Arduino DC Motor with Ultrasonic Sensor

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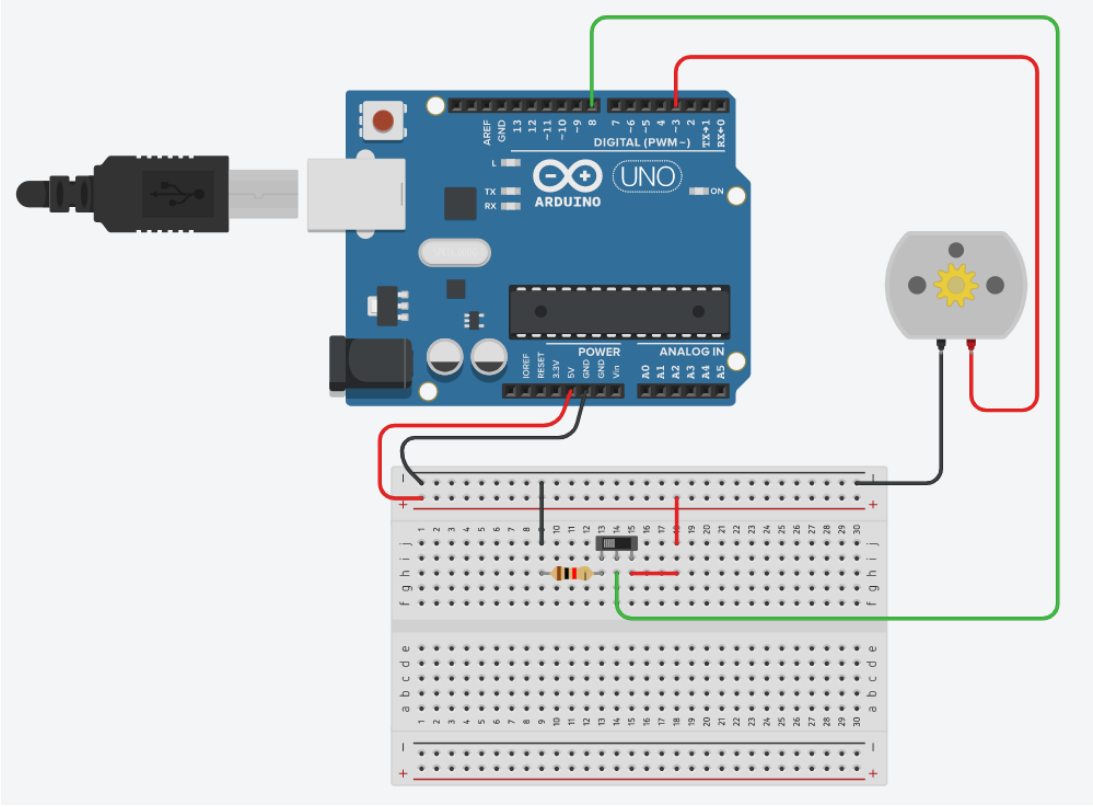
1. Navigate to TinkerCAD > Create the following circuit > Circuit > Create a New Circuit > Rename to DC Motor w/Ultrasonic

DC Motor

2. DC Motor has two wires
    a. Red Wire: Voltage wire that can be
        i. wired into the 5V turning the motor on with no off switch unless a switch is wired in front of it
        ii. wired to a digital port, allowing the user to turn the motor on and off using
    b. Black Wire: Ground Wire

    Motor Movement: DC Motor states
    - High: Full Speed
    - Low: Stopped
    - Variable: With a transistor, diode and potentiometer DC motors can be variable speed and direction

3. Wire the following circuit



4. Write the following code

```
int button = 8;
int motor = 3;


void setup()
{
pinMode(button , INPUT);
pinMode(motor , OUTPUT);
}

void loop()
{

  int buttonstate = digitalRead(button);

  if (buttonstate == 1)
  {

  digitalWrite(motor , LOW);

  } else {

  digitalWrite(motor , HIGH);

  }
}
```

