Wireless Solar Temperature Sensor

Design Document

Contents

1 Introduction

1.1 Project statement

The purpose of this project is to provide power consumption data in different builds of Wireless solar temperature and humidity sensor circuit. The view of design and analysis is on how much low power consumption we can make. My team will try different methods of wireless transmissions and different sensor technologies to find out the lowest power consumption. We will also check the light power supply in different situations such as indoor and outdoor, or daytime and night.

1.2 Purpose

The temperature and humidity sensors are commonly used in farm, pet shop, and weather forecast. The wireless sensors makes much easier to place itself anywhere to get data. This wireless temperature and humidity sensor will be supplied by solar panel so that sensor can be worked for long time without direct contact. This solar panel is beneficial in terms of self generation electricity system.

1.3 Goals

The goal of this project is to determine the low power system that we can use, how open the transmission take place, and to get as much as power consumption data in many different access is important. Dan Stiler, the client, of the Powerfilm Company, wants my team to access many different ways to get the best low power consumption sensor circuit. First of all, we will compare the power consumption in transmission between BLE(Bluetooth low energy) and Wifi. Secondly, we will compare temperature and humidity sensors in different brands and types. Then, We need to find a good

sensor to meet our requirements. Lastly, we also need to check the possible solar energy panel indoors and outdoors. All the functions of the sensor circuit are supposed to be executed at the minimum light energy.

2 Deliverables

At the beginning of Design:

- Build a circuit diagram
- Buy the different electrical components, and test the parameters
- Determine the best electrical components for meeting the requirements

At the middle of Design:

- Analyze the data in the system
- Build the interface
- Create the Android application
- Test the data transmission

At the end of Design:

- Apply solar panel to the circuit.
- Test and feedback

3 Design

Include any/all possible methods of approach to solving the problem. Discuss what you have done so far. What have you tried/implemented/tested etc. We want to know what you have done.

3.1 System specifications

Detail any specifications given and/or assumed about the project.

3.1.1 Non-functional

1. Keep the scale of the system small

3.1.2 Functional

1. make the wireless transmission continuously under 400 lux light level

2. keep the power consumption of the system at a low level

3. precisely record temperature change from sensor

4. with rechargeable battery

3.2 PROPOSED DESIGN/METHOD

Discuss what your team has decided to implement/design/do

1.We plan to use the battery from client and the bq25570 Battery Charger Evaluation Module for Energy Harvesting to build the power system of our circuit.

2.Use the power system to power up our Arduino circuit system and test the performance for our whole sensor system in the first semester.

3. If we have time after we meet the requirement on Arduino based circuit system, we will try to design a simpler circuit structure without Arduino.

3.3 DESIGN ANALYSIS

Discuss what you did so far. Did it work? Did it not work? What are your observations, thoughts, and ideas to modify or continue? If you have key results that may be included here or in section 5 i.e. Results

we are about making an temperature sensor with arduino to check it works or not. At this stage of design, we have done the following things:

- Can sense the right outside environmental temperature from the circuit system, and show the result on the computer. The testing result is in the result part.
- Ordered a few sensors(e.g. LM35 temperature sensor, DH11 temperature and humidity sensor) and recorded some energy consumptions for the sensors. The results are the following:

	DHT22					
Voltage (V)	5	4	3.3	3	2.9	<2.8 not readable
Current During Read .5hz (ma)	1.61	1.58	1.56	1.55	1.04	
Power During Read (mW)	8.05	6.32	5.148	4.65	3.016	
Power On Time During Read 20ms						
	DHT11					
Voltage (V)	5	4	3.3	3	2.9	<2.8 not readable
Current During Read .5hz (ma)	2.4	1.68	1.23	1.03	0.9968	
Power During Read (mW)	12	6.72	4.059	3.09	2.89072	
Power On Time During Read 20ms						
	LM35 (needs ADC)					
Voltage (V)	5	4	3.3	<4 not recommended		
Current During Read (ua)	53.1	53	52.9			
Power During Read (uW)	265.5	212	174.57			
Power On Time During Read Always						

- Connect the cell phone to the the arduino with the bluetooth chip we have. The screen of the cell phone cannot get the temperature which is received on the computer.

