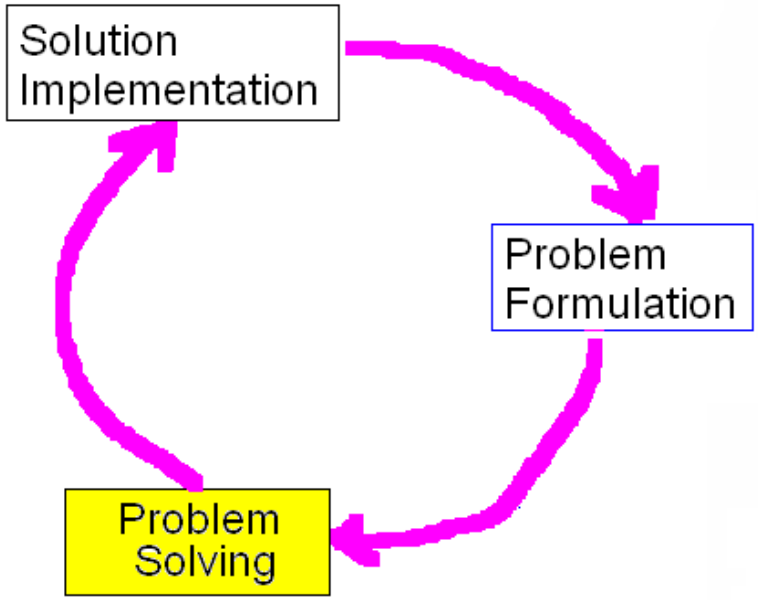
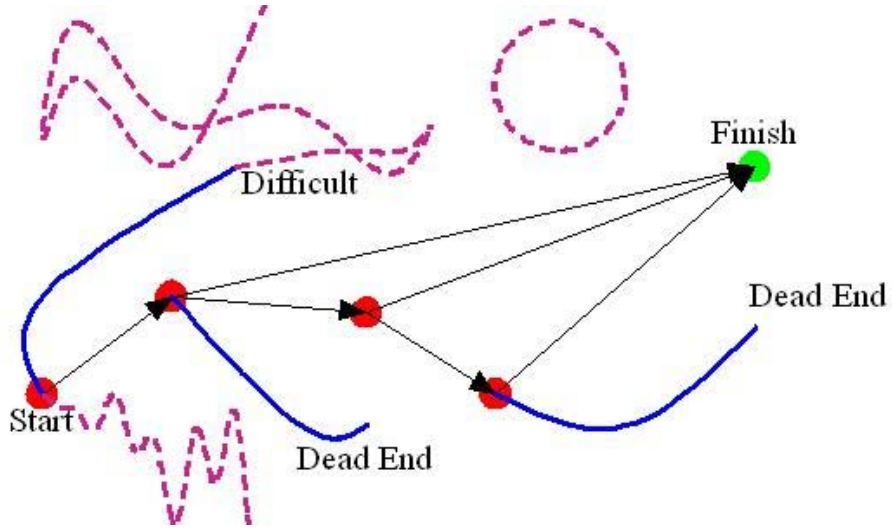
Problem Solving → Solution Generation





- Objectives:
  - –The steps of problem solving
  - –Strategies for generating, analyzing, and selecting alternatives
  - –Making Progress

Class Schedule

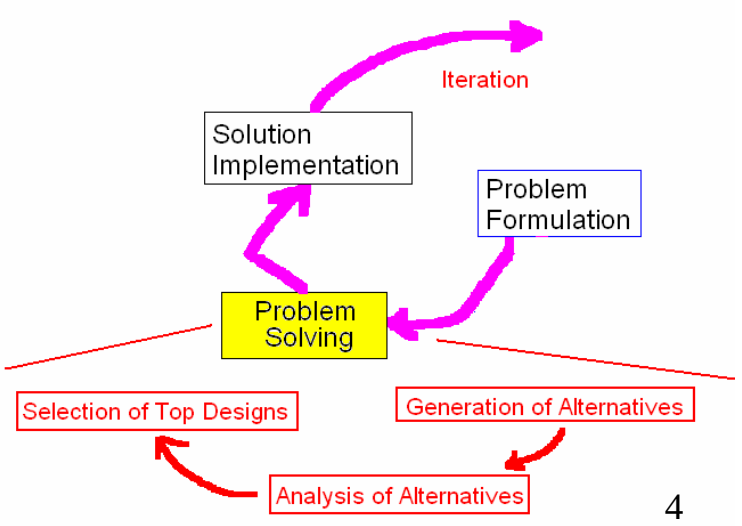
- Schedule
  - –January: Initial System Design and Alternative Solution Generation
    - •System Design and Alternative solutions (of **whole** or **parts**) generation
    - •Final System Design
    - •Parts and Components
    - •Progress Report & Presentation
  - –February: Implementation of the Project
    - •Implementation Plan + Evaluation Plan (Presentation)
    - •Implementation Process
  - –March: Continuation of the Implementation
    - •ECE Progress Presentation --------→ **Public Presentation Event**
    - •Completion of the implementation
    - •Evaluation
  - •April: Final Month of the class (2 – 3 weeks)
- •Final Project Presentation (**ECE Day**)
  - –Thursday, April 18, 2013 (*April 26 --- PG grade posting /End of formal class)
- •Cornell Cup 2013 Presented by Intel
  - –Final competition May 3-6, 2013 at Disney Resorts
- •Class Policy
  - –More time to teams – team meeting log
  - –Progress Report Presentations

