International Journal of Research
Available at https://edupediapublications.org/journals

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 15
May 2018

Iot Based Green House Monitoring and Smart Farming

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Abstract:

Monitoring the vital parameters of a greenhouse namely temperature and soil moisture through internet of things technology (IOT). Irrespective of wherever in the world you are through IOT technology we can monitor and control the greenhouse parameters. All the vital sensor data will be available to authorized users via internet. Even though the technology is yet to take off globally, this report analyses the possibility of integrating a greenhouse and the IOT. The project covers wide area of embedded system and networking. This paper presents a low cost and flexible greenhouse monitoring system using an embedded MCU with wi-fi connectivity to the internet. The proposed system does not require a dedicated server PC with respect to similar systems and offers a light weight communication protocol to monitor and control the environment. To demonstrate the feasibility and effectiveness of this system, devices such as soil moisture sensor and temperature sensor have been integrated with the proposed greenhouse control system

Keywords: - Internet of Things (IoT), Agriculture, IoT, Arduino UNO, Temperature Sensor, Humidity Sensor, Smart Farming, Soil Moisture Sensor, Cloud Computing, Wi-Fi Module ESP8266, Thingspeak.com.

Introduction:

IoT refers to a network of things. The term, Internet of Things refers to uniquely identifiable objects, "Internet of Things" is gaining its important place in this world especially around modern wireless communication technology. Internet of Things was discovered by "Kevin Ashton" in 1999 regarding supply chain management.

In the present scenario were people are moving around the world, there is an increased demand for connectivity with our properties wherever we are on the planet. Here comes the role connecting every device to the internet so that it is accessible wherever we have an internet access. This interesting fact throws upon us the need to implement a solution integrating our present resources. This is where internet of things comes into the picture. This report focuses on implementing a smart greenhouse that can monitored using IOT technology.

1. Network Architecture

The WSN was implemented using a tree topology in beacon enable mode (data being sent continuously without interruption) where sensors collected data and sent it to a base station which is the task manager of the network. The proposed WSN architecture is shown in Fig 1. A few sensor nodes serving as transmitter have been designed to collect, process, and transmit the data in real time. The system operates within a range of 100m from the base station and is suitable for monitoring of greenhouse.

The base station, which is the network coordinator manages the activities of the individual nodes by periodically requesting data. In addition to the data integration and analysis, the base station also relays processed data to display device [5,6]. The base station equipped with an MIB520 for system coordination, a receiving Mesic and a Wi-Fi module for wireless communication and data transmission over the 802.1b/g wireless network, which make it possible to access the data collected via the internet. In addition, the captured data inserted into MySQL database where LabVIEW is used to display data.

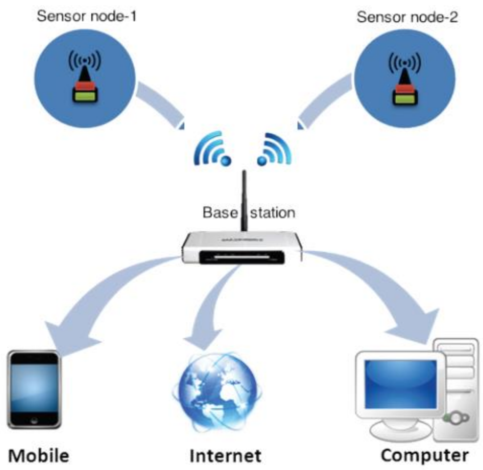


Figure 1: network architecture

2. Existing System:

Greenhouses in India are being deployed in the high-altitude regions where the sub-zero temperature up to 40° C makes any kind of plantation almost impossible and in arid regions where conditions for plant growth are hostile. The existing set-ups primarily are:

MANUAL SET-UP:

This set-up involves visual inspection of the plant growth, manual irrigation of plants, turning ON and OFF the temperature controllers, manual spraying of the fertilizers and pesticides. It is time consuming, vulnerable to human error and hence less accurate and unreliable.

PARTIALLY AUTOMATED SET-UP:

This set-up is a combination of manual supervision and partial automation and is like manual set-up in most respects but it reduces the labor involved in terms of irrigating the set-up.

FULLY- AUTOMATED SET-UP:

This is a sophisticated set-up which is well equipped to react to most of the climatic changes occurring inside the greenhouse. It works on a feedback system which helps it to respond to the external stimulation efficiently. Although this set-up overcomes the problems caused due to human errors it is not completely automated and expensive.

3. Problem Definition:

Complexity involved in monitoring climatic parameters like humidity, soil moisture, illumination, soil pH, temperature, etc... which directly or indirectly govern the plant growth. Investment in the automation process are high, as today's greenhouse control systems are designed for only one parameter monitoring to control more than one parameter simultaneously there will be a need to buy more than one system. High maintenance and need for skilled technical labour.

The modern proposed systems use the mobile technology as the communication schemes and wireless data acquisition systems, providing global access to the information about one's farms. But it suffers from various limitations like design complexity, inconvenient repairing and high price. Also, the reliability of the system is relatively low, and when there are malfunctions in local devices, all local and tele data will be lost and hence the whole system collapses. Moreover, farmers in India do not work under such sophisticated environment and find no necessity of such an advanced system, and cannot afford the same. Keeping these issues in view, an IOT based monitoring and control system is designed to find implementation soon that will help Indian farmers.

4. Motivation:

There is a lack of food stuffs in our nation. This is because of the increased population. Our food crops need some specific environmental conditions for their growth. There is a huge variation in the environmental conditions in the present. This will affect the growth of the crops. Because of the less availability of medicinal plants the cost of the medicines increasing. Also, there is an unavailability of labors in the present. From all these problems, we realized that there is a need of automatic monitoring and control system for greenhouse which is the place we can cultivate the crops under specific conditions suitable for it.

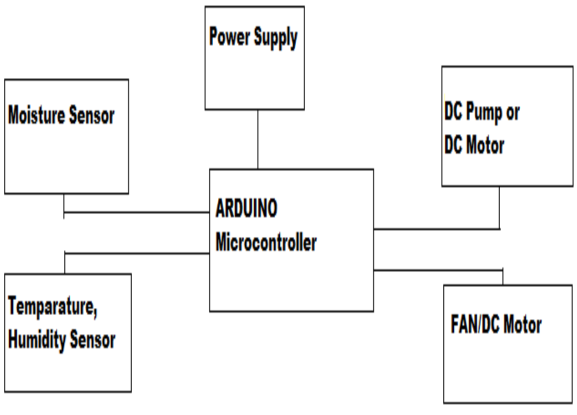
5. Objectives

Objective of this project is to provide greenhouse monitoring hence, IoT based Smart Agriculture System assisting farmers in getting Live Data (Example: Temperature, Humidity, Soil Moisture) for efficient environment monitoring or greenhouse monitoring which will enable them to do smart farming and increase their overall yield and quality of products.

This project is integrated with Arduino Technology, various sensors and live data feed can be obtained online from Thingsspeak.com.

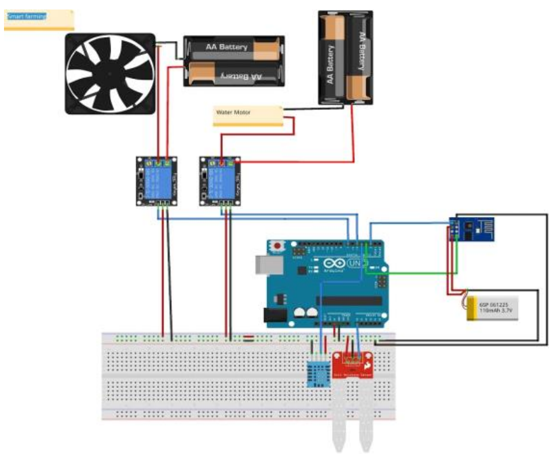
6. Block Diagram

From the current problem section, it can be seen that the existing systems are insufficient to handle the problems of the greenhouse monitoring and control. To solve these problems, we propose the monitoring and control of greenhouse using IOT and WSN. It mainly consists of the sensing part, controlling part, monitoring part and a message sending and receiving part. In the monitoring part the sensors included are temperature sensor, humidity sensor, soil moisture sensor, gas sensor, color sensor and fire sensor. These sensors will sense the various parameters of the environment. And the values will be displayed on an LCD display. These sensors are connected to the microcontroller (P89V51RD2) which is the controlling part. The analog sensors are connected through the ADC. The microcontroller is then connected to a pump, buzzer and a GSM module through MAX232. MAX232 is used to convert the voltage levels to TTL level. When the soil moisture is less the microcontroller will ON the pump. If there is a presence of fire the sensor will sense it and information passed to the microcontroller. Then the buzzer will get ON. The next part is the message sending and receiving part. In the sending part there is a GSM Module which will send the values to the number which is given already. The receiver part is a smart phone, which is having an application that will play a predefined audio message based on the message received from the GSM module. Keil software is used to provide the ease for writing the programs. Figure 1 shows the block diagram.



Bloch Diagram of the Project

7. Implementation:



Power for ARDUINO:

We are using 5 Volts from USB of the Laptop to power the Arduino while programming and in standalone mode external Power supply from the power supply board.

12 Volts DC Power Adapter is used to power the Power supply board which takes 12 Volts input and gives 5 Volts and 3.3 Volts as output.

Power for DC Fan and Pump Motor:

2x5 Volts adapters are used for powering fan and pump. Wi-Fi ESP 8266 is powered 3.3 Volts from Power Supply Board.

The main brain of the project is ARDUINO UNO Development Board and the Program.

The Soil Moisture Sensor is connected to Analog pin A0.

Relay 1 is connected to Arduino output Pin 7. The DC pump is connected to Com and NC of Relay 1.

The Temperature-Humidity Sensor DHT11 is connected to Digital Input Pin 4 of Arduino. Relay 2 is connected to Arduino output pin Pin 8.

DC Fan:

The 5Volts DC Fan Motor is connected to Com and NO of Relay 2.

Wi-Fi Module ESP 8266 is connected to Pins 2 and 3 of ARDUINO for communication and separate external 3.3Volts Power is provided to the Modules VCC and GND Pins. CH_DN of ESP 8266 is connected to GND of Power supply board.

8. Hardware and Software Specification

Hardware:

1. Power Supply:

A 12 Volts Regulated DC Power Adapter is used for powering, 5 Volts and 3.3 Volts DC Power Supply board. This Power Supply Board provide power for Arduino Board, Moisture Sensor, Temperature and Humidity Sensor, Motors, Relay Boards and 3.3 Volts DC for Wi-Fi Module

Two, 5 Volts Power Adapters are also used for powering DC Fan Motor and CD Pump.

These Power Supplies are pluged into the Mains. The power supply consists of switching circuits, circuits for stepping down the voltage, converts AC into DC by using bridge rectifier, and is regulated by a voltage regulator.

2. Arduino UNO

Arduino Uno is a circuit board with a microcontroller installed into it, a USB interface, a DC power socket, many input and output lines, some LEDs for status indication and other miscellaneous components. This board is the Uno (shown in the figure below) uses the **ATMega328 Microcontroller.**

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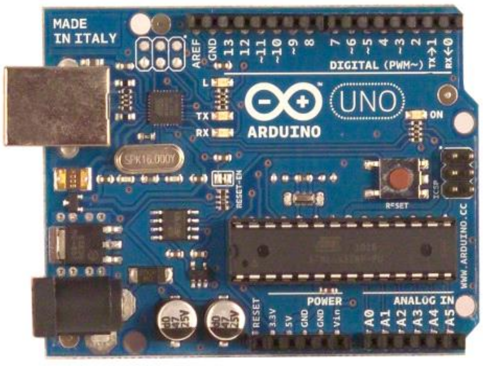


The Atmega328 is a very popular microcontroller chip produced by Atmel. It is an 8-bit microcontroller that has 32K of flash memory, 1K of EEPROM, and 2K of internal SRAM.

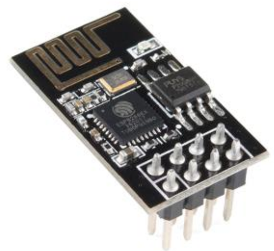
This MCU is a DIP-28 package, which means that it has 28 pins in the dual in-line package. These pins include power and I/O pins. Most of the pins are multifunctional, which means that the same pin can be used in different modes based on how we configure it in the software. This reduces the necessary pin count, because the microcontroller does not require a separate pin for every function. It can also make our design more flexible, because one I/O connection can provide multiple types of functionality.

3. USB Cable:

Arduino has USB socket on top left of the board, we need it to connect PC or Laptop to program the board. The USB cable also powers the Arduino Board and the Devices.

4. Wi-Fi Module:

This module is for interfacing Wi-Fi to PC/Laptop or Arduino, to access Internet. It consists of ESP8266 a low-cost Wi-Fi microchip with full TCP/IP Stack and Microcontroller capability produced by Shanghai-based Chinese manufacturer, Expressive Systems.



The ESP8266 Wi-Fi Module is a self-contained SoC (System on Chip) with integrated TCP/IP protocol stack that can give any microcontroller access to Wi-Fi network. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, we can simply hook this up to Arduino device and get about as much Wi-Fi-ability as a Wi-Fi Shield offers.

This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. It contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts. This is ultra-low cost module that is easy to use and reliable for an IoT (Internet of Things) solution.

5. DC Motors:

Interfacing Arduino with Motors:

DC MOTOR is a machine which converts electrical energy into mechanical energy. The input of a DC motor is current/voltage and its output is torque (speed). These Motor use 5V DC Power Supply, connected through Relay Drive.

A DC motor (Direct Current motor) is the most common type of motor. DC motors normally have just two leads, one positive and one negative. If you connect these two leads directly to a battery, the motor will rotate. If you switch the leads, the motor will rotate in the opposite direction.

6. Relay Module:

Most electric motors need *much* more current than an Arduino pin can supply. A small, low-cost, electric motor might require 0.5A current.

One Arduino OUTPUT pin supply no more than 0.02A (20mA) current. (one pin has an absolute maximum safe current of 40mA, however, that is reduced if other pins being used as an output). A motor uses the most current when it is starting up.

If higher current loads such as Motors are to be driven a Relay is used along with a PNP transistor to the digital output. BC 547 transistor controls an electro-magnetic relay for driving high-current/high voltage loads like water pump motors through its N/C contacts (when soil is wet, relay remains in energized state).

7. DC Pump

A small immiscible DC pump is used to pump the water from water source to the plant. We used a 5Volts DC pup in this project which is connected to Arduino output pin through a Relay. When Soil Moisture sensors dryness, the Arduino output pin become HIGH and drive the Relay to power the motor, and the sensor senses no moisture the pin becomes LOW and put off the Pump. This will repeat according to the loop set in the Program.

8. Sensors:

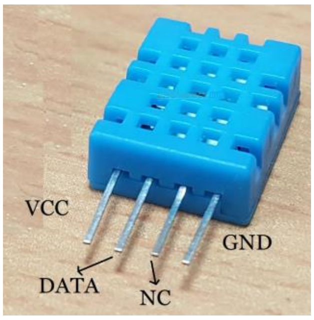
a) Temperature sensor:

Temperature sensor is use in various application to detect temperature. It will measure the amount of heat energy produced or generate by area, system or object. It allows us to sense the temperature changes by producing between analog or digital output. There are few sensors that

Integrated circuit (IC) temperature sensor is use analog circuitry to measure temperature. It is semiconductor that are fabricated in a same way to other semiconductor device such as microcontroller that shown in Figure 9. It have two terminal integrated circuit temperature transducer that produces an output current proportional to absolute temperature. The sensor package is small with a low thermal mass and a fast response time. 55 to 150°C is the most common temperature range that can be detect by IC. The solid state sensor output can be analog or digital. The IC temperature sensor is oftenly used because the price is cheap. It can be use in various area such as in computer to control CPU temperature, telecommunications devices, on circuit board to control temperature and some industrial application.

b) Humidity sensor:

Humidity is generally known as the presence of water in our air. A humidity sensor is very important to control system for industrial activity and for human comfort. In agricultural area, measurement of humidity is used for plantation protection such as dew prevention and soil moisture. Humidity sensor can use in various application such as in home by controlling heating, ventilating or air conditioning.



Capacitive humidity sensors are widely used in industrial, commercial, and weather telemetry applications as shown in Figure 10. It consist of a substrate on which a thin film of polymer or metal oxide is deposited between two conductive electrodes. The sensing surface is coated with a porous metal electrode to protect it from contamination and exposure to condensation. The substrate is typically glass, ceramic, or silicon. The changes in the dielectric constant of a CHS are nearly directly proportional to the relative humidity of the surrounding environment..

c) Soil moisture sensor:

Soil moisture is a variable in controlling the exchange of water and heat energy between the land surface and the atmosphere through evaporation and plant transpiration. Thus, soil moisture plays an important role in the development of weather patterns and the production of precipitation. Measuring soil moisture are useful for minimizing the amount of irrigation water applied for growing plants and for optimizing plant growth. It appears in many area such as agriculture, electronic appliance, houses, packaging or food process.

Software:

1) Arduino IDE:

For writing code, debugging, compiling and downloading to the Arduino controller.

2) AT Commands:

For integrating WiFi module with Arduino and cloud.

3) DHT library:

For adding library functions of DHT module to Arduino.

4) ThingSpeak.com API:

For creating channels and monitoring Data.

9. Advantages:

For farmers and growers, the Internet of Things has opened extremely productive ways to cultivate soil and raise livestock with the use of cheap, easy-to-install sensors and an abundance of insightful data they offer and how high-tech farming techniques and technologies can improve production output while minimizing cost and preserving resources.

Urban, vertical, indoor, hydroponic or smart farming, we`re all about farming using software and sensors.

10.Future of Smart Farming with IoT:

Technology phone, a robot and/or a computer are the new farming tools alongside the tractor. Farmers everywhere use to produce more with less and to make resources last. “Smart Farming” is a globally applicable tool box adaptable to different contexts. It is smart farming and good business.

Mobile Phones listens to farmers to deliver an approach to data they love and makes it simple for farmers to connect, collect, and protect. Smart farming is a concept quickly catching on in the agricultural business. Offering high-precision crop control, useful data collection, and automated farming techniques, there are clearly many advantages a networked farm must offer.

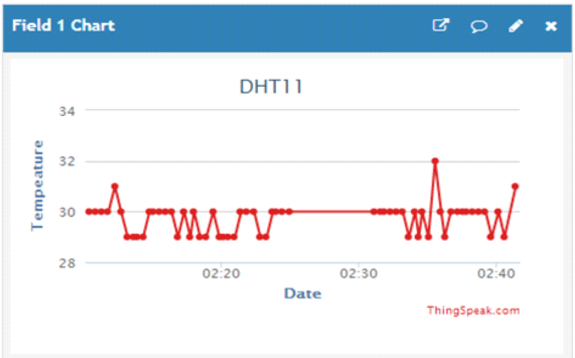
Rapid developments in the Internet of Things and Cloud Computing are propelling the phenomenon of what is called Smart Farming.

11.Result and Conclusion:

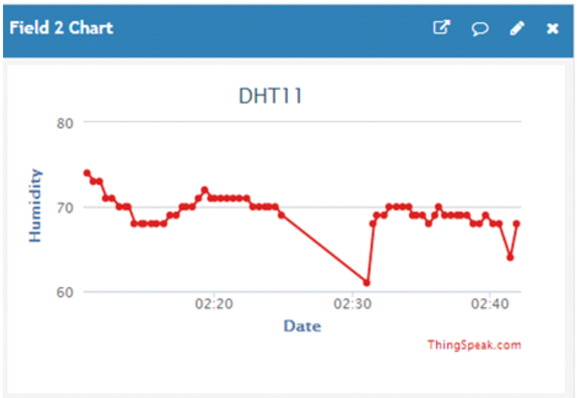
Result:

The experimental work has been deployed in the greenhouse, available in the UniMAP Aggrotech Greenhouse with 18m x80m dimension to monitor the micro climate conditions and controlling water irrigation. Regarding the following results obtained, the designed system presented in this work achieve its primary objective. It manages irrigation and soil moisture efficiently based on Figure.

Temperature:



Humidity:



Conclusion:

The text has studied on the loT technology application in agriculture, and selected mobile wireless communication technology to achieve greenhouse-site monitoring. Remote monitoring system with internet and wireless communications combined is proposed. At the same time, considering the system management, information management system is designed. The collected data by the system provided for agricultural research and management facilities. Research shows the greenhouse monitor system based on loT technology has certain precision of monitor and control. According to the need surrounding monitor, this system has realized the automatic control on the environmental temperature, humidity factors. And the system has offered a good growth condition, it is easy to operate, the interface is friendly, offering the real time environmental factors in the greenhouse. It can revise environmental control parameters, this system realizes the operation online, also have these characteristics: run reliably, high performance, improve easily.

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