Presentation

TEAM A5

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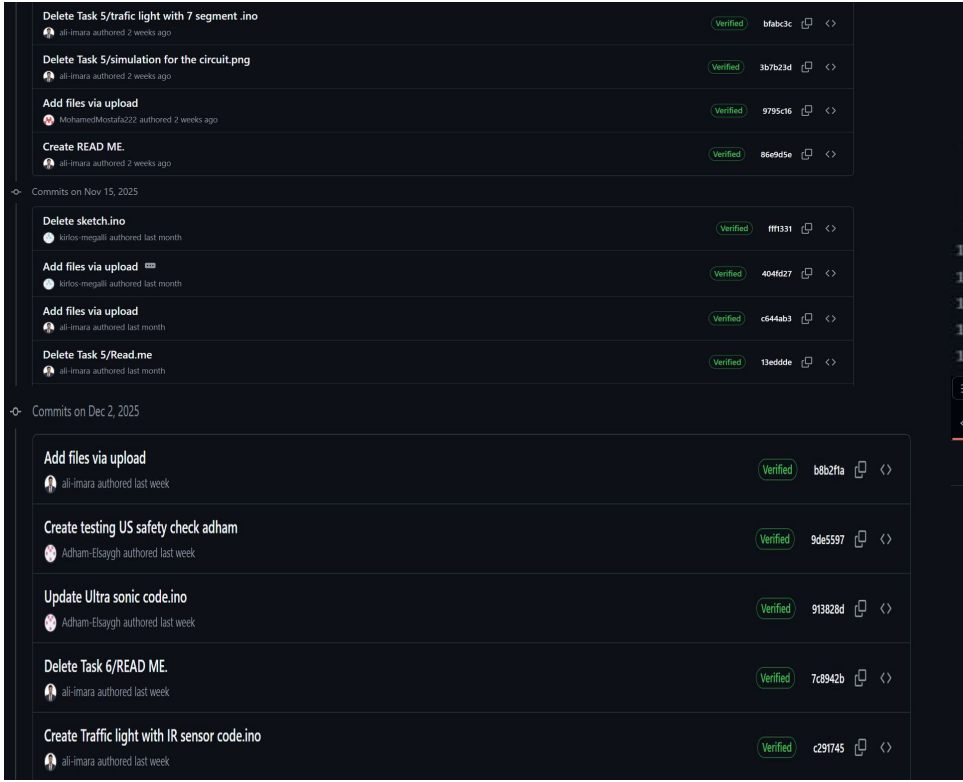
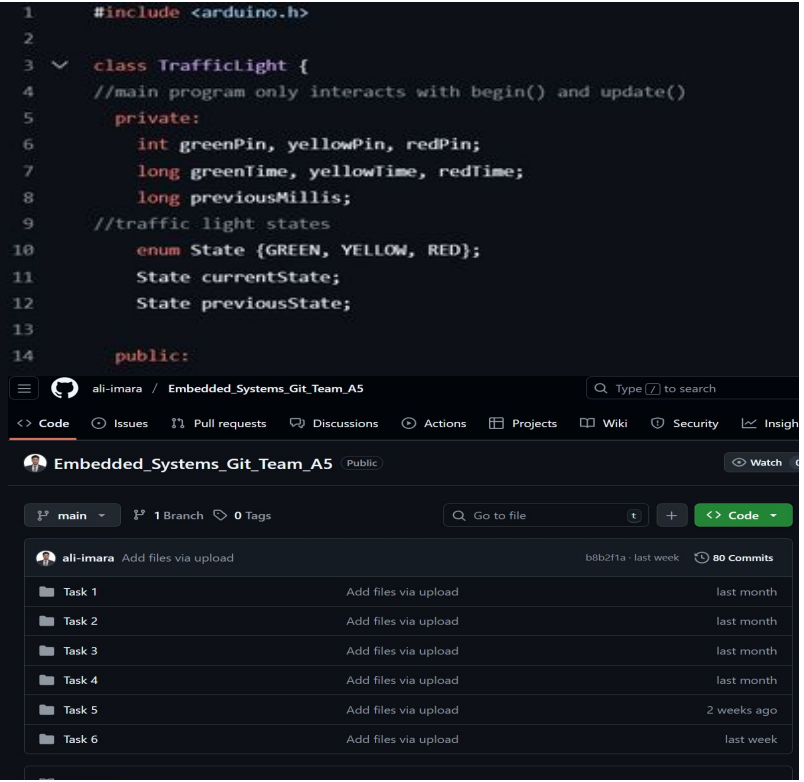
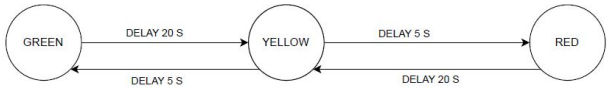
Organisation



