

## Final Project

### System Requirements

Implement the **Door Locker Security System** to unlock a door using a password.

with the specifications listed below:

- 1) Use two **ATmega32** Microcontrollers with frequency **8Mhz**.
- 2) The project should be design and implemented based on the layered architecture model as follow:

**Mc1** → **HMI\_ECU (Human Machine Interface)** with 2x16 LCD and 4x4 keypad.



**Mc2** → **Control\_ECU** with EEPROM, Buzzer, and Dc-Motor.



3) **HMI\_ECU** is just responsible interaction with the user just take inputs through keypad and display messages on the LCD.

4) **CONTROL\_ECU** is responsible for all the processing and decisions in the system like password checking, open the door and activate the system alarm.

### 5) System Sequence:

#### Step1 – Create a System Password

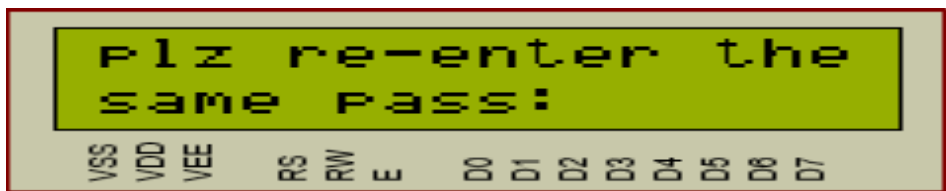
- The LCD should display “Please Enter Password” like that:



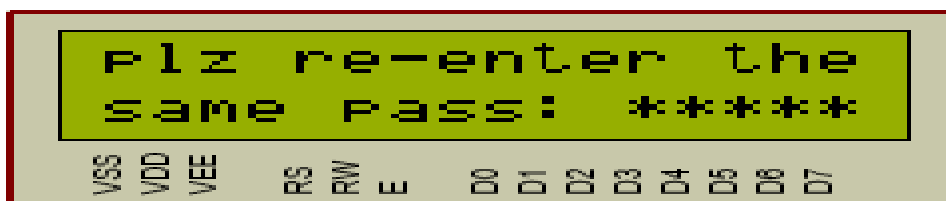
- Enter a password consists of 5 numbers, Display \* in the screen for each number.



- Press **enter** button (choose any button in the keypad as enter button).
- Ask the user to reenter the same password for confirmation by display this message “Please re-enter the same Pass”:



- Enter a password consists of 5 numbers, Display \* in the screen for each number.
- Press **enter** button (choose any button in the keypad as enter button).



- **HMI\_ECU** should send the two passwords to the **Control\_ECU** through the **UART**.

- If the two passwords are **matched** then the system has a password now and save it inside the **EEPROM** and go to **Step 2**.
- If the two passwords are **unmatched** then repeat **step 1** again.

### Step2 - Main Options

- The LCD will always display the main system option:



### Step3 - Open Door +

- The LCD should display "Please Enter Password" like that:



- Enter the password then press **enter** button (choose any button in the keypad as enter button).
- **HMI\_ECU** should send the Password to the **Control\_ECU** and it should compare it with the one saved in the **EEPROM**.
- if two passwords are **matched**:
  - **rotates** motor for 15-seconds **CW** and display a message on the screen "Door is Unlocking"
  - hold the motor for 3-seconds.
  - **rotates** motor for 15-seconds **A-CW** and display a message on the screen "Door is Locking"

#### Step 4 - Change Password -

- The LCD should display "Please Enter Password" like that:



- Enter the password then press **enter** button (choose any button in the keypad as enter button).
- **HMI\_ECU** should send the Password to the **Control\_ECU** and it should compare it with the one saved in the **EEPROM**.
- if two passwords are matched:
  - Repeat Step 1.

#### Step 5

- if the two passwords are **unmatched** at step 3 (+ : Open Door) or step 4 (- : Change Password)
- Ask the user one more time for the password.
- The LCD should display "Please Enter Password" like that:



- Enter the password then press **enter** button (choose any button in the keypad as enter button).
- **HMI\_ECU** should send the password to the **Control\_ECU** and it should compare it with the one saved in the **EEPROM**.
- if two passwords are matched then open the door or change the password in steps 3 and 4.
- If the two passwords are **not matched** again then ask the user **one last time** for the password.
- if two passwords are matched then open the door or change the password in steps 3 and 4.

- If the two passwords are not matched for the **third consecutive** time, then:
  - Activate Buzzer for 1-minute.
  - Display error message on LCD for 1 minute.
  - System should be locked no inputs from Keypad will be accepted during this time period.
  - Go to Step 2 the main options again.

## GPIO Driver Requirements

1. Use the Same GPIO driver implemented in the course.
2. Same driver should be used in the two ECUs.

## LCD Driver Requirements

1. Use a 2x16 LCD.
2. Use the Same LCD driver implemented in the course with 8-bits or 4-bits data mode.
3. Connect the LCD control and data bus pins to any pins of your choice in the MCU.
4. LCD should be connected to the **HMI\_ECU**.

