

Lab B3 – Prototype Phase 1

ECE 298 – F2021

Lab Section: IN-PERSON

Group: 21

Part 1 – Pin Mapping

MCU Pin	Pin Mode	Functional Description
PA[6...9]	GPIO_Output	Output for the keypad
PA[10...12]	GPIO_Input	Received signal from the keyboard
PB12	GPIO_Output	Send trigger for ultrasonic sensor for front door
PB13	GPIO_Input	Monitor the ECHO signal from the front door sensor
PB14	GPIO_Output	Send trigger for ultrasonic sensor for back door
PB15	GPIO_Input	Monitor the ECHO signal from the back door sensor
PC12	GPIO_Input	Input signal for ON/OPEN sensor of window
PB[4...6]	GPIO_Input	Input signal for ON/OPEN sensor of windows
PA[0...1]	GPIO_Input	Input signal for ON/OPEN sensor of doors
PC[0...5]	GPIO_Output	Output signal for status LED for windows
PA15	GPIO_Output	Output signal for status LED for window
PA4	GPIO_Output	Output signal for status LED for window
PC[8...11]	GPIO_Output	Output signal for status LED for doors
PB8	GPIO_Output	Output signal for alarm LED
PB[0...1]	GPIO_Output	External Lightings connected to a relay
PB2	GPIO_Output	Output signal for alarm buzzer connected to a relay
PC6	USART6_TX	Input signal from the comm terminal
PC7	USART6_RX	Output signal for the LCD display

*PB[9...10] not used

Part 2 – MCU Resources

MCU Resource	Functional Description
USART6	Communicates with the LCD screen module
TIM4	Generate PWM signal for DC motor driver FETs