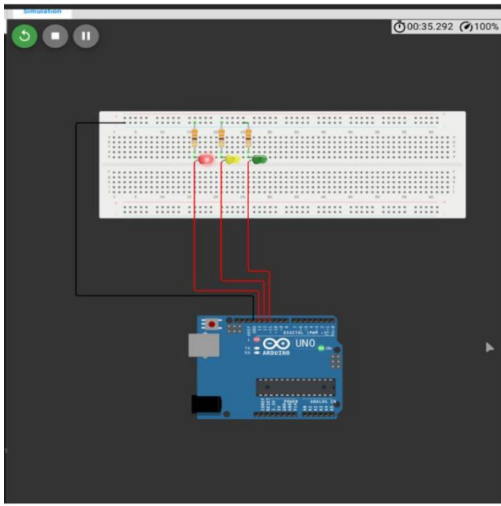


Task 1

TrafficLight
-greenPin:int -yellowPin:int -redPin:int -greenTime:long -yellowTime:long -redTime:long -previousMillis:long -currentstate:State -previousstate:State
+ trafficlight(g,y,r,,gTime,y,Time,rTime) +begin() +setup() -switchto(nextState:State) -turnOn(pin:int)




```
    void update() {
      long currentMillis = millis();
//after red or green defaults to yellow,but after yellow checks previous state and act accordingly
      switch (currentState) {
        case GREEN:
          if (currentMillis - previousMillis >= greenTime) {
            switchTo(YELLOW);
          }
          break;

        case RED:
          if (currentMillis - previousMillis >= redTime) {
            switchTo(YELLOW);
          }
          break;

        case YELLOW:
          if (currentMillis - previousMillis >= yellowTime) {
            if (previousState == GREEN) switchTo(RED);
            else if (previousState == RED) switchTo(GREEN);
          }
          break;
      }
    }
```

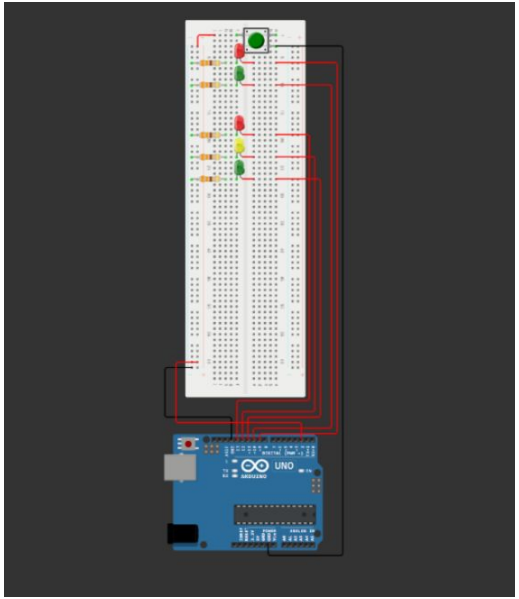


Implementation is structured using Object-Oriented Programming (OOP) principles, with the main function detailing execution flow after hardware initialization

