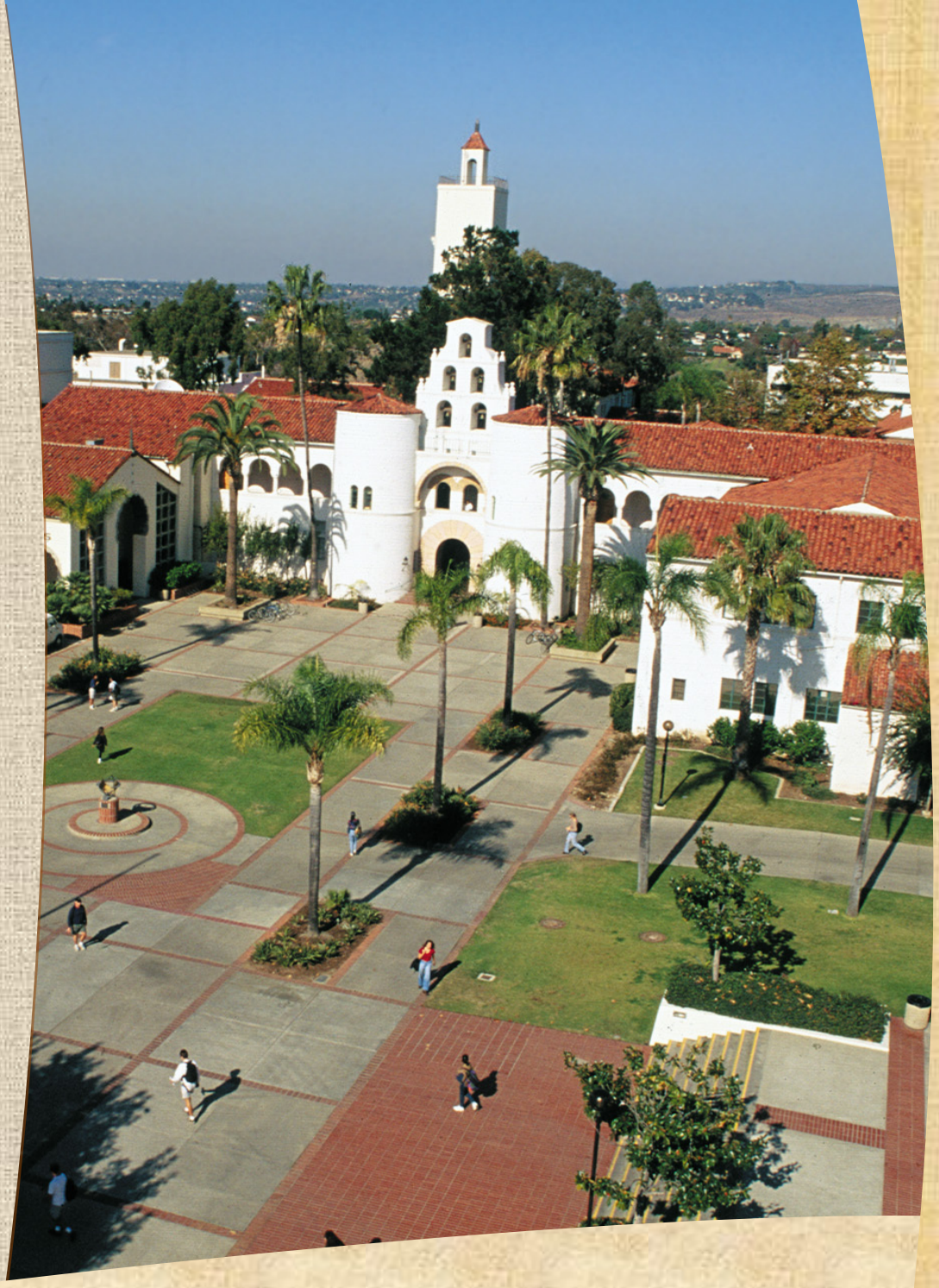
ENGINEERING



SPRING 2012 DESIGN DAY

SAN DIEGO STATE UNIVERSITY

COLLEGE OF ENGINEERING

Welcome to the College of Engineering's Spring 2012 Design Day at the Parma Payne Goodall Alumni Center. We are proud to have over 50 student teams representing undergraduate and graduate students and student groups displaying their design projects for this event. There are 36 teams from our capstone Senior Design Classes in Civil, Construction & Environmental Engineering, Electrical & Computer Engineering and Mechanical Engineering. Representing Aerospace Engineering are the student groups Design, Build & Fly and the Rocket Project. The Civil Engineering group Engineers without Borders also has a design team represented. In addition, we have graduate student teams from Electrical & Computer Engineering and Environmental Engineering.

Please join me in congratulating our student teams on their innovative design projects. These projects represent the culmination of the technical knowledge they have developed during their time at the San Diego State College of Engineering. You will note how these projects are an integral part of our focus on developing critical thinking, enabling the recognition of human and societal needs, designing novel, sustainable engineering solutions, and creating value through the entrepreneurial efforts of our students.

We are grateful to our many sponsors for their generous support for these student projects, including among others the Bill & Melinda Gates Foundation, Cubic Corporation, General Atomic, National Science Foundation, and San Diego Gas & Electric. Many of these sponsors are integrally involved with the student design teams and serve as mentors to the teams. We appreciate all of our sponsors and their support for the student teams.

Enjoy the Spring 2012 SDSU College of Engineering Design Day. Thank you for being a part of this culminating event.

David T. Hayhurst

Dean

College of Engineering

MINI MONTY - DBF

SPONSORED BY: AIAA
MENTOR: NAGY NOSSEIR

AEROSPACE ENGINEERING

Student teams will design, fabricate, and demonstrate the flight capabilities of an unmanned, electric powered, radio controlled aircraft which can best meet the specified mission profile. The goal is a balanced design possessing good demonstrated flight handling qualities and practical and affordable manufacturing requirements while providing a high vehicle performance.

To encourage innovation and maintain a fresh design challenge for each new years participants, the design requirements and performance objective will be updated for each new contest year. The changes will provide new design requirements and opportunities, while allowing for application of technology developed by the teams from prior years.

KIAH, RAMON, ERIC, RAYMOND, AARON, JESSE, RICARDO,
PILOT: PEDRO
MISSING TEAM MEMBERS: MATT, JEROMEY AND ANDRES

2012 MINI MONTY

Competition location 2012 Wichita, Kansas

Mission 1 - Ferry Flight

- Maximum number of complete laps within a **4** minute flight time

Mission 2 - Passenger Flight

- 3 Lap payload flight. Payload will be 8 simulated passengers total 3.75 lbs

Mission 3 - Time to Climb

- Single take-off and climb to **100** m altitude and release 2 liters of water.

COMPETITION FOR 2012 WAS SUSPENDED DUE TO SEVERE STORM AND TORNADO WHICH PASSED 1/4 THROUGH THE CESSNA FIELD

ROCKET PROJECT

SPONSORED BY: FLOMETRICS
MENTOR: CARL TEDESCO

AEROSPACE ENGINEERING

THE SDSU ROCKET PROJECT IS A HANDS ON LEARNING EXPERIENCE THAT TEACHES STUDENTS THE BASICS OF LIQUID FUEL ROCKETRY. STUDENTS LEARN TECHNIQUES SUCH AS WET LAYUPS, USE OF BASIC SHOP TOOLS, AND HOW TO WORK IN A TEAM ENVIRONMENT. THE ROCKET PROJECT ALSO UTILIZES THE LATEST INDUSTRY FABRICATION TECHNIQUES, WHICH INCLUDES FILAMENT WINDING PRESSURIZED FUEL TANKS.

THE ROCKET TEAM

ROCKET SHOW

THE TEAM IS WORKING HARD ON FINISHING THE ROCKET TO LAUNCH THIS YEAR. STATIC TESTS HAVE BEEN CONDUCTED AND CAN BE SEEN ON YOUTUBE.

AUTOMOTO

SPONSORED BY: SDSU
SPONSOR ADVISOR: DR. KEE MOON

MECHANICAL ENGINEERING

2012 SPRING ENGINEERING SENIOR DESIGN DAY

MEMBERS

- **GREGORY BERKELEY**
  - CONTROL THEORY
  - MATHEMATICAL MODELING
  - NEGATIVE FEEDBACK PROGRAMMING
- **LEVI LENTZ**
  - MECHANICAL DESIGN
  - PHNEUMATICS & CALCULATIONS
  - SERIAL PARSING PROGRAMMING

ABSTRACT

MOTORCYCLES HAVE INTERESTING DYNAMIC BEHAVIOR AND ARE NATURALLY UNSTABLE, MUCH LIKE INVERTED PENDULUMS. HOWEVER, UNDER CERTAIN CONDITIONS, A MOTORCYCLE WILL HAVE STABILITY WITH A PROPERLY IMPLEMENTED CONTROL ALGORITHM. AUTOMOTO IS AN UNMANNED ELECTRIC MOTORCYCLE WITH AUTOMATIC STEERING CONTROL WHICH ALLOWS ITSELF TO REMAIN IN A STABILIZED MOTION. THROUGH NEWTONIAN LAWS OF ROTATIONAL DYNAMICS, INERTIAL MEASUREMENT AND VELOCITY SENSORS, AND NEGATIVE FEEDBACK MICRO-PROCESSING, AUTOMOTO IS THE FIRST SUCCESSFUL STABILIZED MOTORCYCLE AT SAN DIEGO STATE UNIVERSITY COLLEGE OF ENGINEERING.

TEAM AUTOMOTO

GREGORY BERKELEY & LEVI LENTZ

SOLIDWORKS OF AUTOMOTO

"NO MOVING MASSES AND NO GYROS…JUST RIDE IT LIKE A HUMAN DOES"

- UC Berkeley, Blue Team

BAKR

SPONSORED BY:
NATIONAL SCIENCE FOUNDATION
SPONSOR ADVISOR: DR. KEE MOON

MECHANICAL ENGINEERING

2012 SPRING SDSU ENGINEERING SENIOR DESIGN DAY

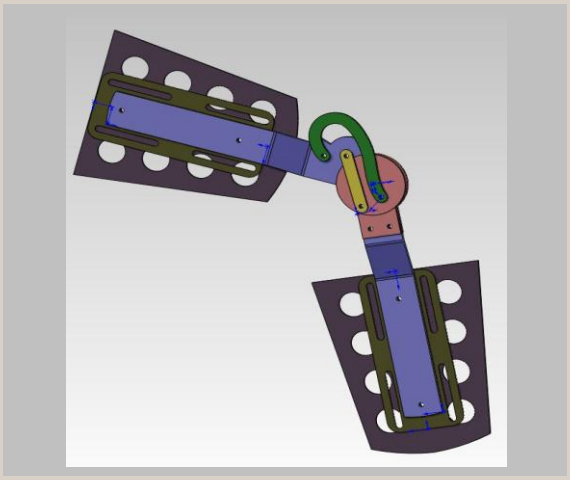
- MICHAEL GAZDAYKA, DESIGN ENGINEER
- JAVIER BATISTA, DESIGN ENGINEER

BIOLOGICALLY ACCURATE KNEE ROTATION (BAKR)

DESCRIPTION

THE HUMAN BODY ALLOWS US TO REGUARLY DISPLACE OURSELVES FROM PLACE TO PLACE THROUGH THE WALKING MOVEMENT. THE COMPLETE CYCLE OF WALKING IS KNOWN AS “GAIT”. DURING GAIT THE HUMAN KNEE PLAYS A CRITICAL ROLE IN WHICH IT ACCOMPLISHES A BACK-AND-FORTH MOTION IN ORDER TO DISPLACE YOUR BODY AFTER EACH STEP. THE KNEE MOTION IS COMPOSED BY A HYBRID MOVEMENT OF COMBINED ROLLING AND GLIDING. SUCH HYBRID MOVMENT CAUSES THE INSTANTANEOUS AXIS OF ROTATION (IAR) TO CHANGE ITS LOCATION EVERY TIME INTERVAL THROUGH THE CYCLE. FINALLY, AN ACCURATE MODEL OF THE KNEE’S IAR WOULD BE INVALUABLE TO DESIGN A KNEE BRACE THAT REPRODUCES NATURAL KNEE MOTION.

BEAUTIFUL PEOPLE



KNEE BRACE SIDEVIEW

“USING FOUR-BAR LINKAGE SYSTEMS TO BETTER THE WORLD ONE KNEE AT A TIME”

AZTEC RACING

SPONSORED BY: MCMILLIN RACING
SPONSOR ADVISOR: DR. MEHRABADI

MECHANICAL ENGINEERING

2012 SPRING ENGINEERING SENIOR DESIGN DAY

- STEPHEN MCFADDEN - TEAM CAPTAIN
- JEFFEREY GUTTERUD - LEAD MACHINIST
- RICHARD LE-NGUYEN - SECRETARY
- SEAN ALBRECQ – TREASURER

OUR MOTIVATION IS TO WIN THE 2012 BAJA SOCIETY OF AUTOMOTIVE ENGINEERS COMPETITION. EVERY YEAR, OVER A HUNDRED COLLEGIATE TEAMS AROUND THE WORLD DESIGN, BUILD, AND COMPETE IN THIS SAE COMPETITION. THESE OFF-ROAD VEHICLES WILL ENCOUNTER A MULTITUDE OF OBSTACLES THROUGHOUT THE EVENTS INCLUDING MUD, LARGE ROCKS, AND A FOUR-HOUR ENDURANCE RACE. ALL VEHICLES WILL BE USING A TEN-HORSEPOWER ENGINE DONATED BY BRIGGS & STRATTON, MAKING THE CHASSIS AND SUSPENSION DESIGNS THE FOCUS OF THE COMPETITION.

