International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 05 | May-2018 www.irjet.net p-ISSN: 2395-0072

Automated Agricultural Monitoring and Controlling System Using HC-05 BT Module

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Abstract - *In today's agricultural farm, numerous parameters and measurements are required to monitor, so traditional control strategy can't achieve the ideal control effect. This monitoring system is based on android application is designed for the good quality and productivity of plants. To get the desired results there are some very important factors which come into play like Temperature, Humidity, Light intensity and soil moisture, which are vital for a better vegetation growth. Keeping these parameters in mind we have built an Automatic Controlling and Monitoring System using Arduino. This system is very efficient for growing good quality plants and has the characteristics of low cost, simple structure, flexible networking and easy extending, which adapts to the requirements of complex control. The other important part of this project is that it is completely programmed. The user can automatically turn on and turn off the appliances with the help of an app. The system shall also demonstrate climatic changes which affect the plant in its productivity and quality. The main purpose of coming up with this project is to build an Automatic Green House Monitoring in which Bluetooth module sends the information of different parameters according to the requirement, user can operate the appliances (Fan and Water pump) that are connected with circuit for controlling parameters (Temperature, Humidity, Light intensity and Water supply) and that too without any internet facility unlike other automated systems.*

Key Words: Micro controller, Arduino, sensors, Android app, Bluetooth, Green house Parameter

1. INTRODUCTION

Agricultural Technology is a specialized area or ground for the growth and farming of plants and vegetables with mechanized and smart equipments. The purpose is to provide suitable conditions and maintain desired parameter values according to the flora requirement.

In the present nurseries, numerous parameter estimations are required to screen and control for the great quality and profitability of plants.

In any case, to get the coveted outcomes there are some imperative variables which become an integral factor like Temperature, Humidity, Light and Water, which are vital for a superior plant development. Remembering these parameters this mechanism is manufactured which is called Automated Agricultural Monitoring & Controlling System using HC-05 Bluetooth Module utilizing Arduino Uno with Atmega 328P microcontroller. This framework is extremely effective for developing great quality plants.

It helps the user in getting the real time values of the parameters (Soil moisture, Temperature and light intensity) and also helps in controlling fans and water pump with just a click on an Android app called "Bluetooth Terminal". The other most important key feature of this working mechanism is that it can work without the requirement of any internet facility which is not the case with other automated systems.

1.1 Need for such an automation control

1.) In today's world the need for automation has drastically increased in every field including Farming and Agriculture.

2.) Traditional method of taking care of fields and sites required many numbers of Labors and hours and hours of time.

3.) This amount of effort people put in is not coping up with the results being produced, which in fact is far less.

4.) Therefore, we need an automated control system which can judge the environment and other factors according to our need and can response and notify us when ever required.

5.) Also since it is equipped with a bluetooth module it can work in areas without internet connectivity since it creates its own localized network for a short range which can be extended by using a different module.

1.2 Literature Review

This paper designs a model of automatic irrigation system which is based on microcontroller ATMEGA328. Temperature, light and soil moisture sensors are placed in the field. Sensors sense the respective parameters of the soil and give the information to farmer through HC-05 Bluetooth Module. Farmer gets to know the status of the parameters via Bluetooth Module without going into the field directly on the Smartphone.

Now when the moisture content reaches below the a desired level according to the user it can switch on the water

supply or if the temperature rises above a certain threshold then user can switch on the fan similarly for light intensity.

The major advantages of the mechanism being that:

a.) It is completely user-friendly and user controlled.

b.) It does not require any internet connection facilities which are very suitable to be used in remote areas lacking communication facilities.

c.) It is a cost effective and directly applicable mechanism for a farmer.

2. Technical framework and working

2.1 Hardware Parts

1.) Arduino Uno:

It has a microcontroller of Atmega328P which has a flash memory of 32kB for storing data. It contains 14 digital I/O pins and 6 analog I/O pins. It has a timer with 16 MHz crystals, a reset button and ICSP header. The code is input into Arduino by a USB cable from Arduino software IDE. The power input can be given by the USB cable as well as using a separate power jack. It also has 6 PWM digital pins to act as analog which are 3, 5, 6, 9, 10 and 11. It is represented by '~'.

