Automated Smart Greenhouse Environment Using IoT

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Abstract- The motive of this paper is to design a smart greenhouse monitoring system based on the Internet of things . The increasing air and noise pollution is one amongst the intense problems recently. This huge quantity of skyrocketing pollution has created human life at risk of sizable amount of diseases. Therefore, it's currently become necessary to regulate the pollution to confirm healthy bread and butter and higher future. The Air and noise pollution monitor is accessed by the authorities and therefore the folk happiness to the realm. The device are put in through a mobile application which is able to show the live updates of the pollution level of the realm. This device is additionally capable of police investigation the fireplace in its space and apprise identical to the fireplace brigade authorities so they might take necessary actions consequently, and conjointly the mobile applications are put in within the fireplace brigades itself so if a fireplace is happening near , it may be controlled in time to cut back loss of individuals and property. This technique works on the strategies of IOT that may be a rising technology supported the fusion of natural philosophy and applied science. The conception of IOT helps to access knowledge from remote locations and put it aside in information so we tend to don't got to really be gift therein space.

Keywords: air pollution, sound pollution, IOT, sensors, monitoring system.

I. INTRODUCTION

Every day we have a tendency to notice some new technology coming back in market to alter our lives quiteever. Back in time checking the pollution during a|a really|a awfully}} specific space was a very tedious task that wasn't very economical conjointly.. Back in time checking the pollution in a particular area was a very tedious task which was not very efficient also. With the increasing pollution and advancing technology various new methods were introduced to keep an eye on the rapid increase in pollution more efficiently. Internet of things is one of the latest works that has been done in this path. The increment in use of internet and the interaction of human with machine gave rise to IOT. It allows exchange of information among various devices like fridge, washing machine, automobiles, watches etc. This exchange of information takes place with the help numerous sensors. The account for the success of IOT is its efficiency and makes it a feasible technology at low cost. Air and sound pollution are two main constituents that have the most adverse effect on humans as well as the entire earth. Therefore it is very important to check and control it. Traditional methods involves manual work in which data loggers used to visit the site to collect the data, analyze it and perform comparisons to provide the output which was very lengthy and time consuming besides being inefficient. The pollution watching system involves use of sensors that measures the pollution concentration and level of harmful gases like CO and SO2 that in the main pollutes theair.Comparisons are done mechanically exploitation ant ecedently hold on knowledge in info and output is hold on on cloud to create it accessible from remote areas. This paper involves description of the system that presents its output with the assistance of associate robot application that the user will transfer in their mobile phones and access it whenever they need.. It can be used for notifying the fire brigade authorities and fire brigades itself if and fire has taken place in the areas. This device is a useful asset to save precious lives of people and property about it. After that the people are made to clear the area and taken to a safe place.

II. RELATED WORK

The MAD [1] architecture used to upload the information related to the agriculture to the cloud. The data (weather, moisture content, soil information etc.) collected from GPS and sensors will be uploaded to the cloud. This information will be provided to the farmer through an application. The LMD (Labour Monitoring Device) which is used to monitors the labour activity in field and also the quantity of crops harvested by the labor. LMD [2] consists of RFID reader, CU (Computational Unit), GPS, and weighing machine. A labour will be provided with a wrist rubber band in which a unique RFID number will be embedded. With the help of weighing machine and computational unit the quantity of crops harvested by the labour will be calculated. This information will be uploaded to the cloud by the LMD. IT infrastructure for agriculture consists of analysis part (computer network with software's) and storage devices. The information

related to soil, temperature, crop information etc. are collected using sensors and cameras. The collected information will be stored in storage devices and this will be analyzed in analyser part by agriculture experts. PDCA (Plan-Do-Check-Act) and cloud services can be used instead of deploying an IT infrastructure.A system using technological development in wireless sensor networks that is Programmable System on Chip (PSOC) , which can monitor and control greenhouse parameter of precision agriculture by conducting several experiments. The design of this system is to avoid irregular distribution of water to the crops in the field.

