Howard University
Department of Electrical and Computer Engineering

DEVELOPMENT OF A TRAINING SYSTEM FOR DEFENSE AGAINST COMMON MODE FAILURE

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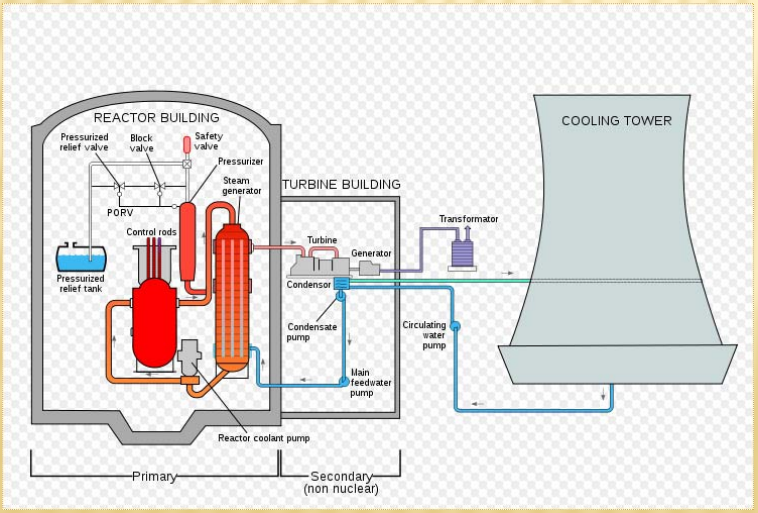
OUTLINE

- Background
- Problem Formulation
- Design Requirements
- Current Status of Art
- Solution Approach
- Scenario of System
- Test of System
- Task and Project Management
- Cost and Resources
- Conclusion

BACKGROUND

- Three Mile Island melt down that took place in Dauphin County, Pennsylvania.
- The most significant accident in American history in commercial nuclear power generating industry.
- Failures in the non-nuclear system.
- Followed by a stuck-open pilot-operated relief valve (PORV)
- The situation spiral out of control because of the combination of mechanical and human errors.



BACKGROUND

- What is Common Mode Failure?
  - Common Mode Failure is a phenomenon that occurs when events are not statistically independent. That is, one event causes multiple systems to fail. e.g. Power Spikes, Water, Magnetism, Temperature Variation, and Software Errors.
- Industry implements systems to prevent common mode failure in their production processes.
- A lot of research is being done in preventing common mode failure.
- The client requires a kit that would assist in the teaching of common mode failure to students of various majors.

PROBLEM FORMULATION

- Problem Definition
  - To develop a kit that would assist in educating engineering students in the area of Common Mode Failure.

DESIGN REQUIREMENTS

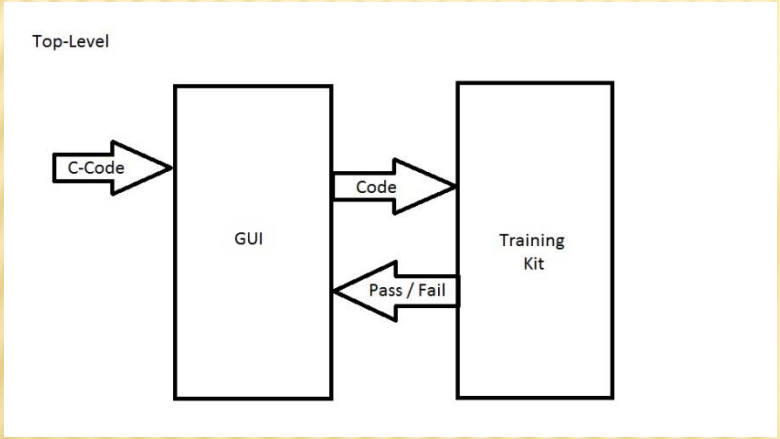
- The kit would only contain four different types of computer systems.
- All the systems contained in the kit can should only be programmed through the C language.
- The entire kit should cost less than $250.00.
- The power supply for the kit should not be more than 9V.
- The kit should be no larger than 8 in x 8 in.
- The weigh of the kit should not be more than 3lb.

