**Report on Password Security System using FPGAs**

Team:

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A Passcode Security System is useful in guarding valuable information, and objects. It eliminates the need to use a physical object for unlocking the system. A Passcode will be memorized by the user and entered to unlock the system.

Our team has implemented a passcode security system on an FPGA using Verilog. The hardware used is Zedboard, and PMOD KYPD. The LEDs, pushbuttons, and OLED display present on the Zedboard have been used for interfacing with the user as well.

A picture containing text, electronics, circuit

Description automatically generatedA picture containing electronics

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*Figure 1: Zedboard  
Source: billauer.co.il/blog/wp-content/uploads/2012/09/zedboard-front.jpg*

The PMOD KYPD is a 16-button push button 4x4 matrix. According to the schematic, the Rows are connected with pull-up resistors to 3.3 volts. Hence, they are defined as inputs in the Verilog module. The columns are defined as outputs in the Verilog module. For example, to detect the press of button *1*, column 1 is set to 0 volts, while the other columns are set to 3.3 volts. When button *1* is pressed Row 1 is connected to 0 volts through the push button. Now, the states of the Rows are taken. If Row 1 is read as 0 volts, then button *1* is pressed. Similarly, the button presses for other digits can be identified.

Diagram, schematic

Description automatically generated

*Figure 3: PMOD KYPD Schematic  
Source: https://digilent.com/reference/\_media/reference/pmod/pmodkypd/pmodkypd\_sch.pdf*

The system uses passwords of length 8 and has a default passcode of *12345678*. To change the passcode, the user must first enter the correct passcode, and then press the push button corresponding to change passcode. The user can then enter their own passcode. The user is given 3 attempts to enter the correct passcode. Upon entering the passcode incorrectly thrice, the system becomes permanently locked, which can be reset. On the FPGA, a push button is used to reset, though any kind of mechanism can be used to generate the reset signal which is a positive edge. After unlocking the system using the correct passcode, the system can be locked again using another push button on the Zedboard. Three LEDs on the Zedboard are used to represent the system’s state, i.e., Unlocked, Locked and Permanently Locked.

A screenshot of a video game

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*Figure 4: Zedboard LEDs, Pushbutton Description*

The following is the flowchart for the system:

Diagram

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*Figure 5: Flowchart*

The OLED must be initialized with few parameters prior using it for displaying data. The parameters such as contrast, charge pump values, pre-charge period, segment remap, scan direction must be set. The above configuration fall under the category of commands, and the characters to be displayed are data. The data must be written to Graphics Display Data RAM (GDDRAM). It consists of the data which corresponds to each pixel on the display.

The Verilog Module instantiation structure is as follows:

* password
  + Keypad
  + StateMachine
  + top\_oled
    - oledControl
      * delayGen
      * spiControl
      * charROM