12-2002

31st Conference on Senior Engineering Design Projects

College of Engineering and Applied Sciences

Senior Design Project

The 31st Conference on Senior Engineering Design Projects

The 31st Conference on Senior Engineering Design Projects
You are invited to attend the thirty first Conference on Senior Engineering Design Projects. The conference will be held from 9 a.m. to 3.30 p.m. **Tuesday, December 3**, **2002** at the Bernhard Center on the campus of Western Michigan University. The College of Engineering and Applied Sciences sponsors the conference to showcase the work of its graduating seniors, who are required to complete a capstone project that puts into practice what they have learned. Many of the projects are sponsored by business and industry.

The conference is **free** and open to the public. You are welcome to attend all or part of the day's events. Reservations are not necessary.

High school and community college teachers are encouraged to bring students to the conference. Buses can drop off passengers in the circular drive in front of the Bernhard Center and then park in the lot in front of Hoekje Hall.
(See map - take North Dormitory Road. Hoekje is #65 on the map.)

Teachers who cannot accompany their students to the conference may ask their students to sign in and out at the information table in the lobby on the second floor of the Bernhard Center. Sign-in sheets will be mailed to teachers the day after the conference.

Parking is available in the ramp near the Bernhard Center. Please park in metered spaces. There is a charge for parking. Meters accept quarters only.

Presentations begin on the hour and half hour. Please do not enter a room after a presentation has begun.

Session locations, starting times for project descriptions:

Construction Engineering	242	9:00 to 10:00
Electrical and Computer Engineering	208	9:00 to 11:30
Industrial and Manufacturing Engineering	209	9:00 to 3:30
Materials Engineering	242	10:00 to 10:30
Mechanical Engineering and Aeronautical Engineering A-I	210	9:30 to 2:30
Mechanical Engineering and Aeronautical Engineering B-I	211	9:30 to 11:30
Paper Science and Engineering	242	11:30 to 12:00

Refreshments will be available in the lobby from 8:30 a.m. to 10:30 a.m.

A **lunch** break is scheduled from noon to 1 p.m.

For more information about the conference, call Cathy Smith at (269) 387-4017.

Click here to see the schedule of the individual presentations

Alectronics Inc.	Arlie F.Casey
Clarion Technologies Inc.	Copper Development Association, Inc

Denso Manufacturing Michigan, Inc
FEMA Corporation
Kalamazoo Center for Medical Studies
Pharmacia Corporation
Stryker Instruments
The Village Link
Whirpool Corporation
Engineered Plastic Components Inc.
Flowserve Corporation
National AMBUCS, Inc
Whirlpool Corporation
Sweet Manufacturing
Wesley Foundation of Kalamazoo

CONSTRUCTION ENGINEERING

Session Chair - Osama Abudayyeh
Room 242

ESTIMATING AND SCHEDULING FOR THE NEW ENGINEERING BUILDING

by Stephen Price, Scott Stelter, and Stacey Teufel
Faculty Advisor: Osama Abudayyeh
9:00 a.m. to 9:25 a.m., Room 242

The time and money required to build one wing of the College of Engineering & Applied Science's building was estimated according to the plans and specifications released. Preparing this estimate consisted of the following tasks: familiarizing ourselves with every detail of the specifications, developing a work breakdown structure, creating a construction sequence, identifying the critical path(s), quantifying and pricing materials and labor, and developing a project management system.

PHASE 2: ACTIVE PHARMACEUTICAL INGREDIENTS - LOW ENDOTOXIN WATER (API-LEW) SYSTEM UPGRADE

by Joshua Myers and Andrew Rossell
Faculty Advisor: Osama Abudayyeh
9:30 a.m. to 9:55 a.m., Room 242

A cost estimate and detailed schedule was developed for Phase 2 of three phase API-LEW system upgrade. Phase 2 deals with the distribution of the water to the production areas. A project management system was also set up which included a safety program and a system for reporting and verifying all work that has been completed in the field.