Grading Policy

- **Grading:**
  - Team Works (t) 80%
    - Class activities + Presentation + contents (40%)
    - Team Binder (10%) with team meeting minutes and all works
    - Final Report Submission (Soft + Binding) (5 %)
    - ECE Day judgment (25%)
    - **“No participation, no team work point”**
  - Attendance (a) 10%
  - Individual presentation (or elevator speech or pitch) score (b): 10%
  - Peer Evaluation (p)
  - Final Score = (a + b) + 0.6*t + 0.4*t*p
  - A> 90
  - 89>B>80
  - 79>C>70
  - 69>D>60
  - 59>F

Problem Solving Process

- Problem Solving Process
  - **Finding** design solutions to a well-understood problem ---" Solutions Generation"
  - **Exploring and Analyzing** those designs, and ---"Analysis of Alternatives"
  - **Selecting** the most promising design for implementation ---"Top Design"



Step 1: Generation of Alternatives

- The act of expansion - all possible solutions (Entire design or a part or a few parts in the design)
- Overcome the temptation to adopt the first idea
- Developing ideas individually and pooling them together generate more ideas
- Wide design space but true to the problem (functional requirements)
- Building onto existing solutions

Step 2: Analysis of Alternatives

- Screening
  - Remove those that do not meet the functional requirements (“concept screening”)
- In-depth analysis of final candidates
  - Modeling analytically with equations - Equations are representations of reality, not reality itself
  - Modeling with a simulation - You get what is modeled, not the reality
  - Experimentation (with prototype) - Requires more time and money
  - Qualitative Reasoning – Exert Opinion. Talk to your advisor

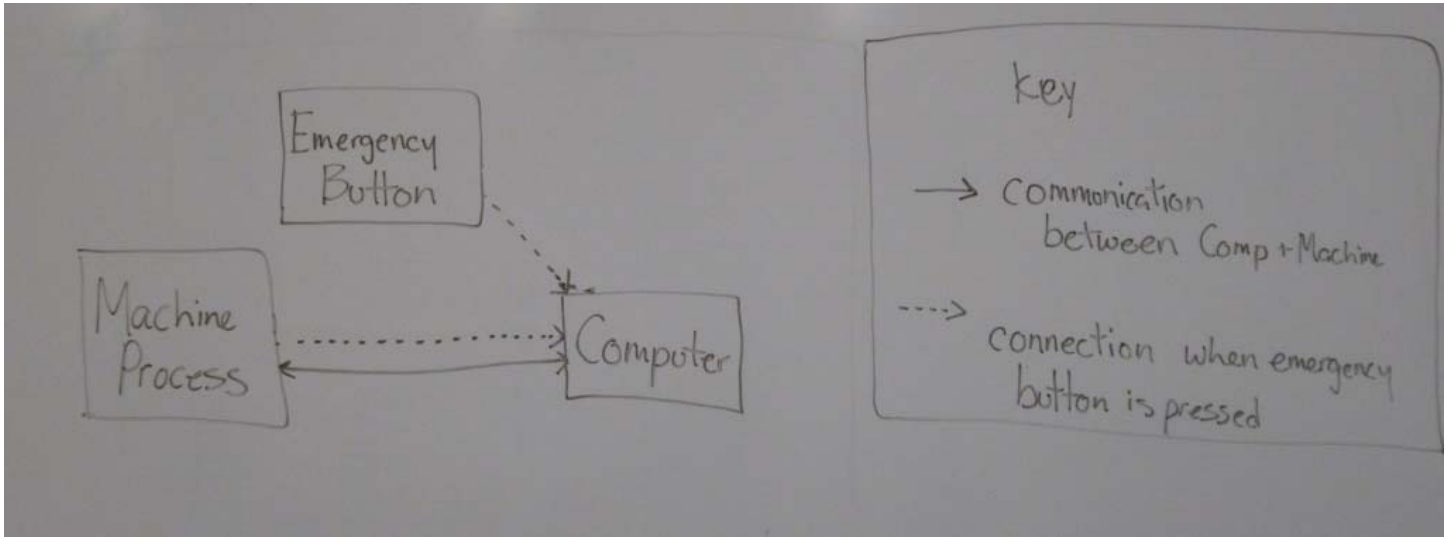
Which approach to use?

