This is the fourteenth year of the Science and Engineering Project Center. I congratulate all those within the School and outside for making this Project Center the success it is today. Welcome, all of you, and thank you for your participation.

On this, Projects Day 2001, we present the results of student work sponsored by industry, government, and other agencies, and developed by senior students in the science and engineering design program at Seattle University. This is a wonderful opportunity for our students to share with you the results of their hard work.

We are grateful to our sponsors — those who are veterans at sponsoring our projects and those who are new this year. It is a tribute to your faith in our students, and in the quality of their work, that you choose to invest your time and resources in these projects.

This senior capstone experience is perhaps the most important learning experience for our students in culminating their careers at Seattle University. Working in small groups, solving open-ended problems that may not have a unique solution, and being responsible to strict timelines, budgets, and the needs of outside agencies, are excellent preparations for the professional positions our students will soon fill.

Congratulations to our faculty, students, and professional mentors for bringing these challenging projects to fruition and to success.

George Simmons, Dean
School of Science and Engineering

On behalf of our faculty and students, I also welcome you to Projects Day 2001, our annual presentation of design team results to sponsoring organizations, visitors, and friends. I am grateful for the encouragement and assistance provided by our Science and Engineering Advisory Board and the Project Center Advisory Committee in promoting the external sponsorship of our projects. I would also like to acknowledge the coordination efforts of professors Rolf Skrinde in Civil and Environmental Engineering, Al Moser in Electrical Engineering, Teodora Rutar Shuman in Mechanical Engineering, Everald Mills in Computer Science, as well as Sheridan Botts, contracts manager, and Kathy Fletcher and Jim Austin, administrative assistants for the Project Center.

Special thanks go to the students in our engineering organizations who are your hosts today and who volunteer to carry out many of the tasks associated with our Projects Day celebration. These student societies are the American Society of Civil Engineers (ASCE), American Society of Mechanical Engineers (ASME), Institute of Electrical and Electronics Engineers (IEEE), National Society of Black Engineers (NSBE), Society of Environmental Engineers and Scientists (SEES), Society of Women Engineers (SWE), and Tau Beta Pi.

Patricia D. Daniels, Director
Science and Engineering Project Center
SCHEDULE

9:00 A.M. LEMIEUX LIBRARY FOYER
Projects Day Registration, project displays

9:15 A.M. – 10:45 A.M. SCHAFER AUDITORIUM
ALSTOM ESCA Corporation
ATL Ultrasound
Vopak USA Inc.
US Coast Guard
Harris Group Inc.
SCADA Management Platform Relay Interface
Prediction of Scanhead Surface Temperatures
Pipeline Pigging to Clean Small Diameter Lines
Alternative Power for Remote USCG Stations
Fuel Recovery from Wastewater Treatment

10:45 A.M.
Break

11:00 A.M. – 12:30 P.M. SCHAFER AUDITORIUM
Seattle Public Utilities
Sound Transit
WSDOT/WOW
AT&T Wireless Services
Better Lifestyles, Inc.
Haller Lake Drainage Improvements
Conceptual Design of Capitol Hill Light Rail Station
Iron Goat Scenic Trailhead and Rest Area
Mobile Load Test Bank
Automatic Switching for Toilet Bowl Exhaust System

11:00 A.M. – 12:30 P.M. STIMSON ROOM
Pratt & Whitney
Boeing, Commercial Airplanes
Amazon.com
Boeing, Phantom Works
Cybergroup/Children's Hospital
Flow Visualization in Pulse Detonation Engines
Pilot Control Test System
Amazon Knowledge Network
Quick Look Processor
Dreamsurfer Network

12:30 P.M. LEMIEUX LIBRARY FOYER
Buffet Lunch

1:30 P.M. – 3:30 P.M. SCHAFER AUDITORIUM
ELDEC Corporation
Honeywell
Kenworth Truck Company
Medtronic Physio-Control
Siemens Medical Systems, Inc.
Thermal Test Monitor Software
High Speed Data Stream Format Converter
Interface to Fingerprint Identification Sensor
Smart Test Load for Defibrillators
Ultrasound Scan Processing

1:30 P.M. – 3:00 P.M. STIMSON ROOM
Engineered Software, Inc.
PNNL – Battelle
WISDM Corporation
Project Magnus
Metadata Viewer and Editor
WISDM Requirements Software
ALSTOM ESCA is a company specializing in real-time control systems for electric utilities. They wanted an improved way to move data from power system relays into their Supervisory Control and Data Acquisition (SCADA) Management Platform (SMP) database and to allow relay engineers and technicians easy and efficient access to that data. The team developed the RelayBridge application to bring data from a relay to the SMP database, and the WebBridge application to allow web browser access to that data. The legacy system required a technician to individually dial into every relay in their system to retrieve its data. The new system allows easy web access to data from all of the relays in the system at once.

