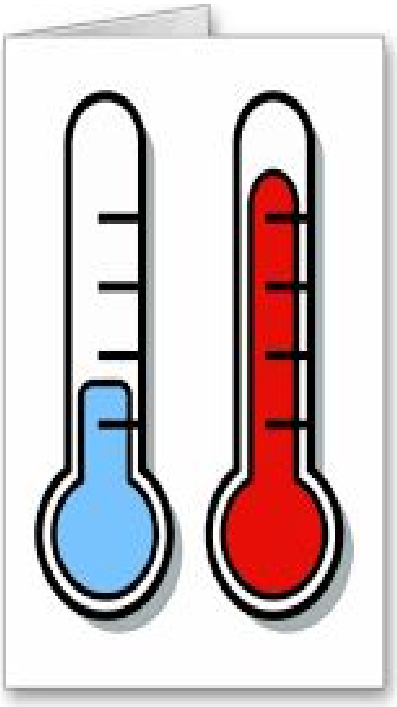
TEMPERATURE

AND

HUMIDITY SENSOR



ANALOG CIRCUITS

(EL 213)

GROUP - 27

Transfer reading from temperature sensor to other two group members using zigbee module and arduino nano.

Assigned by:

Prof. Rutu Parekh

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OBJECTIVE OF THE PROJECT

The primary aim of the project assigned to our group was to record temperature readings using a temperature sensor and then transferring the readings to two other group members. The readings were to be transferred using Zigbee Module and Arduino Nano. Lastly, these readings should be displayed on a LCD screen.

CONTENTS

ACKNOWLEDGEMENT

We would like to thank Professor Rutu Parekh for assigning us this project and giving us the opportunity to work and explore this field. We are thankful for her timely support and constant guidance throughout the course of the project.

The success of this project would not have been possible without the assistance and motivation from all the Teaching Assistants. We are privileged to have received their supervision.

We would also like to thank Mr. Abhishek Jani for his time, encouragement and suggestions for our project work.

We learned a lot of new things while working on this challenging and thought provoking project and we are truly grateful for the knowledge that we have gained.

ABSTRACT

The proposed work is an attempt to design a circuit to record temperature and humidity of a room and transfer the readings to two members of the group. This is implemented using a temperature and humidity sensor that records the readings. These readings are transferred to zigbee via arduino nano. Further, using master and slave approach, the readings from the master zigbee, are transferred to the two slaves by configuring both the slave zigbees with the address of the master. In the slave circuit, the readings from zigbee are transferred to the LCD screen to display, again, via arduino nano.

INTRODUCTION

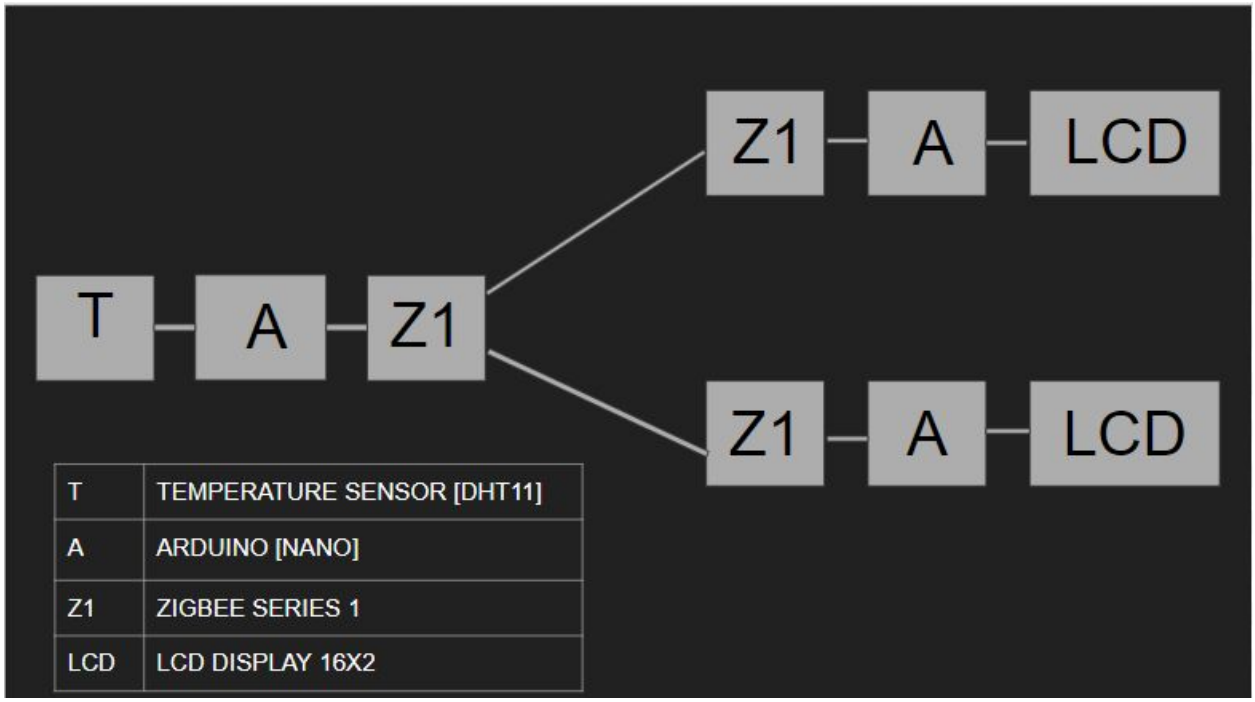
This report highlights the functions and uses of various components that were used during the project. The aim of the project is to record temperature using a temperature sensor and transfer the readings to two other people using zigbee module and arduino nano.

