School of Science, Computing & Engineering Technologies

Labs - Practical Tasks

(On – campus Classes)

ENG20009

Engineering Technology Inquiry Project

Semester 2 2023

Tasks and Details	Individual or Group	Weighting	Unit Learning Outcomes that this assessment task relates to	Assessment Due Date
Portfolio - Practical (i) Portfolio Practical Demonstration (30%) (ii) Portfolio Practical Report (10%)	Individual	40%	1,4,5	(i) From Week 2 to Week 7 during laboratory session. Each lab has 2 weeks for the demonstration. Demonstrated codes due in Week 7 (ii) Sep 22, 2023 by 23:59pm (End of Week 7); submit in Canvas

Portfolio – Practical Assessments:

(i) Practical Demonstration

- Provide practical demonstration for the completed task from Lab 2 to Lab 6 in the lab to the Lab Supervisor/Tutor.
- Each lab has 2 weeks for the demonstration. For example, Lab 2 tasks demonstration is from Week 2 to Week 3 for all Lab's 2 tasks (P, PP, C, D and HD). The Lab 6's demonstration will be from Week 6 to Week 7.
- The demonstrated codes must be submitted in Week 7 as a single compressed ZIP file, which must be named as 'your ID-PC'. For example: 12345678-PC.zip.

(ii) Practical Report

- Create a flowchart or pseudocode for every completed demonstration task. The portfolio practical report covert the flowchart or pseudo code for each completed task.
- The report can be submitted as a single PDF or Word file, which must be named as 'your student ID-PF'. For example, 12345678-PF.pdf.

Portfolio Practical – Lab 1

Topic: Getting started – basic embedded programming

Resources: Week 1 seminar and portfolio practical/lab notes.

Demonstration: No demonstration required

Tool: Using simulation tool with Arduino Mega

Q1. Write a program that will display your name and the ID number once in the serial monitor

Q2. Write a program that will display the unit number and the unit's name at the beginning of the application and then repeatedly print ("Welcome to the lab session") every 2 seconds in the serial monitor.

Q3. Write a program that will blink the built-in LED every 1 second.

Q4. Connect an LED to pin 7, and write a program that will turn it on for 1 second and off for 2 seconds.

Q6. Write a simple program to find out if a students mark (x) belongs to Higher Distinction, Distinction, Credit, Pass or fail using a switch statement. Add the screenshot for the following marks x= 45,55,60,80

Q7. Write a simple program that will print the values from 1 to 10 in the serial monitor using a while loop.

Q8. Using a 'for' loop, write a program that will print your name and the student ID three times in the serial monitor.

Q9. Write a program that will generate a random number between 0 and 300 for ten times. If the generated number is between 0-100 print A, if the generated number is 101-200 print B and if the generated number is 201-300 print C in the serial monitor. (Use if else if statements and for a loop).

Q10. Write a function to multiply 2 numbers together. The numbers being multiplied need to be passed to the function, and the result returned from the function. The numbers to be passed in are 15 & 16, and the result is to be printed to the serial monitor.

Portfolio Practical – Lab 2 – (Swinburne Board – Arduino Zero)

Topic: GPIO

Resources: Week 1 and 2 seminar and portfolio practical/lab notes.

Demonstration: With tutor in the lab in week 2 or week 3

Report: Week 7, in Canvas

Tool: Using Swinburne Lab board with Arduino Zero

Pass: Using 4 push buttons, control the behaviour of 3 LEDs on the bar graph or buzzer:

- The first push button should toggle the top LED (D11) on and off.

Pass Plus: Continuing from Pass question above, make the second from the top LED blink, and add the following functionality for the other 3 pushbuttons:

- The second button should increase the speed of the second top LED's (D10) blinking.
- The third button should decrease the speed of the second top LED's (D10) blinking.
- The fourth button should use PWM to increase/decrease the brightness of the third top LED (D9)/or tone of the buzzer (D6) between 0 and 254.

Credit: Using the dip switch, create a solution to display the following characters on the 8x8 LED matrix.

