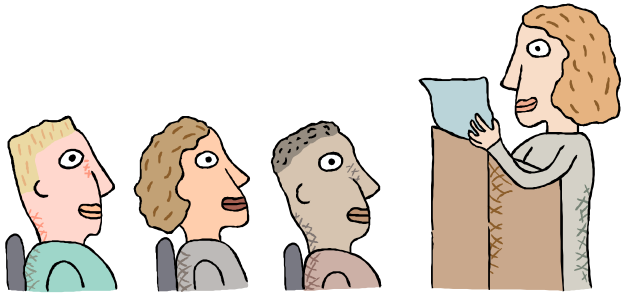
ECE 4805 Two Semester Senior Design Capstone

Project Presentations

October 2, 2015

ECE Advisory Board
Subject Matter Experts
Teaching Assistants
Special Guests
Student Teams



24 “elevator pitches”
2:30-3:18PM

“Meet and Greet”
Reception
3:18- 4:00 PM

Team Presentations

Bit Sniffers
FIDO: Filtering Incoming Disruptive Operations
5E (Enthusiastic, Engineers, Eager to Electrify Everyone)
Beaconator
CDRFTeam
EleComm United
Electrino
FIBS (FPGA implemented Benes-Clos Switches)
Freescale Team
Go Energy (GE)
Hokie Vision
Industrial Systems Applications Team
JeSTeRs
OBD2-Face
Over the Weather
Phoenix
Plasma Etchers
Send and Receive (SAR)
SnapVision
Team Bar-Coded
Team VTIT
The Dipper
The Wireless Team
Turn Down For Watt

The Bit Sniffers

2.4 GHz Wireless Packet Capture Device

United Technologies Aerospace Systems (UTAS)

David Abbott, Brock Allen, Siraj Ali,
Adam Kraimeche, Neil Yavorski

Subject Matter Expert: Dr. Allen Mackenzie
Customer POC: Christopher Fitzhugh

Executive Summary

- Problem: UTAS is in need of a reliable IEEE 802.15.4 packet capture device to be able to run for multiple days without failure.
- Solution: We will design a hardware and software solution that interfaces with Wireshark and test our product for longevity.
- Class Observation: Our team sees extreme value in the leadership and customer experience that we gain from this two semester class.

