

CS F241: Microprocessors Programming and Interfacing

# Cash Register

Design Project - Group 33

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# Contents

1. System Requirements and Technical Specifications.....	3
System Requirements.....	3
System Operation Details.....	4
2. Assumptions and Justifications.....	6
3. Components Used.....	7
4. Address Mapping(I/O and Memory).....	8
Memory Mapping.....	8
I/O Mapping.....	8
5. Design.....	9
6. Flow chart.....	10
7. Variations in Proteus Implementation with Justification.....	15
8. Firmware.....	16
9. List of Attachments.....	17

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# System Requirements and Technical Specifications

The system is a stand-alone 'Cash-Register' with inputs provided through a 'keyboard' and outputs displayed on a 'LCD'. The system gets power via a standard power outlet. It has a chargeable battery that is used as a battery back-up of the RAM. The battery charges itself when the system is on and has a life-time of 36 hours on full charge.

## SYSTEM REQUIREMENTS:

### KEYBOARD

Format of the keyboard is as below:

0	1	2	3	4	5	6	7	8	9	Y	N
Enter	Backspace	Cancel	Item No.	Quantity	Total						
Mode	Trans	Program	Add Item	Del Item	Cost						

### DISPLAY

The display is a 16x1 (16 characters on one line) Liquid Crystal Display connected to the microcontroller through a HD44780 display driver available with the LCD.

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## SYSTEM OPERATION DETAILS:

- The system is Interactive in nature
- The system is provided security by a hardware lock. Only when the lock is open the system is functional.
- The lock system comes with a key. When the key is turned, the lock circuit gives a TTL high output, else it gives a TTL low output.
- If the user presses a key on the keyboard when the lock is closed the system turns on a buzzer.
- At any point of time when the system is operational if the lock is closed the system must be disabled.
- A pulse of frequency 4 KHz turns on the buzzer. Buzzer is turned on for 1 Minute and then turned off.
- After the lock is open, the LCD is turned on and it displays “System Ready”.
- The user has to then press the “Mode” button on the keyboard. The LCD then displays “Select Mode”.
- The user can operate in any of the two modes “Transaction/Program.” Transaction is the normal function and in the Program Mode, the user is allowed to add new items and their cost.
- Every item has an item code and a cost associated with it.
- If the user presses the “Trans” key the system enters into transaction mode. The LCD displays “Enter Transaction Mode Y/N ?”.
- User then has to press Y to confirm. If the user presses N it goes back to Mode Select display.
- In the “Transaction” mode user is expected to enter the item code and the quantity. Item code has to be entered using the “Item No.” key followed by the item code. The item code can be entered with the help of the numeric keys “0-9”. At the end of the item code the user has to press the “Enter” key. The item code will be then displayed on the LCD.
- User can press the “Backspace” key to change the value of the last key press or he can press “Cancel” to delete the whole entry.

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- After the item code is displayed, the user has to enter the quantity by pressing the “Quantity” key followed by the quantity of the item (using the numeric keys) a person wishes to buy and the “Enter” key.
  - Automatically the total cost of the item will be displayed on the LCD.
  - The user can continue entering all the items and finally press “Total” to display the total cost.
  - In the “Program” mode user can add new items or delete an item. If the cost of an item is to be updated it has to first be deleted and re-added to the item list in memory.
  - When you add a new item you have to enter the item number by using the “Item no.” key and the cost using the “Cost” key. After the cost has been keyed in the user must press “Enter”.
  - The interactive display will confirm your entry before storing it in the memory.
  - If an item is to be deleted it is done using the “Del Item” key. Then the user is required to press the “Item No” key followed by the item code and then press “Enter”.
  - The interactive display will confirm your entry before deleting it from the memory.

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# Assumptions and Justification

**Assumption :** More than a hundred items won't be stored in the cash register.

**Justification :** Due to memory constraints.

**Assumption :** Item code and cost of an item cannot be greater than 4 digits.

**Justification :** While storing each entry in memory we assign two bytes for BCD and binary cost which corresponds to 4 digits.

