

Embedded System Product Design: An Educational Program in Applied Engineering

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Overview

- Who are we?
- What are our objectives?
- How do we achieve the objectives?
- What is the Capstone Design process?
- What is E4?

Who are we?

- Texas A&M University ~ 48,000 students
- College of Engineering
 - 11 Departments
 - ~ 10,000 students
- EET/TET Programs
 - 10 faculty
 - 200 students
- Focus on
 - Applied research
 - Product/system development
 - Automotive, medical, homeland security
- Strong relationships with private sector



Objectives

- To provide an undergraduate educational program that prepares students for entry-level positions as electronics and telecom product and system developers
- To foster both entrepreneurial and intrepeneurial attitudes and capabilities
- Promote a life-long learning mentality

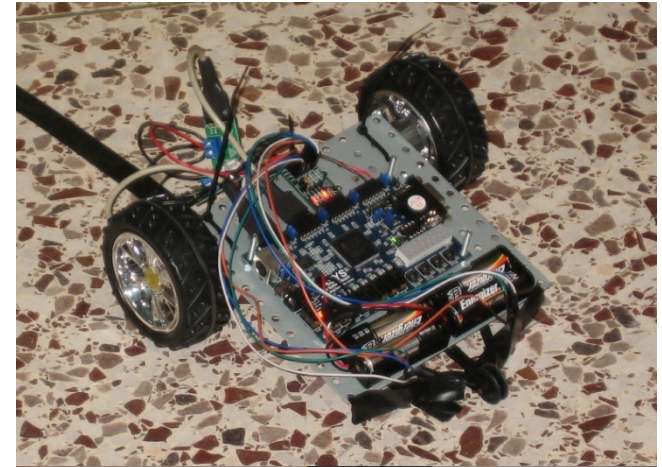
Undergraduate Curriculum

- BS degree
- Certificates in
 - Project Management
 - Entrepreneurship
- Technical Coursework
 - Analog
 - Digital
 - Communications
 - Project management
 - Product/system development
 - Embedded systems focus throughout



2nd Year Courses

- Digital Logic Design
 - Xilinx-based development board
 - PLC and SLC design
 - Course project
- Microcontroller Architecture
 - Xilinx-based development board
 - Use of VHDL in design
 - 8-bit uController design
 - Embedded pBlaze design

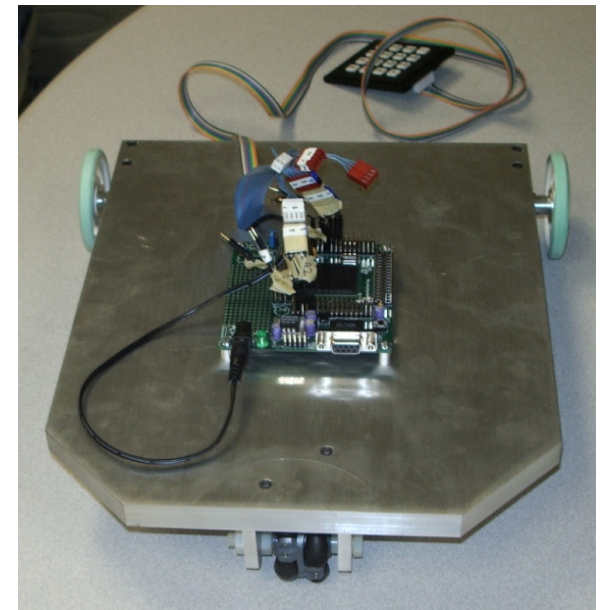


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3rd Year Courses

- Embedded Assembly Language
 - PowerPC architecture
 - Real-time embedded system programming
 - Hardware/software interaction/integration
 - Multiple real-time DC motor control
 - Test and debugging