Task 2

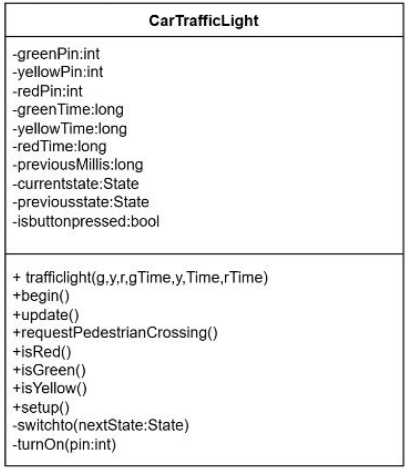
A new class was created for the pedestrian traffic light.

```
// Pedestrian Traffic Light Class
class PedestrianTrafficLight {
  private:
    int greenPin, redPin;
    int buttonPin;
    long previousMillis;

    enum State {GREEN, RED};
    State currentState;

    bool lastButtonState;

  public:
    PedestrianTrafficLight(int g, int r, int button) {
      greenPin = g;
      redPin = r;
      buttonPin = button;
      currentState = RED;
      previousMillis = 0;
      lastButtonState = HIGH;
    }

    void begin() {
      pinMode(greenPin, OUTPUT);
      pinMode(redPin, OUTPUT);
      pinMode(buttonPin, INPUT_PULLUP);
      switchTo(RED);
    }

    void update() {
      // This update just maintains the LED state
      // The actual timing is controlled by the car light's RED phase
    }

    bool isButtonPressed() {
      bool currentButtonState = digitalRead(buttonPin);
      // Button pressed when it goes LOW (with pull-up)
      if (currentButtonState == LOW && lastButtonState == HIGH) {
        lastButtonState = currentButtonState;
        return true;
      }
      lastButtonState = currentButtonState;
      return false;
    }

    void setGreen() {
      switchTo(GREEN);
    }

    void setRed() {
      switchTo(RED);
    }

    bool isRed() {
      return currentState == RED;
    }

    bool isGreen() {
      return currentState == GREEN;
    }

  private:
    void switchTo(State nextState) {
      digitalWrite(greenPin, LOW);
      digitalWrite(redPin, LOW);

      currentState = nextState;
      previousMillis = millis();

      switch (nextState) {
        case GREEN: digitalWrite(greenPin, HIGH); break;
        case RED:   digitalWrite(redPin, HIGH);   break;
      }
    }
};
```



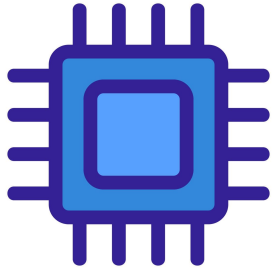
Task 2

```
void loop() {
  // Update car light
  carLight.update();

  // Check for button press
  if (pedLight.isButtonPressed()) {
    carLight.requestPedestrianCrossing();
  }

  // Sync pedestrian lights with car light state
  if (carLight.isRed()) {
    pedLight.setGreen(); // Car is red = pedestrians can walk
  } else {
    pedLight.setRed();   // Car is green/yellow = pedestrians wait
  }

}
```