2.) Soil moisture Sensor KG003:

It is a simple water sensor that can be used to detect soil moisture. Module output is high level when the soil moisture deficit or output is low. It can be used in module plant watering device and the plants in your garden no need people to manage. Dual output mode that is digital (D0 pin) and analog (A0 pin) both. Analog interfacing can be used for accurate output. It has power indicator (red) and digital switching output indicator (green). Also has LM393 comparator chip to stabilize the soil moisture sensor can be easily interfaced to any microcontroller to its digital pin.

3.) Temperature Sensor DHT11:

DHT11 is a Humidity and Temperature Sensor, which generates calibrated digital output. DHT11 can be interface with any microcontroller like Arduino, Raspberry Pi, etc. and get instantaneous results. DHT11 is a low cost humidity and temperature sensor which provides high reliability and long term stability. It displays the temperature in "degree-Celsius".

4.) Light dependent resistor LDR:

It is a light-controlled variable resistor. The resistance of a LDR decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. An LDR can be applied in light-sensitive detector circuits, and light-activated and dark-activated switching circuits. It displays the light intensity in the unit "LUX".

5.) HC-05 Bluetooth module:

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This serial port bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband.

It uses CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). Its hardware features include up to +4dBm RF transmit power, 3.3 to 5 V I/O, PIO (Programmable I/O) control, UART interface with programmable baud rate, with integrated antenna and edge connector.

2.2 Software Parts

Android App:

To display the values of the sensors such as LDR, DHT11 and soil moisture sensor and also to control the motors we have used a user-friendly mobile android app known as "Bluetooth terminal" where we can give user input directly into the given text box as a single character like 's', 'd', 'l' to get real-time data from the sensors and also to control the motors and water pumps.

This app and other similar apps can be found on Playstore or some customized apps may also be developed on MIT app Inventor, Appery.io and many others.

2.3 Circuit Diagram

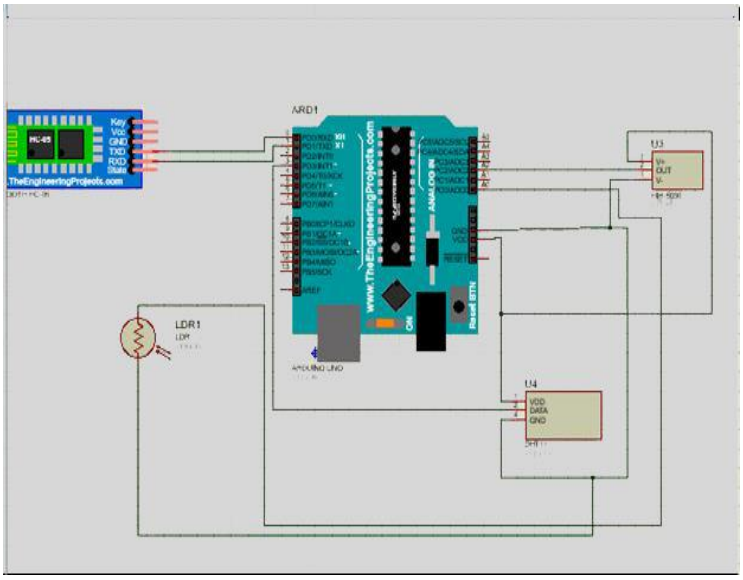

Diagram -1: Circuit Diagram on Proteus Software

2.4 Working Mechanism

After doing the connections as shown in the circuit diagram. Let's focus on the working of our circuit. So as we can see that we have a Soil moisture sensor, DHT 11 and LDR in our circuit so with our android app we can have the real-time data of the three sensors on directly on our mobile phone. So to get the data we need to first give a power supply to the circuit by connecting the USB to the laptop or even a Power bank. Or else we can give supply in the power jack.