However we still face a few problems while designing the project:

- Cannot send back the information back to the phone.
- Build energy harvest system.

4 Testing/Development

4.1 INTERFACE SPECIFICATIONS

Discuss any hardware/software interfacing that you are working on for your project. This section is decided by team advisor/client.

Bluetooth interface between phone and device, and it is secondary important for our project. The most important one for us is to pursue the lowest power consumption.

4.2 HARDWARE/SOFTWARE

Indicate any hardware and/or software used in the testing phase. Provide brief, simple introductions for each to explain the usefulness of each.

Hardware

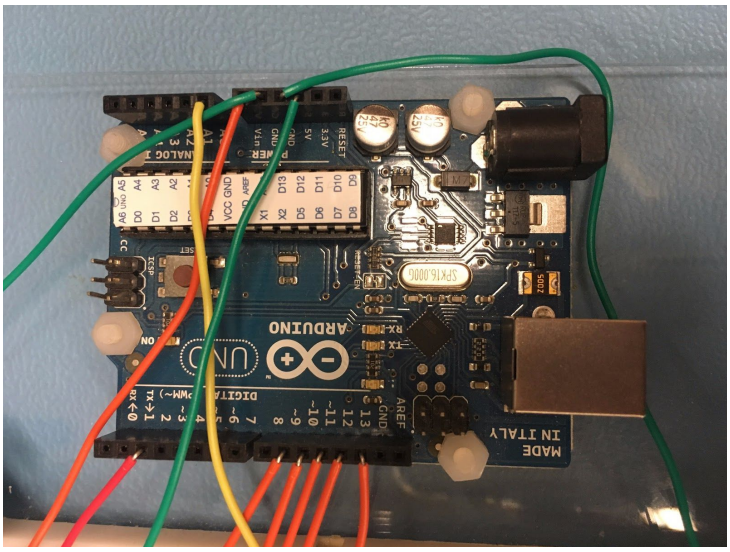


Figure 1. Arduino Uno

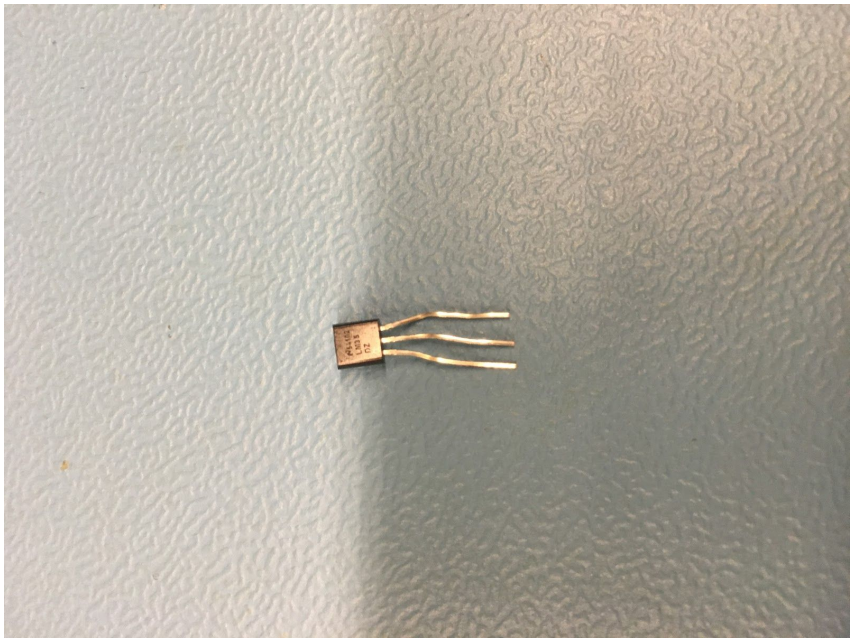


Figure 2. LM35 temperature sensor

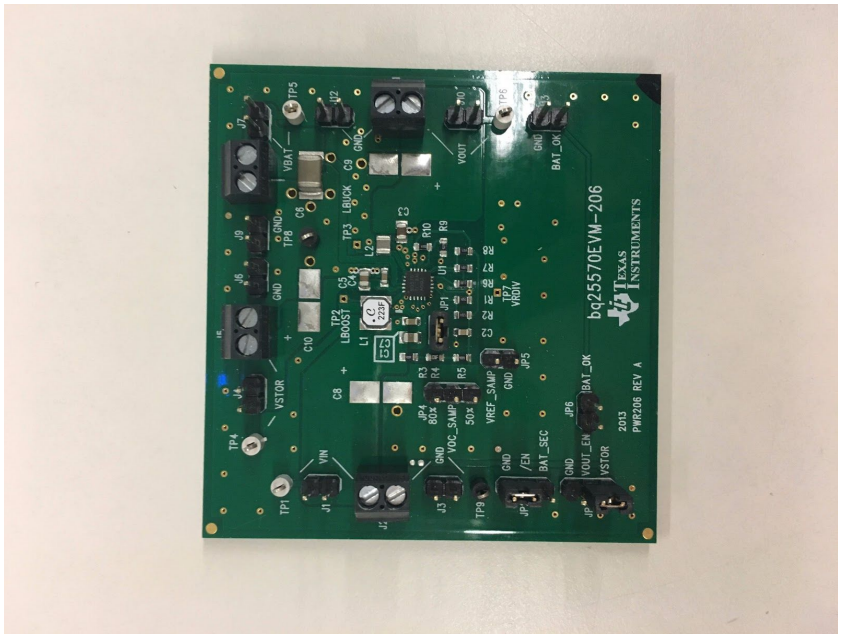


Figure 3. bq25570 Battery Charger Evaluation Module

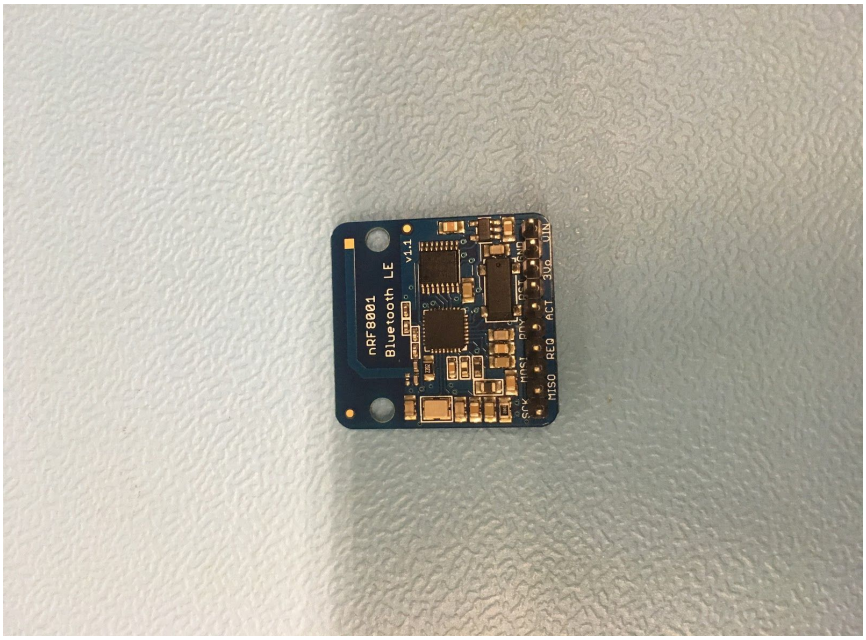


Figure 4. Adafruit nRF8001 BLE Module

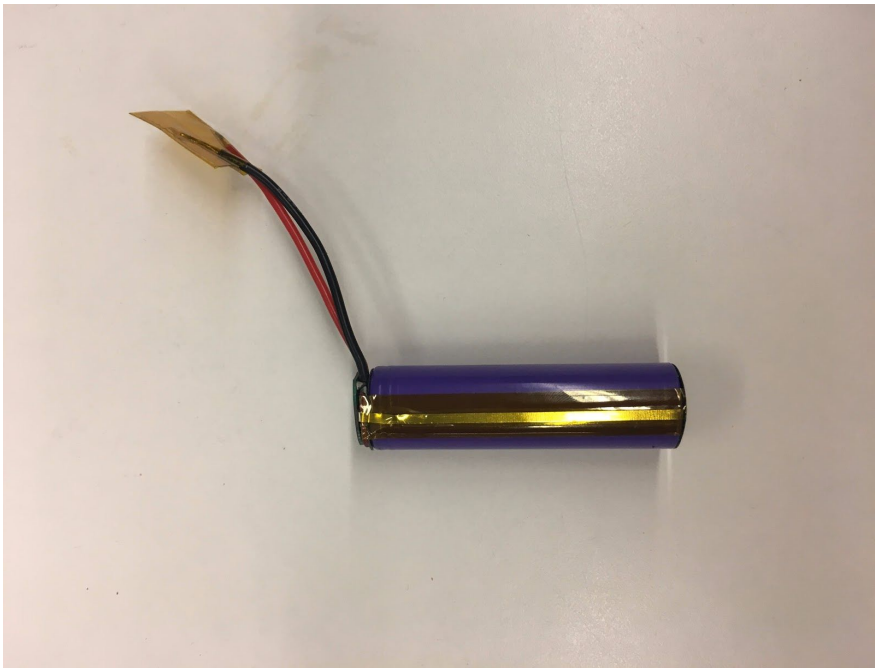


Figure 5. 2PCS New original LG LGABE11865 3200mAh 3.7V rechargeable 18650 lithium battery

Software