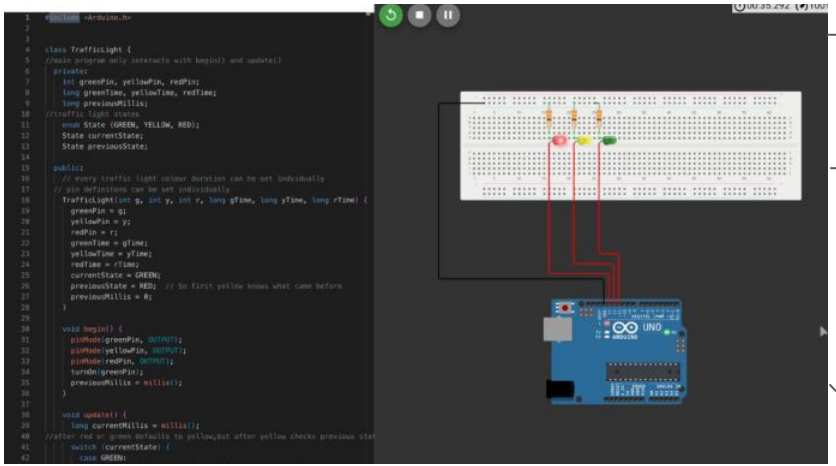
Task 3,4

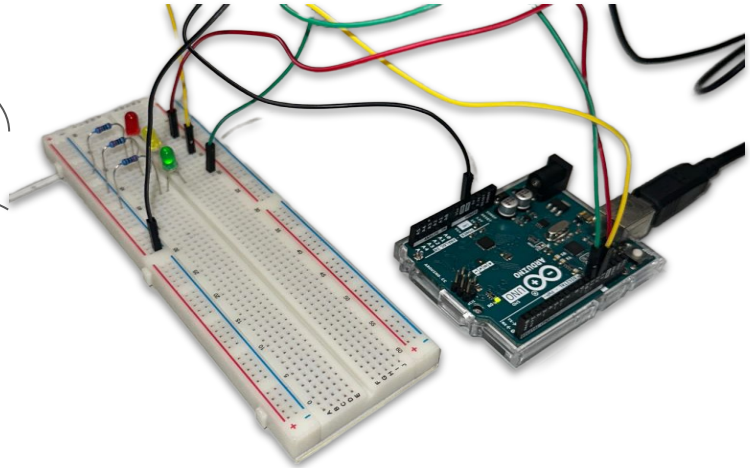
- Mapping of task 1 to a (real) Arduino
- Mapping of task 2 to a (real) Arduino



Task 3

The simulation of Task 1 results are consistent with the behavior of the real-life circuit.





Task 3

The measured voltage from the real red LED closely corresponds to the calculated voltage.

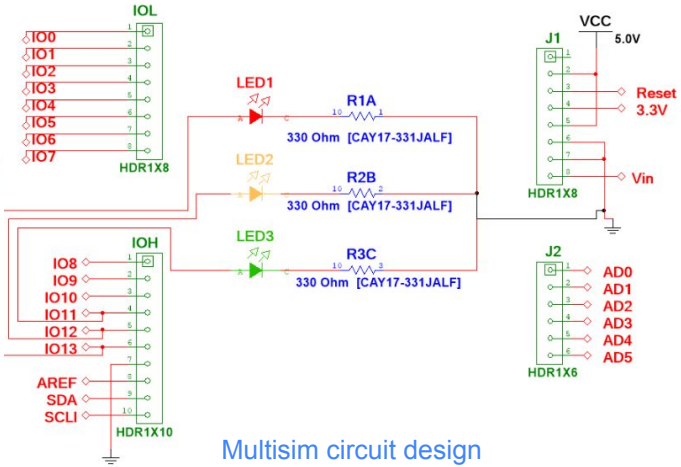
Voltage:

1- Pin13,12,11: V=5.0v

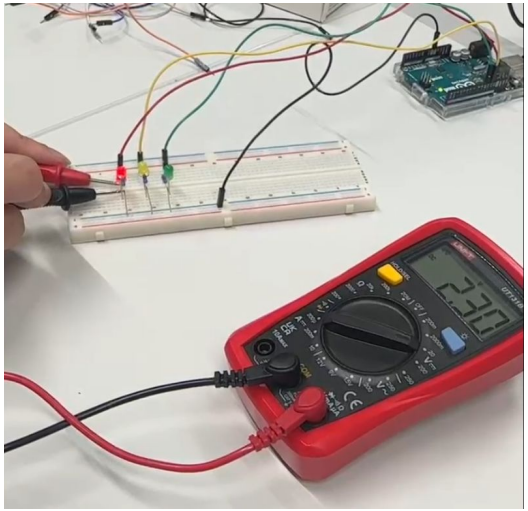
2- Voltage at Red led= 2.0v (1.8-2.2)

3- Voltage at yellow led= 2.1v (2.0-2.4)

4- Voltage at green led= 2.2v (2.0-3.0)



