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***Research paper***

# Humidity and temperature monitoring

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**Abstract**

The prediction of climate in general and weather in particular are of paramount importance, especially with the possible negative consequences that may occur. Therefore, it is necessary to design an affordable, compacted size, and feasible weather station that provides significant information concerning humidity and temperature. In this research, we have employed a highly reliable DHT22 sensor and RF 433 hc12 for transmitting and receiving data. The DHT22 sensor is very accurate regarding humidity and temperature measurement whereas RF 433 hc12 processes high data rate, better range, and portability.
This research involves a system, with low cost and high performance, to provide accurate measurement of humidity and temperature and then transmits the data to display in LCD screen.

***Keywords***: *Arduino Uno microcontroller; DHT22 sensor; Humidity; RF 433 hc12; Temperature*.

## 1. Introduction

Monitoring is considered to be an essential aspect of environmental changing conditions. It is basically employed to assess and mapping of biodiversity over vast regions, in alerting of any changes to the climate conditions, and identifying the zones to be well protected. Therefore, it is inevitable to globally monitoring the earth for identifying and assessing climate changes. Anthropogenic, originating in human activities, is considered to be the main contributor of the climate changes and has resulted in increasing greenhouse gases and aerosols which in turn have negative impacts on global climate changes. Mavromichalaki, et. al. 2016 developed services of essential importance for the fundamental research as well as for practical applications concerning Space Weather [1].

The prime motivation for the weather station is to track any changes in weather parameters due to their significant impacts on human-being over the years.

At the present time, as it is obvious, the global warming has negative impacts on environments so, both humidity and temperature constitute the main factors that should be considered in design of modern weather stations. The highly demanded weather station are characterized with high efficiency, compacted size, portable (in order to measure remote areas), and low power consuming. In contrary to the traditional bulky and high-power consuming weather station.

Kaspar, et. al. 2013, established a pan European accessible plant phenology open data base. PPODB is also including phonological information from additional sources [2]. Detecting the humidity and temperature constitutes a major issue over many decades. Dipak, et. al. 2013, employed several processors such as PIC micro-controller, AVR, ARM, and A/D channels to generate the analog output data of the humidity and temperature sensors [3]. Recent reports about high temperatures and drought conditions in several global areas have raised the concern about whether conditions. A developed global weather monitoring and recording capability are in demand to track the climate trends, and comparison with the updated model and accurate datasets available. It is of high importance to identify all variables associated with their related data which have been collected in order to issue an integrated climate monitoring report at regular intervals.

Susmitha, et. al. 2014, used the microcontroller to collect the data obtained from the sensors to send them in to the LABVIEW via the Serial Communication port. IDE Keiluvision4 is utilized to develop the appropriate programs in embedded C which are loaded into micro-controller by using JTAG [4].

Based on the above-mentioned discussions, we have designed and implemented a temperature and humidity station that allows the user to observe the details of the humidity and temperature at regular time intervals as set by the user [5]. This research is developed a system that can measure and remotely monitor the status of humidity and temperature in Iraq at specific regions using sensing technique

## 2. Methodologies and Instruments

This research discusses the implementation of the project from three perspectives: Hardware, Software, and connectivity.

### 2.1. Hardware implementation

The components employed in this work include the microcontroller, different types of sensors, and motors. One of the main parts of the system is the programmable chip that controls the work.

#### 2.1.1. The microcontroller (arduino)

Arduino Uno is a microcontroller board. Arduino has many inputs pins which are basically fed from a variety of switches or sensors and controls a wide range of outputs such as lights, recorders, motors, actuators …etc. Arduino can be utilized to generate interactive items.

The Arduino board can be assembled manually or purchased preassembled; the open-source IDE (Integrated Development Envi-

ronment) can be downloaded free of charge from the website. The Arduino UNO is based on the ATmega328P microcontroller. The board is programmed with Arduino IDE and provided with 14 input/output (I/O) pins. The board supply voltage is provided through a USB cable or by an external dc supply in a range of 7-20 volts [6].
Fig.1 demonstrates the Arduino Uno Microcontroller used while Table 1 illustrates the specifications of the Arduino Uno.

