Chapter 3

SHM System Overview

3.1. General

The SHM system developed in this work consists of PZT knock sensors to detect the vibration , temperature and humidity sensor to see the variation of temperature and humidity, ultrasonic sensor to measure deflection, an aurinido uno board for reading the sensor outputs, and USB device to forward the data provided by the sensor mote to the laptop.

3.2. PZT knock sensor connection

The black wire (the lower voltage) is connected to ground and the red wire (the higher voltage) is connected to analog pin 0. A 1-megohm resistor is connected in parallel to the Piezo element to limit the voltage and current produced by the piezo and to protect the analog input. Additonal ground is also provided. In order to connect more than two sensor ,a board was prepared

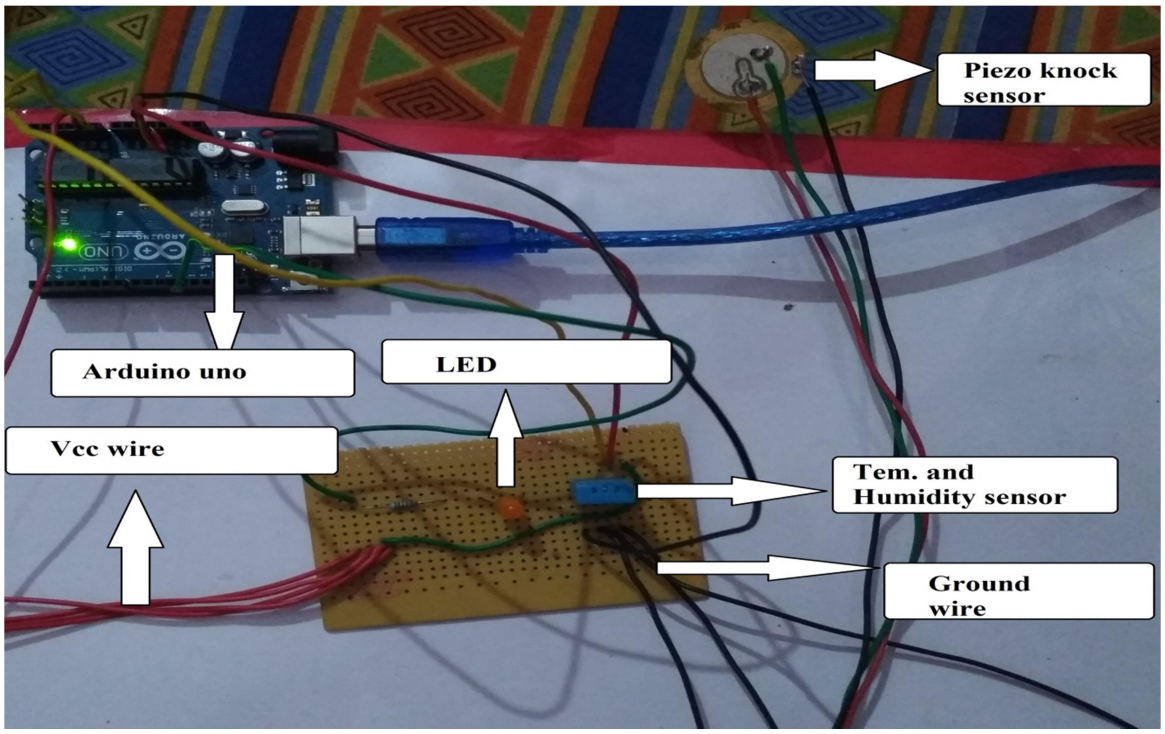

Figure 3.1 Image showing pzt knock sensor connection

Circuit Diagram

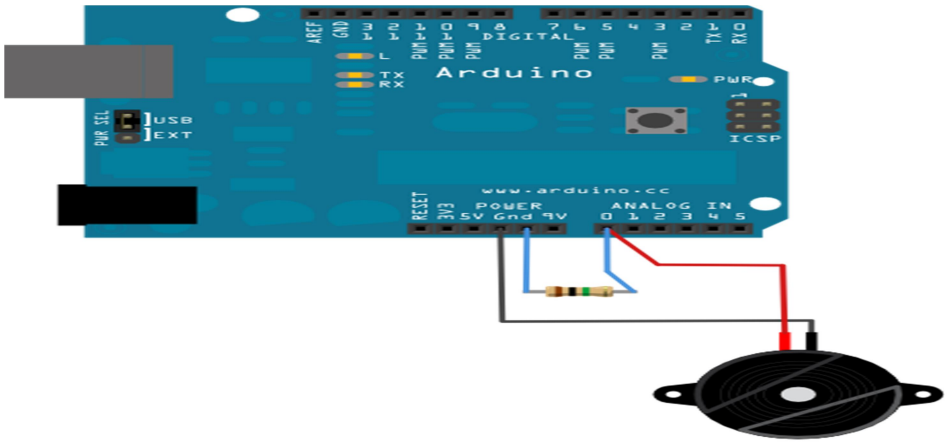

Figure 3.2 Circuit diagram of PZT sensor

Coding for Piezo-knock sensor

```
#include "dht.h"
#define dht_apin A0 // Analog Pin sensor is connected to
 int piezo_Pin= A1;
 int LED_Pin= 13;
dht DHT;
 int threshold=500;
void setup(){

  Serial.begin(9600);
  pinMode(LED_Pin, OUTPUT);
  delay(500);//Delay to let system boot
  Serial.println("DHT11 Humidity & temperature Sensor\n\n");
  Serial.println("Pressure value");
  delay(1000);//Wait before accessing Sensor

}//end "setup()"

void loop()
{
  //Start of Program

    DHT.read11(dht_apin);

    Serial.print("Current humidity = ");
    Serial.print(DHT.humidity);
    Serial.print("%  ");
    Serial.print("temperature = ");
    Serial.print(DHT.temperature);
    Serial.println("C  ");
    int reading= analogRead(piezo_Pin);
    Serial.print("Pressure Value:  ");
    Serial.println(reading);
    if (reading > threshold)
    {
      digitalWrite(LED_Pin, HIGH);
```

```
      digitalWrite(LED_Pin, LOW);
    }

    delay(1000);//Wait 5 seconds before accessing sensor again.

  //Fastest should be once every two seconds.

}// end loop()
```

3.3 Ultrasonic sensor connection

The HC-SR04 Ultrasonic Module has 4 pins, Ground, VCC, Trig and Echo. The Ground and the VCC pins of the module are connected to the Ground and the 5 volts pins on the Arduino Board respectively and the trig and echo pins to any Digital I/O pin on the Arduino Board.

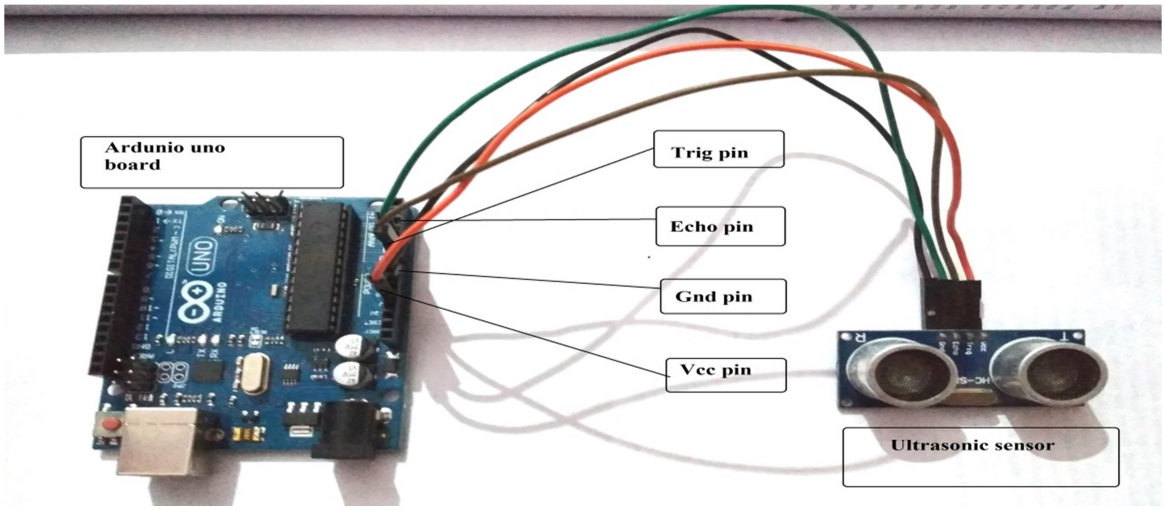

Figure 3.3 Image depicting connection for ultrasonic sensor

Circuit diagram

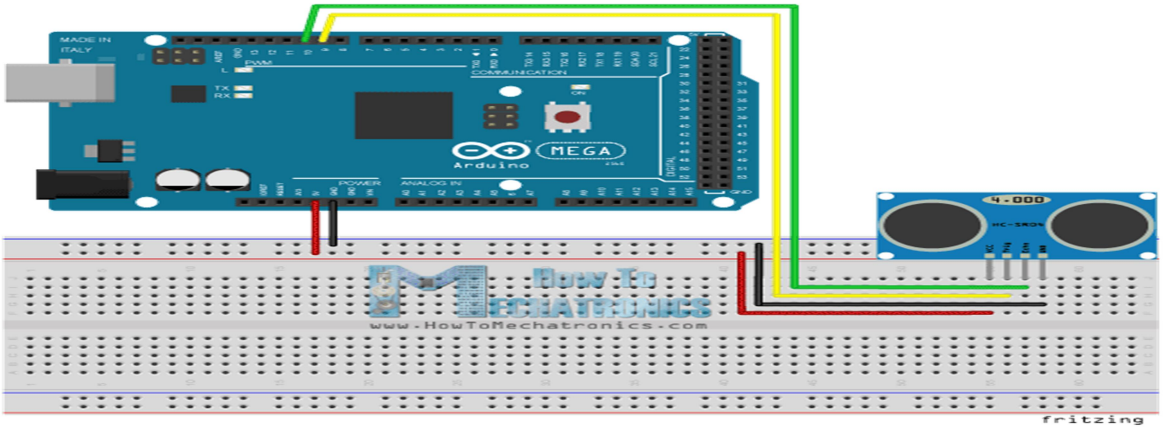

Figure 3.4 circuit diagram of ultrasonic sensor

Coding for Ultrasonic sensor

```
/*
* Ultrasonic Sensor HC-SR04
*
 */
 const int trigPin = 8;
const int echoPin = 9;
// defines variables
long duration;
int distance;
void setup() {
pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output
pinMode(echoPin, INPUT); // Sets the echoPin as an Input
Serial.begin(9600); // Starts the serial communication
}
void loop() {
// Clears the trigPin
digitalWrite(trigPin, LOW);
delay(200);
// Sets the trigPin on HIGH state for 10 micro seconds
digitalWrite(trigPin, HIGH);
delay(500);
digitalWrite(trigPin, LOW);
// Reads the echoPin, returns the sound wave travel time in microseconds
duration = pulseIn(echoPin, HIGH);
// Calculating the distance
distance= duration*0.034/2;
// Prints the distance on the Serial Monitor
Serial.print("Distance: ");
Serial.println(distance);
}
```