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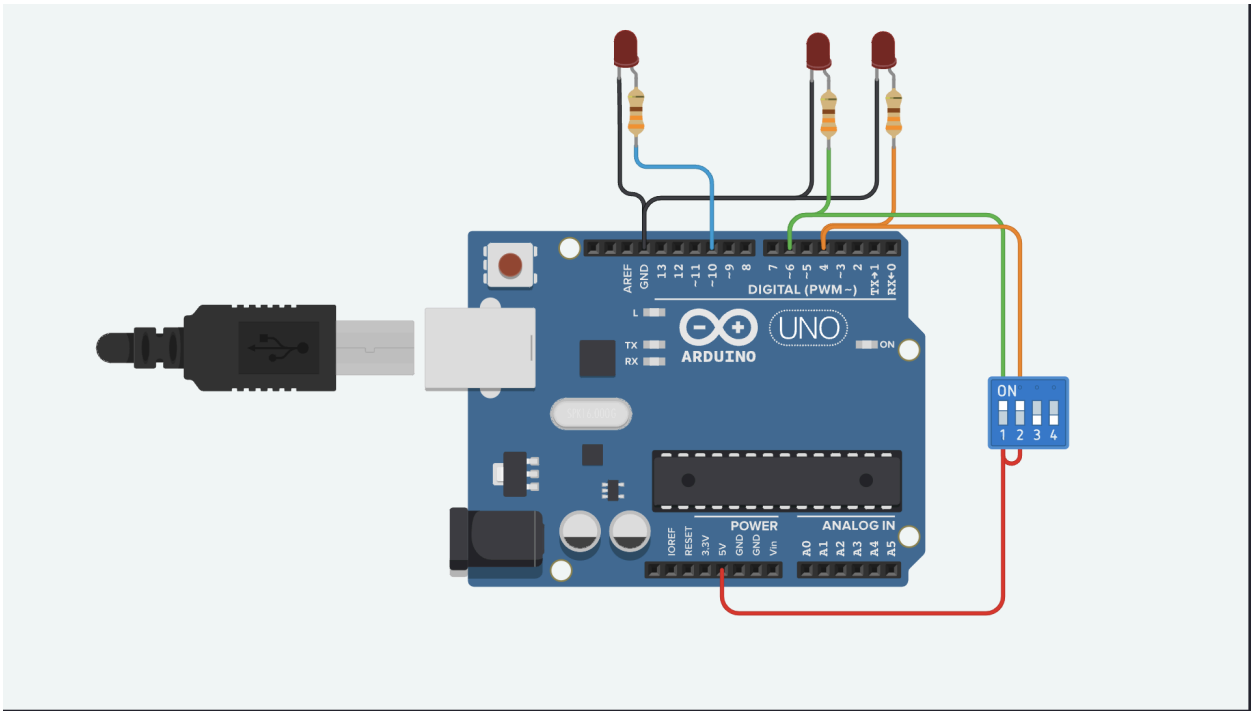
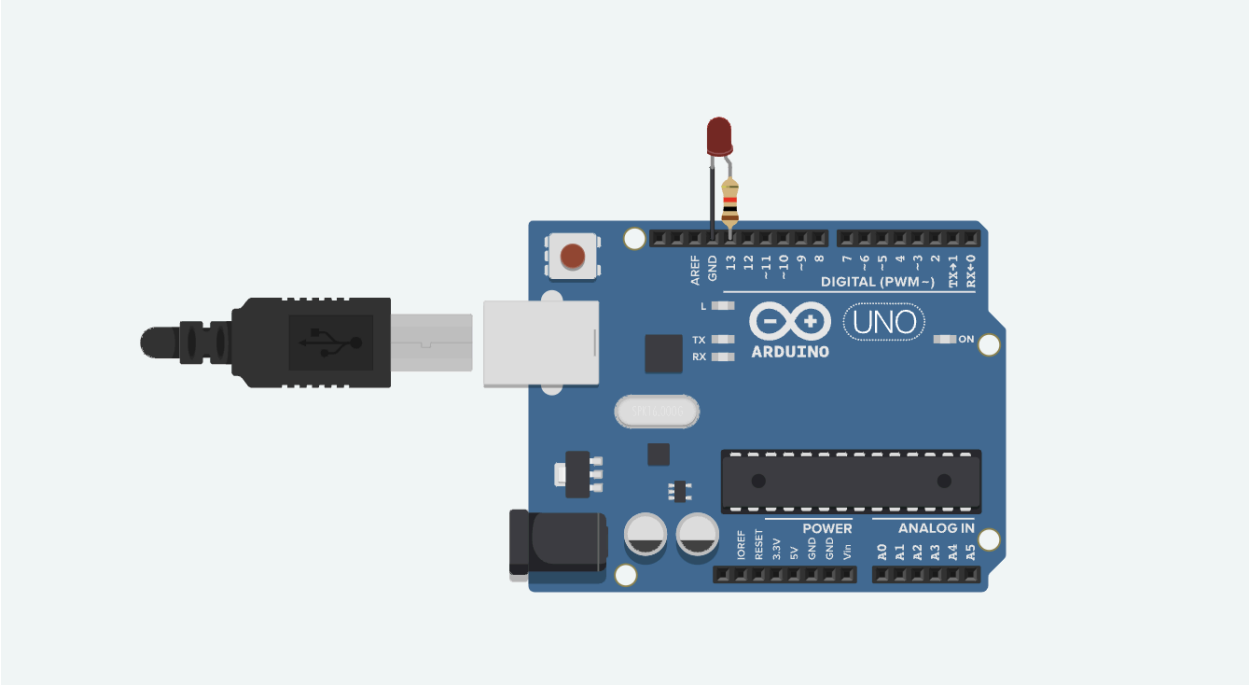
Basic Logic Gates




```
int InputA = 0;
int InputB = 0;
void setup(){
  pinMode(6, INPUT);
  pinMode(4, INPUT);
  pinMode(10, OUTPUT);
}
void loop(){
  InputA = digitalRead(6);
  InputB = digitalRead(4);

//-------------------------------------------------------------

//------------AND GATE--------------------
  //if(InputA == HIGH && InputB == HIGH){
    //digitalWrite(10, HIGH);
  //}else{
    //digitalWrite(10, LOW);
  //}
```

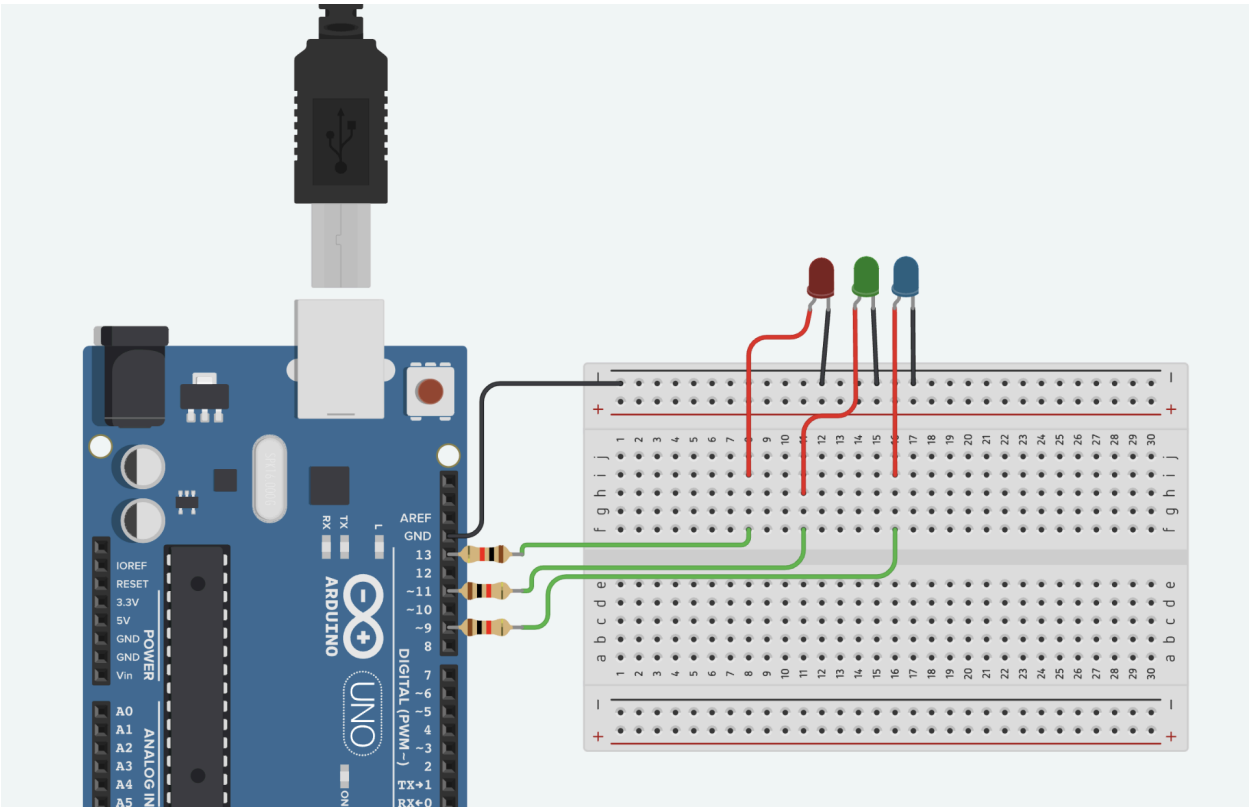
```
//----------OR GATE-----------------------
  //if(InputA == HIGH || InputB == HIGH){
    //digitalWrite(10, HIGH);
  //}else{
    //digitalWrite(10, LOW);
  //}

//-----------NAND GATE---------------------
  //if(InputA == HIGH && InputB == HIGH){
    //digitalWrite(10, LOW);
  //}else{
    //digitalWrite(10, HIGH);
  //}

//-----------NOR GATE---------------------
  //if(InputA == LOW && InputB == LOW){
    //digitalWrite(10, HIGH);
  //}else{
    //digitalWrite(10, LOW);
  //}

//-----------XOR GATE---------------------
  //if((InputA == LOW && InputB == HIGH) || (InputA == HIGH && InputB == LOW)){
