f		j
c	g		k
d	h		l
a. Bolts, Hose Clamps	e. Misc Mechanical Hardware		i. Misc Mechanical hardware
b. Rapid Prototyping Parts,Ultrasonic Transducer	f. Springs, Brackets, Metal Bolts, U Hooks		j. Chains + sprockets
c. Pressure Indicating Films	g. Door Parts, Cabling, Hooks		k. Hydraulics
d.	h.		l. Pneumatics

Front, Bottom Shelf 6
Machine shop handbooks, McMaster catalog
Electrical Components

Side, Bottom Drawers 6		
a		**e**
b		**f**
c		
d		
a. Misc wires		**e.** Motors, Transformers
b. Misc wires		**f.** Large power supplies, Scale
c. Walker MQP		
d.		

Side, Bottom Shelf 7	
MQP	MQP

Side, Bottom Drawers 7		
a	Tubs	**e**
b		**f**
c		
d		
a. Misc wires		**e.** Motors, Transformers
b. Misc wires		**f.** Large power supplies, Scale
c. Bike parts		
d. Ring Stand Clamps		

Side, Bottom Shelf 8	
MQP	MQP

Back, Bottom Drawers 9			
a	b		f
	c		g
	d		
	e		h
a. Wheelchair + cane parts	b. Motors, Transformers, Solenoids		f. BNC sensors & cables
	c. Heavy Supplies		g. Loose wires(Electrical & Electronic devices)
	d.		h. Batteries, Chargers
	e.		

Back, Bottom Shelf 10
Soldering Station, Glue Guns

Tools cabinet 12
a
b
c
d
e

a. Tools box(2), thread spindles(3), storage organizer
b. Sandpaper(2), Drill bit set, Jigsaw blades, Tools box, Power Screw driver, Corded engraver
c. Coping saw(2), Hack Saw(3), Orbit Jigsaw,
d. Wood saw(3), Circular blades
e. Wire mesh, Mounting Tape

Tools Cabinet 11		
Top:		
a	**b**	**c**
d		
e		
f		
g		
h		
i		
j		
k		
l		
m		
n		
o		
p		

Top: Rotary tooling, Drill bits, Socket Set, T handle
a
b. Tape Measures
c. Measurement
d. Screwdrivers
e. Vice grips, Adjustable wrenches
f. Pliers
g.
h.
i.
j.
k.
l. Standard/SAE
m. Metric
n. Hammers
o
p. Misc

8.6.5 High Value Inventory Implementation Example

Item	Status	Description	Tag Number	Loaned To	Loan Start Date	Expected Return	Loanee Contact	Loanee Email	Department
Orbital Jigsaw	In								
Ryobe 18V Battery	Missing								
Flahslight- Ryobe	In								
Circular Saw- Ryobe	In								
Dremel Rotary Tool	Missing								

8.6.6 SOP Archives

8.6.6.1 Conference Room Scheduling: SOP#: 001-2013 R1

Scheduling Procedure for the ATRC Conference Room (HL-123)

SOP#: 001-2013 R1

1. **To request a room time please fill in the following information in the desired time slot:**
    1. **Class: (ME-2300)**
    2. **Group Name or Number (ATRC Ops Team)**
    3. **Time: (8:00-10:00 AM)**
    4. **Professor's Name: (Prof. Hoffman)**

8.6.6.2 Open House Prep List: SOP#: 002-2013 R1

Open House Prep List

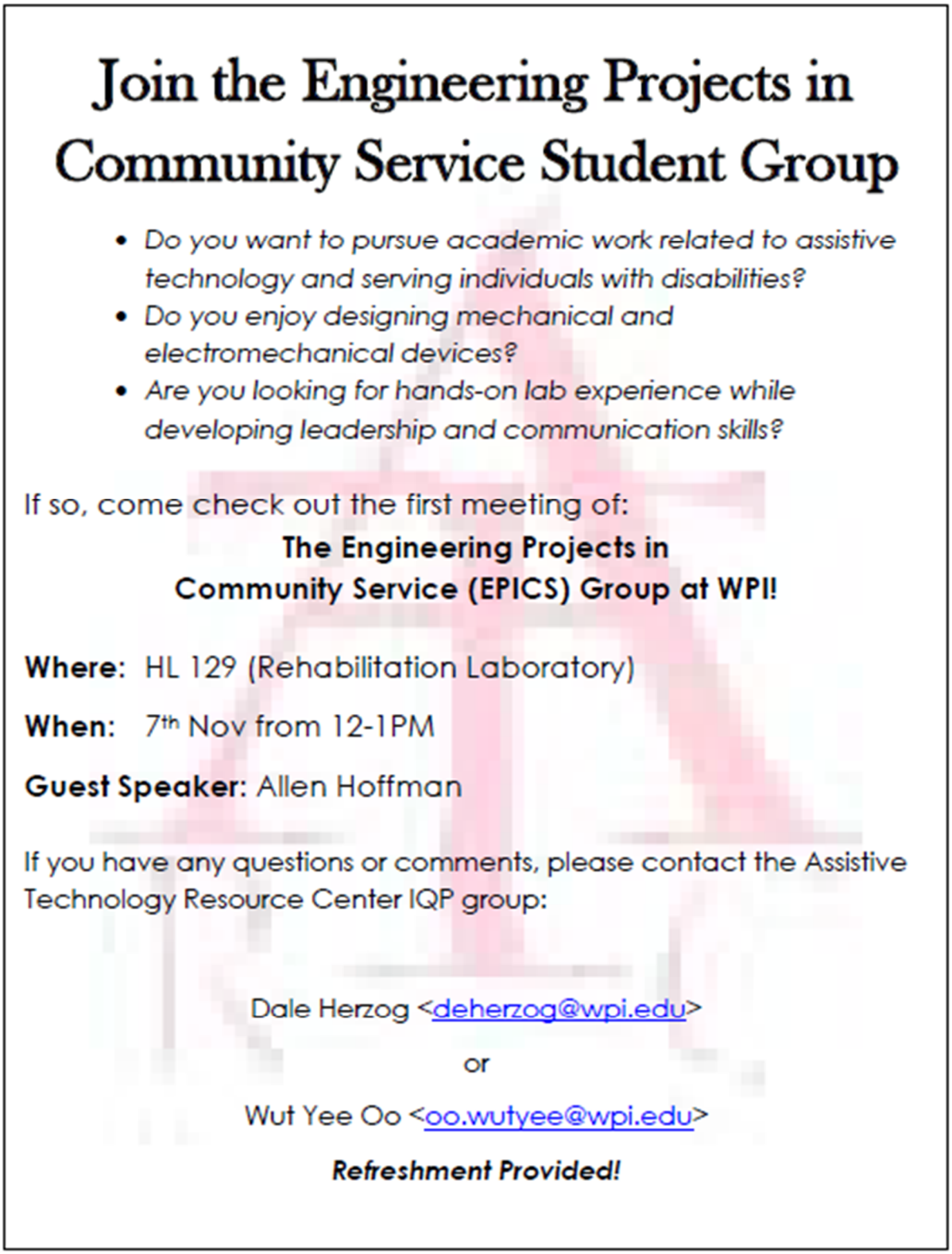
SOP#: 002-2013 R1

1. Check out laptop and projector from the ATC office.
    1. 48 hour reservation lead recommended.
    2. Loop the EPICS WPI video on the projector during unguided tours.
2. Clean and organize lab.
3. Set out past projects around the lab with their title card.
4. Be aware of the group you're presenting too. (Potential students vs. touring educational developers vs. potential sponsors.)