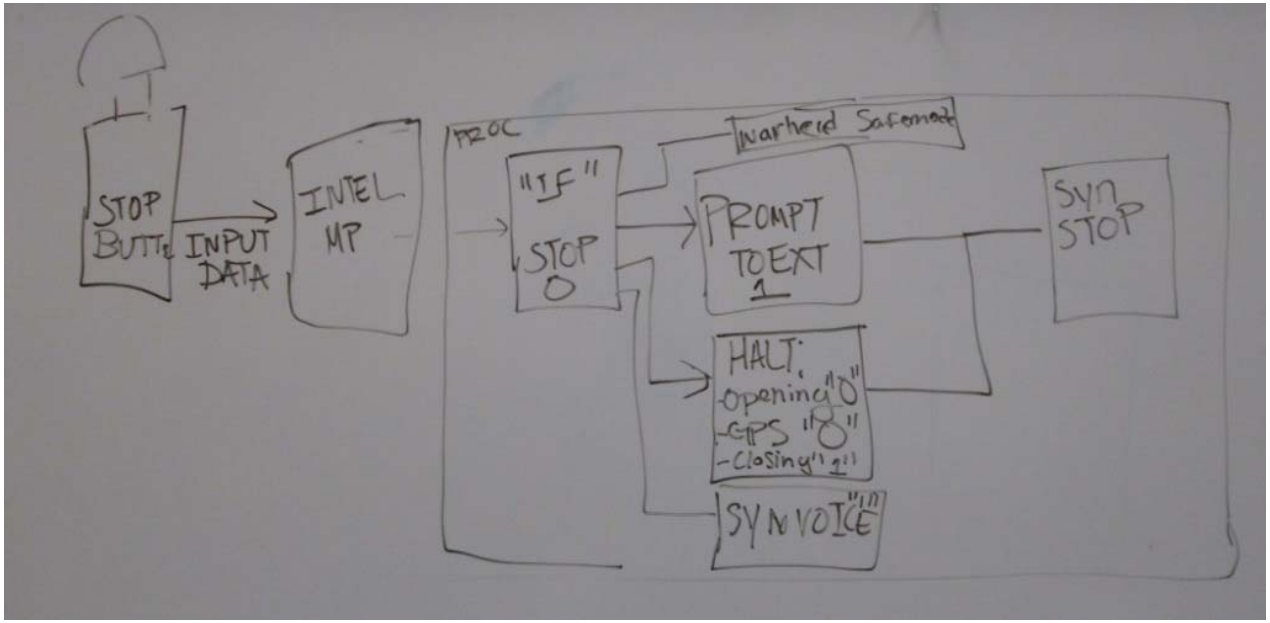
- 3 types of RFID readers on the table and need to choose 1
- Can a red LED be used as a light source for photo-diode based turbidity measurement in place of write LED?
- In handling numerous inputs and outputs, which one do I use, Arduino or I/O explorer?
- Would a single-phase switching cause system unbalance? What condition could minimize the unbalance?
- Which motor is better with the Robo Table purpose, 1/2hp with 5lb weight or ¼ hp with 1 lb weight