The potential transpiration rate is important for healthy plant growth . The reason for the transpiration fall rate below the potential value is because of variations in soil moisture level. After conducting an experiment for the soil moisture, which affects the transpiration process when fall below the potential rate with different graphical representation. A wireless sensor network is as an alternative and efficient way to solve the agriculture issues for monitoring agriculture parameters such as temperature, humidity, etc., for the précised agriculture methods. Here, the focus is on the hardware and network architecture, and software process control for the precision agriculture system.

A control system [8] for an intelligent farming composed mainly two parts in Intelligent Farming (IF) that is sensor system and control system used to monitor and control the farm field. The new technology used for this is Internet of Things (IoT) to monitor and control useful information from the farm field to the owner/farmer. The architecture for IF and the information decision are calibrated by using kalman filtering, to monitor weather condition of farm field.

III. SYSTEM OVERVIEW

The proposed system consists of a sensor that continuously takes in data from the greenhouse environment and reports it to the gateway node. The information or information received at the entree has been examined and filtered then it's processed for economical transmission in wireless networks.The wireless communication technology applied within the entree node cc3200 launcharea can get associate informatics address from association to the closest Wi-Fi router.These gateways ar utilised to transmit the info} to the standalone net server via internetand from the net server varied purchasers will retrieve the desired information.In proposed scheme, the interesting aspect to help the rancher by presenting IoT based precision agriculture framework for greenhouse. The concentration is to give field data that is remotely controlled greenhouse agriculture parameters, for example, CO2, soil moisture, temperature, and light, to the agriculturists from long distance, and in view of the soil moisture esteems the controlling move can be made for the greenhouse windows/doors to roll on/off. This stays away from the agriculturists from physical visit to the fields.

For this utilized an IoT kit with internet connection. The kit comprises of an electronic devices and different sensors.

The components used are

1. IoT kit
2. Sensors
3. Relay logic circuit
4. DC motor driver circuit
5. DC motor
6. Internet connection
7. Cloud account

A. Greenhouse

The development of the greenhouse in view of the harvest accommodation is imperative, here in the proposed conspire, and chose shade net sort greenhouse for regulated temperature range, easy ventilation, required light infiltration and so on.

B. IoT kit

The IoT kit utilized here is comprises of a 32 bit on chip processor and Wi-Fi microcontroller framework. It additionally comprises of various sensors, for example, CO2 sensor, soil moisture sensor, temperature sensor, light sensor, and so forth. The detected analog information from the sensors are given to the processor to change over these signal into digital form and furthermore for other handling reason. The digital values can be seen on the consol of the personal computer.

C. Relay logic circuit

The relay logic circuit commonly used to control output devices with respect to input signals. It is a low powered electrical network with required input and output. The input to the relay logic circuit may be control relay or a switch. Here, in our proposed scheme it is used to control DC motor direction in clockwise and anticlockwise direction.

D. DC motor driver control circuit

The DC motor driver control circuit consists of an IC

L293D; it is used to control DC motor in clockwise and anticlockwise directions. The input signal to the IC is from relay logic circuit.

E. Personal computer

With the help of personal computer we can monitor the greenhouse parameters such as CO2, soil dampness, temperature, and light.

F. Cloud

The IoT kit is compatible with the Amazon Web Service (AWS) cloud benefit, by having a cloud account farmer can get to greenhouse data. This innovation comprises of a virtual groups of personal computer with RAM memory, CPU, hard disk, OS, and so on. With the assistance of sign in facilities, farmer can get to information from the cloud.

G. Farmer or a end user

The farmer or an end user can get greenhouse data by having web association in his portable devices with sign in to the AWS account.

IV. ARTICTURE AND MODULES USED

The implemented greenhouse system consists of two section, monitoring section and controlling section. The monitoring section consists of DHT11 sensor, LDR sensor, Soil moisture sensor and pH sensor to monitor the environmental parameters. A GSM modem and Ethernet are also used to send environmental parameters to android mobile phone. The controlling section consists of cooling fan, exhaust fan, water pump, artificial light and motor pump. Arduino microcontroller forms the heart of the system.