    //digitalWrite(10, HIGH);
  //}else{
    //digitalWrite(10, LOW);
  //

//-----------XNOR GATE---------------------
  //if((InputA == LOW && InputB == LOW) || (InputA == HIGH && InputB == HIGH)){
    //digitalWrite(10, HIGH);
  //}else{
    //digitalWrite(10, LOW);
  //}

//-------------------------------------------------------------

  delay(10);
}
```

Blinking of LED Single




```
// C++ code
//
void setup()
{
  pinMode(LED_BUILTIN, OUTPUT);
}

void loop()
{
  digitalWrite(LED_BUILTIN, HIGH);
  delay(500); // Wait for 1000 millisecond(s)
  digitalWrite(LED_BUILTIN, LOW);
  delay(500); // Wait for 1000 millisecond(s)
}
```

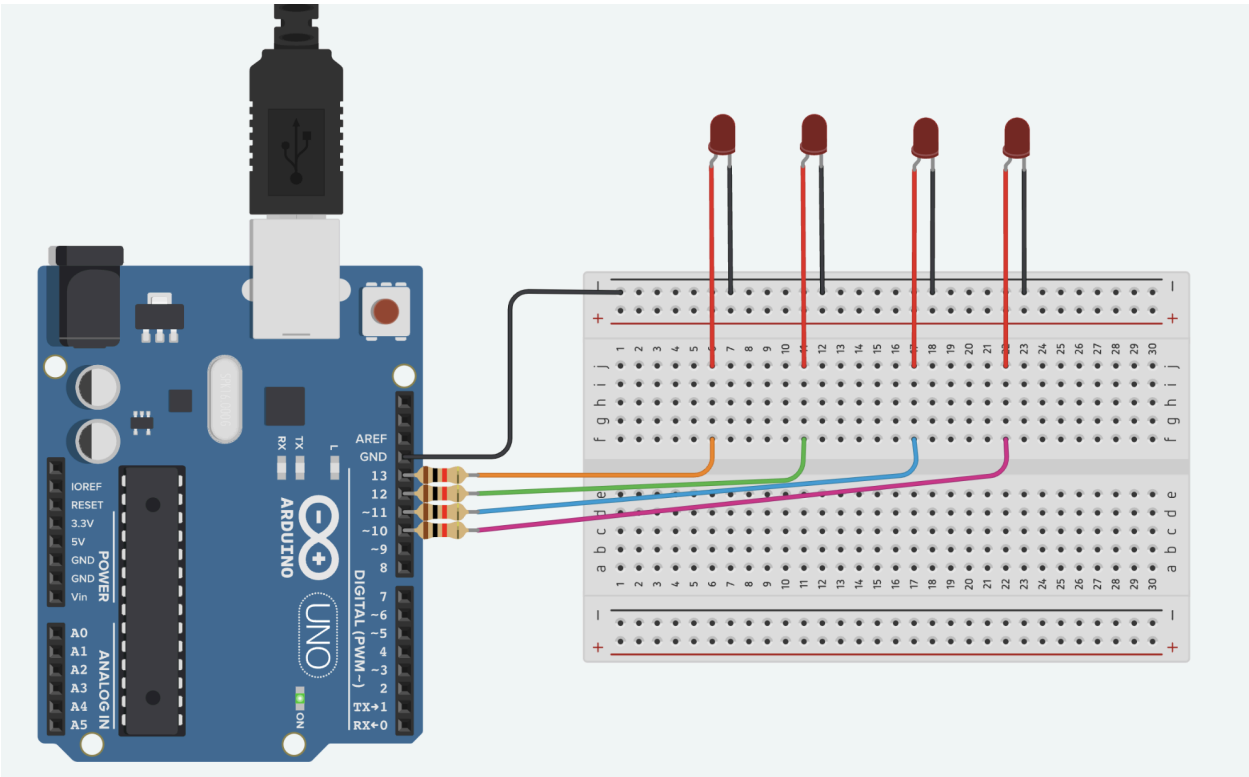
Blinking of LED Single Multiple (1 at a time)




```
// C++ code
//
void setup()
{
  pinMode(13, OUTPUT);
  pinMode(11, OUTPUT);
  pinMode(8, OUTPUT);
}

void loop()
{
  digitalWrite(13, HIGH);
  delay(200);
  digitalWrite(13, LOW);
  delay(200);
  digitalWrite(11,HIGH);
  delay(200);
  digitalWrite(11, LOW);
  delay(200);
  digitalWrite(9, HIGH);
  delay(200);
  digitalWrite(9, LOW);
```

```
  delay(200);
}
```

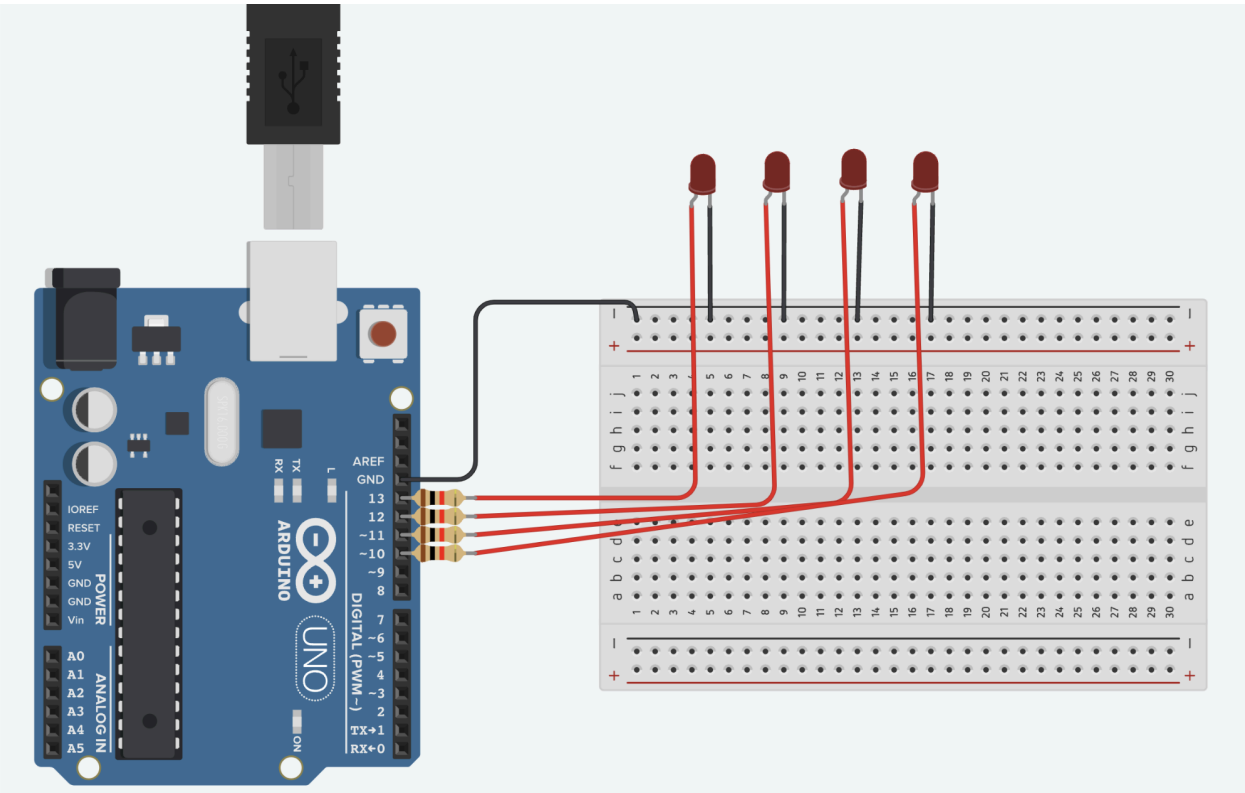
Blinking of LED all together




```
// C++ code
//
void setup()
{
  pinMode(13, OUTPUT);
  pinMode(12, OUTPUT);