In this project version.1, we mainly use two softwares: the Arduino and MIT app inventor 2. The Arduino is needed only if we use the Arduino board. We are thinking of the board without Arduino as a final model. However, we need the Arduino board and codes until we don't use it. The MIT app inventor 2 is used because of its easy accessibility. It provides blocks to use instead of codes. It also provides great interface design tools.

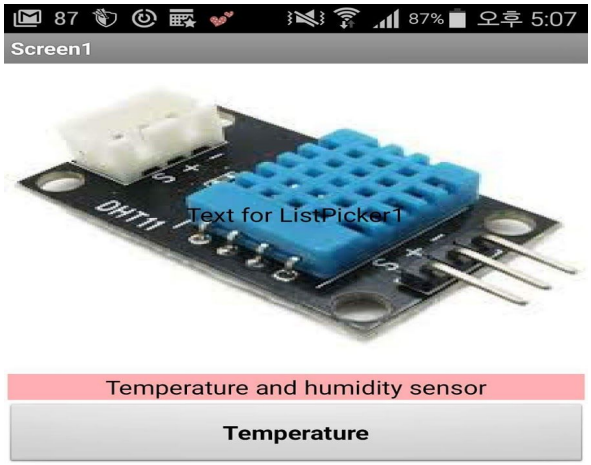


Figure 6. Android application

4.2 Process

Explain how each method indicated in the design section was tested. It might be a good idea to insert a flow diagram of the process.