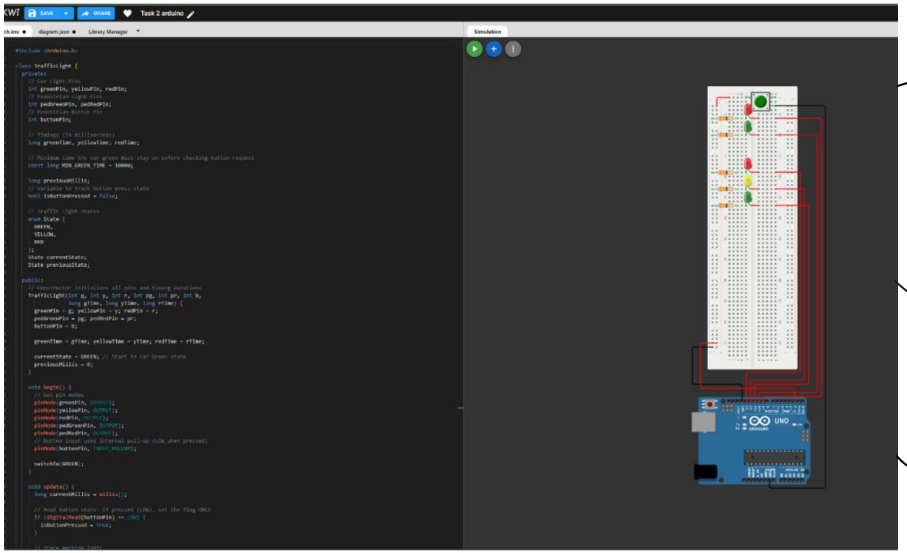
Multisim circuit design

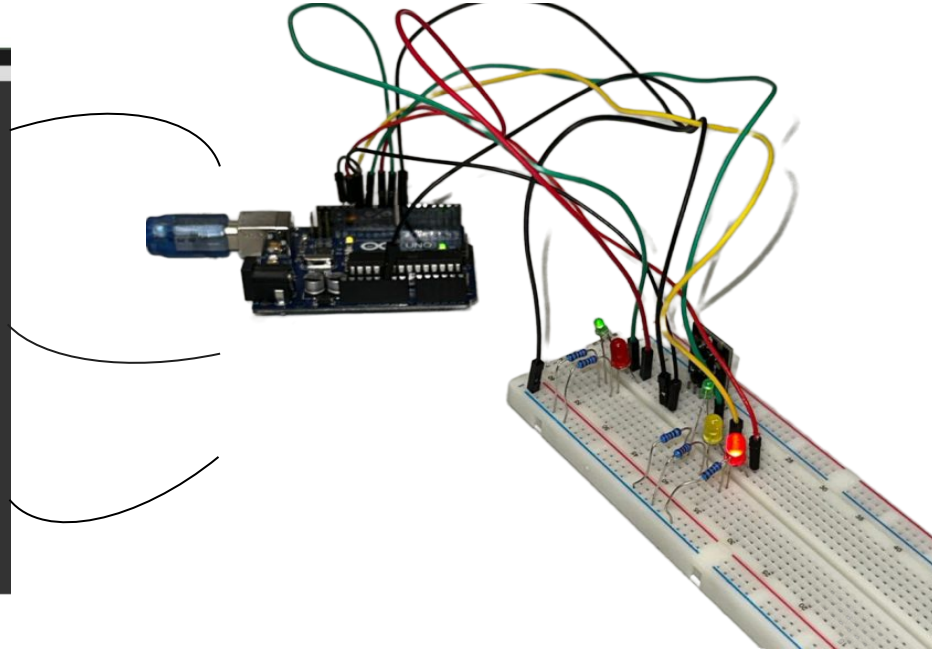


Real life calculation

Task 4

The simulation of Task 2 results are consistent with the behavior of the real-life circuit.