5. Run the Simulation Test > Test the motor turning it On and Off

Ultrasonic Sensor

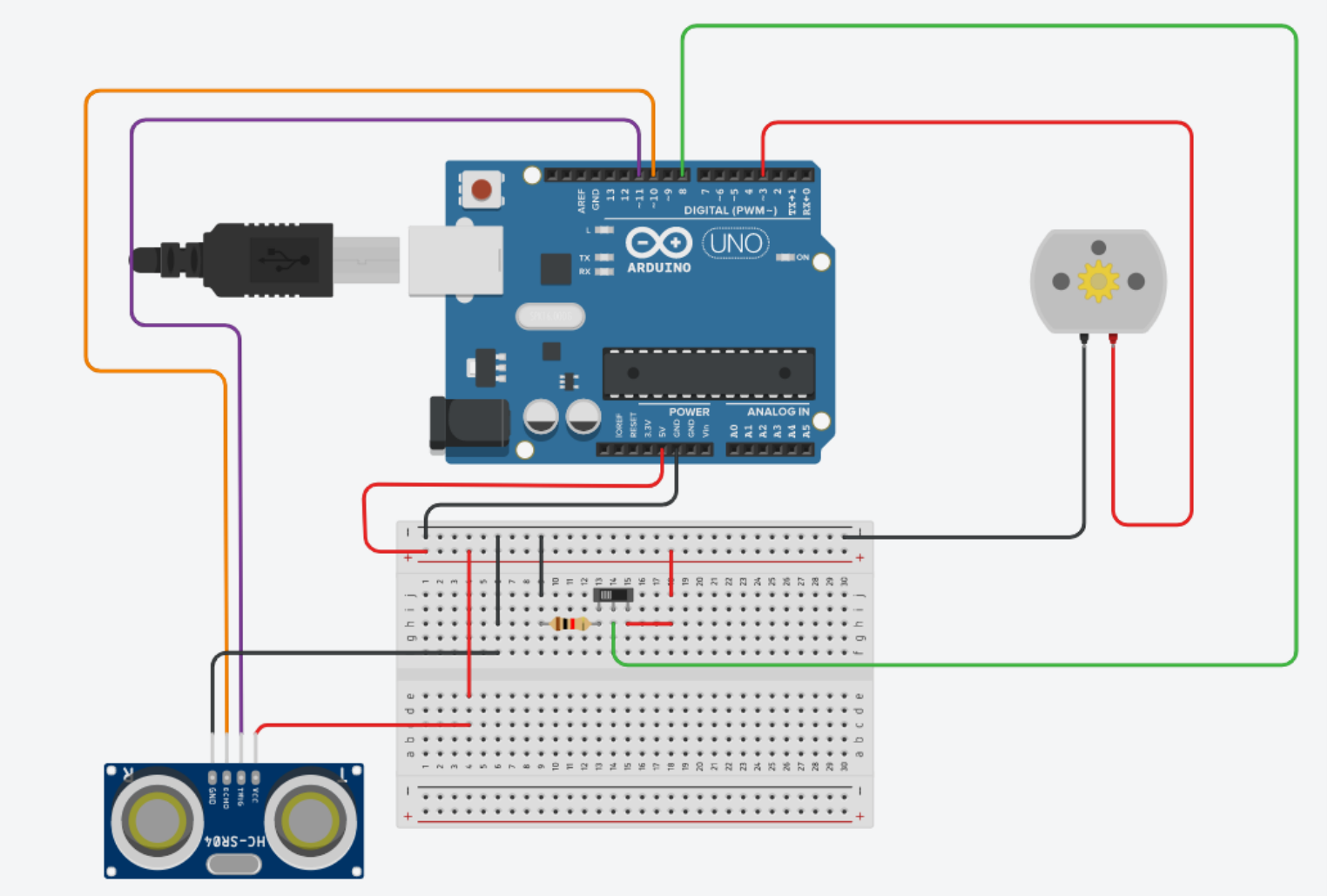
Ultrasonic Sensor is designed to send out a sound wave signal called the Trigger; and receive the bounced back sound wave into the Echo port. The sound wave will pulsate the Trigger on and off so the sound wave returning from the contacted object will be able to pass between the pulses. If the Trigger was constantly on the returning sound wave would be distorted.

Trigger Sound Wave will be a conical shape and can be distorted from ambient noise and materials that absorb sound (i.e cardboard, tennis ball, etc.)

Sound Calculation Formula: Distance L = 1/2 × T × C

where L is the distance, T is the time between the emission and reception, and C is the sonic speed. (The value is multiplied by 1/2 because T is the time for go-and-return distance.)

2. Add the Ultrasonic Sensor to the Circuit as shown

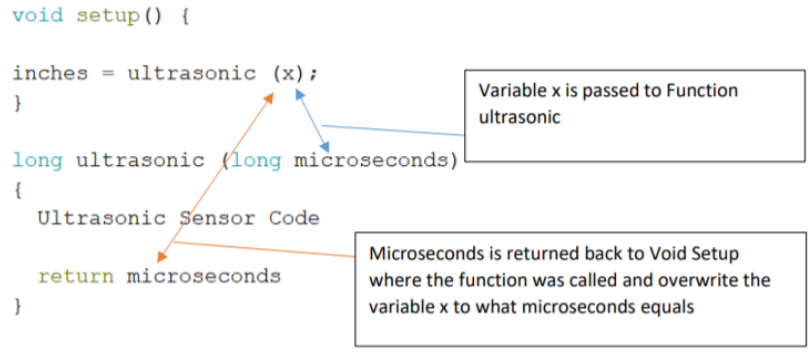


3. Write the following Program

Function: The following program will also use a function to help consolidate the code that will be used to turn the ultrasonic sensor on/off and convert the sound wave value to measureable unit in inches.