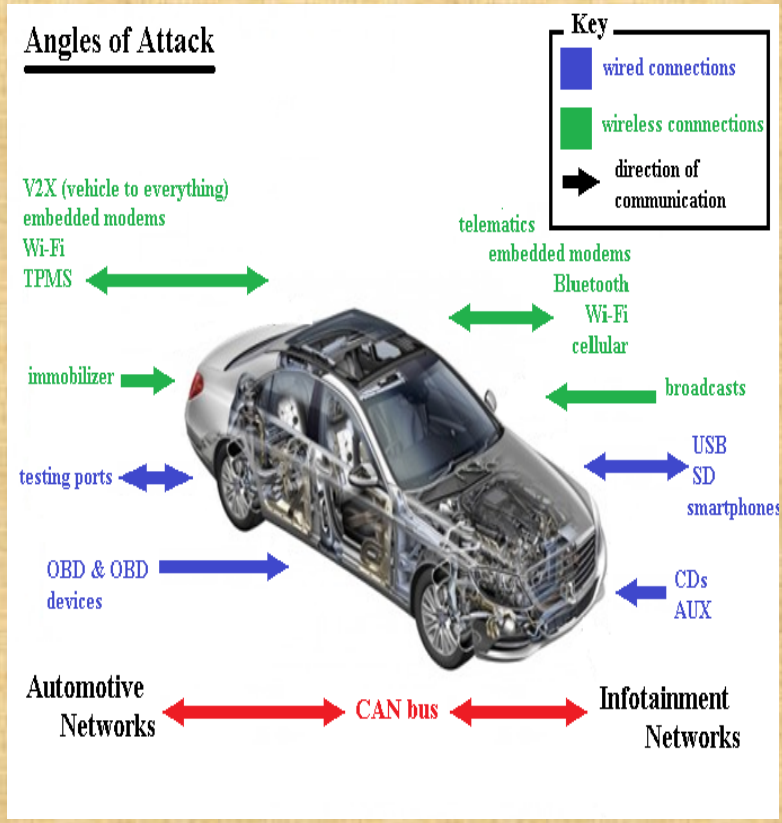
Vehicle Cyber Security WatchDog Device

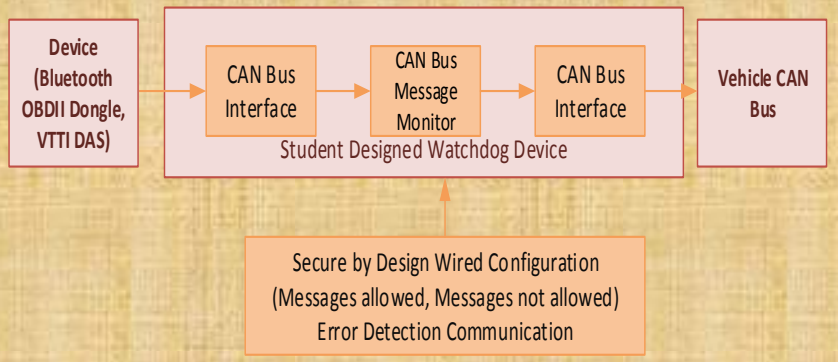
Sponsor	General Motor(GM) and VTTI
Team Name	FIDO: Filtering Incoming Disruptive Objects
Team members	Alex Nguyen Chi Chen Joseph Connors Runtian Lu
SME	Dr. Bill Plymale
Customer	Dan Chilcott Zac Doerzaph

- Design a device that will facilitate wireless or hardwired access to information from a vehicle.
  i. E.g. Wi-Fi, Bluetooth, Auxiliary, Universal Serial Bus
  ii. Process undesired signals and return error messages

- Become familiar with provided equipment (vehicles, networks, systems) to clarify and understand requests from the RFP from customer, then implement design and testing of device.

- Class Observation
  i. It is a professional class to learn the business knowledge, team work experience and technical abilities.





Project Title: Interface and Design Sensor

- Sponsor: General Electric
- Team name: “5E” – Enthusiastic Engineers Eager to Electrify Everyone
- Team members: Colin Burgin, Shuang Cheng, Akshatha Kini, Bing Qi, Chang Sun
- Subject Matter Expert (SME): Dr. William O. Plymale
- Customers: Mike Austin 387-7455

  Brian Holzman 387-8225

  Brian.Holzman@ge.com

- **Problem description:**
  - Need flexible inexpensive non-critical input/output (I/O).
  - The I/O will be able to support various functions such as thermal, humidity, shock or Bluetooth.
- **Proposed approach:**
  - Defining requirements → Designing → Prototyping → Testing → Poster → Final Report
- **Class observation:**
  - Teamwork, communication, project management
  - Industrial experience

