School of Science, Computing & Engineering Technologies

Labs - Practical Tasks

(On – campus Classes)

ENG20009

Engineering Technology Inquiry Project

Semester 1 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) Apr 21, 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

- The portfolio practical report covert the flowchart or pseudo code for each completed tasks.
- The portfolio can be submitted as a single PDF or Word file, which must be named as 'your student ID-PF'. For example 12345678-PF.pdf. Additional file for the codes can be submitted compressed in ZIP file.

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") in every 2 seconds.
Q3. Write a program that will blink the inbuilt LED every 1 second
Q4. Write a program that will On the LED for 1 second and off the LED for 2 seconds. Make sure that the LED is connected to pin 7.
Q6. Write a simple program to find out the students mark (x) belongs to Higher Distinction, Distinction, Credit, Pass or fail. Add the screenshot for the following marks x= 45,55,60,80 (please use switch statements)
Q7. Write a simple program that will print the values from 1 to 10 in the serial monitor using a while loop.
Q8.Write a program that will print your name and the student ID three times in the serial monitor (Use for loop)
Q9. Write a program that will generate a random number under 300 for ten time and if the generated number is between 0-100 print A, if the generate 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 loop)
Q10. Write a function to for multiplication, Values needed to multiply be the inputs to the function and function should output the correct value. Using the function multiply 16 x 15 and print the correct value in the serial monitor.

Portfolio Practical – Lab 2 – (Option 1 – 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 to control the behaviour of 3 LEDs on the bar graph or buzzer:

- The first push button should toggle the first LED/buzzer on and off.

Pass Plus: Continue from Pass question above with the following tasks:

- The second button should increase the speed of the second LED's blinking.
- The third button should decrease the speed of the second LED's blinking.
- The fourth button should toggle the brightness of the third LED between high and low.

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

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

Distinction: Continuing from Credit Task for designing LED matrix with a new feature. Use a pushbutton, when it is pressed, the character will move from left to right.

High Distinction: Continue from Distinction Task for designing LED matrix with additional feature to be added with the same pushbutton to change up to 3 modes for speed of the moving character including slow, medium and fast.

Portfolio Practical – Lab 2 – (Option 2 – Simulation – Arduino Mega)

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 simulation tool with Arduino Mega

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

- The first push button should toggle the first LED/buzzer on and off.

Pass Plus: Continue from Pass question above with the following tasks:

- The second button should increase the speed of the second LED's blinking.
- The third button should decrease the speed of the second LED's blinking.
- The fourth button should toggle the brightness of the third LED between high and low.

Credit: Using a dip switch, create a solution to display the following characters on the 8x8 LED matrix. Make a proper connection for 8×8 LED Matrix with resistors to the microcontroller. The LED matrix have to be constructed manually by using 64 units of LED as 8×8 LED Matrix.

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

Distinction: Continuing from Credit Task for designing LED matrix with a new feature. Use a pushbutton, when it is pressed, the character will move from left to right.

High Distinction: Continue from Distinction Task for designing LED matrix with additional feature to be added with the same pushbutton to change up to 3 modes for speed of the moving character including slow, medium and fast.

Portfolio Practical – Lab 3 – (Option 1 – 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 menu should toggle the first buzzer on and off.

Pass Plus: Continue from the Pass question above with more selection below:

- The second menu should increase the speed of the second LED's blinking.
- The third menu should decrease the speed of the second LED's blinking.
- The fourth menu should toggle the brightness of the third LED between high and low.

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

Distinction: Using the accelerometer of the IMU create a spirit level that displays the current angle away from level on the LCD display and provide a graphic that will assist with levelling the board.

High Distinction:

Using the IMU, move a symbol (**not** a circle or dot) around the LCD screen and output the coordinates to serial terminal. 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 3 – (Option 2 – Simulation – Arduino Mega)

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 simulation tool with Arduino Mega

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

- The first menu should toggle the first buzzer on and off.

Pass Plus: Continue from the Pass question above with more selection below:

- The second menu should increase the speed of the second LED's blinking.
- The third menu should decrease the speed of the second LED's blinking.
- The fourth menu should toggle the brightness of the third LED between high and low.