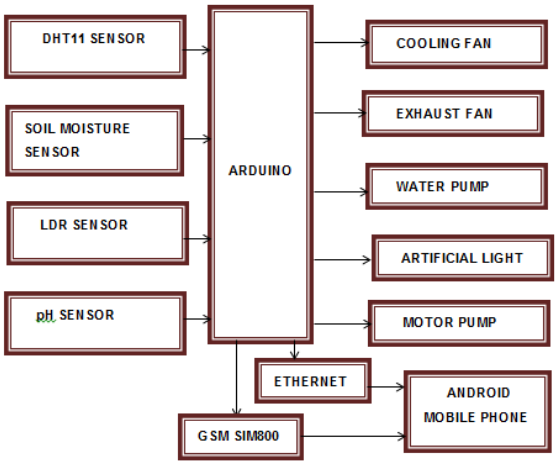


Fig.1 Block Diagram of Smart Greenhouse Monitoring and System

A. Arduino

Arduino is an open source device. It consists of ATmega328P microcontroller. It provides 5V and 3.3V output voltage options. It takes input voltage from the computer using USB cable or from a portable power supply using a coaxial cable. The Arduino board can read twitter messages. Arduino IDE is used to upload sketches. Different types of Arduino boards are Arduino Uno, Arduino Mega, Arduino Yun etc. In this system Arduino Uno board is used. It is cheap and feasible. It has 14 digital input or output pins, 6 analog input pins, 16 MHz crystal oscillator, power jack and ICSP header. Working voltage is 5V and recommended voltage is 7 – 12V

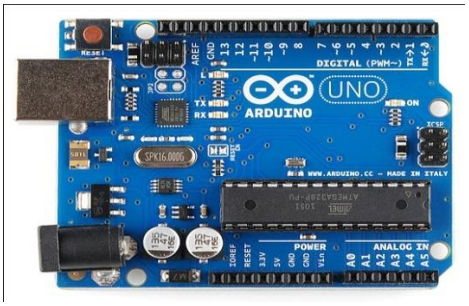


Fig. 2. Arduino Uno

B. Sensor

DHT11 sensor, LDR sensor, Soil moisture sensor and pH sensor are used.

1. DHT11 Sensor

DHT11 sensor is used to measure both temperature and humidity. It is a cheap temperature and humidity sensor. It has high reliability, high efficiency and long-time stability. It has a thermistor for measuring the temperature and a humidity measuring component for measuring humidity. A thermistor is a variable resistor. The resistance of thermistor changes with change in the temperature. Humidity sensing component has pair of electrodes with moisture holding substrate in between them. So as the humidity changes, resistance between the electrodes changes. This change in resistance is measured. The operating voltage is 3.3V and 5V.

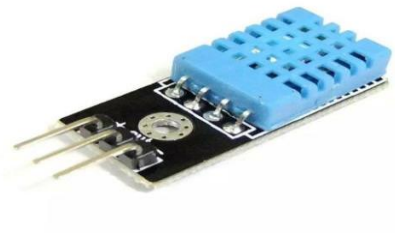


Fig. 3. DHT11 Sensor

2. Soil Moisture Sensor

Soil moisture sensor measures the moisture content in soil. This soil moisture sensor consists of two metal rods held apart at a fixed distance by some insulating material . Fig. shows soil moisture sensor. Two metal rods pass current through the soil and resistance is measured. If the water is more, resistance is low and if the water is less, resistance is high. It also has a potentiometer to adjust the sensitiveness of the sensor. Features are low power consumption, high sensitivity, Arduino compatible interface and the operating voltage is 5V.