LEFT TO RIGHT: STEVE, SEAN, JEFF, RICKY

ONE WEEK BEFORE COMPETITION

SPECIAL THANKS TO MARK MCMILLIN AND EVERYONE AT THE RACE SHOP FOR YOUR INVALUABLE KNOWLEDGE AND GUIDANCE

ROBOTER-GRIFF

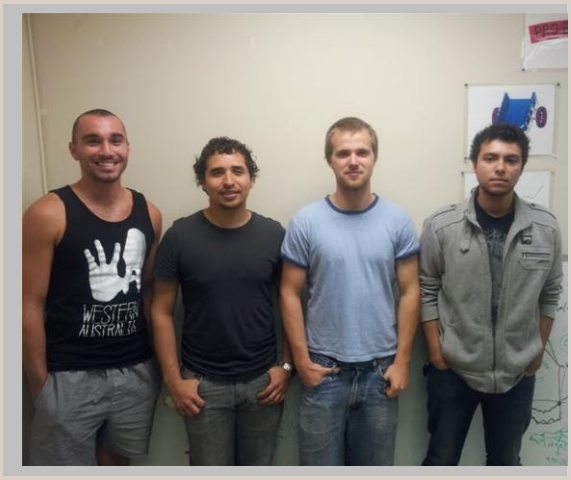
SPONSORED BY: NSF
SPONSOR ADVISOR: DR. KEE MOON

MECHANICAL ENGINEERING

2012 SPRING ENGINEERING SENIOR DESIGN DAY

- TAYLOR ALEXANDER (MECHANICAL SYSTEMS)
- NELSON HERNANDEZ (ELECTRICAL SYSTEMS)
- MARK HIGUERA (ELECTRICAL SYSTEMS)
- MATT VOGEL (MECHANICAL SYSTEMS)

OUR GOAL WAS TO DESIGN AND BUILD A ROBOTIC ARM THAT WOULD BE ABLE TO GRASP EVERYDAY OBJECTS. WE WANTED OUR HAND TO BE RELATIVELY INEXPENSIVE, BUT STILL BE TECHNOLOGICALLY ADVANCED. THERE ARE FIVE SERVOS LOCATED IN THE FOREARM THAT ARE USED TO OPEN AND CLOSE THE FINGERS. EMG SENSORS RECEIVE A SIGNAL WHEN THE USER FLEXES THEIR MUSCLE AND THAT SIGNAL IS SENT TO THE MICROPROCESSOR, WHICH ACTIVATES THE SERVOS. THIS CIRCUIT ALLOWS THE USER TO CONTROL THE HAND WITHOUT HAVING TO RELY ON OUTSIDE INPUT.



THE DREAM TEAM

FINAL MODEL - EXPLODED VIEW

"I'M ONLY GOOD AT 3 THINGS: KILLING FROGS, BURNING EMG'S, AND BUILDING ARMS. I'VE ALREADY DONE 2 OF THOSE TODAY, SO WHAT'S THE THIRD GONNA BE?"
-MATT VOGEL

LBMS MECHANICAL

SPONSORED BY: SCOPE ORTHOTICS
SPONSOR ADVISOR: DR. KEE MOON

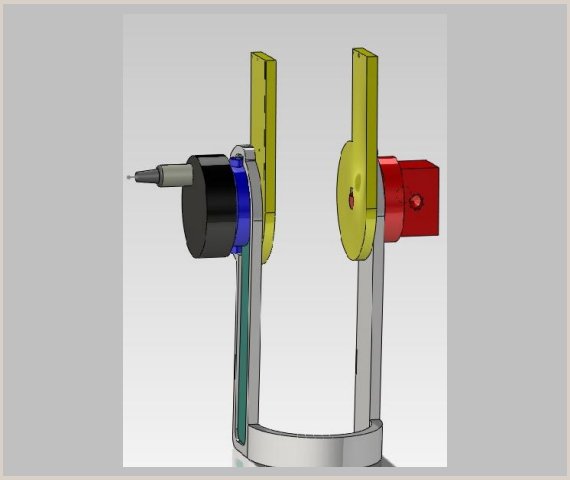
MECHANICAL ENGINEERING

2012 SPRING ENGINEERING SENIOR DESIGN DAY

- LOC BUI – LEAD DESIGNER AND SOLIDWORKS
- BRANDON JASMUND – PROJECT MANUFACTURER
- SEAN MAHER – CONCEPT MANAGER
- MATTHEW RENNICK – PROJECT MANAGER

A KNEE BRACE BUILT TO ASSIST IN THE REHABILITATION PROCESS AFTER A MAJOR KNEE SURGERY. THIS INCLUDES ACL, MCL, LCL, AND PCL TEARS. THE DESIGN OF THE PRODUCT IMPLEMENTS MECHANICAL PROCESSES TO AID IN THIS PROCESS. USING A MOTORIZED HYDRAULIC SYSTEM AND NATURAL RESISTANCE THIS KNEE BRACE WILL HELP STRENGTHEN A KNEE BACK TO NORMAL HEALTH. A HYDRAULIC MOTOR AND PUMP ARE USED TO DRIVE HINGES TO HELP LIFT THE LEG. USING NATURAL RESISTANCE THE USER WILL LOWER THEIR LEG BACK TO REST POSITION. THE GOAL IS OVER TIME THE KNEE WILL BECOME STRONGER.

GROUP PHOTO



CAD MODEL OF BRACE

"GO BIG OR GO HOME"

MICROFLAME TRACKER 2.0

SPONSORED BY: NASA

MECHANICAL ENGINEERING

2012 SPRING ENGINEERING SENIOR DESIGN DAY

BEN FREEMAN

SUSAN AFSHAN

JONAS COCHRAN

MICROFLAME TRACKER 2.0 IS A REDESIGN OF THE FIRST GENERATION MODEL BUILT IN 2011. THIS PROJECT IS PART OF ONGOING WORK AT SDSU IN FLAME SPREAD RESEARCH.

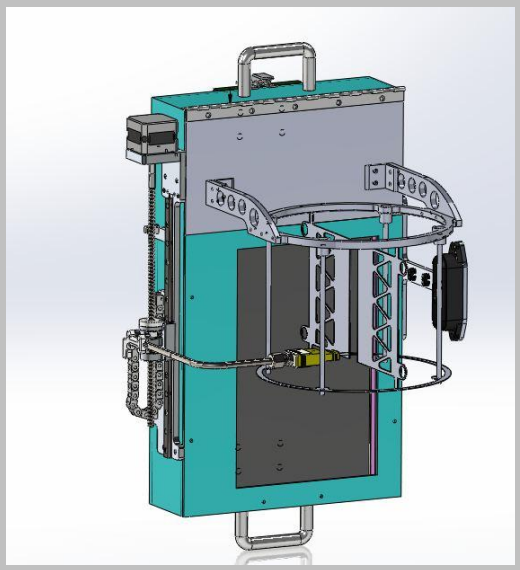
THE SECOND GENERATION FOCUSES TO IMPROVE THE LINEAR MOTION ASSEMBLY, VIDEO RECORDING EQUIPMENT AS WELL AS USER INTERACTION WITH THE EQUIPMENT.

THE LINEAR MOTION ASSEMBLY MOVED FROM A COMPLIANT BEARING DESIGN TO A LINEAR SLIDE BEARING.

VIDEO ANALYSIS IS USED TO COMPARE DATA AGAINST THE MORE DESIRABLE, YET UNPROVEN THERMOCOUPLE DATA COLLECTION. TO IMPROVE UPON THE TIME COMSUMING VIDEO ANALYSIS PROCEDURE, THE PREVIOUSLY USED SONY BLOGGIE HD CAMERA WAS REPLACED WITH A LOGITECH WEBCAM.

A REMOVEABLE SAMPLE HOLDER WAS DESIGNED TO BE ABLE TO PRELOAD SAMPLES BEFORE PLACING THEM INTO THE FLAME TRACKER ONCE IT WAS FASTENED TO THE TOWER TROLLEY.

2012 MICRO-FLAME TEAM



MICRO-FLAME TRACKER 2.0

“THERE IS ALWAYS A BETTER WAY…”

THE IPEER DEVICE

SPONSORED BY: SMART MATERIALS, INC.
JOHNSON MATTHEY, INC.
KEMAC TECHNOLOGIES, INC.
NSF & SDSU ERC

MECHANICAL ENGINEERING

2012 SPRING ENGINEERING SENIOR DESIGN DAY

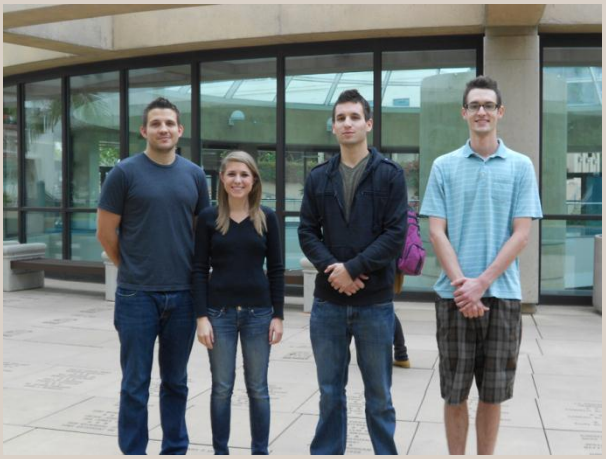
SPONSOR ADVISOR: KEE S. MOON, PH.D

DESIGN TEAM MEMBERS

- ANDREW NORRIS, PROJECT MANAGER
- JEFF DOMENIGHINI
- BRITTANY FODOR
- SONNY BIRTWISTLE

THE GOAL OF THIS DEVICE IS TO ELIMINATE THE NEED FOR THE REPLACEMENT OF BATTERIES IN MEDICAL DEVICES BY UTILIZING THE ENERGY PRODUCED FROM THE HUMAN BODY'S NATURAL PROCESSES. THE MOST ATTRACTIVE PROCESS IN THE HUMAN BODY WAS DETERMINED TO BE THE EXPANSION AND CONTRACTION OF THE RIB CAGE DURING THE RESPIRATORY PROCESS. PIEZOELECTRICITY WAS FOUND TO BE THE OPTIMAL MODE OF ENERGY REGENERATION FOR AN IMPLANTED DEVICE.

BY ATTACHING A PIEZOELECTRIC PATCH TO SUPERELASTIC SHEET METAL, BENDING STRESSES CAUSED BY NATURAL BREATHING MAY GENERATE ELECTRIC CHARGE. THE END USER WILL THEN BE GENERATING THEIR OWN ELECTRICITY SUBCONSCIOUSLY AS THEY BREATHE CONSTANTLY THROUGHOUT DAY AND NIGHT. THE DEVICE IS TO BE OPTIMIZED FOR MICROWATT GENERATION.



SONNY, BRITTANY, JEFF, ANDREW

THE IPEER DEVICE

"THE HUMAN BODY IS CONSTANTLY EXPENDING ENERGY… AND IT IS OUR DREAM TO CONVERT A FRACTION OF IT INTO ELECTRICITY"

FIT N' FLEX BACK SUPPORT

SPONSORED BY: ENGINEERING RESEARCH CENTER
SPONSOR ADVISOR: DR. KEE MOON

MECHANICAL ENGINEERING

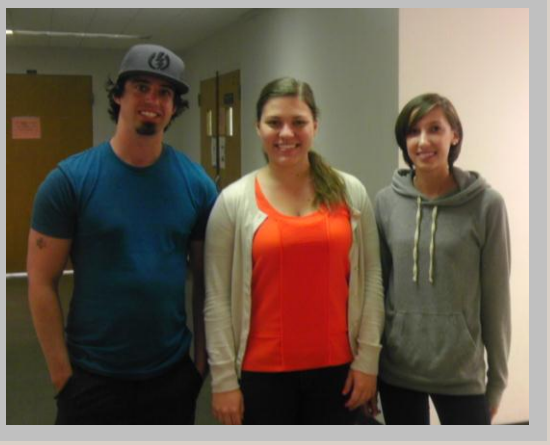
2012 SPRING ENGINEERING SENIOR DESIGN DAY

- NICOLE ALLEN
- CAITLIN ENOMOTO
- PHILIP BERRY

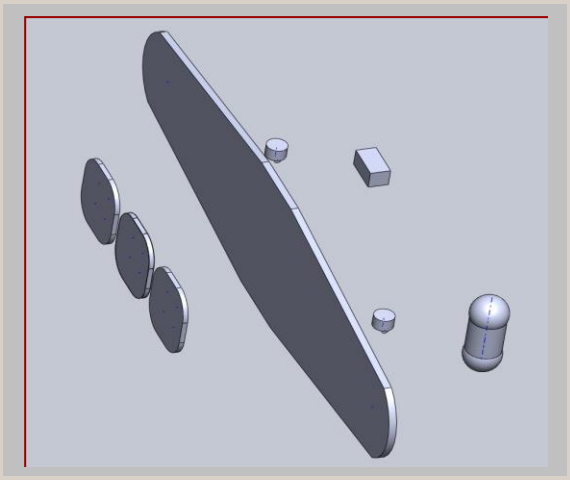
Many people suffer from back injuries and need a back brace. Currently there is no back brace on the market that automatically detects and supports when the back is strained. The back braces on the market today must be manually adjusted to add more support; these back braces are used for minor back strains and/or to assist lifting to avoid injuries.

This innovative back brace senses when users need lower back support, such as while bending. Upon sensing the strained lower back, the back brace would automatically provide stronger support by quickly inflating air pockets to provide a rigid support system on the lower back. While muscles are no longer strained, the brace would deflate, providing increased flexibility for easier movement.

The brace makes use of air tight pockets, plastic tubing, 16 g CO_2 cartridge, CO_2 dual regulator, solenoids, and an arduino board.