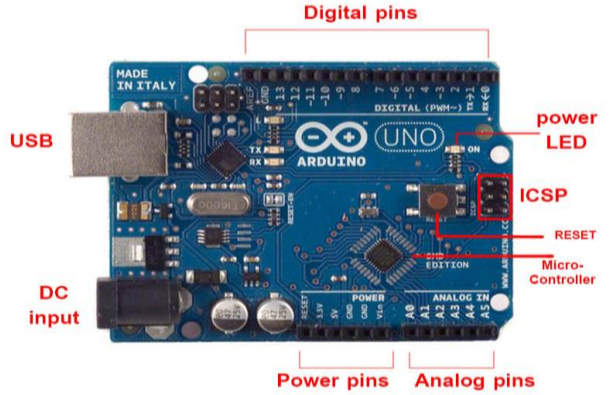


**Fig. 1:** Arduino Uno Microcontroller [6].

**Table 1:** Specifications of Arduino Uno [6].

| Microcontroller | ATmega328 |
|---|---|
| Operating Voltage | 5V |
| Input Voltage (recommended) | 7-12V |
| Input Voltage (limit) | 6-20V |
| Digital I/O Pins | 14 (of which 6 provide PWM output) |
| Analog Input Pins | 6 |
| DC Current per I/O Pin | 40 mA |
| DC Current for 3.3V Pin | 50 mA |
| Flash Memory | 32 KB (ATmega328) of which 0.5 KB used by boot loader |
| SRAM | 2 KB (ATmega328) |
| EEPROM | 1 KB (ATmega328) |
| Clock Speed | 16 MHz |
| Operating Voltage | 5V |

### 2.1.2. DHT22 unit

The DHT22 is the low-cost digital humidity and temperature sensor. It utilizes a capacitor based humidity sensor combined with a temperature sensor component to measure the surrounding air. The output of the sensor is a digital signal that is to be transferred to appropriate data pin. This sensor is perfect and accurate with working in a broad range of humidity and temperature [7].
Fig.2 illustrates the DHT22 sensor used, and Table 2 shows the specifications of DHT22 humidity and temperature sensor.

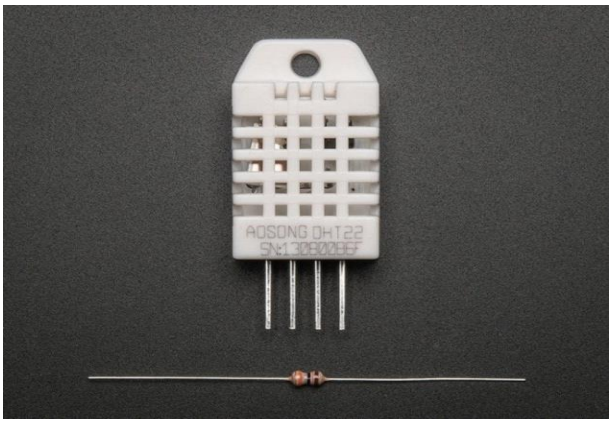


**Fig. 2:** DHT22 Sensor [7].

**Table 2:** Specifications of DHT22 Humidity and Temperature Sensor [7]

| Model | DHT22/AM2302 |
|---|---|
| Power supply | 3.3-6V DC |
| Output signal | Digital signal via 1-wire bus |
| Operating range | Humidity 0-100%RH; |
| Accuracy | Humidity +-2%RH (Max +-5%RH); |
| Temperature <+-0.5Celsius | |
| Resolution or sensitivity | Humidity 0.1%RH; |
| Temperature 0.1Celsius | |
| Repeatability | Humidity +-1%RH; |
| Temperature +-0.2Celsius | |
| Humidity hysteresis | +-0.3%RH |

