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Artificial farming – An electronic approach to grow plants

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ABSTRACT

This project is for growing plants or vegetables inside the packed electronic environment by using the artificial plant grow Led for growing the plants. The photosynthesis process carried out by the plants in dependent on the leds which will provide the total electronic surrounding to the crops so we can call it as an "Artificial farming- an electronic approach to grow plants".

In this project we have made a prototype of actual concept. The amount of water required to grow the plants is very much less as compared to the traditional farming, here we have provided the automation technique for providing water to the plants. In this prototype we have made a rack structure so that we can take the more crop production by making racks on one above in a small area. In this artificial environment we are using sensors to monitor the condition of soil, air, temperature. According to collected data by the sensors, this data is provided to aurdino for the controlling the water supply, lights, fans. The Leds are used to provide the special light wavelength. By using that wavelengths the plants are going to carry out the photosynthesis process. In this process the food making process of plants is light dependent. As the environment is indoor it will not have any insects, and pests affecting the crops, hence no insecticides and pesticides will be required. The indoor environment will neither evaporate water nor will percolate it in to the earth hence water requirements be very small. The indoor environment is equipped with artificial lightening, so crops can be grown independent of season.

By using the electronic farming method we can reduce the greenhouse gases, the overall quality of the food is increased due to the organic fertilizers being used to grow the plant and also the pesticides and the chemical fertilizers are not used in this type of farming. The water required for the electronic farming is much lesser than the ordinary traditional farming. As it is completely indoor so that the atmospheric effect is not observed on the plant so we can take year round food production.

Keywords: *Photosynthesis, LED'S, Artificial farming.*

1. INTRODUCTION

Food, water and shelter are the basic needs of mankind. A man has travelled in all directions in search of food and a better quality food. For travelling we use various modes of transport these days. This includes travelling by foot, vehicle, railway, airplane etc. However, now the food has started traveling towards a human being. During this travelling we burn a large quantity of fossil fuels. Burning of fossils causes pollution; especially air pollution. The greenhouse gases are responsible for increases temperature of the earth. That's the whole world is talking about.

But has anybody given a thought that, "Agricultural sector also causes a significant pollution!" Although it sounds weird, it is true. Every farmer used chemical fertilizers, insecticides, pesticides to protect his crop. While spraying insecticides, large quantity of insecticides and pesticides dissolves in air causing air pollution. Fertilizers used for assisting growth of plants are not completely absorbed by plants. Some traces of these fertilizers are left in the soil. They mix with water and percolate through the layers of soil and make the soil infertile. Isn't it a kind of soil pollution? Fertilizer dissolves in water and through water streams it reaches to the river and thus pollutes the river. Although the efforts are being made to use organic fertilizers, but their use is limited. Also majority of water supplied to crops either percolates in the earth or evaporates.

The artificial farming is an approach to grow crops in a controlled indoor environment. As the environment is indoor it will not have any insects, and pests affecting the crops, hence no insecticides and pesticides will be required. The indoor environment will

neither evaporate water nor will percolate it in to the earth hence water requirements be very small. The indoor environment is equipped with artificial lightening, so crops can be grown independent of season.

2. LITERATURE SURVEY

The basic factors affecting plant growth are sunlight, water content in soil, temperature, etc. Because the temperature and humidity of greenhouse must be constantly monitored to ensure optimal conditions, sensor network can be used to gather the data from point to point. The data from the greenhouse will be measured by the sensor and the data that are collected will be sending to the receiver. By using this system, the process of monitoring is easier and it is also cheaper for installation and maintenance process. Greenhouse prevents the plant from the effects of climate; inspect and so on, which makes great sense for agricultural production. [1] The photosynthetic production based on the absorption spectra of pigments present in spinach leaves, the presence of multiple pigments in spinach leaves, and the apparent relation between light and the production of starch in Geranium leaves. The starch production in leaves is depends on the availability of light in Geranium. The photosynthesis is start in between wavelengths absorbed light of 400 nm and 450 nm and also at 650 nm. It was also found that this green prototroph absorbed light minimally at wavelengths of near 550 nm. [2]

The highly profitable plants can be cultivated in vacant indoor spaces equipped with artificial-lighting sources composed of LEDs. The proposition to use vacant building spaces for agricultural production has many advantages. Because indoor cultivation is free from the influence of weather conditions this technique provides stability in the output and quality of crops as well as increased yield per unit area. The cultivation technique is also unaffected by geographical limitations and provides comfortable working conditions for employees. Furthermore converting unused vacant buildings to controlled plant factories significantly reduces the startup costs associated with the practice. [3]

Understanding plant reactions to varying wavelengths remains imperative to improve growth practices and maximize plant production efficiency. The introduction of LEDs serves as a convenient tool for continuing research. Despite incurring mildly larger initial costs, longevity and energy efficiency, in comparison to traditional lighting systems, LEDs are expected to furthering controlled agricultural development. As food security deliberation continues, long-term benefits of developing ideal lighting schemes for fruits and vegetables will provide a smoother transition to urban agriculture. [4]