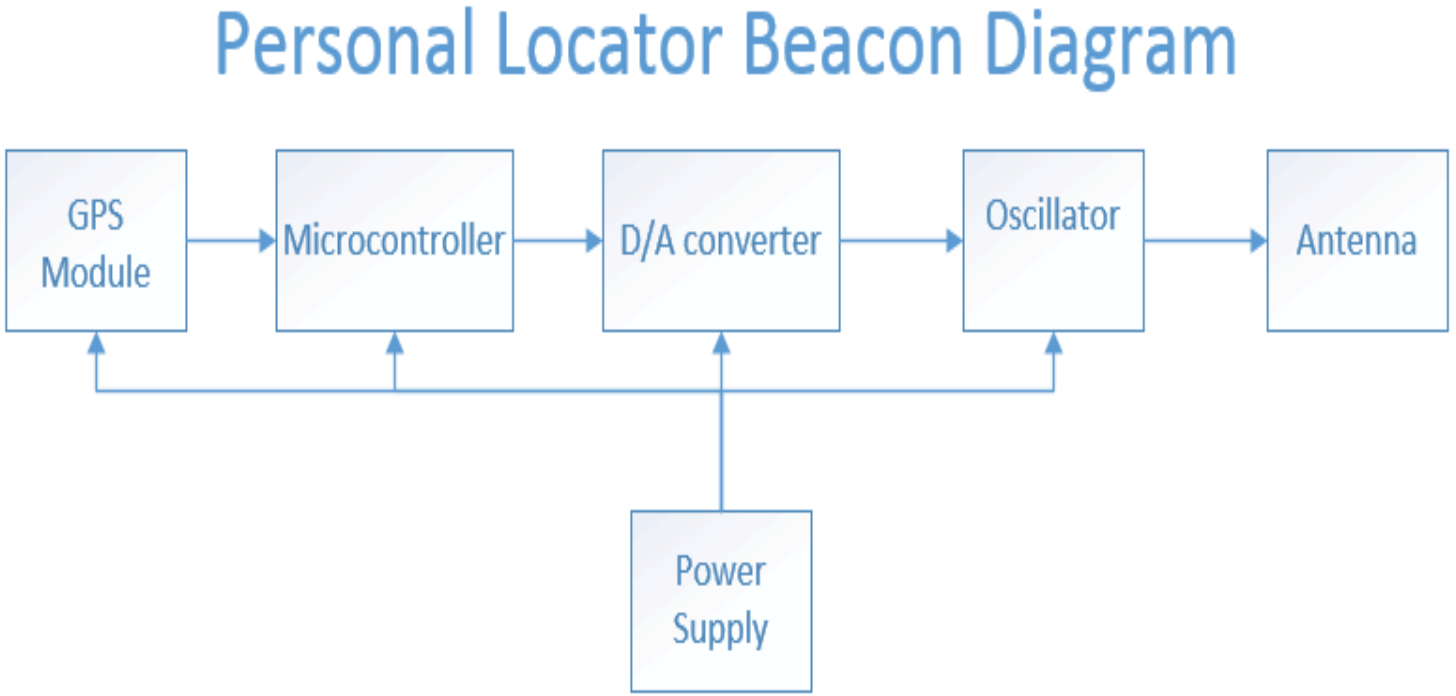
Personal Locator Beacon Zeta-ICE

Team: Beaconators
Russell Bradley, Jacqueline Duong, Wiktor Koczorowski, Devin Utermahlen

SME: Dr. Louis Beex

Zeta-Ice POCs: Benjamin Beasley, Steven Hauser

- Design, Test, and Prototype a complete system architecture to support multiple beacons that will be able to transmit an ID and GPS location.



- We believe this class will help us to become successful professionals in the engineering industry.

Coherent Distributed RF Transmitter

Sponsored by John Hopkins

Customer POC: Jeff Nanzer Jeffrey.Nanzer@jhuapl.edu

CDRFTeam

Members:
Rich Dumene, Ilya Ivanov, Andrew Rosenberger

SME: Dr. Louis Beex

Problem Statement and Approach

- The goal of our project is to synchronize the reference oscillators of three or more randomly placed transmitters in a frequency range greater than 1GHz.
- Phase stability should provide 90% of the theoretical gain for each transmitter.

- We will approach this project by designating one transmitter as a master unit and phase shifting the remaining slave units based on a reference pulse sent by the master.
- Each unit will be controlled by separate microcontroller that will interface with the created network.

To Develop a Low Rate Under Communication Capability Inmarsat Inc.

Elecomm United Team
Benjamin Wengert, Jake Koenig, Kaitlin McCarthy, Omar Al-akwaa

Subject Matter Expert
Dr. Walid Saad
walids@vt.edu

Inmarsat Senior Director
Wendy Votaw
wendy.votaw@inmarsat.com

Inmarsat President of US Government Business Unit
Peter Hadinger
peter.hadinger@inmarsat.com

Inmarsat Company Design Project

Problem

To expand utility of Ka frequency band with communication system design

Approach

Develop an architecture and prototypes with the suitable bandwidth/ power and spreading/despreading techniques according to the specifications

Class Observation

Excellent full-time job preparation class that enhances student's buisness, technical, and problem solving skills

Electrino

Asymmetric Material Design: Analog Circuit

Customer
Edward Pierson
Lockheed Martin Space Systems

Team Members
Linda Li
William Cowen
Ahmed Parvez

Subject Matter Expert
Dr. GQ Lu

- Research and catalog materials and methods for additive electronic manufacturing.
- Using the facilities at Virginia Tech, we will conduct tests on various materials their electrical properties then implement them in simple circuits.
- This class is allowing us to get an understanding of what we can expect from real world engineering.

FPGA Implementation of Benes-Clos Switch Networks

Lockheed Martin

Team Members: Jenfrey Van, Alex Makar, Harsh Sharma, Yibo Xu, Yihan Pang

Subject Matter Expert: Dr. Patrick Schaumont

Point Of Contact: Richard Pedersen

Instructor: Gino Manzo

Executive Summary

- As the number of external connections increases, efficient switch networks needs to be researched and constructed.
- Research and testing of Benes-Clos switch networks implemented on FPGAs.
- Focus on enhancing business, project management, teamwork and communication skills.

TEST CIRCUIT DESIGN AND EVALUATION OF LVDMOS

SPONSOR: FREESCALE SEMICONDUCTOR INC.

Freescale Team Members: Jacob Mullins, Yueyang Sun, Peilin Zhang

Subject Matter Expert: Dr. Dong Ha

Customer Point of Contact: Scott Marshall

- Problem: Characterize and model a package die, which is a type of LVDMOS FET structure on a printed circuit board, then design a test circuit of a Low Noise Amplifier (LNA) used for validation on SOT89 prototypes.

- Approach: First, collect background information of radio frequency (RF) integrated circuits. Then, find different characteristics of the shipped dies from Freescale using probe stations and/or PCBs. Finally design the LNA test circuit for the SOT89 prototypes.

- Class Observation: We think this class is a great opportunity for us to have hands on experience in the technical and non-technical fields of engineering before we go into the workforce.

