Smart Safe Presentation

By: Toshi, Harsh, and Ekam

Introduction

- Escalating thefts due to security staff shortages and population growth

- Heightened demand for advanced security safes with timed auto-locking and programmable passcodes

- Development of a comprehensive report detailing design, decision-making process, project timeline, and future possibilities for product refinement and expansion

Problem Statement

Law enforcement agencies are facing a surge in theft and robbery incidents due to rapid population growth and a shortage of security personnel. To combat this issue, our locking safe is equipped with a digital controller using Xilinx Basys 3 FPGA Board. The safe must not only prevent theft but also be interactive, accommodating various categories of valuables and providing detailed information about its usage.

Design Requirements

- Enhanced Security
- Interactivity
- Efficiency
- One Sequential Machine

Functions

- The device should have user authentication
- Locking and Unlocking
- Monitoring and displaying status of main door
- Security Alarm

Objectives

- Safe should be secure
- Safe should be useable
- Safe should be functional
- Safe should be efficiently designed

Constraints

- FPGA Compatibility
- Safety and Compliance
- Budget must not exceed 10$
- 1 Sequential Machine in the code
- Must be operable with basic logic skills

Solution #1

- Proposed solution: Utilization of 3D printing for housing, door, and locking mechanism of the safe

- Emphasis on robust and durable material for adequate protection of belongings

- Implementation of a simple, efficient door hinge design for user convenience

- Integration of a servomotor controlled by Xilinx Basys 3 FPGA Board for automatic locking after a set time; lightweight, cost-effective, and water-resistant design with compromises in durability and waterproofing

Solution #2

- Solution involves crafting the safe from sheet metal for durability and strength
- Versatile material choice with downsides of sharp edges and high tooling costs
- Design includes hinged door, keypad lock, LCD screen, and servo-controlled locking mechanism
- Utilization of Xilinx Basys 3 FPGA Board and VHDL programming for secure access via correct keypad permutation displayed on the LCD screen

Solution #3 (Final Solution)

Solution involves a cardboard safe with Xilinx Basys 3 FPGA Board, lever action switches, and a numpad

Accessing the safe through flipping the correct switches to unlock via servo-controlled door

Emphasizes safety and security despite lower durability and production complexity

Prioritizes intuitive user experience for all abilities while providing adequate safety and security

Solution #3 (Final Solution)

Table I Decision matrix chart for the considered alternatives

		Solutions					
		Solution 1		Solution 2		Final Solution	
Criteria	Weight	Score	Partial Score	Score	Partial Score	Score	Partial Score
Cost	0.40	8/10	0.320	6/10	0.240	9/10	0.360
Safety	0.25	5/5	0.25	3/5	0.150	5/5	0.250
Durability	0.20	9/15	0.120	14/15	0.187	9/15	0.120
Manufacturability	0.15	9/10	0.135	6/10	0.090	8/10	0.120
Sum	1.00		0.825		0.667		0.85

Solution #3 (Final Solution)

This solution was chosen instead of the others since it scored highest on our decision matrix, while it was not the most durable and easily producible solution. It scored highest in safety and security. These categories are especially important to our design, as it aligns with our vision to provide a safe and secure solution for protection. Furthermore, this solution is also user-friendly and provides an intuitive user experience for people of all abilities.

Environmental, Societal, Safety, and Economic Considerations

- Environment: SMART SAFE uses recycled cardboard and an energy-efficient, reusable Xilinx board, minimizing resources and avoiding unnecessary features.

- Economics: Cost-effective design using sustainable, free materials; Xilinx Basys 3 board costs $150 CAD but is reusable for multiple projects.

- Society: Accessible to all abilities with features like automatic doors, and indicator lights.

- Safety and Health: Prioritizes safety with rounded corners, clean assembly, and a light to prevent hazards.

- Structural Limitations: Vulnerable to physical and elemental damage due to cardboard construction.

- Economic/Technological Limitations: Budget constraints may cause occasional minor bugs in components like the servo motor; resourcefulness is key due to project scope and budget.

Team Work

Time: 6:30 PM

Wednesday Sept 27th

Agenda: Deliverable #1

Team Member	Previous Task	Completion State	Next Task
Harsh Sarvaiya	Introduction	100%	Solution 3 / fix feedback errors
Toshi Turner	Design problem	100%	Solution 2 / Decision Matrix
Ekam Taneja	Design problem	100%	Solution 1 / Features

Time: 6:30 PM
Monday Oct 30

Agenda: Distribution of Tasks / Working on Deliverable #2

Team Member	Previous Task	Completion State	Next Task
Harsh Sarvaiya	Solution 3 / fix feedback errors	100%	Limitations/ Economic, Environmental, Societal and Safety Considerations
Toshi Turner	Solution 2 / Decision Matrix	100%	Feature flow chart
Ekam Taneja	Solution 1 / Features	100%	Features

Time: 6:30 PM
Monday Oct 30

Agenda: Deliverable #2

Team Member	Previous Task	Completion State	Next Task
Harsh Sarvaiya	Limitations/ Economic, and Environmental Considerations	100%	VHDL Simulation /FPGA Implementation
Toshi Turner	Solution 2 / Decision Matrix	100%	VHDL Simulation /FPGA Implementation
Ekam Taneja	Solution 1 / Features	100%	VHDL Simulation /FPGA Implementation

Time:8:00 PM - 8:30 PM

Agenda: Finishing prototype

Team Member	Previous Task	Completion State	Next Task
Harsh Sarvaiya	Create Hardware, Assemble final Prototype	100%	Finish prototype
Toshi Turner	Program Lever Action, and servo motor	100%	Finish prototype
Ekam Taneja	Create circuit, Create Hardware	100%	Finish prototype

Project Management

Programmable Lock Safe

Harsh Sarvaiya , Toshiro Turner, Ekam Taneja

Sept 25 2023 - Nov 10 2023

TASK	Start	Days	End
Project Research			
Brainstorming	Sep 25	8	Oct 3
Materials	Oct 4	1	Oct 5
Design Drawing/Planning	Oct 6	3	Oct 9
Standards/Requirements	Oct 10	1	Oct 11
Make Changes	Oct 12	2	Oct 14
Solidworks			
First Draft Design	Oct 15	2	Oct 17
Draft Improvement Brainstorming	Oct 18	3	Oct 21
Apply Improvements	Oct 22	2	Oct 24
Prototype Assembly			
Purchase Items needed	Oct 25	1	Oct 26
Discuss Building Procedure	Oct 27	2	Oct 29
Assemble Prototype	Oct 30	10	Nov 9
Group Report			
Introduce Project	Nov 10	Dec 31	Nov 11
Problems with Project	Nov 12	1	Nov 13
Solutions to Problems	Nov 14	3	Nov 17
Filling out Specifics	Nov 18	1	Nov 19
SlideShow	Nov 20	1	Nov 21
Final Edit	Nov 22	1	Nov 23
Video			
Final Polishes on project	Nov 24	1	Nov 25
Record with Project	Nov 26	1	Nov 27
Edit Video/Cool Transitions	Nov 28	1	Nov 29
Present in Class	Nov 30	1	Dec 1

Future Work and Conclusion

Future work:

- Material optimization
- Security upgrades
- Improve user experience

Conclusion:

- Requirements analysis
- Programming in VHDL using Vivado and Xilinx Basys 3
- Interdisciplinary collaboration