EE 337: Microprocessors Laboratory (Spring 2021)
Indian Institute of Technology Bombay

Project: 20 points Date: March 8, 2021

ATM Simulator on Pt-51

1. [20 points] In this project, you will be writing a program to simulate the behavior of an ATM which can dispense notes having denominations 2000, 500, 200, and 100. The actions of the ATM user will be simulated using key presses on a keyboard connected to Pt-51 using UART.

   - Initially, the ATM contains the following notes of specified denominations.
     - 20 notes of Rs 2000
     - 30 notes of Rs 500
     - 10 notes of Rs 200
     - 10 notes of Rs 100
   - To enable observation of the ATM state during the simulation, the LCD should display the counts of the different denomination notes for 3 seconds when the key `d` is pressed on the keyboard. For example, if there are 5 notes of each denomination in the ATM, then on pressing `d` the LCD should display `2000:05 500:05` on the first row and `200:05 100:05` on the second row.
   - When not displaying the ATM state, the LCD should display the denominations which are available on the first row separated by commas. Consider the following examples.
     - If the all denominations are available, the LCD should display `2000,500,200,100`. Note that this string has 16 characters.
     - If only the Rs 2000 notes are not available, then the LCD should display `500,200,100` on the first row.
     - If only the Rs 2000 and Rs 200 notes are not available, then the LCD should display `500,100` on the first row.
   - You will not be simulating the ATM PIN verification or user balance verification in this project. We are more concerned with note dispensing by the ATM.
   - An ATM user will type the amount she wants to withdraw using the computer keyboard. The characters typed need to appear on the second row of the LCD. Once the user has finished typing the amount, she will press Enter.
     - If the user types a non-numeric character other than `d` as the first character, display the string `Invalid input` on the second line of the LCD for 2 seconds and clear the second line.
     - From the second character onwards, if the user types a non-numeric character before pressing Enter, display the string `Invalid input` on the second line of the LCD for 2 seconds and clear the second line.
     - The above two points mean the state of the ATM can only be observed by pressing `d` before entering an amount.
     - If the user types a zero as the first character or presses Enter before entering an amount, display the string `Invalid input` on the second line of the LCD for 2 seconds and clear the second line.
     - If the user enters an amount which does not end in two zeros, display the string `Invalid input` on the second line of the LCD for 2 seconds and clear the second line.

- If the amount entered by the user can be dispensed with the notes available in the ATM, then display the string `Collect Cash` on the second line of the LCD and reduce the numbers of different denominations accordingly. Consider the following examples:
  - If the user enters 2000 as the amount and if a Rs 2000 note is available, then the number of Rs 2000 notes should be reduced by 1.
  - Suppose the user enters 2000 as the amount and no 2000 notes are available. However, four Rs 500 notes are available. Then the number of Rs 500 notes should be reduced by 4.
- After dispensing cash for a user, if the ATM has no notes of a given denomination then it should remove the denomination from the first row of the LCD.
- The ATM should always dispense notes of larger denomination whenever possible. For example, suppose the user enters Rs 700 as the amount to be dispensed.
  - The ATM should first try to dispense this amount as Rs 500 + Rs 200.
  - If there are no Rs 500 notes available, then the ATM should try to dispense this amount as 3 × Rs 200 + Rs 100.
  - If there are no Rs 500 notes available and only two Rs 200 notes are available, then the ATM should try to dispense this amount as 2 × Rs 200 + 3 × Rs 100.
  - If there are no Rs 500 or Rs 200 notes available, then the ATM should try to dispense this amount as 7 × Rs 100.
- If the amount entered by the user cannot be dispensed with the notes available in the ATM, then display the string `Try Again` on the second line of the LCD for 2 seconds and clear the second line.
  - For example, if the user enters amount 300 but there are no Rs 100 notes in the ATM, then this amount cannot be dispensed.
- When an amount cannot be dispensed, the number of notes in the ATM should remain unchanged.