  pinMode(11, OUTPUT);
  pinMode(10, OUTPUT);
}

void loop()
{
  digitalWrite(13, HIGH);
  digitalWrite(12, HIGH);
  digitalWrite(11, HIGH);
  digitalWrite(10, HIGH);
```

```
  delay(1000);
  digitalWrite(13, LOW);
  digitalWrite(12, LOW);
  digitalWrite(11, LOW);
  digitalWrite(10, LOW);
  delay(1000);
}
```

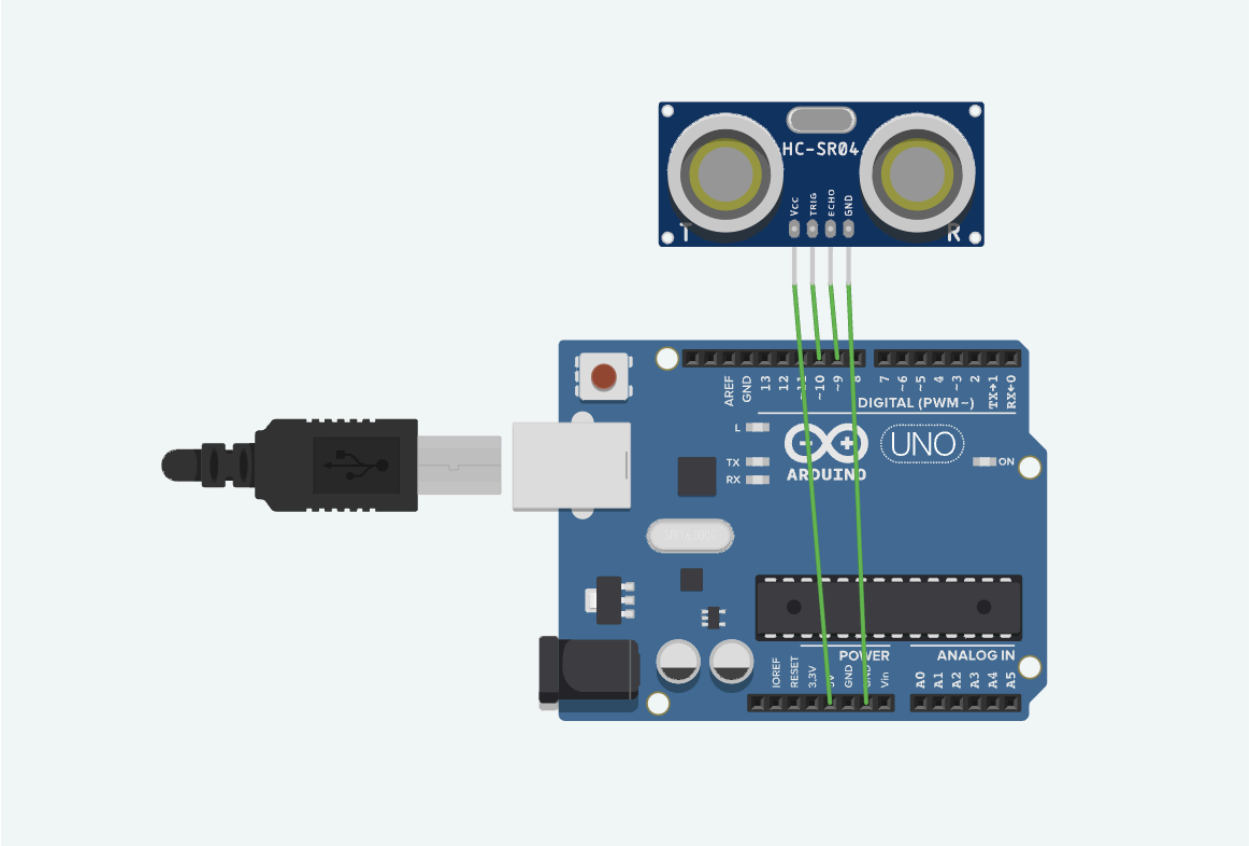
Blinking of LED 2 at a time/ Alternate




```
// C++ code
//
void setup()
{
  pinMode(LED_BUILTIN, OUTPUT);
  pinMode(12, OUTPUT);
  pinMode(11, OUTPUT);
  pinMode(10, OUTPUT);
}

void loop()
{
```

```
  digitalWrite(13, HIGH);
  digitalWrite(11, HIGH);
  delay(1000);
  digitalWrite(13, LOW);
  digitalWrite(11, LOW);
  delay(1000);
  digitalWrite(12, HIGH);
  digitalWrite(10, HIGH);
  delay(1000);
  digitalWrite(12, LOW);
  digitalWrite(10, LOW);
  delay(1000);
}
```

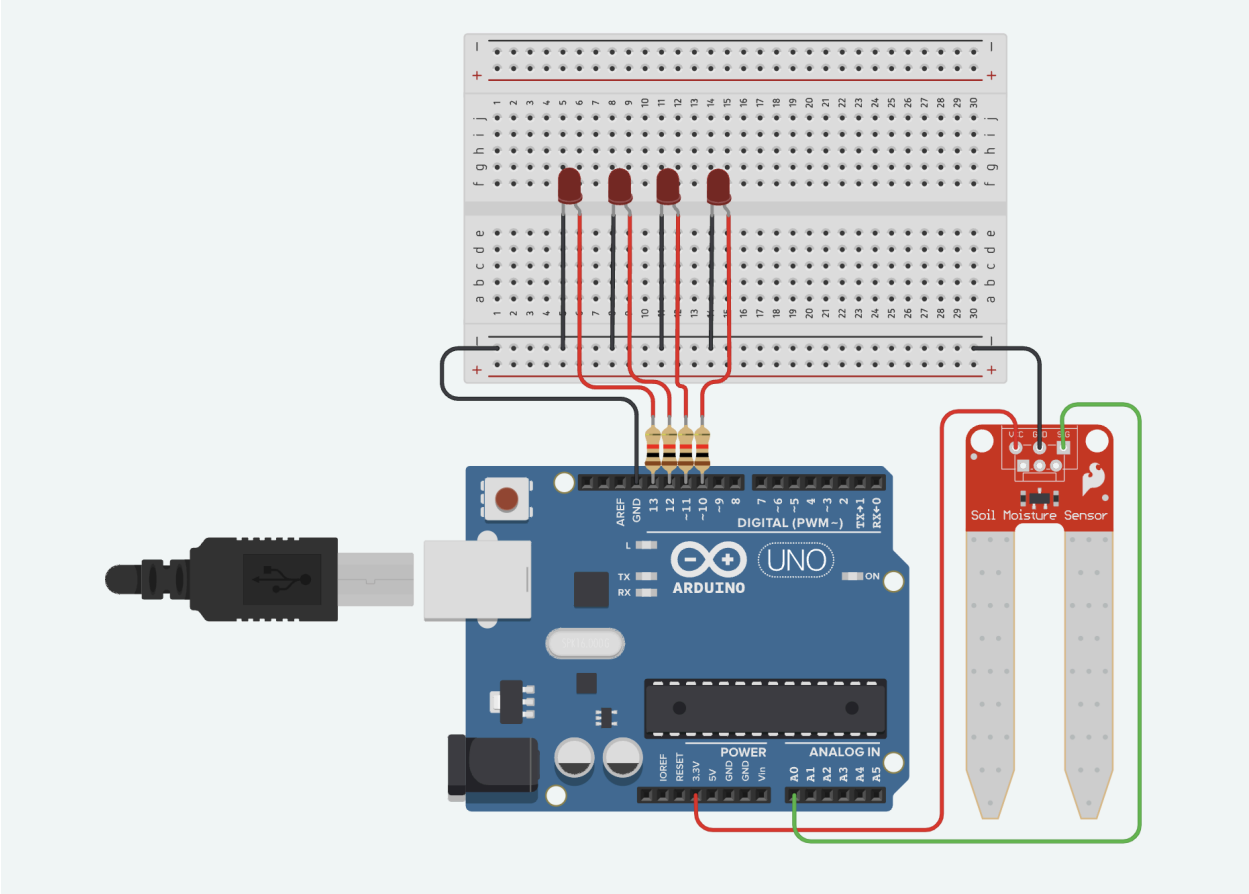
Ultrasonic Sensor




```
// C++ code
//
const int trigPin = 10;
```

```
const int echoPin = 10;

void setup()
{
  Serial.begin(9600);

  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
}

void loop()
{
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(2);
}
```

Soil Moisture




```
// C++ code
//
int moisture_value;
float moisture_percentage;

