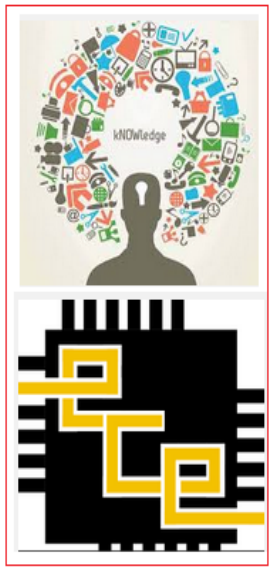
Engineering Design
What is it?

EECE401 Senior Design I

Electrical and Computer Engineering
Howard University

Dr. Charles Kim

“Senior Design” – brief definition ?



"Design" – Full Definitions

- ABET
  - "The **process** of devising a system, component, or process to meet desired needs," which involves
  - "A **decision-making** process (often iterative), to convert resources optimally to meet the stated needs" by applying basic sciences, mathematics and engineering, adequately considering
  - knowledge, standards, and constraints related to the electrical/computer engineering discipline."
- Industry
  - (1)"Determine that a need exists with a customer for specific goods or services and how much that customer is able and willing to pay for it.
  - (2)Then determine if the product or service is compatible with the competencies of the company and if it can be manufactured at a cost that is less than the customer will pay.
  - (3)If so, proceed by designing to match the company's ability to manufacture, rather than basing the design on state-of-the-art technologies.
  - (4)Finally, prior to full implementation, prepare a pilot demonstration"

Engineering Design-Overview

- **Problem Formulation**
  - Recognition of a set of **needs**
  - **Information** gathering about the needs
  - Determine the **requirements** of the project
- **Problem Solving**
  - Investigates the available **alternatives** to meet the requirements – **Current State of the Art**
  - **Generates and Analyzes and Specifies** alternatives with the requirements
  - **Makes Decision** on which alternatives will be implemented
  - **Selects** the Top Design
- **Solution Implementation**
  - Creates an implementation and test **plan**
  - Follows the plan to **build** the design
  - **Evaluates** against the requirements from problem formulation

Characteristics of Design

- Design is:
  - Process cycles through the 3 phases of Problem Formulation, Problem Solving, and Solution Implementation
  - systematic, not trial-and-error
  - adaptive, not a recipe (nor a cookbook)
  - process, not an event or product
  - Iterative back to earlier phases
  - Simultaneous in refinements of the needs/requirements
  - Done based on Engineering and Scientific Knowledge
  - To be Rigorous in testing and evaluation
  - To execute planned activities
  - To comply regulation, codes, rules, standards, etc
  - “Very demanding, overwhelming but awakening experiences that I utilized in my job interview and apply in my work now” – former student

A Case for Bus Boy Robot

Today's Date	
Design Requirement Excise	
Team Name:	
Project Title:	
Problem Statement (1	
Member 1	
Member 2	
Member 3	
Member 4	
Member 5	

Design Requirement Item	Specification	Reason (NEED)
Interface	Wireless/Wired connectivity	Connection between the robot and kitchen
Weight	Less than 10 lb	Lighter robot is efficient in loading
Noise Level	Less than 20dB at 1 ft from the device	The noise shoud lot irritate party attendees
Speed Performance	The max speed is 5 mph and the min speed is 2mph	Should not hit persons
Loading	Max loading is 30lb	Too many used dishes would cause hazard for party attendees.
Standards	EMC standards, FCC part 15 standard	The product must be marketable, and should not interfere with the audio/video systems of the party place
Cost	Prototype cost <$300 (excluding the Atom board)	The product must be cheap or resonably priced.
Battery Life	1 full charge shoud allow 5 hours of use	The product should work continuously over the party period
Safety	Sensors	The product should avoid a collision with objects.
Maintenance	Liquid will pour into bottom basin	Product should avoid spills
Dimensions	24"x36"x30"	Product should not be in the way of party attendees
Environment	The system should run up to 5 hours and automatically shut off if temperatures exceed 90F	To assist with overheating
Patents	Must not infringe on the following patents: D413551, 5519814, and 5303384	