For safety concerns of the patient and FDA regulations, the surface of an ultrasound scanhead must not exceed 41°C when in contact with the patient’s skin. ATL Ultrasound desires to improve its existing temperature testing which measures the conditions of the scanhead as it approaches 41°C. Current thermal testing is excessively time-consuming and not cost-effective. ATL Ultrasound asked the team to develop a method to predict surface temperatures of ultrasound scanheads based on various conditions of the pulse patterns sent to the scanhead. The team analyzed different methods of curve fitting using reference data of past temperature measurements and developed an algorithm to accurately predict surface temperature using the unique characteristics and variables of each discrete transmit pattern.

Vopak uses small diameter pipelines and hoses at its chemical distribution centers nationwide. They must clean these pipelines so that various chemical products can be transported sequentially through the same lines with a minimum of product contamination. Vopak asked the team to adapt the technology of pipeline pigging, a physical/mechanical cleaning method, to clean the lines. The team evaluated various pigs and launching and receiving systems. Pig launching and trap design guidance notes and cost estimates provided by the team will be used by Vopak to construct appropriate equipment for the various distribution centers. The team then developed a pigging procedures manual for distribution center operators.
The United States Coast Guard is responsible for maintaining numerous electrical generating power systems in the support of providing safety at sea. The Coast Guard operates diverse power systems ranging from lighted buoys powered by car batteries and solar panels, to radio receiving/rebroadcasting antennas using commercial power, to one megawatt electronic navigation systems (LORAN) utilizing diesel generators. Most generators, in particular, are characterized as inefficient, environmentally unfriendly, and aging. Because of this, the USCG has requested that the team conduct a feasibility study on alternative power technologies. The technologies considered include fuel cells, wind turbines, wave generators, photovoltaic and geothermal systems. The study includes research, technical requirements, vendor information, economic analysis, environmental concerns, as well as the feasibility of implementing the technologies over the next 15 years. A computer program was developed to aid the USCG in deciding which technology best suits a given application. The project deliverables will support the goal of powering all USCG communication stations with environmentally friendly generators.

The Harris Group has developed a solid waste facility that will convert municipal solid waste into fuel-grade ethanol and carbon dioxide through a concentrated acid hydrolysis-fermentation process. The high-strength industrial wastewater leaving the fermentation process must be treated prior to being discharged to the city's wastewater treatment plant. The team recommended a methane-generating anaerobic treatment technology for the wastewater and has performed a cost/benefit analysis for the process. This team also evaluated the potential toxicity of heavy metals present in the ethanol fermentation waste stream to the anaerobic treatment process and found that the expected concentrations of copper (II), chromium (III), zinc and nickel will not inhibit methane production.
Seattle Public Utilities (SPU) is responsible for the management of city-owned storm drains throughout Seattle's city limits. The Meridian Avenue North storm drain, which empties into Haller Lake, is a public drain that falls within SPU's jurisdiction. Recently, citizens of the Haller Lake community have voiced concern that urban stormwater runoff has degraded Haller Lake's water quality. SPU has acknowledged these concerns and wishes to assess and correct the possible contamination to ensure the water quality of the lake. SPU asked the team to monitor the stormwater entering Haller Lake via the Meridian Avenue North storm drain and identify stormwater contaminants. Based on the monitoring data, a preliminary engineering analysis was conducted and a stormwater treatment system was designed to achieve the best possible reduction in targeted contaminants. The system was designed according to the Washington State Department of Ecology's and the City of Seattle's stormwater guidelines.