8.6.7 Scheduling Binder Weekly Planner

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
8:00							
:30							
9:00							
:30							
10:00							
:30							
11:00							
:30							
12:00							
:30							
1:00							
:30							
2:00							
:30							
3:00							
:30							
4:00							
:30							
5:00							
:30							
6:00							
:30							

8.6.8 EPICS Recruiting Sign



Join the Engineering Projects in Community Service Student Group

- *Do you want to pursue academic work related to assistive technology and serving individuals with disabilities?*
- *Do you enjoy designing mechanical and electromechanical devices?*
- *Are you looking for hands-on lab experience while developing leadership and communication skills?*

If so, come check out the first meeting of:

The Engineering Projects in Community Service (EPICS) Group at WPI!

Where: HL 129 (Rehabilitation Laboratory)

When: 7th Nov from 12-1PM

Guest Speaker: Allen Hoffman

If you have any questions or comments, please contact the Assistive Technology Resource Center IQP group:

Dale Herzog <deherzog@wpi.edu>

or

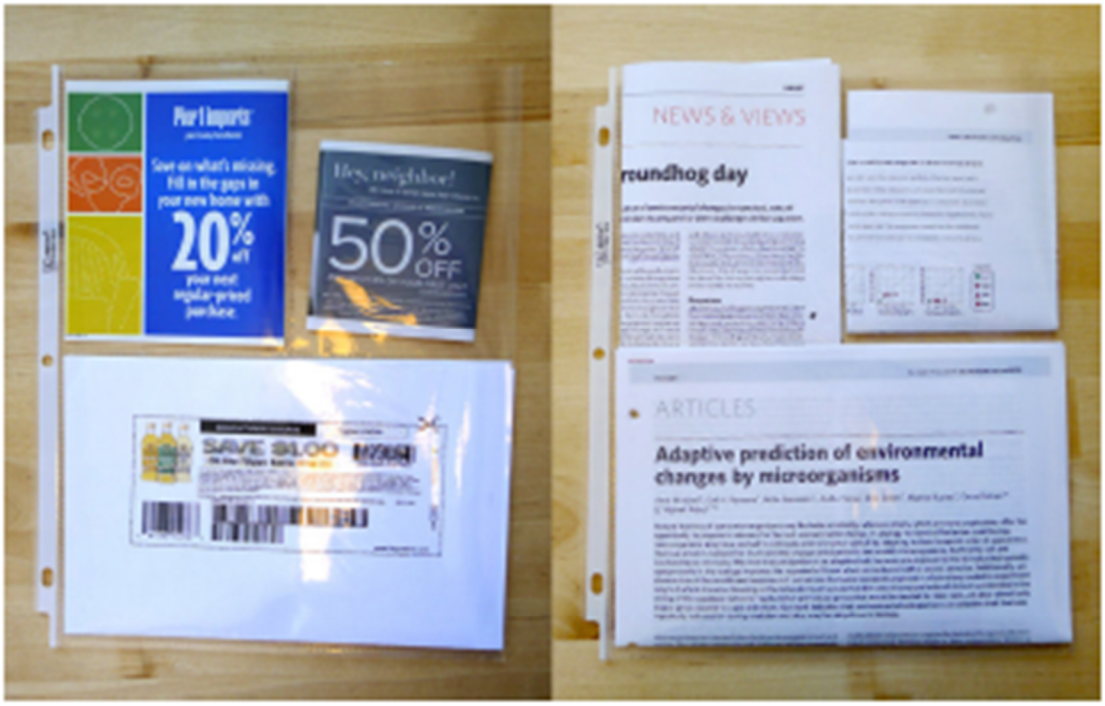
Wut Yee Oo <oo.wutyee@wpi.edu>

Refreshment Provided!

8.6.9 Drawer Label Holders from Sheet Protectors

Divide Your Page Protectors

by aboddy



You can buy page protectors (a.k.a. sheet protectors) that are already divided into sections (a.k.a. pockets), but they tend to be much more expensive, and the shapes/sizes of the sections may not suit your needs.

1. Here are two easy ways to customize your page protectors yourself.
2. **You will need:**
    a. Page protectors
    b. Thick cardstock or thin cardboard
    c. X-acto knife
    d. Ruler
    e. Sharpie
    f. Wood burning pen
    for a no-heat alternative method, see step 4.
3. **Step 1: Draw Your Sections**

a. 

b. Take a piece of thick cardstock or thin cardboard and cut it to fit snugly inside your page protector.
c. Using a ruler and a Sharpie, draw lines on your cardboard to indicate section boundaries. You can make as many sections as you want, but I recommend between 2 and 6 sections total.
d. For my project, I divided the cardboard in two, and then divided the top section into two again.

4. **Step 2: Cut the Page Protector**

a. 

5. Insert the cardboard into your page protector.
6. **For all of the horizontal lines**, lay your ruler on the page protector and carefully cut along the horizontal line with your X-acto knife. Try not to cut the cardboard, as you will want to reuse it for more pages. Don't cut the white section on the left that contains the binder-ring holes.
7. **For all of the vertical lines**, trace the lines with a Sharpie (you can remove the Sharpie later with rubbing alcohol) or some other pen.

8. Step 3:

a. 

b. 

c. Plug in your wood burning pen with a pointed tip.

d. Remove the cardboard from inside the page protector and place underneath the page protector.
e. **For the horizontal lines**, use the wood burning pen to make a dotted line **above the cut** in the page protector.
f. **For the vertical lines**, use the wood burning pen to make a dotted line **on top of the line** you drew with a Sharpie.

9. Tips:
   a. Make the dots fairly quickly; you don't want the holes to get too big.
   b. Use a low heat setting if possible. If you can't change the heat settings, let the pen heat up, then turn it off and use it. When it stops melting the page protector, turn it on again.
   c. Don't make your dots too close together.
   d. While you're working, reach your hand in and test to make sure the two sides are sticking together. If they're not, you may need to use more heat or more pressure.

