A REPORT ON

# Electronic Voting Machine

*PREPARED FOR*

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By

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**In partial fulfillment of the requirement of**

**EEE F241: Microprocessor Programming and Interfacing**

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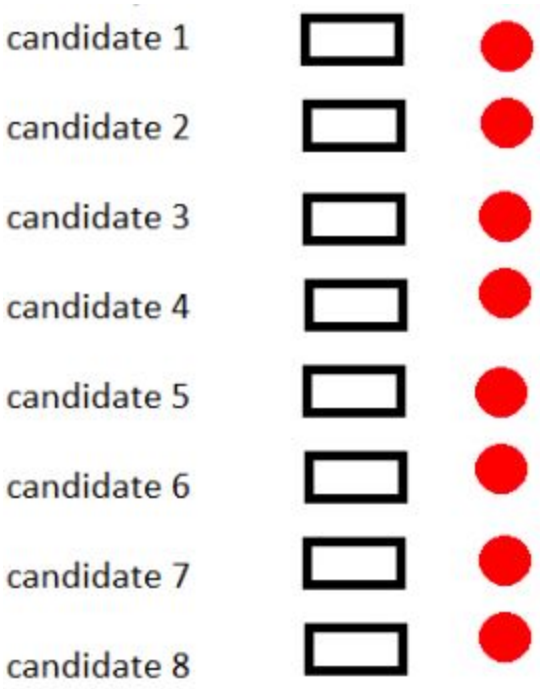
# Acknowledgments

We would like to show our gratitude to Prof. K.R. Anupama and the entire teaching staff of Microprocessor Programming and Interfacing for giving us this opportunity and facilitating extended understanding of the concepts by means of this design assignment.

## Problem Statement

Design a microprocessor Voting Machine which has provision for 8 candidates. It should keep the count of total votes polled and the count of votes polled for each candidate. Before being put in use, it should check if all memory locations allotted to candidates, and the total count are empty. If not, it should clear these as well as the display. There are two keypads, one for the polling officials and one for the voter. The Polling Officers Keypad also comes with a 16 character LCD Display. To put the voter keypad in use, it needs to be enabled by 8 polling agents and the Presiding officer. If anyone is missing it should not be enabled. This enabling is done using the polling officers' keypad. The polling officer's keypad has keys 0-9, backspace, enter, Poll count, Lock, Unlock, DisplayCount. Each polling agent and Presiding officer have a unique 5-digit numeric code. The system when turned on displays officer 1 on LCD. The polling officer then enters his numeric code. If correct then the n display is updated to officer 2 and so on and finally the Presiding officer enters his code. Each person is allowed 2 retries – if there is a failure the voting is blocked.

The voting interface for the user will be as follows




The name of candidate followed by button followed by LED. Voter will press the button against the candidate's name – the LED will glow for 2 seconds. After 10 hours (7 a.m. to 5 p.m.) it should stop taking input from voter There has to be a provision that the Presiding officer by pressing the Lock key followed by a 5-digit code can lock voting in between & then can restart it by pressing the Unlock key followed separate 5-digit code. For retrieving the count of each candidate the Presiding Officer presses the Poll Count key followed by a 5- digit code. The Presiding officer then enters the Candidates Number Followed by Display Count Key – The count for the candidate is displayed. This is done for all candidates.

## System Description

The system aims to count and store the votes of 8 different candidates with specifications as listed below.

1) The first keypad is for the polling officials

Eight polling agents and the Presiding Officer need to enter their unique 5-digit numeric code to enable the voter keypad. While each officer enters the code, a 1 line x 8 character LCD display will show 'Px' where x is the officer's number.

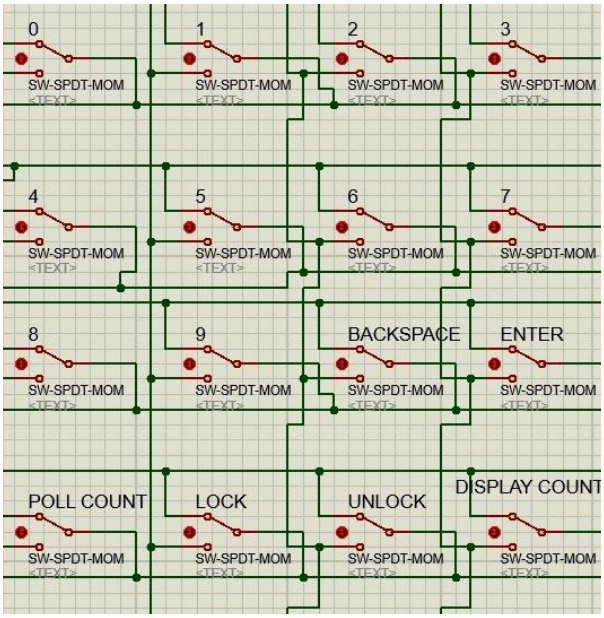



Fig.: The keypad for officers

Password for Officer 1 : 00000

Password for Officer 2 : 11111

Password for Officer 3: 22222

Password for Officer 4 : 33333

Password for Officer 5 : 44444

Password for Officer 6 : 55555

Password for Officer 7 : 66666

Password for Officer 8 : 77777

Password for Presiding officer : 88888

After the officers have entered their respective passwords correctly, the LCD will display 'Start Voting'.

2) When a voter presses the button against any candidate's name, the corresponding LED will glow for 2 seconds.

3) Special provision for the Presiding Officer:

a) LOCKING : Press lock key followed by 5-digit code of the Presiding officer - Can lock the machine.

b) UNLOCKING Press unlock key followed by 5-digit code of the Presiding officer - Can unlock the machine and resume voting after it has been unlocked.

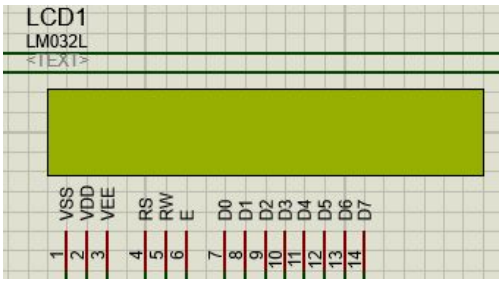



Fig. : LCD for officers

c) Presses poll count key followed by 5-digit code, followed by one candidate's number, followed by Display Count key - Count for that candidate is displayed on the LCD.

4) If any officer enters an incorrect password, that officer will be given two retries to enter the correct password. If after two retries the password entered is incorrect, an alarm will glow (Green alarm connected to Port B of second 8255A) along with the LCD displaying 'ALARM !' and the system will reset.

5) After 10 hours ( 7 am to 5 pm ), the system must stop taking input from the voter.