The Puget Sound region has an increasing need for rapid transit. Thus, Sound Transit is planning to construct a light rail system, the Link Light Rail, which will run from the University District to SeaTac airport. Due to public sentiment and the rising costs, Sound Transit decided to move the Capitol Hill Station from East Broadway Street to Nagle Place, one block to the east. The objective of the design team was to carry out a preliminary engineering study and develop a conceptual design for the new station. The design team studied the vicinity around Nagle Place and decided on the best location for the station. In deciding the station location, several major concerns were addressed. The underground utilities in the area were located and strategies were developed to either protect or relocate these utilities. Limited geotechnical and structural issues were addressed. The environmental impacts on the surrounding community were studied. The team then developed a conceptual design of the station and submitted its recommendations to Sound Transit along with a set of preliminary drawings of the station.
The Iron Goat Trail is an accessible hiking trail located on the abandoned Great Northern Railroad grade in the Stevens Pass Historic District. Volunteers for Outdoor Washington and the Mt. Baker-Snoqualmie National Forest, in conjunction with the Washington State Department of Transportation, seek to provide a trailhead and rest area access from U.S. Highway 2 near Scenic, Washington. The team prepared design plans, specifications, cost estimates and a design report as an integral part of a funding proposal for a U.S. Federal Highway Administration National Scenic Byway Grant. The design provides an aesthetically pleasing, barrier-free trail access and rest area for visitors that enhances the historic and environmental attributes of the site. The facility includes an access road and parking for 60 vehicles, vault-toilet restrooms, picnic tables, solar-power lighting, an information kiosk, stormwater detention and water quality mitigation, and additional amenities.

AT&T Wireless Services wants to develop a working prototype of a load bank suitable for use with its test systems. Designing such a system allows AT&T Wireless Services to improve the quality of services and increase customer satisfaction. To achieve this, AT&T Wireless Services asked the team to plan, design, and develop a device that will incorporate multiple cellular modules in order to provide mobile phone signals to test one or more of their radio-based network elements. The project team researched and designed a multiple-unit test bank, which includes a case, terminal server, power supply, printed circuit boards, and phone modules as its major elements. Team members considered electrical, thermal, and radio isolation concerns throughout the design process.

Better Lifestyles developed a manually operated toilet bowl exhaust system to eliminate odors and reduce airborne microbes. They asked the team to automate this system. The team designed, tested, and put into operation an automatic switching circuit to operate the exhaust system vacuum motor. The switching circuit operates the motor at 60 volts AC when a user is present, and up to 120 volts AC for one minute during the flush cycle to capture airborne microbes. In addition, the team equipped the vacuum motor with a moisture detection switch to shut down the motor if the toilet bowl overflows.
The Pratt & Whitney Aerosciences Center in Bellevue, WA, is currently testing a prototype pulse detonation engine. Unlike conventional rocket propulsion engines, which operate on a continuous fuel burn process, pulse detonation engines operate in cycles. A fuel/air mixture is injected into the combustion chamber where detonation is initiated with a spark. The high-speed detonation results in very high pressures and temperatures that force exhaust from the chamber, providing thrust. Pulse detonation engines are currently being tested for use in military, space and power generation applications. Pratt & Whitney asked the team to design and build a non-intrusive optical system capable of providing images of combustion/pressure waves and fuel/air detonation processes based on differences in fluid density inside the combustion chamber. The team designed and constructed a focusing schlieren optical system capable of providing these photos. These images will complement the readings obtained with pressure transducers and thermocouples that measure combustion/pressure wave motion and the fuel/air detonation process inside the combustion chamber. The information from the Schlieren system will help to increase the overall efficiency of Pratt & Whitney's pulse detonation engine.

The Boeing Commercial Airplanes Group designs and builds flight simulators to train pilots. A pilot uses the aircraft's control column to vary the aircraft's pitch. Accurate tactile response of the column in a flight simulator is necessary to achieve the high degree of realism required for pilot training. The team developed a specialized test device capable of automatically driving the control column in a repeatable manner, with a known force profile, while measuring and recording the positional response of the column. The test device is relatively lightweight and portable, and designed so that it can be quickly and easily installed in the flight deck of either a flight simulator or an aircraft. The test device will be used primarily to verify the accuracy of the column response in flight simulators, but may also be used to collect data from real aircraft to validate and refine existing flight simulator pilot control models.

In recent years, many companies have leveraged the Internet to further educate their employees. Amazon.com has developed a web-based application, together with the Saba Learning Enterprise, to provide online training content to its employees. In the first phase of this project, the team improved the functionality, user interface, and theme of the application. In the second phase, they developed and implemented a testing template. The template utilized Macromedia's Dreamweaver.
4 and an AICC compliant testing format and reported data to an Oracle database using ODBC. In the third phase of the project, they modified and developed reports using Crystal Reports Developer. These reports convey vital data to the appropriate user in a flexible and comprehensive manner. Then the team tested and integrated all of the development changes into the Amazon.com production environment. They also provided information documenting the modifications and additions to the application.