Web-Enable High Voltage Waveform generator By General Electric

Team: Go Energy (GE)

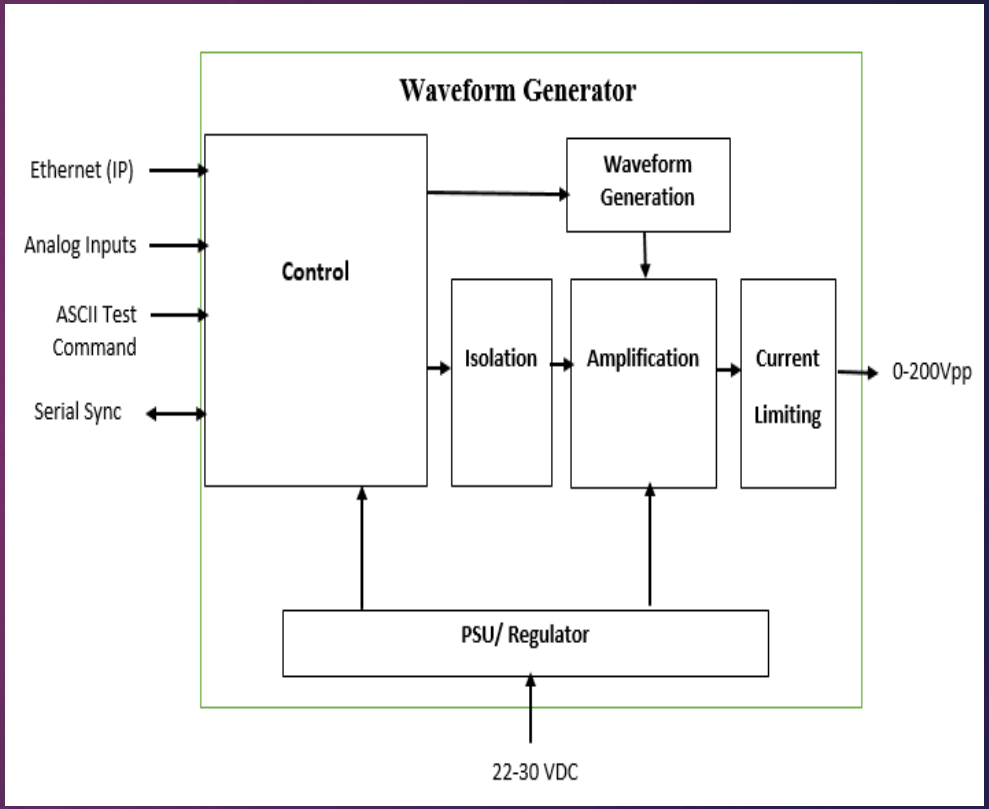
TEAM MEMBERS: XIAOLAN ZOU; YUCHAN LU; SHUCHEN YUE

SME: DR. ROLANDO BURGOS

CUSTOMER: BRIAN BATTEIGER

Problems and Solutions

- Adding higher voltage and current limiting to the output
- Applying appropriate current limiter to control the output current within 1mA to 30mA
- Learning how to become a professional engineer by strengthening teamwork, communication, problem solving and project conducting skills



Realtime Mosaicking with Snapdragon

Qualcomm Technologies, Inc.

Hokie Vision

James Elliott, Mitchell Sturtz, Bryant Sweet, Zhenjie Chu (Charles)

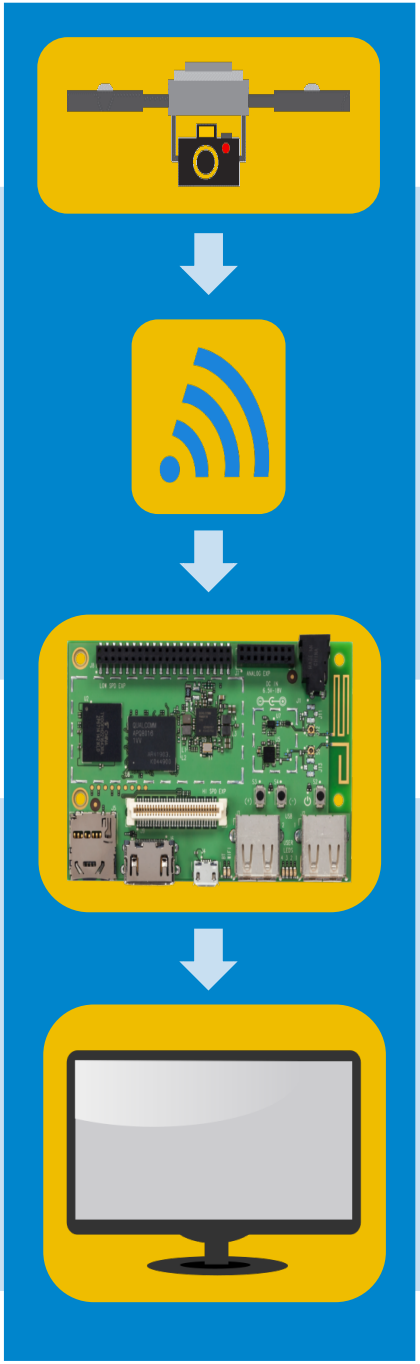
SME: Dr. Lynn Abbott

October 2, 2015

Executive Summary

- Develop an image processing application that operates on video from an aerial survey drone, stitching adjacent frames into a mosaic, enabling real-time analysis by the drone operator.
  - Use of open source software to process images

- A unique experience that provides the entire team with technical, business and professional experience.