Crystal frequency : 15 MHz

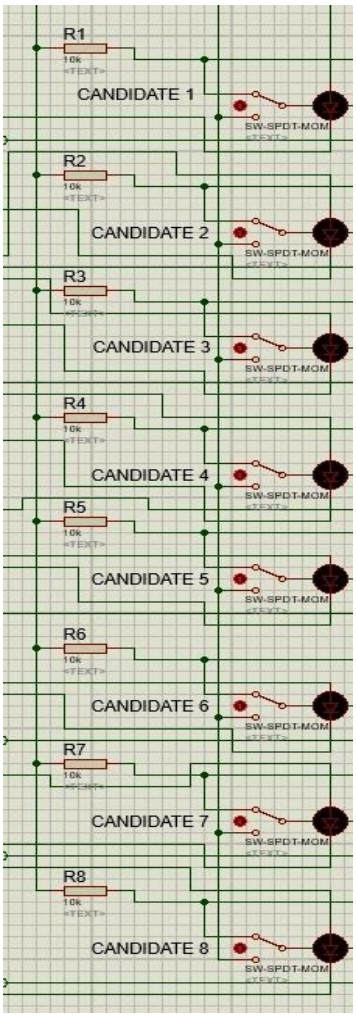
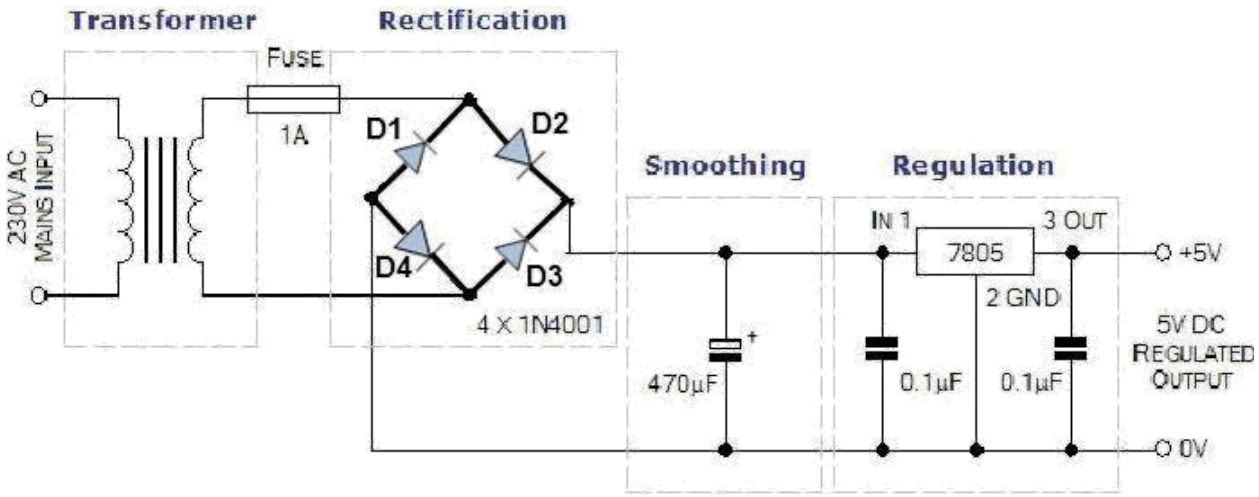



Fig.: The keypad for candidates

## Power Supply:

The 230V AC Mains is passed through a step-down transformer, rectifier and smoothing circuitry to give 5V DC Supply. This is used to power the microprocessor.

MX 5V Battery Backup is used to keep the system running even if the main power goes off. This is done to keep the 24-hour timer running always.



## Assumptions

1) When we reset, we expect the system to be set at 7 AM so that the time matches the exact time at which we start the Electronic Voting Machine.
2) Switches are pressed as required

    If entering a passcode only digits, Backspace and Enter keys are pressed.

    To check whether a password is correct or not, one would have to press the enter key.

    Voters wait at least 2 sec for the LED to switch off before voting.

3) Debounce time has been considered.
4) Passcode remains the same always. Can be changed only before initializing the machine.
5) Maximum votes are assumed to be less than 10000. As we used BCD counting using 1-byte we can take values up to 9999.

## Design Hardware

| S.no | Component Number | Description and Specification | Quantity |
|---|---|---|---|
| 1 | 8086 | 16-bit microprocessor chip | 1 |
| 2 | 8284 | Clock oscillator chip for supplying a clock signal to 8086 | 1 |
| 3 | 8253A | Programmable Interval Timer which performs timing And counting functions using 3 16-bit counters. | 1 |
| 4 | 8255A | Programmable input-output device consisting of 3 8-bit directional input-output ports (24 i/o ports) | 2 |
| 5 | 2732 | 4KB programmable memory EPROM chip | 4 |
| 6 | 6116 | 2KB programmable memory SRAM chip | 2 |
| 7 | 7432 | OR Gate | 4 |
| 8 | 7404 | NOT Gate | 5 |
| 9 | 74LS138 | 8x3 Decoder Chip | 3 |
| 10 | 74LS373 | Octal Latch with 3 outputs | 3 |
| 11 | 74LS245 | Octal Bus Transmitter/Receiver designed for 8-line asynchronous 2-way data communication between data buses | 2 |
| 12 | 74LS244 | Octal 3-state buffer | 1 |
| 13 | LED-RED | LEDs | 8 |
| 14 | LED-GREEN | LED | 1 |
| 15 | SW-SPDT | SPDT Momentary Switch | 25 |
| 16 | Resistors | 10k ohms, 1k ohms | 11 |
| 17 | LM020L | 16*2 LiquidCharacter Display | 1 |

## Memory Mapping

| | |
|---|---|
| $ROM_{1E}$ (4K chip) | $00000_H$ - $01FFE_H$ |
| $ROM_{1O}$ (4K chip) | $00001_H$ - $01FFF_H$ |
| $RAM_{1E}$ (2K chip) | $02000_H$ - $02FFE_H$ |
| $RAM_{1O}$ (2K chip) | $02001_H$ - $02FFF_H$ |
| $ROM_{2E}$ (4K chip) | $FE000_H$ - $FFFFE_H$ |
| $ROM_{2E}$ (4K chip) | $FE001_H$ - $FFFFF_H$ |

