RF Sensor Smart Network

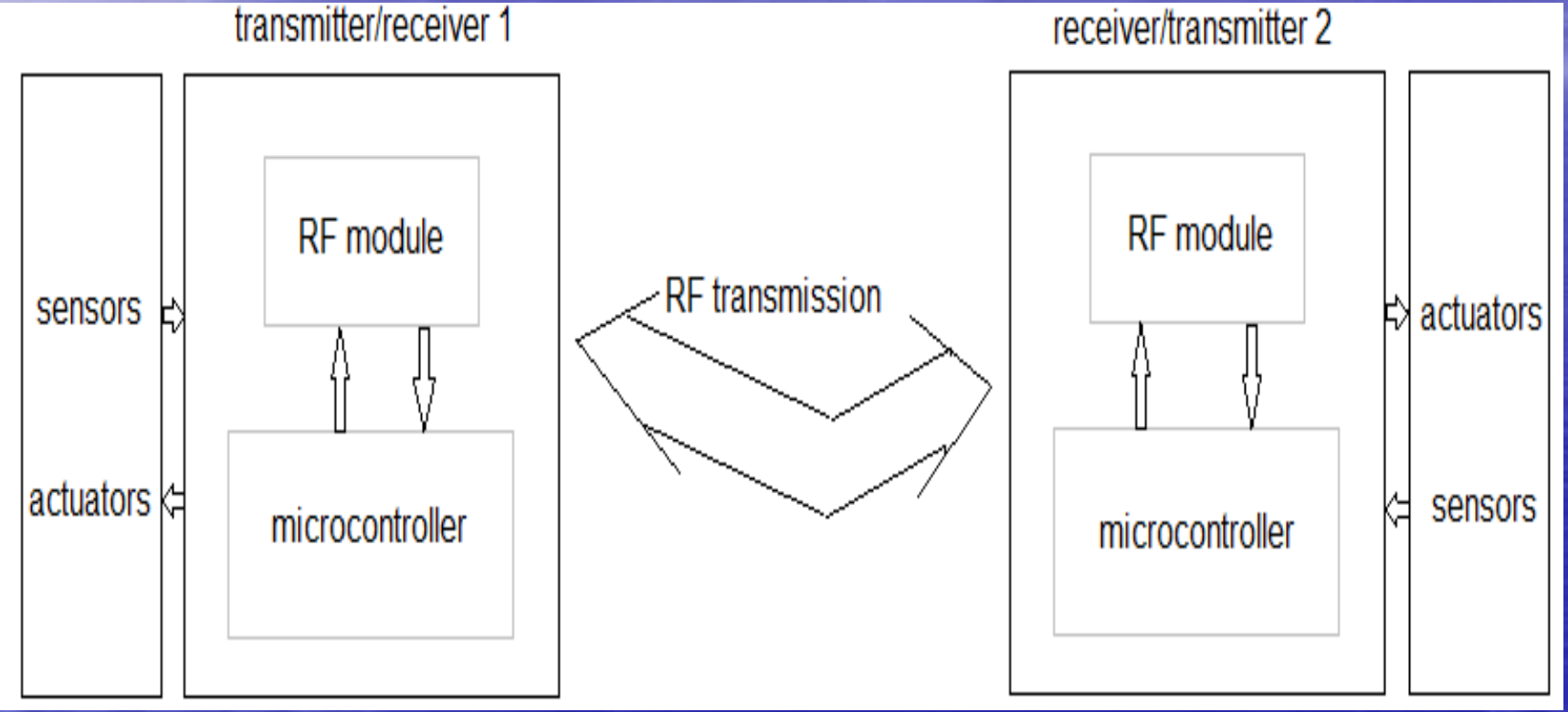
Purpose of the paper

- Design and of a practically realized on process RF sensor network
- The application is intended for data collection in remote processing plants and their transmission to the main central control panel.

- The solution is based on the RF interface module NRF24L01 and microcontroller.
- Two such modules communicate in the RF connection, as transmitter and receiver.
- On the receiving side, the received process data is displayed on an LCD display and stored in an excel log file.