Zigbee is a low power wireless network which is used to connect two devices. It is mainly used in small scale projects that need wireless network. Zigbee is found to be less expensive and less complex than other Wireless Personal Area Networks like Bluetooth or WiFi. It provides secure networking and long battery life. Zigbee are of two types, series 1 and series 2. While series 1 is less complex than series 2, series 2 is more power efficient than series 1 module.

Arduino is a simple microcontroller board. It is an open source computing platform and has an environment for developing software for the arduino board. Arduino nano and arduino uno are few of the types of arduino used. Arduino nano is more compact and breadboard friendly. Both uno and nano have essentially the same functionalities.

A temperature sensor detects the temperature of a body and converts it to an electrical signal DHT11 is a low cost temperature and humidity sensor that provides stability and reliability.

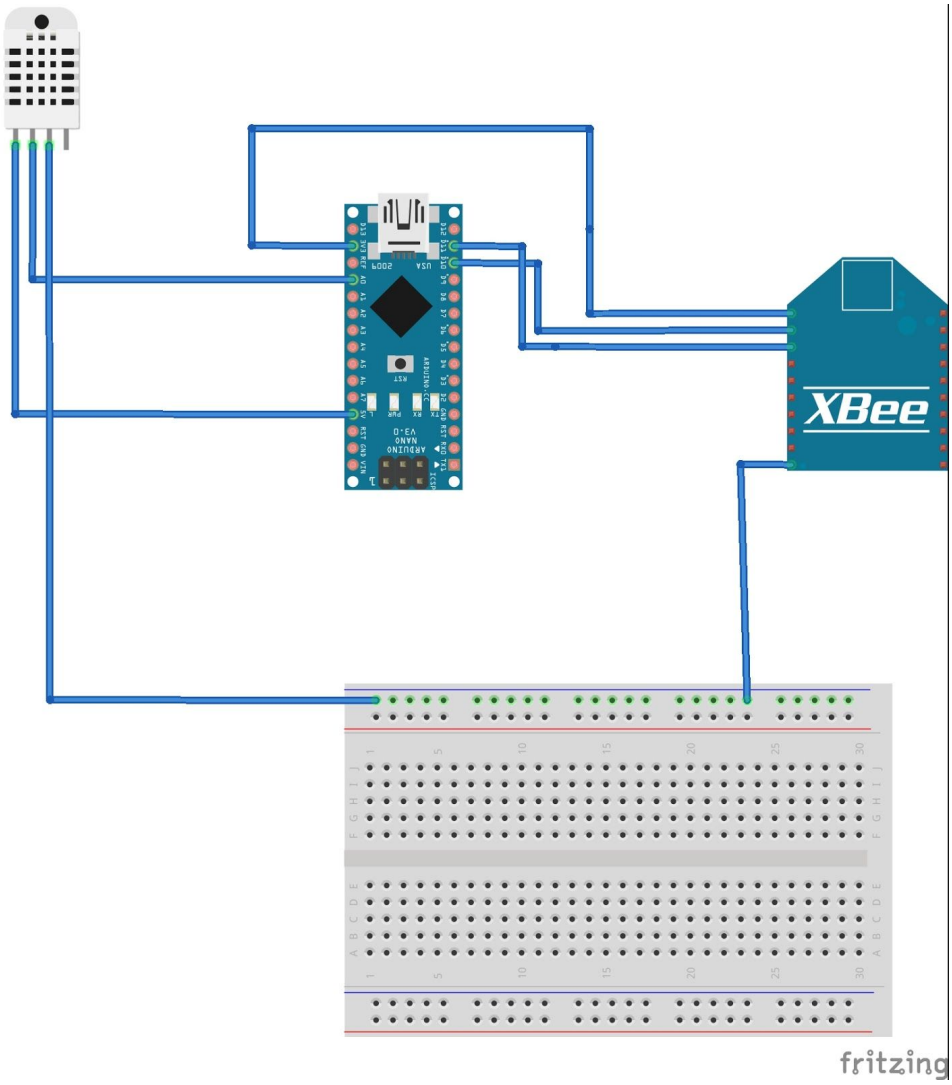
BLOCK DIAGRAM



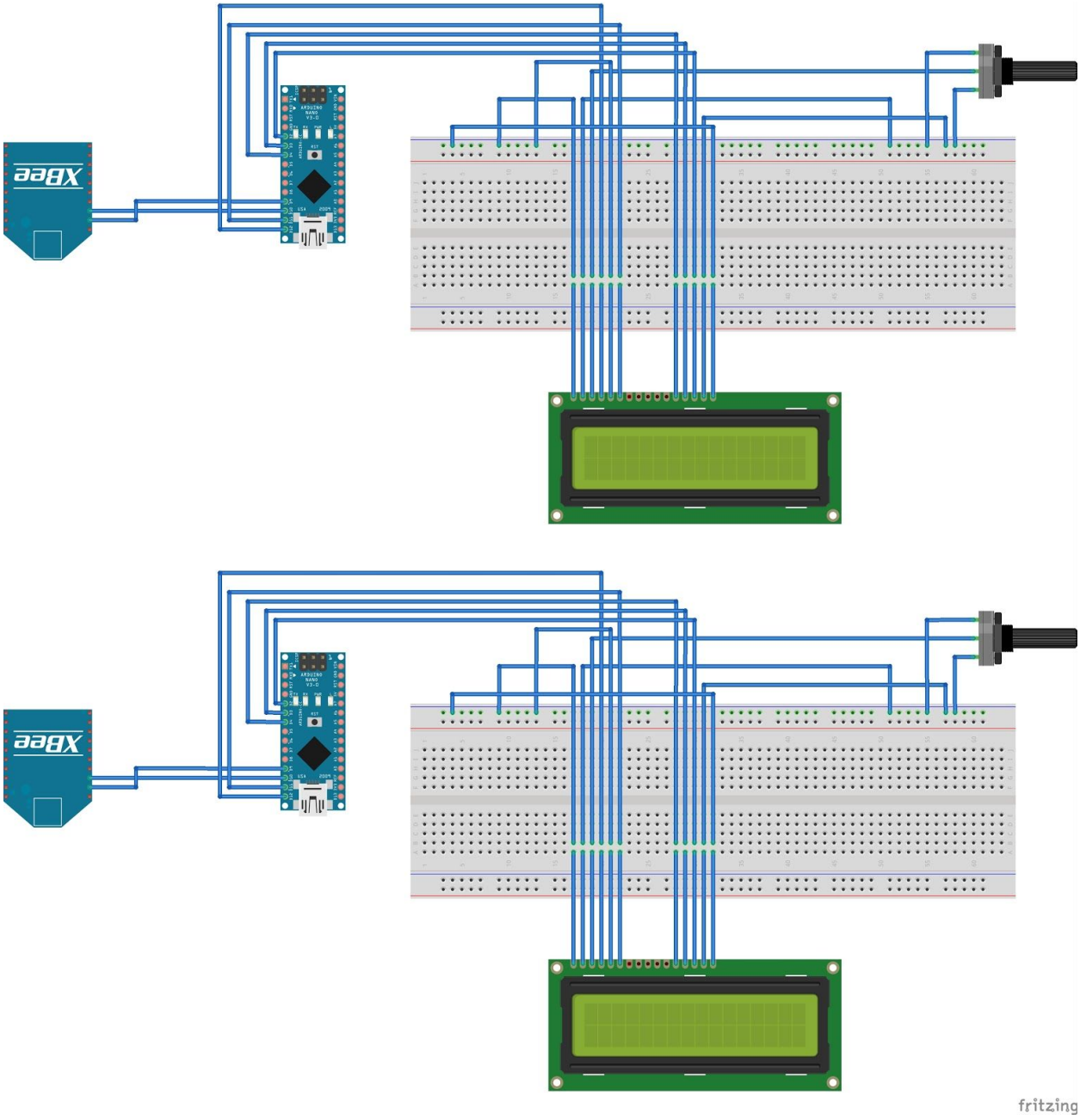
T	TEMPERATURE SENSOR [DHT11]
A	ARDUINO [NANO]
Z1	ZIGBEE SERIES 1
LCD	LCD DISPLAY 16X2

