ROB-GY 6103 Advanced Mechatronics: HW 3

Problem 1: Connect one terminal of a push button to pin P2 of an Arduino UNO through a 220Ω resistor. Connect the other terminal of the push button to the Arduino GND. Write a program that configures an external interrupt on P2 to print the button press count each time the button is pressed.

Problem 2: Connect an LED to pin P4 of an Arduino UNO with an appropriate resistor. Write a program that uses bit(), bitSet(), bitClear(), and port registers to blink the LED at 1Hz, ensuring that all other pins on the same port remain unaffected.

Problem 3: Write an Arduino program to print the current program runtime in milliseconds once every second, without using Serial.print(). Instead, implement the USART register-based communication as shown in slide 132 of Lecture 4 (and required material from Lecture-4-Appendix-Arduino.pdf). Add comments to explain each line of your sketch for demonstrating your understanding.

Problem 4: Program an Arduino UNO to blink the built-in LED on pin P13 at 1hz (500ms ON time/500ms OFF time) using an internal timer interrupt. Modify the timer registers to achieve the desired blink rate. Refer slide 74/75 of Lecture 4 for sample code. Add comments to explaine each line of your sketch for demonstrating your understanding.

Problem 5: Design and build a circuit using an Arduino UNO that demonstrates interrupt-based button debouncing. Connect an LED to pin P8 and a button to pin P2 of the Arduino UNO. Write a program that uses the external interrupt feature of P2 to toggle the LED state when the button is pressed, incorporating proper debouncing techniques. Explain why debouncing is necessary.

Problem 6: Design a circuit with three buttons and three LEDs appropriately interfaced with an Arduino UNO. The buttons are connected to pins P4, P10, and A3 and the LEDs are connected to pins P5, P6, and P7. Write a program for a pin change interrupt-based system that monitors the three buttons and causes a corresponding LED to turn on (when an interrupt is triggered by the corresponding button, e.g., LED_{P5}: BTN_{P4}, LED_{P6}: BTN_{P10}, LED_{P7}: BTN_{A3}). Recall and use the following information as needed. Use only register-level programming (no reliance on high-level Arduino functions).

- P4 (PCINT20)
- P10 (PCINT2)
- A3 (PCINT11)