Characters to be displayed in order: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F.

Distinction: Keeping all the functionality of the Credit Task, add a function that when a pushbutton is pressed the character starts to scroll left to right.

High Distinction: Continuing on from the Distinction Task for designing LED matrix, an additional feature is to be added to the same pushbutton, when it is pressed, a string of character (ENG20009) will toggle from left to right/right to left. *The string shouldn't start scrolling until the button is pressed a second time – first time moves the character left to right.*

Portfolio Practical – Lab 3 – (Swinburne Board – Arduino Zero)

Topic: Analog to Digital Conversion

Resources: Week 1, 2, 3 and 4 seminar and portfolio practical/lab notes.

Demonstration: With tutor in the lab in week 4 or week 5

Report: Week 7, in Canvas

Tool: Using Swinburne Lab board with Arduino Zero

Pass: Create a night activated LDR sensor to turn on the LED bar during night time and turn off LED bar during day time.

Pass Plus: Instead of LDR, use potentiometer to adjust the brightness of the LED bar.

Credit: Write a program that controls the volume of the buzzer (PWM) using the input from the potentiometer.

Distinction: Using a microphone to create a simple access control by counting the number of claps. The passcode is 3 claps within a certain interval of time.

This passcode needs to be activated via the mic. If the passcode is correct, the 8x8 matrix shows graphical symbol for correct authentication, otherwise shows incorrect symbol on the matrix.

High Distinction: Create a waveform generator by using, a push button, potentiometer and LED Matrix to display. The LED matrix should be able to display the below waveforms, and frequency should be dependent on the potentiometer, with a push button to change/select the following wave waveforms.

- Sine
- Triangle
- Square
- Sawtooth

Portfolio Practical – Lab 4 – (Swinburne Board – Arduino Zero)

Topic: Interfacing with UART, SPI and I^2C

Resources: Week 1, 2 and 3 seminar and portfolio practical/lab notes.

Demonstration: With tutor in the lab in week 3 or week 4

Report: Week 7, in Canvas

Tool: Using Swinburne Lab board with Arduino Zero

Pass: Create menu using the UART and display in the serial monitor which has selection at the following:

- The first option should toggle the top LED (D11) on and off.

Pass Plus: Continuing from the Pass question above, add more selections:

- A second option to increase the speed of the second top LED's (D10) blinking.
- A third option to decrease the speed of the second top LED's (D10) blinking.
- A fourth option to use and control a PWM to increase/decrease the brightness of the third top LED (D9)/ or buzzer (D6) between 0 and 254.

All menu options should be able to return to the main menu to be executed again or changed to a different option

Credit: Using the RTC and LCD. Create a digital clock by reading the data from RTC and displaying it on the LCD.

Distinction: Using the accelerometer of the IMU, display an arrow in 4 directions (left, right, forward and backward) on the LED Matrix.

High Distinction:

Using the IMU, move a symbol (**not** a circle or dot) around the LCD screen and output the coordinates to serial monitor. Use the accelerometer values for direction and for speed, the symbol must start in the middle of the board when the program starts no matter the angle of the IMU and wait till the IMU is moved before moving on screen.

Portfolio Practical – Lab 5 – (Swinburne Board – Arduino Zero)

Topic: Memory

Resources: Week 1, 2, 3, 4 and 5 seminar and portfolio practical/lab notes

Demonstration: With tutor in the lab in week 5 or week 6

Report: Week 7, in Canvas

Tool: Using Swinburne Lab board with Arduino Zero

Pass: Store the following list in PROGEM, then print them from PROGEM onto the LCD screen. Each item from the list should scroll from right to left one at a time.

- *Student ID*
- *Student name*

Pass Plus: Continue from the Pass question above add the following list:

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Credit: Using 1-wire protocol, connect to the EEPROM component. Write to the component your student ID and display it back on the LCD from the EEPROM.