ELECTRICAL AND COMPUTER ENGINEERING

Session Chair - John Gesink
Room 208

MAZE MAPPING MOBILE ROBOT

by Ahmad Najib Jarrad, Abdullah Yahya Marta, Roshini Naidu, and Jay Otto
Faculty Advisor: Frank Severance
9:00 a.m. to 9:25 a.m., Room 208

An autonomous mobile robot that is able to traverse through a rectangular maze was designed and built. Using a sensor array as its guide and a microcontroller as its decision maker, the robot is able to avoid obstacles, automatically align itself and detect, memorize and determine its pathway. Upon exiting the maze, the robot can be connected to a PC, which will then print a map of the discovered maze.

CONTROL OF AN INVERTED PENDULUM
by Ho Wei Hann, Tan Ban Kee, and Jason Ho Wye Meng
Faculty Advisor: Ralph Tanner
9:30 a.m. to 9:55 a.m., Room 208

The inverted pendulum is a classical control problem. The pendulum is a one-dimensional element, that is, movement is restricted to a single rotational axis. The angular and traverse displacement of the system is detected through the use of two encoders. The inputs gained from these encoders are then transmitted into an evaluation board, which uses a microcontroller to process the controls scheme. The system's angular and traverse velocities are also calculated by the microcontroller. Pulse-width modulation (PWM) was used to set the required output to the motor, which moves according to the balance of the pendulum. The control system was programmed in assembly language and the control-loop was built upon state-space theory.

DEVICE TO MEASURE CHARACTERISTICS OF A DC MOTOR
by Bushra Khalid Choudry, Muhammad Saufi Mudzafar, and Shana M. Zainal
Sponsor: Chris Philipp - Stryker Instruments
Faculty Advisor: Raghvendra Gejji
10:00 a.m. to 10:25 a.m., Room 208

Product testing of a DC motor for surgical equipment requires three separate devices. These devices measure speed, temperature, and running time of the motor. A unit was designed, built, and tested to incorporate the functions of the three separate devices into one. This unit can measure and display the three characteristics of the DC motor simultaneously. Powered by a microprocessor, it reduces set-up time and offers portability to the user.

ELECTRICAL SYSTEM POWER MONITORING
by Michael Kelly, DeLance Lenyard, and Greg Pattison
Faculty Advisor: Ted Sarma
10:30 a.m. to 10:55 a.m., Room 208

A college campus needs to monitor electrical power usage on university grounds in an effort to pinpoint power consumption and waste. Over 100 Siemens power meters were installed in buildings across the campus to monitor energy usage. A Web-based interface was designed to collect data from the meters providing real time data readings for online display, reports, and e-mail alarms. In addition, an adjustable and accurate exterior lighting sensor was designed to control the outdoor lighting. It will replace less sensitive commercial sensors currently in service, providing a more accurate light threshold to reduce energy waste.

REGENERATIVE BRAKING SYSTEM FOR A HYBRID ELECTRIC VEHICLE (H.E.V.)
by Scott Brondyke, Shane Evens, and Deacon Hobbs
Faculty Advisor: Joseph Kelemen
11:00 a.m. to 11:25 a.m., Room 208

A regenerative braking system was designed and built for an H.E.V. The system uses the vehicle's electric motor as a generator to cause braking and converts kinetic energy (normally lost to friction) to electrical energy to charge the battery system. The braking force of the hydraulic and regenerative braking systems is proportioned. The end result is an H.E.V. that can travel greater distances because of the additional charging of the batteries from the braking system.

WIRELESS IGNITION PYROTECHNIC SYSTEM (WIPS)
by Dan Lull, Aaron Paluzzi, and Robert Warn
Sponsor: Edward Whobrey - Nite Lites Pyrotechnics
Faculty Advisor: Dean Johnson
11:30 a.m. to 11:55 a.m., Room 208

Typical firing systems used in the pyrotechnic industry require expensive disposable igniters and cumbersome cables. A modular and wireless ignition pyrotechnic system (WIPS) was designed to allow ultimate flexibility during setup. A central control module provides a simple user interface of 128 field addressable modules independently. Each field module is entirely self-contained and reliably ignites pyrotechnic materials at a range of 1,000 feet using ordinary batteries. Coordination of commands and security over the radio frequency channel used in communication between modules was accomplished through microprocessor control. A custom antenna was designed to specifically direct signal power and meet FCC power guidelines during transmission of information.