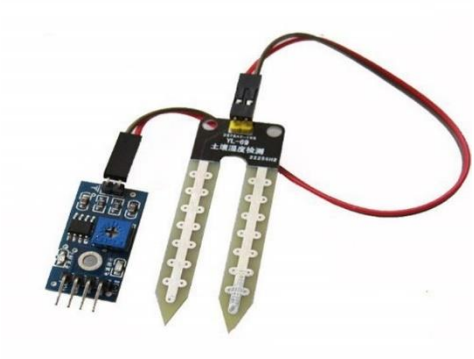


Fig. 4. Soil Moisture Sensor

3. LDR sensor module

LDR (Light Dependent Resistor) sensor module is used to measure light intensity. It has both analog output pin and digital output pin. If light intensity increases, resistance of LDR decreases. If light intensity decreases, resistance of LDR increases. The sensor has a potentiometer knob that can be used to adjust the sensitivity of LDR towards light. LDR is also known as photoconductor. Cadmium Sulphide (CdS) is used to make LDR. Cadmium Sulphide is deposited on an insulator in the shape of a zigzag line. The purpose of zigzag path is to boost up dark resistance and therefore decrease the dark current.

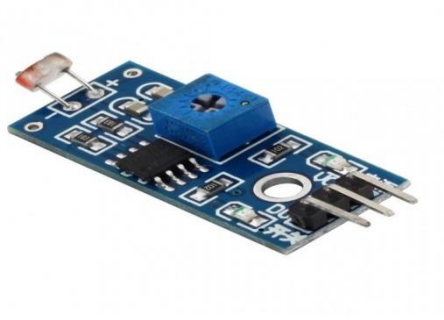


Fig. 5. LDR Sensor Module

4. pH sensor

pH sensor is used to measure pH of the soil. The pH indicates a solution's acidity or alkalinity. pH sensor consists of a pH probe and a pH sensor module. Fig. 7 shows pH sensor. The pH probe has two electrodes, one is a glass electrode and other is reference electrode. These electrodes are empty bulbs consist of potassium chloride solution with a silver chloride wire suspended into it. pH probe measures the electrochemical potential between a known liquid inside the glass electrode and an unknown liquid outside. pH sensor module consists of potentiometer to vary the value of the sensor.

Fig. 6. pH Sensor

5. GSM SIM800

GSM SIM800 is a quad band GSM device. It is compatible with frequencies ranges in 850 MHz, 900 MHz, 1800 MHz and 1900 MHz. The transmission of voice, SMS and data information with low power consumption can be done. It is very compact in size. The plug in GSM modem can easily be used. It supports Bluetooth function. Its operating voltage is 3.3V to 5V.

Fig. 7. GSM SIM800

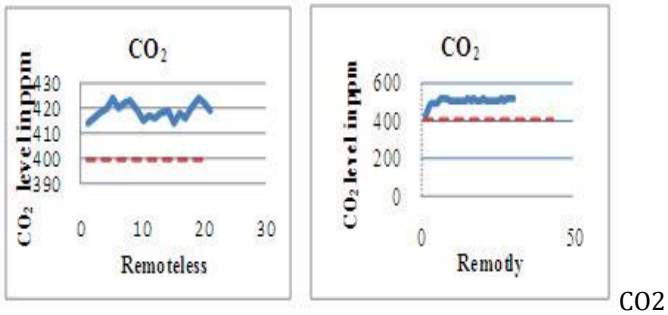
6. Arduino Ethernet Shield

The Arduino Ethernet Shield allows Arduino board to connect to the internet. The wiz net W5100 provides a network (IP) stack that can access both TCP and UDP. It supports up to four simultaneous Socket connections. The Arduino, Ethernet, DHT11 sensor, soil moisture sensor, LDR sensor and pH sensor are initialized by supplying the required power of +5V. The GSM800 is initialized by supplying the required power of +12V. The GSM800 sends

SMS to the user when the sensor value exceeds a defined level. The user turns on the actuator by sending another SMS. All environmental parameters are sending to server through Ethernet and stored in the database. So the user can monitor and control parameters through android mobile application.