Web-Enabled Secure Industrial Control System

- **Sponsor:**
  - General Electric
- **Team Name:**
  - Industrial System Application Team (ISAT)
- **Team Members:**
  - Ryan Curtis, Daniel Davenport, Ruizhe Song, Mingrui Zhao
- **SME:**
  - Dr. Cameron Patterson
- **Customer POC:**
  - Brian Batteiger Brian.Batteiger@ge.com
  - Rodney Clemmer rodney.clemmer@ge.com

- **Problem Description:**
  - Industrial Internet control collaborative applications lack a development environment and runtime system
- **Approach:**
  - Create a development environment for user with and easy to use interface
  - Use internet to communicate between use interface and control platform
  - Both frontend and backend use runtime system
  - Use industrial security protocol to secure data transportation and command implementation
- **Class Observation:**
  - Teamwork and project management
  - Real industrial project

Hybrid Antireflection Coating for Photovoltaics

A Micron Sponsored Project

Team JeSTeRs

Jahin Habib | Sharon Ferracci | Tianfang Liu | Ryan Potter

Subject Matter Expert: **Dr. Wei Zhou**

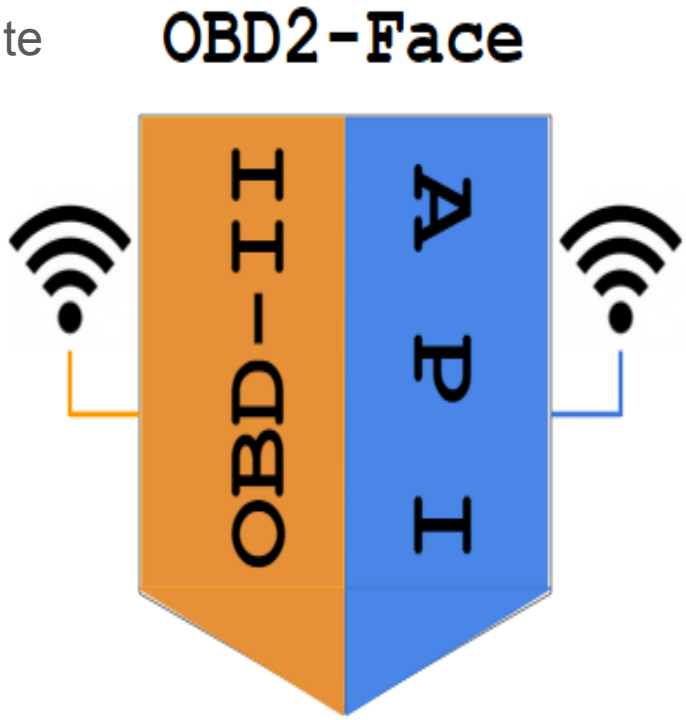
Customer POC: **Mr. Thomas Joseph**

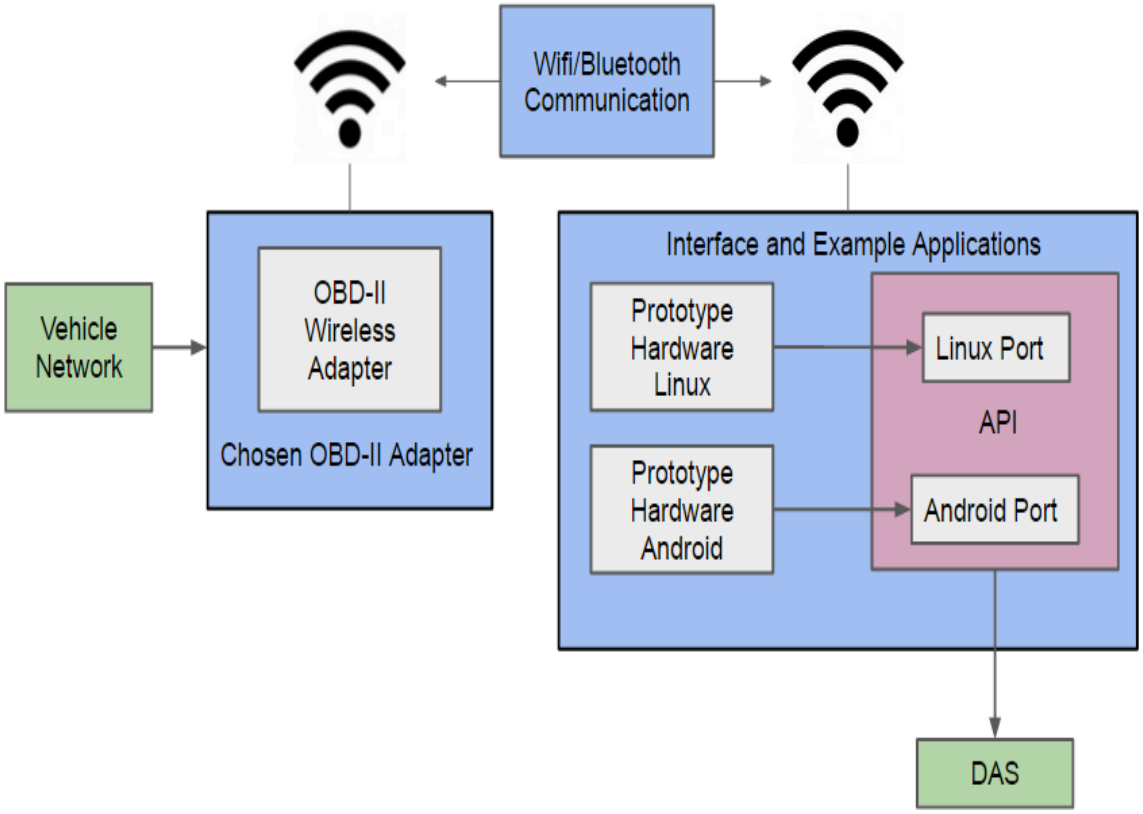
Hybrid Antireflection Coating for Photovoltaics

- **Problem:** Inefficient solar cells
  - Incident light reflected leading to less solar energy conversion.
- **Solution:** Implement photovoltaic coating with antireflective film
  - Coating traps light including at non-normal angles.
- **Class observations:**
  - Real world experience, research, industry training, and networking opportunities.

Software for OBD-II Wireless Interface Adapter

Team Name:	OBD2-Face
Sponsors:	General Motors Virginia Tech Transportation Institute
Customer POC:	Loren Stowe