## I/O Mapping

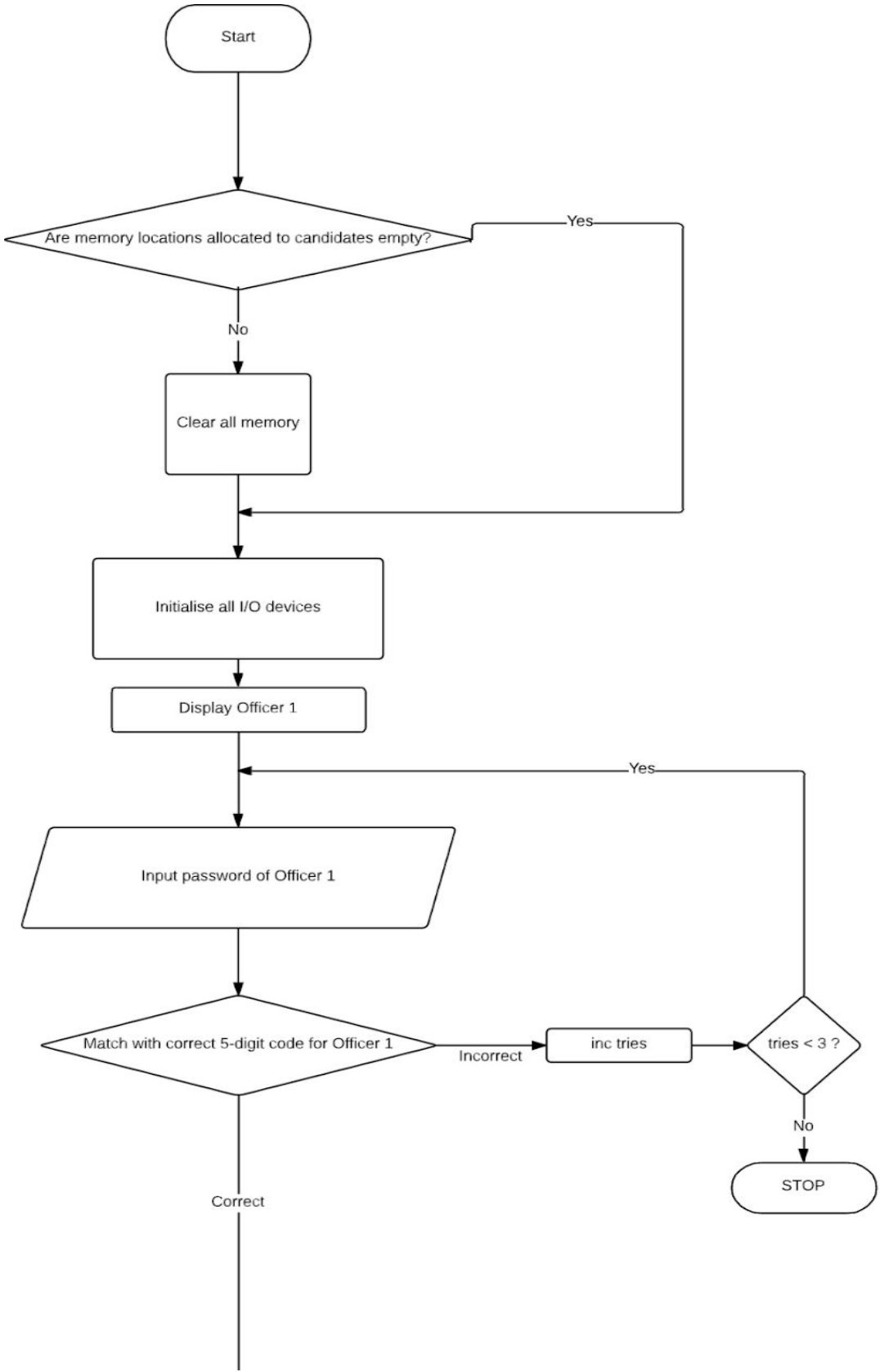
| | |
|---|---|
| $8255_{(1)}$ | $00_H$ - $06_H$ |
| $8255_{(2)}$ | $10_H$ - $16_H$ |
| 8253 | $30_H$ - $36_H$ |

