Digital Controller for a Programmable Locking Safe

CENG 3010 - Presentation

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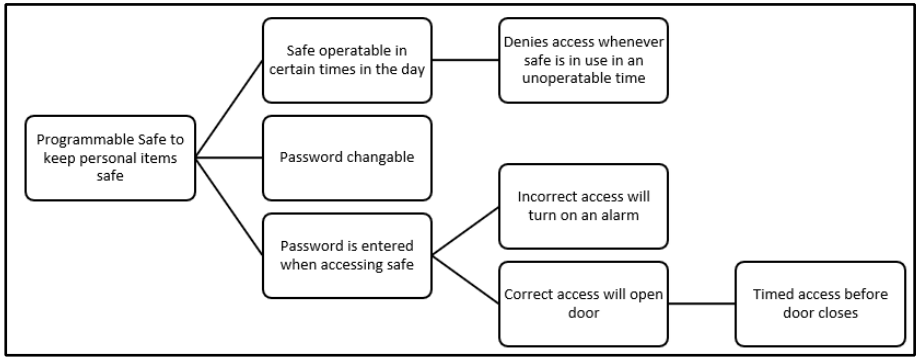
Problem Definition

- There is about on average 2.5 million burglaries that occur around the world with 66% of these begin break-ins. With that, about 50% of stolen goods are irreplaceable or have sentimental value towards the owner.
- Programmable locking safes can provide protection over these items and prevent personal items from being either:
  - Damaged or stolen.
  - Reduce the need for more security.
  - Gives relief to the item’s owner by reducing the stress of the owner.

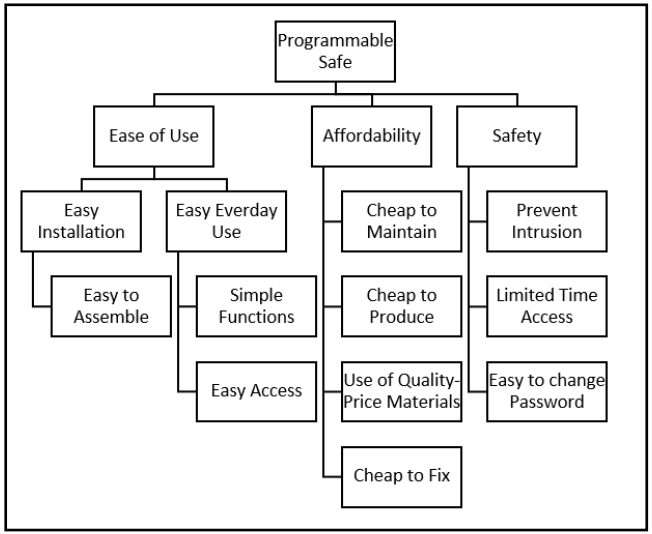
Functions

- The system should:
  - Allow users to open the door on keypad.
  - Use the 7 segment display to display information when the safe is being used.
- The door should lock when it is either closed and that any incorrect password should not let the door open.
- The door should unlock when a correct password has been implemented.
  - Timer for the duration whenever the door is open.



Objectives

- The system should:
  - be easy to use for new users.
  - be able to keep the user's items safe.
  - use a sequential machine to run all possible outcomes.
  - be able to change password when needed to.
  - be cost effective.



Constraints

- The door of the safe should only open when the correct password is entered.
- The safe should automatically lock after a certain time frame.
- The safe should use one or more sequential machines.
- The Safe should be cost-effective.

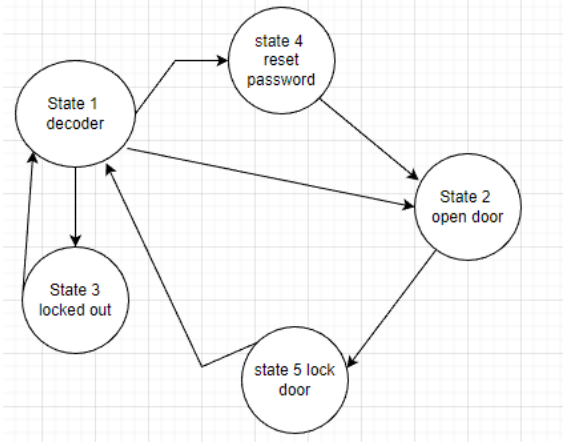
Stakeholders

Stakeholders	Required Needs
User / Owner of the safe	• To keep important and valuable items safe from unwanted users or environments. Such as unwanted guests, burglars and house fires.
Programmers creating the code	• To create a code that can prevent break-ins into the safe. • To create a code that can't be hacked easily.
Programmable Safe Company	• To generate money from users who require a safe to protect and keep important or valuable items safe. • To generate money from users to improve the programmable safe.