CIRCUIT DIAGRAM

TRANSMITTER:



RECEIVER:



LIST OF COMPONENTS

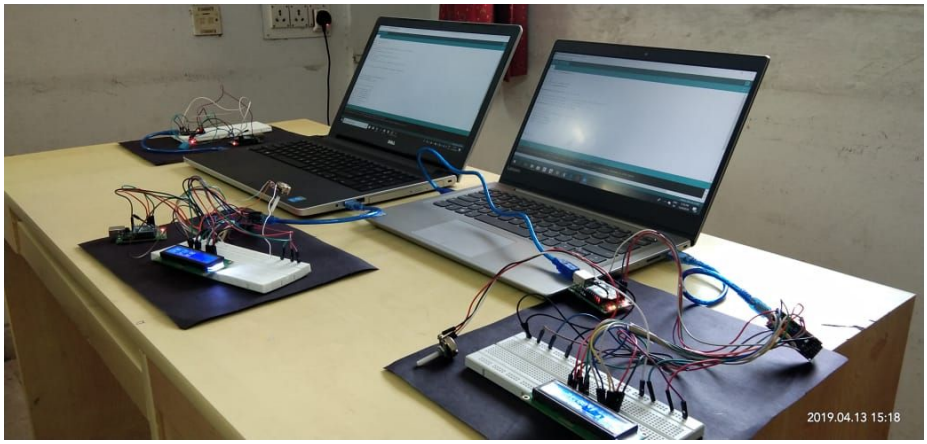
Hardware Specifications:

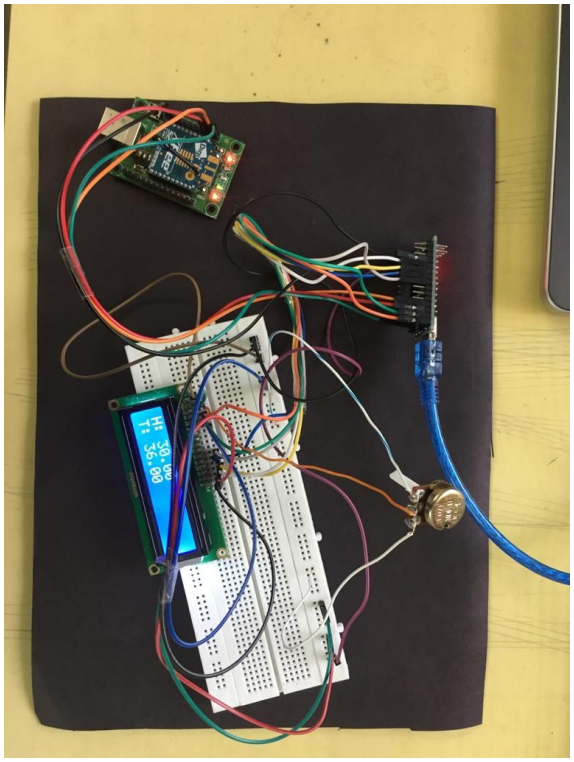
1. Arduino Nano board CH340 chip
2. Arduino Nano board CH340 chip with USB cable
3. DHT11 Humidity and Temperature Sensor Module
4. Dual Male jumpers
5. Dual Female jumpers
6. Male Female jumpers
7. XBEE Explorer USB CP2102 Based
8. 16 X 2 LCD with backlight
9. Xbee S2C low-power module, with wire Antenna for Zigbee Network
10. Breadboard 830 points Rectangular
11. Potentiometer 10k
12. Explorer board