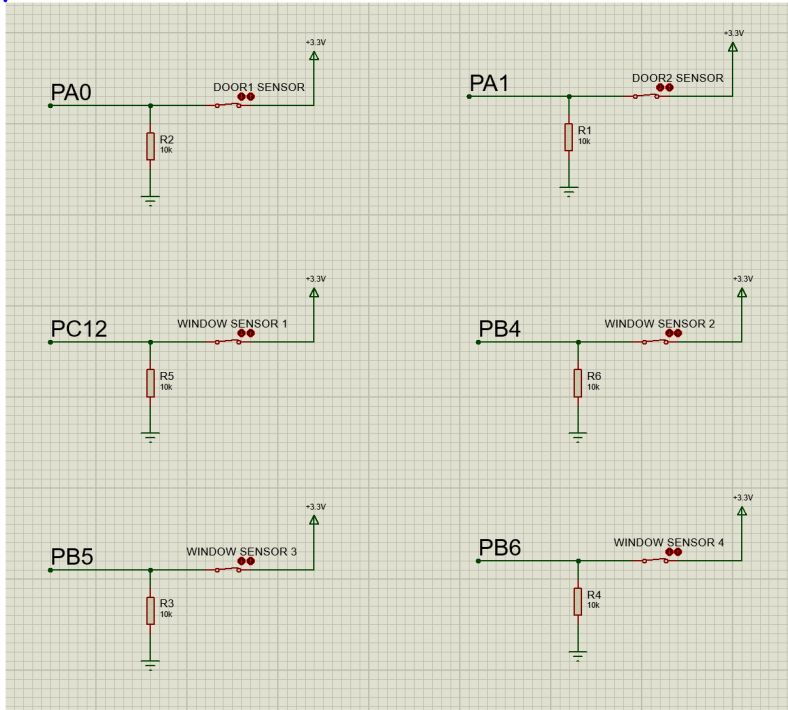
Part 3 – Test Cases

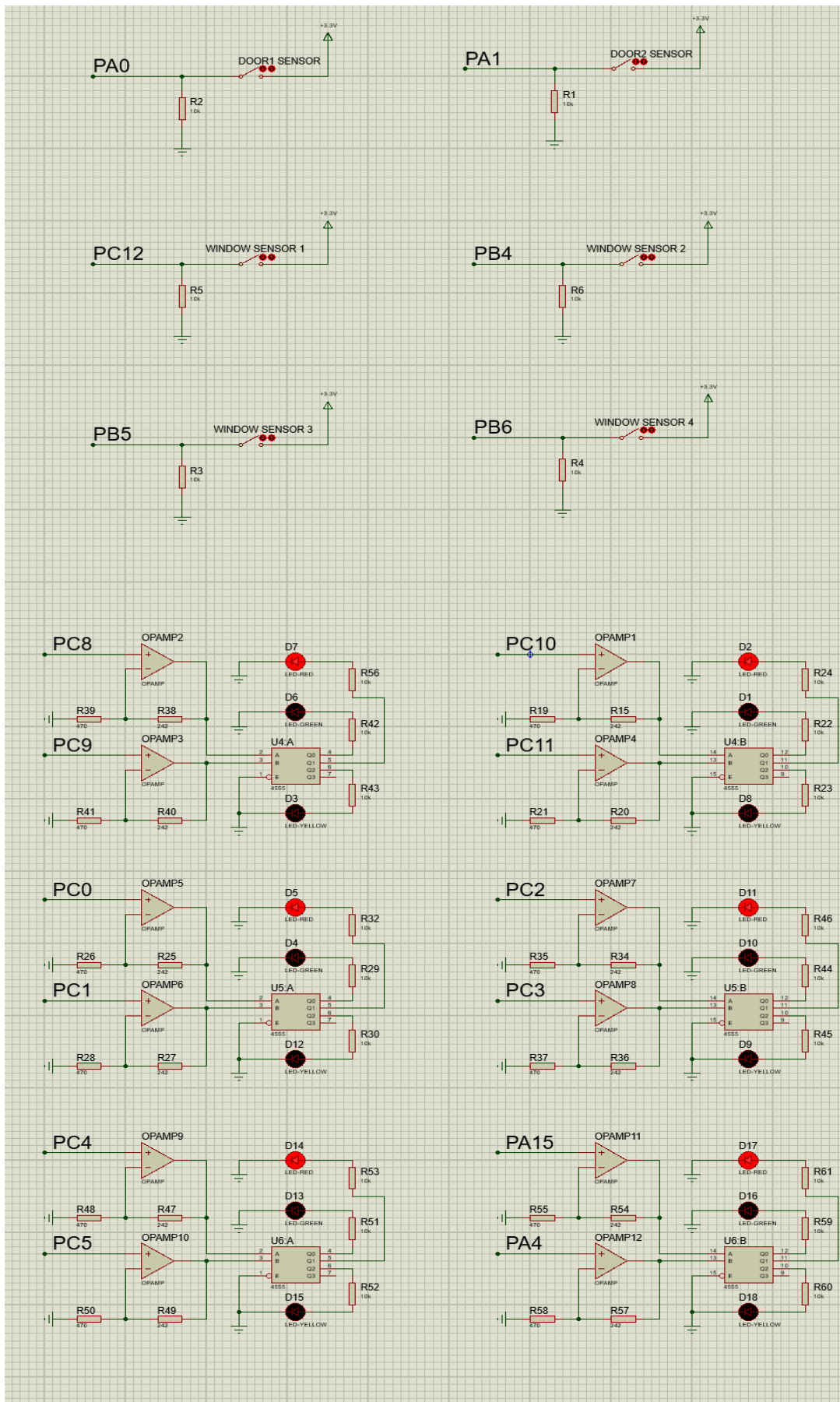
{ON/OFF Sensor - Switch}

Brief Test Summary

The switches are used as the ON/OFF sensors for the windows and doors, each switch is connected to a GPIO_Input signal. When the switch is closed, the MCU receives an input signal of 1 from the switch, and when the switch is open, the MCU receives an input signal of 0. The Switch worked well with the common terminal command. When the mode is in the ARMED mode, the LED will turn to red resulting in the switch open.