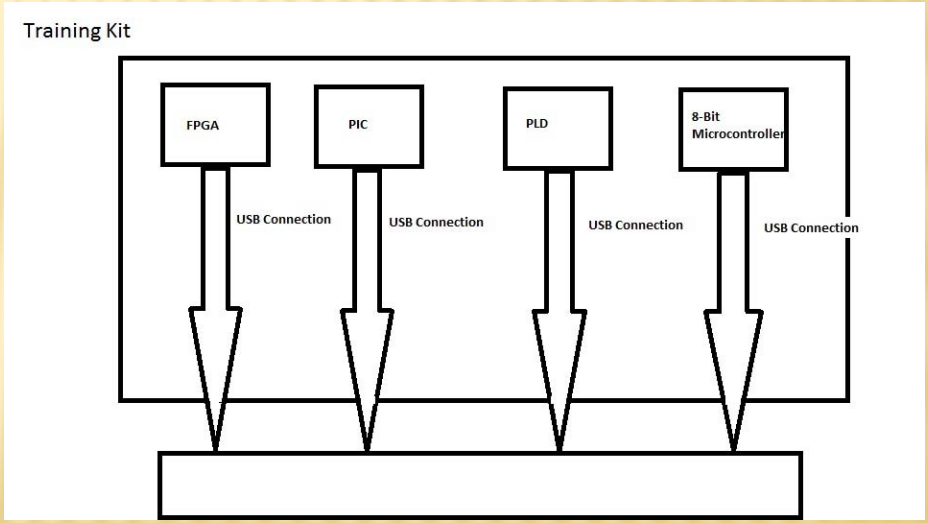
CURRENT STATE OF ART

- A training kit for teaching CMF is not currently on the market.
- There is no single course in any university that educate students in CMF in both hardware and software applications.
- There are many institutions that lecture on CMF in hardware using FPGAs, PICs, and PLDs.
- Also a lot of research is being done on CMF in software, and hence there exist graduate level courses that lecture on CMF in software applications.

SOLUTION APPROACH

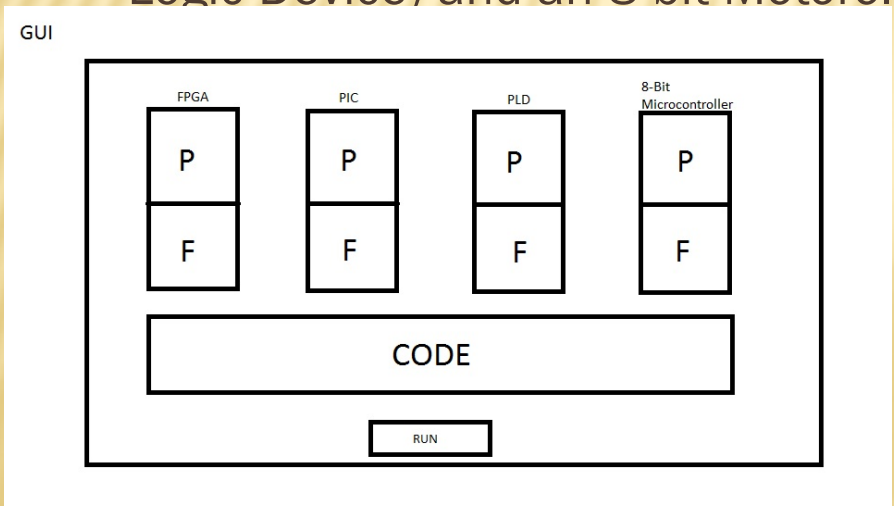
- Our project will consist of a training kit made to show how common mode failure works.
- This training kit will connect to the computer and be monitored by a GUI.