10. Step 4: No-Heat Alternative Method

a.

b. **You will need**:
   i. Page protectors
   ii. Thick cardstock or thin cardboar
   iii. X-acto knife
   iv. Ruler
   v. Clear tape

c. Follow steps 1 and 2, but use the X-acto to cut both the horizontal and the vertical lines.
d. Taping your sections can be tricky if you have vertical cuts. Start with the sections that are on the left of the page and tape all of their edges down onto the bottom sheet of the page protector.
e. Work your way right, taping each section on top of the previously taped sections.
f. For horizontal cuts, tape the sections above the cuts to the bottom sheet of the page protector.

11. Step 5: Fill Your Page Protectors

12. What do you need all these sections for? Here are some ideas:
    a. Organize your stickers or stamps
    b. Organize your greeting cards or postcards
    c. Organize your coupons
    d. Organize your recipes
    e. Hold your photographs
    f. Hold your collectable cards
    g. Fold up papers, articles, or documents to save room in a binder and keep related documents together

8.7 Laboratory Signs

Please Clean Your Workspace Before Leaving The Lab.

- This Includes:
  - Vacuuming or sweeping all saw dust.
  - All project materials must be :
    - Stored in the group tub or
    - Appropriately labeled and racked.
      - How you treat your workspace reflects on you (and your grade).
  - Returning all tools to their proper drawer, shelf or cabinet.

- Have a question?
  - Do you know about the AT Lab Users' Handbook contains necessary references for:
    - Working inside the lab
    - Working around campus
    - Internet resources to help with your AT projects?
  - Feel free to email 2012-13 ATRC student assistants with any questions or comments.
    - Dale Herzog: (deherzog@wpi.edu)
    - or
    - Wut Yee Oo: (oo.wutyee@wpi.edu)

8.8 Archival Software Research:

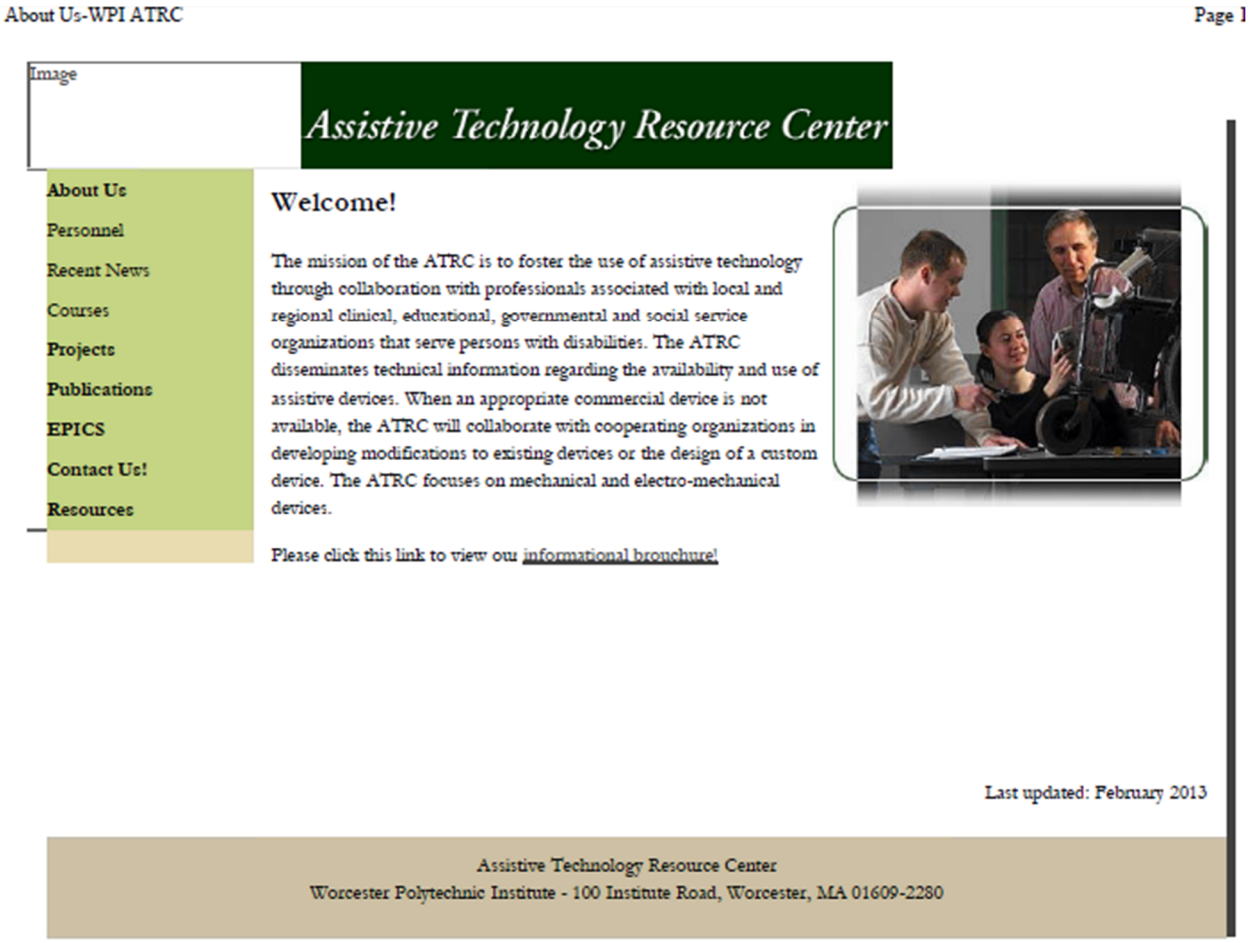
1) **Archiving Software**
    i) DT search alternatives
        (a) Cons
            1. Costs
            2. Higher server loading.
        (b) Pros
            1. Works out of the box./ Instant implementation
            2. Has technical support out of the box so it can be fixed after programmer leaves school
        (c) Other info
            1. DT search
                i. Quick start
                ii. HTML based
                iii. http://www.dtsearch.com/PLF_web_2.html
                iv. http://www.youtube.com/watch?v=0-O5-jIfalk
                v. Example Web search
                vi. DT Search Web with Spider: http://www.dtsearch.com/PLF_web_2.html
                vii. Demo: http://support.dtsearch.com/Support/demos/forms/BooleanSearch/dtsearch.html
        (d) Info to find
            1. Cost of software?
            2. How much space does index take on hard drive? / Server resources?
            3. Permissions access? (People With WPI ID/General public/ ATRC Members)
    ii) Integrate into school database
        (a) Can school process project files the same way it does MQP/ IQP papers?
    iii) Writing our own database
        (a) Time and learning commitments?
    iv) Copernic
        (a) Has free version and paid version
            (i) Costs: Desktop is free
                1. Pro= $49
                2. Corporate= $59 per seat (required for web interface)
                    i. How does client licensing work?
                    ii. Can search link be added to a webpage?
        (b) Comparison between versions
            1. http://www.copernic.com/en/products/desktop-search/cds-compare.html
        (c) Desktop version
            1. http://www.copernic.com/en/products/desktop-search/index.html
    v) Windows Desktop Search 4.0
        (a) Free
        (b) Questions
            1. Can it be used through web interface?/ Can it access network drives?
            2. General FAQ
                i. http://windows.microsoft.com/en-US/windows7/Improve-Windows-searches-using-the-index-frequently-asked-questions
    vi) X1 Pro
        (a) Free and paid versions
        (b) http://www.x1.com/