PROJECT NUMBER: CSSE 01.3
PROJECT TITLE: Quick Look Processor
SPONSOR: The Boeing Company, Phantom Works
SPONSOR LIAISON: Dale Karr
FACULTY ADVISOR: Prof. Mitchell Spector
STUDENTS: Hsin-yi Berg, Chan Chaiyochlarb, Kevin Cheung, Gabe Ingram, Colin Thorgerson.

Boeing's Phantomworks creates hardware and software products for military use. The Quick Look Processor is a visualization and testing tool for the 'Single Integrated Air Picture', which combines data from several radar sites to create a unified air picture. The team was asked to convert Boeing's previous Quick Look Processor from the language Tcl to Java, as well as enhancing its data collecting and recording abilities. The improved system gives Boeing greater power, flexibility, and extensibility in the Quick Look Processor.

PROJECT NUMBER: CSSE 01.4
PROJECT TITLE: Dreamsurer Network
SPONSOR: Cybergroup, Inc. and Children's Hospital
SPONSOR LIAISONS: Greg Bean, Andrea Everton, Bonnie Shultz
FACULTY ADVISOR: Prof. Susan Reeder
STUDENTS: Tanna Giroux, Brandon Loo, Roy Mamuad, Margaret Streckenbach, Matt Vahlsing

Dreamsurfer Network's mission is to help develop and nurture hospital based support groups for seriously ill adolescents through an interactive and innovative Web site. The Dreamsurfer Network currently links support groups throughout the United States in an encouraging, confidential, counselor supervised setting. The team modeled the Dreamsurfer desktop site and linked the current tools to a site accessible via handheld devices. This allows mobile access for teens confined to hospital beds or without desktop computer access. With the guidance of Cybergroup, a copy of the network was transferred to Seattle and alterations to the site were made. The product was taken for testing to the Dreamsurfer teens at Children's Hospital in Seattle, and the wireless site was transferred back to Cybergroup to be implemented alongside the desktop network.
Because of critical safety concerns in the aviation industry, ELDEC thoroughly tests all of its products under a wide range of environmental conditions. The current test station for temperature and vibration has a controller based on the DOS operating system that continues to run even after a unit under test (UUT) failure. There is no automated test failure notification to a technician. The objective of this project was to improve the efficiency and reduce the cost of ELDEC's thermal test operations. The team used C++ and LabVIEW on a Windows NT workstation to design a top-level software. Thorough testing demonstrated that this software will perform a controlled shutdown of the thermal chamber and notify a technician via a pager when a test fails.

Aircraft use various data formats to transmit information to the black box data recorders. Honeywell needed a means to convert a data stream from one format to another. The team designed and built a circuit to convert a digital, serial 12-bit data stream ARINC (Aeronautical Radio Incorporation) 573/717 into a digital 32-bit ARINC 429 data stream. The 429 word contains the original 573/717 word, with the addition of other information. The team used VHDL code to program a chip to do the conversion.

Each year, clients of Kenworth Truck Company report high turnover rates of truck driver employees, with many companies averaging nearly 100%. As a result, problems arise when drivers and vehicles must be reassigned since locks and keys to the trucks must be duplicated each time. Moreover, security becomes an issue if old drivers fail to return their keys. Kenworth wishes to address these concerns by replacing the traditional “lock and key” system in their T2000 truck line with a fingerprint verification system based on the MVI100 fingerprint identification sensor by Biometrics. The objective of this project was to implement the interface between the fingerprint sensor and the truck's control system. After considering different alternatives, the final design consisted of an LCD/keypad user interface based on the Motorola 6811 microprocessor. This design choice produced a simple, user-friendly, expandable and programmable interface with the identification sensor.
EE 01.7
Smart Test Load for Defibrillators: Design and Testing
Medtronic Physio-Control
Scott Eby
Prof. Robert Heeren
Wyatt Erickson, Josey Sandoval, Eleazar Santos, Scott Wolf

Medtronic Physio-Control specializes in the design and manufacture of accurate cardiac tools that help save lives. The company currently manufactures a line of defibrillators that produces a new pulse waveform, which the current test load does not monitor accurately. The company asked the team to redesign the test load to more accurately monitor the new pulse waveform. The team redesigned the circuit using non-inductive low tolerance resistors and high accuracy instrumentation amplifiers. The new test load design produces an accurate representation of the new pulse waveform and also a better low frequency response for the old waveform.