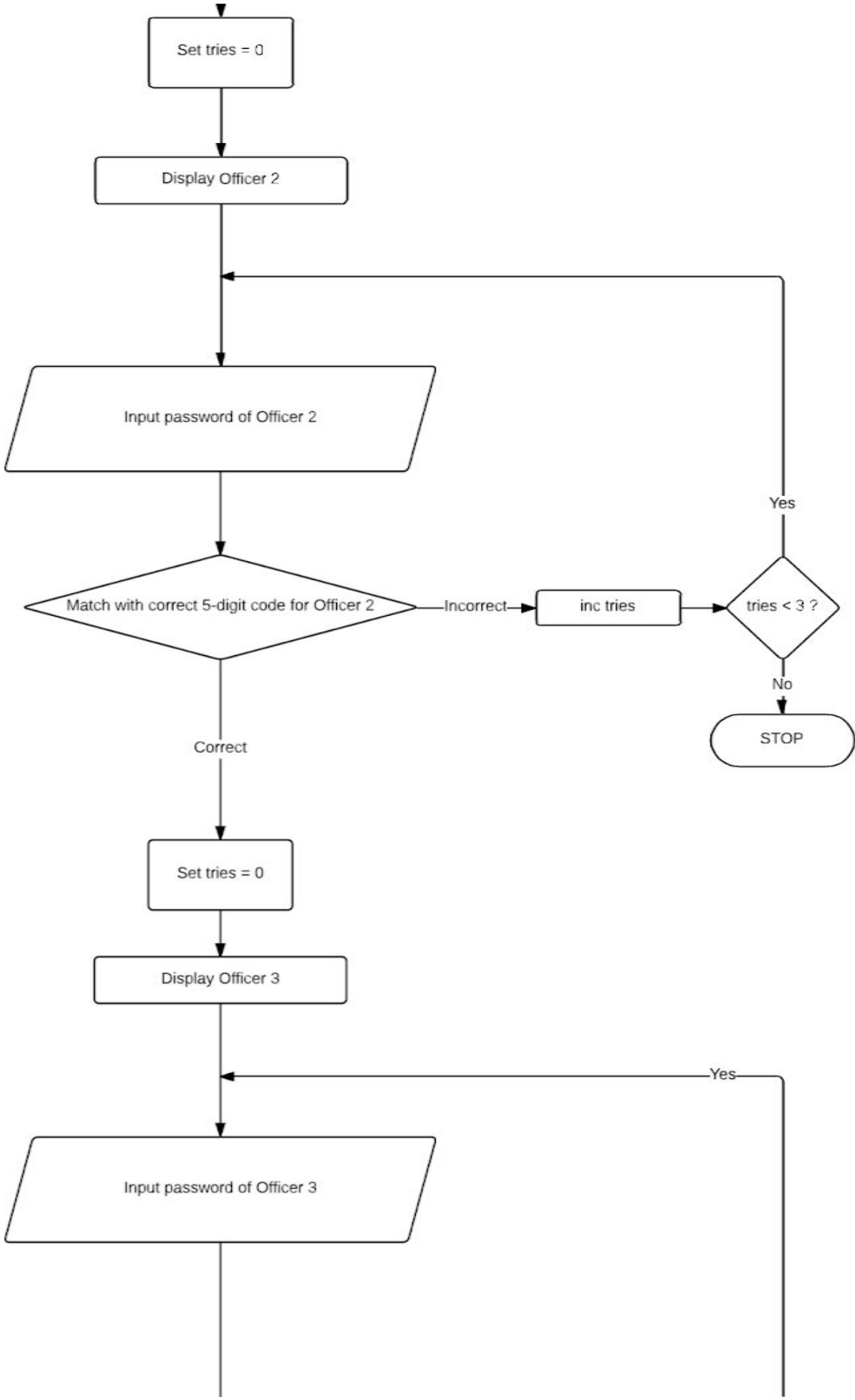
## Datasheets

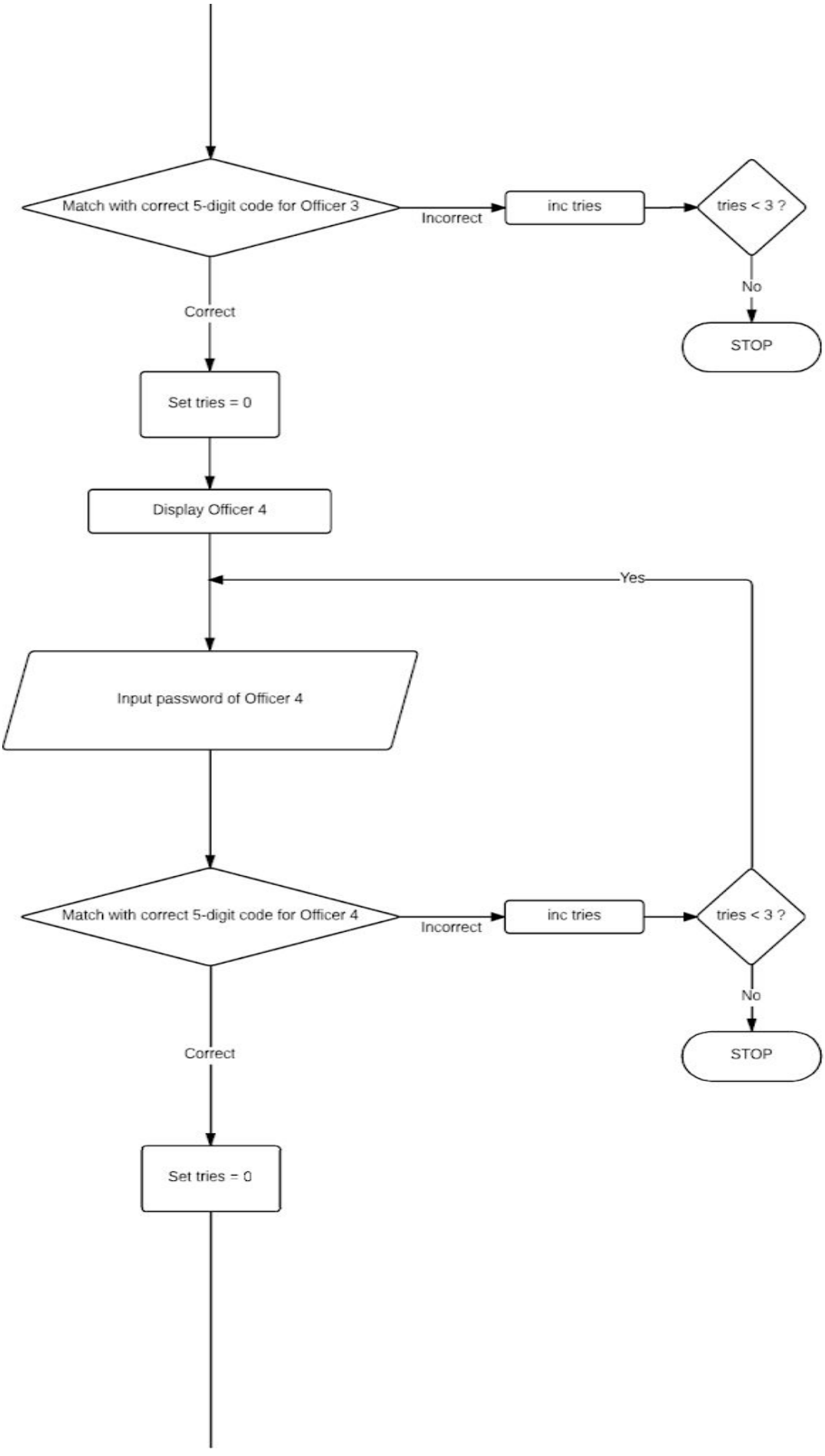
- **8086**
  - http://www.ece.cmu.edu/~ece740/f11/lib/exe/fetch.php?media=wiki:8086-datasheet.pdf
- **8284**
  - **http://pdf.datasheetcatalog.com/datasheets/185/155416_DS.pdf**
- **8253**
  - http://www.cpcwiki.eu/imgs/e/e3/8253.pdf
- **8255**
  - https://www.csee.umbc.edu/~cpatel2/links/310/data_sheets/8255.pdf
- **2732**
  - https://edge.edx.org/c4x/BITSPilani/EEE231/asset/2716_EPROM.pdf
- **6116**
  - http://www.princeton.edu/~mae412/HANDOUTS/Datasheets/6116.pdf
- **74LS373**
  - http://ecee.colorado.edu/~mcclurel/sn74ls373rev5.pdf
- **74LS245**
  - http://ecee.colorado.edu/~mcclurel/sn74ls245rev5.pdf
- **74LS244**
  - https://www3.amherst.edu/~sfkaplan/courses/2002/spring/cs14/74LS244-datasheet.pdf
- **74LS138**
  - http://www.ti.com/lit/ds/symlink/sn74ls138.pdf
- **LM020L**
  - http://www.datasheetspdf.com/datasheet/LM020L.html
  - https://mil.ufl.edu/3744/docs/lcdmanual/commands.html
- **7408**
  - https://www.jameco.com/jameco/products/prodds/49146.pdf
- **7432**
  - http://ee-classes.usc.edu/ee459/library/datasheets/DM74LS32.pdf
- **7404**
  - https://www.electroschematics.com/wp-content/uploads/2013/07/dm7404-datasheet.pdf