FLEXIBLE ELECTRICAL AND COMPUTER SOFTWARE PROGRAMMABLE TRANSCEIVERS
by Mike Ellinger, James Etters, and Eric Juntunen
Faculty Advisor: Bradley Bazuin
1:00 p.m. to 1:25 p.m., Room 208

The Flexible Electrical and Software Programmable Transceiver (FEAST) project is aimed at advancing both research and educational opportunities in wireless communications. The FEAST II project focus is on the development of RF and analog components for radio transceivers and advancing the all-digital, "software radio" signal processing within the system. The FEAST wireless transceiver consists of RF signal downconverters and upconverters, high speed analog-to digital and digital-to-analog converters, hardware digital signal processing IC's, and real-time software signal processing.

SELF-DIAGNOSTIC CONTROLLER
by Ming Kai Chai, Byong Yong Jung, and Abhishek Man Shrestha
Sponsor: Jeffrey C. Fields - Whirlpool Corporation
Faculty Advisor: Janos Grantner
1:30 p.m. to 1:55 p.m., Room 208

A Self-Diagnostic Controller (SDC) was designed to continuously monitor a refrigerator for failures in the electrical system as well as failures in the controller itself. When a failure is detected, the SDC will provide a clear text message indicating the type and location of the malfunction through a Liquid Crystal Display.

A FOOLPROOF LABELING SYSTEM DESIGN AND OPERATION
by Bridgette Marsh, Chris McCall, Marty Rippee, and Solange Yohali
Sponsor: DENSO Manufacturing Michigan, Inc.

Faculty Advisor: Norali Pernalete
2:00 p.m. to 2:25 p.m., Room 208

A new labeling system was developed to eliminate batch printing of labels and to avoid mislabeling errors. The existing system consisted of assembly stations, a testing station, and unloading stations. A barcode scanner, a thermo printer, and a Programmable Logic Controller (PLC) were added to this. The user interface for the design was the PanelviewÓ touch-screen display. The Foolproof PLC communicated with the Testing PLC through the input-output card. It was programmed to make the correct decision and send a string to the printer that issued the appropriate label. The new controls provided more accuracy, better efficiency and greater flexibility.

VIRTUAL HOCKEY SIMULATOR
by Ryan Lynn Chamberlain, Anthony Duane Macklin, and Mark David Patrizi
Faculty Advisor: John Mason
2:30 p.m. to 2:55 p.m., Room 208

The Virtual Hockey Simulator is the first interactive hockey simulation. Through the use of an array of infrared sensors, which are controlled centrally by a microcontroller, the user can feel the realistic intensity only seen in a real-life hockey game. The user will see a simulated shot on a monitor, through the use of Visual Basic, and have to "make the save" by covering the appropriate region of the goal. This product implements the latest technology to provide a heart-pounding leisure time activity.

METAL OXIDE-BASED ELECTRONIC NOSE
by Joseph Davenport, Shakil Hossain, and Brent Meyer
Faculty Advisor: Massood Zandi Atashbar
3:00 p.m. to 3:25 p.m., Room 208

A sensor research laboratory required an efficient system for testing signals received from an "electronic nose" made up of an array of metal oxide sensors. The nose was placed in a testing chamber to detect target gases in a controlled environment. A microcontroller and a digitizer were used to interface the sensors with a personal computer. Computer-aided signal analysis was performed to identify and quantify the concentrations of the individual gases within the mixture. Results of the analysis were then presented in a user-friendly format using LabVIEW software. This project will aid future testing of gas sensors based on a variety of different principles involving nano-technology.

THREE-AXIS ACCELERATION SENSOR DATA ACQUISITION SYSTEM
by Gerald Adam Covington, Vernen Ray La Belle, and Ryan Od'Neal
Faculty Advisor: Johnson Asumadu
3:30 p.m. to 3:55 p.m., Room 208

A data acquisition system was designed and built that collects and sends three-axis motion data to a computer-based system. This system is comprised of a sensor unit that sends data as it has been collected and a receiver that is connected to a computer's parallel port. The sensor unit contains a microcontroller, a gravity switch, the accelerometers, a radio transmitter, and an antenna. This system can be extended to help with other remote data acquisition needs.