8.9 Standard Operations Contact List

1. Office related work
    a. Canning, Statia M. [scanning@WPI.EDU]
2. Lab Cleaning
    a. Larry from HL office, 1st floor
3. Software
    a. Randolph H. Robinson [rhr@WPI.EDU]
4. IT person
    a. Allan E. Johannesen [aej@WPI.EDU]
5. WPI Gordon Library Digital Commons Archivist
    a. Colati, Jessica [jcolati@WPI.EDU]

8.10 ATRC Marketing Documents

8.10.1 Website Updates



Image

Assistive Technology Resource Center

About Us

Personnel

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Publications

EPICS

Contact Us!

Resources

About Us

"We shall use Assistive Technology to refer to a broad range of devices, services, strategies, and practices that are conceived and applied to ameliorate the problems faced by individuals who have disabilities."
- taken from Assistive Technologies: Principles and Practice by Cook and Hussey (1994)

History & Mission of the ATRC

In 1995, the Rehabilitation Engineering Laboratory at Worcester Polytechnic Institute received a grant from the Fairlawn Foundation, in Worcester, Massachusetts,to develop an Assistive Technology Resource Center (ATRC). The mission of the ATRC is to foster the use of assistive technology through collaboration with professionals associated with local and regional clinical, educational, governmental and social service organizations that serve persons with disabilities. The ATRC disseminates technical information regarding the availability and use of assistive devices. When an appropriate commercial device is not available, the ATRC will collaborate with cooperating organizations in developing modifications to existing devices or the design of a custom device. The ATRC focuses on mechanical and electro-mechanical devices.

Aiming for this mission, the ATRC strives to accomplish the two main objectives as follows:
1. To provide a centralized information resource for rehabilitation professionals within the region.
2. To provide a technically based resource for either the modification, or the design and development of customized assistive devices.
-taken from (Hoffman, Ault, &Cattricala, 2001)

Overview of the ATRC

ATRC is located at the Rehabilitation Engineering Laboratory (HL 129) on the first floor of Higgins Laboratories of WPI Mechanical Engineering Department. The ATRC supports projects and research by undergraduates and graduates in the area of AT associated with mobility disabilities resulted from Cerebral Palsy, Arthrogryposis and Spinal Cord Injury.

Last updated: February 2013

Assistive Technology Resource Center
Worcester Polytechnic Institute - 100 Institute Road, Worcester, MA 01609-2280

Image

Assistive Technology Resource Center

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Wut Yee Oo

Mechanical Engineering '14
Email: oo.wutyee@wpi.edu

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Assistive Technology Resource Center

Recent News

2013

- 2013 Spring Newsletter
- The lab office was moved to HL 123 in C term 2012.
- The lab has an official establishment of EPICS as a students' organization.
- The lab has updated project, contact and resource database and website.

2012

- 2012 Spring Newsletter

2010

- WPI EPICS places second in National Video Contest!

(Click the image below to play)

Read more: http://www.wpi.edu/news/20090/vcontest.html

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Courses

ES 1020. INTRODUCTION TO ENGINEERING

Cat. I This course is for first year students with an interest in engineering. The course focuses on the design process. Students are introduced to engineering through case studies and reverse engineering activities. Students will learn the steps in the design process and how engineers use this process to create new devices. Teams of students are then assigned a design project that culminates in building and evaluating a prototype in their design. Results of the design project are presented in both oral and written reports. This course does not require any prior engineering background. Note: This course can be used towards the Engineering Science and Design distribution requirement in IE, ME, and MFE.

ME 2300. INTRODUCTION TO ENGINEERING DESIGN

Cat. I Real world engineering design problems usually have more than one correct solution. This course utilizes a realistic design process to introduce students to the methods and techniques for solving engineering problems. Lectures will support the design projects and may cover engineering economics, fluid dynamics, heat transfer, mechanics, statistics, and basic circuits. No prior knowledge of fluids, heat transfer, economics, statistics or electrical circuits is required. Laboratory sessions will be used to build, test and demonstrate various designs. This course is designed for sophomores and juniors to provide a broad overview of engineering design. The course includes a significant writing component and makes extensive use of PCs for word processing, spread sheet calculations and programming. Recommended background: Ordinary Differential Equations (MA 2051), mechanics (PH 1110), statics (ES 2501), any programming language.

ME 3501. ELEMENTARY CONTINUUM MECHANICS

Cat. II In typical mathematics courses, students learn principles and techniques by solving many short and specially prepared problems. They rarely gain experience in formulating and solving mathematical equations that apply to real life engineering problems. This course will give students this type of applied mathematical experience. The course emphasizes the application of basic laws of nature as they apply to differential elements which lead to differential equations that need to be solved; all of these ideas are used in higher level engineering science courses such as fluid mechanics, heat transfer, elasticity, etc. Emphasis will be placed on understanding the physical concepts in a problem, selecting appropriate differential elements, developing differential equations, and finding ways to solve these equations. Limitations on the mathematical solutions due to assumptions made will be considered. Recommended background: Ordinary Differential Equations (MA 2051), statics (ES 2501), dynamics (ES 2503). This course will be offered in 2014-15 and in alternating years thereafter.

ME 3506. REHABILITATION ENGINEERING

Cat. I The course exposes the students to the use of technology to design devices to ameliorate the handicaps of individuals with disabilities. This course focuses on the design process for assistive devices including defining the problem, setting design criteria, developing preliminary designs, selecting, analyzing and testing a final design. Human factors are integrated into all phases of the design process. Topics include: ergonomics, physical and cognitive parameters that effect the user interface, safety, economics, reliability and esthetics. Design and analysis of devices used for mobility and in daily activities in residential, educational and vocational settings. Laboratory sessions will be used to develop conceptual designs that solve real problems. Recommended background: mechanics (ES 2501, ES 2502, ES 2503), kinematics (ME 3310), design (ME 2300), materials (ME 1800, ME 2820), electrical engineering (ECE 2010).

Image

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Projects

Below are MQPs and IQPs pursued currently and likely to be pursued in the future. If you are interested to be getting involved in any of these, contact Professor Hoffman or Professor Ault for further information.