void setup()
{
  Serial.begin(9600);
  pinMode(13,OUTPUT);
  pinMode(12,OUTPUT);
  pinMode(11,OUTPUT);
  pinMode(10,OUTPUT);
}

void loop()
{
  moisture_value = analogRead(A0);
  moisture_percentage = ((moisture_value/539.00)*100);
```

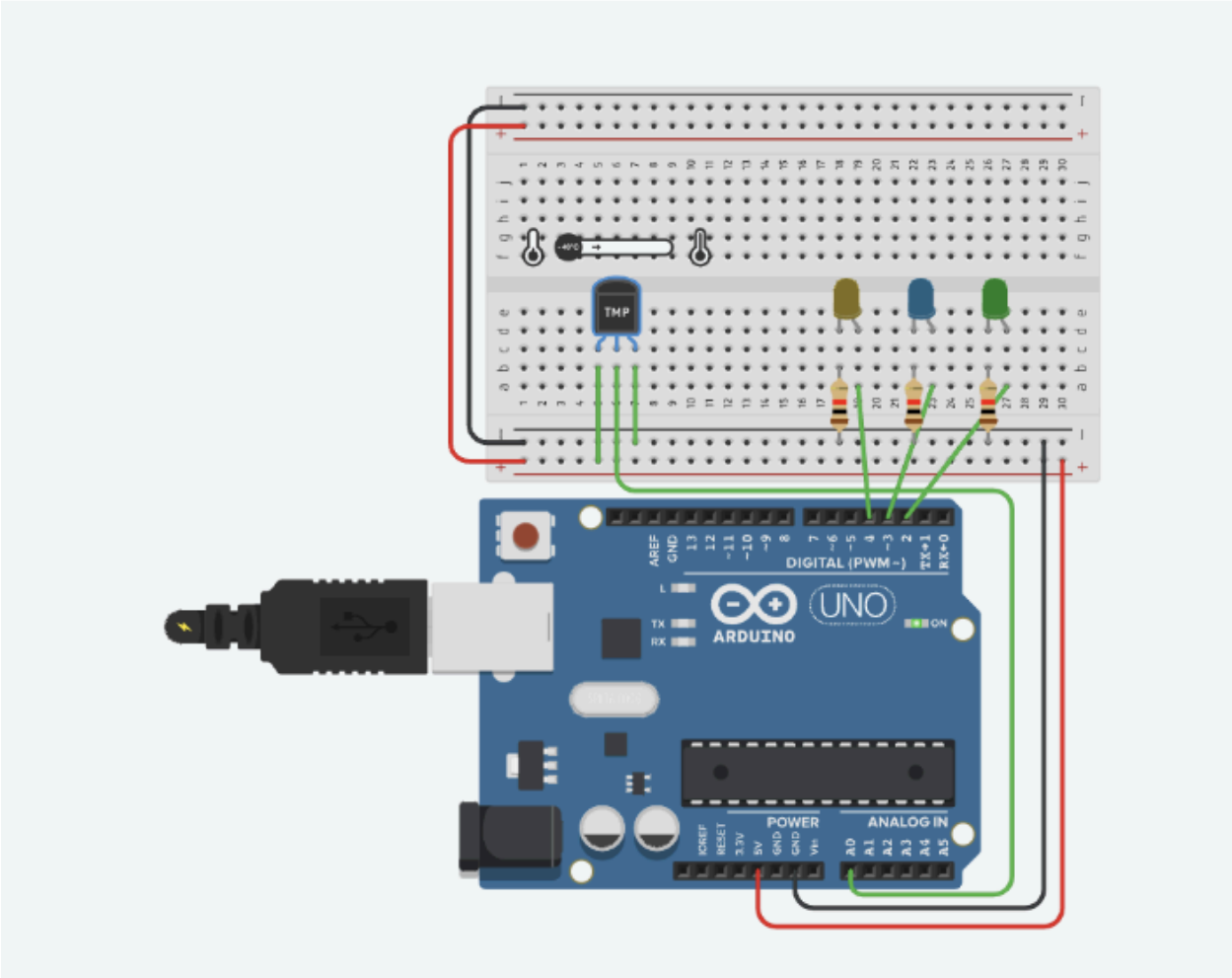
```
  if(moisture_percentage<25)
           digitalWrite(13,HIGH);
  else
  {
         digitalWrite(13,LOW);
if(moisture_percentage<50)
                digitalWrite(13,HIGH);
else
         {
                digitalWrite(13,LOW);
                if(moisture_percentage<75)
                        digitalWrite(11,HIGH);
                else
                {
                        digitalWrite(11,LOW);
                        if(moisture_percentage<100)
                                digitalWrite(10,HIGH);
                        else
                                digitalWrite(10,LOW);
                }
         }
  }
  Serial.print("\n Moisture Value (in %): ");
  Serial.print(moisture_percentage);
  Serial.print("%");
  delay(1000);
}
```

MY MODIFIED VERSION

```
// C++ code
//
int moisture_value;
float moisture_percentage;

void setup()
{
  Serial.begin(9600);
  pinMode(13,OUTPUT);
  pinMode(12,OUTPUT);
  pinMode(11,OUTPUT);
  pinMode(10,OUTPUT);