### 2.1.3. RF 433 HC12

HC-12 is a multichannel wireless data transmitter with 100 channel. The frequency band of this series port communication module is 433.4-473.0MHz, and the stepping frequency is 400 kHZ.The advantages of this sensor are: low power consumption, time saving, faster data transfer, high receiving sensitivity, low cost, very accurate, with the communication distance is 1km in open space [8]. Built-in MCU, and it can communicate with external devices with unlimited bytes to one time [9]. The communication distance can be increase by spring antennas. The specifications of this module can be summarized as per Table 3 shown below.
Fig.3 depicts the RF 433 hc12 used.

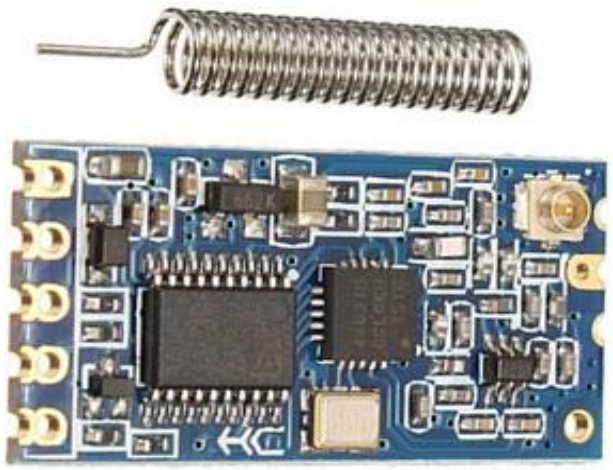

**Fig. 3:** The RF 433 HC12 [9].

**Table 3:** Specifications of RF 433 HC12 [9]

| Working frequency | 433.4MHz to 473.0MHz |
|---|---|
| Supply voltage | 3.2V to 5.5VDC |
| Communication distance | 1,000m in the open space |
| Serial baud rate | ١،٢Kbps to 115.2Kbps (default 9.6Kbps) |
| Receiving sensitivity | -117dBm to -100dBm |
| Transmit power | -1dBm to 20dBm |
| Interface protocol | UART/TTL |
| Operating temperature | -40℃ to +85℃ |
| Dimensions | 27.8mm x 14.4mm x 4mm |

### 2.1.4. Alphanumeric LCD display (16 x 2)

This an intelligent dot matrix display is employed for very broad applications such as very small size computers(palmtop),photo copier machines, cellphones, medical devices, …etc. This type of displays has a capability to display 224 different sorts of characters and symbols and normally powered by 5V voltage supply source [10].
Fig.4 demonstrates the LCD display used

**Fig. 4:** LCD Display (16 X 2) [10].

The flowchart of the work is showing in Fig. 5 below

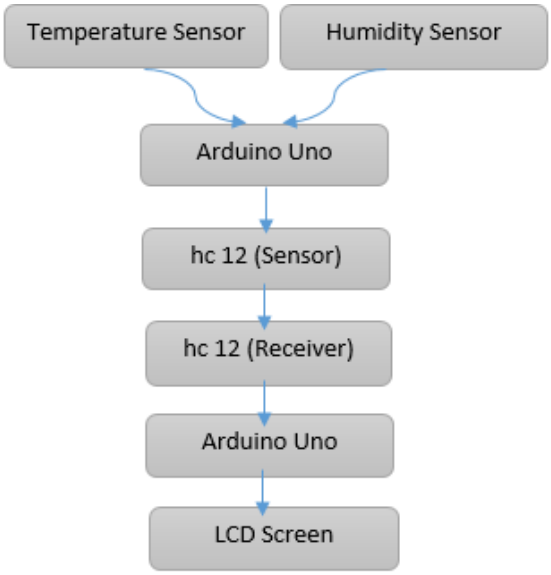


**Fig. 5:** Flowchart of the Work.

### 2.2. Software implementation [11]

An open source software for Arduino boards is used to write and upload codes on the Arduino boards without any complicates. It runs on different platforms including Windows. It provides extra options to monitor and communicate with Arduino boards.