**Assumption :** No item is free and item codes start from 0001.

**Justification :** While deleting an entry from memory, we replace the entry with zeroes.

**Assumption :** Max total cost possible is 65535.

**Justification:** While calculating total cost we store it using two bytes.

**Assumption :** User will enter exactly 4 digits for item no. and cost, and exactly 2 digits for quantity.

**Justification:** This makes the software/firmware implementation simpler.

**Assumption :** After entering the required no. of digits, the user will press enter(or backspace/cancel) and not enter extra digits.

**Justification:** Required constraint for proper implementation of Backspace/Cancel functionality.

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# Components Used

Component	Name	Number
8086	Microprocessor	1
74LS245	Buffer	4
74LS373	Latch	3
74LS138	3:8 Decoder	3
2732*	ROM-4k	4
6116	RAM-2k	2
8253	Programmable Timer	1
8255	Programmable Peripheral Interface	1
LM020L (HD44780)	16 x 1 LCD Display	1
Switches	Switches	26
Buzzer	Buzzer	1
7432	OR gate	4
7404	NOT gate	2
Battery	Battery	1

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# Address Mapping

## Memory Mapping

1. ROM1 : 00000H - 01FFFH
2. RAM1 : 02000H - 02FFFH
3. ROM2 : FE000H - FFFFFH

\*8KB of ROM used in beginning and since 2k chip not available in proteus

## I/O Mapping

1. 8255 : 00H , 02H, 04H, 06H
2. 8253 : 08H , 0AH, 0CH, 0EH



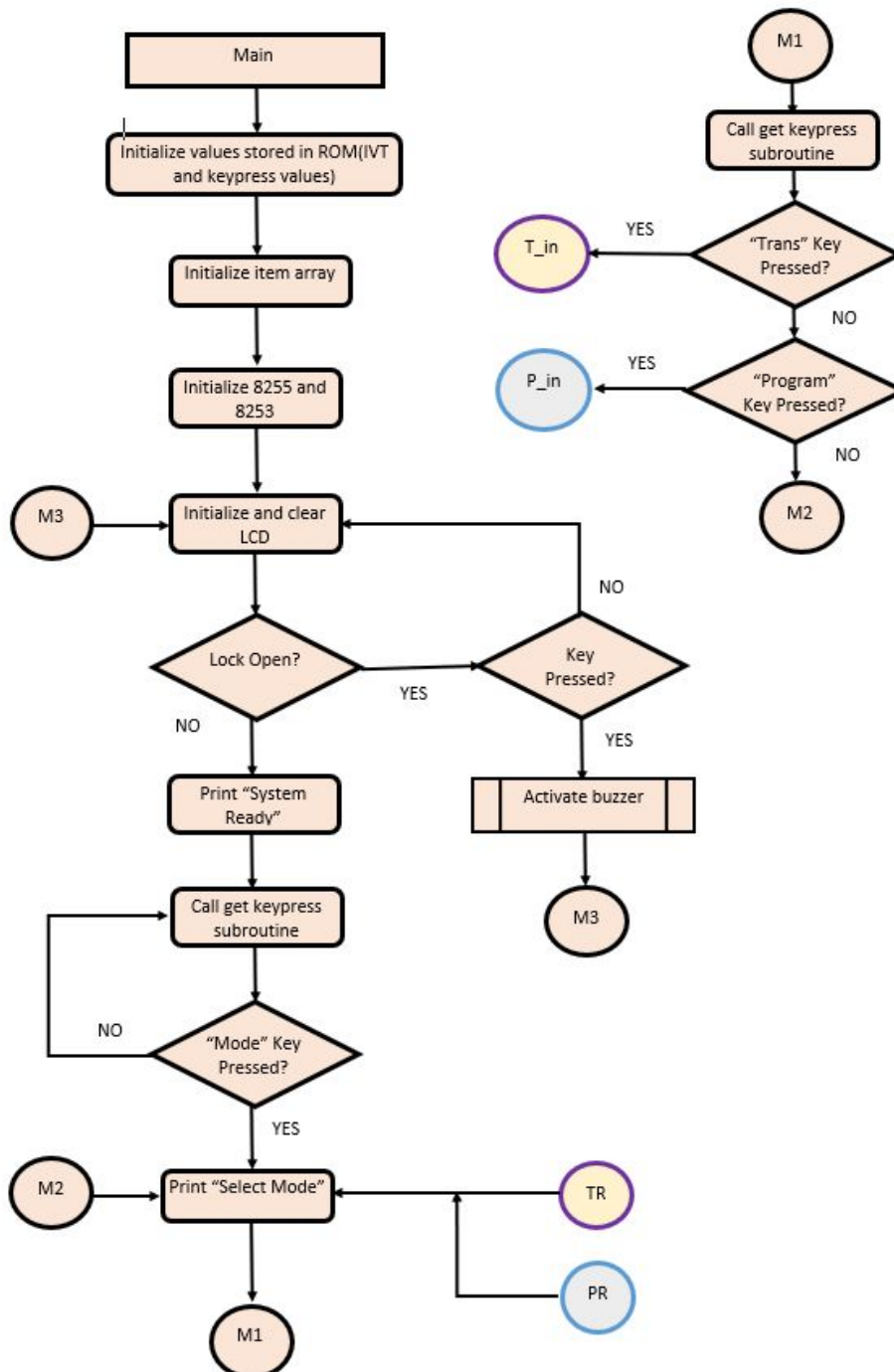
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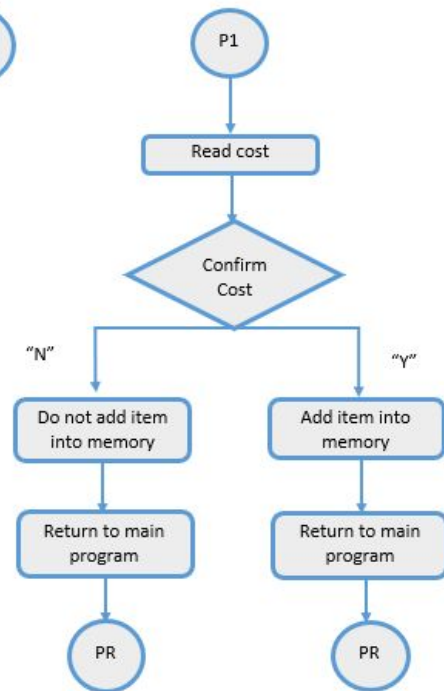
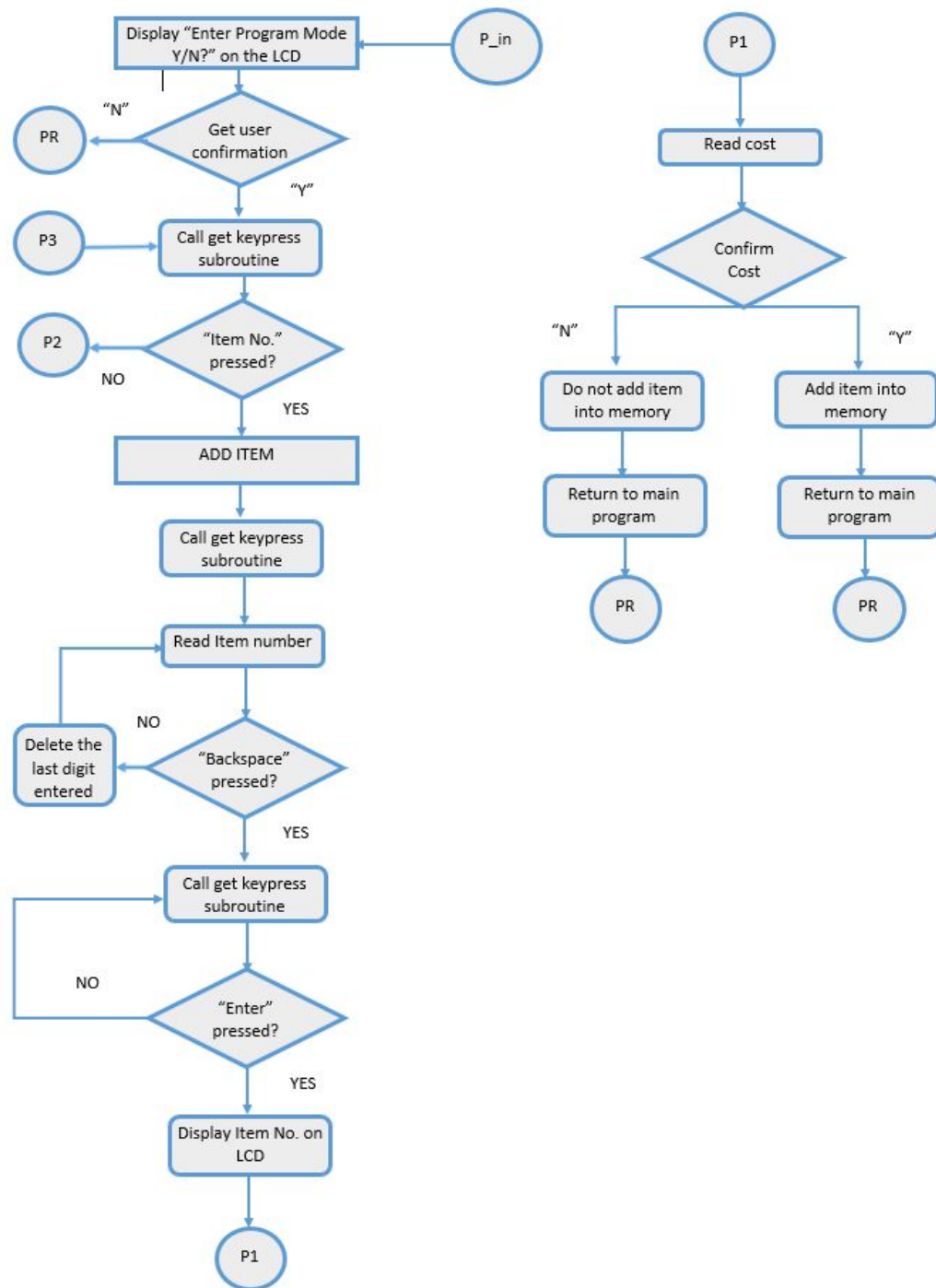
# Design