INDUSTRIAL AND MANUFACTURING ENGINEERING
Session Chair - Betsy Aller

Room 209

DOOR CLOSER ADAPTATION
by Alexandrea Arrandale, John Klender, Amy Szejbach, and Marcy Teer
Faculty Advisor: Alamgir Choudhury
9:00 a.m. to 9:25 a.m., Room 209

Door closer mechanisms are commonly used for closing doors safely without manual input. Due to safety and reliability concerns, the designs of such devices are generally large and unattractive. Adapting a door closer to be concealed from view may improve the form attributes of its installation (such as aesthetics, space-saving, and architectural integration with its surroundings) without compromising elements of its function. While incorporating effective management and using the overall design process, an alternative, hidden, door closer was designed and simulated in a virtual environment: a prototype was fabricated; and its functionality was evaluated.

DESIGN AND FABRICATION OF A FUEL INJECTION TEST BENCH
by Derek Crawford, Dean Huizenga, Sean Tucker, and Richard Williams
Faculty Advisor: James VanDePolder
9:30 a.m. to 9:55 a.m., Room 209

Due to the variables of the mechanical fuel injection system used in Super Modified racecar competition, a fuel injection test bench was designed and fabricated using actual components of the system. The goal was to reproduce the system's shortcomings and improve control of the air/fuel ratio. The test bench utilizes a Hilborn mechanical fuel injection system and all related components to create a stand-alone operating system for analysis. The project included the design of the fixture, material selection, determination of all test components, fabrication, and fitting of all necessary components on the test bench. The design mandated that the unit use available power, safety, and space requirements and provide pertinent information as requested by the users. The completed test bench meets all the design requirements and allows a full system test of the Hilborn mechanical fuel injection system.

ISO 9000 CONCEPT APPLIED TO A JOINT COMMISSION ON THE ACCREDITATION OF HEALTHCARE ORGANIZATIONS (JCAHO) STANDARD
by Derek Contizano, Christopher Giles, and Shannon Sanborn
Sponsor: Cherie Trippy - Kalamazoo Center for Medical Studies
Faculty Advisor: Fred Sitkins
10:00 a.m. to 10:25 a.m., Room 209

To satisfy the needs of an area hospital that is striving for JCAHO certification, a convention was designed for assessing the level of risk associated with different medical devices. A preventative maintenance schedule was then created for a device from each category. The preventative maintenance schedule included manufacturer recommendations, as well as information provided from other hospitals. This project is a pilot program that will develop into a hospital wide preventative maintenance and training policy.

FEASIBILTY STUDY FOR MAGNESIUM DIE CASTING
by Katie Crabtree, Danielle Jaskot, and Stephanie Morrison
Faculty Advisor: Kailash Bafna
10:30 a.m. to 10:55 a.m., Room 209

Due to the development of new alloys, the price of magnesium has fallen, leading the automotive industry to consider making more and larger parts from this material. The company currently produces

die-castings on machines ranging in size from 450 to 800 tons. The team studied types of products that can be manufactured on the existing equipment. The current market conditions for magnesium die-casts were investigated, and a feasibility study regarding the company's abilities to meet the changing market demands was developed. Finally, the project generated a recommendation in terms of the company's ability to move forward to serve the market.

MULTI-ATTRIBUTE PRODUCT COMPARISON USING ANALYTICAL TECHNIQUES
by Robert Baker, Metz Manurung, and Jesse Williams
Faculty Advisor: Steven Butt
11:00 a.m. to 11:25 a.m., Room 209

A local hospital sought to improve its ability to select the best available equipment. Product comparisons and recommendations were based on multiple criteria. Three possible solution methods were considered in the analysis: Data Envelopment Analysis, the Analytical Hierarchy Process, and the Rank-Based Method. A computer model was developed to aid in the hospital's future product selections. Equipment to be purchased in the future may range from low cost, high volume products to high-end specialty products.

IMPLEMENTATION OF LEAN MANUFACTURING IN A JUST-IN-TIME PRODUCTION ENVIRONMENT
by Darren Kahl, Malgorzata Sieminska, Jimy Jap Suwarno, Mohammed Faizan UlHaq, and Jerome Swie King Yan
Faculty Advisor: Colleen Phillips
11:30 a.m. to 11:55 a.m., Room 209

A local manufacturer of automotive parts desired to increase the productivity of its plastic molding assembly lines. Time studies were conducted on two lines delivering two styles of air conditioning registers to identify the bottlenecks and balance the distribution of work on the lines. Data from the time studies were used as input to the simulation to determine the effect of alternative modifications on the productivity of the lines. Alternative modifications included redesign of the layout, implementation of various lean manufacturing principles to improve line flow, reduced operation costs, increased line efficiency, and utilization of the floor space. Statistical analysis was used to identify the set of alternative modifications chosen.

SOLAR CAR CHASSIS DESIGN
by David Knapp, Ndjeka Luhahi, Jason Porter, and Jeffrey Samler
Faculty Advisor: Mitchel Keil
1:00 p.m. to 1:25 p.m., Room 209

A solar car needs to be reliable while sustaining a minimal amount of weight to be competitive. The chassis for a solar car designed using CAD software based on the use of tetrahedral trusses. The tetrahedral truss was chosen because of its excellent strength to weight ratio. Flex, weight, and durability were studied using simulation software. The final design accomplished the goals of less chassis flex and lighter weight.

ESTABLISHING PROCESS PARAMETERS FOR A LOW-PRESSURE DIE CASTING MACHINE
by Joseph Bigelow, David Concannon, and Manson Williams
Faculty Advisor: Sam Ramrattan
1:30 p.m. to 1:55 p.m., Room 209

Low-Pressure die-casting (LPDC) process is growing in recognition and offers advantages over other casting processes, including surface finish, dimensional accuracy, and near net shape. The implementation of the LPDC process at Western Michigan University required machine modification, process simulation, and determination of processing parameters. The initial project task involved machine modifications for suitability in a laboratory environment. Determination of baseline processing parameters was aided by simulation software that is utilized in industry. Information gathered from the simulations helped establish an initial machine setting, which was refined experimentally. These guidelines and modifications will allow future students to gain hands-on training with current industrial machinery.

THE REDESIGN OF A CONTINUOUS MIXER TO PREVENT MAINTENANCE DOWNTIME
by Christopher Lee and Jason Traub
Faculty Advisor: Sam Ramrattan
2:00 p.m. to 2:25 p.m., Room 209

Continuous mixers are used in the foundry industry to create sand molds and cores. The WMU foundry possesses a Palmer M50 high-speed continuous mixer, but it was not part of the curriculum because of the repeated maintenance required to unclog the chemical binders used in the pumping system. The mixer's pumping system was redesigned and a new peristaltic pump was put in place, resulting in a reduction of maintenance downtime. The Palmer mixer can now be used in the foundry at Western Michigan University.

WATER FOR INJECTION PIPING SYSTEM STUDY
by Matthew Bohn, Shad Brooks, Jason Buero, and LaKeisha Hamilton
Sponsor: Dick Cottrell, James Ledden, and Joe Markus - Pharmacia Corporation
Faculty Advisor: Jorge Rodriguez
2:30 p.m. to 2:55 p.m., Room 209

The design of piping systems can be a challenging process of hand calculations and assumptions. Modeling pharmaceutical production line Water for Injection (WFI) piping system in flow analysis software is important in saving time and money. The study involved comparing drawing documentation of the WFI piping system to actual existing field conditions. The piping system was then modeled using flow analysis software (PIPE-FLO). The WFI piping system model gives engineers the ability to make quick system modifications and perform an analysis in order to report changes on system behavior. The results from the analysis tell the engineer if the new design will perform as expected. The team calculated the system's existing load capabilities and advised possible piping modifications for more efficient performance.