## 3. Results and discussions

The transmitter part consists of Arduino, the board connected with, sensor, and resistor 10K for reducing the voltage difference and protecting the sensor from the high current, and sending piece hc12, as shown in Figs. from 6-11.

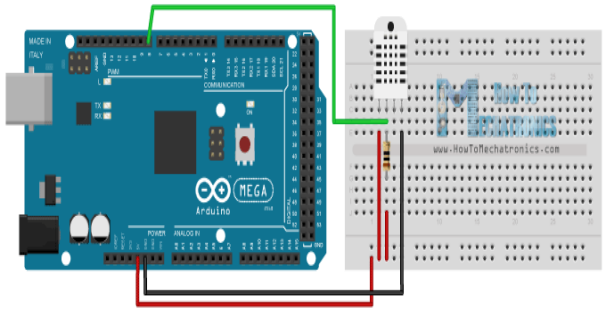

**Fig. 6:** Diagram of the DHT22 Temperature and Humidity Sensor Combined with Arduino Uno Microcontroller.

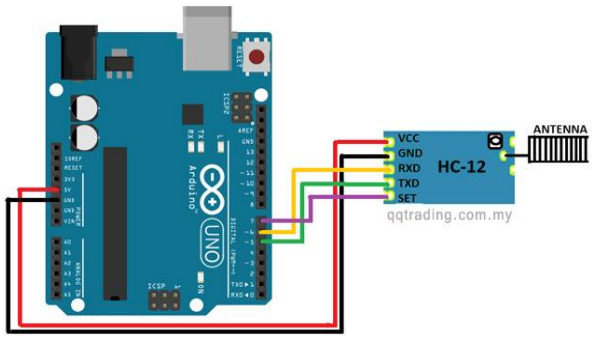


**Fig. 7:** The RF 433 Hc12 Combined with Arduino Uno Microcontroller.

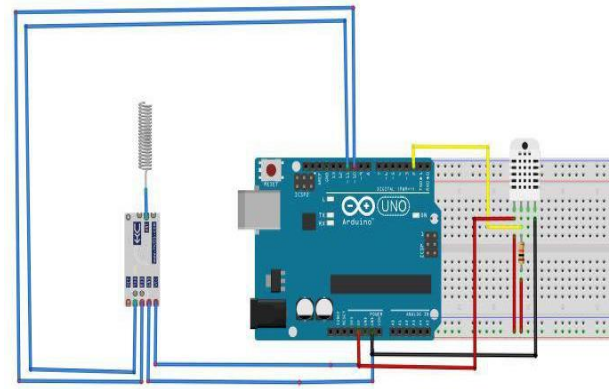

**Fig. 8:** Diagram of the Entire System.

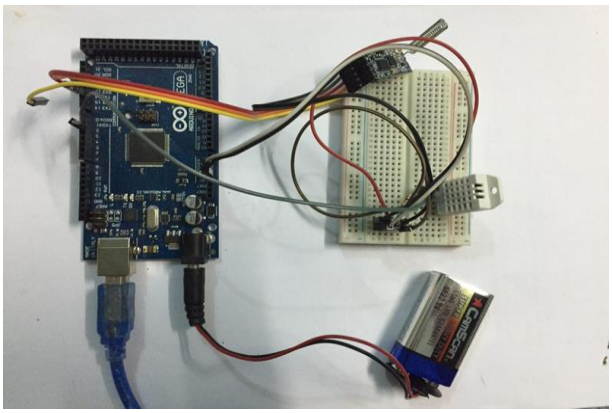

**Fig. 9:** The System Assembly (Sensors and Receiver) Through the Arduino Uno.

The system went through a number of iterations of testing the operation, and correction. This section shows the final results we have obtained for each part of the system.