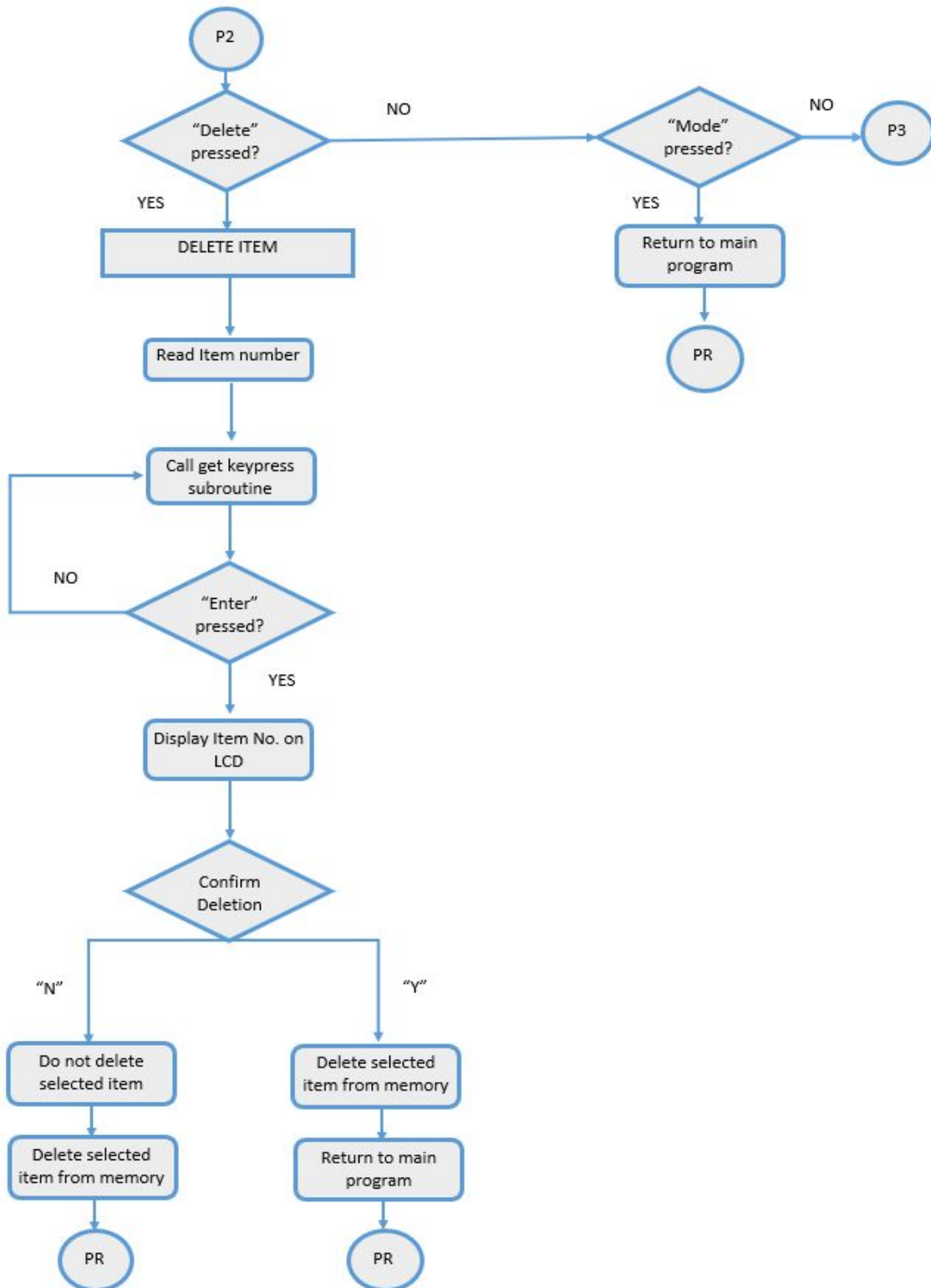
(Cash\_register hardware diagrams have been attached as a pdf file)

