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| **ASSIGNMENT BRIEF 2023/24** |
| **Microprocessor Based Systems** |
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| **Embedded Burglar Alarm System** |

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| **Learning Outcomes** |
| This assignment achieves the following learning outcomes:  LO 2 -Use software for developing embedded systems in ‘C’ and testing microcontroller systems including the use of design tools such as Integrated Development Environments and In Circuit Debugger.  LO 3 -Design and implement microcontroller systems for: - signal processing - simple control applications - intelligent systems |
| **Weighting** |
| This assessment forms 50% of the overall assessment |

### NOTE:

The assignment is to be undertaken individually. Any instance of plagiarism (i.e. attempting to pass off the work of others as one’s own), from whatever source: books, internet, other students etc. will be zero rated. For further information related to Academic Misconduct, please refer to Section 13 of the module guide.

# Introduction

## Coursework Task

The purpose of this assignment is to:

* + - Design a preliminary hardware for a specified microprocessor-based system.
    - Develop and implement the hardware and software of the designed system.

### The developed system is an embedded burglar alarm system, which consists of a PIR sensor (HC-SR501 PIR Module), a buzzer, buttons, LCD Display and LEDs. The alarm includes features contained in a commercial burglar alarm. These features are:

* + - A user interface
    - A sounder
    - Timed entry and exit delays.
    - PIR Sensor

## System Hardware

The system hardware consists of four inputs and five outputs, which is listed in Table 1.

### Table 1: System Hardware List

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| **Input/ Output Requirements** | **Description** |
| **Input 1** | A button used to activate/deactivate the system. |
| **Input 2** | A button to reset the system when alarm is ringing. |
| **Input 3** | A button to run a short test that alarm buzzer is working. |
| **Input 4** | The signal from the PIR Sensor. |
| **Output 1** | A buzzer |
| **Output 2** | LED1 showing the system is powered on or off. |
| **Output 3** | LED2 showing that the system is activated or deactivated |
| **Output 4** | LED3 for Intruder Alert. |
| **Output 5** | LCD Display |

Each student will have to refer to Table 2 to determine the allocated port for the Activate/Deactivate button (Input 1) and Reset button (Input 2) that you will have to integrate into the assignment.

**Table 2: Input 1 and Input 2 Allocated Ports Connection**

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| --- | --- | --- |
| **Student No.** | **Activate/Deactivate button (Input 1)** | **RESET Button (Input 2)** |
| 2305214 | RD6 | RD1 |

## System Specification

The completed system will be required to demonstrate the following supported functionalities:

* + - When the system is powered, LED1 will need to be ON and when system is powered off, LED1 will then be OFF.
    - The system will be activated and deactivated when the user presses a button (Input 1) once.
    - When the system is deactivated, the LED2, LED3 and buzzer will be off, and the PIR Sensor is disabled.
      * During this deactivated state, the LCD display will show the word Deactivate, until the system is activated.
      * This is the default state of the system.
    - When the system is activated, LED2 is ON, and the PIR Sensor is enabled.
      * The LCD display will show the word Activate for 4 seconds.
      * When the system is initially activated, the user has 6 seconds to exit the protected area with LED2 blinking during this 6 second.
      * After that 6 second, LED2 will be permanently ON and LCD display shows “ALARM ON”.
    - When the system is activated and the PIR sensor detects the presence of humans within a range, the buzzer will sound a short tone of 1 second ON and 1 second OFF continuously for 5 seconds, to notify user the alarm has been triggered. The user has 5 seconds to deactivate the system. The LCD display shows “SENSOR\_TRIG”.
    - When the system is activated, and movement has been detected by the PIR sensor, and if the system is not deactivated within 10 seconds, the buzzer will sound for 5 seconds then pause for 5 seconds. The buzzer will repeat sounding and pausing continuously and the LED3 will be blinking continuously with the LCD display showing the message “BREACH ALERT”. Buzzer alarm, LED3 blinking, and display message will repeat continuously until system is reset.
    - When the reset button is pressed for 4 seconds, it will reset the system to the default state as mentioned above.
    - An additional requirement is when input 3 button is pressed, the buzzer will play a 5 second warning tone on and off intermittently and repeat until the input 3 button is pressed again to disable this functionality.