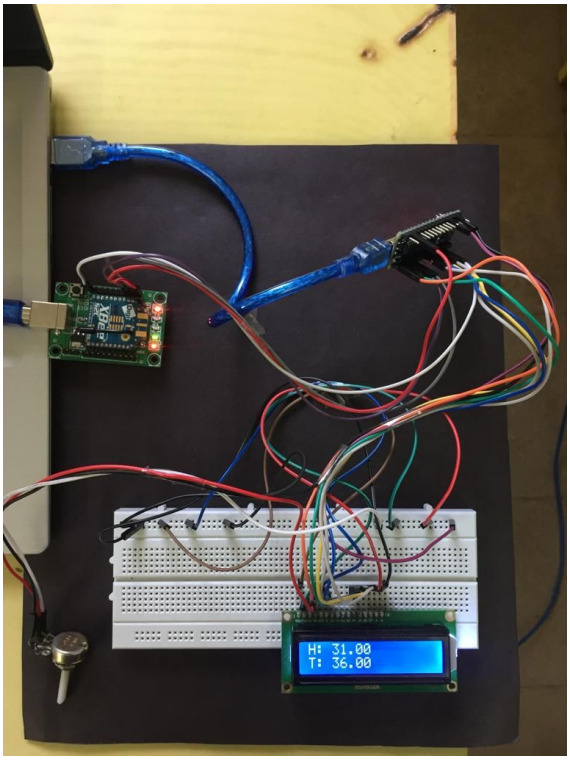
Software Specifications:

1. Fritzing
2. XCTU
3. Arduino

TEST RESULTS :







DESCRIPTION OF COMPONENTS :

Arduino Nano.

It is a Microcontroller board developed by Arduino.cc and based on Atmega328p / Atmega168. Arduino boards are widely used in robotics, embedded systems, and electronic projects where automation is an essential part of the system. These boards were introduced for the students and people who come with no technical background.

- **Arduino Nano** is a small, compatible, flexible and breadboard friendly Microcontroller board, developed by Arduino.cc in Italy, based on ATmega328p (Arduino Nano V3.x) / Atmega168 (Arduino Nano V3.x).
- It comes with exactly the same functionality as in Arduino UNO but quite in small size.
- It comes with an operating voltage of 5V, however, the input voltage can vary from 7 to 12V.
- **Arduino Nano Pinout** contains 14 digital pins, 8 analog Pins, 2 Reset Pins & 6 Power Pins.
- Each of these Digital & Analog Pins are assigned with multiple functions but their main function is to be configured as input or output

No.	Pin Number	Pin Description
1	D0 – D13	Digital Input / Output Pins.
2	A0 – A7	Analog Input / Output Pins.
3	Pin # 3, 5, 6, 9, 11	Pulse Width Modulation (PWM) Pins.
4	Pin # 0 (RX) , Pin # 1 (TX)	Serial Communication Pins.
5	Pin # 10, 11, 12, 13	SPI Communication Pins.
6	Pin # A4, A5	I2C Communication Pins.
7	Pin # 13	Built-In LED for Testing.
8	D2 & D3	External Interrupt Pins.

Arduino Nano

DHT11 Humidity Sensor on Arduino

DHT11 is a Humidity and Temperature Sensor, which generates calibrated digital output. DHT11 can be interface with any microcontroller like Arduino, Raspberry Pi, etc. and get instantaneous results. DHT11 is a low cost humidity and temperature sensor which provides high reliability and long term stability.This DHT11 Temperature and Humidity Sensor features a calibrated digital signal output with the temperature and humidity sensor capability. It is integrated with a high-performance 8-bit microcontroller. Its technology ensures the high reliability and excellent long-term stability. This sensor includes a resistive element and a sensor for wet NTC temperature measuring devices. It has excellent quality, fast response, anti-interference ability and high performance

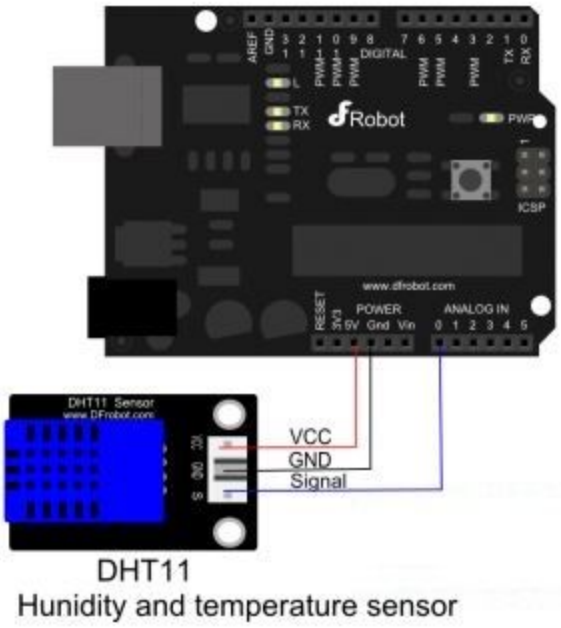
Specification

- Supply Voltage: +5 V
- Temperature range :0-50 °C error of ± 2 °C
- Humidity :20-90% RH ± 5% RH error
- Interface: DigitaL

Applications of DHT11:

- HVAC (Heating, Ventilation and Air Conditioning) Systems
- Weather Stations
- Medical Equipment for measuring humidity
- Home Automation Systems

- Automotive and other weather control applications



Jump wire

A **jump wire** (also known as jumper wire, or jumper) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.

Jumper wires typically come in three versions: male-to-male, male-to-female and female-to-female. The difference between each is in the end point of the wire. Male ends have a pin protruding and can plug into things, while female ends do not and are used to plug things into.

Xbee

XBEE 2mW Wire Antenna S2C, the latest of its kind in Series 2, offers point to multipoint device connectivity with ease, providing cost-effective wireless solutions for electronic devices. They are interoperable with other ZigBee feature set devices.

This version (S2C) of XBee ZigBee Series 2 module utilizes EM357 transceiver. The EM357 transceiver is faster, has lower current draw, and has significantly more RAM and Flash. These advanced features allow EM357-based modules to support more network traffic, have more memory for code updates, and operate more efficiently.

Features:

- Integrated Wire Antenna
- Interoperable with other ZigBee-compliant devices
- Programmable versions with on-board microprocessor enable custom ZigBee application development
- Supports binding and multicasting for easy integration into a home automation platform
- Through-hole form factor enables flexible design
- 15 general-purpose I/O lines
- Industry-leading sleep current of sub 1 µA
- Firmware upgrades via UART, SPI, or over the air

Potentiometer

The Potentiometer is an electric instrument that used to measure the EMF (electromotive force) of a given cell, the internal resistance of a cell. And also it is used to compare EMF's of different cells. It can also use as a variable resistor in most of the applications. These potentiometers are used in huge quantities in the manufacture of electronics equipment that provides a way of adjusting electronic circuits so that the correct outputs are obtained.

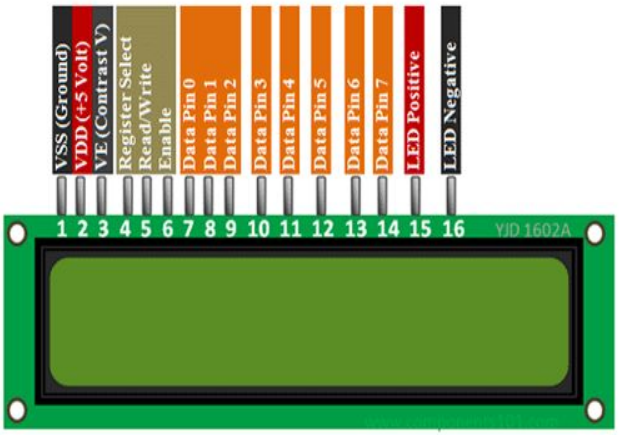
The basic working principle of this is based on the fact that the fall of the potential across any portion of the wire is directly proportional to the length of the wire, provided wire has uniform cross-sectional area and the constant current flowing through it.

16x2 LCD Module

LCD modules are vey commonly used in most embedded projects, the reason being its cheap price, availability and programmer friendly.**16×2 LCD** is named so because; it has 16 Columns and 2 Rows.

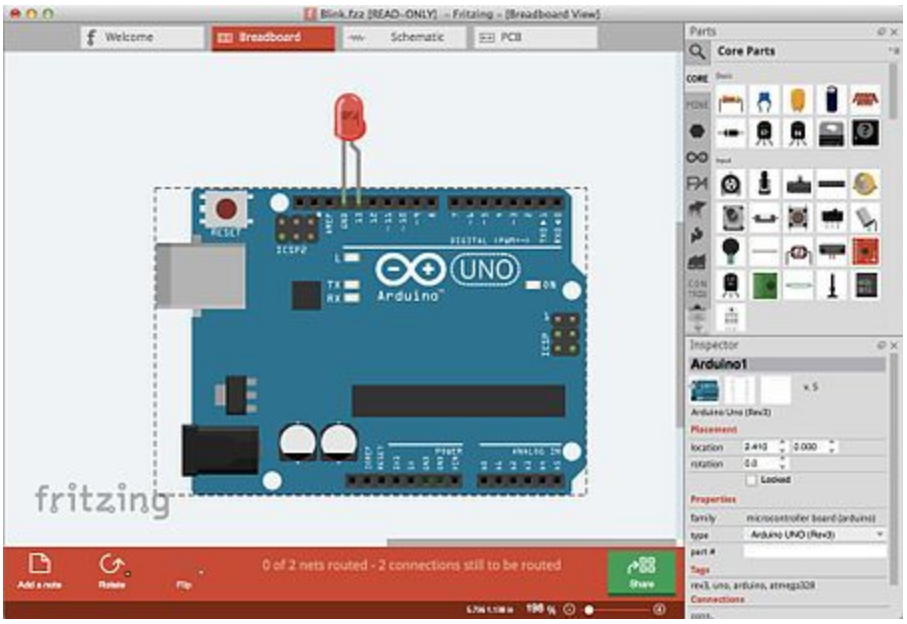
Features of 16×2 LCD module

- Operating Voltage is 4.7V to 5.3V
- Current consumption is 1mA without backlight
- Alphanumeric LCD display module, meaning can display alphabets and numbers
- Consists of two rows and each row can print 16 characters.
- Each character is build by a 5×8 pixel box
- Can work on both 8-bit and 4-bit mode
- It can also display any custom generated characters
- Available in Green and Blue Backlight



Fritzing Software

Fritzing is an open-source initiative to develop amateur or hobby CAD software for the design of electronics hardware, to support designers and artists ready to move from experimenting with a prototype to building a more permanent circuit. It was developed at the University of Applied Sciences of Potsdam. The software is created in the spirit of the Processing programming language and the Arduino microcontroller[1] to document their Arduino-based prototype and create a PCB layout for manufacturing.



XCTU

XCTU is a free multi-platform application designed to enable developers to interact with Digi RF modules through a simple-to-use graphical interface. It includes new tools that make it easy to set-up, configure and test XBee® RF modules.

XCTU includes all of the tools a developer needs to quickly get up and running with XBee. Unique features like graphical network view, which graphically represents the XBee network along with the signal strength of each connection, and the XBee API frame builder, which intuitively helps to build and interpret API frames for XBees being used in API mode, combine to make development on the XBee platform easier than ever.

Arduino IDE

The Arduino integrated development environment is a cross-platform application that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards.