Bus Boy - Design Requirements

- It must weigh approximately 40lbs so that the weight of the motor, battery and load (15lbs of dishes) are accounted for.
- Must have dimensions of 24” x 36” x 30” (?)
- Should be able to travel comfortably between 2 and 5 miles/hour
- Should function with a noise level less than 20db at 1ft from the device
- No interference with phone/audio/visual signals in the vicinity
- Must be a container integrated in the design that allows all liquid to drain into a basin without causing any damage to the wiring
- Must be able to return to the base for unloading, back to service again.

Bus Boy - Current Status of Art

Hammacher Schelemmer Room Tidying PickUp Robot

•Picks up objects on command & loads onto cargo bed
•six rubber wheels at 2lbs each
dimensions 13" L x 8 1/2" W x 8" H
•Is equipped with a remote to drive
Picks up items around 1oz. such as balls, toys or socks .
•Can operate autonomously using its four infrared "eyes".
•Seek and discovers objects within an 8-12” range. Once object is secure it will be deposited into its cargo bay. The robot will vibrate in order to dislodge the objects from its bay.

Current Status of Art (cont.)

Willow Garage PR2 Robot

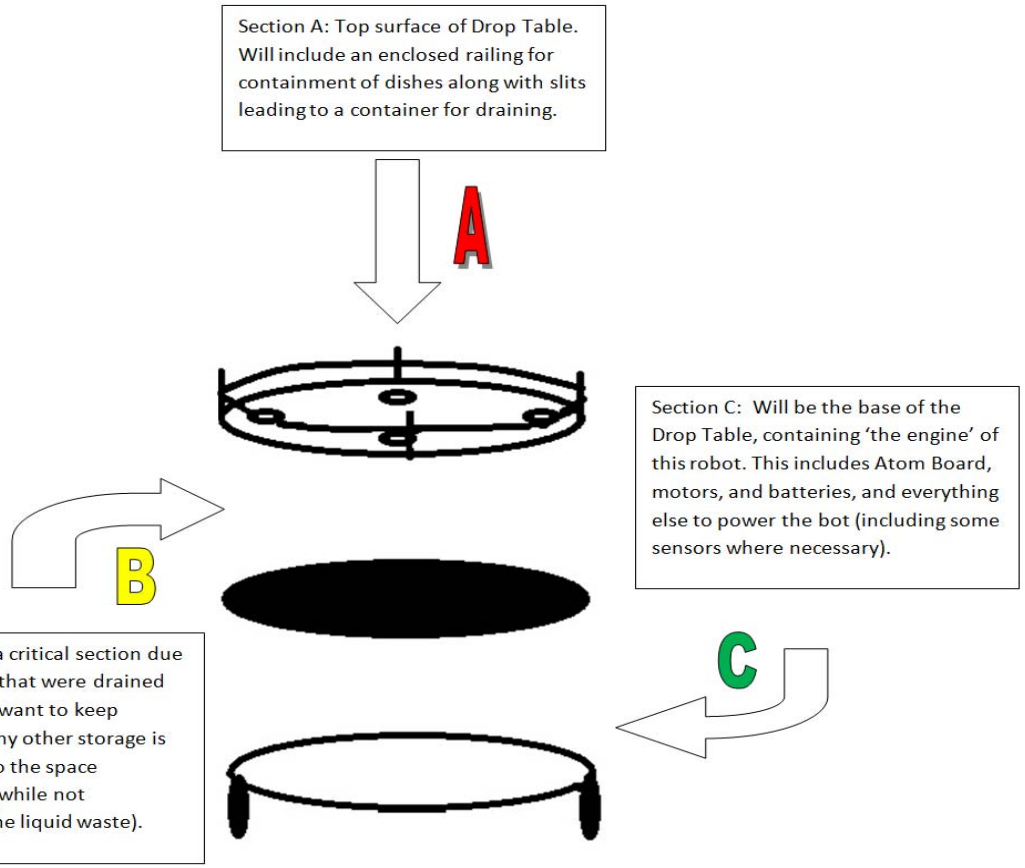
- 11 teams of roboticists at 11 different institutions to take in a beta robotics project in June 2010