Schematics and Simulations



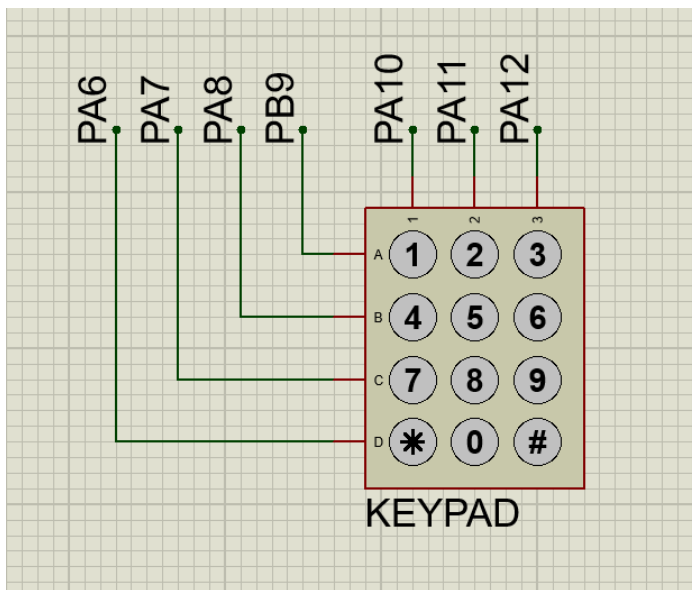


{Keypad}

Brief Test Summary

The rows of the keypad are connected to four different GPIO_Output pins on the MCU, and the columns are connected to three different GPIO_Input pins on the MCU. The rows are initialized with a output level of low and the columns are initialized as high, when a key is pressed, the corresponding GPIO_Input signal will be changed to low, and each row signal of the keypad will be turned high, when the correct row is found, the chosen column signal will be turned high again and thus we would be able to determine the key being pressed by the user. The key pressed will be stored within a buffer and is compared to a stored passcode, if the correct passcode is entered, signals are sent out to disarm the windows and doors. However, the keypad is malfunctioning due to an interrupt problem.

Schematics and Simulations



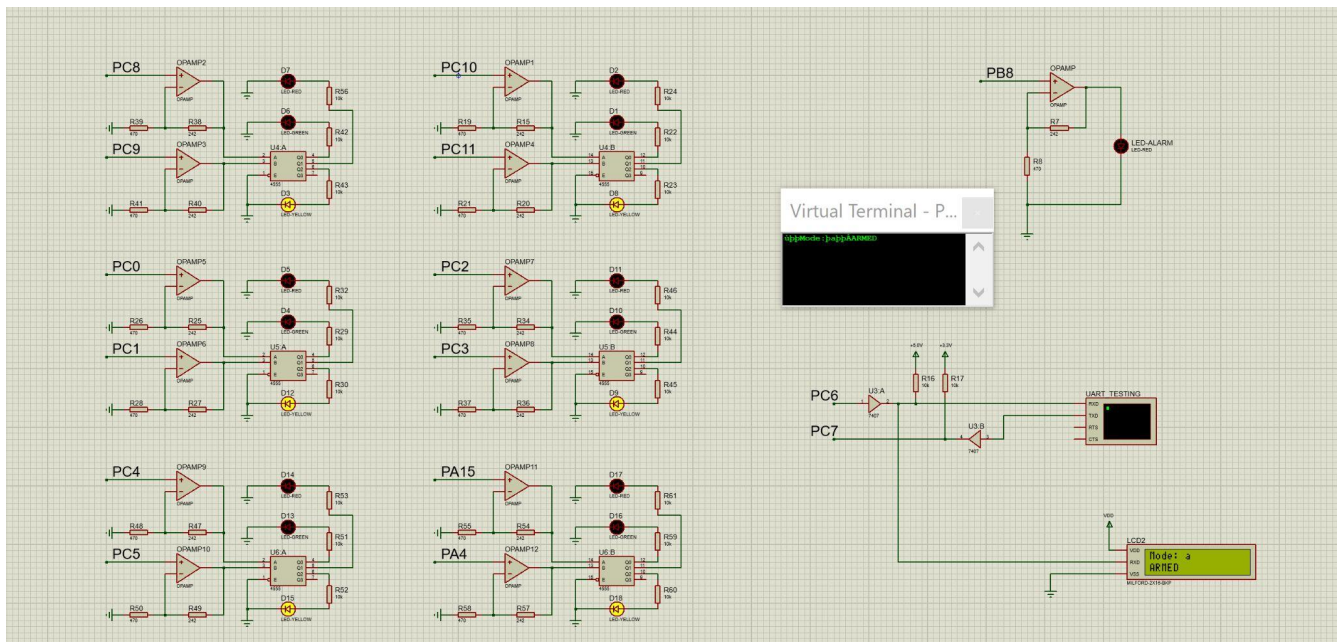
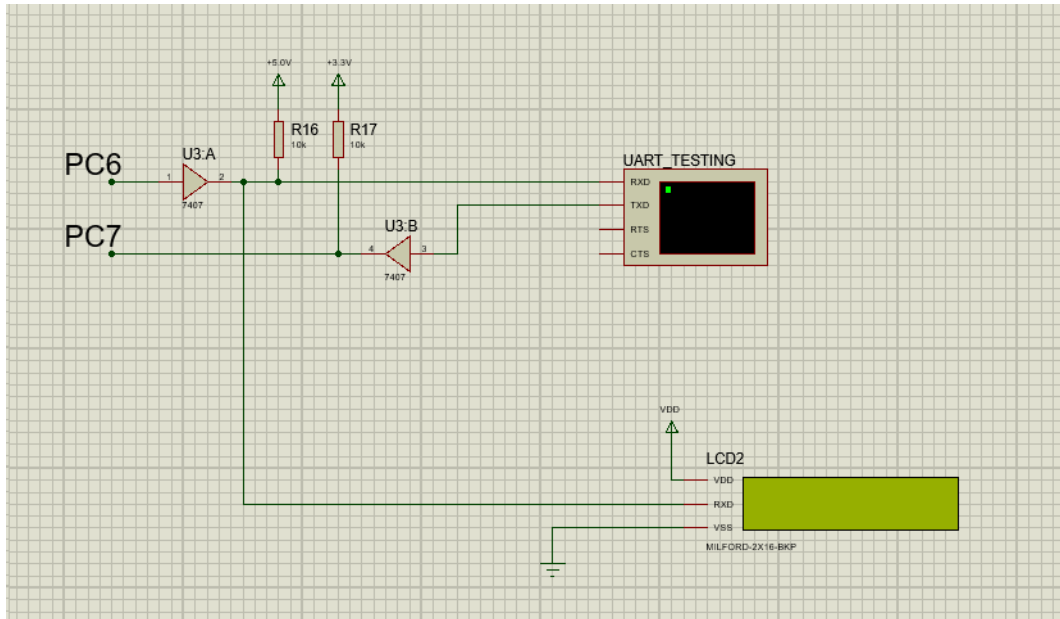
{LCD & Common Terminal}