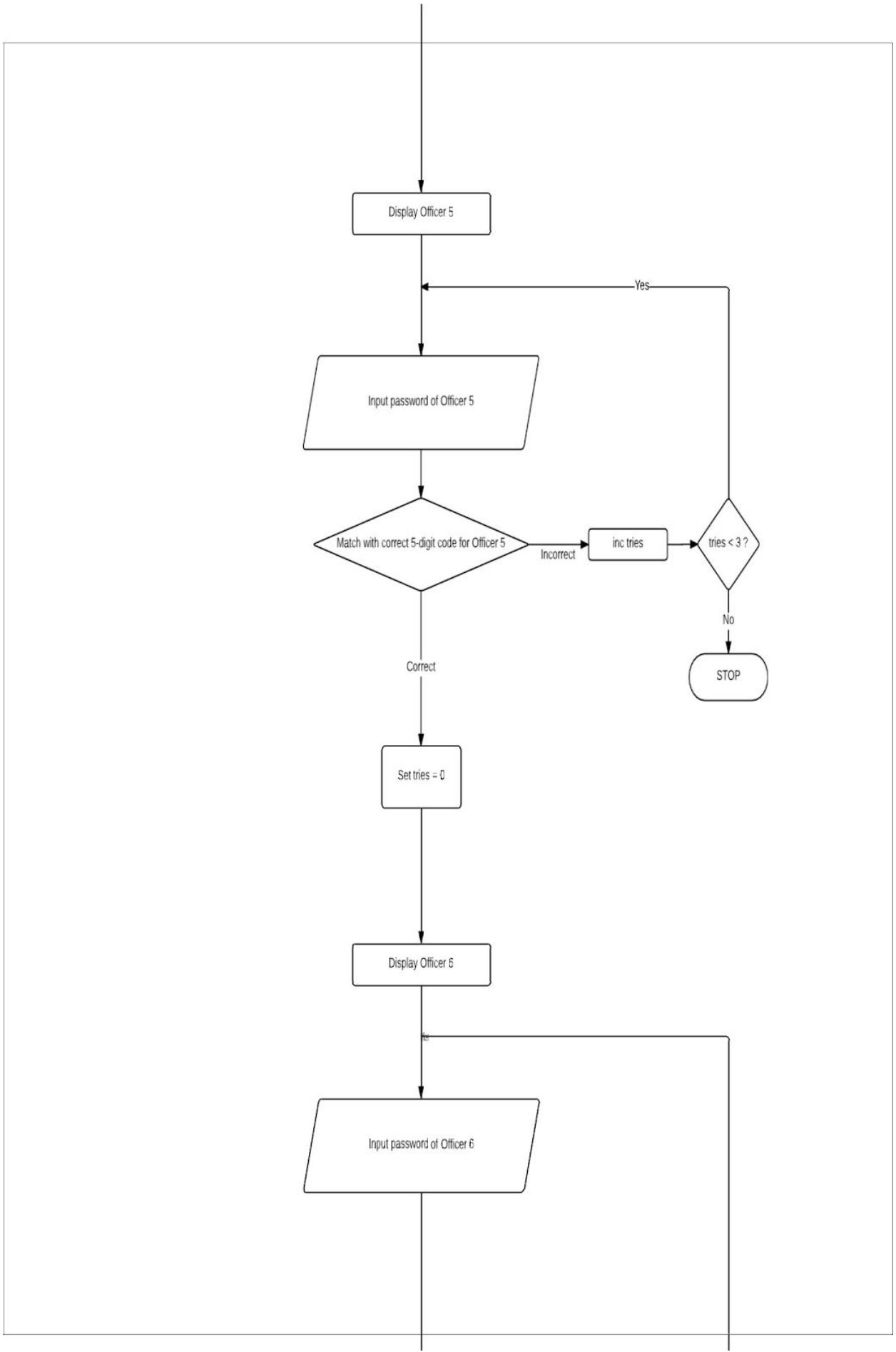
# Algorithm

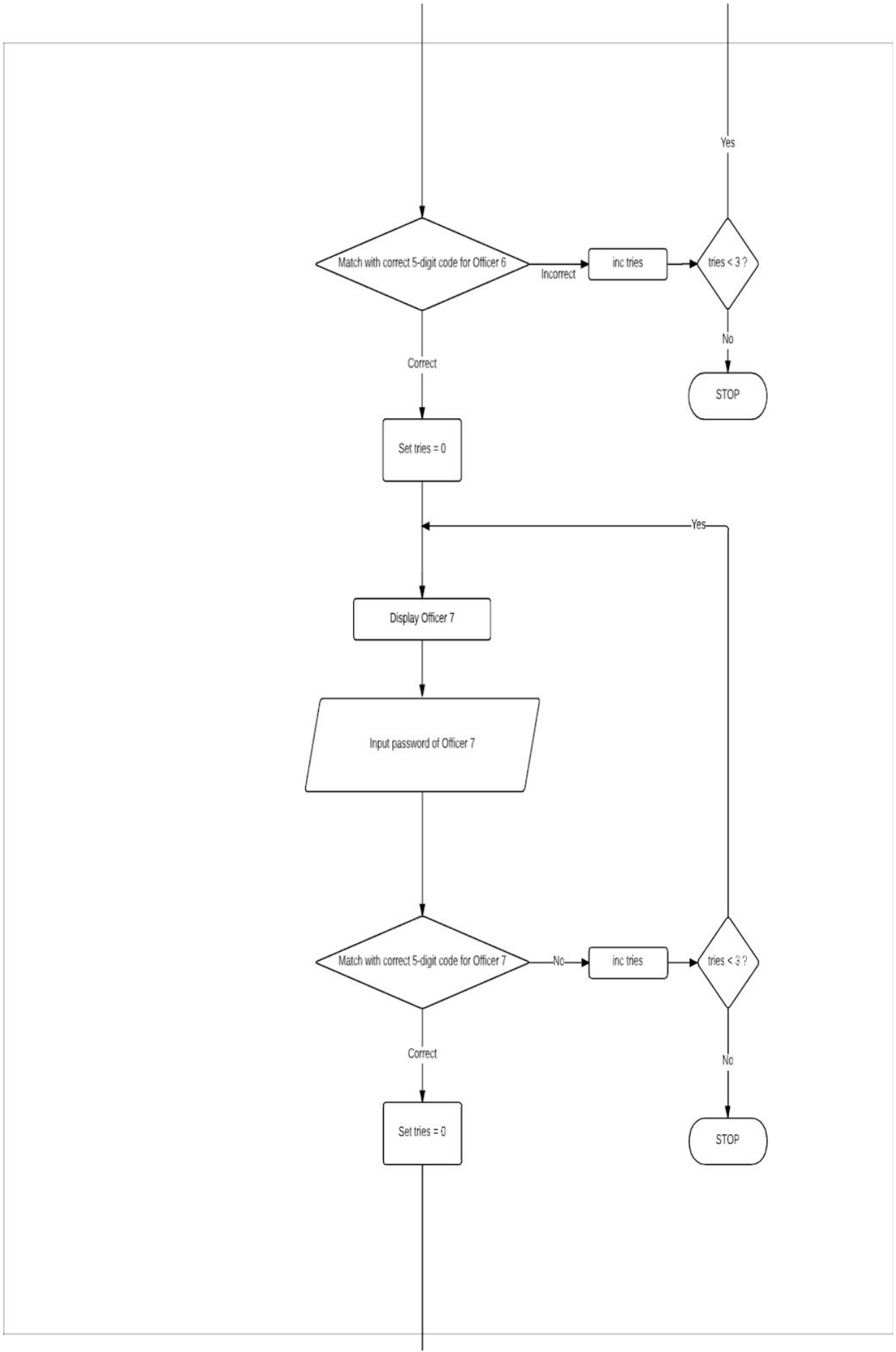
## Flowchart

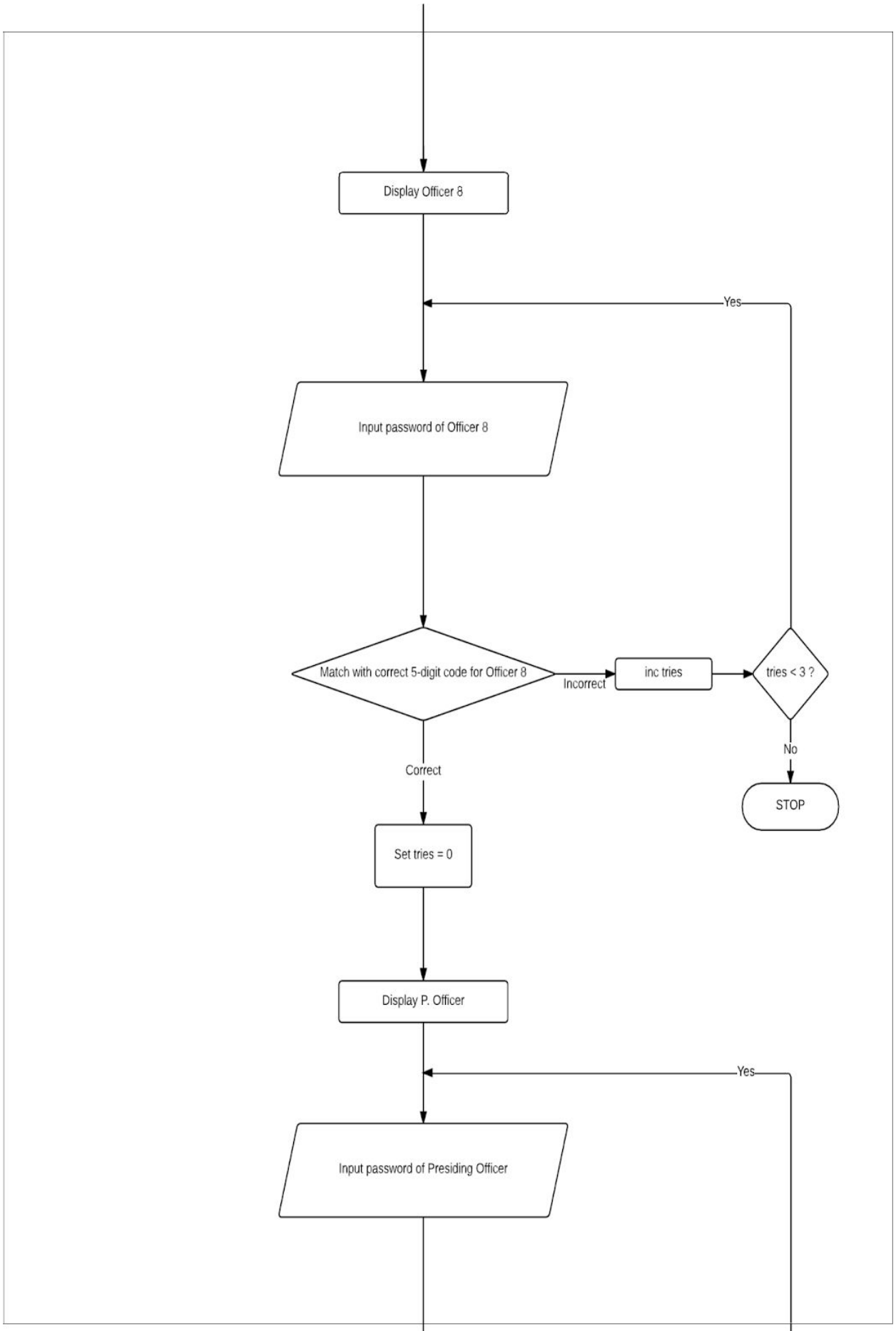


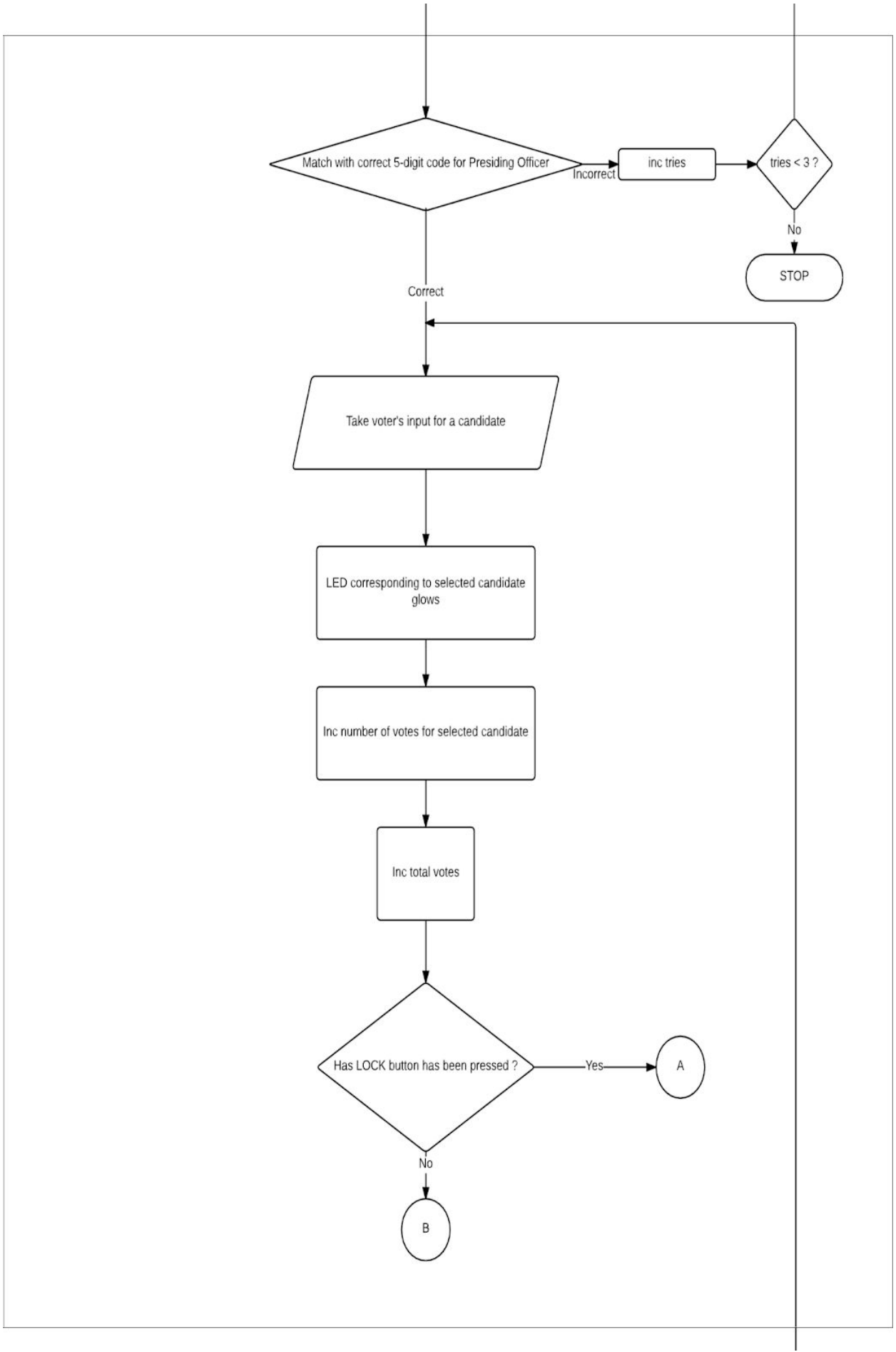

Set tries = 0
Display Officer 2
Input password of Officer 2
Match with correct 5-digit code for Officer 2
Incorrect
inc tries
tries < 3 ?
Yes
No
STOP
Correct
Set tries = 0
Display Officer 3
Yes
Input password of Officer 3