TEAM FIT N' FLEX



CAD OF FINAL DESIGN

"BACK PAIN IS NO JOKE"

THERMOELECTRIC HEARING AID

SPONSORED BY: DR. KEE MOON
SPONSOR ADVISOR: DR. FLETCHER-MILLER

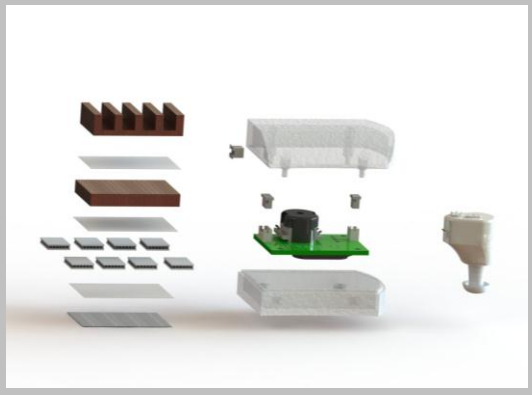
MECHANICAL ENGINEERING

2012 SPRING ENGINEERING SENIOR DESIGN DAY

- KENNY LILJESTROM: TEAM MANAGER
- JAVIER CORDOVA: RESEARCHER & DESIGNER
- KEVIN BRANDERHORST: DATA LOGGER & SIMULATION SPECIALIST
- ANDREW REESE: CAD EXPERT & MACHINIST

ANDREW, KENNY, KEVIN, JAVIER

- HARVESTING WASTE HEAT FROM THE HUMAN BODY AND TURNING IT INTO USABLE ENERGY WITH A THERMOELECTRIC GENERATOR.
- THERMOELECTRIC GENERATOR TURNS HEAT INTO ELECTRICITY BASED ON A TEMPERATURE DIFFERENCE.
- ENERGY USED TO POWER OR CHARGE SMALL ELECTRONICS.
- LOW VOLTAGE BOOSTING CIRCUIT TO GENERATE HIGHER VOLTAGES FROM THE THERMOELECTRIC GENERATOR.
- VOLTAGE FROM THE CIRCUIT USED TO TRICKLE CHARGE A RECHARGEABLE HEARING AID.
- CREATING AWARENESS OF REUSABLE ENERGY HARVESTING WITH THE HUMAN BODY.
- FACILITATING AID FOR THE ELDERLY AND HEARING IMPAIRED INDIVIDUALS



EXPLODED VIEW OF THERMOELECTRIC HEARING AID

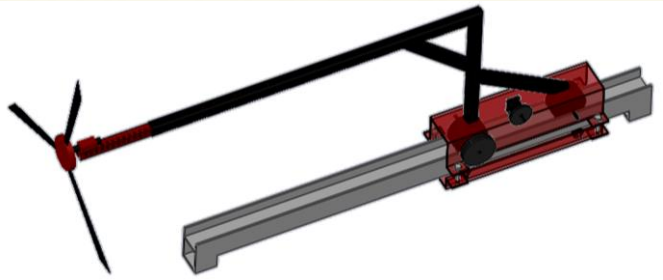
"INSPIRING THE WORLD WITH GREEN ENERGY."

TROLLEY TRACK SYSTEM

MECHANICAL ENGINEERING

SPONSORED BY: SDSU RESEARCH FOUNDATION
SPONSOR ADVISOR: DR. BEYENE

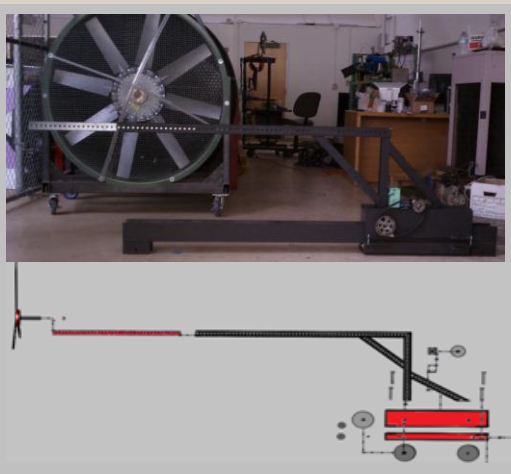
2012 SPRING ENGINEERING SENIOR DESIGN DAY



- AMBER RITCHEY
- ARTHUR KLUCH

OUR TEAM WAS ASKED TO DESIGN AND BUILD A DYNAMIC TROLLEY TRACK SYSTEM TO TEST TURBINE BLADES IN DR. BEYENE'S LOW SPEED WIND TUNNEL. IT WAS IMPORTANT TO CREATE A DESIGN THAT WOULD INCORPORATE ALL OF THE FEATURES NECESSARY TO COLLECT ACCURATE DATA DURING TESTING. THE TROLLEY TRACK SYSTEM WILL BE USED TO MOVE TEST TURBINE BLADES DOWN THE LENGTH OF WIND TUNNEL. IN ORDER TO DETERMINE ITS PRECISE LOCATION IT IS CONTROLLED THROUGH LABVIEW. LABVIEW ENABLES USERS TO INPUT EXACT DISTANCES IN REFERENCE TO THE FAN, THIS FEATURE WILL BE HELPFUL WHEN DOCUMENTING TEST RESULTS. OUR DESIGN USES A STEPPER MOTOR TO MOVE THE SYSTEM ALONG THE TRACK. THE STEPPER MOTOR WAS CHOSEN BECAUSE OF ITS PRECISION AND ABILITY TO LOCK INTO POSITION. AN ARDUINO BOARD WHICH WILL BE THE INTERFACE BETWEEN THE MOTOR AND LABVIEW.

SENIOR DESIGN TEAM 2012



TROLLEY TRACK DESIGN

"THE ONLY REASON FOR TIME IS SO EVERYTHING DOESN'T HAPPEN AT ONCE" ALBERT EINSTEIN

PROJECT GUNGNIR

SPONSORED BY: SDSU
SPONSOR ADVISOR: DR. KEE S MOON

MECHANICAL ENGINEERING

2012 SPRING ENGINEERING SENIOR DESIGN DAY

- CHRISTIAN IGARTUA - PROGRAMMING
- JAVIER BANUELOS - MECHANICAL DESIGN

JAVIER AND CHRISTIAN

IN AN INCREASINGLY DIGITAL INTERACTIVE WORLD PROJECT GUNGNIR IS AN ATTEMPT AT UNDERSTANDING A FACET OF THAT INTERACTIVITY.

BODY MOTION SENSING TECHNOLOGY HAS BEEN AROUND FOR A FEW SHORT DECADES AND HAS RECENTLY GAINED MUCH GROUND IN THE ENTERTAINMENT AND MEDICAL FIELDS. CGI BENEFITS GREATLY FROM BODY MOTION SENSING AS DOES GAIT CYCLE ANALYSIS FOR BIOMECHANICAL ENGINEERS.

PROJECT GUNGNIR IS AN EDUCATIONAL ENDEAVOR TO BETTER UNDERSTAND BODY MOTION SENSING TECHNOLOGY, REPLICATE ITS CURRENT USES AND HOPEFULLY IMPROVE UPON THE OVERALL PROCESS.

ACCELEROMETER + GLOVE

"THESE ARE NOT THE SENSORS YOU ARE LOOKING FOR"

SLT MECHANICS

SPONSORED BY:
SDSU RESEARCH FOUNDATION
SPONSOR ADVISOR: DR. KEE MOON

MECHANICAL ENGINEERING

2012 SPRING SDSU ENGINEERING SENIOR DESIGN DAY

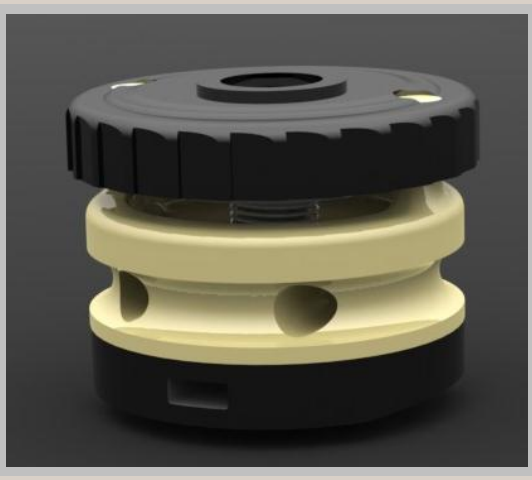
- DEVON GREER
  - SECONDARY DESIGN
- CAMERON KNAPP
  - CONCEPT DEVELOPEMENT
- MITCHELL LEE
  - MATHMATICAL MODEL
- CHRISTOPHER MCMONIGLE
  - PRIMARY DESIGN

SLT Mechanics will provide a product to consumers whose needs and desires surpass conventional thinking. This product will be a self-tying shoe lace system, compatible for use on the consumer's favorite shoe. We will be working alongside major companies, in order to compete in the alternative footwear industry that goes against the traditional shoe model (Velcro, slip-on shoes).

Our project deliverable is to design two systems that work seamlessly together to fasten a shoe tightly and securely without the user needing the use of their hands. Our primary system is a ratchet that interfaces with any shoe that will be lightweight, reliable, and comfortable. In the design process, we uncovered intricacies of creating such a system due to the high flexibility and odd shape of the human foot and shoe. Shoes, especially for exercise, must be comfortable. In order to design a reliable and comfortable system, we needed to factor all of these variables into the design. By incorporating padding and curvature in rigid components, we have mitigated discomfort that this mechanism may cause.

The key point is to have our product be compatible and flexible in order to accommodate any desired shoe, providing customers with the ability to convert their favorite shoe into one that works for their needs.

SLT MECHANICS TEAM



PRIMARY SYSTEM RENDERING

"SLT MECHANICS OFFERS A PRODUCT THAT AIDS PEOPLE WHO ARE HANICAPED TO MAINTAIN AN ACTIVE LIFESTYLE"

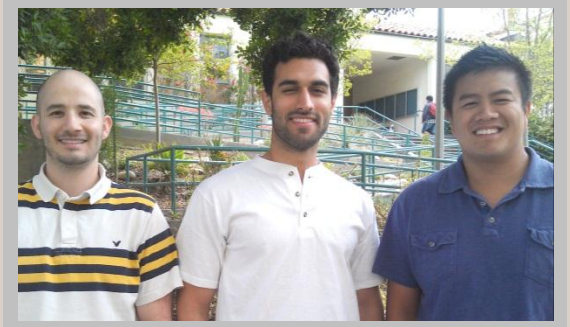
uGRAB

SPONSORED BY: NATIONAL SCIENCE FOUNDATION
SPONSOR ADVISOR: DR. KEE S. MOON

MECHANICAL ENGINEERING

2012 SPRING ENGINEERING SENIOR DESIGN DAY

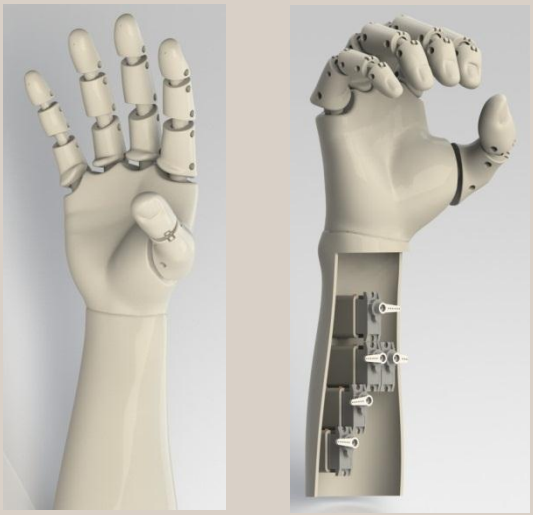
- **PHILLIP VU**: PROJECT COORDINATOR AND ENGINEERING TECHNICIAN
- **RYAN LEVIN**: CAD DESIGNER AND SYSTEMS INTEGRATION ENGINEER
- **MUDASIR NAZIR**: ADMINISTRATIVE DUTIES AND GRAPHICS DESIGNER



GROUP PHOTO

The goal of the team was to design and produce a functioning robotic grasping device that will imitate a human hand with five digits, one of them opposing, and multiple joints. The project contained multiple objectives, including the ability to grasp a full 16.9 fluid ounce bottle of water. The machine is designed to be self-powered, remotely operated, and includes a haptic feedback system which will allow the operator to determine how much pressure the device is applying to a specimen.

The final prototype includes an advanced CAD design which looks almost identical to a human hand, giving a realistic non-robotic appearance. The hand was then manufactured using Fused Deposition Modeling and assembled with 0.013" diameter multi-strand nylon coated steel wire, 2.5mm diameter elastic bands, 1.3 kg-cm micro servos, a 12-channel USB servo controller, and a vibration feedback circuit that analyzes the current drawn from the servos to power a vibration motor. Room Temperature Vulcanization (RTV) silicone was also applied to the hand to create non-slip grip surface.



HAND PROTOTYPE

"The best place to find a helping hand is at the end of your own arm with the uGrab."