Task 5

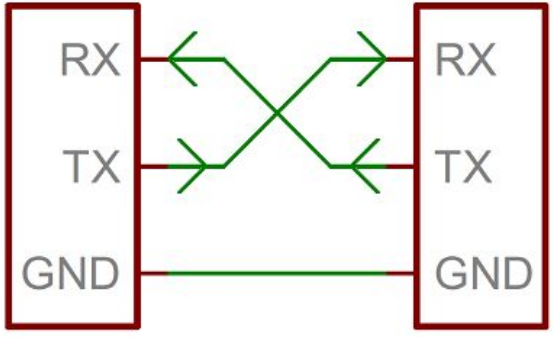
Connections Techniques to connect µCs

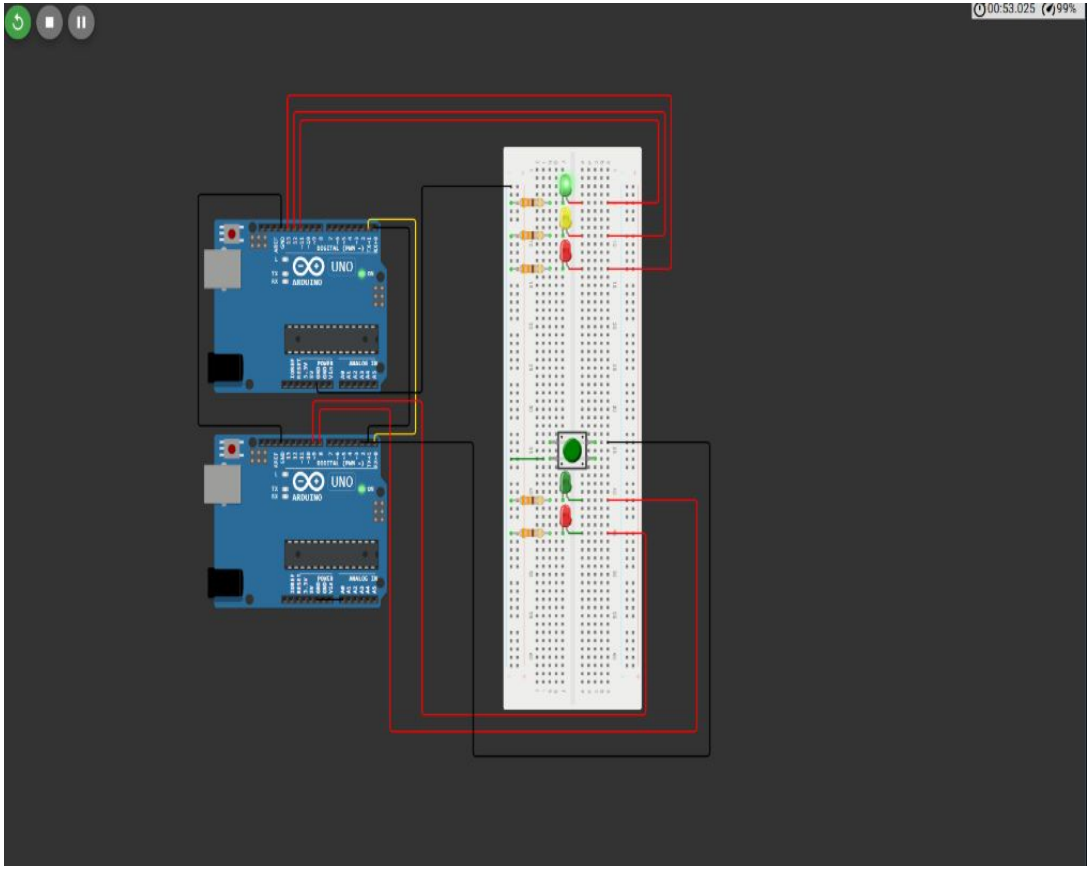
UART SPI

I2C CAN

Task 5

Adjusting the circuit from task 4 by adding a second microcontroller, and wiring the two microcontrollers according to the UART wiring.





Task 5

Starting the serial communication Between the car traffic light and the pedestrian light

```
117  void loop() {
118    // Update car light
119    carLight.update();
120
121    // check for data from pedestrian uC
122    if (Serial.available() > 0) {
123      char received = Serial.read();
124      if (received == 'P') {
125        carLight.requestPedestrianCrossing(); // button was pressed
126      }
127    }
128
129    // send status to pedestrian uC
130    // 'G' = car is red (ped go), 'S' = car is moving (ped stop)
131    char stateToSend;
132    if (carLight.isRed()) {
133      stateToSend = 'G';
134    } else {
135      stateToSend = 'S';
136    }
137
138    // only send if state changed to avoid flooding serial
139    if (stateToSend != lastSentState) {
140      Serial.write(stateToSend);
141      lastSentState = stateToSend;
142    }
143  }
```

```
55  void setup() {
56    pedLight.begin();
57    Serial.begin(9600); // start serial communication
58  }
59
60  void loop() {
61    // check button and send request
62    if (pedLight.isButtonPressed()) {
63      Serial.write('P'); // send 'P' to car uC
64    }
65
66    // check for command from car uC
67    if (Serial.available() > 0) {
68      char command = Serial.read();
69
70      if (command == 'G') {
71        pedLight.setGreen(); // car is red, walk
72      }
73      else if (command == 'S') {
74        pedLight.setRed();   // car is not red, wait
75      }
76    }
77  }
78
```

Thanks For Your Attention