SME:	Dr. Sook Ha
Team Members:	John Bialick Alexander DeRieux Alexander LePelch Shengsheng Yuan





Problem: Inefficient systems for OBD-II diagnostic data retrieval.

Solution: Design wireless system for rapid retrieval of OBD-II vehicle network data.

Class Observation: Gives new perspective to the engineering design process.

Low-Cost Unmanned Aerial System (UAS) for Meteorological Data Collection

Johns Hopkins Applied Physics Laboratory

Over The Weather

Team Members

Garrett Rosich

Eric Petrosky

Matthew Fontaine

William Gerhard

SME

Dr. Scott Bailey

Customer

Thomas Hanley

Problem: How to increase meteorological data collected from the lower troposphere?

Our solution: Use a modified off the shelf drone

Class Observation: More realistic look at engineering outside of academia

TASSBIEH HASSAN, MOMIN HAQ, HAMZA NAQI, BLEN DEMENA, KENNETH BERRY, AND YE FAN

Project Overview

Sponsor: Intel

Project: Dielectric Reliability in Logic, Memory, and Metal Interconnect Devices

Subject Matter Expert: Dr. Mariusz Orlowski

Customer Point of Contact: Dr. Sean King

Project Overview

Problem: Failure and lack of reliability of the dielectric breakdown and resistive switching device operation.

Solution: Perform TDDB characterization of an insulating dielectric such as TaOx which is commonly used in resistive switching devices

Class Observation:

Solving real-life problems while gaining technical, business, and professional skills that will be beneficial to us in our careers.

We plan to accomplish manufacturing, testing, and radiation and have a product to call our own.

Developing Dry Etching Process for 2D Materials Coating

Plasma Etchers:

Ryan Baker

Arshiya Gupta

Ajay Randhawa

Mikhail Wolff

Mentored By:

Dr. Xiaoting Jia

Micron POC:

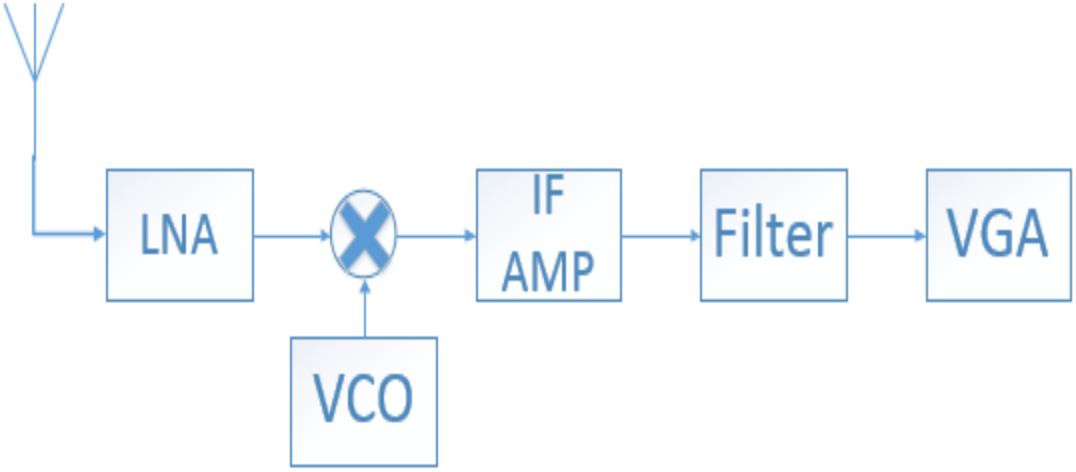
Thomas Joseph

- Problem:
  - Provide a process to make graphene and to give it semiconductor properties.
- Solution:
  - Design, fabricate, and test masks with various geometries to determine how each shape affects graphene's material properties.
- Class Observation:
  - This class allows us to experience a type of work which we are not subject to in our normal class schedules, and gives us real world experience.

RFIC Receiver Building Blocks

Sponsor: Lockheed Martin
Team Name: Send and Receive (SAR)
Team Members: Jason Eller,Yingying Gui, Daniel Hall
SME: Dr. Dong Ha
POC: Peter Delos
Date: 10/2/2015

Project Description



Problems: Pick up a reasonable operating band and design an RFIC receiver considering notional objectives like NF, TOI, gain, filtering needed.

Approach: The team will use existing RFIC designs to simulate and test RF receivers using Cadence IC design software.

Class Observation: Much higher emphasis on development of professional and communication skills than traditional Capstone class

SnapVision

Real-time Mosaicking with Snapdragon™ SoC Development Board

SME

Harpreet S. Dhillon, Ph.D.
Assistant Professor
Wireless@Virginia Tech

Customer POC

David Mayer
Qualcomm®

Team

1. Akrit Mohapatra
2. Kyle Imhof
3. Ria Sarkar
4. Sushma Burujupalli
5. Zawad Chowdhury

- **Problem** - Develop a video processing application on the Snapdragon™ SoC development board that will process a video stream and stitch adjacent frames into a mosaic. Possible application on drones.

- **Approach** - Use C++ and open-source computer vision libraries like OpenCV to do image stitching.

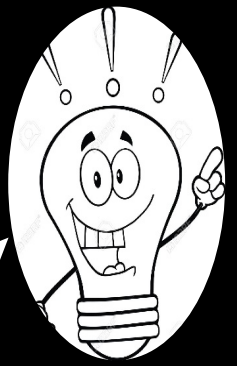
- **Observation** - It's a great class to get experience in "real-world" projects and work in a professional team environment.

VIRGINIA TECH ECE DEPARTMENT

Inventory Database System

- Existing inventory system is sequential & relies on paperwork.
- Item transfers and location changes in inventory not documented.
- Large amount of time and effort wasted in locating items.

- All items will be tracked using a mobile application.
- Our process: Scan barcode→ Retrieve item → Locate item with its ownership details → Transfer item to anyone else → View history of ownership and location of item.
- Our new process is distributed and efficient.



- Perfect campus to corporate transition course.
- Enables us to understand the working process and structure of a today's industry.
- Excellent guidance and support to help students find their dream job! ☺

SINGLE SIGN-ON MOBILE SOLUTION

Virginia Tech IT

Team VTIT

Brian Kaplan

Steve Briceno

Shobal Sam Attupurath

Shobek Sam Attupurath

SME

Dr. Sook Ha

Customer POC

Karen Herrington

EXECUTIVE SUMMARY

- Problem Definition
  - Enable Single-Sign-On mechanism for Android and iOS devices
- Approach

[Project components and Interactions are displayed in Figure 1]