- Group 8

INTELLI-BRACE

SPONSORED BY: SAN DIEGO STATE UNIVERSITY, BREG INC., NAV-AIR, SMITH PRECISION PRODUCTS
SPONSOR ADVISOR: KEE MOON

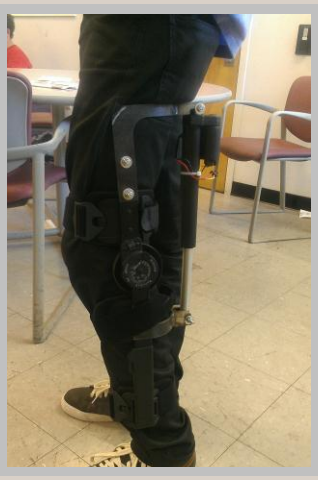
MECHANICAL ENGINEERING

2012 SPRING ENGINEERING SENIOR DESIGN DAY

- KHOA NGUYEN, ELECTRICAL SUBYSTEMS AND PROGRAMMING
- CHARLES SMITH, FABRICATION AND DESIGN
- SEAN BARTEE, FABRICATION AND DESIGN
- KEENAN MCCOLLOM, ELECTRICAL SUBSYSTEMS AND PROGRAMMING

THIS PROJECT AIMS TO REHABILITATE THOSE WHO SUFFER FROM SYMPTOMS LEADING TO AN ABNORMAL GAIT CYCLE, OFTEN CAUSED BY STROKE AND OTHER AILMENTS. THIS IS DONE BY INCORPORTATING MECHANICAL AND ELECTRICAL SYSTEMS COMPOSED OF AN ACTUATOR, AN ARDUINO MICROCONTROLLER, TWO PRESSURE SENSORS AND AN EXISTING KNEE BRACE. ONE SIDE OF THE GROUP FOCUSED ON THE PLACEMENT AND ATTATCHMENT OF THE ACTUATOR WHILE THE OTHER FOCUSED ON THE PROGRAMMING OF THE SENSORS IN ADJACENT WITH THE WALKING MOTION. WHEN THE PATIENT'S HEEL COMES OFF THE GROUND, THE ACTUATOR EXTENDS SUPPLEMENTING A FORWARD MOTION, AND RETRACTS WHEN THE FOOT IS OFF THE GROUND.

FROM LEFT TO RIGHT: SEAN, KEENAN, KHOA, AND CHARLES



INTELLI-BRACE RETRACTED ON SUBJECT

"INTELLIGENT AND PORTABLE"

CS^3 REHABILITATION TECHNOLOGIES

SPONSORED BY: BALL SALES AND ENGINEERING
& NATIONAL SCIENCE FOUNDATION
SPONSOR ADVISOR: KEE MOON

MECHANICAL ENGINEERING

2012 SPRING ENGINEERING SENIOR DESIGN DAY

- SCOTT LINDMAN – GLOVE DESIGN, FINANCIAL ADVISOR, SEAMSTER
- CHRIS HAMMETT – PROGRAM DESIGN, ELECTRONICS SPECIALIST
- SAM TOLPEN – PROGRAM SPECIALIST, ELECTRONICS DESIGN
- SEAN NGUYEN – GLOVE DESIGN, PROJECT MANAGER

DESIGN AND BUILD A FORCE SENSING GLOVE TO AID PATIENTS IN REBILITATION WHOS INJURIES CAUSE LOSS OF SENSATION IN THE HAND. FORCE SENSORS PLACED ON THE FINGERS AND PALM READ APPLIED FORCE AND TRANSDUCE TO AN AUDIBLE TONE THAT INCREASES IN FREQUENCY AS FORCE INCREASES. GLOVE WOULD BE WORN IN A REHABILITATION SETTING WITH REHABILITATION SPECIALIST SUPERVISING PATIENT AS HE OR SHE GRASPS DIFFERENT OBJECTS. THIS GLOVE WILL HELP PATIENTS RETRAIN THEIR BRAINS TO ASSOCIATE SOUND WITH GRASP RATHER THAN SENSTION FROM THE HAND.

CS^3 REHAB. TECH. TEAM

TFR GLOVE PROTOTYPE

"I haven't failed, I've found 10,000 ways that don't work"

-Thomas Alva Edison

AFTERSHOCK

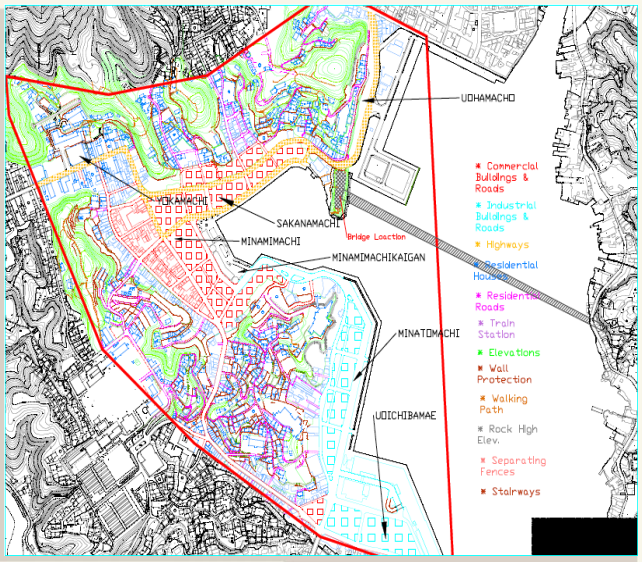
ADVISOR: ROBERT DOWELL

CIVIL ENGINEERING

SPRING 2012 SDSU ENGINEERING SENIOR DESIGN DAY

- FIGUEIREDO, MARIANNA – GEOTECHNICAL ENGINEERING
- HOSSEINI, MAHTA – HYDRAULICS ENGINEERING
- BIRINCI, OZKAN – TRANSPORTATION ENGINEERING
- JACKSON, THOMAS – CONSTRUCTION ENGINEERIG
- BENNETT, BRETT – STRUCTURAL ENGINEERING

RE-DEVELOP THE SMALL FISHING TOWN OF KESENNUMA, JAPAN THAT WAS DESTROYED IN THE 9.0 MAGNITUDE EARTHQUAKES AND TSUNAMI OF 2011. THE PURPOSE OF THIS PROJECT IS TO CREATE A NEW TOWN OF KESENNUMA THAT WILL BE ABLE TO WITHSTAND A SIMILAR EARTHQUAKE AND TSUNAMI IN THE FUTURE, REPRESENTING APPROXIMATELY A 1000 YEAR RETURN PERIOD (ON AVERAGE IT WILL OCCUR EVERY 1000 YEARS).



A good scientist is a person with original ideas. A good engineer is a person who makes a design that works with as few original ideas as possible - Freeman Dyson

COLLEGIATE CONST.

SPONSORED BY: SAN DIEGO STATE UNIVERSITY
ADVISOR: DR. DOWELL

CIVIL ENGINEERING

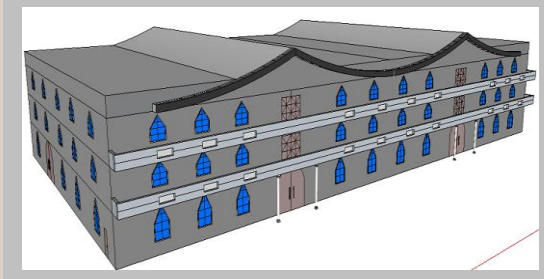
SPRING 2012 SDSU ENGINEERING SENIOR DESIGN DAY

- JEFF AZAULA: CONSTRUCTION ENGINEERING
- ASHLEY INCIONG: HYDRAULIC ENGINEERING
- MICHAEL KNIGHT: TRANSPORTATION ENGINEERING
- IAN CRANO: GEOTECHNICAL ENGINEERING
- NICHOLAS POSSE: STRUCTURAL ENGINEERING

ON MARCH 11, 2011 KESENNUMA, JAPAN, WAS HIT BY A MASSIVE TSUNAMI GENERATED BY AN EARTHQUAKE THAT REGISTERED A MAGNITUDE OF 9.0, THE LARGEST QUAKE THE COUNTRY HAS EVER FELT. THE EXTREME FORCE OF THE EARTHQUAKE AND RESULTING 7 METER HIGH TSUNAMI TOPPLED BUILDINGS, PUSHED 20-TON SHIPS MORE THAN 100 METERS INLAND, AND EVEN MOVED THE ENTIRE COUNTRY 2.4 METERS EAST CAUSING LARGE SINKHOLES THROUGHOUT THE CITY.

THE TASK PRESENTED TO THE SAN DIEGO STATE UNIVERSITY STUDENTS ENROLLED IN CIVIL ENGINEERING 495: CAPSTONE DESIGN, WAS TO BREAK INTO TEAMS OF FIVE STUDENTS, EACH REPRESENTING A DIFFERENT DISCIPLINE (HYDRAULIC, GEOTECHNICAL, STRUCTURAL, TRANSPORTATION, AND CONSTRUCTION ENGINEERING), AND CREATE A COMPREHENSIVE PROPOSAL TO REBUILD THE CITY. THE MAIN DESIGN CRITERIA GIVEN WERE TO CREATE A NEW TOWN OF KESENNUMA THAT WILL BE ABLE TO WITHSTAND A SIMILAR EARTHQUAKE AND TSUNAMI IN THE FUTURE.

TEAM PHOTO



KESENNUMA UNIVERSITY

COLLEGIATE CONSTRUCTION:
"J.A.M.I.N. TO THE BEAT OF THE BUILD"

WASABI ENGINEERING
CIVIL & CONSTRUCTION

ADVISOR: DR. ROBERT DOWELL

CIVIL ENGINEERING

SPRING 2012 SDSU ENGINEERING SENIOR DESIGN DAY

NICK PALLARES – STRUCTURAL

CHRISTINA PADDACK – GEOTECHNICAL

TAMINA ARKAM – CONSTRUCTION

ABIGAIL GOODE– TRANSPORTATION

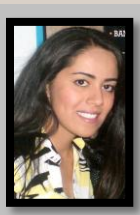
DARIA YEGOROVA – HYDRAULICS

ENGINEERING THE RECONSTRUCTION OF KESENNUMA JAPAN

PROJECT OVERVIEW:

- STRUCTURAL DESIGN & ANALYSIS OF THE PROPOSED EVACUATION CENTER BUILDING (TYP.) TO WITHSTAND SEISMIC AND TSUNAMI FORCES.
- CORRESPONDING GEOTECHNICAL DESIGN & ANALYSIS OF THE UNDERLYING FOUNDATION AND SOIL.
- STORM FLOOD ROUTING. DESIGN & ANALYSIS OF A HYDRAULIC SYSTEM FOR STORAGE AND CONVEYANCE OF AN EMERGENCY WATER SUPPLY TO THE INDIVIDUAL EVACUATION CENTER BUILDINGS.
- TRANSPORTATION ENGINEERING; LAYOUT OF A TYPICAL MAIN EMERGENCY ROAD. ASSOCIATED ROAD DESIGN INCLUDING CROSS SECTION AND SUPERELEVATION DIAGRAM.
- CONSTRUCTION METHODS FOR THE PROPOSED STRUCTURES AND SYSTEMS. INCLUDES MATERIAL AND LABOR COST ESTIMATIONS, CONSTRUCTION SCHEDULING, SITE AND LABOR CONTROL.

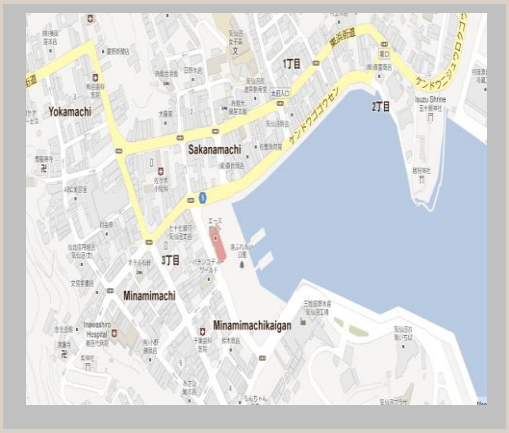

Christina Paddack


Tamina Akram


Abigail Goode


Daria Yegorava


Nick Pallares



RECOSTRUCTION OF KESENNUMA JAPAN

"ENGINEERING IS THE ART OF MODELING MATERIALS WE DO NOT WHOLLY UNDERSTAND, INTO SHAPES WE CANNOT PRECISELY ANALYZE SO AS TO WITHSTAND FORCES WE CANNOT PROPERLY ASSESS, IN SUCH A WAY THAT THE PUBLIC HAS NO REASON TO SUSPECT THE EXTENT OF OUR IGNORANCE." – ANONOMOUS

SDSU COMMERCIAL TEAM

SPONSORED BY: HENSEL PHELPS CONSTRUCTION
ADVISOR: CLARK CONSTRUCTION

CONSTRUCTION ENGINEERING

SPRING 2012 SDSU ENGINEERING SENIOR DESIGN DAY

- STEPHEN DAVIS- PROJECT MANAGER
- DAVID FLICKINGER:PROJECT ESTIMATOR
- TIM KUNZ- PROJECT ENGINEER

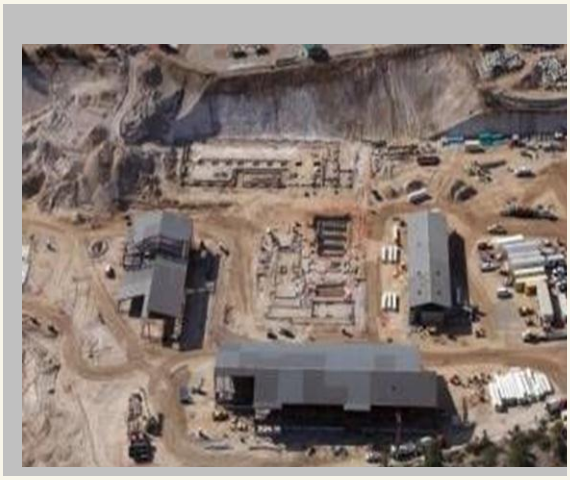
PROJECT INFORMATION:

COUNTY OF LOS ALAMOS AIRPORT BASIN SITE

LOCATION: LOS ALAMOS, NM

- OWNER: LOS ALAMOS COUNTY
- ARCHITECT: WHPACIFIC
- DELIVERY SYSTEM: CM AT RISK/GMP
  - 30 ACRE SITE
  - 5 “OCCUPIED” BUILDINGS
  - 3 “SUPPORT” BUILDINGS
    - CUMULATIVE BLDS SF: 165,000

THIS PROJECT WILL BE USED TO SERVICE ALL OF THE COUNTY OF LOS ALAMOS SERVICE VEHICLES AND FACILITIES.



“BUILD IT ONCE, BUILD IT RIGHT!”