Future '13 - '14: MQP-Design of Assistive Technology Devices

The student project teams will develop original designs or design modifications to existing assistive devices used to aid persons with disabilities. All projects require design, manufacturing, testing and evaluation of a device. An application process is used to recruit students.Teams will be assembled so that each team has the broad spectrum of skills required to complete the project. Examples of past projects can be viewed in the Rehabilitation Engineering Laboratory (HL 129). Please contact Prof. Hoffman or Prof. Ault for further information.

Future '13 - '14: IQP-Managing the Assistive Technology Resource Center

The Assistive Technology Resource Center www.me.wpi.edu/Research/ATRC, founded in 1999, disseminates information regarding the availability and use of electromechanical assistive devices for people with disabilities. This project involves the management of the center, development of outreach activities, web page development and public presentations. Further details can be obtained from Prof. Hoffman. Preference will be given to students who have the appropriate skills and have taken a course associated with the ATRC (ES 1020, ME 2300 or ME 3506).

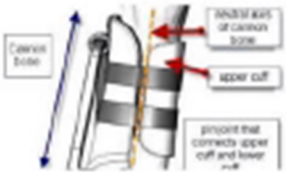
2011-2012

MQP: Redesign of a Dental Mirror

During dental procedures mirrors used can become soiled with debris, obstructing visibility. A disposable two piece push wiper system was developed to remove this debris while inside the patient's mouth. A rod with a wiper at the end slides inside of a case that attaches to the dental mirror handle. Pushing the rod deflects the wiper up the mirror surface and cleans off debris in the process. The wiper head contains a slit for a rubber insert, the means by which debris is removed. Tests were conducted using 3 types of debris: toothpaste, simulated blood, and solid fragments. Debris was added to the mirror surface, the wiper was actuated, and visibility was measured. These tests indicate that this attachment can consistently clean 80% or more of the mirror in 3 activations.

MQP: Redesign of the Restrainer band for a Horse Leg Protective Device Based on a Static Analysis

Conventional horse leg protectors, such as bandage-wrapped boots, are not energy dissipative and require operation by professionals. Manta Design, Inc. designed a protective device intended to minimize the hyperextension of the flexor tendons in a horse's forelimb by providing counter tensions with an attached restrainer band. However, the current band design does not provide consistent tension and is insufficient at protecting the metatarsophalangeal joint (MCPJ) from injury. This project studied the static performance of the MCPJ to determine the required



restrainer band tensions needed for Manta Design's protectant. It was found that restrainer band should be designed to counter the tension of the suspensory ligament tendon, which contributed to most of the MCPJ tension. The allowed minimum and maximum restrainer band tensions were determined to be 87N and 162(N, respectively, in order to reduce MCPJ moment by 10 percent. The improved restrainer band achieves an 8.4% MCPJ moment reduction at maximum extension.

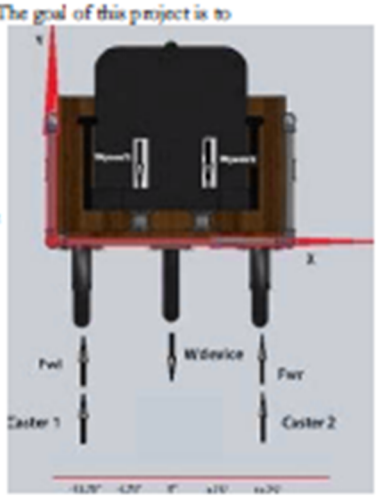
IQP: ATRC Communications

The Assistive Technology Resource Center (ATRC) at Worcester Polytechnic Institute(WPI) was founded in 1999 to serve as a regional provider of assistive devices, services, and engineering solutions. Through courses, projects, and other activities, the WPI ATRC provides a more technical approach to developing assistive technology solutions for its clients than other Assistive Technology (AT) centers that focus more on the clinical aspects of Assistive Technology. Several IQP's have been conducted in the 4 preceding academic years. Lyons and Trimby (2008) defined the need to organize past projects into a central data base. Hristov, Mawhiney, and Wilson (2009) created that database but left a need for a more comprehensive collection. George and Kalluri (2010) created a marketing document for the ATRC, as well as a more comprehensive list of past ATRC projects. These advancements established the need for providing an adequate framework for the ATRC to communicate with the WPI community as well as the outside community. Over the course of this project a management structure for the ATRC along with procedures for operation of the Rehabilitation Engineering Lab were developed. To create an ideal outcome where the ATRC's operation will become self-sustainable and sound enough to re-establish regular communications, an informational brochure, newsletter, and website templates were all created to assist in this communication. After these implementations, the ATRC's primary need becomes a dependable staff to carry out the outlined procedures and to re-establish the EPICS (Engineering Projects in Community Service) program in the efforts to expand and gain internal and external support and attention for the WPI ATRC.

2010-2011

MQP: Front Mounting Bicycle Attachment for Improved Accessibility of Adult Passengers

Current most bicycle attachments capable of transporting an adult passenger are limited to rear mounting products. Few available devices place the passenger in front of the existing bicycle which would significantly improve the passenger's range of vision and enjoyment. In addition, these current devices are purchased as stand-alone units that include both the bicycle and attachment which make them expensive and inconvenient. The goal of this project is to design a front mounting device capable of carrying an adult passenger that can be purchased separately and then attached to an existing bicycle. Two important design characteristics of this device were adaptability and accessibility; the device was designed to attach to different bicycle frames and accommodate a range of adult passengers, including those with limited mobility. After benchmarking current products, a design was developed satisfying this project goal. The steering system uses a parallelogram linkage to transfer rotational motion of the existing bicycle handlebars to two adjacent device wheels for a 1:1 steering ratio to maintain driver cycling instincts. The attachment mechanism consists of a compression device between the existing bicycle head tube and the space between the top and down tubes of the frame to maintain rigidity of the system while not harming the bicycle. Recommendations are made at the end of this report in order to provide solutions to problems discovered during the design and manufacturing processes.



Image

Assistive Technology Resource Center

Publications

Recent Publications:

- A. H. Hoffman, K. N. Liadis (2011). "Design of a Power-Assist Wheelchair for Persons with Hemiplegia", Proceedings of the 2011 IEEE International Conference on Technologies for Practical Robot Applications, April 11-12, 2011, Woburn, MA.
- A.H. Hoffman (2010), "Work In Progress - Encouraging Innovation by Having Students Develop Their Own Course Design Projects" Proceedings of the 40th ASEE/IEEE Frontiers in Education Conference, Washington DC, October 27-30, 2010
- A.H. Hoffman, J.R. Quinn, V. Tate, B. Singer, K.L. Billiar (2010), "Work In Progress - Combining Service Learning with the NSF Research Experiences for Teachers Program", Proceedings of the 40th ASEE/IEEE Frontiers in Education Conference, Washington DC, October 27-30, 2010
- A. H. Hoffman, (2006) The Role of Robotics in the Design of Devices to Assist Persons with Disabilities, Proceedings of the 2006 IEEE International Conference on Technologies for Practical Robot Applications, Boston, MA.