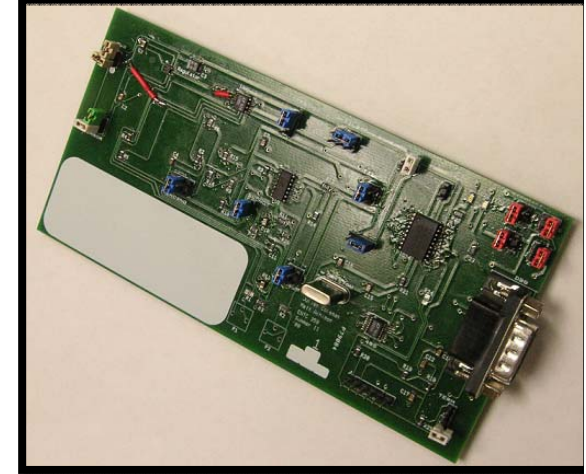
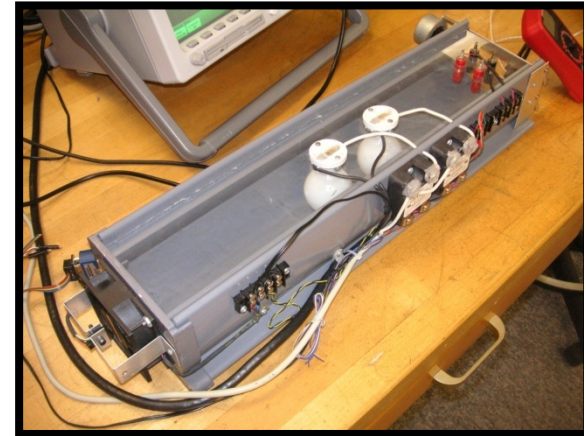
3rd Year Courses

- Embedded System Software
 - Structured C programming techniques
 - Interrupt-based software development
 - Real-time operating system (RTOS)
 - Communications emphasized
 - Hardware interfacing
 - Autonomous vehicle control
 - Sensors, feedback, communications



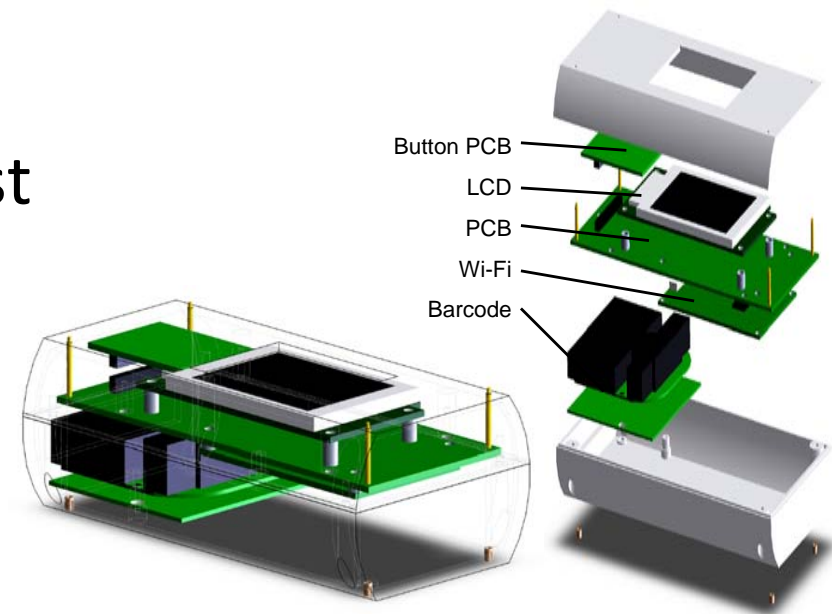
3rd Year Courses

- Instrumentation and Control
 - System monitoring/control
 - Master/Slave
 - Microchip uController
 - Sensor characterization
 - Signal conditioning
 - Modbus-based communications
 - Schematic capture/simulation
 - PCB layout/manufacturing
 - PCB population/testing