TSUNAMI SURFERS

s

CIVIL ENGINEERING

SPRING 2012 SDSU ENGINEERING SENIOR DESIGN DAY

- MONICA ARREDONDO, STRUCTURAL
- WHITNEY WHITTAKER, GEOTECHNICAL
- ZHELAN TAHIR, TRANSPORTATION
- MARY ROSE SANTOS, HYDRAULICS
- MATTHEW HARDY, CONSTRUCTION

ON MARCH 11, 2011 AN EARTHQUAKE OF MAGNITUDE 9.0 STRUCK 60 MILES NORTH EAST OF JAPAN. SUBSEQUENTLY, A TSUNAMI FORMED AND HIT THE COAST OF JAPAN. THE CITY OF KESENNUMA WAS ONE OF THE MANY CITIES AFFECTED BY THE TSUNAMI. THERE WAS APPROXIMATELY 520 REPORTED FATALITIES IN KESENNUMA ALONE.

THE PURPOSE OF THIS PROJECT IS TO REBUILD THE CITY OF KESENNUMA WHILE SIMULTANEOUSLY PREPARING IT FOR THE NEXT MAJOR EARTHQUAKE AND TSUNAMI. KESENNUMA IS A CITY KNOWN FOR ITS FISHING PORT. ONE OF THE GOALS OF OUR PROJECT IS TO RECONSTRUCT THE CITY TO MAINTAIN THIS SOURCE OF ECONOMIC REVENUE.

OUR RECONSTRUCTION PLAN FOR KESENNUMA INCLUDES RELOCATING THE RESIDENTIAL AREAS AND BUSINESSES, PROVIDING EVACUATION LOCATIONS, AND REDIRECTING THE FLOW OF WATER.

TEAM PHOTO

CAPTION PHOTO HERE

“WE ARE AFRAID OF NO CHALLENGE.”

NEW KESENNUMA

ADVISOR: DR. DOWELL

CIVIL ENGINEERING

SPRING 2012 SDSU ENGINEERING SENIOR DESIGN DAY

- CHASE BILLS – STRUCTURAL
- ROB LECHICH – CONSTRUCTION
- BRIAN NGUY – GEOTECHNICAL
- CORY RAPOZA – HYDRAULICS
- DAVID SALAS - TRANSPORTATION

THE PURPOSE OF THIS PROJECT WAS TO CREATE A NEW TOWN OF KESENNUMA THAT WILL BE ABLE TO WITHSTAND AN EARTHQUAKE AND TSUNAMI SIMILAR TO THE ONE THAT OCCURRED IN MARCH 2011, REPRESENTING APPROXIMATELY A 1000 YEAR RETURN PERIOD (ON AVERAGE IT WILL OCCUR EVERY 1000 YEARS). THE HISTORICAL GEOLOGICAL RECORD AT THE SITE CONFIRMS THIS AVERAGE RETURN PERIOD. OUR TEAM CONSISTS OF A STRUCTURAL ENGINEER, GEOTECHNICAL ENGINEER, HYDRAULIC ENGINEER, TRANSPORTATION ENGINEER AND CONSTRUCTION ENGINEER. TOGETHER, WE BELIEVE WE HAVE CREATED A CITY THAT WILL WITHSTAND SUCH CONDITIONS.

TEAM NEW KESENNUMA

MAP OF KESSENUMA

"NEW KESSENUMA, NEW BEGINNINGS"

AZTEC PROJECT

ADVISOR: ROBERT DOWELL

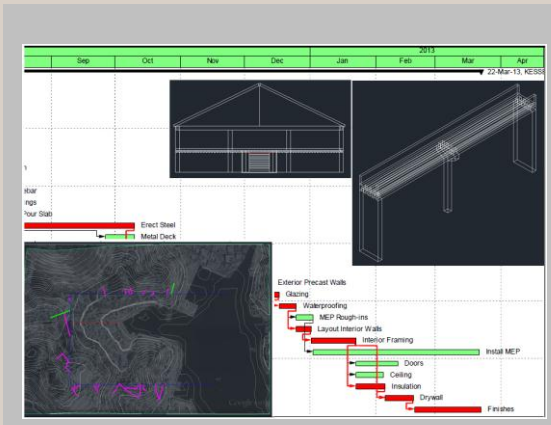
CIVIL ENGINEERING

SPRING 2012 SDSU ENGINEERING SENIOR DESIGN DAY

- JESS ARCILLAS – STRUCTRUAL
- OTHMAN ELMEZAIN - TRANSPORTATION
- HONG LE - HYDRAULICS
- CURTIS LESTER - CONSTRUCTION
- JONATHAN VALDEZ - GEOTECHNICAL

ON MARCH 11 2011, A 9.0 MAGNITUDE EARTHQUAKE CREATING A MASSIVE TSUNAMI WHICH STRUCK JAPAN'S EASTERN SHORE, DESTROYING MANY CITIES. KESENNUMA IS ONE CITY THAT WAS DEVASTATED AND IT IS OUR RESPONSIBILITY TO REDESIGN IT TO MINIMIZE FUTURE DAMAGES FROM EARTHQUAKES AND TSUNAMIS. ELMEZAIN ESTABLISHED NEW TRANSPORTATION ROUTES TO ENSURE SAFE AND EFFECTIVE EVACUATIONS. ARCILLAS DESIGNED STRUCTURALLY SOUND BUILDINGS AND BRIDGES. VALDEZ ANALYZED THE SOIL AND CONSULTED WITH THE TEAM TO SOLIDIFY THE FOUNDATIONS AND REDUCE THE EFFECTS OF LIQUEFACTION. LE DESIGNED A CHANNEL TO MITIGATE THE WATER TO THE OCEAN IN ADDITION TO STRATEGICALLY DISTRIBUTING VEGETATION TO DECREASE THE TSUNAMI'S VELOCITY. LESTER CREATED A SCHEDULE AND ESTIMATED THE TIME AND COST OF THE ENTIRE PROJECT.

AZTEC PROJECT GROUP



AZTEC PROJECT DESIGNS

"IN THE CASE OF A TSUNAMI, THE BEST DEFENSE IS A GREAT OFFENSE"
-TOM ZINK

SDSE INT.

ADVISOR: R. DOWELL

CIVIL ENGINEERING

SPRING 2012 SDSU ENGINEERING SENIOR DESIGN DAY

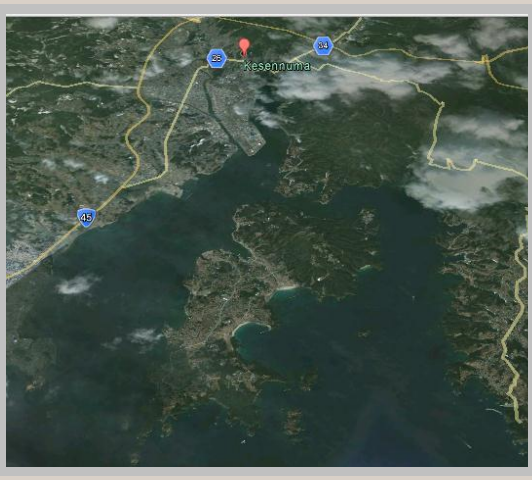
- PETE VRETTAS: CONSTRUCTION ENG.
- FADI ABDELMUTI : HYDRAULIC ENG.
- GARRET SHELTON: STRUCT. ENG. I
- EYOEIL MENGISTA: STRUCT. ENG. II
- ZACK BAKIER : GEOTECHNICAL ENG.

TEAM SDSE

PROJECT DESCRIPTON HERE

This site is located in the small fishing town of Kesennuma, Japan. It is a tourist location with fairy landings, parking structures and several small shops scattered across the coastline. The town is subject to frequent earthquakes from a nearby fault zone which can create many problems. The last large earthquake was of the magnitude 9 and caused a complete rise of sea level which forced water into Kesennuma and destroyed almost every structure. Now, the town's economy is at risk, not only because of the damage but also due to a recent decline in the towns fishing industry.

Kesennuma was at one point the 6th largest fishing port of Japan. Now, because of overfishing, the fish population is declining by about 1% every year. The community is hoping to see other sources of profit come out of this reconstruction, maybe museums or hotels for example. Simply adding 6 meter high walls along the coast will not work. Tsunami protection cannot interfere with the town's appearance or character.



INLET TO KESENNUMA BAY

"EQUILIBRIUM IS ETERNAL."

ENGINEERS WITHOUT BORDERS

ADVISORS: JULIO VALDES, TOM ZINK, AND DONOVAN GEIGER

CIVIL ENGINEERING

SPRING 2012 SDSU ENGINEERING SENIOR DESIGN DAY

- VANESSA BOLLES - GEOTECHNICAL
- NICOLE DIAS - STRUCTURAL
- BRYAN NORD - CHLORINATION
- RONAK REKANI - HYDRAULICS
- NICK TSUJI - CONSTRUCTION
- JOE NEILLY - CONSTRUCTION

THIS PROJECT CONSISTS OF ALTERING AN EXISTING WATER SUPPLY A COMMUNITY OF 600 HONDURAN RESIDENTS. THE CURRENT SYSTEM IS LACKING IN PROPER SEDIMENT REMOVAL, CHLORINATION AND DISTRIBUTION. OUR PROPOSAL CONSISTS OF ALTERATIONS AND EXPANSIONS TO THEIR INTAKE, WEIR BOX, CHLORINATION TANK, OVERFLOW SYSTEM, EXTRA CAPACITY TANKS AND DISTRIBUTION LINES.

THE HYDRAULIC ENGINEER WILL DETERMINE HOW TO BEST SLOW THE VELOCITY OF THE WATER SO APPROPRIATE SEDIMENT CAN BE REMOVED. CHLORINATION ENGINEER WILL ROUTE ENOUGH WATER TO PROPERLY CHLORINATE THE HOLDING TANK'S SUPPLY. GEOTECHNICAL AND STRUCTURAL ENGINEERS WILL DESIGN FOUNDATIONS AND STRUCTURES NEEDED TO HOLD THE EXTRA CAPACITY TANKS, AS WELL AS MINOR ADJUSTMENTS TO EXISTING SYSTEM. CONSTRUCTION ENGINEER WILL DETERMINE A SCHEDULE AND COST ESTIMATE.

THE EWB DESIGN TEAM

EXISTING DISTRIBUTION TANK

"BUILDING A BETTER WORLD, ONE COMMUNITY AT A TIME"

TEAM: HONEY BADGERS
ADVISOR: DR. ROBERT DOWELL

CIVIL ENGINEERING

SPRING 2012 SDSU ENGINEERING SENIOR DESIGN DAY

- JOSEPH ILAGAN – STRUCTURAL
- JEFF NAVARRETE - TRANSPORTAION
- ISAAC POOLE – HYDRAULICS
- AUSTIN FREEMAN - CONSTRUCTION
- JOSHUA SANTOS - GEOTECHNICAL

PROJECT DESCRIPTION:

THE SCOPE OF WORK FOR THIS PROJECT IS TO REDESIGN THE TOWN OF KESSENUMA IN JAPAN. THE GOAL IS TO LIMIT THE AMOUNT OF DAMAGE AND TO ENSURE THE SAFETY OF THE PEOPLE WHEN AN EARTHQUAKE AND TSUNAMI OCCURS OF EQUAL MAGNITUDE TO THAT OF THE MARCH 11, 2011 NATURAL DISASTER. THE TOWN'S MAIN ATTRACTION IS THE HARBOR THAT IS USED PRIMARILY BY FISHING VESSELS. DESIGN IDEAS INCLUDE HOUSES THAT SIT ON STILTS, ADDITIONAL ACCESS ROADS FOR EVACUATIONS, ROCK/STONE PILES AND BREAK WATER WALLS.

HONEYBADGER

SATELLITE VIEW OF KESSENUMA

"BE THE CHANGE YOU WANT TO SEE IN THE WORLD" – MAHATMA GANDHI

TEAM MIYAGI

ADVISOR: PROF. ROBERT DOWELL

CIVIL ENGINEERING

SPRING 2012 SDSU ENGINEERING SENIOR DESIGN DAY

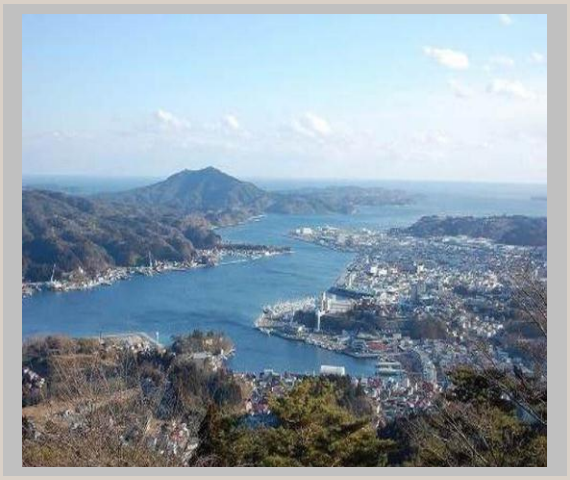
- CARLOS ALANIZ - STRUCTURAL
- KRIS TANNER - HYDRAULICS
- OSCAR MARTHA - GEOTECHNICAL
- OSVALDO JOYA - TRANSPORTATION
- YANNET CASTILLO - CONSTRUCTION

TEAM MIYAGI

THE PROJECT CONSISTS OF A WALL THAT WILL DIVERT PART OF THE TSUNAMI IMPACT FORCE TOWARDS OUR CHANNEL THAT WILL DECREASE THE ENERGY OF THE TSUNAMI USING POTENTIAL ENERGY; SINCE THE VOLUME OF WATER WITHIN THE CHANNEL WILL BE SUBJECTED TO AN INCREASING SLOPE AS THE INCOMING WATER FILLS AND CLIMBS THE CHANNELL LENGTH.