IMPLEMENTATION OF COPPER ALLOYS INTO INJECTION MOLDING
by Paul Campbell, Craig Merizon, and Isaiah Tregloan
Sponsor: Harold T. Michels - Copper Development Association Inc.
Faculty Advisor: Paul Engelmann
3:00 p.m to 3:25 p.m., Room 209

In today's plastics industry, mold makers and technicians are constantly searching for new ways to improve part quality and reduce cycle times. Copper alloy inserts used for molding directly affect defects, flatness, stress levels, cycle times and dimensional warpage. A series of molding experiments were performed on a thin part to establish if a correlation existed between predicted and actual part warpage by measuring the parts. A decrease in cycle time and an increase in part quality were shown with the implementation of copper alloys in the mold

MATERIALS ENGINEERING

Session Chair - Valery Bliznyuk
Room 242

CARBON NANOTUBES - A NEW REINFORCEMENT IN PLASTICS

by Jeffrey R. Foster
Faculty Advisor: Valery Bliznyuk
10:00 a.m. to 10:25 a.m., Room 242

Carbon Nanotubes (CNT) were discovered less than ten years ago. The search to uncover all their properties and capabilities is growing by the day. This project was centered on determining if CNT could be successful as a reinforcement in plastics. The selected plastics used include polyurethane (low E ~ 1 Mpa) and polystyrene (low and high molecular weight). Dip coating was used to orient the CNT within the plastic. Nanomechanical characterization and imaging of the reinforced plastic was conducted using Atomic Force Microscopy. As expected, CNT enhanced nanomechanical properties of both plastics and proved to be a positive reinforcement.

MECHANICAL AND AERONAUTICAL ENGINEERING A-1

Session Chair - Jerry Hamelink
Room 210

ENDOTRACHEAL CARDIAC OUTPUT MONITOR TEST STAND

by Steven Bahling, Yibin Fu, and Steven Szarejko
Faculty Advisor: Jerry Hamelink
9:30 a.m. to 9:55 a.m., Room 210

The Endotracheal Cardiac Output Monitor (ECOM) Test Stand is a device that was created to test the accuracy of the ECOMs ability to analyze the volume of the flow of blood of the human heart. The ECOM uses a noninvasive technique of bioimpedance. The testing apparatus was designed to simulate the flow of blood of the human heart under a variety of conditions. The testing apparatus was built, tested, and evaluated using both a saline solution and animal blood.

MANWAY ASSEMBLY AND SUPPORT ARM DESIGN

by Matthew Fox and Erica Selby
Sponsor: Robert Worden - Pharmacia Corporation
Faculty Advisor: Dennis VandenBrink
10:00 a.m. to 10:25 a.m., Room 210

Materials have a tendency to break down when exposed to corrosives. In this project a new manway nozzle and flange assembly was developed to resist corrosion. The assembly was also designed to be larger for tank entry purposes. The team utilized the ASME code for guidelines on designing the assembly and verified their findings with computer software. Using finite element analysis an adequate support arm for the removable manway cover was also designed.

ANALYSIS OF CASEY ENGINE

by Vivek K. Agarwal
Sponsor: Arlie F. Casey

Faculty Advisor: Jerry Hamelink
10:30 a.m. to 10:55 a.m., Room 210

Since its inception, the automobile industry has been researching to develop a more efficient gasoline engine. The "Casey Engine" is claimed to be twice as effective in power generation as a regular internal combustion engine. Verification of the claim included modeling the engine in a software program to evaluate the power output. The power output was compared to that of a standard internal combustion engine with the same critical dimensions.

AUTOMATED MECHANICAL BALANCE
by Lik Teck Chin
Faculty Advisors: Jerry Hamelink and Frank Severance
11:00 a.m. to 11:25 a.m., Room 210

A mechanical balance system was designed and built to digitally acquire weight measurements. The balance will serve as a part of an instructional tool in designing control systems. The weight balancing system, which consists of three adjustable counter balance weights when shifted along threaded rods, will measure a maximum weight of 2.5kg. This mechanism operates smoothly, accurately and reliably. The power distribution system of the balance was designed by a electrical engineering student. The mechanical balance system works in conjunction with an embedded microcontroller control system that was designed by two computer engineering students.