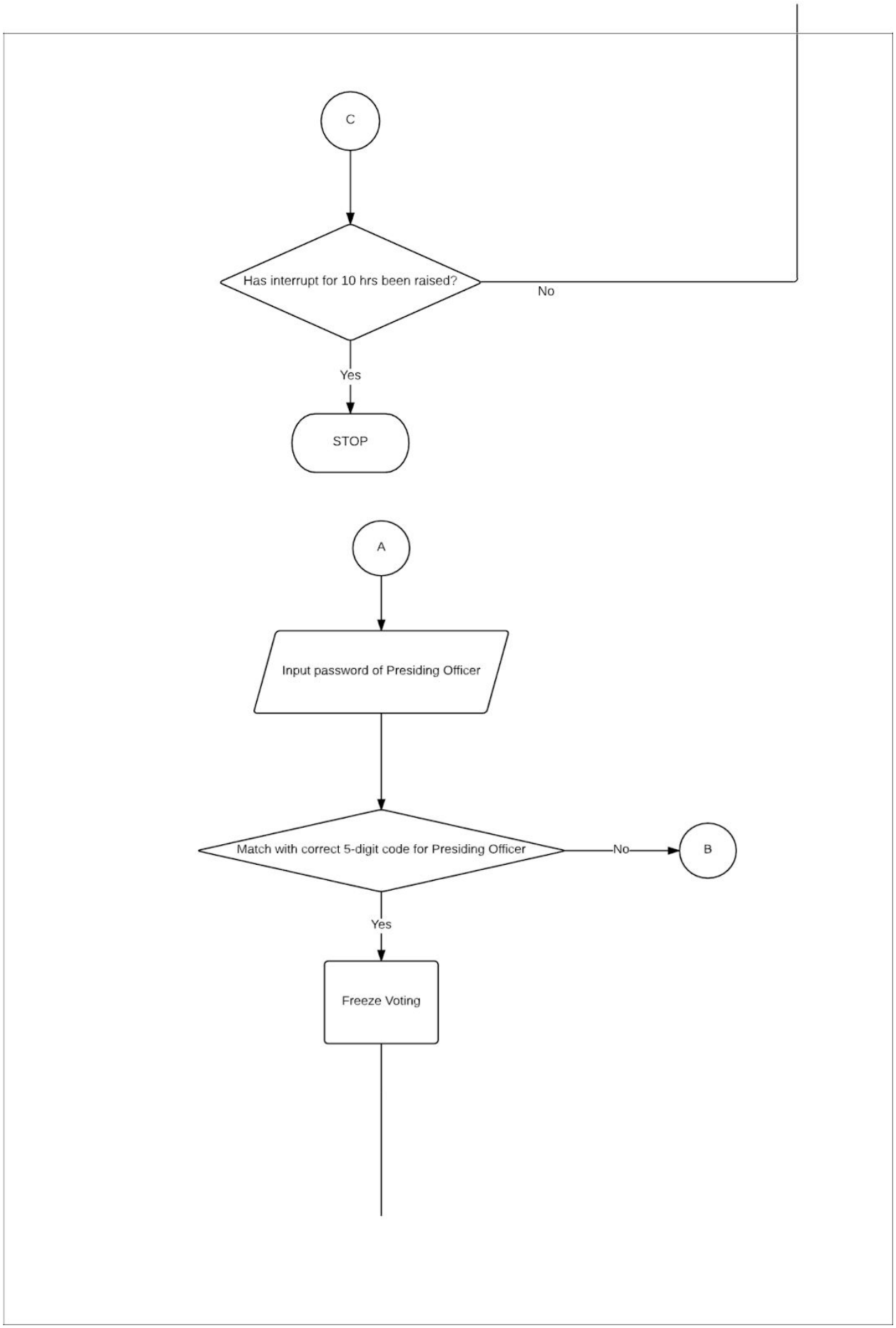

Match with correct 5-digit code for Officer 3
Incorrect
inc tries
tries < 3 ?
No
STOP
Correct
Set tries = 0
Display Officer 4
Yes
Input password of Officer 4
Match with correct 5-digit code for Officer 4
Incorrect
inc tries
tries < 3 ?
No
STOP
Correct
Set tries = 0

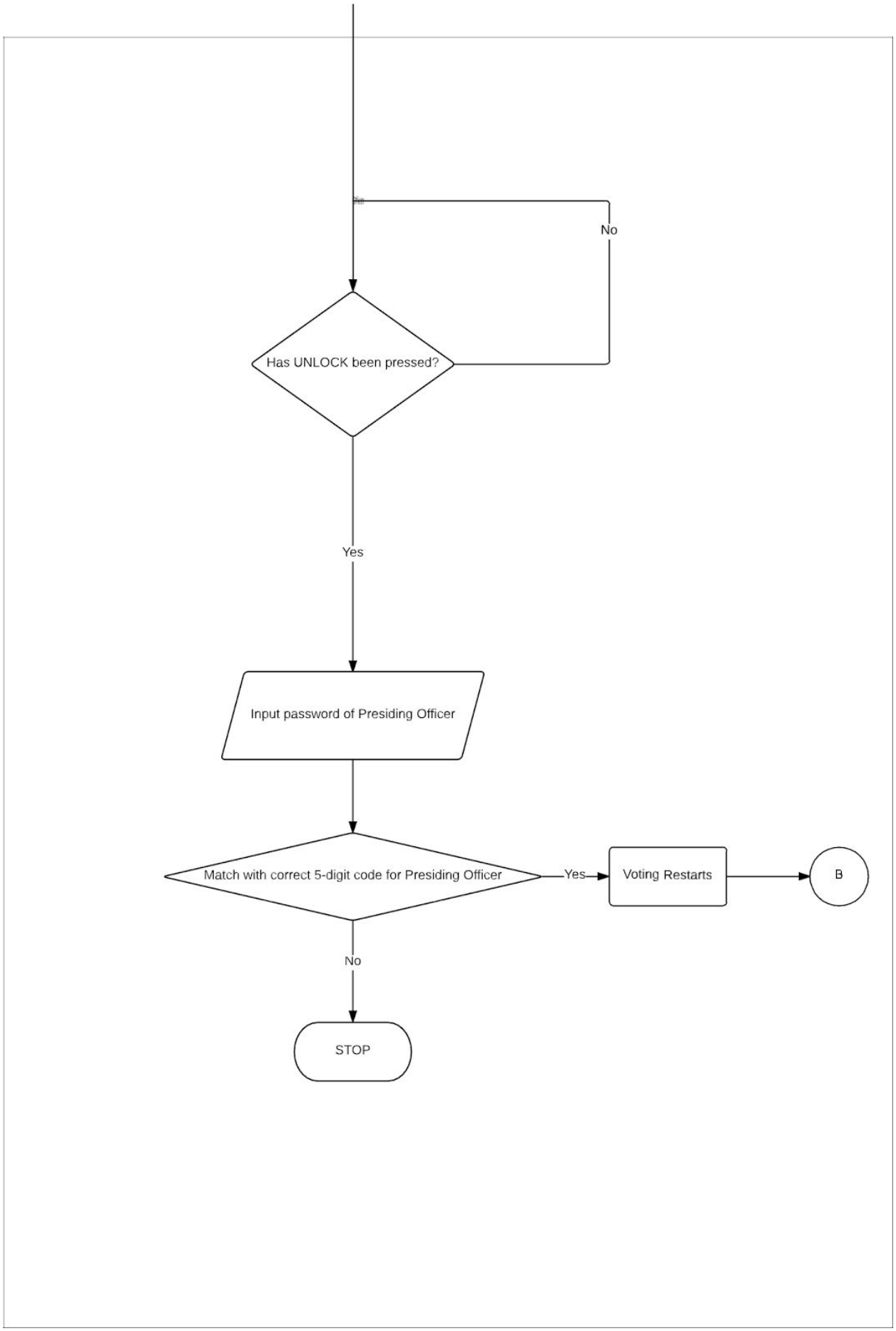

Display Officer 5
Yes
Input password of Officer 5
Match with correct 5-digit code for Officer 5
Incorrect
inc tries
tries < 3 ?
No
STOP
Correct
Set tries = 0
Display Officer 6
Input password of Officer 6