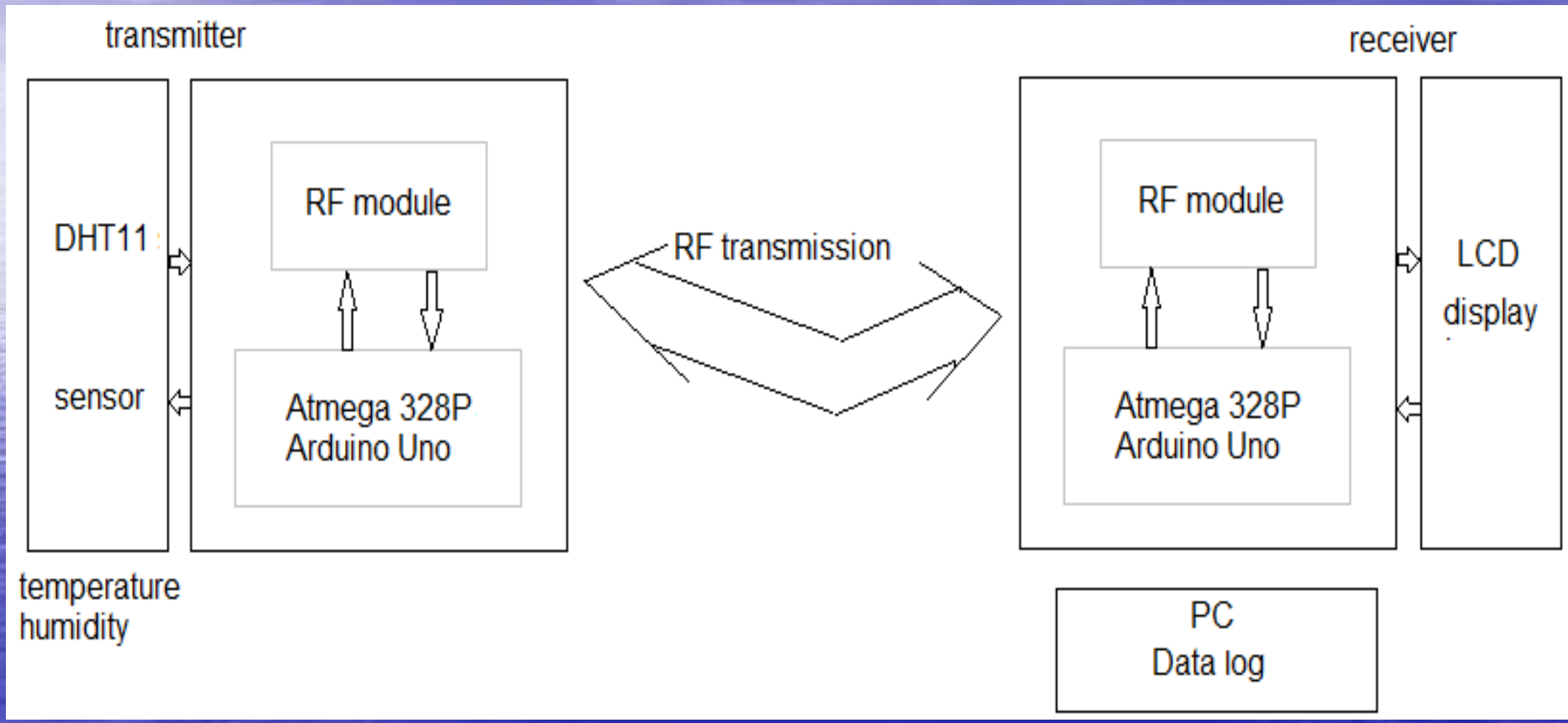
There are various wireless communication technologies used in building IoT applications and RF (Radio Frequency) is one of them. Usually such radio communications are two-way. In the Fig 1 is shown block diagram of one RF sensors network.

- Block diagram of RF sensors network.



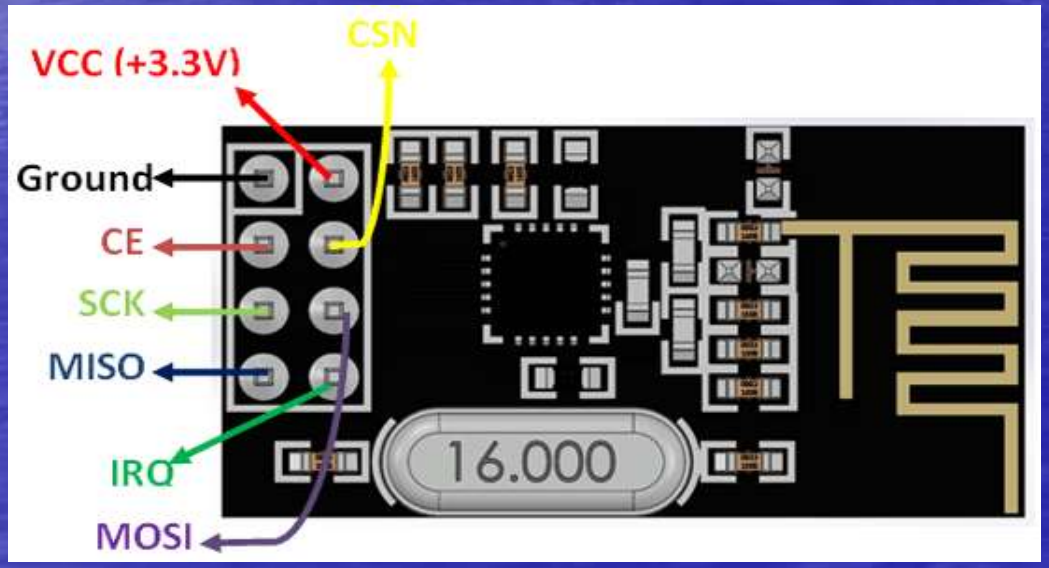
The designed sensor network in this paper has the task to measure temperature and humidity at the measuring point and send measured values via RF transmission to the receiving point where these values are displayed on LCD screen and stored on PC ina data log file compatible with Microsoft Excel