OPTIMIZATION OF THE COOLING SYSTEM FOR AN INJECTION MOLD
by Nurzaki Nurikhsan, Patrick Peck, and Sebuh Semerciyan
Sponsor: Beryl D. Brown II - Engineered Plastic Components, Inc.
Faculty Advisor: Christopher Cho
11:30 a.m. to 11:55 a.m., Room 210

A mold cooling upgrade was proposed by the mold supplier for a plastics manufacturer. The supplier planned to upgrade the cooling of their existing system by decreasing the cooling time for the injection molding machines. After careful analysis and computer simulations, it was found that three main factors played a big part in designing the optimum mold cooling system. These factors were the cooling line size through the molds, the percent of ethylene glycol used in the cooling mixture, and the flow rate of the coolant through the cooling lines. Using the results obtained, upgrades to the cooling system were determined.

ERGONOMIC AND CONTROL OPTIMIZATION OF THE AMTRYKE™
by Dan Paternoster and Matthew Sasina
Sponsors: Joe Copeland - National AMBUCS, Inc. and Alan Eakle - Alektronics, Inc.
Faculty Advisor: James Kamman
1:00 p.m. to 1:25 p.m., Room 210

The AmTryke™ is a tricycle with hand cranks as well as foot pedals, designed to help disabled children improve their motor skills and muscular stamina. However, the original design was not ergonomically correct for simultaneous hand/foot movement, and the body position was difficult to adjust. Also, the hand crank motion often caused steering difficulties for the children. Ergonomic research let to a design that allowed the user to operate the tricycle with the correct opposing hand/foot movement. A new steering mechanism and more passenger friendly seating setup were also incorporated into the new design, all while maintaining the look of a common tricycle.

SPRING RATE AND TIRE DEFLECTION ANALYZER
by Paul Michael Cochran and Kelly Lind

Faculty Advisor: Richard Hathaway
1:30 p.m. to 1:55 p.m., Room 210

The Spring Rate and Tire Deflection Analyzer was designed to achieve knowledge of suspension components of a racecar. In the field of racing, knowledge about suspension component performance characteristics is the key to winning. This device was designed and built to properly measure the spring rate value for both suspension springs and tires. The analyzer accurately simulates the same loading conditions a component would encounter on a racecar. Using an electronic load cell and a distance-measuring device in conjunction with an electronic interface, the required accuracy and repeatability was attained.

DUNE BUGGY SUSPENSION AND STEERING DESIGN
by Nathaniel Dobbs and Steven Myers
Faculty Advisor: Richard Hathaway
2:00 p.m. to 2:25 p.m., Room 210

A steering/front suspension system was designed for a single seat dune buggy used in sand drag racing. It was necessary for the vehicle to have exceptional handling and reliable performance while maintaining a high degree of safety when used in extreme conditions. Using suspension simulation and analysis programs, a proposed solution was attained. The suspension and steering that was designed provided adequate suspension travel while optimizing vehicle roll, bump-steer, and steering forces. Employing structural analysis techniques, individual components were designed that met the stated criteria.

MECHANICAL AND AERONAUTICAL ENGINEERING B-1

Session Chair - Koorosh Naghshineh
Room 211

REDESIGN OF A HYDRAULIC PRESSURE CONTROL VALVE
by Marc Richard Algra, Jason Philip Idalski, and Chye Chun Phua
Sponsor: Mark Oerther - FEMA Corporation
Faculty Advisor: Iskender Sahin
9:00 a.m. to 9:25 a.m., Room 211

The redesign of a hydraulic pressure control valve was needed to improve performance of an existing system. The problems with the previous design were studied to gain information. Testing that simulated the application was conducted to obtain benchmark data. A prototype design was created to hold a low-pressure head on the work port of the valve. This pressure head will improve system performance.

IMPROVED WEIGHING METHOD FOR DISABLED PATIENTS
by Amy McGee and Jason Musgrave
Faculty Advisor: Iskender Sahin
9:30 a.m. to 9:55 a.m., Room 211

Care centers and hospitals were in need of a better method of weighing their disabled patients. Research was conducted on the current methods of weighing patients and the short-comings associated with those methods. Multiple designs for improvement were developed and one was

chosen for prototype construction. This prototype was then tested in computer simulation programs and modified based on the results.