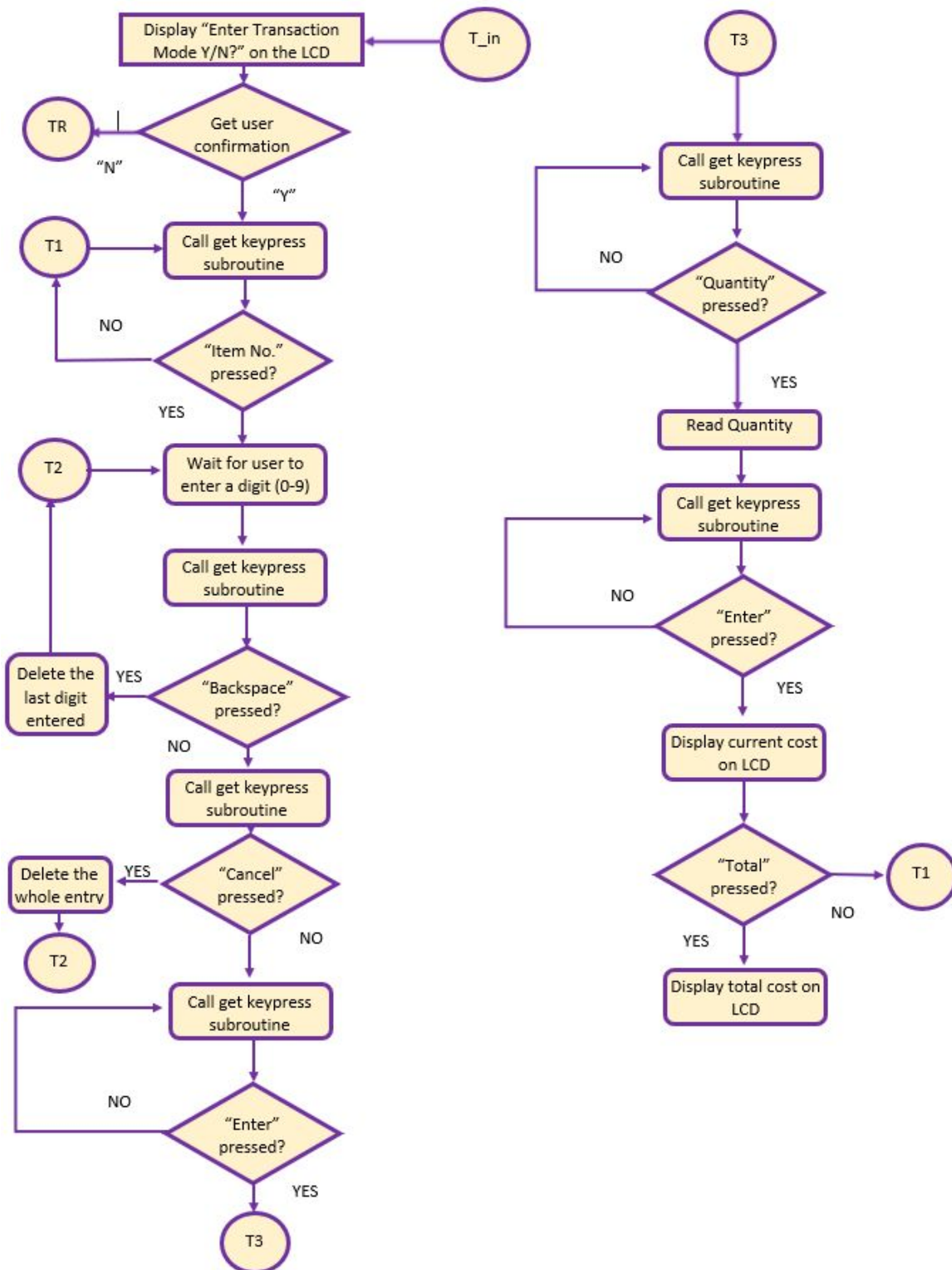
# Flowchart

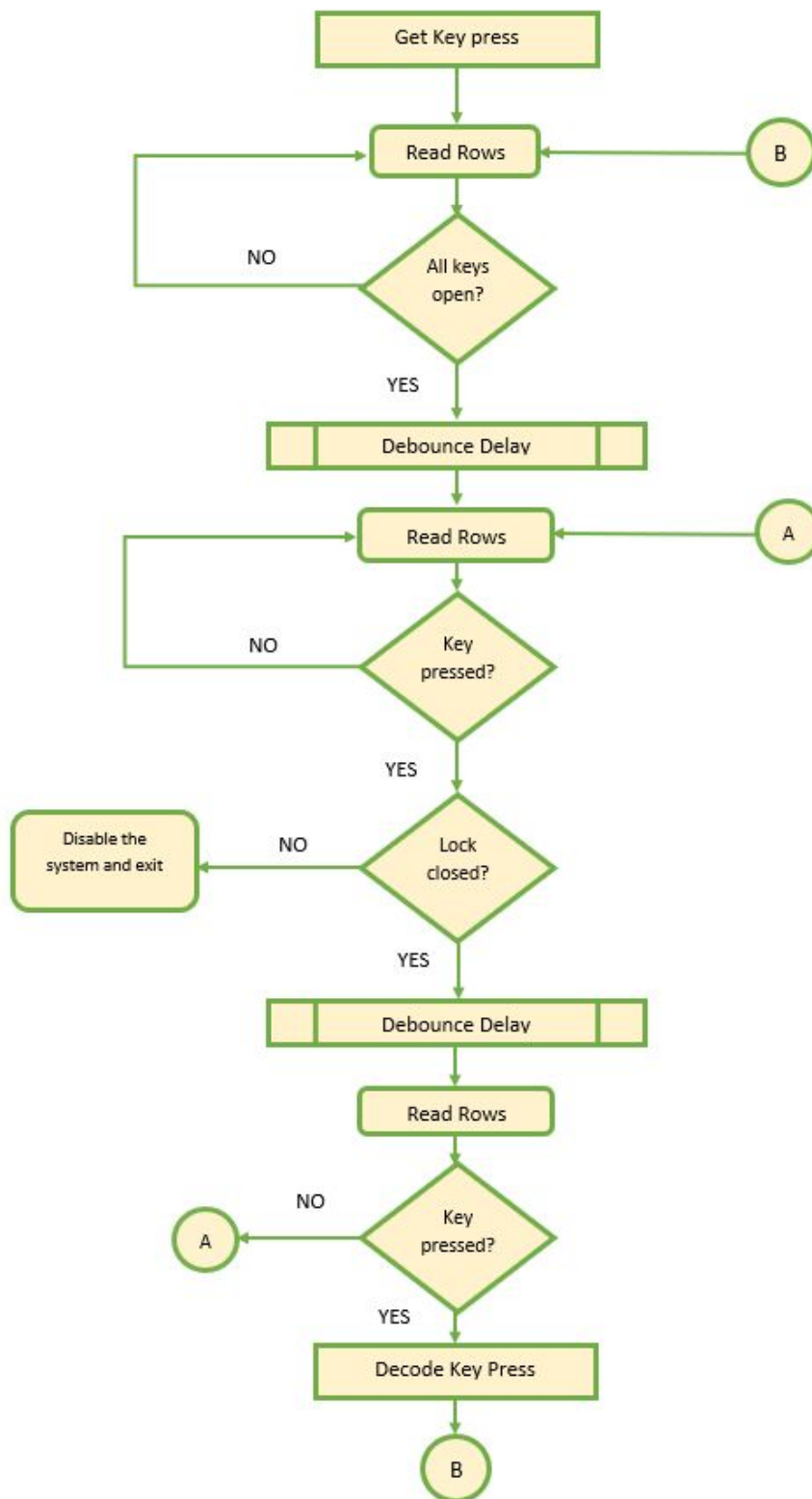
Main program followed by flowcharts for program mode subroutine, transaction mode subroutine and keypress subroutine











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# Variations in Proteus Implementation with Justification

- Used 2732(4 KB) instead 2716 (2KB) for ROM
- Battery not available in Proteus so omitted.
- 8284 chip model not available in Proteus so pulse generator is used.
- LM020 is used instead of HD44780

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# Firmware

(Cash\_Register\_code.asm file has been attached)



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# List Of Attachments

1. Proteus file (DSN file)
2. EMU 8086 ASM file (ASM file)
3. EMU 8086 BIN file (BIN file)
4. Hardware Design (PDF file)
5. Manuals
  - a. HD44780 (PDF)
  - b. LM020L (PDF)