}

void loop()
```

```
{
  moisture_value = analogRead(A0);
  moisture_percentage = ((moisture_value / 539.00) * 100);

  if (moisture_percentage < 25){
    digitalWrite(13, HIGH);
  }
  else if (moisture_percentage > 25 && moisture_percentage < 50){
    digitalWrite(13, HIGH);
    digitalWrite(12, HIGH);
  }
  else if (moisture_percentage > 50 && moisture_percentage < 75){
    digitalWrite(13, HIGH);
    digitalWrite(12, HIGH);
    digitalWrite(11, HIGH);
  }
  else if (moisture_percentage > 75){
    digitalWrite(13, HIGH);
    digitalWrite(12, HIGH);
    digitalWrite(11, HIGH);
    digitalWrite(10, HIGH);
  }
  else
  {
    digitalWrite(10, LOW);
    digitalWrite(11, LOW);
    digitalWrite(13, LOW);
  }

  Serial.print("\n Moisture Value (in %): ");
  Serial.print(moisture_percentage);
  Serial.print("%");
  delay(1000);
}
```

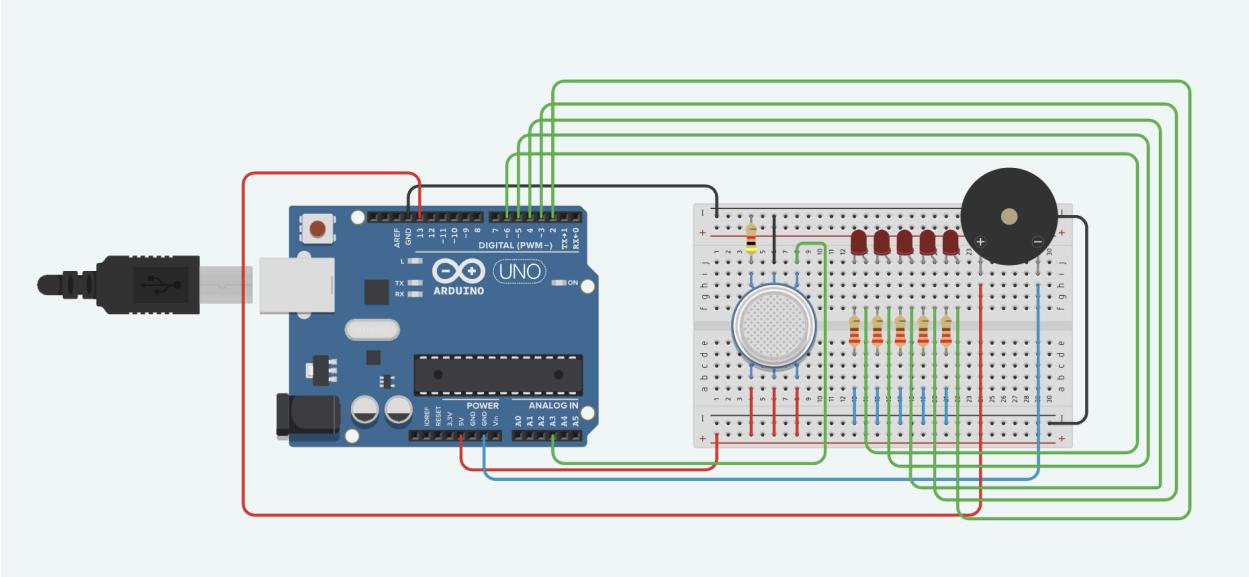
Temperature




```
int baselineTemp = 0;
int celsius = 0;
int fahrenheit = 0;

void setup()
{
  pinMode(A0, INPUT);
  Serial.begin(9600);

  pinMode(2, OUTPUT);
  pinMode(3, OUTPUT);
  pinMode(4, OUTPUT);
}

void loop()
{
  baselineTemp = 25;
```

```
  celsius = map(((analogRead(A0) - 20) * 3.04), 0, 1023, -40, 125);

   fahrenheit = ((celsius * 9) / 5 + 32);
