A Simple Automated Teller Machine (ATM)

You will design a simple ATM and implement it on the FPGA device. You will be asked to demonstrate your implementation on the BASYS FPGA board . In your design, there will be login operation where the user first should insert its debit card and then enter his/her password. After having entered the password correctly, user may do: 1) deposit/withdraw money to/from his/her account, 2) change the password of the account or 3) log out from the ATM.

Inputs

There will be 5 (five) inputs in your circuitry:

- *rst* will set your circuitry to its initial state. This input should be provided from BTN0 of the BASYS board.
- *BTN3* will be used for different operations in different states. For example, in the IDLE state, it is used to insert the debit card while it is used for entering the password in another state. Details will be provided below. This input should be provided from BTN3 of the BASYS board.
- *BTN2* will be used for changing your password and withdrawing money from your account. Details will be provided below. This input should be provided from BTN2 of the BASYS board.
- *BTN1* will be used to log out from ATM and navigating in ATM menu. Details will be provided below. This input should be provided from BTN1 of the BASYS board.
- *SW* is a 4-bit input and it will be used to set password or the amount of money to deposit/withdraw to/from your account. Details will be provided below. This input should be provided from SW[3:0] of the BASYS board, where SW[0] will be the least significant bit of its value.

Outputs

There will be 2 (two) different types of outputs in your circuitry:

- LED outputs: You are required to show in which state your system is by using LEDs. Details will be provided below.
- 7-segment displays (SSDs): SSDs will be used to show messages and balance information. Details will be provided below.

Operation Steps

The circuitry will start in the IDLE state, in which it displays 'CArd' in SSDs with only LED0 is being ON. In IDLE state, the user can insert its debit card by simply pressing *BTN3*. Then, the circuitry will go to password entry state where 'PE-3' will be displayed in SSDs with only LED7 is being ON. The initial password of the user is '0000' and the user should enter the password by setting the *SW* input and pressing *BTN3*.

The user has 3 rights to enter password correctly at the password entry state. If the user enters the password wrong for the first time, LED6 should also be ON along with LED7 and 'PE-2' should be displayed on SSD. If the user enters the password wrong for the second time, LED5 should also be ON along with LED6 and LED7, and 'PE-1' should be displayed on SSDs. If the user enters password wrong for the third time in a row, the ATM should be locked (no button works except for reset button) for 5 seconds where all LEDs should be ON and 'FAIL' should be displayed on SSDs. After 5 seconds, the circuitry should go to the IDLE state. If the user presses *BTN1* at any point of password entry stage, it should be logged out from the system and go to the IDLE state.

If the user enters the password correctly, it goes to the ATM menu state where only LED4 is ON and 'OPEn' is displayed on SSDs. In this state, the user has 3 options: 1) press *BTN3* and perform money deposit/withdraw operations, 2) press *BTN2* and change the password, 3) press *BTN1* and log out from the ATM (go to IDLE state).

1) If the user presses *BTN3* in the ATM menu state, the circuitry should go to a state where the user can see the account balance and deposit/withdraw money to/from the account. In this state, only LED3 is ON and the current balance of the user should be displayed on SSDs in 4-digit hexadecimal format. In this state (money operation state), the user can deposit money to the account by setting the *SW* input and pressing *BTN3*. After money is deposited into the account, the updated account balance should be displayed on SSDs. In this state, the user can withdraw money from the account by setting the *SW* input and pressing *BTN2*. After money is withdrawn from the account, the updated account balance should be displayed on SSDs. If the user tries to withdraw an amount of money that is higher than the money in the account, the circuitry should not perform the operation and it should be locked for 2.5 seconds (no button works except for reset button) and '-NA-' should be displayed on SSDs with all LEDs are ON. Then, the circuitry should go back to the money operation state. In this state, if the user presses *BTN1*, the circuitry will go back to the ATM menu state.

2) If the user presses *BTN2* in the ATM menu state, the circuitry should go to a state where the user can change the password. In this state (password change state), only LED2 should be ON and 'PC-3' should be displayed on SSDs. In this state, the user first should enter the current password by setting the *SW* and pressing *BTN3*. The user has 3 rights to enter the current password correctly. If the user enters the password wrong for the first time, LED1 should also be ON along with LED2 and 'PC-2' should

be displayed on SSD. If the user enters the password wrong for the second time, LED0 should also be ON along with LED1 and LED2, and 'PC-1' should be displayed on SSDs. If the user enters the password wrong for the third time, the circuitry should be locked (no button works except for reset button) for 5 seconds, all LEDs should be ON and 'FAIL' should be displayed on SSDs. After 5 seconds, the circuitry should go to the IDLE state. If the current password is entered correctly, only LED1 should be ON and 'PASS' should be displayed on SSDs. Then, the user should enter the new password by setting the *SW* and pressing *BTN3*. Then, the circuitry should go back to the ATM menu state. In password change state, if the user presses *BTN1*, the circuitry will go back to the ATM menu state.

3) If the user presses *BTN1* in the ATM menu state, the user should be logged out and the circuitry should go to the IDLE state.

Unless the user resets the circuitry, user's current balance and password should not be reset. For example, the user enters the system, changes the password, deposit money into the account and log out from the ATM. If the user wants to re-enter the ATM, he/she should use the new password (and the user's account balance should be equal to the amount of money deposited.).

Simulation Scenario

Reset the circuit

       a. Inset the debit card by pressing *BTN3*
       b. Enter the password correctly and go to the ATM menu state
       c. Go to the money operation state by pressing *BTN3*
       d. Deposit 5 into your account (by setting the *SW* and pressing *BTN3*)
       e. Go back to the ATM menu state by pressing *BTN1*
       f. Go to password change state by pressing *BTN2*
       g. Enter the current password correctly (by setting the *SW* and pressing *BTN3*)
       h. Enter the new password (by setting the *SW* and pressing *BTN3*)
       i. Log out from the ATM by pressing *BTN1*
       j. Inset the debit card by pressing *BTN3*
       k. Enter the password wrong for 3 times (by setting the *SW* and pressing *BTN3*)
       l. Inset the debit card by pressing *BTN3*
       m. Enter the password correctly and go to the ATM menu state (by setting the *SW* and pressing *BTN3*)
       n. Go to the money operation state by pressing *BTN3*
       o. Withdraw 4 from your account (by setting the *SW* and pressing *BTN2*)
       p. Withdraw 2 from your account (by setting the *SW* and pressing *BTN2*)
       q. Go back to the ATM menu state by pressing *BTN1*
       r. Go to the password change state by pressing *BTN2*
       s. Enter the current password wrong for 3 times (by setting the *SW* and pressing *BTN3* -- you should be logged out)