THE CITY BUILDINGS HAVE BEEN STRUCTURALLY DESIGNED TO WIDTHSTAND THE EARTHQUAKE FORCE, INCLUDING LIQUEFACTION EFFECT.

THE CITY WILL ALSO HAVE EVACUATION ROUTES LEADING TO HIGH GROUND, AND BRIDGES SPANING OVER THE CHANNEL TO MAINTAIN EASE OF INGRESS AND EGRESS THROUGHOUT THE CITY.



KESENNUMA, JAPAN

NOVA ENGINEERING

CIVIL ENGINEERING

SPRING 2012 SDSU ENGINEERING SENIOR DESIGN DAY

- VANIA FERNANDEZ- GEOTECHNICAL
- ALEJANDRA GONZALEZ- HYDRAULICS
- JOSE GONZALEZ- TRANSPORTATION
- KELVIN GOMEZ- CONSTRUCTION
- ROBERTO RUVALCABA- STRUCTURAL

GROUP MEMBERS

NOVA ENGINEERING HAS BEEN ASSIGNED THE TASK TO REDEVELOP THE CITY OF KESSENUMA, JAPAN, FOLLOWING THE DESTRUCTION CAUSED BY THE TSUNAMI OF MARCH 2011. THE RECONSTRCUTION WILL CONSIST OF PREVENTING MAJOR DAMAGE IN CASE OF ANOTHER NATURAL DISASTER. THE TEAM HAS CONSIDERED A SERIES OF OPTIONS TO MITIGATE FUTURE DAMAGES TO THE CITY:

- DESIGN TWO HYDRAULIC CHANNELS TO REDIRECT WATER FLOW
- MODIFY THE TOPOGRAPHY TO CREATE HIGHER ELVATIONS
- DESIGN PILES TO PREVENT THE FAILING OF STRUCTURES IN CASE OF LIQUEFACTION
- DESIGN HOMES THREE METERS ABOVE GROUND TO REDUCE BUILDING DAMAGES

THIS PROJECT AIMS TO IMPROVE THE CITY'S RESISTANCE TO AN EXTREME EVENT WHILE ENSURING ITS OWN SUSTAINABILITY THROUGH A PLANNED SCHEDULE AND PROPOSED COST ESTIMATE.

KESENNUMA CITY, JAPAN

NOVA Engineering:
Innovative solutions through the Power of Engineering

TSUYOSHI ENGINEERING

ADVISOR: DR. DOWELL

CIVIL ENGINEERING

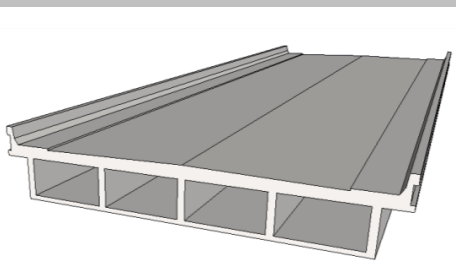
SPRING 2012 SDSU ENGINEERING SENIOR DESIGN DAY

- JAIME AKAMINE- STRUCTURAL
- DALLAS BUCKNER- TRANSPORTATION
- LAURA BYRD- HYDRAULICS
- DAVIN HEATON- CONSTRUCTION
- LINH NGUYEN- GEOTECHNICAL

The purpose of this project is to re-create the town of Kesennuma, Japan that was destroyed in the 2011 Tōhoku tsunami. The new city will be able to withstand a similar 9.0 magnitude earthquake and tsunami in the future, representing approximately a 1000-year return period (on average it will occur every 1000 years). Due to the extensive damage of existing structures caused by the tsunami, we will consider all existing structures as damaged beyond repair. Therefore, all existing structures and roadways need not be considered in the redevelopment of Kesennuma.

The redevelopment of Kesennuma will involve the construction of earth mounds that will provide "safety zones" (evacuation locations above the high water mark), as well as house a business/tourist district that will stimulate the economy of this small fishing town. A sample apartment complex has been designed to demonstrate the type of buildings that will reside in the "safety zone" and to highlight the integrated tsunami defense mechanisms. Natural channels have been designed to direct the inundation of tsunami water using the newly designed roadways as channel beds. Additionally, a 150 foot bridge has been designed to connect the earth mounds and allow access to the business district for pedestrians, bicyclists, tourists and residents of the apartment buildings. See Box Girder bridge model to the right.

TSUYOSHI DESIGN TEAM



Reinforced Concrete Box Girder Bridge

150-FOOT SPAN

"A SMARTER TODAY IS A SAFER TOMORROW."

-DAVIN HEATON

SHOCKWAVE DESIGN GROUP

ADVISOR: PROFESSOR DOWELL

CIVIL ENGINEERING

SPRING 2012 SDSU ENGINEERING SENIOR DESIGN DAY

- RIAD BITAR – TRANSPORTATION
- BASIM SALIB – GEOTECHNICAL
- BRANDON DAVIS – CONSTRUCTION
- KYLE SCHROEDER – STRUCTURAL
- EMERSON HERRERA – HYDRAULICS

Shockwave Design Group was given the opportunity to redesign the recently destroyed city of Kesennuma, Japan as part of San Diego State University's earthquake and tsunami mitigation proposal. The small fishing town was devastated by a 9.0 magnitude earthquake and subsequent tsunami in March of 2011. Shockwave Design Group chose to overhaul the city by focusing on the design of tsunami mitigation features within the fields of structural, geotechnical, hydraulic, and transportation engineering along with the development of a city-wide emergency evacuation plan. Focusing on mitigation and emergency evacuation plans allowed for our design to strive in ensuring the safety of Japanese citizens, our number one priority. Once our proposed design has been fully implemented, Kesenumma and its citizens will be fully prepared and protected in a future tsunami disaster.

SHOCKWAVE DESIGN GROUP

KESENNUMA, JAPAN

"TO THE OPTIMIST, THE GLASS IS HALF FULL. TO THE PESSIMIST, THE GLASS IS HALF EMPTY. TO THE ENGINEER, THE GLASS IS TWICE AS BIG AS IT NEEDS TO BE."

HEAVY CIVIL

MENTORED BY: FLATIRON
PROJECT: '12 ASC RENO COMPETITION

CIVIL ENGINEERING

SPRING 2012 SDSU ENGINEERING SENIOR DESIGN DAY

TEAM MEMBERS (ENROLLED IN CIVE 495)**:**

- ROBERT LECHICH, CAPTAIN
- BRENT COLLINS
- WILL WEGENER
- KYLE M$_C$CARTHY
- DYLAN KNAPPE

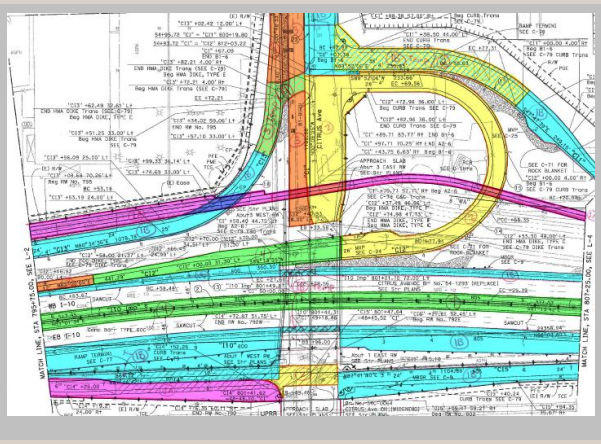
PROJECT DESCRIPTON:

SDSU'S 2012 HEAVY CIVIL TEAM COMPETED IN THE ASC STUDENT COMPETITION REQUIRING A COMPLETE HARD BID PACKAGE SUBMITTAL AND PRESENTATION TO OUR ACTING UPPER MANAGEMENT (PANEL OF JUDGES).

THE PROJECT GIVEN TO US INCLUDED TAKEOFFS OF A TRAFFIC CONTROL SYSTEM, CLEARING & GRUBBING, REMOVING AND RECONSTRUCTING A CAST-IN-PLACE BRIDGE, ROADWAY EXCAVATION, HMA PAVING, JOINTED PLAIN CONCRETE PAVEMENT, REINFORCED CONCRETE PIPE, STREAM DIVERSION/CHANNEL & CULVERT RENOVATION, AND A BOX GIRDER BRIDGE OVER A SECTION OF THE UPRR. THE BID PACKAGE INCLUDED A SCHEDULE, BONDS, SUBCONTRACTOR SELECTION, ADDENDA, GOOD FAITH EFFORT, ETC. KYLE'S QUOTE WAS A NOTABLE CONTRIBUTION TOWARD OUR PROJECT MANAGEMENT PLAN.

THE HEAVY CIVIL TEAM PLACED IN THE TOP 5 OF THE COMPETITION.

JUDGES, TEAM, AND MENTOR AFTER PRESENTATION



STAGING LAYOUT

"POSTPONING STAGE 2 UNTIL AFTER THE E.P.A. PERIOD OF CEASED CONSTRUCTION WILL SAVE THE COST OF A MOBILIZATION" –K. M$_C$CARTHY

MULTI-FAMILY TEAM

SPONSORED BY: SWINERTON
ADVISOR: LAUREN NUNNALLY

CONSTRUCTION ENGINEERING

SPRING 2012 SDSU ENGINEERING SENIOR DESIGN DAY

TEAM MEMBERS:

- DENISE CORTEZ – SITE LOGISTICS
- JOSEPH NEILLY – SCHEDULE
- THOMAS BROWN – ESTIMATING & PLAN READING
- NATHAN DOBBS – RFI & PLAN READING
- RUBEN GOMEZ - ESTIMATING

PROJECT DESCRIPTON HERE

512 ROSE IS A MIXED-USE DEVELOPMENT IN THE HEART OF VENICE FEATURING 65 APARTMENT UNITS, FIVE TOWNHOME-STYLE UNITS WITH 10, 000 SQUARE FEET OF GROUND FLOOR RETAIL SPACE, 2 RESTAURANTS, AND 5 RETAIL UNITS. THE FACILITIES ALSO PROVIDE 2 LEVELS OF UNDERGROUND PARKING FOR TENANTS AND SHOPPERS. THIS PROJECT IS DESIGNED TO ACHIEVE LEED PLATINUM FOR NEW HOMES, WHICH WILL BE A MARK OF PRIDE FOR THE SURROUNDING COMMUNITY.

MULTI-FAMILY TEAM

512 ROSE AVE APARTMENTS

"KNOWING IS NOT ENOUGH; WE MUST APPLY. WILLING IS NOT ENOUGH; WE MUST DO"

- JOHANN WOLFGANG VON GOETHE

RENO - PRECON

ADVISOR: DR. K. WALSH

CONSTRUCTION ENGINEERING

SPRING 2012 SDSU ENGINEERING SENIOR DESIGN DAY

- **ALEX MCCARTHY** – PROJECT EXECUTIVE
- **AREN AVAKIAN** – SR. PROJECT MANAGER
- **PAT GALVIN** – SR. PROJECT SUPERINTENDENT

THIS PROJECT IS THE RITZ CARLTON, LOCATED IN VAIL COLORADO, WHICH IS A HIGH END LUXURY CONDOMINIUM RESORT, INCLUDING AMMENTITIES FOR THE TENANTS. THE SURROUNDING COMMUNITY IS THE BASE OF A SUMMIT MOUNTAIN SKI RESORT, WITH OTHER HIGH END HOTELS AND CONDOMINIUMS ADJACENT TO THE PROJECT LOT.

THE PROPOSAL FOR THIS PROJECT REQUIRED A TWO-PHASE SUBMISSION, INCLUDING FULL PRECONSTRUCTION SERVICES CONSISTING OF A COMPLETE CONCEPTUAL ESTIMATE, A PRELIMINARY SCHEDULE, AND RISK ANALYSIS SUBMISSION. OTHER PROPOSAL REQUIREMENTS INCLUDE A SITE LOGISITICS PLAN, A SITE SPECIFIC SAFETY PLAN, COMPLETE BUILDING INFORMATION MODELING SERVICES CLASH DETECTION, CONSTRUCTABILITY REVIEW, AND A BID ANALYSIS FOR MECHANICAL, ELECTRICAL, AND PLUMBING TRADES.

TOTAL PROJECT ESTIMATION: $303 MILLION DOLLARS; 36 MONTH SCHEDULE.

RENO COMPETITION 2012

RITZ CARLTON – VAIL CO.

"THE ROAD TO SUCCESS IS ALWAYS UNDER CONSTRUCTION"

AESIR

SPONSORED BY: AETHERON SCIENTIFIC
MENTOR: RUSSELL CHUNG

ELECTRICAL AND COMPUTER ENGINEERING

Website: AESIR.sdsu.edu

TOUCH FREE WIRELESS ENVIRONMENT

FOR REMOTE INDIUSTRIAL WATER CONDUCTIVITY SENSING

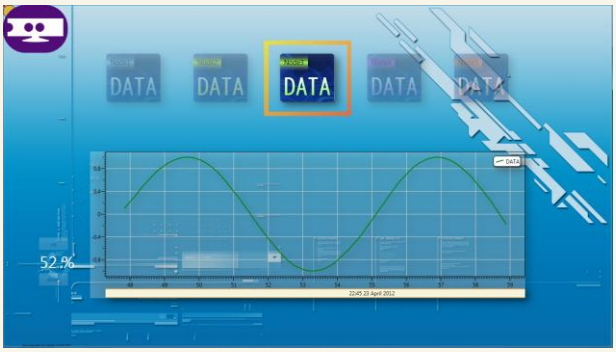
THE PURPOSE OF THIS PROJECT IS TO PROVIDE AN ADAPTIVE SENSOR ENVIRONMENT CAPABLE OF MEASURING BOTH WATER CONDUCTIVITY AND TEMPERATURE FOR INDUSTRIAL MANUFACTURING AND CONTROL.