After that to get individual data in the app of each sensor we have specified some characters:

's'- soil moisture sensor (To get the moisture values)
'd'- DHT 11 (Temperature values in degree Celsius)
'l'- LDR (to get the value of light intensity)

As we type it in the text field of the app we get the respective values.

Also to control the Motors we have a character 'm' which turns on/off the motor.

2.5 Proposed Circuit diagram and description for implementation on agricultural fields

As seen above we have connected a normal small DC motor just to show the prototype working. But we all know that it is not sufficient for direct application in agricultural fields and gardens. So we need a high-voltage switching relay that is compatible with AC single phase Submersible pumps (Rated voltage 180-240 volts) and current drawn capacity of upto 10 Amperes.

So the only change we need to do is remove the normal low voltage DC motor and connect it to the relay where AC single phase supply also comes and goes to the submersible pumps terminals without changing any Arduino pins.

Fig -1: 10A 250 V Relay

Fig -2: Agricultural Submersible Pump (180-240 Volts)

2.6 Results

Below shown is the real-time data collected from the working prototype on the Smartphone using Android App "Bluetooth terminal" via bluetooth communication channel.

Here
's' represents the soil moisture value. (Variation in moisture causes a change in conductivity)
'd' represents the temperature value in degree Celsius.
'l' represents the light intensity value in Lux.(Variation in light intensity causes change in resistance)

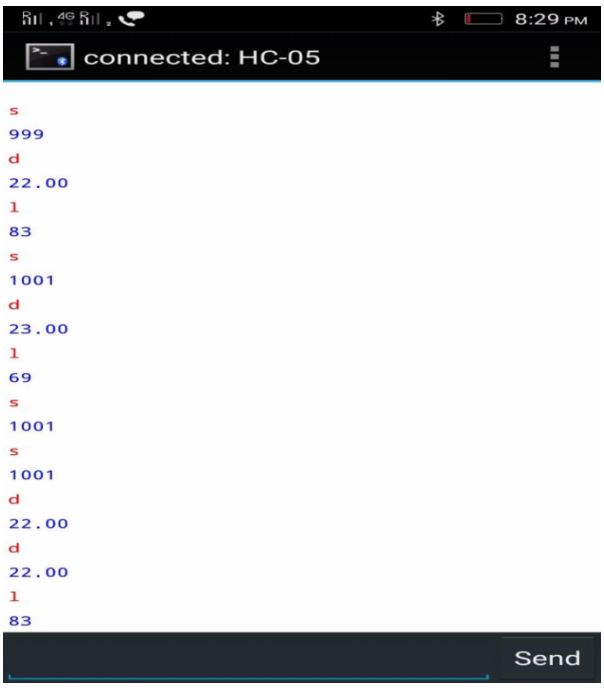

Fig -3: Screenshot of the parameter values obtained on mobile app

2.7 Future Developments

1. We can monitor more parameters like Humidity, PH of soil, pressure, and water level and at the same time and control them.

2. We can send this data to a remote location using mobile or internet

3. We can draw graphs of variations in these parameters using computer

4. Finally lighting controls could be added to the system using the same by expanding the number of relays used.

5. We can use the same technology in sophisticated greenhouses and related research.

3. CONCLUSIONS

The purpose of this project was to design and build a working prototype of monitoring and control system for agricultural field. This system allows users to obtain temperature, humidity, light intensity and soil moisture readings on their smart phone as well as send the commands remotely. This was achieved using Arduino Uno (microcontrollers) and a Bluetooth (HC-05) wireless module. This prototype is considered to be cost effective, user-friendly and reliable system. The project had three main sections: monitoring, control system and wireless communication.

Monitoring provided the real-time value of humidity, temperature, light intensity and soil moisture. The control system includes the working of pump, artificial light and exhaust fan according to users. Wireless communication connects the users to all the information regarding to his field. The system performed as designed and was able to perform all the objectives mentioned.

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