  Serial.print(celsius);
  Serial.print(" C, ");
  Serial.print(fahrenheit);
  Serial.println(" F");

   if (celsius < baselineTemp) {
    digitalWrite(2, LOW);
    digitalWrite(3, LOW);
    digitalWrite(4, LOW);
  }
  if (celsius >= baselineTemp && celsius < baselineTemp + 10) {
    digitalWrite(2, HIGH);
    digitalWrite(3, LOW);
    digitalWrite(4, LOW);
  }
  if (celsius >= baselineTemp + 10 && celsius < baselineTemp + 20) {
    digitalWrite(2, HIGH);
    digitalWrite(3, HIGH);
    digitalWrite(4, LOW);
  }
  if (celsius >= baselineTemp + 20 && celsius < baselineTemp + 30) {
    digitalWrite(2, HIGH);
    digitalWrite(3, HIGH);
    digitalWrite(4, HIGH);
  }
  if (celsius >= baselineTemp + 30) {
    digitalWrite(2, HIGH);
    digitalWrite(3, HIGH);
    digitalWrite(4, HIGH);
  }
  delay(1000);
}
```

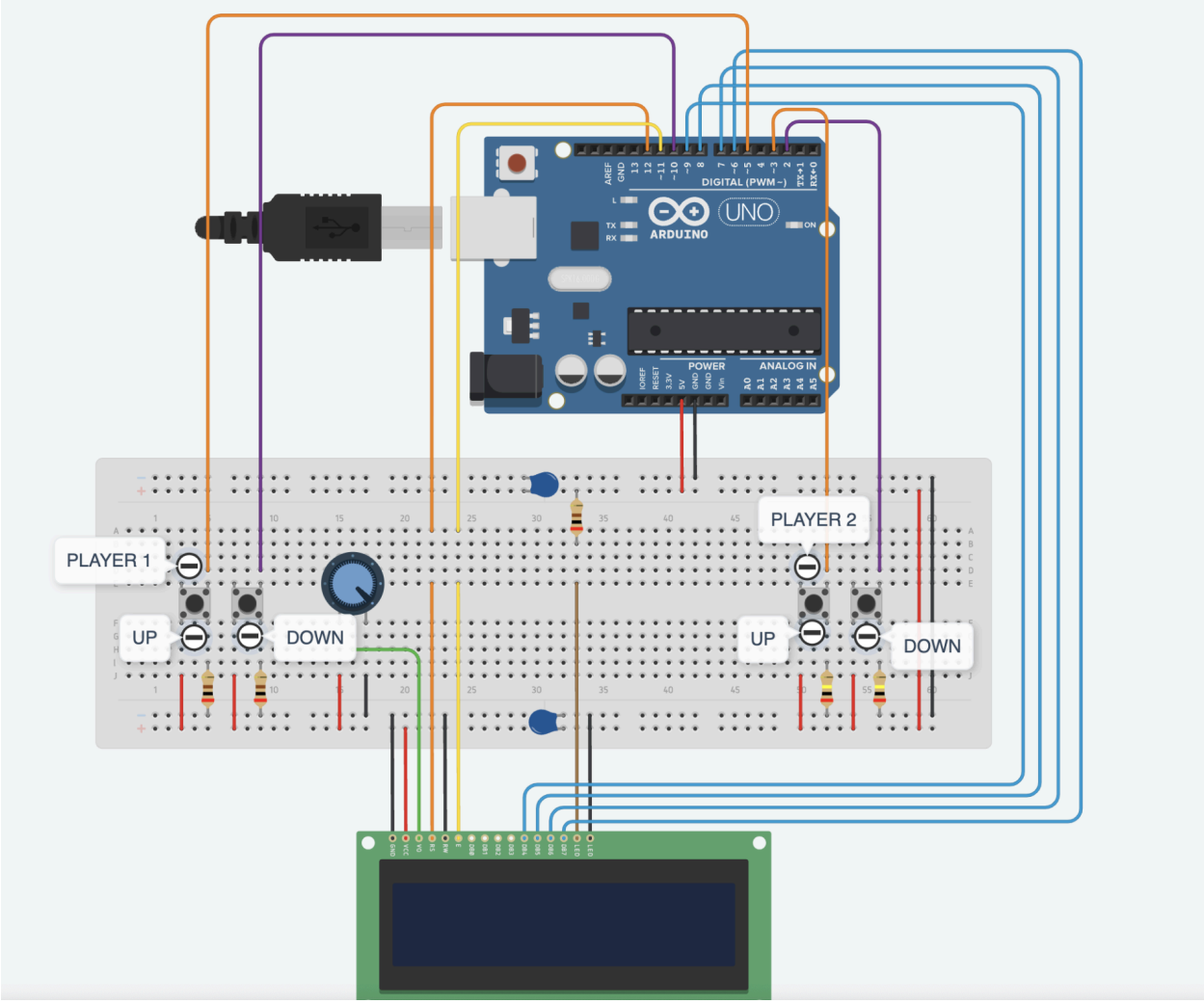
GAS SENSOR




```
#define BUZZER_PIN  13

// Pin 13 has an LED connected on most Arduino boards.
// give it a name:
#define PIN_LED_1   6
#define PIN_LED_2   5
#define PIN_LED_3   4
#define PIN_LED_4   3
#define PIN_LED_5   2
#define PIN_GAS     A3

// the setup routine runs once when you press reset:
void setup() {
  // initialize the digital pin as an output.