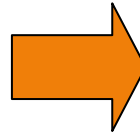


4th Year

- Capstone Design Project
 - 2 Course sequence (9-12 months)
 - Team (Startup company)
 - Advisor (Faculty)
 - Sponsor (Industry)
 - Idea to Prototype
 - Plan, Design, Develop, Test
 - Document, Demonstrate
 - **Must work!**
 - Technical Merit



**E4 Project
Completed May 2007**



Diesel Power Magazine – June 2008

THE PERFORMANCE PRESCRIPTION

Introducing The Breakthrough Fully Programmable Diesel Engine Management System

STRIKER™

No Other Diesel Power Module Offers You The Freedom Of The Striker MD™

The all new Striker Diesel MD is your prescription for maximum diesel performance. Diesel MD is the only module on the market that allows you to fine tune the power curves beyond the factory settings. Now you can dial fuel and boost pressures in an infinite number of combinations for the most precise tuning possible. Here's how it works:

NEW!

- Dim feature for night driving capability**
- Green, yellow, and red color EGT warning LEDs let you know when things are cool, warming up or a hot potato.**
- Thermocouple stackable, no need to add a second thermocouple in order to read EGTs**
- On-the-fly switching between power levels**
- Ten pre-calibrated power levels**
- Unlimited re-calibration capability**
- Includes custom Painless Performance wire harness**
- Watch real time data graphs showing history of boost, fuel pressure and EGTs over a specified period of time - valuable for even more precise tuning.**

All bolt-on diesel power modules interrupt signals from the fuel and boost pressure sensors. Each sensor transmits a signal ranging from 0 Volts to 5 Volts. Our Diesel "Multiplier on Demand" tuning system captures these signals, applies a multiplier to them and then transmits to the ECM. Power gains are a result of applying these multipliers to boost pressure and fuel pressure signals. Until now you've never been able to decide your own multipliers. Until Diesel MD, that is.

Modification of the boost and fuel pressure multipliers is simple. Just select a preprogrammed profile to modify, press the menu key and the screen shown at right will open. Then, using the up and down keys, you can add or subtract from each multiplier by hundredths. Discover hidden fuel economy or give a familiar payload its own tune. The Diesel MD allows you to create a custom profile for your own personal needs. You can tweak it any time as conditions change.

Striker Diesel MD comes with ten pre-calibrated power levels. You can use these preset levels or modify them at your choosing. Later, if you decide to make other performance modifications like exhaust, turbo, fuel pumps, intake, etc., you can easily fine tune the Diesel MD to accommodate the changes.

Menu Screen

Profile Screen

Calibration Screen

EGT Screen

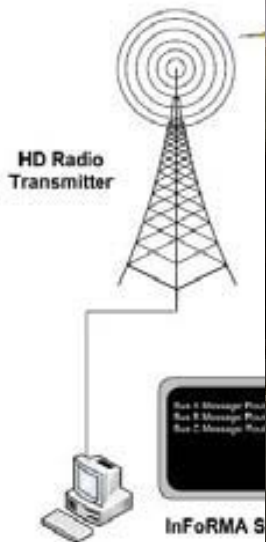
#63000	2001-04 Chevy LB7
#63001	2006-07 Chevy LBZ
#63010	1999-03 Ford 7.3L
#63011	2003-07 Ford 6.0L
#63020	2003-04.5 Cummins 5.9L
#63021	2004.5-07 Cummins 5.9L