Credit: Using the RTC and GLCD (SSD1306 OLED Display or TFT-LCD display). Create a digital clock by reading the data from RTC and displaying it on LCD.

Distinction: Using the accelerometer of the IMU (MPU6050) create a spirit level that displays the current angle away from level on the LCD display (SSD1306 OLED Display or TFT-LCD display) and provide a graphic that will assist with levelling the board.

High Distinction:

Using the IMU (MPU6050), move a symbol (**not** a circle or dot) around the LCD screen (SSD1306 OLED Display or TFT-LCD display) and output the coordinates to serial terminal. 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 4 – (Option 1 – 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 noise from the speaker using input from the potentiometer.

Distinction: Using a microphone and potentiometer to create an audio frequency meter. This will need to detect sounds and output the frequency in hertz (Hz) in the serial monitor and LCD.

High Distinction: Create a waveform generator by using 2 pushbuttons, potentiometer, and LCD to display. The screen should be able to display the below waveforms, and frequency should be dependent on the potentiometer, with 1 push button to change the speed/time (fast, medium & slow), and the other the waveform.

- Sine
- Triangle
- Square
- Sawtooth

Portfolio Practical – Lab 4 – (Option 2 – Simulation – Arduino Mega)

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 simulation tool with Arduino Mega

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 noise/tone from the speaker/buzzer using input from the potentiometer.

Distinction: Using a microphone and potentiometer to create an audio frequency meter. This will need to detect sounds and output the frequency in hertz (Hz) in the serial monitor and LCD (SSD1306 OLED Display or TFT-LCD display)

High Distinction: Create a waveform generator by using 2 pushbuttons, potentiometer, and LCD to display. The screen should be able to display the below waveforms, and frequency should be dependent on the potentiometer, with 1 push button to change the speed/time (fast, medium & slow), and the other the waveform.

- Sine
- Triangle
- Square
- Sawtooth

Portfolio Practical – Lab 5 – (Option 1 – 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.

- *Student ID*
- *Student name*

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

- ENG20009
- Engineering Technology Inquiry Project
- Semester 1
- 2023

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 the following items:

- Change the format of displaying clock between 12-hour and 24-hour format
- Setup 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 sensor values from one of the 3 sensors onboard the IMU. The sensor data should be timestamped and saved to a .txt file on the SD card. Using a push button, the Arduino should display the data to the LCD reading from the SD card.

Portfolio Practical – Lab 5 – (Option 2 – Simulation – Arduino Mega)

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 simulation tool with Arduino Mega

Pass: Store the following list in PROGEM, then print them from PROGEM onto the LCD screen (SSD1306 OLED Display or TFT-LCD display). Each item from the list should scroll from right to left.

- *Student ID*
- *Student name*

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

- ENG20009
- Engineering Technology Inquiry Project
- Semester 1
- 2023

Credit: Using 1-wire protocol, connect to the EEPROM component. Write to the component your student ID and display it back on the LCD (SSD1306 OLED Display or TFT-LCD display) from the EEPROM.

Distinction: Using RTC create digital clock and display in LCD (SSD1306 OLED Display or TFT-LCD display). Create menu in the LCD which can be navigated with the pushbuttons. The menu the following items:

- Change the format of displaying clock between 12-hour and 24-hour format
- Setup 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 sensor values from one of the 3 sensors onboard the IMU. The sensor data should be timestamped and saved to a .txt file on the SD card. Using a push button, the Arduino should display the data to the LCD (SSD1306 OLED Display or TFT-LCD display) reading from the SD card.

Portfolio Practical – Lab 6 – (Option 1 – Swinburne Board – Arduino Zero)

Topic: Interrupts

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: Continue Pass question above, using the interrupt hardware for pushbutton, display various symbols on the LCD, each time the button is pressed it should trigger an interrupt to change the symbol.

Credit: Using a timer interrupt, create a digital clock and display in the LCD. A push button is used as well. When push button is pressed, hardware interrupt is detection, the digital clock will be converted to analog clock display.