Example Design Study for Alternative Solution

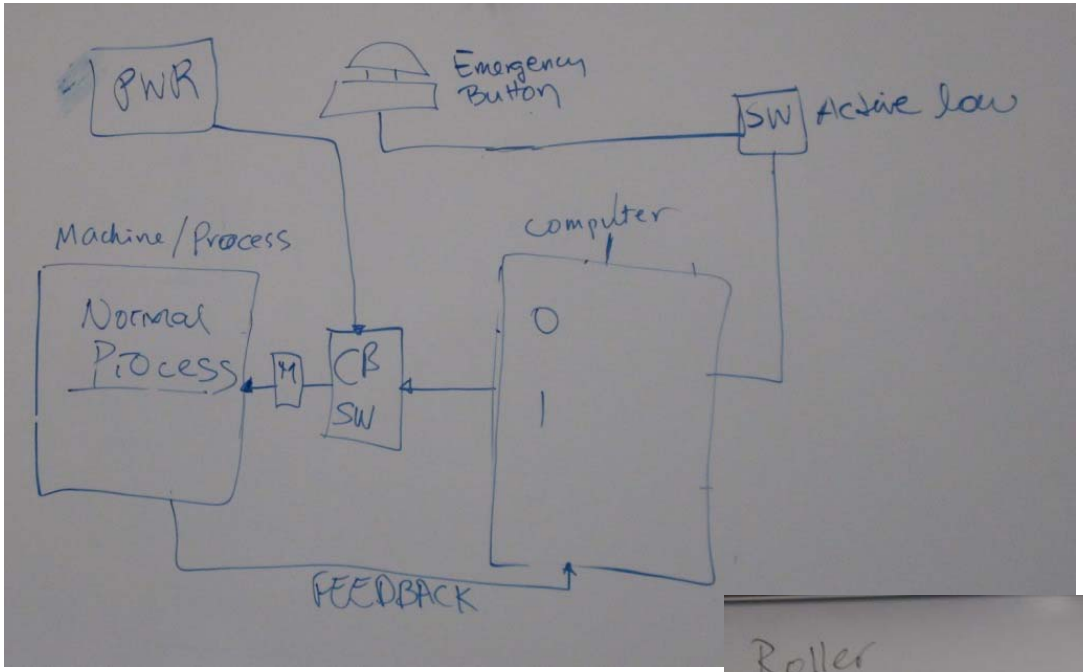
- Background:
  - Some aspects of designs may have safety implications which must be treated seriously to ensure that they operate correctly
- Design Project:
  - How should an emergency stop button be interfaced to a microcomputer based machine control system to ensure its correct operation?
  - Each team generates a solution design (Block or Schematic Diagram – as detailed as possible): 10 - 20 minutes
  - Each team explains the reason behind the design.