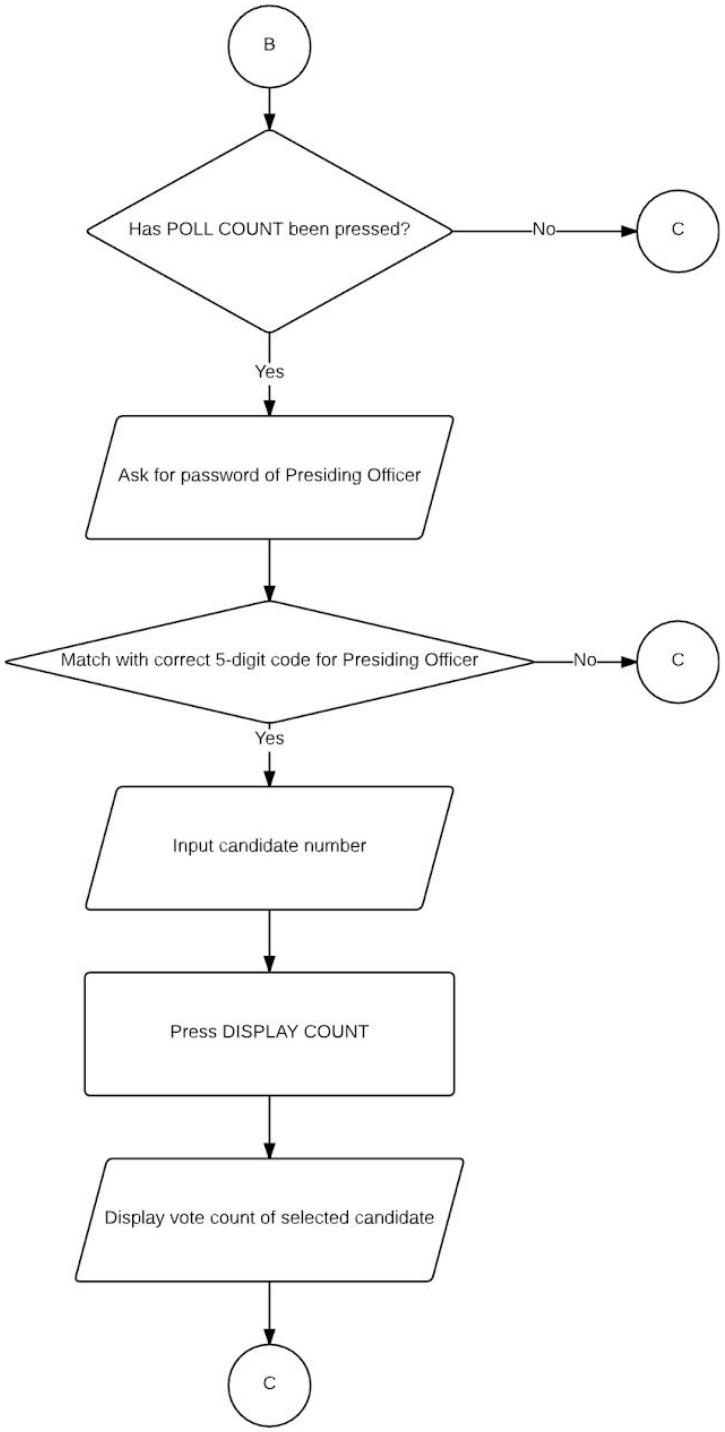

Yes
Match with correct 5-digit code for Officer 6
Incorrect
inc tries
tries < 3 ?
No
Correct
STOP
Set tries = 0
Yes
Display Officer 7
Input password of Officer 7
Match with correct 5-digit code for Officer 7
No
inc tries
tries < 3 ?
Correct
No
Set tries = 0
STOP


Display Officer 8
Yes
Input password of Officer 8
Match with correct 5-digit code for Officer 8
Incorrect
inc tries
tries < 3 ?
No
STOP
Correct
Set tries = 0
Display P. Officer
Yes
Input password of Presiding Officer


Match with correct 5-digit code for Presiding Officer
Incorrect
inc tries
tries < 3 ?
No
STOP
Correct
Take voter's input for a candidate
LED corresponding to selected candidate glows
Inc number of votes for selected candidate
Inc total votes
Has LOCK button has been pressed ?
Yes
A
No
B


C
Has interrupt for 10 hrs been raised?
No
Yes
STOP
A
Input password of Presiding Officer
Match with correct 5-digit code for Presiding Officer
No
B
Yes
Freeze Voting


No
Has UNLOCK been pressed?
Yes
Input password of Presiding Officer
Match with correct 5-digit code for Presiding Officer
Yes
Voting Restarts
B
No
STOP


B
Has POLL COUNT been pressed?
No
C
Yes
Ask for password of Presiding Officer
Match with correct 5-digit code for Presiding Officer
No
C
Yes
Input candidate number
Press DISPLAY COUNT
Display vote count of selected candidate
C

## Interfacing Procedure

- We first start with I/O Interfacing
- We will use **I/O Mapped I/O Interfacing** along with **Fixed Addressing**
- Clock signal is sent to 8086 microprocessor from external clock generator 8284.
- 8284 has internal divide by 3 counter circuit and a further divide by 2 counter circuit
- So a crystal of 15MHz is given to 8284, which then gives out 5MHz as CLK signal and 2.5MHz as PCLK signal.
- Now CLK is given as a clock to the 8086 microprocessor.
- 8253 takes 2.5MHz and using all 3 counters of 8253, we run the EVM for 10 hours.
- Buffers (74LS245) are connected to system buses to boost the strength of signals during transmission
- We will interface the 8086 to I/O devices using latches (74LS373). This is because the data provided by the microprocessor is available for a short time (in ns), data must be latched else it will be lost.
- The chip select for the I/O devices is done through a 3x8 Decoder
- (74LS138) with M/IO' as one of the enabled signals. The two 8255s receive appropriate chip selects through this decoding logic.
- First 8255 works in I/O Mode with Port A acting as output in Mode 0, Port B as input in Mode 0.
- Port C (PC0-PC7) of the first 8255A is Connected to 8 LEDs to lit up for 2 seconds every time the corresponding Candidate gets a vote
- Second 8255 is also given the same initialization. Port A is now connected to the data line of LCD and C7-C5 is connected to R/W, RS, E of LCD while PA0-PA7 (Port A) are connected to D0-D7 of the LCD, respectively.

**While initializing LCD:**

**Function Setting** - setting to 8 bit operation and 1 line. Here RS, R/W, D6-D7 bits of LED are set to 0, while making D5 bit and D4 (data length) equal to 1, D3 (set no. of lines) and D2 (data font) equal to 0, D0 and D1 are don't care and then make the E bit of LCD to toggle from 1 to 0.

To set display on- Here RS, R/W, D4-D7 bits of LED are set to 0, while making D3 bit equal to 1, D2 (set on display) and D1 (show cursor) equal to 1, D0 (blink) equal to 0 and then make the E bit of LCD to toggle from 1 to 0.

**Entry mode set** - setting address to increment by 1 and display shifting enabled. Here RS, R/W, D3-D7 bits of LED are set to 0, while making D0 (shift) bit equal to 0, D1 (increment/decrement) bit equal to 1, D2 bit equal to 1 and then make the E bit of LCD to toggle from 1 to 0.

**To Write** - We make RS equal to 1 and then make the E bit of LCD to toggle from 1 to 0.

**To clear Display**- RS, R/W, D1-D6 bits of LED are set to 0, while making D0 bit equal to 1, and then make the E bit of LCD to toggle from 1 to 0.

- We use 8253 as a programmable timer device to run for a period of 10 hours from 7AM to 5 PM and stop the voting system by raising an interrupt in Mode 2. We can directly use the 2.5 MHz from PCLK of 8284 rather than 5 MHz since, if we were to double frequency we would have to double the count which could probably have crossed the 16-bit maximum value. The maximum frequency of 8253 is 2.6MHz, so we can use 8253 practically.
- Memory interfacing is done using **Absolute Addressing**
- We use 8K of ROM starting at 00000h as IVT is stored in this location and also 8K of ROM at FE000h since on reset the first execution is executed from FFFF0h
- The memory to be stored is done in 4K of RAM starting from 01000h We use 4 of 2732 (4K ROM) and 2 of 6116 (2K RAM)

## References


- Anupama, K. R. 2019 *I/O Interfacing - The Basics,* lecture PowerPoint slides
- Brey, B. 2009, *The Intel Microprocessors,* Dorling Kindersley (India)


## Firmware

Implemented using emu8086 attached

*Please run the project file evm.pdsprj using only **Proteus 8**

## List of Attachments

1. Complete Hardware Real World Design - evm.pptx
2. Manuals
    a. LM020L_Hitachi (LCD 16x02 Display)
3. Proteus 8 File - evm.pdsprj ( Design file ROOT.dsn in folder evm1 )
4. EMU8086 ASM File - evm.bin~asm
5. Binary file - evm.bin