  pinMode(PIN_LED_1, OUTPUT);
  pinMode(PIN_LED_2, OUTPUT);
  pinMode(PIN_LED_3, OUTPUT);
  pinMode(PIN_LED_4, OUTPUT);
  pinMode(PIN_LED_5, OUTPUT);
  Serial.begin(9600);
}

// the loop routine runs over and over again forever:
void loop() {

  long frequency;
```

```
  int value = map(analogRead(PIN_GAS), 300, 750, 0, 100);
  digitalWrite(PIN_LED_1, HIGH);
   digitalWrite(PIN_LED_2, value >= 20 ? HIGH : LOW);
  digitalWrite(PIN_LED_3, value >= 40 ? HIGH : LOW);
  digitalWrite(PIN_LED_4, value >= 60 ? HIGH : LOW);
  digitalWrite(PIN_LED_5, value >= 80 ? HIGH : LOW);

  frequency = map(value, 0, 1023, 1500, 2500);
  // заставляем пин с пищалкой «вибрировать», т.е. звучать
  // (англ. tone) на заданной частоте 20 миллисекунд. При
  // следующих проходах loop, tone будет вызван снова и снова,
  // и на деле мы услышим непрерывный звук тональностью, которая
  // зависит от количества света, попадающего на фоторезистор
          if (value>=50){
             tone(BUZZER_PIN, frequency, 250);
    }

  Serial.println(value);
  delay(250); // wait for a quarter second
}
```

PING PONG




```
#include <LiquidCrystal.h>
#include <avr/interrupt.h>

//---------------------------------------MACROS-----------------------------------------

// Assigning LCD PINS
#define RS 12
#define EN 11
#define D4 9
#define D5 8
#define D6 7
#define D7 6

// Buttons that move the paddle
#define Player_1_moveDownButton 10   // Player 1's Down Button is connected to digital pin 4
```

```
#define Player_1_moveUpButton 5     // Player 1's Down Button is connected to digital pin 4
#define Player_2_moveDownButton 2   // Player 2's Down Button is connected to digital pin 4
#define Player_2_moveUpButton 3     // Player 2's Down Button is connected to digital pin 4

// Assigning Player Numbers
#define Player_1 1
#define Player_2 2

// Delay for updating the ball
#define DiagonalballUpdateTime 21
#define HorizontalballUpdateTime 15

//Starting Position of the Ball
#define Start_X 35
#define Start_Y 7

#define Button_Pressed (p1_UpButState | p1_DownButState | p2_UpButState |
p2_DownButState)

void(* resetFunc) (void) = 0;       //declaring reset function at address 0

// Global Variables for Pin Change Interrupt Service Routine
volatile boolean x_Up = true;
volatile boolean x_Down = true;

LiquidCrystal lcd(RS, EN, D4, D5, D6, D7);    // Creating Object of type Liquid Crystal

//-----------------------------------PADDLE CLASS----------------------------------------

class Paddle
{
  public:
  // Storing Value of each row of the Character Column for the Player's Paddle
  uint8_t PaddleColArray[16] = {0,0,0,0,0,4,4,4,0,0,0,0,0,0,0,0};

  uint8_t PaddlePos = 6;     // Recording Paddles's middle position as reference to move it
  uint8_t Score = 0;         // Score of each Player

  // When the Player presses the "UP" Button
  void MovePaddleUp()
  {
    // Make sure the paddle doesn't go off the board
    if(PaddlePos != 1)
    {
```

```
    PaddlePos--;
    PaddleColArray[PaddlePos+2]=0;
    PaddleColArray[PaddlePos-1]=4;
  }
}

// When the Player presses the "DOWN" Button
void MovePaddleDown()
{
  if(PaddlePos != 14)
  {
    PaddlePos++;
    PaddleColArray[PaddlePos-2]=0;
    PaddleColArray[PaddlePos+1]=4;
  }
}

// Printing Paddles using each Player's Number
void PrintPaddles(uint8_t Player_Num)
{
  if(Player_Num == 2)
  {
    // Each character must have a unique character ID and array to print
    lcd.createChar(0, PaddleColArray);
    lcd.createChar(1, PaddleColArray+8);

    // Move cursor to 15th character on the 1st row
    lcd.setCursor(14, 0);
    lcd.write(byte(0));

    // Move cursor to 15th character on the 1st row
    lcd.setCursor(14, 1);
    lcd.write(byte(1));
  }

  //if(Player_Num == 1)
  else
  {
    lcd.createChar(2, PaddleColArray);
    lcd.createChar(3, PaddleColArray+8);

    lcd.setCursor(1, 0);
    lcd.write(byte(2));
```

```
      lcd.setCursor(1, 1);
      lcd.write(byte(3));
    }
  }
};

// Creating Objects of Class "Paddle"
Paddle p1, p2;

//------------------------------------PRINT_GAME CLASS----------------------------------------

class Print_Game
{
  public:

  // Printing texts when the game starts
  void Start_Game()
  {
    lcd.print(F(" PING PONG GAME "));

    //Set the Cursor at the starting of 2nd row
    lcd.setCursor(0, 1);
    lcd.print(F("PRESS ANY BUTTON"));

    // Variables to record the state of Push-Buttons
    uint8_t p1_UpButState = 0;
    uint8_t p1_DownButState = 0;
    uint8_t p2_UpButState = 0;
    uint8_t p2_DownButState = 0;

    // Waiting till any one of the button is pressed
    while(!(Button_Pressed))
    {
      // Low Level Code for digitalread() function for each input pin
      p1_UpButState = ((PIND & (1 << Player_1_moveUpButton)) );
      p1_DownButState = ((PINB & (1 << (Player_1_moveDownButton-8))) );
      p2_UpButState = ((PIND & (1 << Player_2_moveUpButton)) );
      p2_DownButState = ((PIND & (1 << Player_2_moveDownButton)) );
    }
    lcd.clear();        //Clearing LCD to start the game
  }

  // Printing score each time a player scores
  void Print_Score()
```

```
  {
    // Clearing the LCD to print scores
    lcd.clear();
    lcd.print(F("PLAYER1  PLAYER2"));
    lcd.setCursor(3 ,1);
    lcd.print(p1.Score);
    lcd.setCursor(12 ,1);
    lcd.print(p2.Score);

    // Scores remain on the display for 2 seconds
    delay(2000);

    // Clearing the display to continue the game
    lcd.clear();
  }

  // Printing the Winner on Display
  void Print_Winner(int Player_Num)
  {
    lcd.setCursor(0 ,0);
    lcd.print(F("   GAME  OVER   "));
    lcd.setCursor(1, 1);
    lcd.print(F("PLAYER "));
    lcd.print(Player_Num);
    lcd.setCursor(11 ,1);
    lcd.print(F("WINS"));

    // Text remains on screen for 5 seconds
    delay(5000);

    // Resetting the Game
    resetFunc();
  }
};

// Creating an Object of Print_Game Class
Print_Game g;

//-----------------------------------BALL CLASS---------------------------------------

class Ball
{
  private:
```

```
  // Flag to reset the ball and paddles when a point is scored
  uint8_t Point_Scored = 0;

  // X and Y Direction Components of the Ball
  uint8_t ballYDir = 0;       // Ball starts off going horizontal
  uint8_t ballXDir = -1;      // Call starts off going left

  // Location of the Ball
  uint8_t ballY = Start_Y;
  uint8_t ballX = Start_X;

  // Row values of Character of the LCD in which the Ball is present
  uint8_t ballCharArray[8] = {0, 0, 0, 0, 0, 0, 0, 16};

  public:

  // Declaring member fucntions defined outside of class
  void GenerateBallArray();

  void PrintBall();

  void UpdateBall(uint8_t , uint8_t);

  void AwardAPoint();
};

//----------------------------Member Fuctions of Class BALL---------------------------------

// Generate the 8 values that make up the character to draw
