Final Project

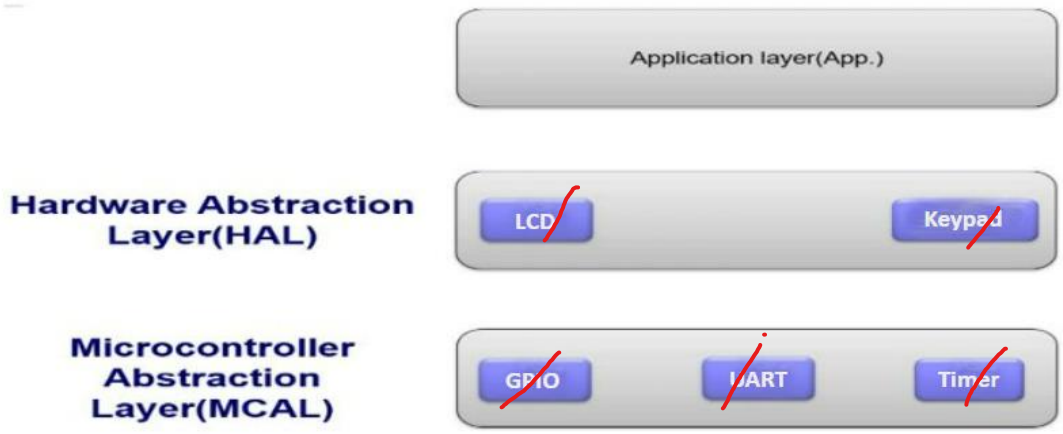
System Requirements

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

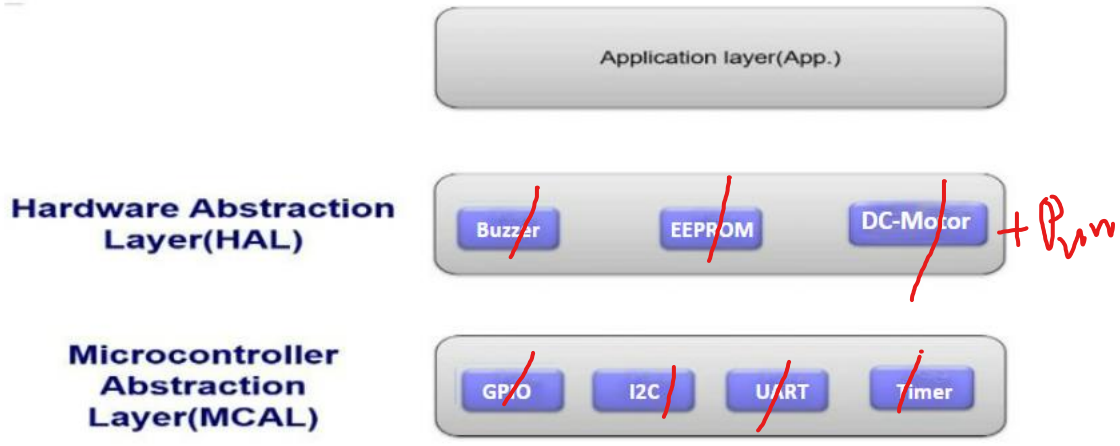
with the specifications listed below:

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

$\mathcal{M}$c1 → HMI_ECU (Human Machine Interface) with 2x16 LCD and 4x4 keypad.



$\mathcal{M}$c2 → 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.

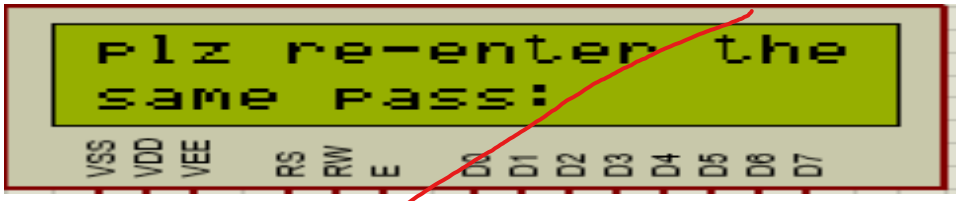
5) **System Sequence:**

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 renter 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 **EEPORM** 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 **<u>one last time</u>** 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.

6. The **CONTROL_ECU** Microcontroller should be act as Master with **device address 10** and the used **baud rate** should be **400K Bits/Sec**.

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**.

6. The UART Frame should be in the below format:
   - **Date Length:** 8-Bits Data
   - **Parity Type:** Even Parity
   - **Stop Bits:** 1-Stop Bit

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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