Block diagram of designed RF sensor network



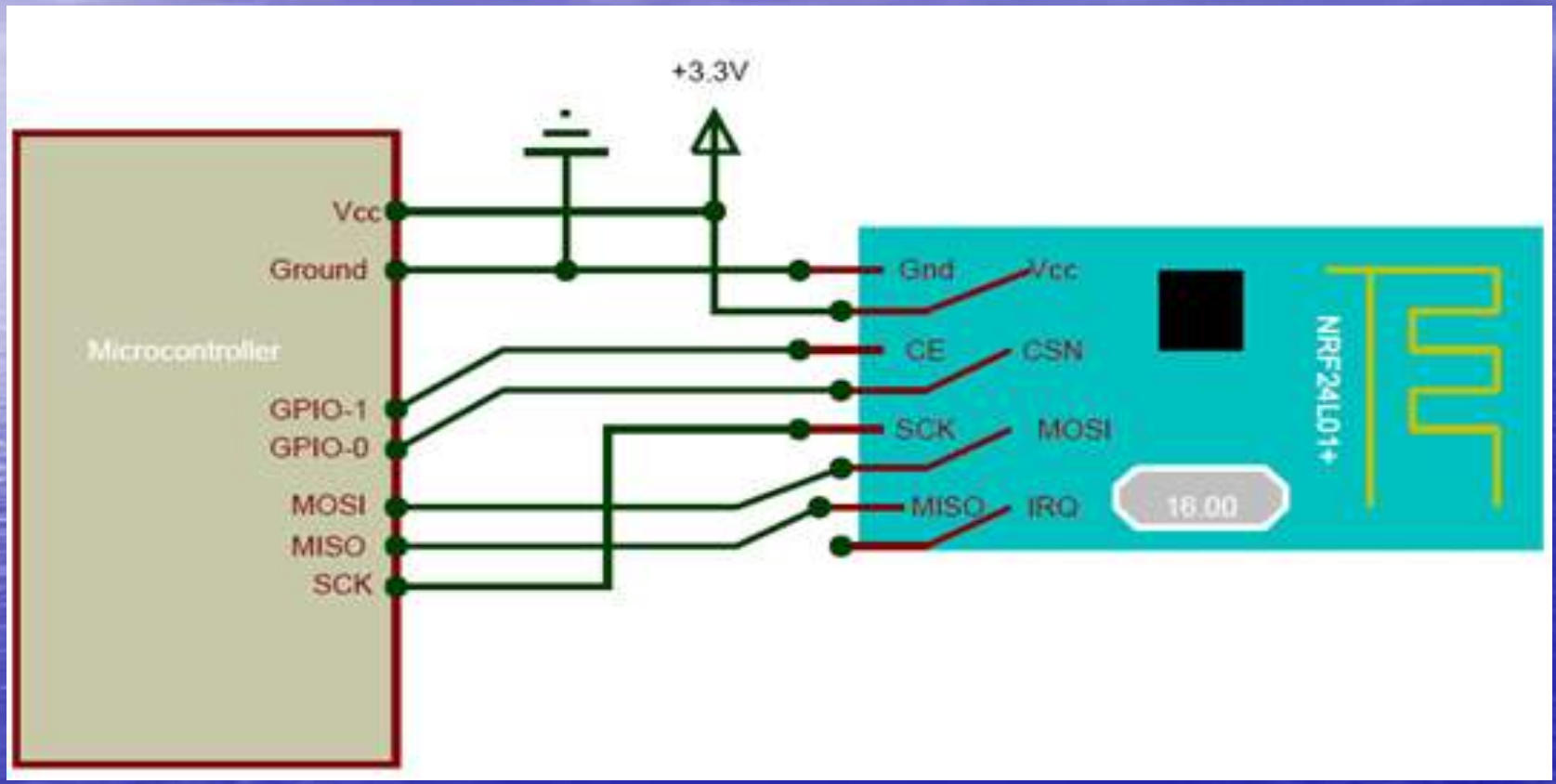
NRF24L01 module

Single-chip radio transceiver module that operates on 2.4 - 2.5 GHz (ISM band). This transceiver module consists of a fully integrated frequency synthesizer, a power amplifier, a crystal oscillator, a demodulator, a modulator, and Enhanced ShockBurs protocol engine.