Distinction: Using RTC create digital clock and display in LCD. Create menu in the LCD which can be navigated with the pushbuttons. The menu needs to contain the following items:

- Change the format of displaying clock between 12-hour and 24-hour format
- Setup & run an alarm

The changes are saved into EEPROM.

High Distinction: Using an SD card, display, and the IMU create a data logger that will log the values onboard the 9-axis IMU (accelerometer, gyroscope and compass). The sensor data should be timestamped and saved to a .txt file on the SD card automatically. Using a push button, the Arduino should display the latest data to the LCD reading from the SD card.

Portfolio Practical – Lab 6 – (Swinburne Board – Arduino Zero)

Topic: Interrupts (no delay, millis, micros functions)

Resources: Week 1, 2, 3, 4 and 5 seminar and portfolio practical/lab notes

Demonstration: With tutor in the lab in week 6 or week 7

Report: Week 7, in Canvas

Tool: Using Swinburne Lab board with Arduino Zero

Pass: Using the interrupt hardware for pushbutton, display a non-alphanumeric symbol on the LCD.

Pass Plus: Continuing on from the Pass question above, using the interrupt hardware for pushbutton, display 4 different symbols on the LED Matrix, each time the button is pressed it should trigger an interrupt to change the symbol.

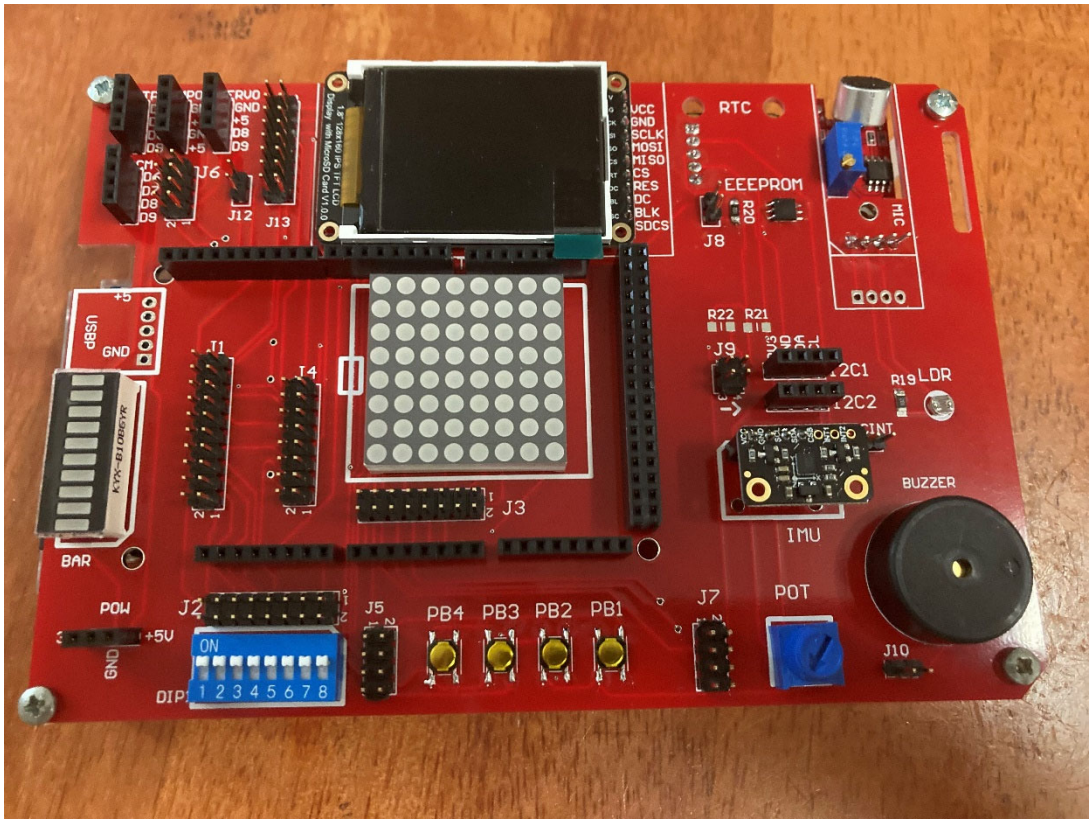
Credit: Create timer interrupt that can read data from the three sensors of IMU at 0.5 Hz rate, to be displayed on the LCD. Use graphical representation rather than just a number. Use buttons as menu selection of the three sensors.