– InFoRMS

- HD R area
- Free

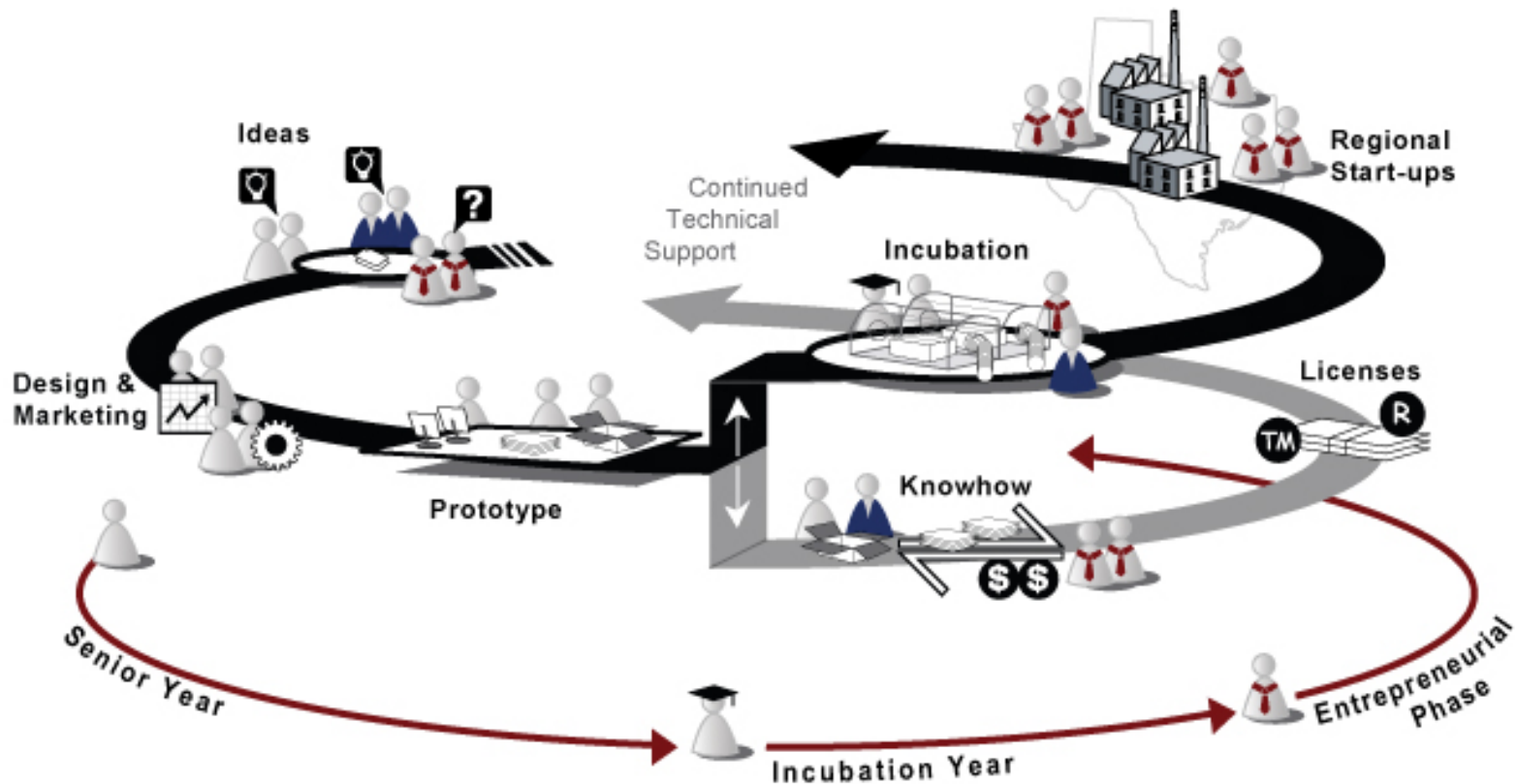
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Capstone Design ➡ E4

- All stakeholders must agree to E4
- Students assign IP rights to University
- Students receive inventor status
- University owns design package and represents IP (know-how) to private sector
- IP is licensed by private sector for product development
- University receives and distributes royalties based on sales