Solution 1

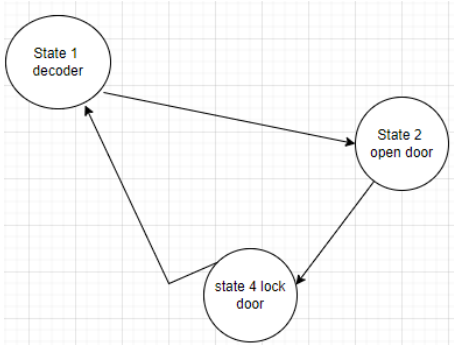
- Allows users to enter password instantly using states.
  - When a user enters a button, it will go to the next digit on the 7-segment display.
  - All digits of the password is display on the 7-segment display.
- After the password is entered, it would compare with the system and either let the user access or not.

- We did not use this design due to:
  - The decoder showing only 1 digit at a time.
  - The system showing the entire password which can:
    - Reduce the security.
    - Allow unwanted users from viewing the Password.



Solution 2

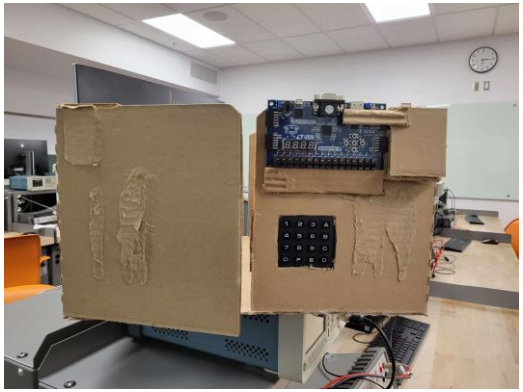
- Allows users to enter password using states.
  - When a user enters a button, they would need to press the next button to advance to the next digit.
  - After they have enter in all 4 digits, the user can press the confirm button, which would compare the entered password to the password of the system.

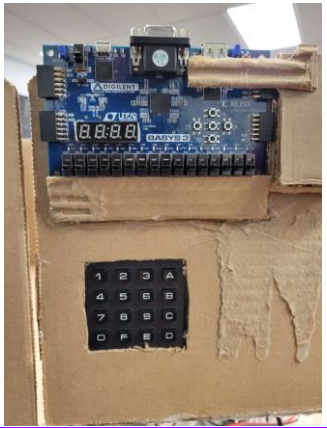


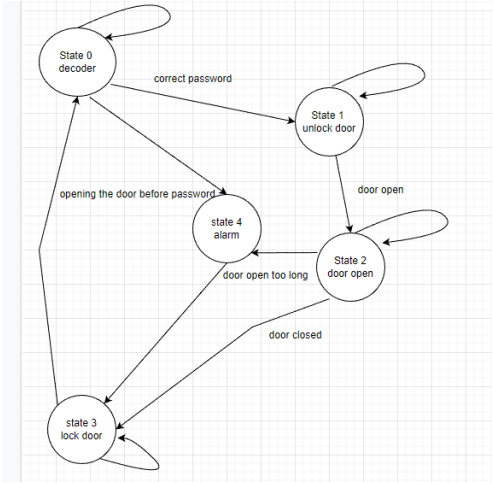
- Reason why we didn’t use this solution was because:
  - The decoder only allowed 1 digit to show instead of all the digits.
  - When pressing the next button, it would quickly advance through the states, and skip some of the other digits.

Final Solution

- Uses 2 switches to change between digits on 7-segment display (11,10,01,00).
- Only shows 1 digit at a time.
  - This allows users to enter password without showing the rest of the code
  - Acts as an Enhanced Security Measure.
- Alarm for whenever someone forgets to close the safe door and if someone is trying to open the safe with an incorrect password.



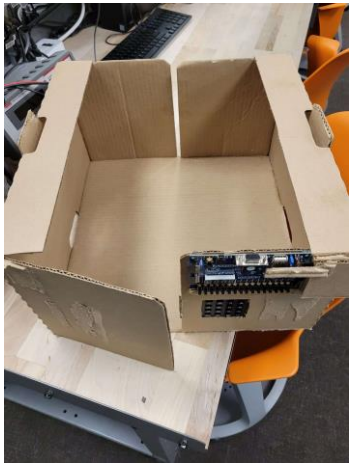




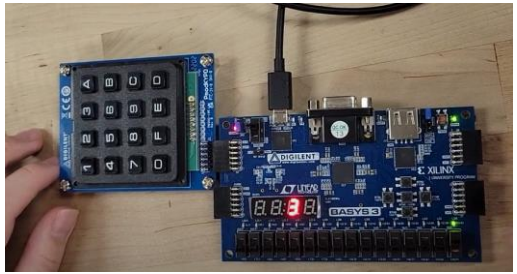
Decision Matrix

		Solutions					
		Solution 1		Solution 2		Final Solution	
Criteria	Weight	Score	Partial Score	Score	Partial Score	Score	Partial Score
Security	0.40	7/10	0.280	6/10	0.240	8/10	0.320
Safety	0.35	6/10	0.210	6/10	0.220	7/10	0.245
Simplicity	0.25	6/10	0.150	8/10	0.200	7/10	0.175
Sum	1.00		0.640		0.660		0.740