Papers:

- A. H. Hoffman, Eric D. Couture (2008), "Design and Development of an Elevating Articulating Manual Wheelchair Legrest" in Proceedings of 2008 International Mechanical Engineering Congress and Exposition, Boston, MA.
- A. Hoffman, S. Cassidy, S. LeMarbre, T. Madsen, H. Ault (2007), "Development of an Ergonomic One Arm Drive Wheelchair", Proceedings of the 2008 Annual RESNA Conference, Washington, D.C.
- A. H. Hoffman, H. K. Ault, M. J. Scanella, S. P. Toddes (2007), "Service Learning as a Means of Delivering Assistive Technology Solutions", in Proceedings of the 2007 Annual RESNA Conference, Phoenix AZ.
- L. Manrique, G. Rabideau, G. Reinhold, A. Hoffman (2007), "Using an Obstacle Sensing System in Power Wheelchair Training of Children", in Proceedings of the 2007 Annual RESNA Conference, Phoenix AZ.
- M. J. Scanella, G. A. Fredette, B. D. Dubois, E.R Stefano, A. A. Katz, C. Hunter, K. E. Bombassaro, A. H. Hoffman (2007), "Development of a Posterior Walker for the Visually Impaired", in Proceedings of the 33rd Northeast Bioengineering Conference, pp. 261-262, Stony Brook NY.
- H. K. Ault, A.H. Hoffman, K. N. Liadis, M. J. Scanella and S. P. Toddes (2006), "Unique Projects for Individual Needs - Assistive Technology Designs in Engineering", Proceedings of the 2006 International Mechanical Engineering Conference and Exposition, Chicago, IL.
- A.H. Hoffman, R. Glynn and H.K. Ault (2006), "The Effect of Restricted Ankle Motion on Stair Ambulation", in Proceedings of the 2006 Annual RESNA Conference, Atlanta, GA.
- B. Boettcher, T. McLean, K. Sundberg, B. Klockars and A. H. Hoffman (2006), "Design of a Glide Control Device for a Manual Wheelchair", in Proceedings of the 2006 Annual RESNA Conference, Atlanta, GA.
- A. H. Hoffman, H. K. Ault, K. N. Liadis, M. J. Scanella, and S. P. Toddes (2006), "Implementing Service Learning Across the Curriculum Through Projects that Design Assistive Devices", in the Proceedings of the National Conference on Service Learning in Engineering, Washington DC
- A. H. Hoffman and H. K. Ault (2005), "Design Course Projects that Aid Persons with Disabilities," Proceedings of the 2005 Frontiers in Education Conference, (compact disk), Boulder, CO.
- H.K. Ault, A.H. Hoffman and L. Manrique (2005), "Design of a Dynamic Bi-ski Armrest Mechanism", Proceedings of the RESNA 2005 Annual Conference, (compact disk), Nashville, TN.

- H.K. Ault and A.H. Hoffman (1993), "Teaching Design Through the Development of Devices to Assist the Disabled", in Innovations in Engineering Design Education, ASME, NY, pp. 241-243.
- A.H. Hoffman, H.K. Ault, H. Toriumi, S.A. Smith, C. Felice, "The Design and Kinematic Evaluation of a Passive Wearable Upper Extremity Orthosis", *Proceedings of the 2002 Annual RESNA Conference*, in press, 2002.
- A.H. Hoffman, H.K. Ault, R. Catricala, "The Development of a Regional Assistive Technology Resource Center", *Proceedings of the 2001 Annual RESNA Conference*, pp.172-174.
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- K.D. Belliveau, M. Carreau, "Development of a Prototype Retractable Wheelchair Foot Tray", *Proceedings of 2001 Annual RESNA Conference*, pp.388-390, 2001.
- A.H. Hoffman, H.K. Ault, R. Catricala, G.M. Rabideau, S. Kohn and J. Ripley, "Development of a Prototype Bumper System for Powered Wheelchairs", *Proceedings of the RESNA 2000 Conference*, pp. 468-470, 2000.
- A.H. Hoffman, H.K. Ault, C. Demetry, and D.W. Nicoletti, "Teaching Disability Awareness and Universal Design to Middle School Students", *Proceedings, Designing for the 21st Century II. An International Conference on Universal Design*, Vol. 5, pp. 10-12, 2000.
- A.H. Hoffman, H.K. Ault, M.H. Becker, A.E. Hoover, M.E. Johnson, M.C. Malchiodi, "Impact Forces Associated with Powered Wheelchairs", *Proceedings of the RESNA 95 Conference*, pp. 239-241, 1999.
- C. Bruno and A.H. Hoffman, "Modeling the Dynamic Stability of an Occupied Wheelchair", *Proceedings of the RESNA 98 Conference*, pp. 164-166, 1998.
- A.H. Hoffman and H.K. Ault, "Powered Arm Orthosis" , *Rehabilitation R&D Progress Reports*, Vol. 35, pp. 225, 1998. (abstract).
- D.A. Rice, R.J. Hirko, A.H. Hoffman, H.K. Ault and R.C. Anderson, "Assistive Technology Transfer and the NSF Bioengineering Research to Aid the Disabled (BRAD) Program", *Technology and Disability*, Vol. 7, pp. 47-54, 1997.
- C. Bruno, "Development of a Mathematical Model to Investigate the Static and Dynamic Stability of a Wheelchair System", M.S. Thesis, Worcester Polytechnic Institute, Worcester, MA, 1997.
- A.H. Hoffman and H.K. Ault, "A Retrospective Study of the Use and Abandonment of Assistive Devices Developed by Student Design Projects", *Proceedings of the RESNA 96 Conference*, pp. 131-133, 1996.
- A.H. Hoffman and H.K. Ault, "Student to Student Technology Transfer", *Annals of Biomedical Engineering*, Vol. 22 Supplement 1, pp. 68, 1994. (abstract)
- A.H. Hoffman, H.K. Ault, D.E. Brewster, C.R. Merkle and J.A. Conkey, "The Effects of Ankle-Foot Orthoses on the Kinematics and Energy Content of Gait", *Proceedings of the 12th Triennial Congress of the International Ergonomic Association*, Vol. 3, pp. 182-184, 1994.
- A.H. Hoffman and H.K. Ault, "Rehabilitation Engineering at WPI", abstract and video presentation, *1993 RESNA Conference*, Las Vegas, June 1993.
- A.H. Hoffman, H.K. Ault, D.R. Flinton and W.B. Sullivan, "The Design and Development of a Reacher/ Gripper Device for a Child with Arthrogryposis", *Proceedings of the RESNA 93 Conference*, Vol. 13, pp. 507-509, 1993.