CHESTER PARAS
POCHOLO FRANCISCO
ALVARO MANCERO
ANDREW MILLER
MCLAINA OUM
LUKE SIOSON
RICHARD JULIANO
MARK MANALO

SOLAR-POWERED SENSOR SYSTEM WITH CONDUCTIVITY PROBE

TOUCH FREE USER-INTERFACE MADE POSSIBLE BY **MICROSOFT KINECT.**

THE USER CAN SELECT WHICH SENSOR DATA DISPLAYS ON THE SCREEN BY PERFORMING SPECIFIC HAND GESTURES.



GUI PREVIEW

ESMART

SPONSORED BY: SDG&E
MENTORS: SHERWIN YARI AND DANIEL SMITH

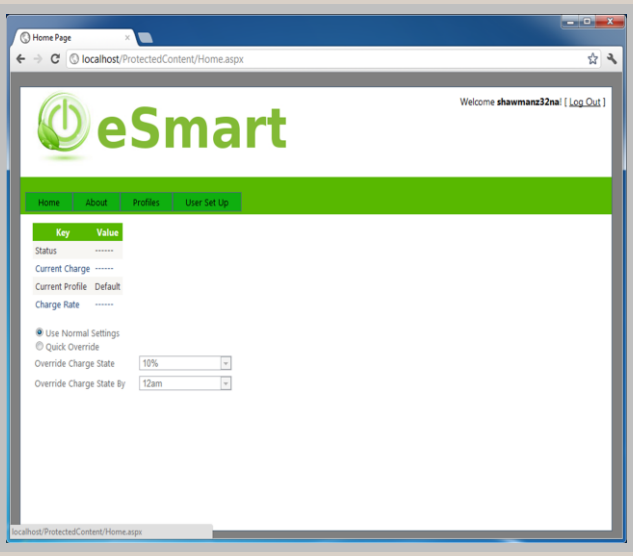
ELECTRICAL AND COMPUTER ENGINEERING

Website: Esmart.sdsu.edu

The growth of Electric Vehicles (EVs) contributes to the ever-increasing demand for power. When consumers plug in to recharge their EVs, they add significant load to the distribution transformers. Team eSmart has reproduced actual data at a smaller scale in order to construct an optimized charging system. Our system enables multiple EVs to charge simultaneously while satisfying customer needs and abiding by system constraints.

The eSmart system considers system parameters as well as customer preferences to intelligently manage EV charging. By managing the charging schedules, customer satisfaction is insured, system constraints are met, and the overall system peak load is shaved.

FROM LEFT TO RIGHT: JIN CHOI, ARMAN BOROUMAND, NICKOLAY KONDRATYEV, KEVIN SHAW, KASSANDRA HOYER, MARQUIS BLOUNT, GIULIO BOREAN, DAVID POTTINGER, ALEXANDER MATTHEW REYES, DAVID GULLINS



A PROTOTYPE ESMART CHARGING SIMULATION SYSTEM

Charging systems and an electrical power infrastructure already exist in homes across San Diego. The eSmart system brings a unique approach to managing the current system by distributing the demand for power to charge EVs intelligently, and charging the vehicles during off-peak hours. In order to test the implementation of the system, a mock charging scenario was needed. Two design teams have come together to achieve this goal.

The eSmart server team designed a smart algorithm to intelligently control the charge in a number of lithium polymer batteries. The system design was configured and implemented by the eSmart hardware team.

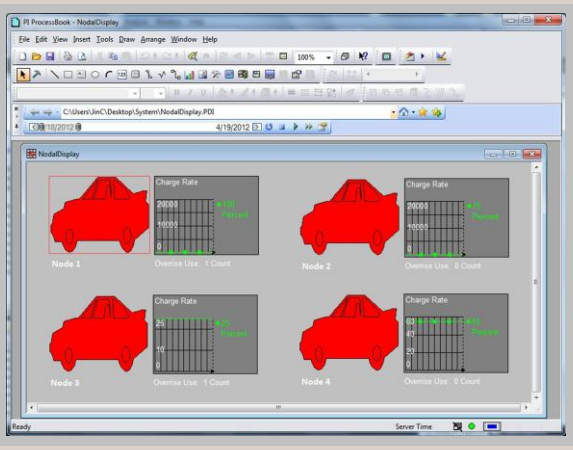
ESMART

SPONSORED BY: SDG&E
MENTORS: SHERWIN YARI AND DANIEL SMITH

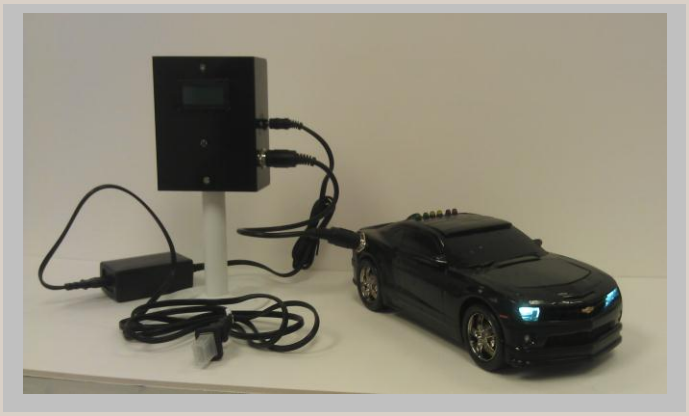
ELECTRICAL AND COMPUTER ENGINEERING

The purpose of the eSmart server team is to create a software package capable of managing the power consumption of multiple EVs charging at the same time. To do so effectively, the eSmart server team chose to utilize the OSI PI software package to manage the real-time data being transmitted from each EV.

The eSmart server team's smart algorithm utilizes information from multiple sources to determine the best allocation of available resources to each EV. The system load, the transformer capacity, the time of day, the current charge state of each EV, the individual users' selected charge profile, and the usage patterns of the individual users were parameters used to calculate the best distribution of power to meet customer needs.



A SCREENSHOT OF THE OSI PI ASSET FRAMEWORK BEING EMPLOYED BY THE ESMART SERVER TEAM



A PROTOTYPE ESMART CHARGING SIMULATION SYSTEM

The purpose of the hardware team is to accurately simulate the influence of the eSmart system on a scaled down model of a neighborhood containing multiple EVs. Each simulated home contains a wall unit as well as a mock-up EV.

The wall unit contains a user interface to display the current charge state of the EV and the selected charge profile, as well as a wireless radio to relay user input and data collected from the car to the eSmart server.

The charging unit consists of a battery, a charger, a coulomb counter, and an interface to the other (wall) unit. This unit simulates the physical properties of the lithium polymer batteries used in EVs without the expense of real vehicles.

TRIGRS

SPONSORED BY: CUBIC CORP
MENTOR: KEVIN PRIEST

ELECTRICAL AND COMPUTER ENGINEERING

Website: TRIGRS.sdsu.edu

Current battle training systems utilize lasers to simulate the ballistic trajectory of weapon firing. This approach has several downsides, including failure to determine a hit if line-of-sight is compromised, as well as not accurately simulating the real trajectory with linear lasers. The TRIGRS solution mitigates these shortcomings by using geo-pairing (GPS sensors) to determine location of launcher and target, and other sensors and mathematical calculations to determine the trajectory of the projectile in real time. The TRIGRS projectile launcher will use PVC pipes and fittings for barrel construction alongside a gas compressor for launching methods. Various sensors will be used to help determine the angle, wind speed, location and air pressure needed accurately hit a target within 1 meter of accuracy at a minimum distance of 100 yards. All the necessary system information should be readily available through an android-based touch display.

JONATHAN BRANDES, KEVIN TRUONG, PETER DOAN, KEVIN ALBERTS, LUIS MATA, COI LEE, KYLE BRUMFIELD, MATTHEW VOGEL, RAFID DAMMAN, CARLOS JIMENEZ, DAVID BORJAS

LAUNCHER

LAUNCHER AND AIR COMPRESSOR

Hardware

V102 Differential GPS unit
1. Provides Geo-Location of launcher.
2. Provides heading angle of launcher.

Muzzle Velocity Sensors
1. Two laser diodes with photosensors provide interrupt times to determine the projectile's muzzle velocity. V=d/t.
2. Muzzle velocity will be used during testing and calibration of the system to determine what muzzle velocity corresponds to which PSI values.

Anemometer
1. In order to accommodate for the effects of wind on the projectile's path, the anemometer will provide wind direction and speed to adjust trajectory calculations accordingly.

Accelerometer
1. Provides tilt angle of launcher to be used in the trajectory calculations.

Transceiver
1. Facilitates wireless data transfer between the target and the launcher to send the GPS coordinates of the target to the launcher.

Air Compressor
1. Provides compressed air to the chamber of the launcher.

Launcher
1. Built using PVC pipe for the barrel and chamber.
2. Electronically controlled valve allows software and hardware to fire the projectile.

Car Battery
1. Provides 12VDC to the entire system.

TRIGRS

SPONSORED BY: CUBIC CORP
MENTOR: KEVIN PRIEST

ELECTRICAL AND COMPUTER ENGINEERING

Software

The TRIGRS software is the glue that holds the project together. A master microcontroller operating in host mode interfaces with an Android OS device that facilitates user interaction with the TRIGRS system. This master microcontroller will also utilize the SPI protocol to communicate with 5 smaller microcontrollers operating in slave mode. These slave controllers will collect sensor data, package it, and send it to the master controller, which will then forward the data to the Android user interface for processing.

Software resides on:

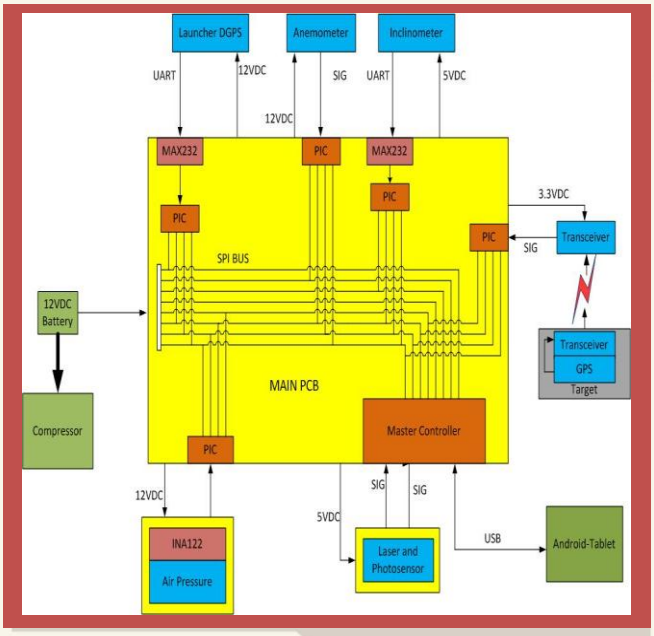
- Master: PIC24FJ256GB106 (C Language)
- Slaves: PIC16F1823 x5 (C Language)
- Android Tablet (Java)

Communication:

- UART/RS232
  - From sensors to the slave controllers
- SPI
  - From slave controllers to master controller

JONATHAN BRANDES, LUIS MATA, MATTHEW VOGEL, COI LEE, DAVID BORJAS

SYSTEM LEVEL BLOCK DIAGRAM



ANDROID TABLET INTERFACE

The TRIGRS System will provide user interaction through an Android-powered tablet. A custom-built Android app will allow the user to see the position of the launcher, the target, and the projected path of the projectile on a map. A panel of sensor gadgets will provide the user with the sensor data in an easy-to-use, graphical format to keep updated with the system in real-time. As new sensor data is forwarded to the tablet, trajectory calculations are run to project on the map where the projectile is expected to land. The user can then aim the launcher to line up the projected path with the target marker by watching the updated map positions.

SAN DIEGO STATE UNIVERSITY
COLLEGE OF ENGINEERING

SPRING 2012 ENGINEERING DESIGN DAY

FLY HIGH AZTECS

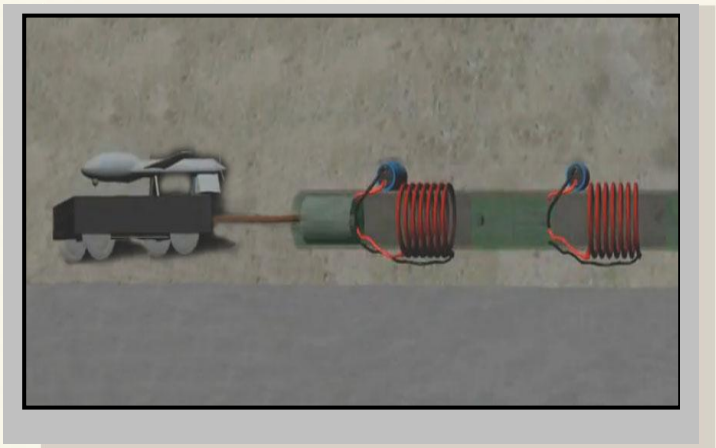
SPONSORED BY: GENERAL ATOMICS AERONAUTICAL SYSTEMS INC.
MENTORS: KONSTANTIN DUBOVENKO & PHILIP BRUTTIG

ELECTRICAL AND COMPUTER ENGINEERING

Website: FHAztecs.sdsu.edu

Electromagnetism, conjured from the combination of electric current and magnetic fields, gave rise to many enchanting concepts and awesome inventions. At SDSU, a group of engineering students applied this very concept to flight mechanics. This group, Fly High, combined the practical knowledge of power electronics, electromagnetic physics, embedded programming and teamwork to create an Electromagnetic Unmanned Aerial Vehicle Launcher. Our project serves as a coilgun-like device that launches an Unmanned Aerial Vehicle [UAV].

FlyHighAztecs: (front row, from left to right) Ronnie Ross Carpio, Kevin Sarmiento, Robel Ghebrehiwet, Jose Nava, Russell Arroyo, Salman El Aissami. (back row) Smith St.John, Mike Hlavaty, Steven Baker.