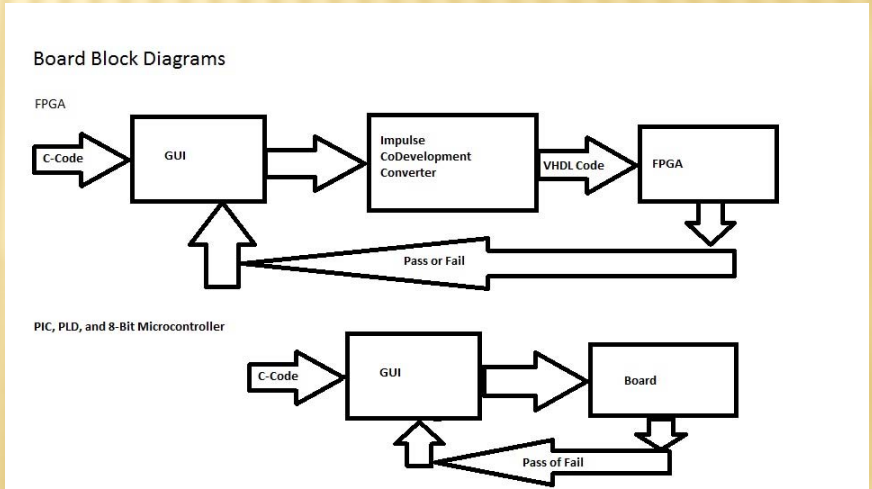




SOLUTION APPROACH

- Our training kit will consist of a metal box that will house the four architectures.
- Each computing system will connect independently to a computer through a USB connection.
- By using four different computing systems running the same program there is less of a chance of the entire system failing.
- The four architectures to be used will be a FPGA (Field-Programmable Gate Array), a PIC (Programmable Interface Controller), a PLD (Programmable Logic Device) and an 8-bit Motorola Microcontroller.





SCENARIO

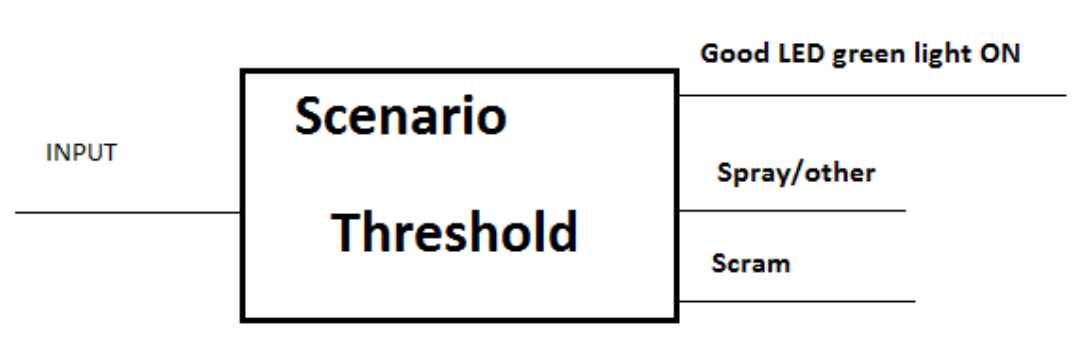
- The conditions to be monitored are pressure, temperature, water level, and thermal power.
- 0 is normal 1 is abnormal
- When the LED's are 0 there is no action being taken, but when the LED's are 1 it means the power plant would be performing a certain action.
- LED1 = Inject More Coolant
- LED2 = Containment Spray System
- LED3 = Insert Control Rods into Reactor
- LED4 = Plant Shutdown

SCENARIO

Pressure	Temperature	Water Level	Power	LED1 Inject More Coolant	LED2 Containment Spray System	LED3 Insert Control Rods into Reactor	LED4 Plant Shutdown
0	0	0	0	0	0	0	0
0	0	0	1	0	0	1	0
0	0	1	0	0	0	1	0
0	0	1	1	0	0	0	1

TEST SCENARIOS

- Software
  - Algorithm Test
    - The use of different algorithms to perform the same function.
- Hardware
  - Magnetism
    - A change in the magnetic field can corrupt data stored in memory.
  - Temperature
    - The changes in temperature can affect the functions of the different types of architecture.
  - Power Fluctuations
    - Changes in power can affect the system.
  - Water
    - Water can cause short circuits.



TASKS AND PROJECT MANAGEMENT

Task	Assignment
Information Collection	Alix Martin
Develop User Interface	Don King II
Housing Kit	Alix Martin
Software Application	Don King II, Ravindranath Jaglal
Power Supply	Alix Martin, Ravindranath Jaglal

Objective	Due Date
Proposal of Design	12/01/10
Acquire Computer Architectures	01/19/11
Design of Power Supply	02/02/11
Housing for Architectures	02/02/11
Design of Interface	02/02/11
CMF Application	02/23/11
Prototype Completion	03/09/11
Final Testing	03/16/11

RESOURCES AND BUDGET

Resource	Cost
FPGA	$120.00
PIC	$50.00
8 Bit Microcontroller	$35.00
Housing Kit	$20.00
Power Supply	$10.00
Miscellaneous	$50.00
Total	$285.00

CONCLUSION

- The training kit will be an aid in teaching students about common mode failure.
- Students will be able to test the kit in different situations and monitor whether the program still runs under certain conditions.
- As stated before we will be using the C programming language to program all of the computing systems.
- The entire system will be monitored by a GUI of our creation that will show whether if each architecture passed our failed during our testing scenarios.
- The project should cost no more the $250 including software and materials.

QUESTIONS?