Distinction: Using a timer interrupt, create a digital clock and display in the LCD. When push button is pressed, hardware interrupt is detected, the digital clock will be converted to analogue clock display.

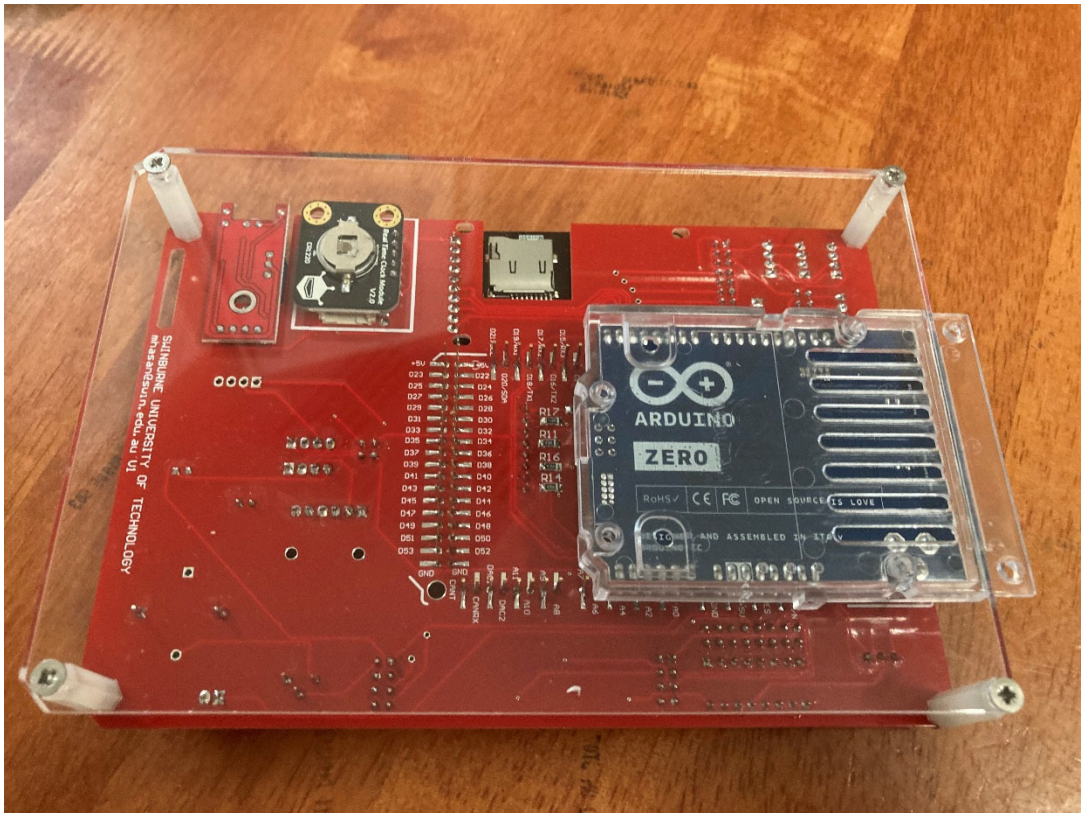
High Distinction: Using the 8x8 matrix and a push button (hardware/software interrupt), create a text scroller. The text should initially move left to right and be set using serial monitor.

- If the pushbutton is pressed for a short press, the direction should change from left to right, to right to left & vice versa.
- If the pushbutton is pressed for a long press the speed should change from slow to medium, medium to fast, or fast back to slow.

Hardware - Project Board – Front View:



Hardware - Project Board – Back View (Arduino Due):



Hardware - Project Board – Schematic: