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# An Arduino UNO Based Environment Monitoring System

Anas Tukur Balarabe[1], Abdurrashid Sani[2], Zahriya Lawal Hassan[3]
*[1,3](Department of Computer Science, Sokoto State University, Sokoto-Nigeria)*
*Corresponding Author: Anas Tukur Balarabe*

***Abstract:*** *This paper converses a system for measuring, monitoring and estimation of some environment's parameters like temperature, humidity, and volume of $CO_2$. The system was developed using Arduino Uno micro-controller and its platforms. It has high level scalability and is cost-effective, which makes it suitable for other environment monitoring applications. The paper contains elaborate explanations of the overall system architecture as well as hardware and software requirements of the system. Viability of the system has also been demonstrated through presentation of some results obtained.*

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## I. Introduction

The advancement and innovations in technology triggers the needs for controlling and monitoring of different environmental parameters such as temperature, humidity and $CO_2$. The system hardware platforms are basically low-power embedded microcontroller systems with on board sensors and analog I/O ports for connecting the sensors[1].

Prediction and estimation with Arduino has two components, hardware components and software components. Hardware component are those components that detect and organized the environment parameter e.g. Arduino board, bread board, sensors, jumper wires, USB cable for connecting Arduino board with computer. Then second component is Arduino software which tells what hardware component of Arduino to do. The software has an environment in which codes are typed and edited. Initially, the hardware connection is made and deployed, the connection in environment surfaces to detect the parameters (e.g., temperature, humidity and CO2 and etc.) while a program codes extract and organize data from the sensors, manage it and display variations in the environmental parameters. Sensor devices are placed at different locations to collect the data and predict the behavior of a particular area with variations in selected environmental parameters, the output of each sensor is then loaded and displayed in a serial monitor. The program in Arduino IDE uses looping i.e. a particular program will keep on iterating until it has been terminated [2].

## II. Related Work

According to the literature reviewed there were some related systems that were designed by different researchers. Some systems were designed to predict only temperature of an environment, some humidity and some restricted gas. The followings are some of the reviewed works.

A system for remotely prediction of environmental parameters like temperature, atmospheric pressure and relative humidity was designed by [3]. The system uses Arduino micro controller, sensors and an LCD display for data output. The output is analog in nature but is presented as digital by means of analog to digital converter interfaced with a microcontroller. Data analysis is done by the PC with a graphical user interface.

Another system was developed for monitoring of environmental parameters like temperatures, humidity, and quality of air. The system was implemented using smart phones. Data was collected from sensor nodes to the destination ZigBee network and then retransmitted to the end node using Bluetooth network [4].

A Supervisor Control and Data Acquisition system (SCADA) was developed for measuring and controlling of the environmental parameters like temperature, pressure and humidity remotely by using an integrated wireless SCADA system. It uses GPRS based mobile network to display it predicted data using LCD screen. The major setback recorded by this work was it dependence on large infrastructure for implementation [5].

A prototype product of a Web Based Temperature Monitoring System was developed; it allows the users to monitor the temperature condition of particular environment. Hardware and C programming language as a software specifications and an active Server Page (ASP) scripting language was used as the server side scripting to make available the current temperature at the web browser [6].

## III. System Hardware and Software Components

In this research, an environment monitoring system has been developed using Arduino module. Arduino is widely used open-source single-board microcontroller development platform with flexible, easy-to-use hardware and software components. Arduino Uno R3 is based on Atmel Atmega328 microcontroller and has a clock speed of 16MHz. It has 6 analog input and 14 digital I/O pins, thus, a number of sensors can be connected to it. Arduino-compatible custom sensor expansion board can be, known as shield, can be developed to directly plug into the standardized pin-headers of the Arduino Uno [7][8]. Other hardware components of the system are the two sensors used for temperature and humidity and for sensing $CO_2$, namely: DHT11 temperature sensor and MQ-135 gas sensor. At the core of the software part of the system is a simple algorithm that received the readings of the selected parameters and process them for display. Fig 8 shows a description of the system block diagram.

**Arduino Board**

The most popular Arduino boards out there is the Arduino Uno R3, even though it is not the first board to be released, it remains the most actively used and most widely documented on the market [8]. Arduino Uno board has been used throughout this project because of its extreme popularity, simplicity, accuracy and ease of use.

**Fig. 1.** Arduino Uno R3

**a. DHT11 Temperature Sensor**

The DHT11 is a basic, digital temperature and humidity sensor. It detects temperature, humidity, heat index and other related parameters. DHT11 reads it data in small scale and the read data is processed in two second intervals [9].


**Fig. 2.** DHT11 Temperature Sensor

**b. MQ135 $CO_2$ Sensor**

MQ-135 is gas sensor that senses gases like ammonia nitrogen, oxygen, alcohols, carbon die-oxide aromatic compounds, sulfide and smoke [10]. MQ135 operate within 2.5 to 5.0 voltages. In this project sensor has been used to detect carbon die-oxide level of particular environment, the level has been detected in PPM (part per million).


**Fig. 3.** MQ135 $CO_2$ Sensor

**a. Bread Board**

Arduino Uno breadboard is a board that enables ground connection i.e. circuit to be designed using male and female jumpers wires, it allows different sensors, LED and other required device to be plug and configuration [10].

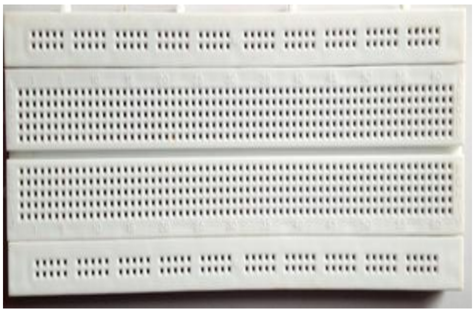

**Fig. 4.** Bread Board

**b. USB Cable**

USB cable (universal serial bus) is used to connect Arduino board to computer. This USB has four cables, two for carrying light and the other two for transmitting of data between PC and the board. The cable is approximately 178cm [11].

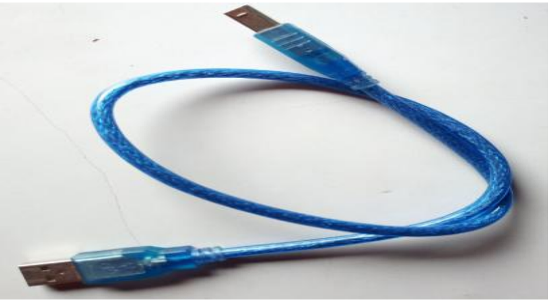

**Fig. 5.** USB Cable for Connection to PC

**c. Jumper Wire**

Jumper wire, also known DuPont wire is an electrical cable for connecting of components of bread board and testing of some made prototypes and circuit. Jumper wires are of two categories, there are male and females jumper wire. And each jumper wire has either pin or connector at the end [13].

**Fig. 5.** Jumper Wires

## IV. System Block Diagram

A simple block diagram of the system is shown below where each block represents a foremost component of the system.

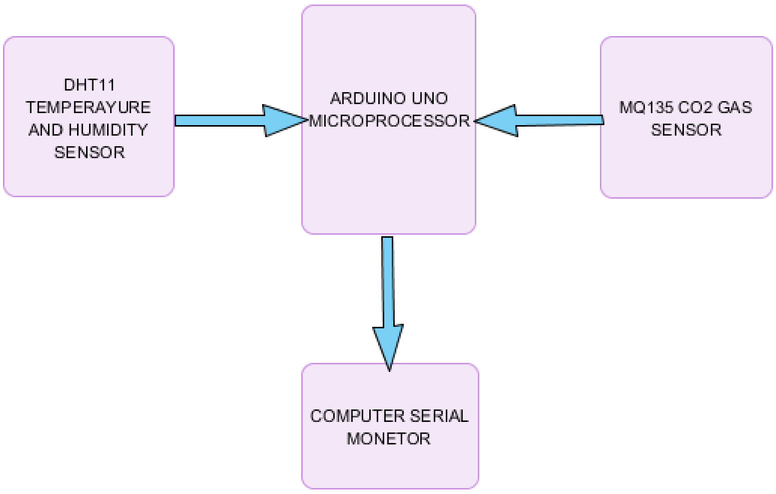


**Fig. 6.** Block Diagram of the System

## V. System Implementation

**Implementation of Temperature System**

- Plug the temperature sensor into the bread board holes i.e. it will occupy three holes.
- Plug three jumper cables into breadboard in a position opposite to the holes of sensor i.e. GND, DATA and VCC.
- Connect first cable that pointed to GND on the bread board to GND hole on the Arduino board.
- Connect second cable that pointed to DATA on the breadboard to the pin7 or any other digital pin (optional) depending on the pin that is used when coding.
- Connect third cable pointed to VCC on the bread board to the hole that show 5v on the Arduino board.
- Then connect power cable from Arduino board to computer.

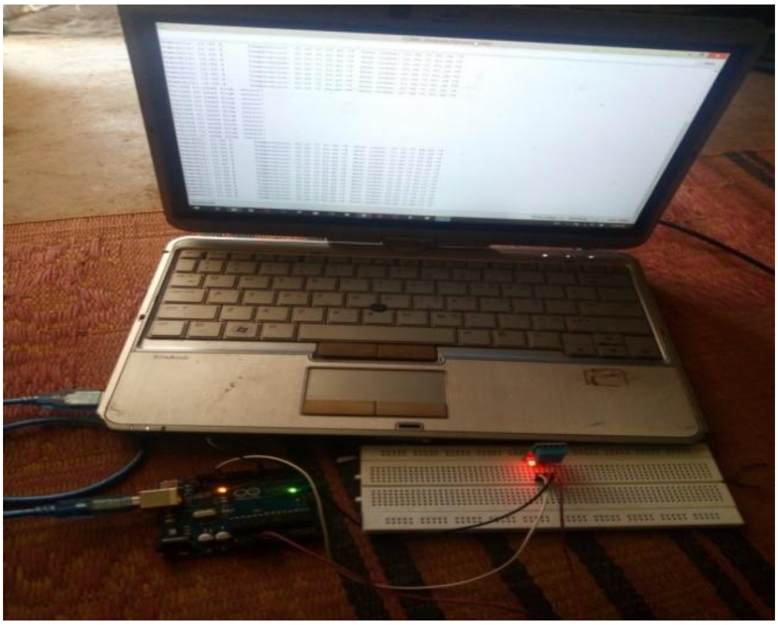

**Fig. 7.** A Snapshot of the System

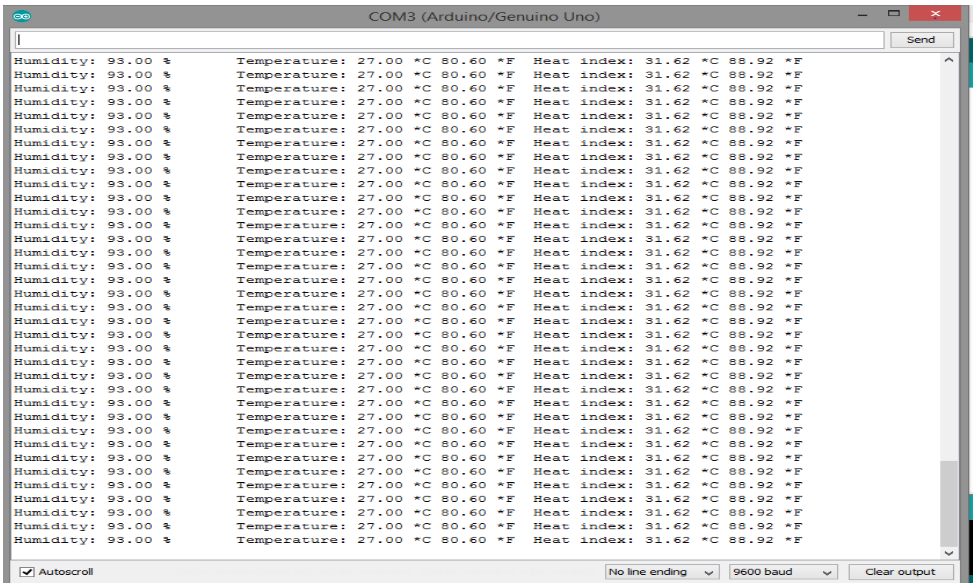


**Fig. 8.** Output of Temperature Sensor

**Implementation of co$_2$ System**

- Plug sensor into the bread board holes i.e. it will occupy four holes.
- Plug four jumper cables into breadboard in a position opposite to the holes of sensor i.e. A0, DO, GND and VCC.
- Connect first cable that pointed to AO on the bread board to AO Analog pin/hole on the Arduino board.
- Second hole of the sensor is optional i.e. for jumper that pointed to the DO hole of the bread board.
- Connect third jumper cable that pointed to GND on the bread board to the GND hole on the Arduino board.
- Connect fourth cable pointed to VCC on the bread board to the hole that marked 5v on the Arduino board.
- Then connect power cable from Arduino board to computer.

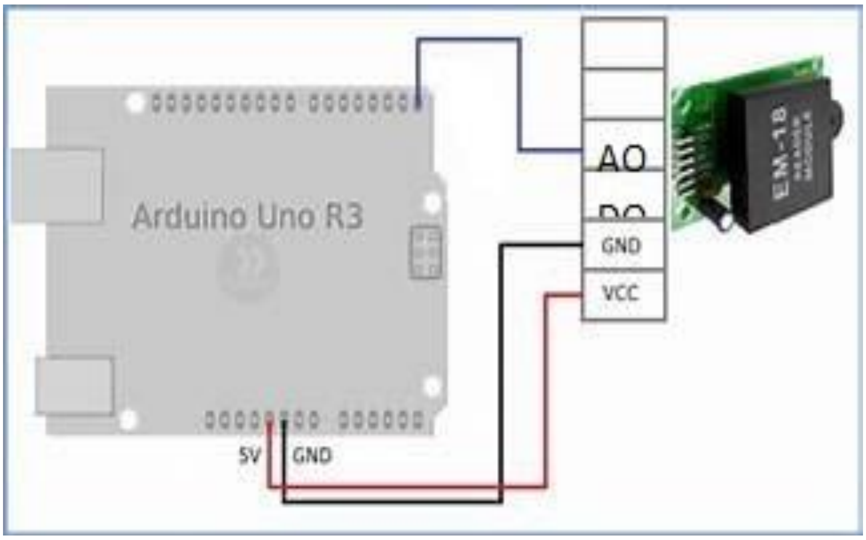


**Fig. 9.** Output of $CO_2$ System

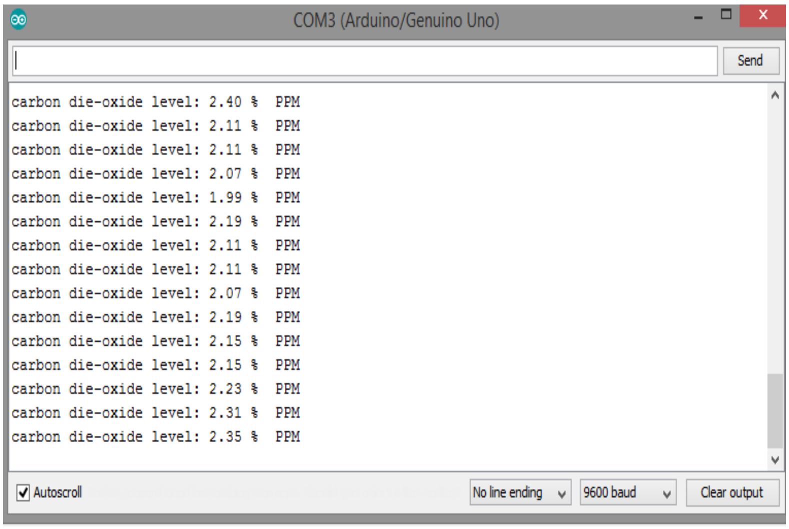


**Fig. 10.** Output of Temperature Sensor

## VI. Conclusion

In this paper, we have presented an environment monitoring system developed using Arduino Uno. The system has a number of attractive attributes, which include low-cost, scalable, supports customization, ease of deployment and ease of maintenance. It measure set back is it in ability read data from remotely connected sensors. This forms the next phase of our research which will focus on converting this system into a wireless based system by introducing a Raspberry Pi, ZigBee Module and a web-based application for managing the system.

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