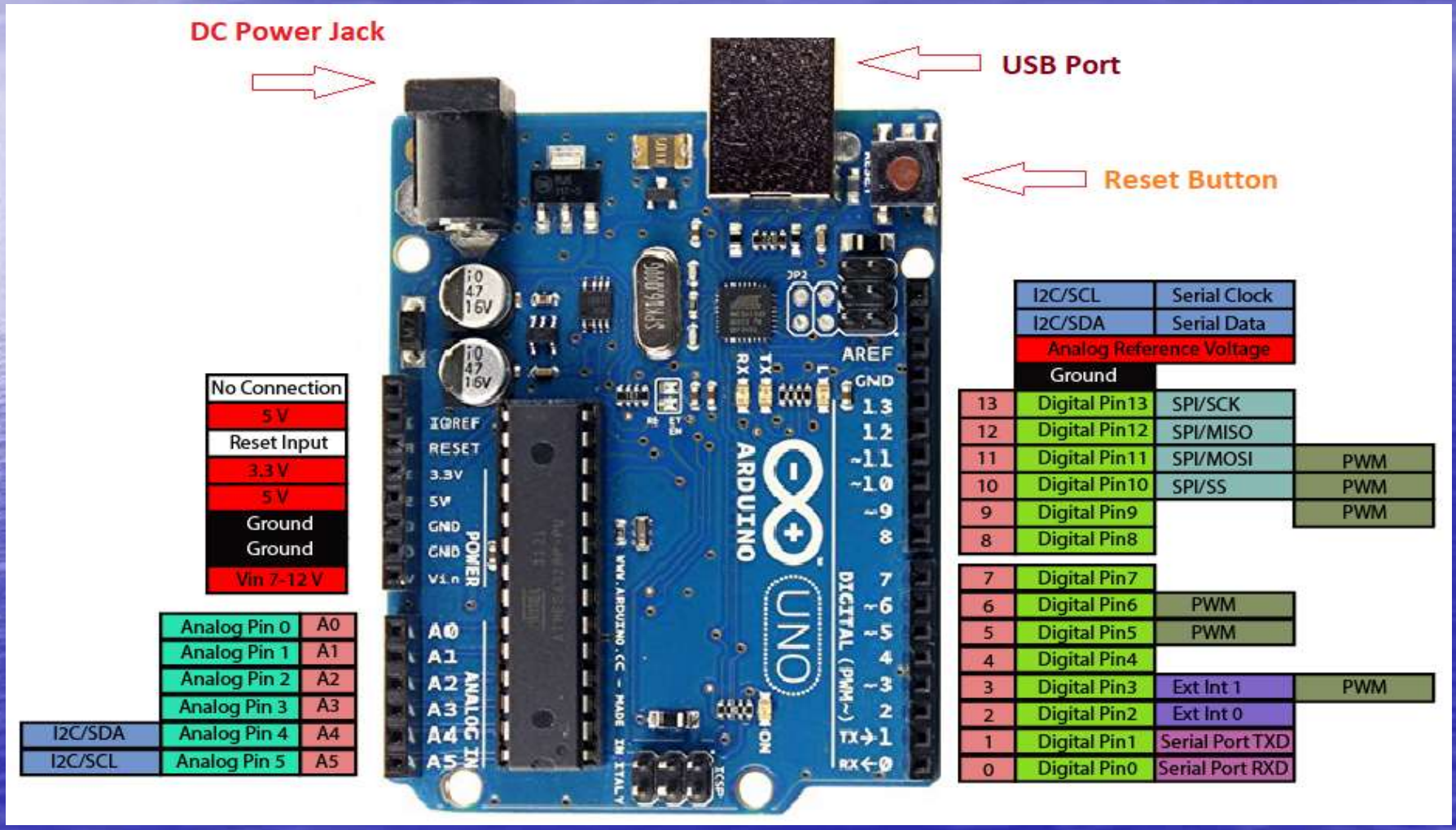


- NRF24L01 Features:
- 2.4GHz RF transceiver Module
- Operating Voltage: 3.3V
- Nominal current: 50mA
- Range : 50 – 100 m
- Operating current: 250mA (maximum)
- Communication Protocol: SPI
- Baud Rate: 250 kbps - 2 Mbps.
- Channel Range: 125
- Maximum Pipelines/node : 6
- Low cost wireless solution