V. RESULTS ANALYSIS

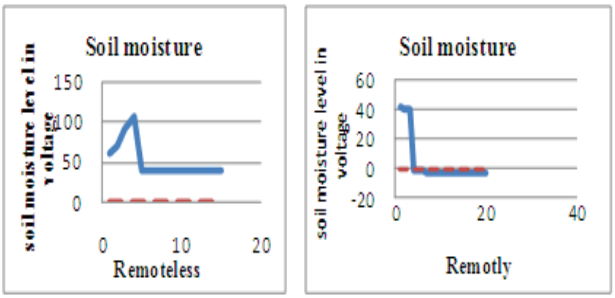
In the proposed conspire, there is an analyzation for the execution parameters of greenhouse, for example, CO2, soil moisture, temperature, and light for bell pepper plant with practical outcomes by utilizing IoT kit. And based on the soil moisture values the greenhouse doors/windows can be roll on/off.



CO2 concentration level 1 CO2 concentration level 2

Fig.8 Concentration gradient representation of CO2 concentration level in greenhouse.

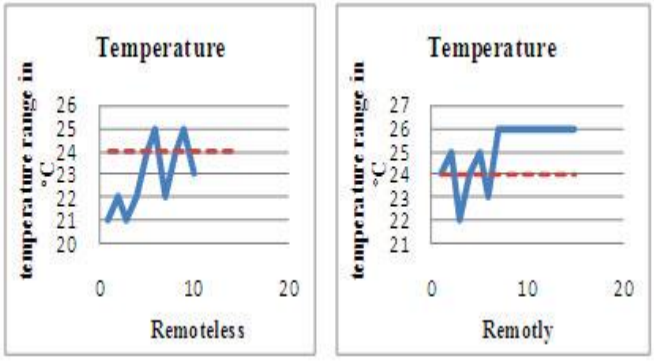
The plant photosynthesis process required a most extreme measure of CO2 concentration level and water around evening time contrasting with day time; with the assistance of these two energies the photosynthesis procedure keeps the plant cool and aides in quick development of the plants. After conducting a experiment for the CO2 concentration level in green house, maintained a CO2 level maximum at night time as shown in figure because from day time the greenhouse start to consume CO2 level till night time.



(a)Dry soil (b) Wet soil

Fig 9. Representation of Soil moisture measurement in greenhouse.

Water content in the soil is important factor because for the plant, excess of water can produce a fungal infection at the same time plants with less water becomes dry or sometimes they may get damage. So, the required level of water to the plant is very much essential. At, night time plants require a more water with CO2 for photosynthesis process. In IoT kit the soil moisture sensor gives a negative value it means the full of water is covered by the plants as shown in figure (b), at that time the greenhouse windows/doors will be closed automatically with the help of DC motor. The positive value indicates the dryness of the soil as shown in figure (a), so need to re-wet the soil.

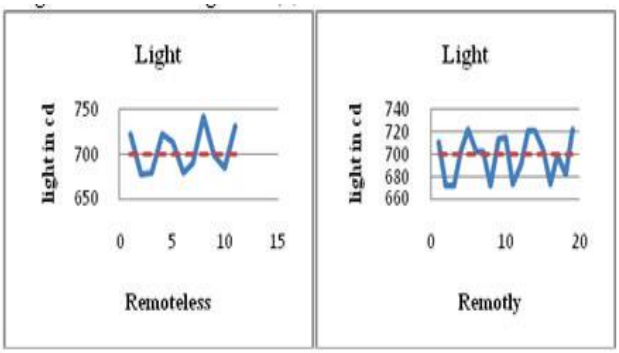


(a) Temperature range outside greenhouse

(b) Temperature rang inside greenhouse

Fig 10. Representation of Temperature range control in greenhouse

The temperature is also a one of the important parameter in greenhouse; the temperature should be maintained maximum. Because, the temperature helps in flowering, fruits, photosynthesis, seed germination, etc. Therefore in greenhouse maintained a maximum amount of temperature range as shown in figure (b), compared to outside greenhouse environment temperature range.