Distinction: Create timer and I2C interrupts that can read data from the three sensors of IMU at 0.5 Hz rate, to be displayed on the LCD. Buttons can be used to create menu selection of the three sensors.

High Distinction: Using the 8x8 matrix and a push button (hardware interrupt), create a text scrolled. The text should initially move left to right.

If the pushbutton is pressed for 0.5-2 seconds, the direction should change from left to right, to right to left & vice versa.

If the pushbutton is pressed for 2.5-4 seconds the speed should change from slow to medium, medium to fast, or fast back to slow.

Portfolio Practical – Lab 6 – (Option 2 – Simulation – Arduino Mega)

Topic: Interrupts

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 simulation tool with Arduino Mega

Pass: Using the interrupt hardware for pushbutton, display a non-alphanumeric symbol on the LCD LCD (SSD1306 OLED Display or TFT-LCD display).

Pass Plus: Continue Pass question above, using the interrupt hardware for pushbutton, display various symbols on the LCD, each time the button is pressed it should trigger an interrupt to change the symbol.

Credit: Using a timer interrupt, create a digital clock and display in the LCD (LCD (SSD1306 OLED Display or TFT-LCD display). A push button is used as well. When push button is pressed, hardware interrupt is detection, the digital clock will be converted to analog clock display.

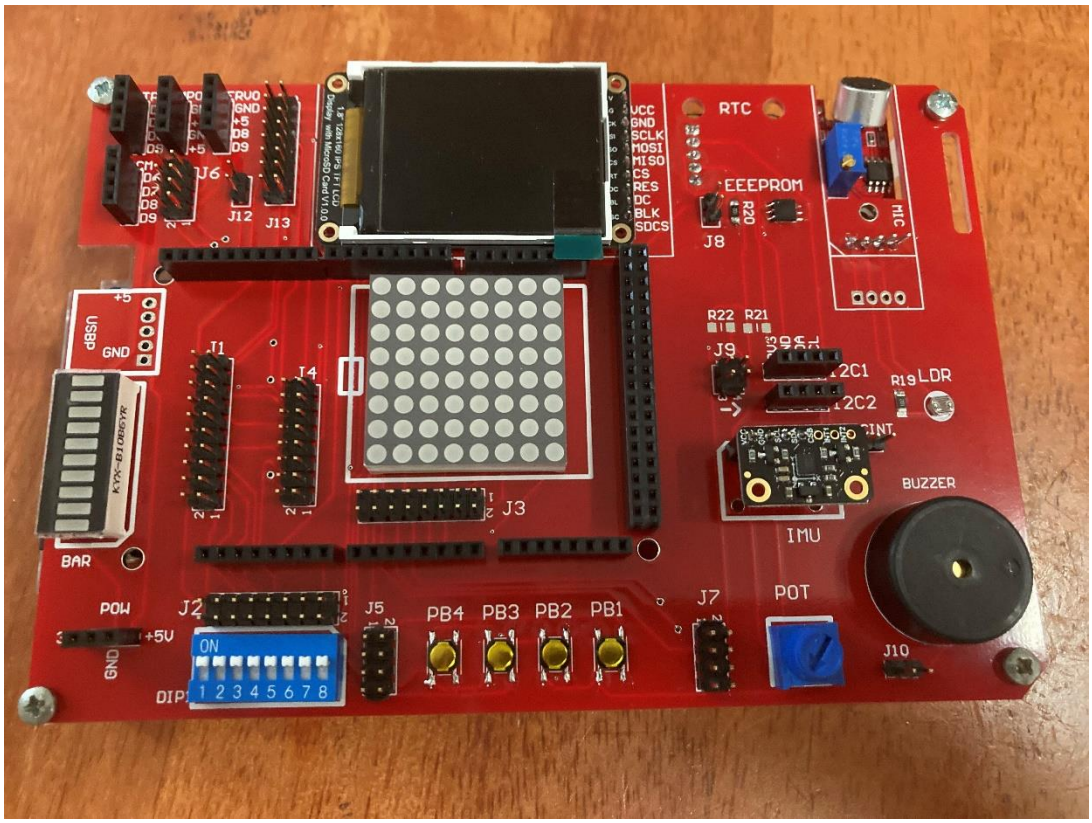
Distinction: Create timer and I2C interrupts that can read data from the three sensors of IMU (MPU6050) at 0.5 Hz rate, to be displayed on the LCD. Buttons can be used to create menu selection of the three sensors.