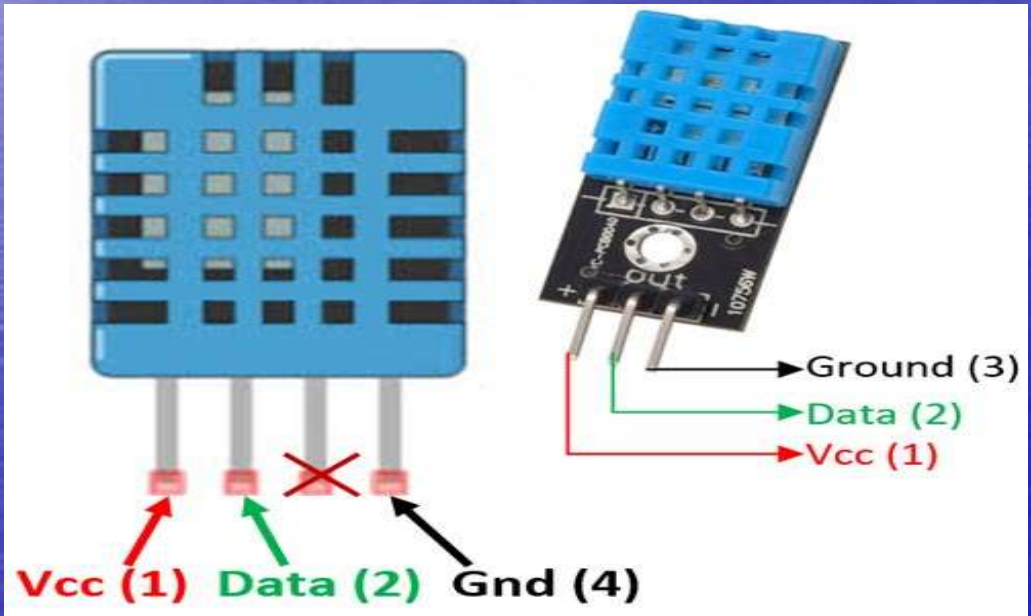
NRF24L01 module interfaced with a microcontroller