# Assessment Deliverables

## System Hardware

You will be required to construct the hardware circuit on Proteus outlined in Section 1 for this assignment. This will include the following:

* + - An overall block diagram illustrating your system design.

A schematic diagram (pin diagram) illustrating your chosen microcontroller (PIC18F452) and showing the pin connections and circuit connectivity of the system components.

## Code and Report

You should include in your report the formal design methods you used to formulate your design. Your submitted code needs to be programmed and tested to fulfil the functionalities specified in Section 1.3 on Proteus and MPLAB X. Your written report will need to include the details on the design of your application (what you did, why you did it, and how you did it), implementation and analysis of your developed system and explaining the functionalities performance supported in your developed system in accordance with the system specification in Section 1.3. Your commented code should be listed in the appendix of your report and should also employ software design techniques, such as state machine or flow chart, to show the implemented system’s software process. Students are required to work as an individual and produce a report explaining what they have done for the circuit design, coding of the microcontroller programming, signal processing, signal detection and the computer simulations carried out in the design platforms.

This report should contain the following contents:

1. Title of report
2. Person who wrote this report
3. Date submitted.
4. Who you submit to
5. Content page: heading/chapter/section, and corresponding page no.
6. Introduction section – what is the outcome of this work?
7. Procedure – what method you use to implement the task.
8. Results and Discussion – the heart of the report, the top-level behavioural design, test strategy, Verilog code, simulation results with diagrams, pictures and their discussion.
9. Conclusion – Do the simulation responses agree with the desired function that the circuit had to perform?
10. Reference section: all the material you refer to include textbook and websites.

The report should be word-processed, and formatted to look like a **professional report**, with alignments on both left and right side. Suitable **font size should be used (12 for** example) and font should be traditional like **Arial, or Times New Roman**, or others of your choice. But be consistent with the choice, do not mix them up in the middle of the report. **All diagrams should have a caption and a figure number**. **For example: Fig 10: Circuit Diagram of the adder**. Always refer to this diagram in the text, and it forms a link from your discussion to the diagram. This is good practice, and you will be penalized if you do not follow such rules. Apart from diagrams, you should include **experimental results, codes, captured timing waveforms etc**.

All work will be put through the Turn-it-in software to detect plagiarism.

## Viva

You will be required to demonstrate your code to your tutor and be able to answer questions concerning aspects of your code. The demonstration of the assignment will take place. A demonstration scheduled will be announced in due course.

## Submission Instructions

Your assignment report will have to be well structured and must clearly describe your system design taking into consideration the requirements stated in Section 2.1. The written report should not be more than **2000** words long and will need to be submitted via the Turnitin assignment link on Moodle.

## Marking Criteria

This coursework assignment will form 50% of the total module mark.

Marks allocated for this assignment will total 100% and will be assessed using the marking criteria shown below.

### Marks Criteria (100 %)

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| **Design and Code** | **25 %** |
| Marks for the design and code will be given for best practice in:   * Use of the appropriate design methods and supported documentation. * Appropriate use of the 'C' language. * Appropriate comments * Clarity and formatting of code. * Code structure. * Elegance of design method. * Portability * Correct operation of the system. * Accuracy and implementation of the timing strategy | |

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| **Report** | **40 %** |
| Marks for the report will be given for:   * A professionally presented report with appropriate formatting. * Clarity of the content. * Good structure. * An appropriate level of detail. * Appropriate use of figures and diagrams. * Also, refer to Section 2.2 in the coursework brief. | |
| **Proteus Design of System** | **15 %** |
| **Demonstration** | **20 %** |

The University Academic Assessment and Examinations regulations and procedures are applied to this assignment and will be enforced rigorously.

### END