Teams received:

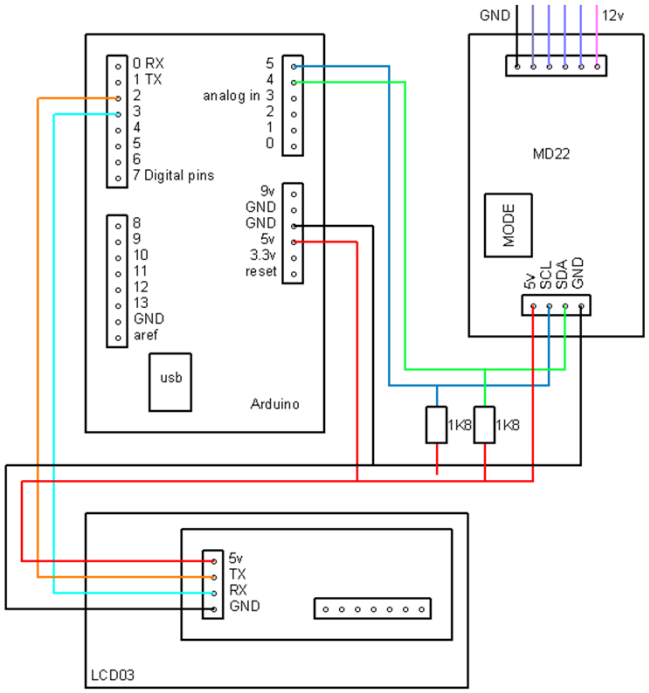
- two-year loan of a Personal Robot 2. This Personal Robot 2 (PR2) which is a completely programmable machine
- free, open-source Robot Operating System (ROS) framework with software libraries for perception, navigation and manipulation.
- One team is looking at getting the robot to learn how to carry an object through a crowded space.

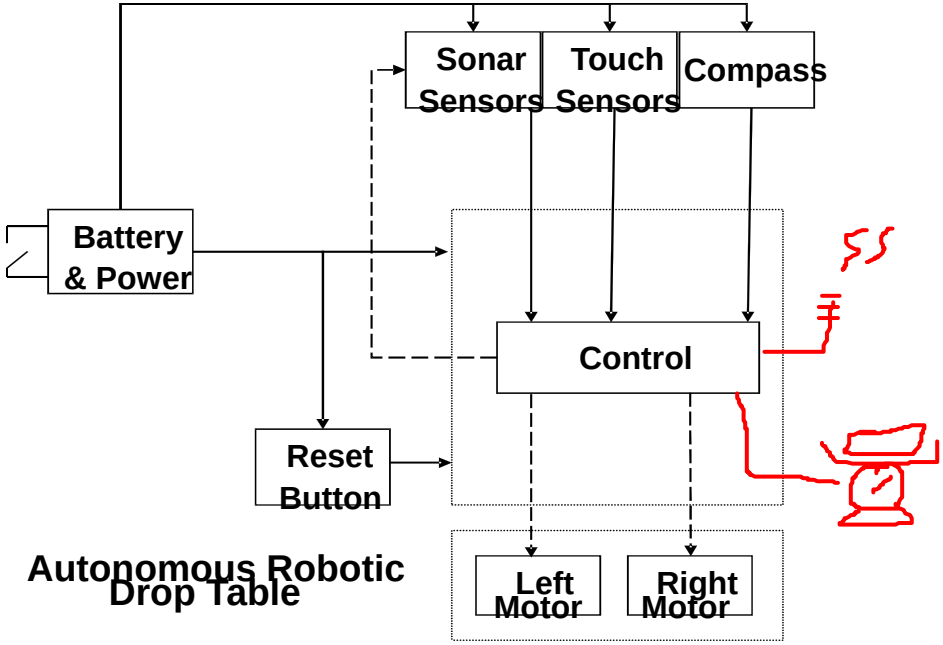
Solution Approach

✓Ordered Rex-14D bot



Solution Approach





Autonomous Robotic Drop Table

Implementation

- Hardware design for the autonomous robot
- Building the hardware for the autonomous robot
- Software design for [all] programming: including sensors, weight requirements, homing requirements, etc.
- Software implementation (i.e coding for the atom board)
- System integration -- Assembling of the entire hardware and software
- Test and evaluation