Arduino Uno

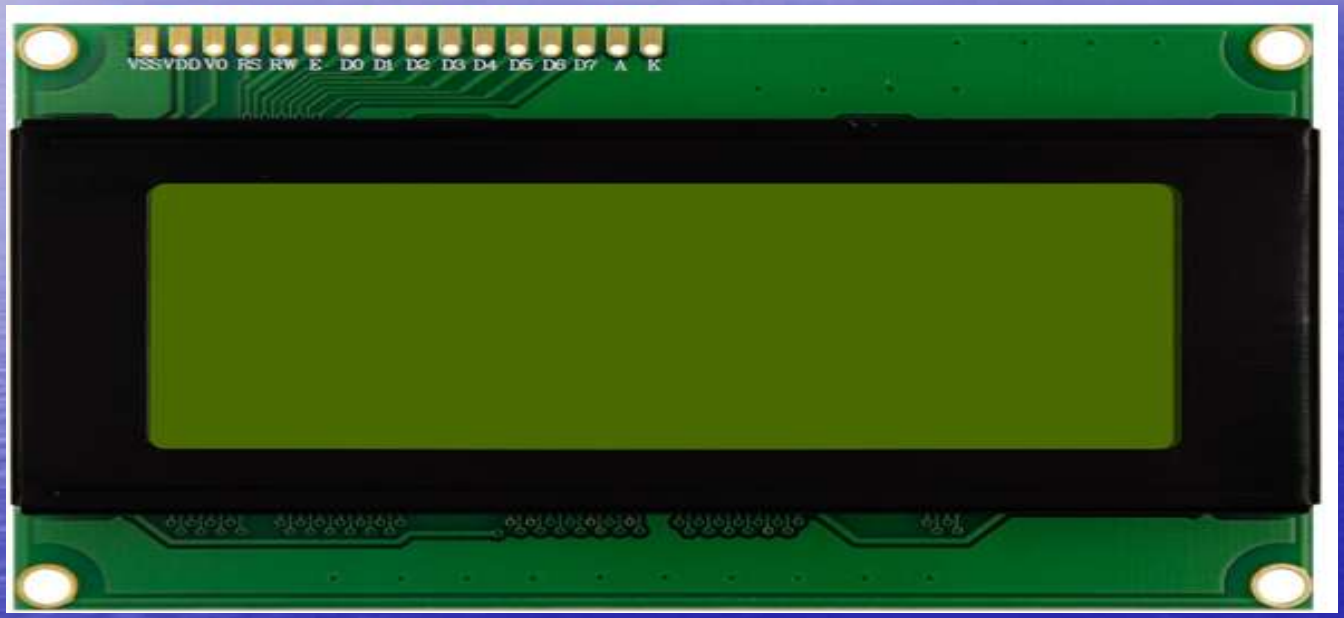

DC Power Jack
USB Port
Reset Button
No Connection
5 V
Reset Input
3.3 V
5 V
Ground
Ground
Vin 7-12 V
Analog Pin 0 A0
Analog Pin 1 A1
Analog Pin 2 A2
Analog Pin 3 A3
I2C/SDA Analog Pin 4 A4
I2C/SCL Analog Pin 5 A5
I2C/SCL Serial Clock
I2C/SDA Serial Data
Analog Reference Voltage
Ground
13 Digital Pin13 SPI/SCK
12 Digital Pin12 SPI/MISO
11 Digital Pin11 SPI/MOSI PWM
10 Digital Pin10 SPI/SS PWM
9 Digital Pin9 PWM
8 Digital Pin8
7 Digital Pin7
6 Digital Pin6 PWM
5 Digital Pin5 PWM
4 Digital Pin4
3 Digital Pin3 Ext Int 1 PWM
2 Digital Pin2 Ext Int 0
1 Digital Pin1 Serial Port TXD
0 Digital Pin0 Serial Port RXD
ARDUINO
UNO

DHT11 temperature and humidity sensor



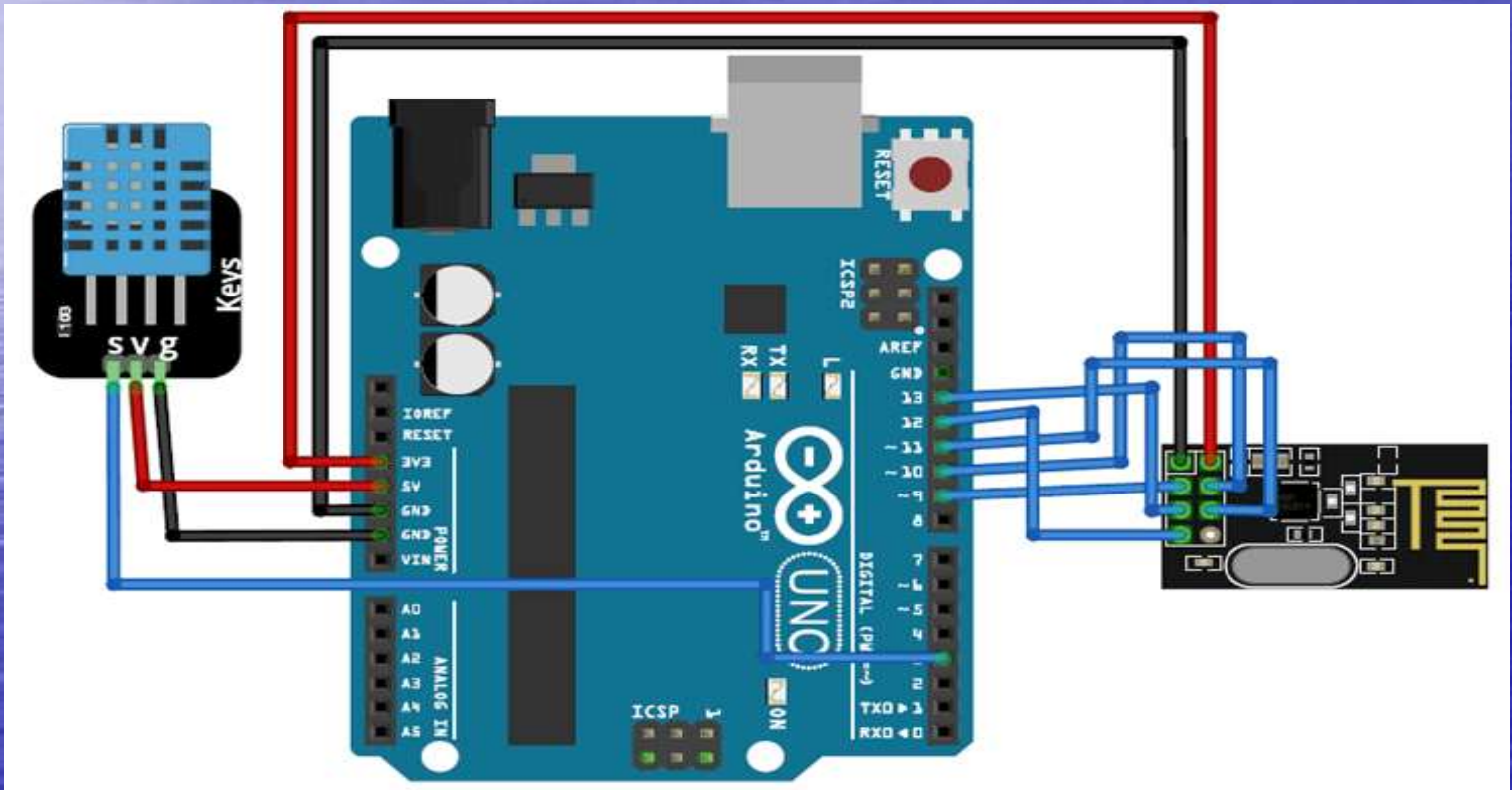
- DHT11 Specifications:
- Operating Voltage: 3.5V to 5.5V
- Operating current: 0.3mA (measuring) 60uA (standby)
- Output: Serial data
- Temperature Range: 0°C to 50°C
- Humidity Range: 20% to 90%
- Resolution: Temperature and Humidity both are 16-bit
- Accuracy: ±1°C and ±1%