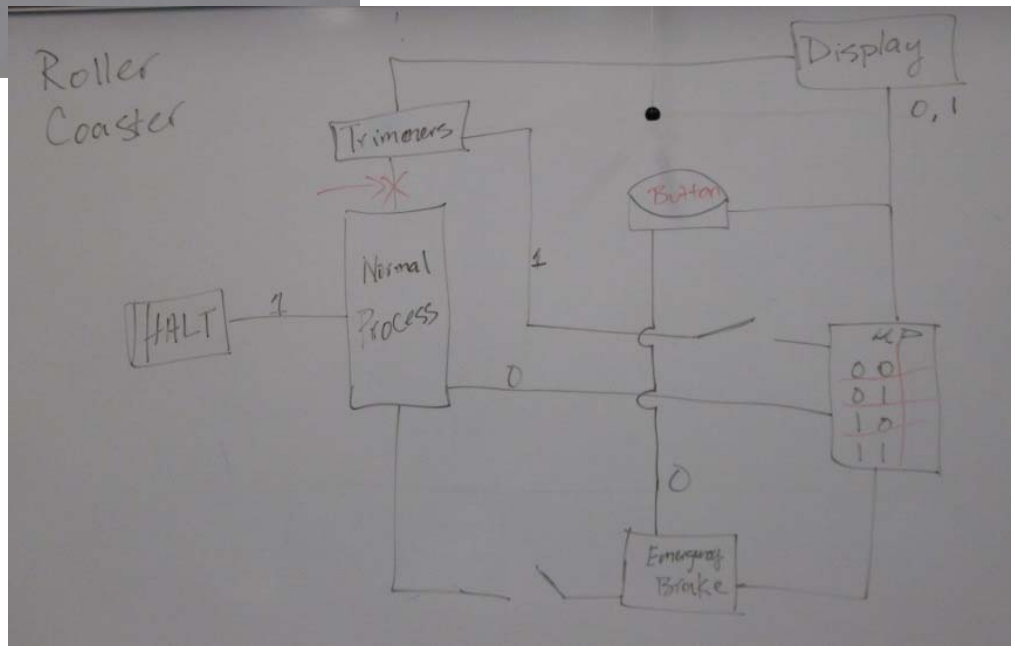
Students Works



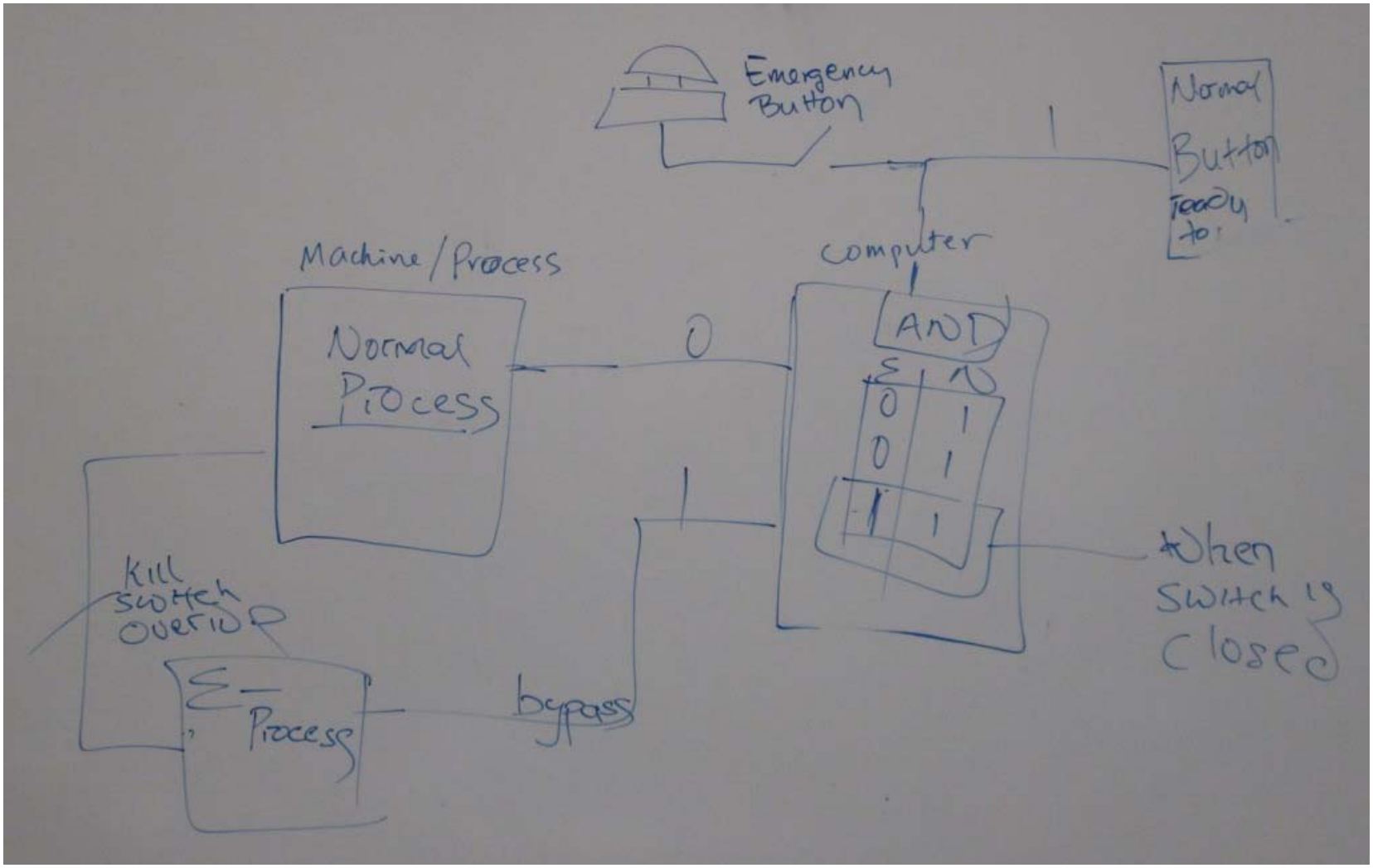


Student Works

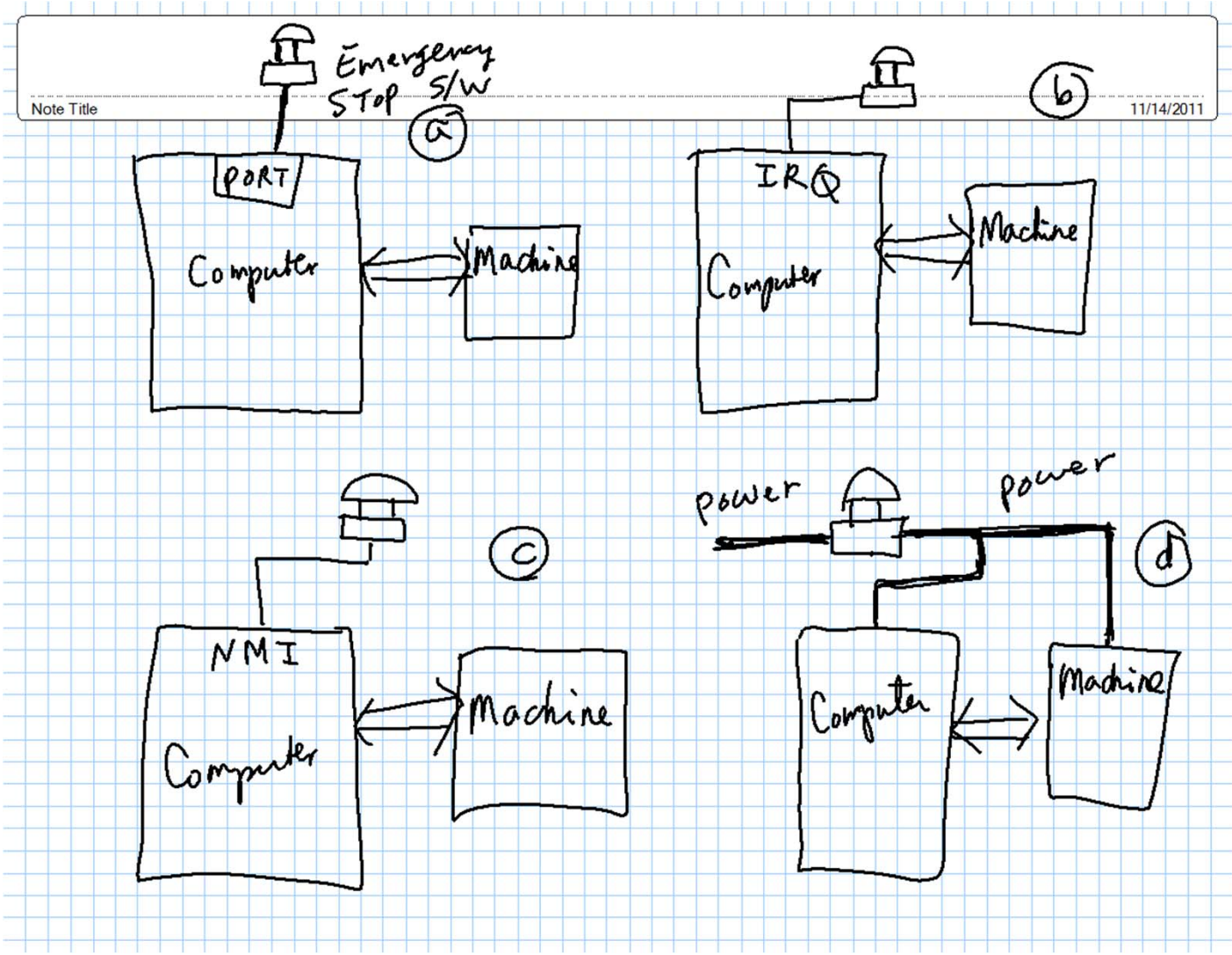




Student Work

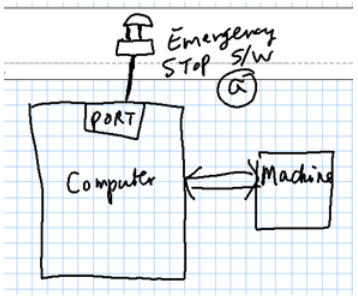


4 different methods

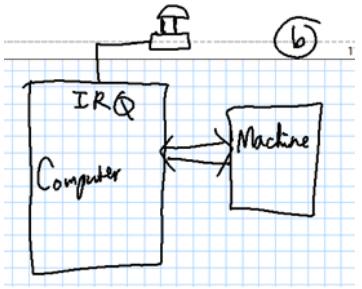


4 Methods - description

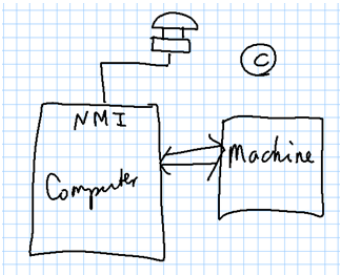
- (a)
  - Serial/Parallel input port to S/W
  - Poll periodically: sense and act



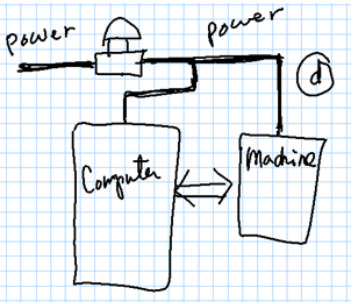
- (b)
  - IRQ (Interrupt request) line to the S/W



- (c)
  - NMI (non maskable interrupt) line to the S/W
  - IRQ always accepted



- (d)
  - Main power supply line to switch operation
  - Safety function is provided by Power Switch



Solution Generation: Problems Observed

- The problems observed in the previous Senior Designs
  - No Serious Alternative Designs
  - Simulation for Simulation's Sake
  - No rigorous analysis for design comparison
  - No effort of designing a circuit
    - Instead, let Internet do for them
    - A purchased kit replaced the design
  - No evaluation of the design

Selection of Top Designs

- Selection is decision-making
- Decision-making involves making trade-offs
  - The results of the analyses
  - Requirements from customer
  - Conflicting requirements
  - Requirements of different importance
- Decision Tool
  - Decision Matrix

Decision Matrix Example

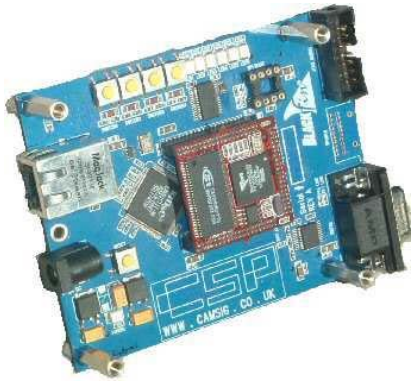
Purchase of a used car

CAR	COST	ODOMETER READING	MECHANIC'S RATING (1 - 10)	LOOKS (1 - 10)
RED	$2000	50,000	7	5
BLACK	$2500	40,000	5	6
BLUE	$3000	20,000	8	8

- Which car do you buy under the following two different weight scenarios
  - You concerned about all four attributes equally.
  - You concerned about cost and fairly indifferent about looks. Mileage and the mechanic's ratings are equally important for you.

Using a Decision Matrix

- Step 1: Collect Information (Analyses)
- Step 2: Determine and Weight Attributes
- Step 3: Rate the Concepts
- Step 4: Rank the Concepts
- Step 5: Combine and Improve the Concepts
- Step 6: Resolve the Decision



		Bluetooth Development Boards							
		Teleca Comtec		Stonestreet One		GCT		Atmel	
Selection Criteria	Weight	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score
Price	40	4	1.6	3	1.2	1	0.4	1	0.4
Power	15	4	0.6	4	0.6	4	0.6	1	0.15
Software	35	2	0.7	4	1.4	3	1.05	2	0.7
Version	10	1	0.1	4	0.4	4	0.4	4	0.4
Total Score			3		3.6		2.45		1.65
Rank			**2**		**1**		**3**		**4**

Class Schedule of January - Feb

- Jan 23:
  - Elevator Speech (pitch)
- Jan 30:
  - Presentation of Alternative Designs (components and parts) and Analyses & Top Design Solution
  - **Presentation**
    - 15 minutes of presentation time
    - 2 presenters and 1 Answerer from each team
      - Presenter 1: Alternative Solutions and Analyses of them (5 min)
      - Presenter 2: Decision Making and Top Design Selection (5 min)
      - Answerer: Answer to Questions (5 min)
- Feb 6: No official Class
  - FINAL VERSION of [Top design + Component selection]
  - Submission: by Feb 6, 2013 (5:00pm) via email
    - Final Design (MS Word file)
      - **Hardware component**: detailed schematics
      - **Software component**: Flowcharts or block diagrams) in MS Word file
    - Final Component/Part list (MS Excel file)
      - product name, description, product no, vendor, price, etc.
- Feb 13: Lecture on Progress Reporting