14	BUS	Wheels	NT-2252	4	$9.99	$39.96	3	Robotmarketplace	http://www.robotmarketplace.com/products/NT-
15	BUS	Motor (12A)	RB-Ban-71	4	$28.00	$112.00	2	Robotshop	http://www.robotshop.com/en/banebots-first-cir
16	BUS	Sonar Sesnsor	28015	1	$29.99	$29.99	2	Parallax	http://www.parallax.com/product/28015
17	BUS	Weight Sensor (Load Sensor) 50kg	SEN-10245	1	$9.95	$9.95	3	Sparkfun/Karlsson Robotics/Robotshop	http://www.karlssonrobotics.com/cart/load-sens
18	BUS	Gyro Sensor	28526	1	$29.99	$29.99	3	Parallax	http://www.parallax.com/product/28526
19	BUS	Homing Device	702	2	$49.95	$99.90	1	Pololu	http://www.pololu.com/product/702
20	BUS	Arduino 3S Motor Driver Shield (1.2A)	VUPN5799	1	$24.99	$24.99	1	Vetco	http://www.vetco.net/catalog/product_info.php?p
21	BUS	12V 8A Rechargable Battery with Charger	IK-018049	1	$24.74	$24.74	1	Cabela's	http://www.cabelas.com/product/Cabelas-Rech

Final Product ?

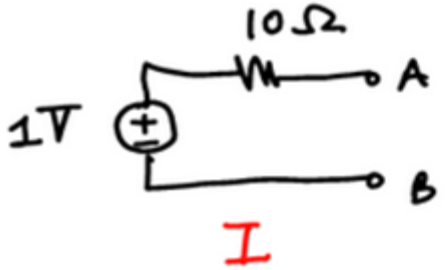
- What went wrong?

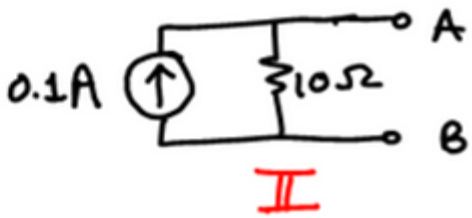
Lessons

- Joining a Team
  - EE and CpE (and CS and ME)
  - No Hardware and System Integration Experience
- Team Dynamics
  - Did not overcome technical difficulties
  - Did not consider alternative way of solving the problem
  - Lack of commitment
  - Leadership problem
- Changes in Design
  - Sought easier path for implementation
  - Did not consider the entire system
  - Frequent design/component change
- Time
  - Need more time to complete ---VIP philosophy

Class Activity (→ Assignment)

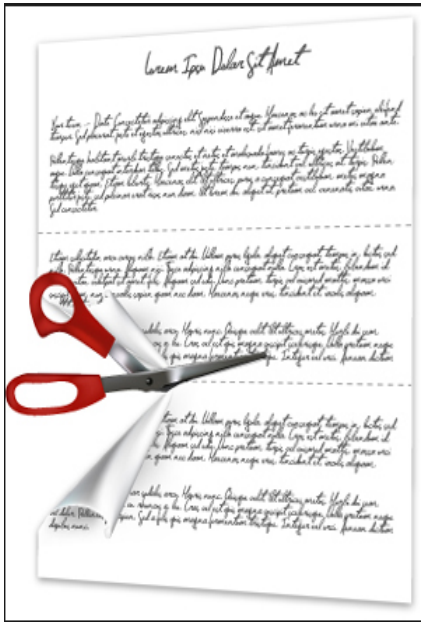
- **Two circuits I and II shown below are equivalent, one being a Thevenin circuit and the other a Norton. A technician built a circuit with an actual power source and an actual resistor, and put the circuit inside a metal box, and made out two terminals A and B. How do we know if the circuit made inside the metal box is of circuit I or II? Write your solution approach and solution and submit. In writing, be conscious of your thinking process .**