EE 01.8
Ultrasound Scan Processing
Siemens Medical Systems, Inc., Ultrasound Group
Dr. Doug Hewett
Prof. Paul Neudorfer
Emmanuel Elmido, Jason Nguyen, David Truong, Man Wong

Siemens Medical Systems is dedicated to improving the science of medicine through advances in diagnostic ultrasound. Siemens' ultrasound group seeks to develop an automated selection of specific filtering parameters for ultrasound transducer data using Matlab. Currently, Siemens manually determines the proper local oscillator frequency and bandwidth of the transducer's data. This is considered imprecise, inefficient, and time consuming. The design team generated a Matlab program that automatically segments the transducer data, applies an FFT algorithm to generate a series of spectral representations, and selects the local oscillator frequency and the upper and lower frequencies of the bandwidth. The result of this algorithm can be used to create bandpass filters for the preprocessing of signals in Siemens Ultrasound instrumentation.
Project Magnus

Engineered Software, Inc. produces applications used to design, analyze, and troubleshoot fluid piping systems. Their Pump-Flo application software relies on pump data provided by pump manufacturers. This critical information is typically calculated by hand and is a long, tedious, and error-prone process, often taking vendors many months to deliver. The team developed an interactive Windows-based application that automates the process of calculating test and family curves; displays the generated curve data; and stores the results to a database, which can then be exported to Engineered Software's Pump-Flo application. Automating this procedure saves the vendors much time and effort and also supplies Engineered Software with data in the form their application requires.

Metadata Viewer and Editor

Pacific Northwest National Laboratory uses a hierarchical storage management system called SDMExplorer. A distributed client-server application, SDMExplorer runs in a mixed hardware, software, and networking environment. SDMExplorer provides scientists with the capabilities to access and view archive files and metadata describing the contents of the archive. However, the metadata must be viewed in an external editor in order to modify it, which is slow and time consuming. PNNL would like an application that will work in conjunction with SDMExplorer, allowing users to view, modify, and save the metadata in a more useable way. PNNL also requested that the application be able to run on multiple platforms and dynamically display the metadata. The project team researched various solutions for providing these extra capabilities and has concluded that Mozilla XPToolkit is best equipped to meet the demands of the problem. XPToolkit allows for the dynamic display of metadata content based upon a schema and can run on a wide variety of platforms.

WISDM Requirements Software

The WISDM Corporation conducts workshops and provides specialized software for the development of requirement specifications. WISDM asked the team to design and develop the second release of their WISDM Requirements Software, Version 3.0. The team used Java SDK and an Oracle 8i database to develop Release 2 of the WISDM Requirements Software, Version 3.0. This solution provides the option of a web-based or stand-alone desktop application to aid WISDM workshop facilitators and their clients in the development of requirement specification documents.
SPONSORING ORGANIZATIONS AND LIAISONS

We want to acknowledge with special thanks the organizations that sponsored projects in 2000-2001, and especially the liaisons representing the sponsors, who worked with the students throughout the year. The time these liaison representatives spent in consultation with our teams is much appreciated by the students and their faculty advisers. It is the liaisons who provide the history and background of each project, its relationship to other work in the sponsoring organization, and much of the technical direction that makes a project successful.

ALSTOM ESCA Corporation, Emmanuel Pinault and Rob St. Andre
Amazon.com, Garrett Stokes and Nick White
AT&T Wireless Services, Ian King
ATL Ultrasound, Kevin Lantz and Kurt Sandstrom
Better Lifestyles, Inc., Britt Cardwell
The Boeing Company, Commercial Airplanes Group, Dan Cartmell
The Boeing Company, Phantom Works, Dale Karr
Cybergroup, Inc., Greg Bean and Andrea Everton
Children’s Hospital and Regional Medical Center, Bonnie Shultz
ELDEC Corporation, George Pavlakos and Andrew Siguenza
Engineered Software, Inc., Carolyn Popp
Harris Group Inc., John Lukas and Andrea Slayton
Honeywell, Wendell Frost and Tehmosp Khan
Kenworth Truck Company, Ted Scherzinger
Medtronic Physio-Control, Scott Eby
Pacific Northwest National Laboratory – Battelle, Judi Thomson
Pratt & Whitney Seattle Aerosciences Center, Scott Henderson
Seattle Public Utilities, Darla Inglis and Beth Schmoyer
Siemens Medical Systems, Inc., Doug Hewett
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United States Coast Guard, Debra Chinn, Ed Smith, and Carl J. Uchytil
Vopak USA Inc., Paul Camera
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