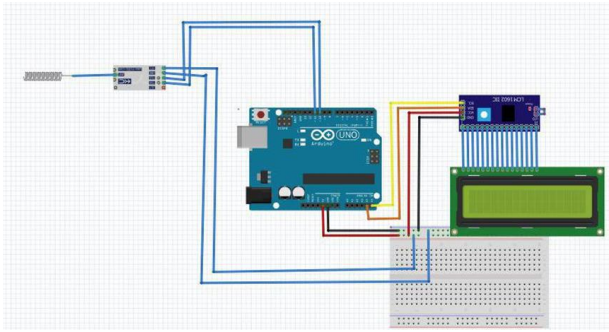

**Fig. 10:** Diagram of the System Connected to LCD Screen.

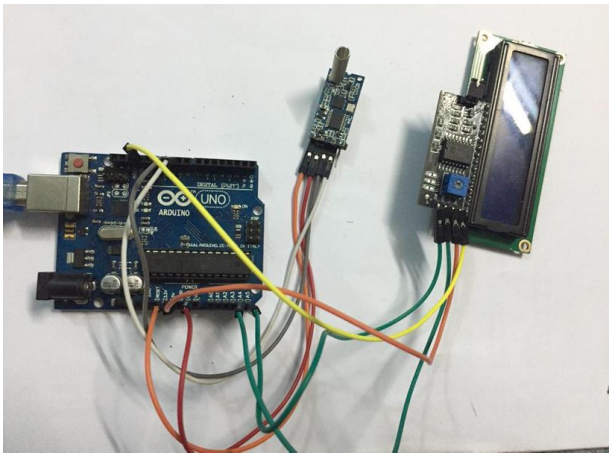

**Fig. 11:** Final Assembly (Sensors and Receiver) Through the Arduino Uno with the LCD Screen.

### 3.1. Humidity and temperature control

The DH22 sensor detects the humidity then transmits it to the first Arduino by hc12 sender, then the second Arduino receives it by hc12 receiver and display the output in LCD.
The Arduino's IDE serial monitor shown in Fig. 12 which shows a sample of the readings of humidity and temperature obtained.

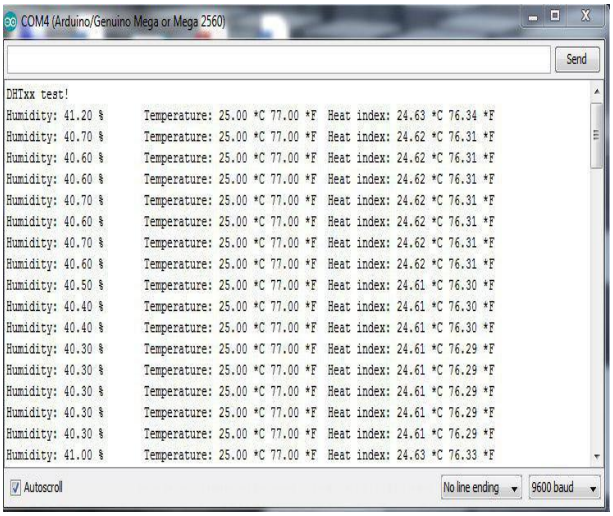


**Fig. 12:** Humidity and Temperature System Results.

## 4. Conclusion

The word 'humidity and temperature change" has begun to draw more attention of many scientists and researchers. Basically, it refers to a continuous process that has an alerting and perhaps dangerous consequences. Monitoring the humidity and temperature is a fabulous technique to record and track any changes in order to enable the decision makers to prepare or follow the proper procedure to prevent any environmental disasters that could lead to jeopardising the natural resources such as water, air, soil…. etc. The huge developments in the field of Information and communication technology in the climate change, mitigation, adoption and monitoring have added significant improvements to the traditional techniques in terms of accuracy, reliability, and faster data transfer. Consequently, these updated techniques reduce the overall system cost; provide real time observation, low power consumption, lively tracking, real time data processing and analysis. At the end of the day, having such improved national humidity and temperature monitoring system will positively affect people's livelihoods.

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