CHALLENGES :

We experienced many challenges while working on this project which enhanced our critical thinking and problem solving skills.

The major challenge that we faced was during the inter-connections of Zigbee module. Configuring the Zigbee was a difficult task, specially to decide the destination address for the coordinator as the n device could directly be given the address of coordinator but due to the presence of 2 n devices, the issue was giving a lot of problems until we came to the conclusion to make coordinator as the universal device.

Another major challenge that we faced was during the soldering of LCD, Arduino . That was really a time consuming job for us

CONCLUSION :

What was once very complex and expensive using microprocessors is now a lot easier using Arduino. The less cost and efficiency of the arduino makes it popular amongst hobbyists, students and professionals as well. It is much simple to program the boards using a computer, via a USB cable. It is also trouble-free to integrate it with a wide array of sensors or other devices.

Furthermore, Zigbee is a technology that finds its applications in diverse fields like home automation, medicine, remote control etc due to its low cost, low data rate and low power consumption.

There are numerous uses of a temperature sensor. The temperature sensor works by measuring the temperature that's being given off by the thermostat and/or the coolant itself in the vehicle The temperature is then sent to the on-board control system. From there, your vehicle's computer will use this temperature information to either continue operating or adjust certain engine functions, always working to keep the engine temperature at an ideal level.

There can be upgradations made in this setup and integrated together, this is an enabling and promising technology that will have a great scope in the future.

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7. https://www.instructables.com/id/How-to-Make-HELLO-WORLD-on-a-LCD-DisplayArduino-Na/
8. https://www.instructables.com/id/Arduino-Nano-Directly-Connected-2-X-16-LCD-Display/

APPENDIX :

```
#include <SoftwareSerial.h>

#include <dht.h>

dht DHT;

// if you require to change the pin number, Edit the pin with your arduino pin.

#define DHT11_PIN A0

SoftwareSerial mySerial(10, 11); // RX, TX

void setup() {

 // Open serial communications and wait for port to open:

 Serial.begin(9600);

 while (!Serial) {

  ; // wait for serial port to connect. Needed for native USB port only

 }


 Serial.println("Welcome to Group 27 Humidity and Temperature Detector");
```

```
  //Serial.println("Goodnight moon!");

  // set the data rate for the SoftwareSerial port
  mySerial.begin(9600);
  mySerial.println("Hello, world?");
}

void loop() { // run over and over

  int chk = DHT.read11(DHT11_PIN);
  Serial.println(" Humidity " );
  Serial.println(DHT.humidity, 1);
  Serial.println(" Temparature ");
  Serial.println(DHT.temperature, 1);
  mySerial.write("H: " );
  mySerial.print(DHT.humidity);
  //mySerial.print("#");
  mySerial.write("T: ");
  mySerial.print(DHT.temperature);
```

```
  //mySerial.print("$");
  delay(1000);

  if (mySerial.available()) {
    Serial.write(mySerial.read());
  }
  if (Serial.available()) {
    mySerial.write(Serial.read());
  }
}
```

```
#include <SoftwareSerial.h>
// include the library code:
#include <LiquidCrystal.h>

SoftwareSerial mySerial(9, 10); // RX, TX
char c;
```

```
// initialize the library by associating any needed LCD interface pin
// with the arduino pin number it is connected to
const int rs = 12, en = 11, d4 = 5, d5 = 4, d6 = 3, d7 = 2;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

void setup() {
  // set up the LCD's number of columns and rows:
  lcd.begin(16, 2);
  Serial.begin(9600);
  mySerial.begin(9600);
  lcd.setCursor(0,0);
  // Print a message to the LCD.
//  lcd.print("hello, world!");
}

void loop() {
  //Serial.write(mySerial.read());
   if (mySerial.available()) {
    //Serial.write(mySerial.read());
```

```
    c=(char)mySerial.read();
    Serial.print(c);
    if(strcmp(c,'T')==0)
      lcd.setCursor(0,1);
     if(strcmp(c,'H')==0)
      lcd.setCursor(0,0);
    lcd.print(c);
  }
  if (Serial.available()) {
    mySerial.write(Serial.read());
  }

}
```