High Distinction: Using the 8x8 matrix and a push button (hardware interrupt), create a text scrolled. The text should initially move left to right. Make a proper connection for 8×8 LED Matrix with resistors to the microcontroller. The LED matrix have to be constructed manually by using 64 units of LED as 8×8 LED Matrix.

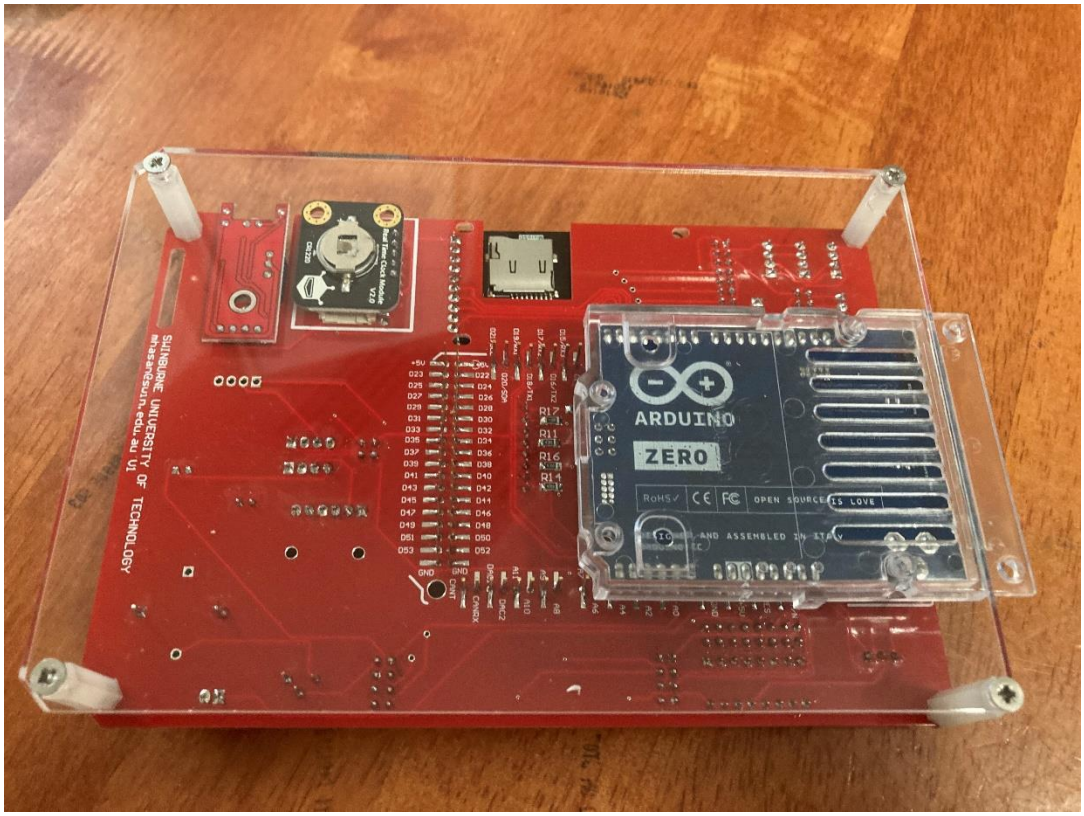
If the pushbutton is pressed for 0.5-2 seconds, the direction should change from left to right, to right to left & vice versa.

If the pushbutton is pressed for 2.5-4 seconds the speed should change from slow to medium, medium to fast, or fast back to slow.