How to write well for Senior Design class

- People are more likely to read subjects/writings/emails that create curiosity or provide utility.
- When they are busy
  - Curiosity fades in importance
  - They read only the ones with practical importance ["utility"]
- So, write as if you are a staff writer (targeting for busy people) for a newspaper, and remember that you have an editor whose job is to cut your article to fit into a limited space, maybe just 1 inch in a column.
  - Important things [Conclusions and summary] in the first paragraph
    - Summary of the event/thing first so that it delivers message even though only that summary survives the "cutting"
  - Then expand your story after the First Paragraph
  - Use your own words



Compare this

www.cbsnews.com/8301-202_162-57600384/syria-strike-seems-inevitable-as-u.n-warns-against-unilateral-military-action-hunt-

Updated at 6:48 a.m. Eastern

DAMASCUS, SYRIA | U.N. chemical weapons experts investigating an alleged poison gas attack near Damascus left their hotel again Wednesday hoping to carry out their second field trip, which was delayed Tuesday for security reasons.

The team of about 20 inspectors left their hotel in the Syrian capital in a convoy of cars to visit the eastern Ghouta suburbs, where the Obama administration says President Bashar Assad's forces unleashed a chemical weapons attack on Aug. 21 that killed hundreds of people.

Local opposition activists told CBS News that the convoy had reached the town of Mleiha, in the sprawling Ghouta area, and videos posted online by the activists showed the U.N. inspectors interviewing patients at clinics in Mleiha and the nearby town of Zamalka.

Play VIDEO

Intercepted communications, tissue samples prove Syrian regime responsible for gas attack

On Tuesday, Vice President Joe Biden made it clear that regardless of what the U.N. inspectors find, the White House is now convinced the attack was carried out by Assad's forces.

The American government's assessment is based on the circumstantial evidence from videos posted on the internet, and, as CBS News correspondent David Martin reported Tuesday, intelligence -- much of it still classified -- ranging from intercepted Syrian communications to tests of tissue samples taken from victims.

Another key piece of circumstantial evidence which has been cited by both officials and analysts for days is the simple fact that the regime is the only entity in Syria known to have chemical weapons and the means to disperse them.

With this

By Oliver Holmes and Erika Solomon
BEIRUT | Wed Aug 28, 2013 7:59am EDT

(Reuters) - The United Nations Security Council was set for a showdown over Syria on Wednesday after Britain sought authorization for Western military action that seems certain to be vetoed by Russia and probably China.

U.N. chemical weapons experts investigating an apparent gas attack that killed hundreds of civilians in rebel-held suburbs of Damascus made a second trip across the front line to take samples. Secretary-General Ban Ki-moon pleaded for them to be given the time they need to complete their mission.

But the United States and European and Middle East allies have already pinned the blame on Assad and, even without full U.N. authorization, U.S.-led air or missile strikes on Syria look all but certain, though the timing is far from clear.

That has set Western leaders on a collision course with Moscow, Assad's main arms supplier, as well as with China, which also has a veto in the Security Council and disapproves of what it sees as a push for Iraq-style "regime change" - despite U.S. denials that President Barack Obama aims to overthrow Assad.

Uncertainty over how the escalation of the conflict at the heart of the oil-exporting Middle East will affect trade, and the world economy sent oil prices, and gold, to their highest levels in months while stocks fell. Fears over the economy of Syria's hostile neighbor Turkey pushed its lira to a record low.

Analysis & Opinion

Western powers could strike Syria within days

West mustnâ€™t rush into Syrian conflict

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U.N. resumes Syria chemical attack probe
4:20am EDT

Rebels gain ground in Northern Syria

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Biden: No doubt Syrian regime used chemical weapons