Project # : E-25-T85  
Center # : 10/24-6-R8674-0A0  
Contract # : MF-6-0040  
Prime # : DMI-9413089  

Cost share # :  
Center shr #:  
Subprojects : N  
Main project #:  

Project unit: MECH ENGR  
Project director(s): MISTREE F  

Unit code: 02.010.126  
(404)894-8412  

Sponsor/division names: WORCESTER POLYTECHNIC INSTITUTU / WORCESTER, MA  
Sponsor/division codes: 400 / 163  
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Sponsor amount  
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Title: PREPARING ENGINEERS FOR THE NEW WORKPLACE: MULTIMEDIA IN A SYSTEM ...

PROJECT ADMINISTRATION DATA

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Sponsor X GIIT  

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Security class (U,C,S,TS) : U  
Defense priority rating : NA  
Equipment title vests with: Sponsor X GIT  
NONE PROPOSED OR ANTICIPATED.  

Administrative comments -  
INITIATION OF 12-MONTHS COST-REIMBURSEMENT P.O. ISSUED UNDER NSF (TRP) GRANT.
GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

NOTICE OF PROJECT CLOSEOUT

Closeout Notice Date 10/21/96

Project No. E-25-T85

Project Director MISTREE F

Center No. 10/24-6-R8674-0A0

School/Lab MECH ENGR

Sponsor WORCESTER POLYTECHNIC INSTITUTION/WORCESTER, MA

Contract/Grant No. MF-6-0040

Contract Entity GTRC

Prime Contract No. DMI-9413089

Title PREPARING ENGINEERS FOR THE NEW WORKPLACE: MULTIMEDIA IN A SYSTEM ...

Effective Completion Date 960731 (Performance) 960731 (Reports)

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Comments

Subproject Under Main Project No.

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In this proposal we focused on ONE aspect of product realization, namely, getting students to learn how to design and build systems using available assets. But first a brief introduction to the relevant courses.

**ME 3110 Design I**: This is the first design course in our curriculum and is required for every ME student. Original design of engineering systems is the focus of the course. Major course topics include introduction to the engineering design process, design making, and synthesis and analysis methods. The students are required to design, build, and test a mechanism under competition conditions. This Quarter we have students from two Schools taking this course (Mechanical Engineering and Textile and Fiber Engineering). We are involved in making major changes to this course. The changes revolve around the development of a *Design Learning Simulator* (DLS). The DLS consists of three components - processes that are embodied in the Decision Support Problem Technique, tools that support the processes, and a domain knowledge base from which to gather information to complete tasks. The use of the DLS in a design classroom is at the very cutting edge of design pedagogy. We are developing the DLS by running a ME4901 Special Topics course concurrently with ME3110. Every Quarter we offer three sections of ME3110 to about 100 students. The Design Learning Simulator is available at:

http://srl.marc.gatech.edu/education/ME3110/me3110-Web.html

We proposed to create a component knowledge base using multi-media technology that can be accessed by the DLS. This knowledge base contains information on components such as gears, mechanisms, fasteners, shafts, motors, electrical circuits, control mechanisms, etc. Students are able to select objects from this data-base, configure a system. This is the portion of the knowledge base that is used in ME3110 by students who are learning the elements of how to design systems.

**2.0 THE DESIGN CATALOG**

The Design Catalog is now available at:

http://srl.marc.gatech.edu/education/ME3110/design-reports

/RSP/DR4/catalog/main.html
2.1 Purposes of the Online Design Catalog

The purpose of the ME3110 online catalog is to provide ME3110 students with a resource that will encourage them to use computers to accomplish more analysis on their projects while taking ME3110. This broad goal is made up of the following, more specific target goals of the project:

1. Provide a practical, useful, and convenient information resource for ME3110 students.

2. Encourage ME3110 students to gather more information which can be used in the design process to further refine designs and increase the success rate of students' projects in general.

3. Help move the ME3110 coursework and resources into a computer-based environment, as well as encourage students to use the computerized resources that are available.

4. Demonstrate some of the powerful, interactive resources that are possible through the use of the WWW as an information resource.

Keeping the first goal in mind, most of the information is presented with a qualitative and practical perspective. Critical relations are generally presented, but the larger portion of the information is general and designed to introduce a student to the most important, elementary concepts. References are provided for more in-depth information if necessary.

2.2 Layout of the Online Catalog

The online catalog is organized primarily by the type of information that is indexed. There are 6 main sections of the catalog, which correspond to the six most commonly encountered elements that are used in ME3110 projects. They are:

- Gears
- Motors
- Springs
- Statics
- Electrical and electronic components
- Fasteners

Each section contains information in most, if not all, of the following areas:

- General Information and common uses.
- Elementary theory and applicable relations.
- Useful information and application notes.
- Advantages and disadvantages.
- Commonly encountered problems and their solutions.
- Analysis tools such as online calculators or Working Model files and tutorials.
- Locations where the component can be purchased or obtained.
• WWW links of interest.
• References for more information.