TEST FIXTURE FOR STUDY OF ACOUSTICS OF MOVING SOUND SOURCES
by Robert Booth, Kevin Braat, and John Stahl
Faculty Advisor: Koorosh Naghshineh
10:00 a.m. to 10:25 a.m., Room 211

A laboratory test setup was designed and fabricated to facilitate research into the acoustic field generated by moving sound sources. These sources were to be evaluated at different speeds while traveling in a straight line as well as a circular path. Two distinct test fixtures were developed: the first to move the receiver and the second to move the source. The project incorporates programmable control and makes use of LabView software to coordinate the motor speed, timing and data acquisition trigger signal.

ERGONOMICALLY SOUND DESIGN OF BOTTOM DISHWASHER RACK
by Dena Dobson, Bethany Hyvarinen, and Katie Roberts
Sponsor: Paul Foster - Whirlpool Corporation
Faculty Advisor: Koorosh Naghshineh
10:30 a.m. to 10:55 a.m., Room 211

In today's society, a common health problem for many consumers is an aching lower back. An everyday household chore that aggravates this condition is the loading and unloading of a dishwasher. For this reason, a lifting mechanism was designed for the bottom rack of a dishwasher to prevent lower back strain. Because a current lifting design did not exist, benchmarking was done on other industrial lifting mechanisms. Testing and analysis was completed using computer simulation, modeling, and load analysis. Once the analysis was completed, a specific design was chosen and finalized for production.

PLASTIC INJECTION MOLDING DRYER MONITORING AND SYSTEM ANALYSIS
by Chee Han Chow, Michael E. Johnson, and Michael B. Moore
Sponsor: Dan VanSolkema - Clarion Technologies, Inc.
Faculty Advisors: Ho Sung Lee
11:00 a.m. to 11:25 a.m., Room 211

A study of an injection molding dryer system was accomplished through mathematical modeling. Based on this modeling, a monitoring system was developed and built that was capable of measuring important conditions within the dryer system and recording these conditions in an ongoing and cost effective manner. The monitoring system was designed to be both portable and easy to install and remove. Verification of dryer unit modeling results was done initially and eventually proper monitoring performance was also verified.

MODIFICATION OF A POOL BOILING VESSEL FOR EVALUATING BOILING HEAT TRANSFER
by Chan Sin Lee and Christina Schwentor
Faculty Advisor: Ho Sung Lee
11:30 a.m. to 11:55 a.m., Room 211

A pool boiling vessel was redesigned and modified to incorporate a hot wire, temperature control, and pressure control. SolidWorks and LabView software were used throughout the design and evaluation process. To obtain data on boiling heat transfer, boiling on the horizontal heated wire immersed in both pure water and in a 50/50 mixture of ethylene glycol and water was investigated. Boiling curves (graphs that plot surface heat flux as a function of wall superheat) were obtained for both media. These

clearly illustrated different boiling regimes. A high-speed motion analyzer with digital imager was used to capture photographs from each regime.

PAPER AND PRINTING SCIENCE AND ENGINEERING

Session Chair - Peter Parker
Room 242

THE APPLICATION OF A POLYSILICATE MICROGEL TO INKJET PAPER COATING

by Adam Baumgartner
Faculty Advisor: Dewei Qi
11:30 a.m. to 11:55 a.m., Room 242

A polysilicate is used as a coating pigment for ink jet papers. Borax is added to create a polysilicate microgel with particle sizes of about one nanometer. The printability was compared with larger particle silica pigments that are currently being used. There is an interaction between starch and polysilicate, so starch was tested as a binder substitute for polyvinyl alcohol. This will yield an energy savings because less energy will be needed to dry the coating.

Sponsors

Alectronics Inc.
Clarion Technologies Inc.
Denso Manufacturing Michigan, Inc
FEMA Corporation
Kalamazoo Center for Medical Studies
Pharmacia Corporation
Stryker Instruments
The Village Link
Whirpool Corporation
Arlie F.Casey
Copper Development Association, Inc
Engineered Plastic Components Inc.
Flowserve Corporation
National AMBUCS, Inc
Whirlpool Corporation
Sweet Manufacturing
Wesley Foundation of Kalamazoo