Brief Test Summary

LCD transmits data asynchronously. Using a single wire to connect TXD pin in MCU UART and RXD pin LCD UART. PC6 MCU TXD pin Code 0xFE(254) is sent to differentiate between control codes and normal characters, clear screen use code 1, move to the Home use code 0, and display to the second line use code 192.

LCD can successfully display the mode status and user input('a','d'); Mode: 'a' is for the ARMED status, and 'd' is for the DISARMED status;however, the time display is malfunctional. Receive and transmit can be done by LCD and MCU. The Common terminal is connected to the LCD to let the user input command.

Schematics and Simulations

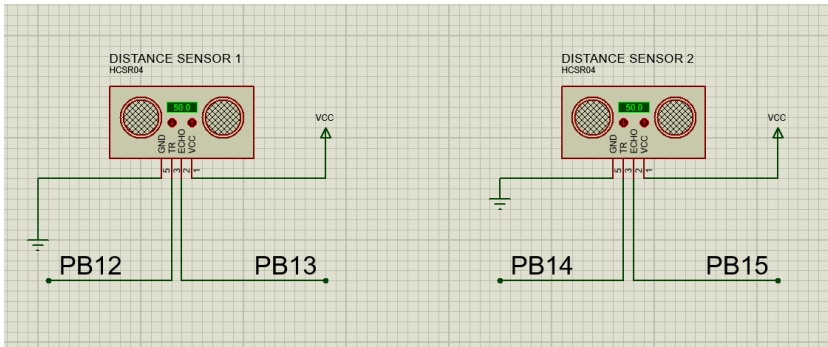


{Distance Sensor}

Brief Test Summary

Each of the distance sensors is connected to one GPIO_Output pin and one GPIO_Input pin. The MCU will send out a signal once after a period of time, and when a person is being detected by the distance sensor, a signal will be received from the input pin. The system will then turn on the corresponding external light. However, the distance sensor is malfunctioning due to an interrupt problem.