(a)Light penetration outside greenhouse

(b) Light penetration inside greenhouse

Fig 11. Representation of Light penetration in greenhouse

The different colours of sun light are useful in photosynthesis process, which is present in the green part of the plants used for plant growth, flowering, and shape of the plant. Thus, maintained a sustainable amount of light.

Penetration inside the greenhouse as shown in figure(b), compared to normal light penetration outside of the greenhouse as shown in Figure (a).

VI. SYSTEM FLOW CHART

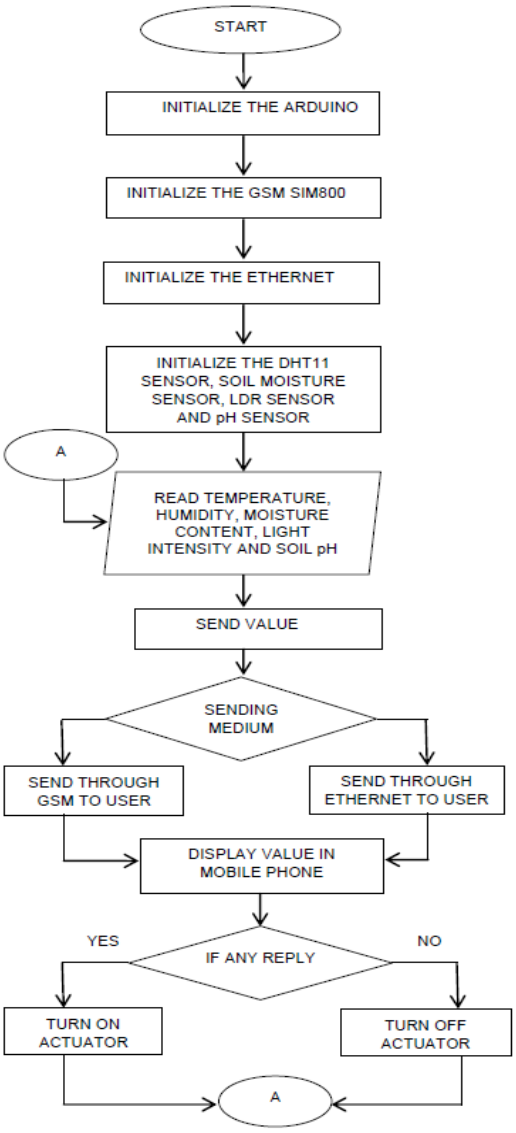


Fig.12 . Smart Greenhouse System Flow Chart

Figure shows flow chart representing the working of the greenhouse system. The Arduino, Ethernet, DHT11 sensor, soil moisture sensor, LDR sensor and pH sensor are initialized by supplying the required power of +5V. The GSM800 is initialized by supplying the required power of +12V. The GSM800 sends SMS to the user when the sensor value exceeds a defined level. The user turns on the actuator by sending another SMS. All environmental parameters are sending to server through Ethernet and stored in the database. So the user can monitor and control parameters through android mobile application.

VII. CONCLUSIONS AND FUTURE SCOPE

Intelligent agriculture is developing rapidly in recent years and it raises more attentions in both industrial and academic societies. The paper take a full consideration of cost, practicability and other factors, combining the IoT with fuzzy control method , using GPRS to remote control, designing an smart greenhouse monitoring system with better performance, simple structure and easy extensibility. There is also controlling action taken automatically that is greenhouse windows/ doors roll on/off based on the soil moisture levels. Thus, the system will help the farmers to avoid physical visit to the field, and increase the yield with the maintenance of précised parameters such as CO2, soil moisture, temperature, and light in the greenhouse with the help of IoT. The project is carried out with the help of IoT kit and internet connection. The results are analyzed for the greenhouse parameters such as CO2, soil moisture, temperature, and light for bell pepper plant with the help of graphical representation based on the practical values taken by the IoT kit. The comparative result shows the effectiveness of the proposed work.

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