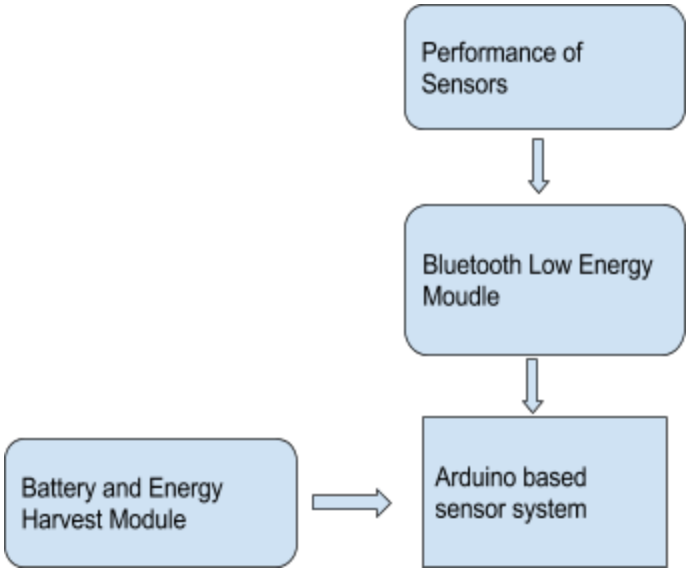


Figure 7. Flow diagram of the project

Software

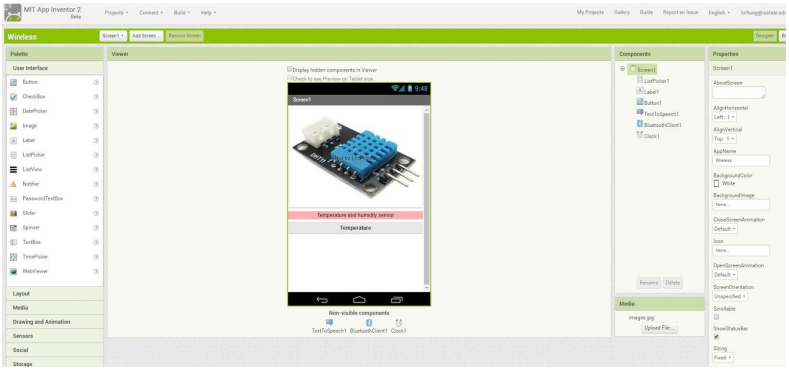


Figure 8. MIT app inventor design program

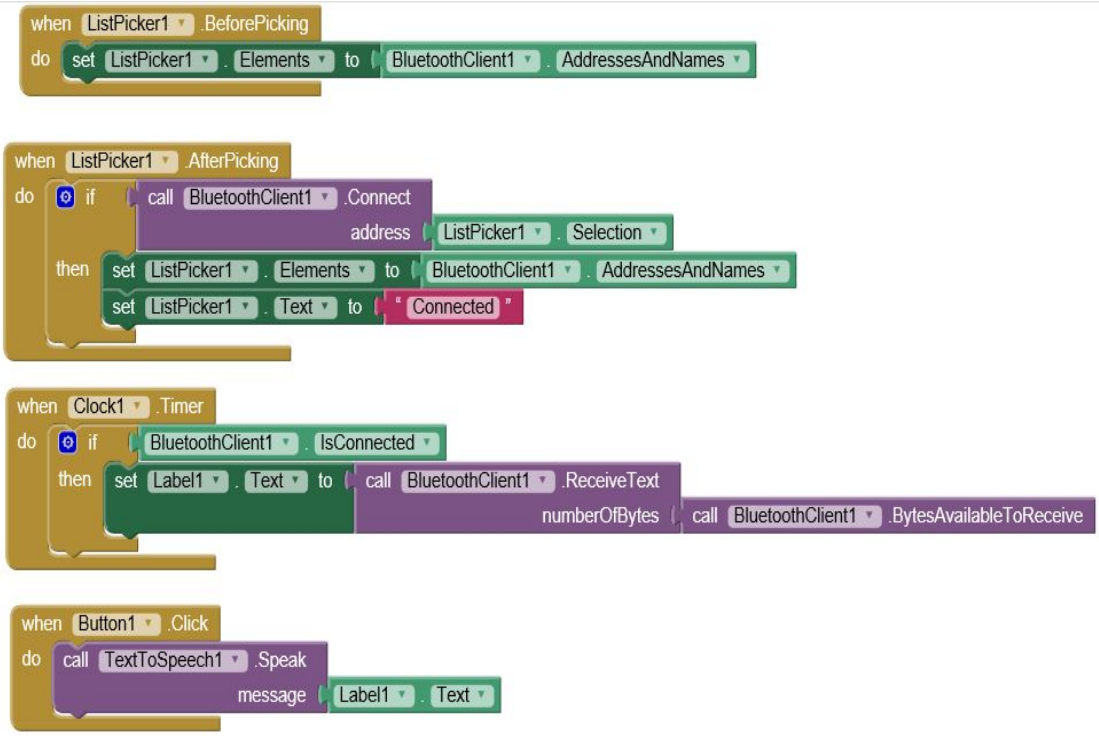


Figure 9. MIT app inventor 2 block diagram

Blocks description

ListPicker1 - ListPicker1 is a button that shows the list when it is clicked.

We have two events for ListPicker blocks: BeforePicking, and AfterPicking. Before picking, it shows the list of bluetooth addresses. After picking any of bluetooth address, it will connect to the address that the user pick. Then, it will show the text "Connected"

Clock1 - Clock1 is a component to create a time that signals events at regular intervals

If any of bluetooth is connected, it will receive the text data from the bluetooth.

Button1 - Button1 is a button that implements something when it is clicked.

We put TextToSpeech1 code to speak the label1 text which is stored from the bluetooth receive function.