Schematics and Simulations



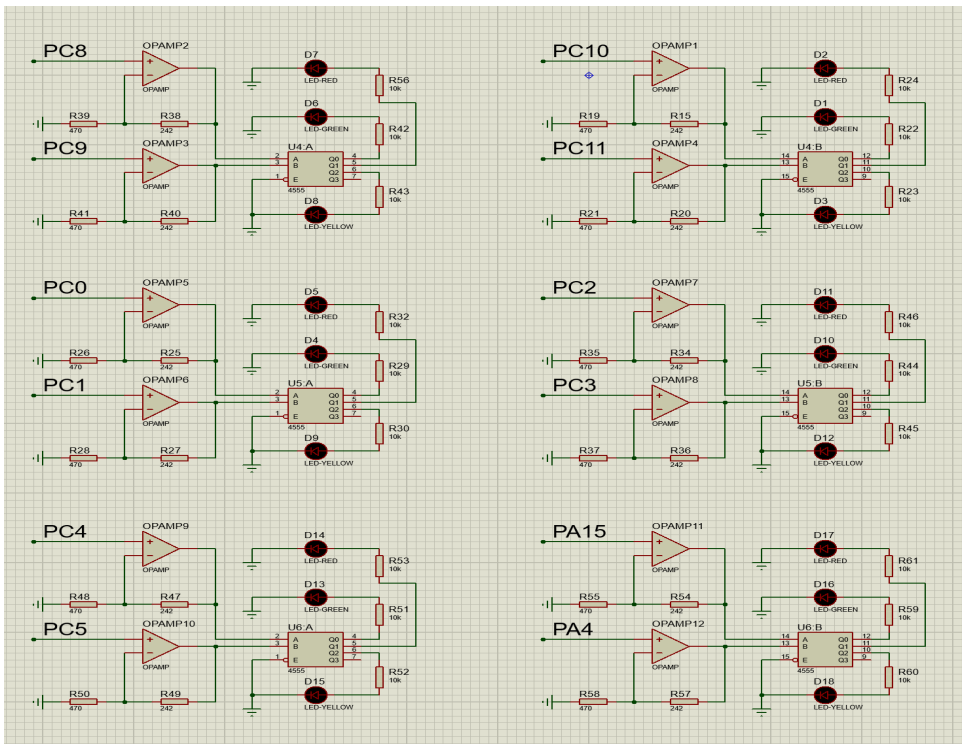
{Status LED}

Brief Test Summary

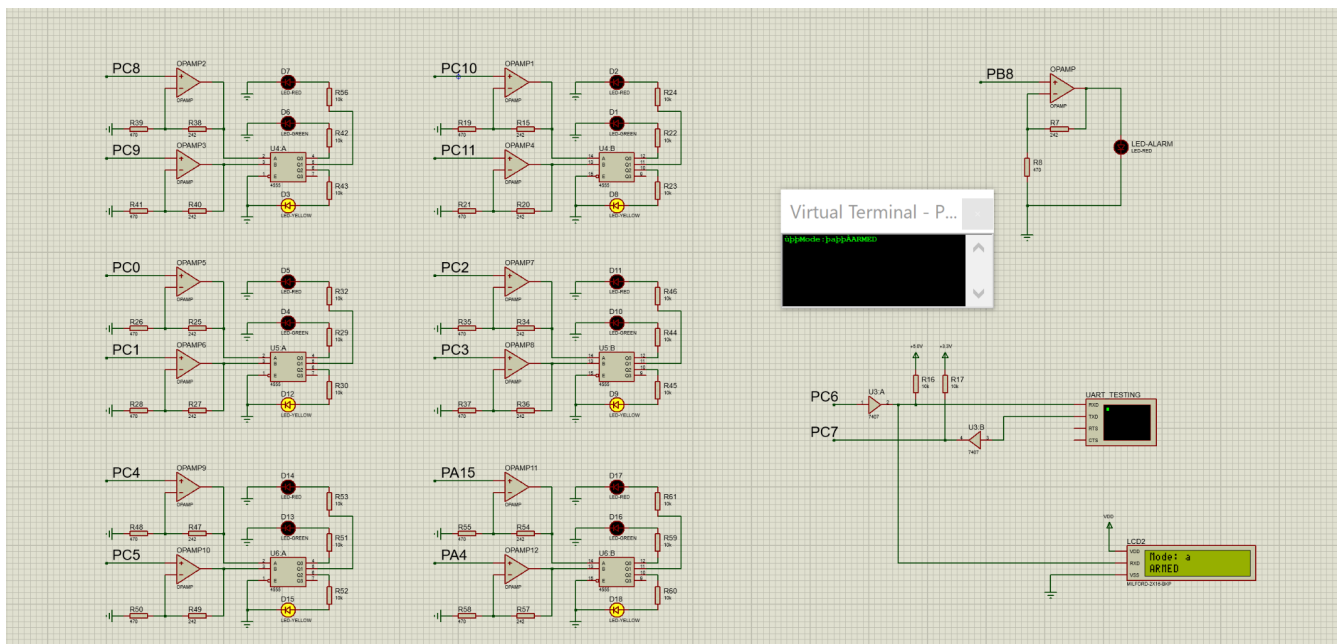
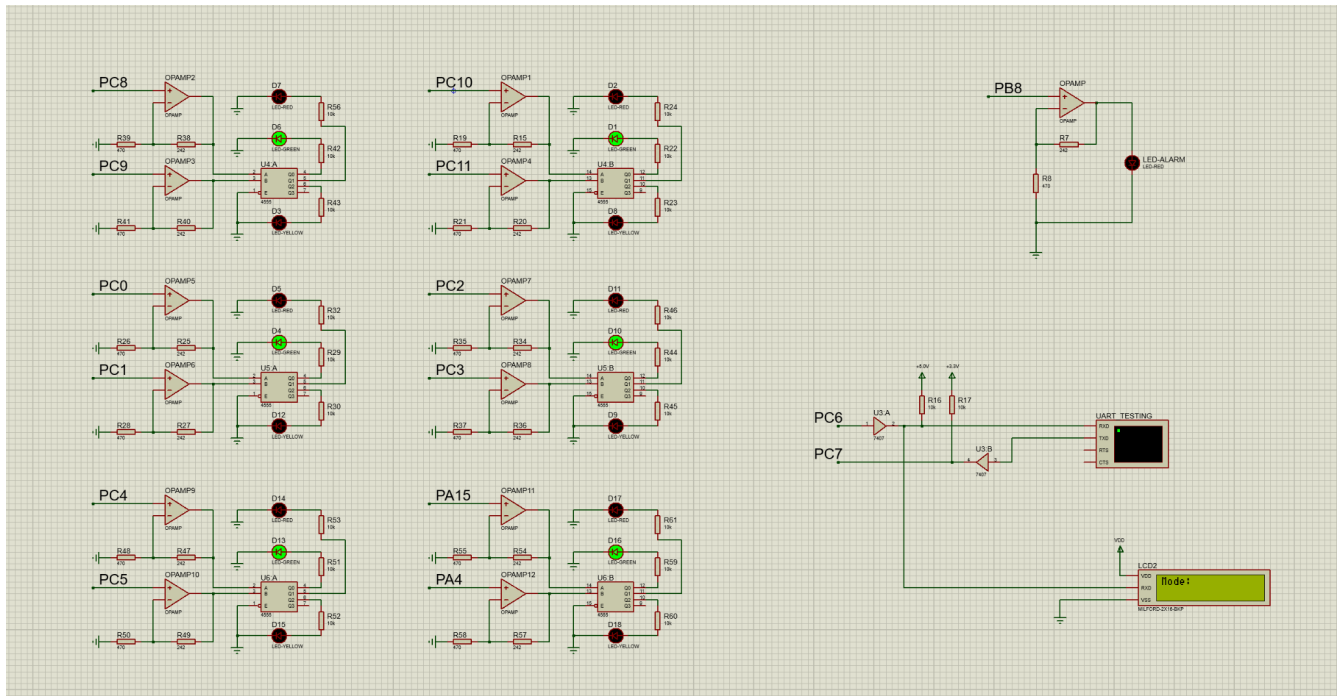
The status LEDs for the windows and doors are controlled using binary multiplexers each connected to two GPIO_Output pins. An output signal of 00 will activate the green LED representing DISARMED, an output signal of 01 will activate the yellow LED representing ARMED, and an output signal of 10 will activate the red LED representing ALARM. An output signal 00 is ignored and not used.