Last updated: February 2013

Image

Assistive Technology Resource Center

Engineering Projects In Community Service

About EPICS

EPICS (Engineering Projects in Community Service) was founded at Purdue University in 1995. The creators of this program saw a way to combine student work with the needs of local community service organizations that could benefit all involved. Student teams are comprised of multiyear, multidisciplinary students that solve engineering and technology-based problems for these partnering organizations to create solutions that can be used by the organization.

EPICS has been a part of the ATRC since the ATRC was first founded but EPICS did not have specific people leading the group and it had always been continued by students who want to further work on projects started in courses related to assistive technology. Foreseeing that having EPICS as an official students club will to have officers as well as funding which are two main resources required to keep the ATRC running, EPICS was re-established with a few interested students in C term 2013.

Mission Statement

The mission statement of EPICS at WPI is to develop a robust team of students working together to design, build, and deploy real systems that solve engineering-based problems for local community service and educational organizations. To achieve this goal, EPICS strives to provide its members with valuable hands on project experience they might not otherwise gain.

The goal of EPICS is to

- Allow students to work on assistive technology projects that focus on developing assistive technology for persons with disabilities.
- Give members experience working on "job shop" project organization with enthusiastic individuals with industry experience.
- Collaborate with off campus organizations to lend engineering know how to serve persons with disabilities.
- Promote positive attitudes towards persons with disabilities at WPI.
- Promote assistive technology education programs at WPI!

Benefits for Students

- Real World Skills for Engineering Students
- Communication Skills
- Teamwork
- Start-to-Finish Design Experience
- Project Management, Organizational, and Leadership Skills
- Resource Management
- Professional Ethics
- Customer Awareness
- Interdisciplinary Experience
- Resourcefulness
- Community Awareness
- Maturity
- Pride

Benefits to Community Project Partners

- Engineering Change in Our Community

- Engineering Change in Our Community
- Access to technical knowledge and resources that would otherwise be prohibitively expensive
- Opportunities to improve current services
- Opportunities for new services
- Opportunities to try new, innovative ideas
- Positioning as a leader among area not-for-profits

Member Institutions

Since its founding, EPICS has grown to become an international consortium of the following universities:

- University of Auckland, New Zealand
- Butler University
- University of California, Merced
- University of California, San Diego
- Columbia University
- Dartmouth College
- Drexel University
- George Fox University
- Georgia Institute of Technology
- Illinois Institute of Technology
- University of Notre Dame
- Penn State University
- Princeton University
- University of Puerto Rico, Mayaguez Campus
- Purdue University
- San Jose State University
- Texas A&M University
- University of Virginia
- University of Wisconsin, Madison
- Worcester Polytechnic Institute

To see the complete constitution of EPICS students' club, please click here!

Activities

Our activities revolve around academic and community service activities in the area of Assistive Technology AT. The Projects involving hands-on development of prototypes are EPICS' primary focus and we hope to serve AT needs around Worcester regions, particularly in collaboration with Worcester Public Schools and Massachusetts Hospital School which have built connection with the ATRC since its establishment. In addition, we will also strive to reconnect with EPICS from other constitutions to gain further public exposure such as attending the regional and national design conferences and competitions and giving presentations.

We are open to any project ideas from the club members, the faculty members and community organizations in needs of AT. Many of our EPICS projects at WPI have beenassociated with these existing courses: ES 1020 (Introduction to Engineering Problems), ME 2300 (Introduction to Engineering Design) and ME 3506 (Rehabilitation Engineering).In addition, there are opportunities to pursue major group projects relating technology and society (Interactive Qualifying Project) and senior design projects (Major Qualifying Project).

We have weekly General Body meetings on Friday from 5pm-6pm at HL129. Everyone is welcome!

Projects

Future Projects

- Dog Harness Device
- Wheelchair decorated with LEDs
- Contact Lens remover

C'13-D'13: Distance Sensor for Play Therapy Biome

This project was modified from the course project in ME3506 from 2012. e "Play Therapy Biome" is used by children with disabilities as well as ablebodied children. The Biome features lights and a fan that can be operated

lights and a fan that can be operated
using various switches, one of which is a buddy button. The fan propels paper butterflies within the toy to give the illusion that they are live butterflies which are actually flying. This project will integrate force sensors and micro controller board to constrain the flying space of the butterflies without hitting the wall of the Biome.

C'13-D'13: Beach Friendly Wheelchair

Among many potential projects that came out of discussion, the group showed strong interest in designing a beach friendly wheel chair which can drive on the beach. It was hoped that the application of the wheelchair can further be extended to driving on snow and rough terrain. The wheelchair was donated by one of the team members who initiated the project. This gave the group to effectively research and come up with specific design solutions for the project. Because of liability issues pertaining to the commercial use of the wheelchair, the final outcome is to fulfill the educational purposes only, rather than to develop a fully functional working prototype.

The first two weeks of the project were spent studying the design specification sheets of the existing product, Jaguar powered wheelchair. Based on the exploded views showing how parts were organized as well as the power rating of the motor and such, the group was able to narrow down their design solutions to two main areas. One is to modify the wheel hub for a different type of wheel such as bubble tire to be mounted on and the other is to design a 3D printed pile drive to be readily attached on the wheel tire.

Connect with EPICS

If you want to get involved with EPICS and want to be in the email list, please contact epics-officers@wpi.edu! You can also visit EPICS facebook page and orgsync!

Officers C'13 - B'14

President - Congi Li congi@wpi.edu

Vice President - Wut Yee Oo oowutyee@wpi.edu

Secretary - Ayesha Fathima afathima@wpi.edu

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Treasurer - Yihao Zhou yzhou2@wpi.edu

Technical Project Leader - Sarah Chamberlain smchamberlain@wpi.edu

Last updated: February 2013


Image
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Please feel free to e-mail either of our student assistants Dale Herzog(dehertog@wpi.edu), Wut Yee Oo (oo.wutyee@wpi.edu), or call us at 1-508-831-6056.
We are in the process of sending out newsletters and brochures. Please indicate if you are interested in receiving either of these!
Last updated: February 2013
Assistive Technology Resource Center
Worcester Polytechnic Institute - 100 Institute Road, Worcester, MA 01609-2280

Recent Publications:

- A.H. Hoffman, Eric D. Couture, "Design and Development of an Elevating Articulating Manual Wheelchair Leg-rest" in Proceedings of 2008 International Mechanical Engineering Congress and Exposition, Boston, MA.
- A. H. Hoffman, S. Cassidy, S. LeMarbre, T. Madsen, H. K. Ault, "Development of an Ergonomic One Arm Drive Wheelchair", Proceedings of the 2008 Annual RESNA Conference, Washington, D.C.
- A. H. Hoffman, H. K. Ault, M.J. Scarsella, S.P. Toddes, "Service Learning as a Means of Delivering Assistive Technology Solutions", in Proceedings of the 2007 Annual RESNA Conference, Phoenix, AZ
- A. H. Hoffman, "The Role of Robotics in the Design of Devices to Assist Persons with Disabilities, Proceedings of the 2009 IEEE International Conference on Technologies for Practical Robot Applications, Boston, MA.

Contact Information

The ATRC warmly welcomes new requests for assistance from cooperating agencies and organizations.

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Assistive Technology Resource Center

WPI

Working together to design a more accessible tomorrow…

http://www.me.wpi.edu/Research/ATRC

About the ATRC

- Serves as a central information source for Assistive Technology (AT).
- Provides education about AT devices
- Provides networking between organizations and agencies serving persons with disabilities
- Provides technical resources from the selection, modification, design, and development of assistive devices.

Goals:

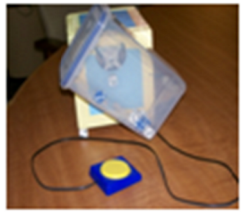
The ATRC strives to disseminate technical information regarding the availability and use of electromechanical assistive devices for individuals with disabilities.

WPI graduate and undergraduate students participate in ATRC activities through class projects, interdisciplinary student projects, major design projects, and graduate thesisresearch.

Prototype:
One arm drive wheelchair

Spray can holder for a man with partial finger amputations

Single switch dice roller



Glide control for a manual wheelchair

Elevating leg rests

Assistive TechnologyResourceCent

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8.10.3 ATRC 2013 Spring Newsletter

WPI ATRC Newsletter

Summer 2012

Assistive Technology Resource Center

Volume 11, Issue 1

Summary of 2012-13 Activities

The WPI ATRC embarks on another successful year of students pursuing Major Qualifying Projects and course projects. (See page 2-3), along with the officially founded Engineering Projects in Community Services EPICS initiating a new project as highlighted in page 4. In addition, under the guidance of an IQP team comprised of Dale Herzog and Wut Yee Oo, the lab has been modernized efficiently with tool supplies and inventory sheets, updated resources, and website.

- ATRC lab office moved to HL 123
- Lab Reorganization:
- Workflow Study and Summary
- Official establishment of EPICS as students' club
- ATRC website update
- ATRC general project resource database created
- ATRC project and contact database updated with Microsoft Access

What's Inside:

About the ATRC

Mission Statement:

"The mission of the ATRC is to foster the use of assistive technology through collaboration with professionals associated with local and regional clinical, educational, governmental and social service organizations that serve persons with disabilities"

ATRC History

In 1999, the Rehabilitation Engineering Laboratory at Worcester Polytechnic Institute received a grant from the Fairlawn Foundation to develop an Assistive Technology Resource Center (ATRC). ATRC disseminates technical information regarding the availability and use of assistive devices.

Website Update

The ATRC website was updated such that WPI students can explore the classes and projects they can take part at the ATRC. The list of ATRC personnel was updated. EPICS page included the latest project information, club officers and future activities the club is planning on. Lastly, the website links to the archive of newsletters, project operations binder and other activity highlights of the ATRC.

(http://www.me.wpi.edu/

Lab Operations

The IQP team designed a sustainable plan to organize the lab as a students-centered workspace and management. Provided with a collection of lab resources for students, the lab was designed into a "job shop" style workshop where tools can be easily relocated and tracked down, and the individual project storage and workspace are retained.

As a first attempt to minimize the waste of lab space, the IQP team introduced totes with customized labels as individual project storage for MQP groups and smaller tubs for in class projects. This allows the lab to be organized at all times and offer spaces for more project groups. The lab's physical state was also improved with cabinets and drawers properly labeled, tools restocked and documented in the inventory sheets and signs encouraging the lab users to follow lab rules.

[INSERT IMAGE]

Another crucial factor for long term success of the ATRC is to archive ATRC related information in a centralized database. A modified, searchable Microsoft Access database of projects and AT resources was first implemented. The team also collaborated with WPI DigitalCommons, an online repository system, to co-manage the database and update ATRC news on a regular basis in the future.

Recent Course Projects

WPI students develop prototypes of assistive devices as part of three undergraduate design courses. The following paragraphs highlight some of the devices that were developed during the 2011-2012 academic year:

Introduction to Engineering Problems (ES 1020) is a design course developed for first-year entering students.
[ES 1020: PROJECT DESCRIPTION]
[INSERT IMAGE]

Introduction to Engineering Design (ME 2300) is directed toward 2nd and 3rd year mechanical engineering students

[ME 2300: PROJECT DESCRIPTION]
[INSERT IMAGE]

Recent Course Projects (continued)

Rehabilitation Engineering (ME 3506) is directed toward 3rd and 4th year students in mechanical engineering. The students in this class must develop the need for a new or significantly improved assistive device and build a working prototype.

[ME3506: PROJECT 1]
[INSERT IMAGE]
[ME3506: PROJECT 2]
[INSERT IMAGE]
ME3506: PROJECT 3]
[INSERT IMAGE]

Major Qualifying Projects

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Find Us Online!

http://www.wpi.edu/academics/me/ATRC/

http://www.facebook.com/groups/wpiepics

Newsletter Editors:
Dale Herzog & Wut Yee Oo

Interested in working with the ATRC?

The ATRC actively accepts ideas for potential projects from persons those with disabilities. In the past, WPI students have worked in collaboration with agencies such as the Massachusetts Hospital School, Easter Seals Mass DDS and various other programs.

Engineering Projects in Community Services

EPICS (Engineering Projects in Community Service) was founded at Purdue University in 1995. WPI joined the EPICS program in 2004, with a focus on developing devices to assist people with disabilities. Students who have an interest in assistive technology pursue projects as extracurricular activities with EPICS, developing hands-on engineering skills and prototypes while satisfying community needs.

To take this core nature of EPICS to the next level, the IQP team proposed to establish EPICS as an official students' organization. EPICS started off with a group of around 10 students from mechanical, robotics, biomedical and electrical & electronic engineering area who came together and discussed project ideas. EPICS is also cooperating together with IQP team to maintain resources, contacts, lab operating procedures and management in order to keep the lab running as planned in the future.

EPICS is currently working on modifying the wheelchair tire to be able to drive the existing electric wheelchair on the beach. Under the assistance of Professor Hoffman, the team is looking at different options, from 3D printing detachable pile chains to redesigning a wheel hub and frame to adapt the wheel drive to bubble tires. The EPICS team goal of any design solution is to make them universal and applicable to any condition.

Figure: A close up of the wheel and hub receiving an upgrade.

Do you want to get involved in EPICS?

Please contact:

epics-officers@wpi.edu to request information!

Assistive Technology Resource Center

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