5 Results

- Can sense the right outside environmental temperature from the circuit system, and show the result on the computer. The testing result is on Figure 11.
- Ordered a few sensors(e.g. LM35 temperature sensor, DH11 temperature and humidity sensor) and recorded some energy consumptions for the sensors.
- Connect the cell phone to the the arduino with the bluetooth chip we have. The screen of the cell phone cannot get the temperature which is received on the computer correctly, you can see that on the figure 11.

However we still face a few problems while designing the project:

- Cannot send back the information back to the phone.
- Build energy harvest system.

so far we have build the temperature sensor circuit with Arduino and BLE module, and sense the right temperature. We still need to keep figuring out the problem we have in the code for translating the temperature from computer to cell phone. We also plan to build the energy harvest system and test it.

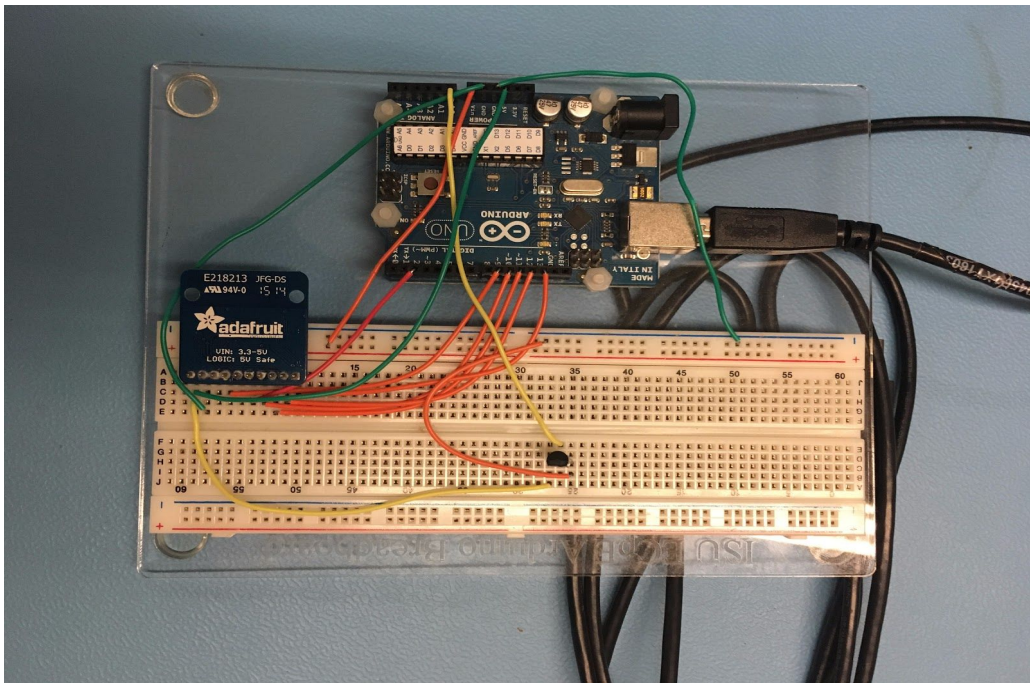


figure 10. The Arduino circuit

Bluetooth Connection

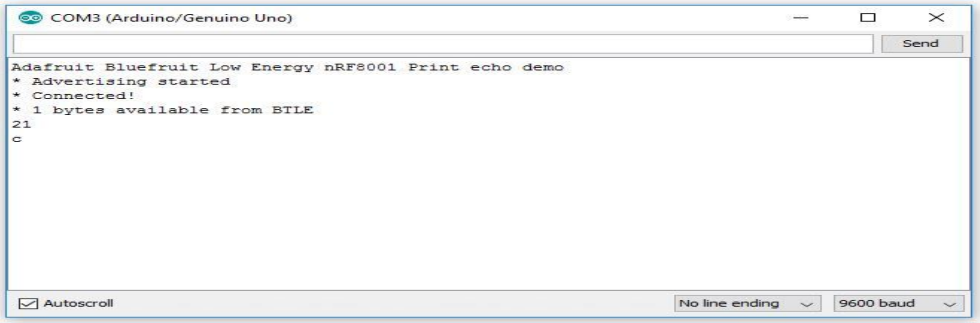


figure 11. The screenshot the bluetooth connection test

We could connect to the nRF8001 bluetooth module which is named as “UART” on the list. The right top screen is taken from the android phone. We typed ‘c’ as a start button. At the serial monitor, we got 21 celsius value from the temperature sensor. Our next goal of coding is to send the temperature data to the phone and to make connection between BLE and MIT app.

6 Conclusions

Summarize the work you have done so far. Briefly re-iterate your goals. Then, re-iterate the best plan of action (or solution) to achieving your goals and indicate why this surpasses all other possible solutions tested.

We have done the the following things:

- We have built the flowchart of what we are going to do for this project and find the possible ways to do the project.
- We have done a few power and property test with the temperature and humid sensor we ordered.
- we have built the circuit with arduino and have written the arduino code for that.

Our goals are :

determine the low power system that we can use, how open the transmission take place, and to get as much as power consumption data in many different access is important

The best plan is :

Using arduino board to control the circuit of sensing the temperature and humid, then provide feedback on the phone.

the reason for choosing this plan is :

It seems to be the easiest way for us to approach to the result we want, however the power consumption may not be as ideal as we supposed, so we may discover a new way to build the circuit without arduino after finish the circuit test with arduino.

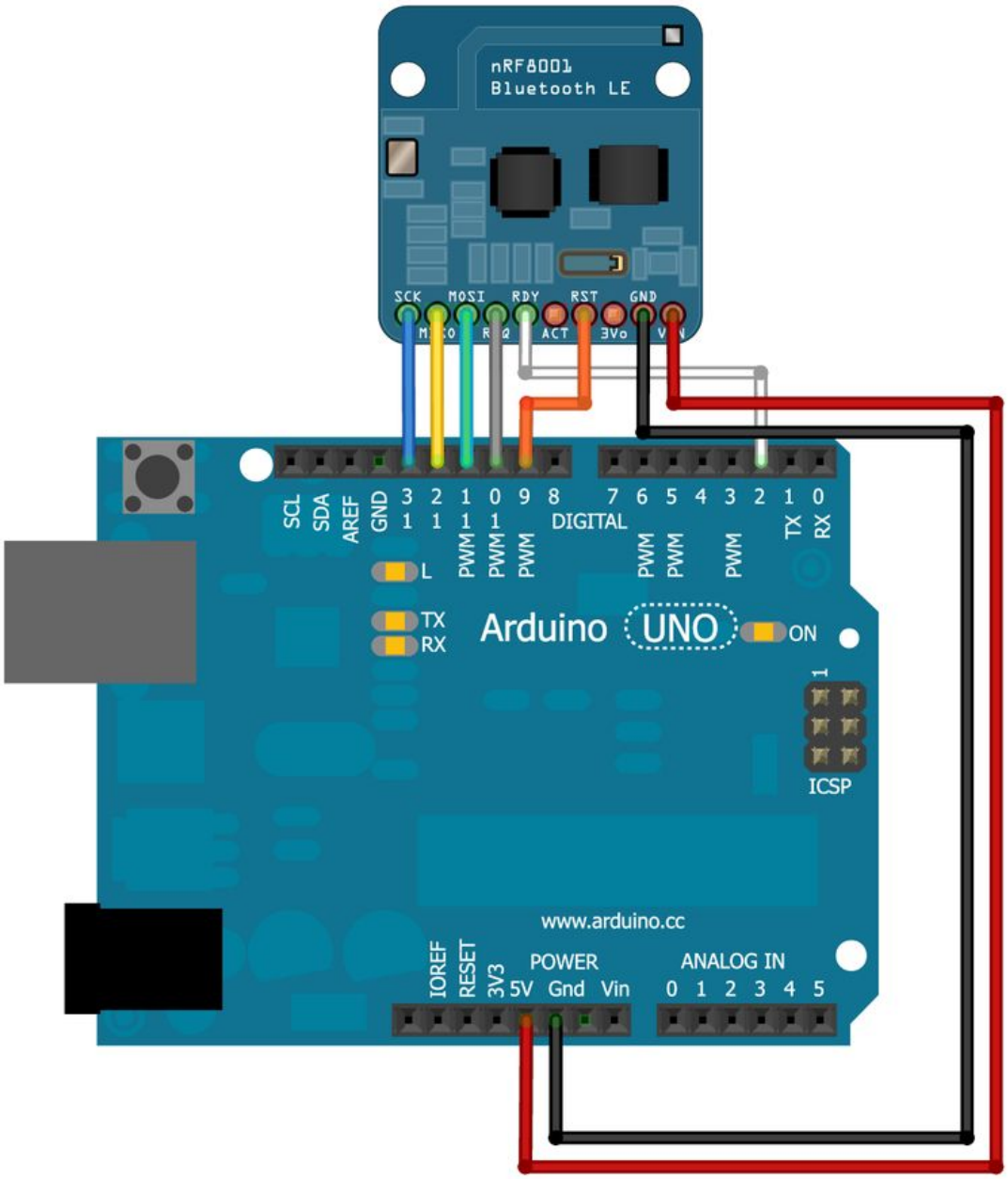
7 References