void Ball :: GenerateBallArray()
{
  for(uint8_t i=0; i<8; i++)
    {
    if(i == (ballY % 8))
    {
      ballCharArray[i] = 2 << (4 - (ballX % 5));
    }
    else
    {
      ballCharArray[i] = 0;
    }
  }
}
```

```
void Ball :: PrintBall()
{
  // Calculate the column we will draw in
  uint8_t LCDCol = ballX / 5;

  // Either the top or bottom row
  uint8_t LCDRow = (ballY <= 7) ? 0 : 1;

  // Assign array to the charNum
  lcd.createChar(4, ballCharArray);

  // Move the cursor into position
  lcd.setCursor(LCDCol,LCDRow);

  // Draw the character
  lcd.write(byte(4));
}

// Updating the Ball's Position
void Ball :: UpdateBall(uint8_t P1_PaddlePos, uint8_t P2_PaddlePos)
{
  // Short wait before update
  // Handling different delays so that
  // ball has same speed when it's going diagonally
  if(ballYDir)          // When it's going Diagonally
  {
    delay(DiagonalballUpdateTime);
  }
  else                  // When it's going Horizontally
  {
    delay(HorizontalballUpdateTime);
  }

  //-------------CALCULATING BALL'S NEXT POSITION------------

  //If the Ball goes off-board
  if((ballX <= 6) || (ballX >= 73))
  {
    AwardAPoint();
  }

  //If Ball is at the Player 2 edge
  else if(ballX == 72)
  {
```

```
  // IF THE BALL STRIKES THE MIDDLE POSITION OF THE PADDLE
  if(ballY == P2_PaddlePos)
  {
    ballXDir = -1;
  }

  // IF THE BALL STRIKES THE BOTTOM POSITION OF THE PADDLE
  else if(ballY == (P2_PaddlePos + 1))
  {
    ballXDir = -1;
    if(ballY == 15)    // If the ball strikes the paddle at the bottom corner of the display
    {
      ballYDir = -1;
    }
    else
    {
      ballYDir = 1;
    }
  }

  // IF THE BALL STRIKES THE TOP POSITION OF THE PADDLE
  else if(ballY == (P2_PaddlePos - 1)){
    ballXDir = -1;
    if(ballY == 0)    // If the ball strikes the paddle at the upper corner of the display
    {
      ballYDir = 1;
    }
    else
    {
      ballYDir = -1;
    }
  }
}

//If Ball is at the Player 1 edge
else if(ballX == 7)
{
  // IF THE BALL STRIKES THE MIDDLE POSITION OF THE PADDLE
  if(ballY == P1_PaddlePos)
  {
    ballXDir = 1;
  }

  // IF THE BALL STRIKES THE BOTTOM POSITION OF THE PADDLE
```

```
  else if(ballY == (P1_PaddlePos + 1)){
    ballXDir = 1;
    if(ballY == 15)    // If the ball strikes the paddle at the bottom corner of the
    {
      ballYDir = -1;
    }
    else
    {
      ballYDir = 1;
    }
  }

  // IF THE BALL STRIKES THE TOP POSITION OF THE PADDLE
  else if(ballY == (P1_PaddlePos - 1))
  {
    ballXDir = 1;
    if(ballY == 0)    // If the ball strikes the paddle at the upper corner of the display
    {
      ballYDir = 1;
    }
    else
    {
      ballYDir = -1;
    }
  }
}

// If the Ball Hit top or bottom of display then change Y Direction
else if((ballY == 0) || (ballY == 15))
{
  ballYDir *= -1;
}

//Resetting the Ball and Paddles IF a point is scored
if(Point_Scored == 1)
{
  // Resetting the Ball
  ballX = Start_X;
  ballY = Start_Y;
  ballXDir *= -1;
  ballYDir = 0;

  // Resetting the Paddles
  p1.PaddlePos = 6;
```

```
    p2.PaddlePos = 6;

    for(uint8_t i=0; i<16; i++)
    {
      if((i==5) || (i==6) || (i==7))
      {
        p1.PaddleColArray[i] = 4;
        p2.PaddleColArray[i] = 4;
      }
      else
      {
        p1.PaddleColArray[i] = 0;
        p2.PaddleColArray[i] = 0;
      }
    }

    Point_Scored = 0;         //Resetting the Point_Scored Flag
  }

  //  Delete Ball from it's Current Location
  uint8_t LCDCol = ballX / 5;
  uint8_t LCDRow = (ballY <= 7) ? 0 : 1;
  lcd.setCursor(LCDCol, LCDRow);
  lcd.print(" ");

  // Change ball's position based on direction set on X & Y
  ballX += ballXDir;
  ballY += ballYDir;

  // Create the array for the ball character
  GenerateBallArray();

  // Printing ball after calculating the new location
  PrintBall();
}

// Increase player's score each time one scores
void Ball :: AwardAPoint()
{
  if(ballX <= 8)    // When Player 2 Scores
  {
    p2.Score++;
  }
```

```
  else              // When Player 2 Scores
  {
    p1.Score++;
  }

  // When one of the player reaches the winning score of 10

  if(p1.Score == 10)            // If Player 1 reaches 10 first
  {
    g.Print_Winner(Player_1);   // Printing Player 1 as Winner
  }

  else if(p2.Score == 10)       // If Player 2 reaches 10 first
  {
    g.Print_Winner(Player_2);   // Printing Player 2 as Winner
  }

   // Printing the Score of both players
  g.Print_Score();

  Point_Scored = 1;         // Setting the Flag to reset the locations of Paddles and Ball
}

// Creating an Object of class BALL
Ball b;

//---------------------------------------SETUP-------------------------------------------

void setup()
{
  // The display has 2 rows with 16 characters per row
  lcd.begin(16, 2);

  // Setup buttons so we can receive input
  DDRD &= ~(1<<Player_1_moveUpButton);
  // Low level version of the statement: pinMode( Player_1_moveUpButton, INPUT);
  // Similarly, setting all other pins to input
  DDRD &= ~(1<<Player_1_moveDownButton);
  DDRD &= ~(1<<Player_2_moveUpButton);
  DDRD &= ~(1<<Player_2_moveDownButton);

  // Printing the first statement
  g.Start_Game();
```

```
  // Print paddles on LCD
  p1.PrintPaddles(Player_1);
  p2.PrintPaddles(Player_2);

  // Print Ball on LCD
  b.PrintBall();

  // Enabling Pin Change Interrup for Player 1's "UP" Button
  PCMSK2 |= (1 << PCINT21);
  PCICR |= (1 << PCIE2);

  // Enabling Pin Change Interrup for Player 1's "DOWN" Button
  PCMSK0 |= (1 << PCINT2);
  PCICR |= (1 << PCIE0);

  // Enabling Global interrupts
  sei();

  //Player 2 will input through Interrupts
  attachInterrupt(digitalPinToInterrupt(Player_2_moveDownButton), P2_Move_Down, RISING);
  attachInterrupt(digitalPinToInterrupt(Player_2_moveUpButton), P2_Move_Up, RISING);
}

//--------------------------------------LOOP--------------------------------------------

void loop()
{
  //Printing Both Paddles
  p1.PrintPaddles(Player_1);
  p2.PrintPaddles(Player_2);

  //Updating Ball's Position
  b.UpdateBall(p1.PaddlePos, p2.PaddlePos);
}

//-----INTERRUPT SERVICE ROUTINES----FOR PLAYER 2-------------

void P2_Move_Down()
{
  p2.MovePaddleDown();
}

void P2_Move_Up()
{
```

```
  p2.MovePaddleUp();
}

//----PIN CHANGE INTERRUPT SERVICE ROUTINES----FOR PLAYER 1-----

// Interrupt Routine for Player 1 "UP" Button
ISR(PCINT2_vect)
{
  // The if statements make sure that interrupts does something
  // only on rising edge of the clock
  if(x_Up)
  {
    p1.MovePaddleUp();
    x_Up = false;
  }
  else
  {
    x_Up = true;
  }
}

// Interrupt Routine for Player 1 "DOWN" Button
ISR(PCINT0_vect)
{
  // The if statements make sure that interrupts does something
  // only on rising edge of the clock
  if(x_Down)
  {
    p1.MovePaddleDown();
    x_Down = false;
  }
  else
  {
    x_Down = true;
  }
}
```