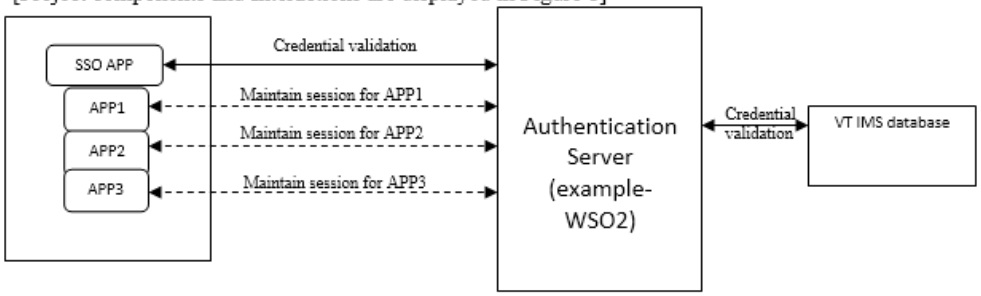
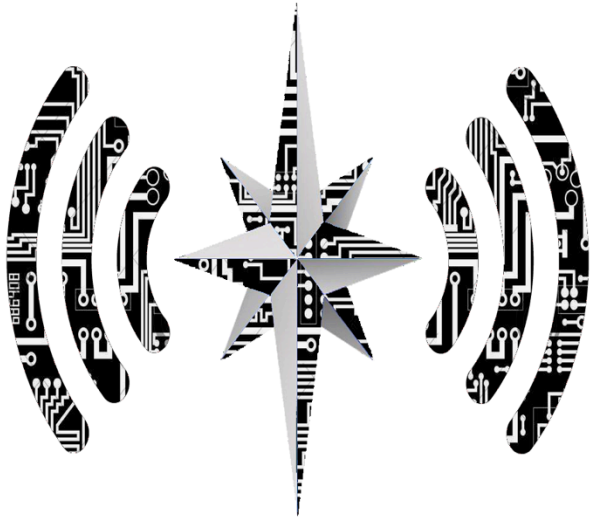


Figure 1
Project Components and Interactions

  - Implement **Authentication Server** and **Mobile SSO App** to handle credential validation
  - Allows 3rd party mobile applications to piggy back on the SSO app for authentication
- Class Observation
  - Team Work, Project Management, Handling Customer

Satellite Telephony Modem Auto-dialer System

Team Name: The Dipper
Team Members: Daniel Nguyen, Jenil Patel, and Sean Morse
Subject Matter Expert: Dr. Mark Jones



Problem Statement

- **Utilize the BeagleBone Black to interface with Iridium's modem to record and playback glitchless bit-accurate audio files, and as well as allow playback to subscribers through a message broker.**

Solution/Approach

- **BeagleBone will record and store the data to the onboard flash memory to be used for processing. The BeagleBone should be able to playback the processed audio. A system for testing and measuring audio quality and call metrics will available on the BeagleBone for subscribers to access for prove glitchless quality.**

Class Observation

- **Being able to effectively collaborate as a team will increase our chances of delivering a successful product for our customers. This same mindset will help in tackling tough problems in the industry.**

UTC Aerospace Systems

4.2 - 4.4 GHz Wireless Communication

Sponsor: United Technoloies Aerospace Systems

Team Name: The Wireless Team

Team Members: Ehsaan Pakmehr, Xiaofan Yang, Jordan Smith

Subject Matter Expert: Dr. Walid Saad

Sponsor Point of Contact: Christopher Fitzhugh

In A Nutshell

Objective: Detect and mitigate interference from radio altimeters aboard aircraft.

Approach: Simulate the aircraft enviorment with various sensors and altimeters, detect interference, mitigate intereference using known mitigation methods, report on findings.

Class Observation: Best part is collaborating with others rather than sitting in lecture multiple times a week. Networking and learning.

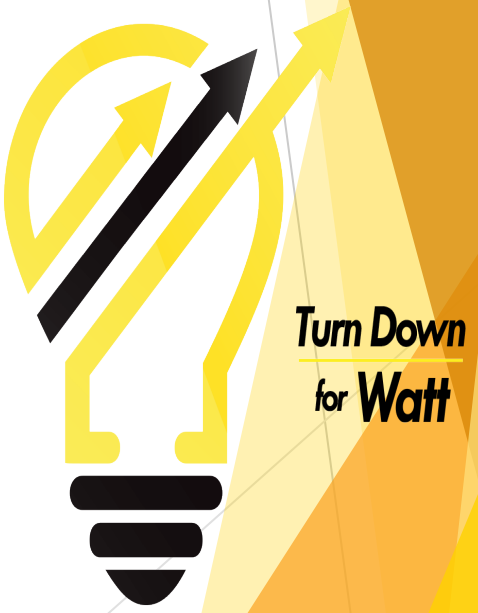
United Technologies: Additive Manufacturing of Magnetic Components

Team Members: Sulman Khan, Dana Kazerooni, Nathan Woods, Dounan Li, Elizabeth Nerdig, David Garcia

Subject Matter Expert: Dr. GQ Lu

Point of Contact: Eelco Scholte

Instructor: Gino Manzo



Executive Summary

- Modern magnetics are very bulky and tedious to produce.
- Additive manufacturing can provide an alternative production method that can allow for innovative design.
- The combination of the ECE and MSE capstone classes provides team members with a wonderful opportunity to gain real world experience.


THANK
YOU!