[Project Model]

Our system uses a set of mounted coils with high power solid state switches, which are controlled by 8-bit microprocessors. To accelerate the aircraft, an iron core projectile (slug) pushes a launching sled with a UAV mounted on top Due to electromagnetic induction the slug accelerates through the launching tube pushing the UAV in front of it. As a result, the UAV will fly as it accelerates. This will be a modernized version of today's current short airstrip launching system and will effectively reduce the number of moving parts.

FLY HIGH AZTECS

SPONSORED BY: GENERAL ATOMICS AERONAUTICAL SYSTEMS INC.
MENTOR: KONSTANTIN DUBOVENKO & PHILIP BRUTTIG

ELECTRICAL AND COMPUTER ENGINEERING

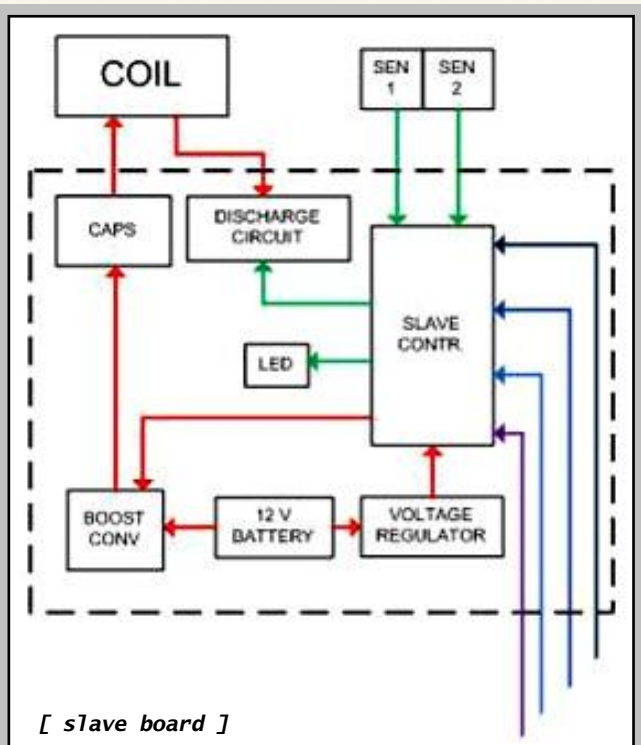
Hardware:

[Coil & Launcher] In order to successfully launch the UAV, we require a way to effectively accelerate the aircraft to the desired velocity. This will be done with a design that uses multiple electromagnetic coils mounted along the launching tube.

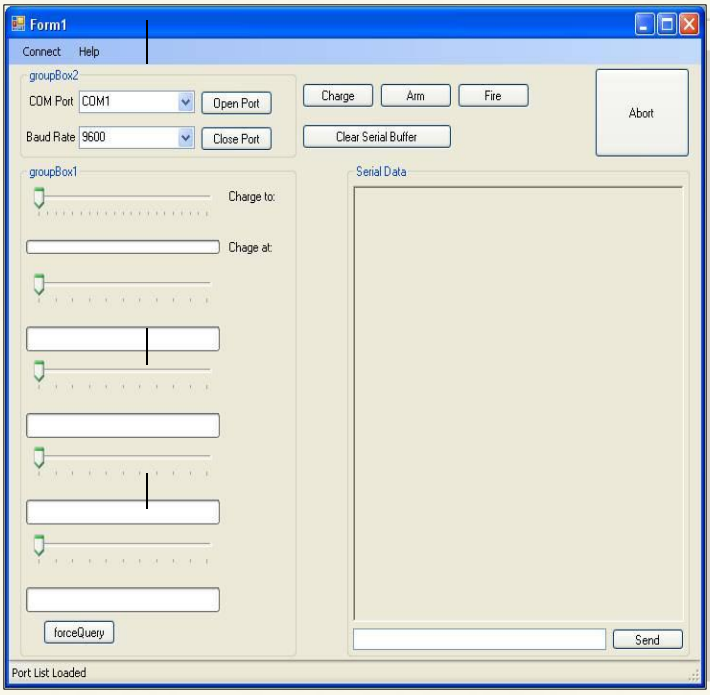
[Charging Circuit] A high-voltage capacitor must be charged to a desired voltage to be used as the source electromagnetic energy. A DC/DC converter is used to boost a 12V voltage source to 200V or higher.

[Switch Circuit] This circuit supplies precise computer controlled current pulse to each coil from a high-voltage capacitor though a low-side MOSFET switch.

[Sensor Circuit] This is a key component to the firing system. It allows the system to determine the position of the projectile along the barrel that, in turn, triggers the discharge of the high voltage capacitors.



[slave board]



[Graphical User Interface]

Software:

[Microcontroller] The brains behind the entire system, 6 ATmega328 Microcontrollers control how the system operates. Their job is to launch the projectile at the desired settings received from the user interface. Upon launch, each microcontroller waits to receive data from the sensors to determine the slug position in the launching tube. When the slug triggers sequential position sensors next processor in line triggers its coil and thus, accelerates the projectile

[User Interface] The user interface gives the operator the freedom to dynamically set launching parameters as well as to monitor the entire system status.

A.I.R.S.

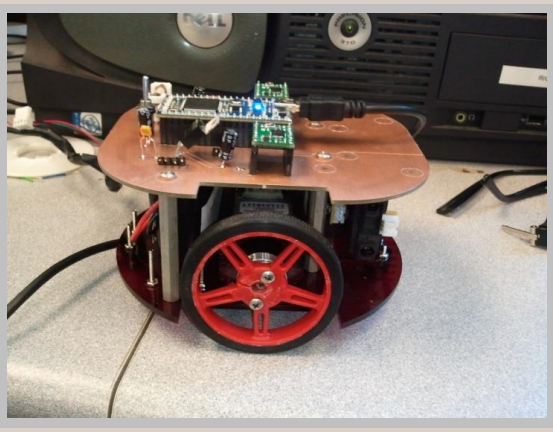
SPONSORED BY: SDSU
MENTOR: JOHN KENNEDY

ELECTRICAL AND COMPUTER ENGINEERING

Website: AIRS.sdsu.edu

The MicroMouse is a self-contained robot designed and built to navigate a 16x16 cell maze with each cell measuring 18x18 cm. The robot must be self-navigating and have no outside user control while it's solving the maze. The solution to maze is arriving at the center in 10 minutes or less. Once the MicroMouse completes the mapping of the maze, it will be placed again at the start of the maze and find the shortest path to the finishing point.

(FROM LEFT) DONOVAN GREEN, EDWIN OBERGFELL, JAMES HOPE



The MicroMouse

The MicroMouse will be utilizing a 32-bit ARM based processor and analog infrared sensors to detect and store its path through the maze. The A.I.R.S. team intends on entering the IEEE MicroMouse Region 6 competition that will be held at UCSD on May 24th, 2012.

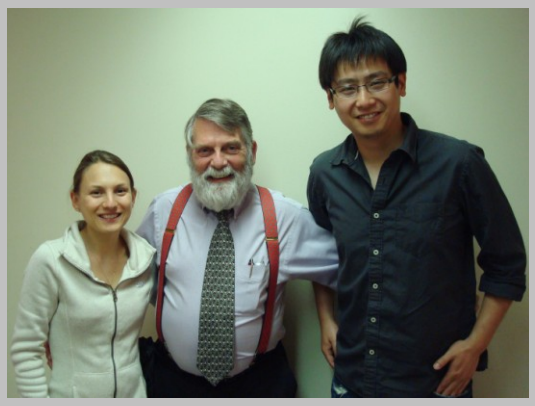
DSP RESEARCH GROUP

SPONSORED BY: FRED J HARRIS
MENTOR: FRED J HARRIS

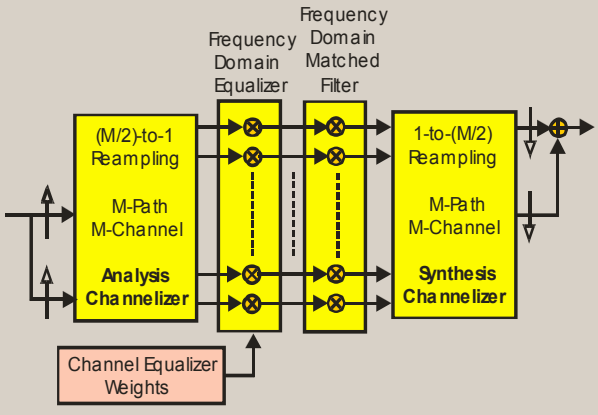
ELECTRICAL AND COMPUTER ENGINEERING

AN EFFICIENT FREQUENCY DOMAIN EQUALIZATION METHOD FOR CANNELIZER-BASED SOFTWARE DEFINED RADIOS

In this project we present an efficient method for equalizing the wireless channel in DSP-based radio architectures. Equalization is usually performed in the time domain via transversal filters. Our proposal performs the channel equalization in the frequency domain by adjusting scalar gains and phases of each path of a perfect reconstruction filter bank. In this process the spectral products form a composite channel-equalizer and matched filter frequency response with uniform gain and phase profiles. This process cancels severe signal distortion caused by the multipath channel. The appropriate gain and phase profiles can be obtained adaptively or from a channel probe.



ELETTRA VENOSA, PROF. FRED HARRIS AND XIAOFEI CHEN



PROPOSED FREQUENCY DOMAIN EQUALIZER

For this project the frequency domain equalization method is applied in fully digital receivers containing perfect reconstruction (PR) polyphase filter banks designed to synthesize processing arbitrary filter response. The output ports of an M-path analysis channelizer present samples of the narrow band complex envelope from spectral segments spanning the entire signal bandwidth. Appropriate scalar gains and phase shifts are applied to each path to reverse the distortion caused by the wireless channel. An estimation block guides the selection of the proper parameter values. Trade-off considerations between total workload and receiver performance influence the selection of the number of IFFT spectral sample points in the analysis channelizer. The channelizer spectral response interacts with the applied gains to form a "connect the dots" piece-wise linear approximation to any specified frequency response. Theoretical analysis and simulation results, which prove the efficacy of the proposed method, will be provided along with suggestions for further research and development work.

DSP RESEARCH GROUP
SPONSORED BY: FRED J HARRIS
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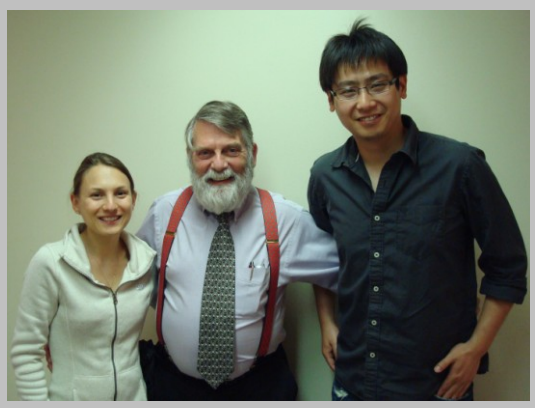
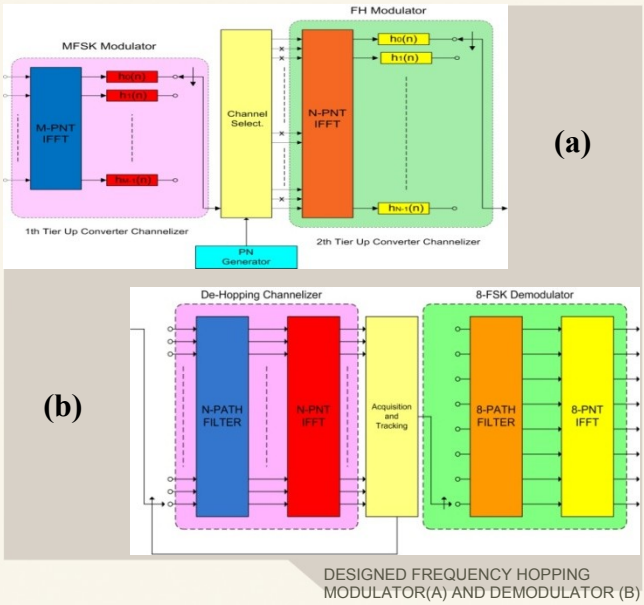
ELECTRICAL AND COMPUTER ENGINEERING

POLYPHASE CHANNELIZERS FOR FULLY DIGITAL FREQUENCY HOPPING SYSTEMS

Frequency hopping (FH) is a spread spectrum (SS) transmission technique that achieves frequency diversity gain over frequency selective fading channels and also has a low probability of interception. This technique has been widely used in military applications, for its recognized anti-jamming performance, and in some wireless standards such as GSM and Bluetooth, for its interference resistance. Our goal is to design fully digital architectures for performing frequency hopping modulation and demodulation.



ELETTRA VENOSA, PROF. FRED HARRIS AND XIAOFEI CHEN



DESIGNED FREQUENCY HOPPING MODULATOR(A) AND DEMODULATOR (B)

The proposed modulator is composed of a cascade of two polyphase up converter channelizers. The first one performs the digital M-FSK modulation of the baseband signals while the second one accomplishes the task of hopping the FSK modulated spectra under the control of a pseudorandom sequence generator. On the receiver side, two dual down converter channelizers undo the frequency shifts performed by the digital channelizers in the transmitter. Synchronization is a key aspect in frequency hopping systems. Transmitter and receiver must both know the hopping pattern and they must be finely synchronized in order to capture the desired information. In this project we provide a fully digital architecture that, embedded in the proposed channelizer-based receiver, performs signal acquisition and tracking. According to our knowledge, a fully digital architecture for frequency hopped transmission has never been designed. For this project, both theoretical aspects and simulation results, demonstrating the effectiveness of the proposed fully digital structure, are explored.

Thank you to our Sponsors

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