## Keypad Driver Requirements

1. Use a **4x4 Keypad**.
2. Connect the Keypad pins to any pins of your choice in the MCU.
3. Keypad should be connected to the **HMI\_ECU**.

## DC\_Motor Driver Requirements

1. Use the Same **DC\_Motor** driver implemented in the fan controller project.
2. Motor should always run with the maximum speed using **Timer0 PWM**.
3. Motor should be connected to the **CONTROL\_ECU**.
4. Connect the Motor pins to any pins of your choice in the MCU.

## EEPROM Driver Requirements

1. Use the Same **external EEPROM** driver controller by the I2C.
2. EEPROM should be connected to the **CONTROL\_ECU**.

## I2C Driver Requirements

1. Use the Same I2C driver implemented in the course.
2. I2C driver will be used in the **CONTROL\_ECU** to communicate with the external EEPROM.
3. You need to modify the **TWI\_init** function implemented in the I2C session to take a pointer to the configuration structure with type **TWI\_ConfigType**.
4. The function declaration should be:

```
void TWI_init(const TWI_ConfigType * Config_Ptr)
```

5. The **TWI\_ConfigType** structure should be declared like that:

```
typedef struct{  
    TWI_Address address;  
    TWI_BaudRate bit_rate;  
}TWI_ConfigType;
```

The **TWI\_Address** and **TWI\_BaudRate** are types defined as **uint8/uint16/uint32** or **enum**.

## UART Driver Requirements

1. Use the Same UART driver implemented in the course.
2. Same driver should be used in the two ECUs.
3. You need to modify the **UART\_init** function implemented in the UART session to take a pointer to the configuration structure with type **UART\_ConfigType**.
4. The function declaration should be:

```
void UART_init(const UART_ConfigType * Config_Ptr)
```

5. The **UART\_ConfigType** structure should be declared like that:

```
typedef struct{  
    UART_BitData bit_data;  
    UART_Parity parity;  
    UART_StopBit stop-bit;  
    UART_BaudRate baud-rate;  
}UART_ConfigType;
```

The **UART\_BitData**, **UART\_Parity**, **UART\_StopBit**, and **UART\_BaudRate** are types defined as **uint8/uint16/uint32** or **enum**.

## Timer Driver Requirements

1. Same driver should be used in the two ECUs.
2. In the **HMI\_ECU** to count the displaying messages time on the LCD while opening/closing the door. In the **CONTROL\_ECU** to count the time for controlling the motor.
3. Implement a full Timer driver for **TIMER1** with the configuration technique.

4. The Timer1 Driver should be designed using the Interrupts with the callback's technique.
5. The Timer1 Driver should support both **normal** and **compare** modes and it should be configured through the configuration structure passed to the init function.
6. The Timer Driver has 3 functions and two ISR's for Normal and Compare interrupts:

a. **void Timer1\_init(const Timer1\_ConfigType \* Config\_Ptr)**

- **Description**

- Function to initialize the Timer driver

- **Inputs: pointer to the configuration structure with type Timer1\_ConfigType.**

- **Return: None**

b. **void Timer1\_deInit(void)**

- **Description**

- Function to disable the Timer1.

- **Inputs: None**

- **Return: None**

c. **void Timer1\_setCallBack(void(\*a\_ptr)(void));**

- **Description**

- Function to set the Call Back function address.

- **Inputs: pointer to Call Back function.**

- **Return: None**

4. The **Timer1\_ConfigType** structure should be declared like that:

```
typedef struct {
```

```
    uint16 initial_value;
```

```
    uint16 compare_value; // it will be used in compare mode only.
```

```
    Timer1_Prescaler prescaler;
```

```
    Timer1_Mode mode;
```

```
} Timer1_ConfigType;
```

The **Timer1\_Prescaler** and **Timer1\_Mode** are types defined as **uint8** or **enum**.



## Buzzer Driver Requirements

1. Implement a full **Buzzer** driver.
2. Buzzer should be connected to the **CONTROL\_ECU**.
3. Connect the **Buzzer** pin to any pins of your choice in the MCU.
4. The buzzer pin should be chosen by **static configurations**.
5. The Buzzer Driver has 3 functions:
  - a. **void Buzzer\_init()**
    - **Description**
      - Setup the direction for the buzzer pin as output pin through the GPIO driver.
      - Turn off the buzzer through the GPIO.
    - **Inputs: None**
    - **Return: None**
  - b. **void Buzzer\_on(void)**
    - **Description**
      - Function to enable the Buzzer through the GPIO.
    - **Inputs: None**
    - **Return: None**
  - c. **void Buzzer\_off(void)**
    - **Description**
      - Function to disable the Buzzer through the GPIO.
    - **Inputs: None**
    - **Return: No**

**Thank You & Good Luck**  
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