The initial status of the windows and doors are disarmed, so the green LEDs are turned on, and under this mode, the user can choose to change the status to armed by entering 'a' into the comm terminal. When the status is changed to armed, the yellow LEDs will be turned on. If one of the ON/OFF sensors for the windows and doors detects an open signal, all the red LEDs will be turned on after a short delay. The user can choose to disarm the system again by entering 'd' into the comm terminal.

Schematics and Simulations



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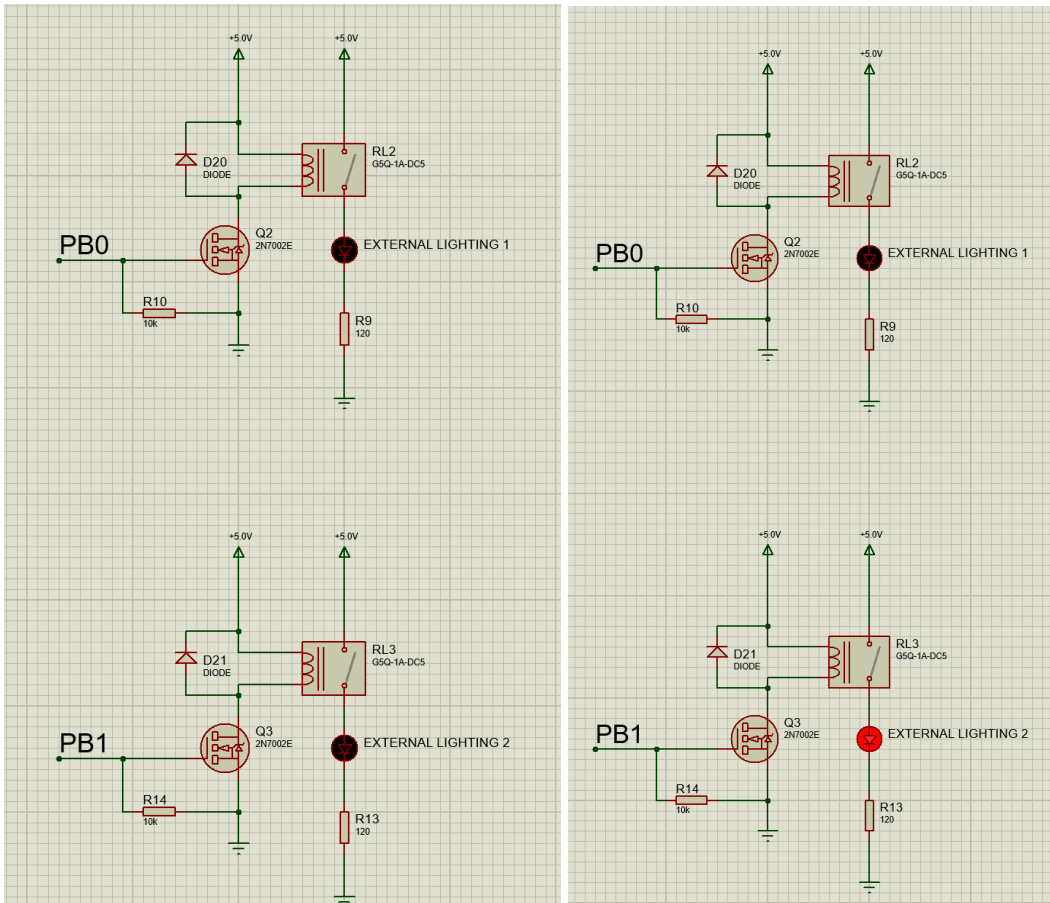


{External Lighting}

Brief Test Summary

Each of the external lighting is connected to a relay that is connected to the MCU through a GPIO_Output pin. When the distance sensor is triggered, the MCU will send an output signal to this pin which will activate the LED connected to the relays. When there is no signal received from the distance sensor, the MCU will stop sending a signal and the lights will be turned off.

Schematics and Simulations



{Audible and LED Alarm}

Brief Test Summary

The audible alarm and the LED alarm are both connected to the MCU through a GPIO_Output pin. When an alarm situation is triggered, the LED alarm will immediately be activated by the MCU and start to flash by continuously toggling the output pin after a small delay. The audible alarm will wait for an activation delay, and if the correct passcode is not entered by the user within this activation delay period, the alarm will then be sounded. Both the audible alarm and the LED alarm will be turned off by an interrupt when the corrected passcode is entered.

Schematics and Simulations