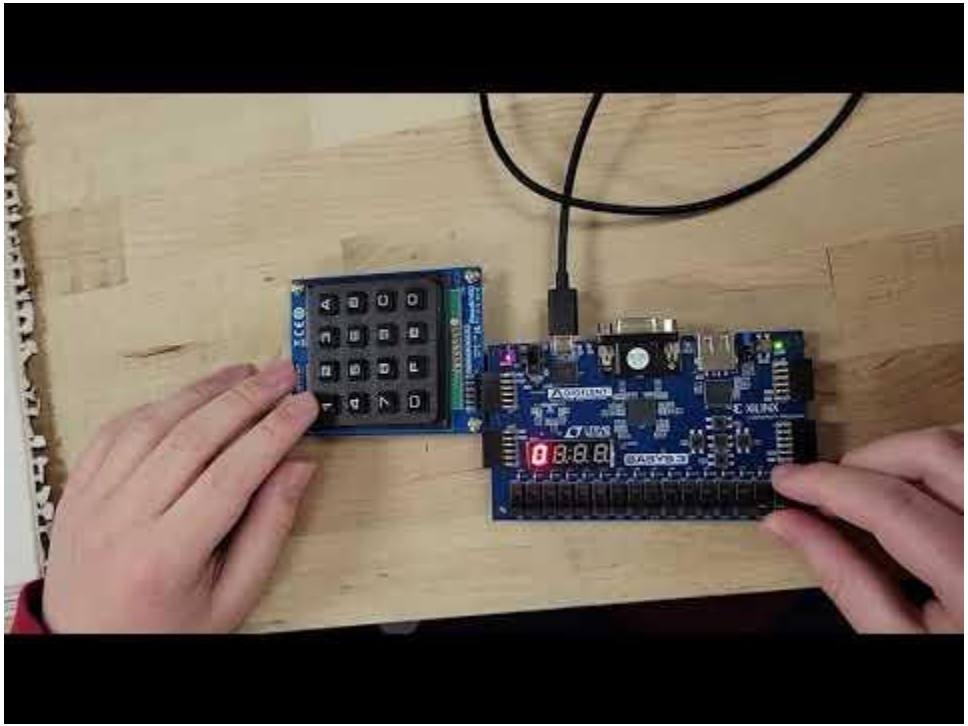
Features



- The 7-segment display displays one digit at a time,
  - acting as an **Enhanced Security** feature.
  - prevents others nearby from viewing the password.
- Timer for the door whenever it is open.
- LEDs indicating the correct password, door open and alarm.
- Alarm will go off for whenever:
  - Someone tries to open the safe door when password hasn't been entered.
  - The safe door isn't closed during the time limit.



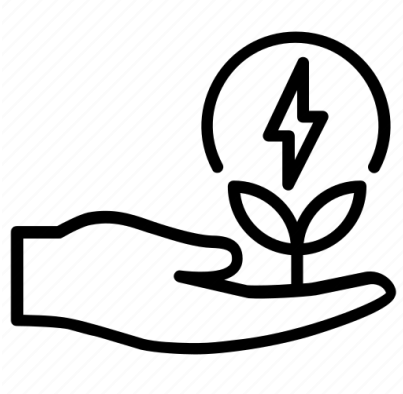
Prototype Demo Video



Considerations

Environmental:

- Simple program that doesn't use a lot of energy.
  - By reducing the energy consumption of the safe, we can also reduce the carbon footprint.
- Prototype safe is made out of cardboard.
  - Made without any harmful materials.



Societal:

- Helps keep personal belongs safe from unwanted users.
- Reduces stress of the user knowing that their belongs are stored in a secure location.
- Safe must be built strong and tamper-proof.

Considerations Cont.

Safety:

- Safe only displays the current digit, preventing others nearby from viewing the rest of the password.
- Alarm that is triggered whenever someone is trying to open the door when the password hasn't been enter.

Economic:

- Cost-Effective Program.
- Cheap to produce.
- Minimal Amount of Components.
- Affordable to users.

Limitations

- Password can only be changed in the program itself.
- Physical Prototype doesn’t actually lock the safe.
- Due to time constraints we wanted to:
  - Implement a servo motor as a locking mechanism.
  - Implement more external LEDs.
  - Implement a reset password for users.

Lifelong Learning

- We learned how to incorporate external components to the FPGA board.
  - Learned how to implement the PMod Keypad to our program.
- Figured out how the PMod keypad decoded information whenever a button was pressed.
- Mapped each decoded information to the 7-segment display.

Conclusion

- Went through many considerable solutions for our program.
  - How the program will function.
  - How we would incorporate external devices.
- The biggest challenges for that users is that home intrusions and break-ins can lead to:
  - Valuable Items being taken or destroyed.
  - Items being irreplaceable.
- With the help of programmable locking safes, it can reduce:
  - The chance of home intrusions / break-ins.
  - Improve the overall security of ones belongings.

Future Work

- Improve the overall security by:
  - Implement a way to reset the password.
  - Implement the alarm whenever the password has been entered incorrectly more than 3 times.
- Implement a bluetooth device that can allow the user to open the safe remotely.

Thank You For Your Attention

Any Questions?

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