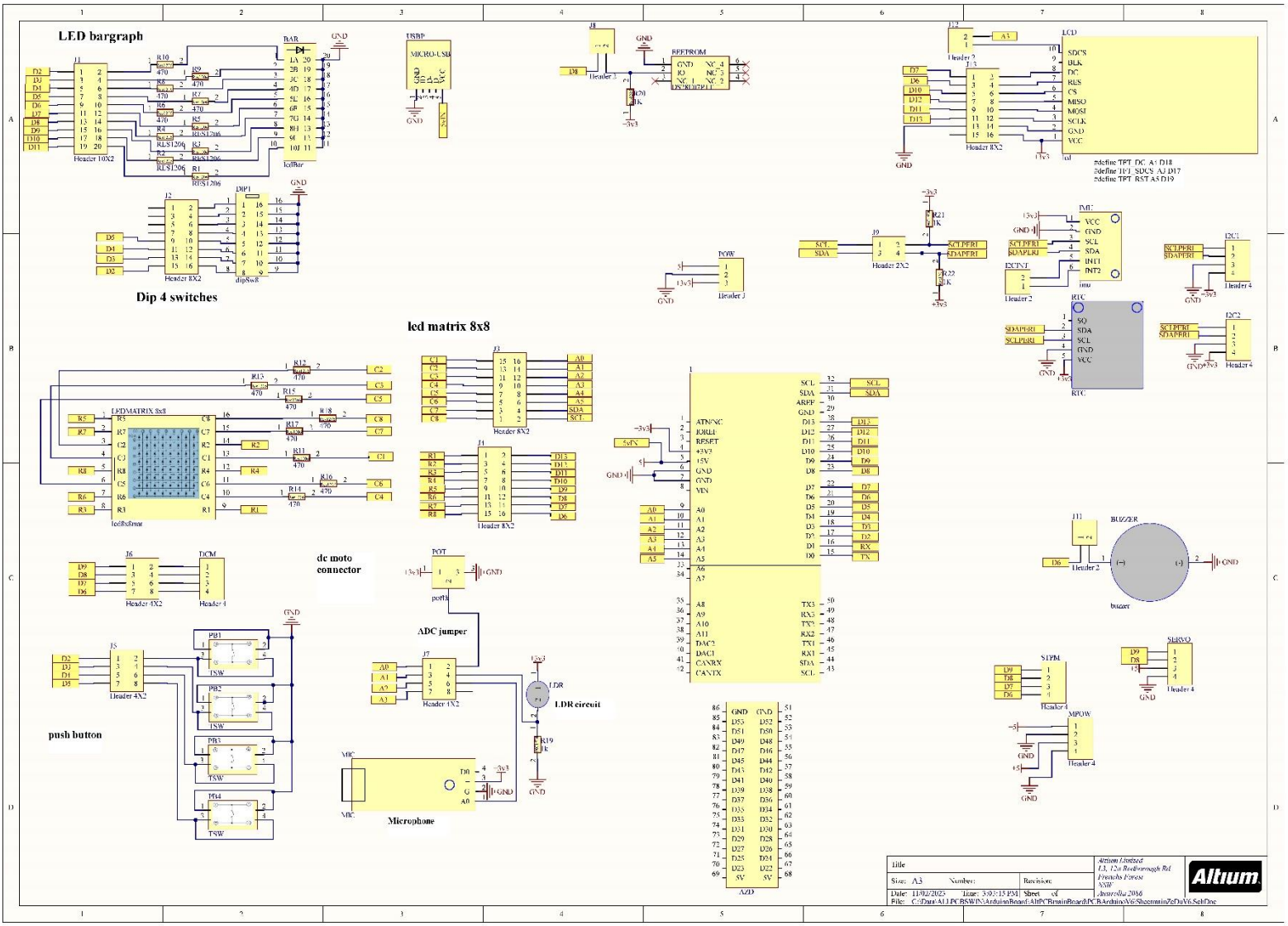
Hardware - Project Board – Front View:



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



Hardware - Project Board – Schematic:


LED bargraph
Dip 4 switches
led matrix 8x8
dc moto connector
ADC jumper
LDR circuit
push button
Microphone
BUZZER
buzzer
LCD
RTC
imu
EEPROM
Title
Size: A3
Number:
Revision:
Date: 11/02/2020
Time: 3:03:15 PM
Sheet of
File: C:\Data\ALDC BSWFS\ArduinoBoard\AllPcBrainBoard\PCBArduinoV6\SheeminoZeOuV6.SchDoc
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