Not all of these sections are always applicable, but in general most of the categories are usually present. In addition to the individual component sections, there are also three general features which help users use the online catalog:

• A comprehensive directory that lists all topics on all pages of the design catalog.
• A complete reference section that lists all of the references used in the catalog.
• A consistent and intuitive navigation scheme that allows users to easily move from one topic to another

A complete copy of the directory of the online catalog is included in the appendix, which details all of the topics that are currently available in the online catalog.

2.3 Future Features and Direction of the Online Catalog

The online catalog has a great deal of potential, especially in support of an extremely computer based and collaborative course such as ME3110. As the capabilities of WWW software and hardware increase, the online catalog can expand to present much more interactive, complex, and useful information to students of ME3110. Some future features could include collaborative design-report generation, full-featured analysis tools for all of the component types, 3-D modeling and simulation tools (the output of which could be used in the other analysis tools), inline video showing implementations of various components, vendor purchasing catalogs for the components, and databases from previous designs and analyses. Such information would allow groups to do most of their analysis in the Online Catalog environment.

3.0 OTHER ACCOMPLISHMENTS

Group Formation Database - this allows students to discover valuable information about the other members of the class so that the group forming decisions can be based on common interests and goals as well as geographical location and team skills.

Rule Clarifications - while this option has been available to the students in past quarters, all petitions and rule clarifications are now handled over the web. No paper forms were allowed, and the system has been a huge success.

Thomas Register - This is a free service that will help the students to find mechanical parts and components for the construction phase of their projects. This database contains pricing, ordering, and sizing information from literally thousands of manufacturers.

Learning Essay Environment - The learning essay environment is a web based environment that allows the students to submit their learning essays electronically. In addition, the instructors can also grade and return the essays electronically making the need for paper copies obsolete. This environment was tested this quarter on six students with limited success.
New set of design reports - Thanks to recent technology developments, the time required to produce web documents has been drastically reduced. Because of this, a complete set of design reports from this quarter's project will be available at the end of the quarter, as well as a video of the final project.

Moment Calculator - a simple calculator has been created to work over the web that will calculate the moment of inertia for different types of beams for different loading conditions. While this particular calculations may be limited, this has proved that the web can be used to assist in mathematical design problems, and that it is fairly easy to implement.

On-line Design Catalogue/Tutorial - this catalogue has reached completion. Six of the most common mechanical design parts are shown in this catalogue complete with design theory, common problems and solutions, and ordering information. The catalogue is fully searchable by text, and can be used in many phases of the ME3110 coursework.

ME4901 - Each quarter a group of students has been chosen to participate in the development of the Design Learning Simulator. These students have tried all of the new developments on the web, and have successfully completed the entire course electronically. This is a giant step for the development of the design learning simulator, and while showing us some additional problems to correct, it has been fairly successful.

AutoPEI Software - This software, written in excel, has automated the painstaking process required to create a PEI diagram. All of the bar charts and storyline are automatically created when the user sets a date for a certain phase, event, or information submission.
# Appendix 1: Directory Listing of Online Catalog Topics

## Springs
- **Helical Springs**
  - Constitutive Relations
  - Design Guidelines
  - Examples
  - Calculating the Stiffness of a Spring
  - Stresses in Springs

## Torsion Springs
- Constitutive Relations
- Calculating the Stiffness of a Spring
- Examples

## Flat Springs

## Gears
- **Types of Gears**
  - Spur Gears
  - Helical Gears
  - Bevel Gears
  - Worm Gears
  - Racks (Straight Gears)

## Basic Gear Theory
- Calculating Gear Ratios
- Gear Train Efficiency/Power Loss
- Worm Drives - Efficiency and Special Characteristics
- Using Premade Gear Trains
- Finding Gears
- Common Problems
- Using Working Model
- References

## Motors
- **Types of Motors**
- The Theory of Permanent Magnet DC Motors
- Characterizing Motors in Practice
- Places to find motors
- Common Problems when using Motors
- References

## Electrical Components
- **Passive Components**
- Batteries
- Battery Statistics
- Switches
- Transducers
- Common Integrated Circuits
- Finding Electronic Components
- References
Fasteners
Types of Fasteners
  Welding/Brazing
  Threaded Fasteners
  Adhesives/Tape
  Rivets

Basic Fastener Theory
General Theory
Adhesives Theory
Threaded Fastener Theory
Finding Fasteners
Common Problems with Fasteners
References

Static Analysis of Beams
Beam Elements-Definition
Stresses in Beams
Section Modulus Calculation
Typical Moduli of Elasticity for Common Materials
Deflections in Beams
References

References