E4 Model



Engineering Entrepreneurship Educational Experience

COMMUNITY SUPPORT	Brazos Valley Small Business Development Center, Research Valley Partnership, City of College Station, City of Bryan	
AGENCIES	Office of Technology Commercialization, Texas Engineering Extension Service, Texas Transportation Institute	
INSTITUTIONS	Texas A&M University, Prairie View A&M University, Texas State University	
INDUSTRIES	Banyan Tree Holdings Group	
 Students (Undergraduate, Graduated)	 Faculty	 Private Sector, Entrepreneur

Win-Win-Win

- **Students**

- Work on real-world project
- Higher level of enthusiasm and engagement
- Potential participation in royalty stream

- **Faculty**

- Increase involvement with private sector
- Expand technical expertise
- Evaluate innovative solutions

- **Industry**

- Define and direct development work to meet needs
- Significant return on investment (\$50K - \$100K of effort)
- Access to wide range of hardware/software development and testing tools
- Access to Technical Solutions Library – builds on previous projects
- Ownership and management of IP package by University
- Ability to secure exclusive license to technology
- Include University in funding/development efforts
- Leveraged investment in education
 - \$25K **Scholarship** *may* impact -- one student -- for one year
 - \$25K **Sponsorship** *will* impact -- 20 students -- for life

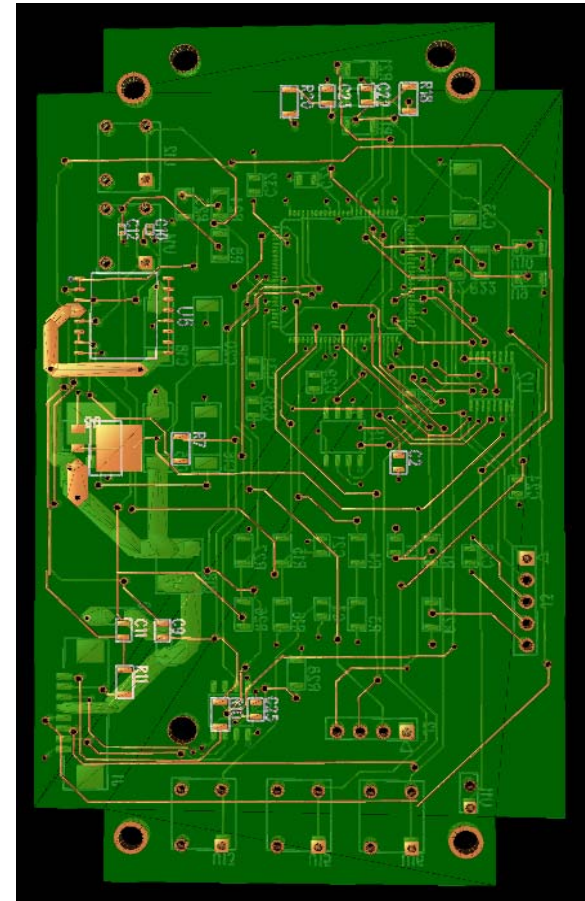
Next Steps

- More industry sponsors
- Formal agreement with Mays Business School
 - Feasibility Study Project Plan
 - Industry Survey Initial Design

 - Market Analysis Prototype Development
 - Business Plan Test and Documentation
- Set up small on-campus incubator
- Seek long-term sponsorship/endowment

Competencies

- Hardware
 - FPGA
 - FPGA embedded uBlaze
 - 8-16 bit uContoller
 - 32-bit RISC uController
- Software
 - LabView
 - VHDL
 - Assembly
 - Embedded C
- Prototype design/fabrication
- Project management
- Entrepreneurship/Intreprenurship



ELECTRONICS



TELECOM *

Cons and Pros

- Pure/Basic Research Institution
- Export talent to other cities/regions
- No resident industry component

- Interest in small, high-tech business partnerships
- Relationships with other institutions
- Focus on international presence
- New Office of Technology Commercialization
- Relationship with School of Business
- More emphasis on innovation

To learn more about
EET/TET Embedded Systems

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or visit our website at

capstone.tamu.edu