Function Example (See Reference Document Function for more details.)

Tutorial Program Function:




```
#include <Servo.h>

int button = 8;
int motor = 3;
int trigpin = 11;
int echopin = 10;


void setup()
{
  pinMode(button , INPUT);
  pinMode(motor , OUTPUT);
  pinMode (trigpin, OUTPUT);
  Serial.begin (9600);
}
```

```
void loop()
{
  long x, inches;
  int buttonstate = digitalRead(button);
  while (buttonstate == 1)
  {

    // microsecondsToInches sends variable x to the function. Senses distances using sound
    //calculate sound wave distance to inches and sends the value back to the void loop function
    inches = microsecondsToInches(x);
    delay (1000);
    Serial.print ("Inches= ");
    Serial.println (inches);



   // Turning the motor on/off
   // High = On, Low = Off
   if (inches > 10)
   {
     digitalWrite(motor, HIGH);
   }
   else
   {
     digitalWrite(motor, LOW);
   }
  }
}
```

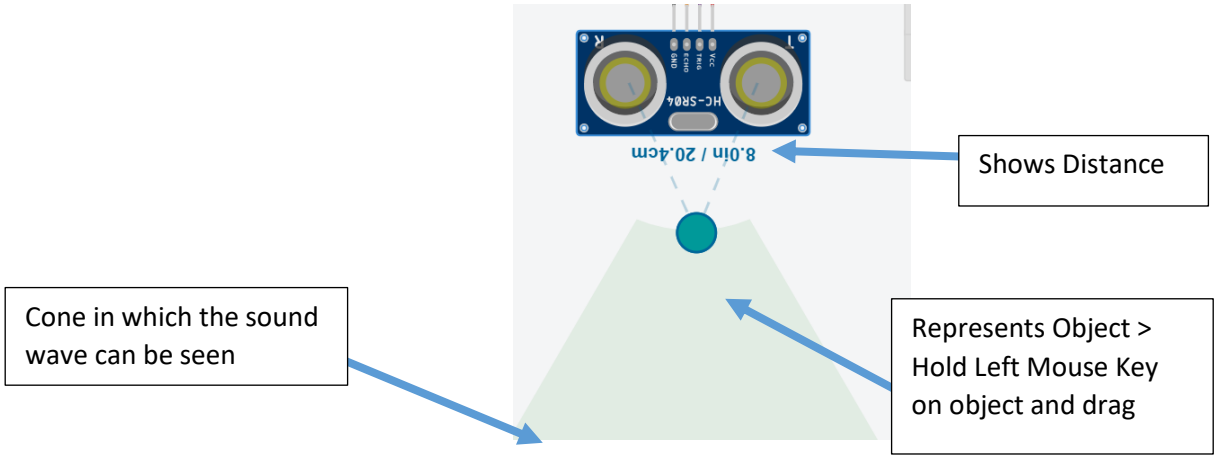
```
double microsecondsToInches(long duration)
{
  // Function is a sub program that can be utilized
  // in many parts of the program without rewriting the code.
  // The Return Function returns a value of microseconds to
  // the main program body


  //Next four lines of code pulsate a single out then in for defined time
  //calulates the duration the sound wave takes to come back to sensor
  digitalWrite(trigpin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigpin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigpin, LOW);

  // converts duration (Sound) to inches
  duration = pulseIn(echopin, HIGH);
  return duration / 74 / 2;
}
```

3. Run the Simulation Test button and the ultrasonic sensor

How to Work the Ultrasonic Sensor > Select Ultrasonic Sensor > Drag the blue location dot that represents an object



Assignment: Add the following components and add code to the program

1. Add a push button that represents Emergency Stop
    a. Activated only when in the Object is out of range with the ultrasonic sensor
    b. When pressed Motor will stop
    c. Attach a Speaker (See Reference Document Piezo) Will sound error sound; use Piezo Speaker (NOTE: noTone ("DIGITAL PORT#"); will turn off the piezo speaker
2. Distance Reactions
    a. Object: Less than 8in and greater 125"
        i. RGB LED: RED Color
        ii. Output in Serial Monitor: Error! Out of Range
        NOTE: Only output 1 time
        iii. Sound Piezo speaker until Emergency Button is pressed then turn off piezo speaker
        iv. Stop Motor
    b. Object: Object< = 15 or Object>=100
        i. RGB LED: Yellow Color
        ii. Output in Serial Monitor: Caution!!
        iii. Motor Runs
    c. Object: Object > 15 and Object < 100
        i. RGB LED: Green Color
        ii. Output in Serial Monitor: Within Operating Range
        iii. Motor Runs

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