- Kevin Townsend, (2014), Hooking Everything Up. adafruit.com, Retrieved from https://learn.adafruit.com/getting-started-with-the-nrf8001-bluefruit-le-breakout/hooking-everything-up
- Texas Instrument, (1999), LM35 Precision Centigrade Temperature Sensors, Retrieved from http://www.ti.com/lit/ds/symlink/lm35.pdf

8 Appendices

1) nrf 8001 BLE module connection with Arduino board.
2) lm35 pin configuration
3) DHT11 pin configuration

Appendix.1

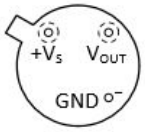

nRF8001
Bluetooth LE
SCK
MOSI
RDY
RST
GND
ACT
SCL
SDA
AREF
GND
DIGITAL
PWM
TX
RX
L
Arduino
UNO
ON
ICSP
www.arduino.cc
IOREF
RESET
3V3
POWER
5V
Gnd
Vin
ANALOG IN
0 1 2 3 4 5

Appendix.2

o

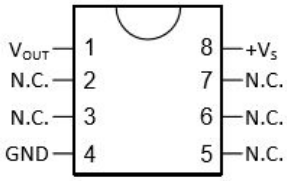
5 Pin Configuration and Functions

NDV Package
3-Pin TO-CAN
(Bottom View)



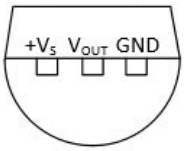
Case is connected to negative pin (GND)

D Package
8-PIN SOIC
(Top View)

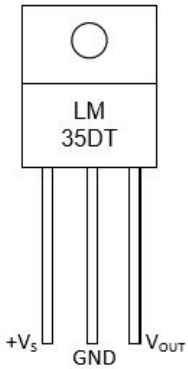


N.C. = No connection

LP Package
3-Pin TO-92
(Bottom View)



NEB Package
3-Pin TO-220
(Top View)



Tab is connected to the negative pin (GND).

NOTE: The LM35DT pinout is different than the discontinued LM35DP

Appendix.3

3. Typical Application (Figure 1)

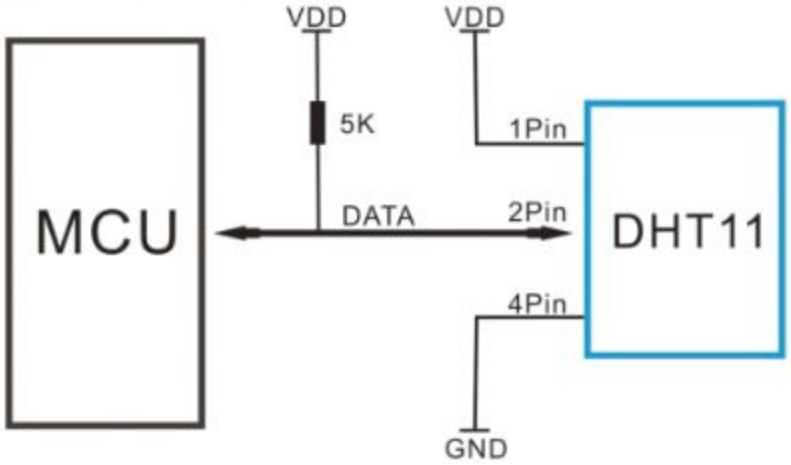


Figure 1 Typical Application

Note: 3Pin – Null; MCU =Micro-computer Unite or single chip Computer