LCD 20x4 display

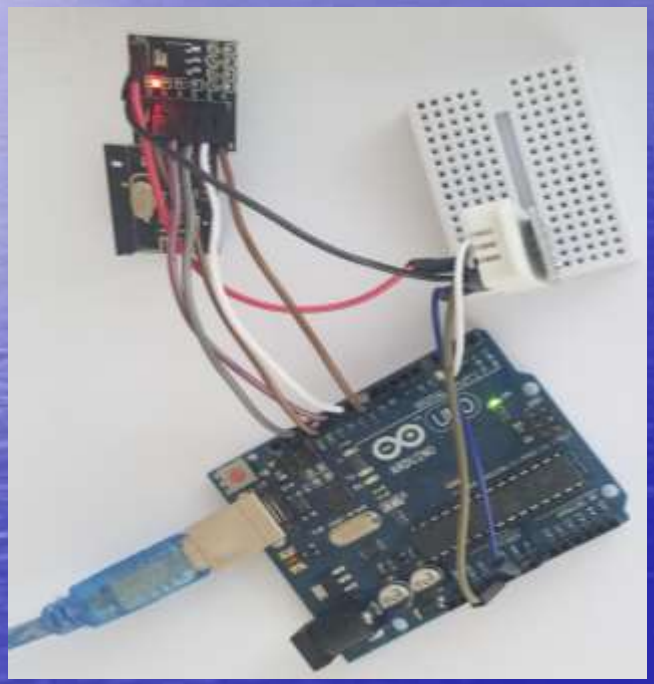


Experimental results

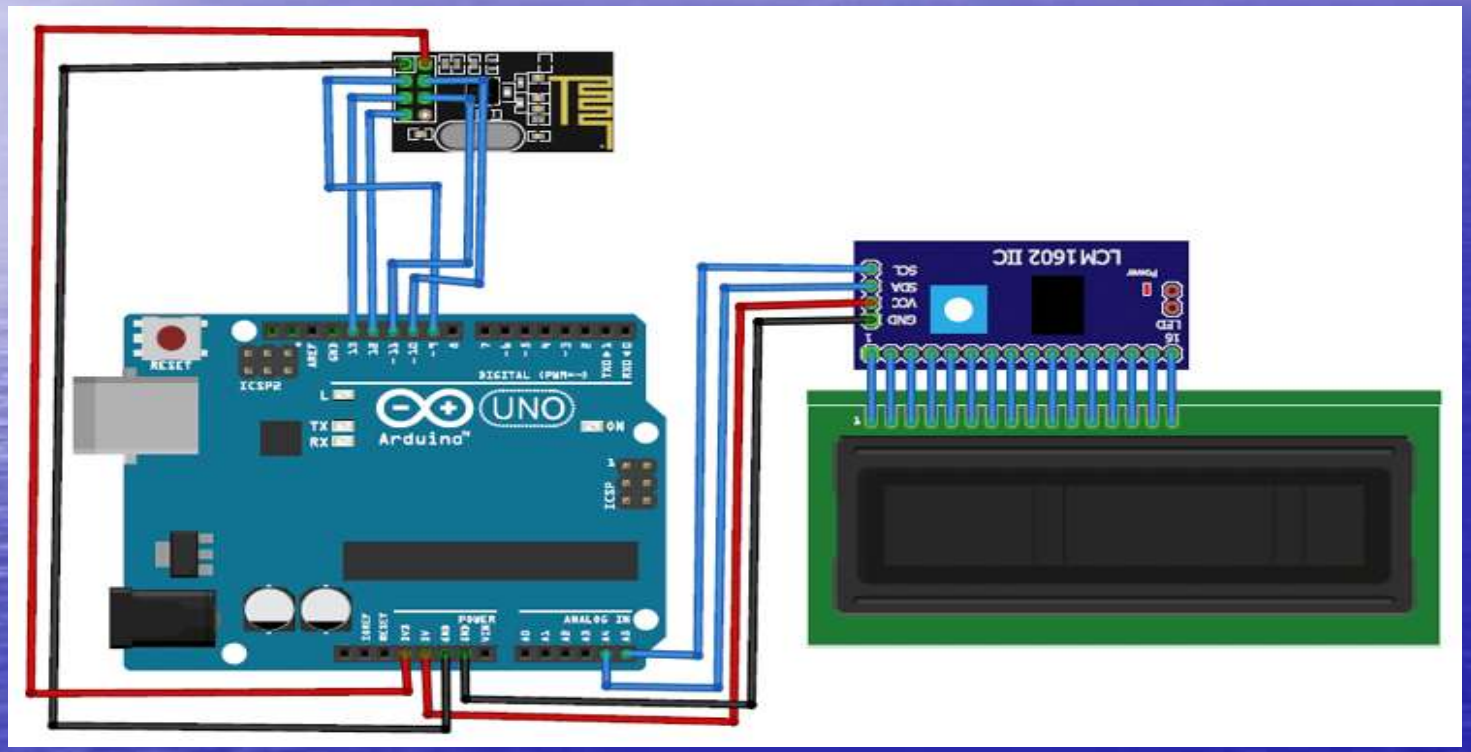
The connection of the components of RF transmitter sideThe connection of the components of RF transmitter side



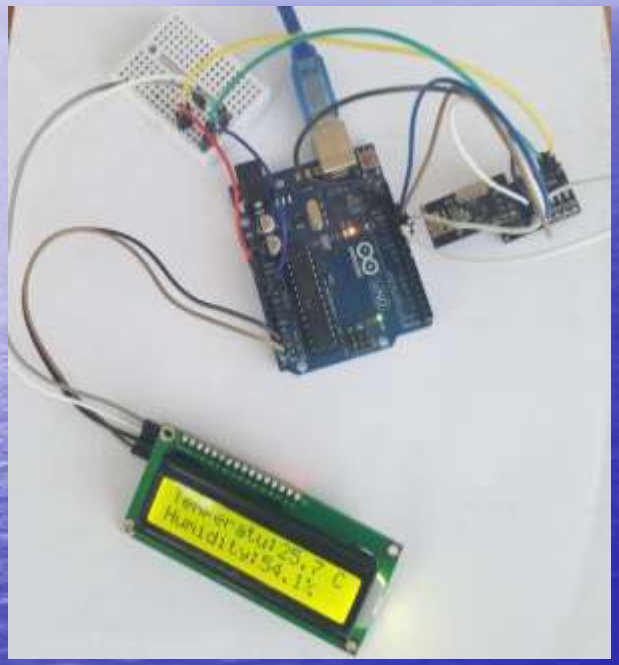
The practically realized prototype of the RF transmitter, and the finished RF transmitter device.



The connection of the components of RF receiver side



The practically realized prototype of the RF receiver, and inFig. 14b is shown the finished RF receiver device



Temperature and the humidity data measured by the DHT11 sensor, sent by the RF transmitter, received from the RF receiver in a data log file

	A	B	C	D	E
1	**Date**	**Time**	**Temperature©**	**Humidity(%)**	
2	6/11/2021	11:41:32	26.5	56.9	
3	6/11/2021	11:42:27	26.5	56.8	
4	6/11/2021	11:42:47	26.7	56.6	
5	6/11/2021	11:42:52	26.7	56.6	
6	6/11/2021	11:42:58	26.7	56.6	
7	6/11/2021	11:43:03	26.7	57.1	
8	6/11/2021	11:43:08	26.7	57.5	
9	6/11/2021	11:43:13	26.7	57.1	
10	6/11/2021	11:43:18	26.8	56.5	
11	6/11/2021	11:43:23	26.8	56.3	
12	6/11/2021	11:43:28	26.8	56.1	
13	6/11/2021	11:43:33	26.8	56.2	
14	6/11/2021	11:43:38	26.8	56	
15	6/11/2021	11:43:43	26.8	56.1	
16	6/11/2021	11:43:48	26.8	56.2	
17	6/11/2021	11:43:53	26.8	56.2	
18	6/11/2021	11:43:58	26.8	56	
19	6/11/2021	11:44:03	26.8	55.9	
20	6/11/2021	11:44:08	26.9	55.8	
21	6/11/2021	11:44:13	26.8	55.7	
22	6/11/2021	11:44:18	26.8	55.7	

Simple Data | Simple Data with Plots | Interactive Bar Graph

Conclusions

- In paper with theoretical analysis is designed and practically realized process RF smart sensor network
- Sensor network measurement and collection data for temperature and humidity in measurement point at one remote processing plants and transmission to the main central control panel.
- The data is displayed on the LCD display and stored in an excel log file
- The solution also provides the ability for upgrade to remote transfer on the data over the internet