Greenhouses can help farmers reduce spoilage and increase yields, and therefore improve their livelihoods. As compared to open air farming, greenhouse farming requires less water due to reduced evaporation. Current estimates on water savings vary in wide range and fail to clearly specify relevant test parameters such as the irrigation method, size of the greenhouse, or climatic conditions at the time of the study. Results indicate that the water savings within greenhouses are around 50-90%. This significant reduction in water consumption allows for agricultural intensification as well as horticultural production in arid and semi-arid regions that make up over 80% of the land. [5]

Green Sense Farms is a leader in indoor controlled environment agriculture. As the global population exceeds 7 billion people, this sustainable method of farming requires a small footprint to produce high volumes of quality leafy greens year round to local consumers while conserving energy and water. The future of farming is now. Such farm employs more efficient use of land, water and energy. [6]

An automated greenhouse, with a temperature control system and a watering system, was built in order to answer the research questions. The microcontroller used to create the automated greenhouse wasan Arduino UNO. The temperature control system consists of a temperature sensor, a computer fan and a power resistor with a heat sink. The fan and heater were controlled separately to adjust the temperature. The watering system consists of a soil moisture sensor, a water tank, a water circulator pump and a hose. The watering was turned on or turn off based on the soil moisture level read from the sensor. [7]

This designed system for monitoring and controlling the greenhouse is based on measuring the humidity and temperature by a sensor that located at different places. The monitoring and controlling of greenhouse parameters are conducted through Android Smartphone. Smart Green House Automation System consists of the DHT11 sensor for the humidity, microcontroller, wireless connection, and serial communication, a personal computer as a server, power supply unit and model of the greenhouse. The input to the microcontroller is the values from the sensor. The values are then sent to the computer by the microcontroller through serial communication. In this system, the working of the computer is to transfer the data to android mobile through wireless communication. Android smartphone control the microcontroller and the components such as fogger and heater. In this system three kinds of activities are performed, the level of humidity inside the greenhouse is monitored with the help of a DHT11 sensor. If the greenhouse is too dry fogger is activated to maintain the humidity level. Deactivation of fogger can also take place. If the greenhouse is too humid, the heater in the greenhouse is turned on to maintain the level of humidity. [8]

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 data received at the gateway has been examined and filtered and then it is processed for efficient transmission in wireless networks. The wireless communication technology applied in the gateway node cc3200 Launchpad will get an IP address from connection to the nearest Wi-Fi router. These gateways are utilized to transmit the data to the standalone web server via internet and from the web server various clients can retrieve the required information. [9]

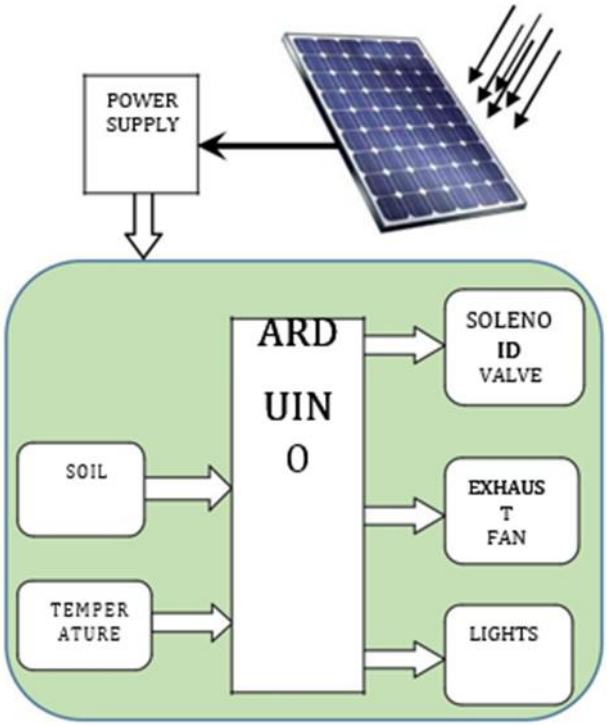
Use of Home Automation techniques to design and implement a remotely controlled, energy-efficient and highly scalable Smart Home with basic features that safeguard the residents' comfort and security. The system consists of a house network (sensors and appliance actuators to respectively get information from and control the house environment). As a central controller, we used an

Arduino microcontroller that communicates with an Android application, our user interface. Our house network brings together both wireless Zigbee and wired X10 technologies, thus making it a cost-efficient hybrid system. Events can be programmed to be triggered under specific conditions, and this can have a great role in reducing the total energy consumed by some appliances. On the other hand, the system can suggest smart task scheduling. The scheduling algorithm we present is a heuristic for the Resource-constrained-scheduling problem (RCPSP) with hybrid objective function merging both resource leveling and weighted completion time consideration [10]

Plants found in greenhouse is affected by various factors, such as water in soil, and climatic conditions (temperature, humidity, etc.). In this work, we've been focused on design and implementation for monitored climate conditions and to control the different devices on output (shutter, solenoid valve, and fan). Various inputs (sensors) and output (motors) are installed and connected to PC via controller circuit (Arduino UNO) determined as data acquisition. A graphical user interface has been designed using MS Visual Basic 2012 to retrieve and display the condition of climate by sensing data. [11]

3. HARDWARE DETAILS

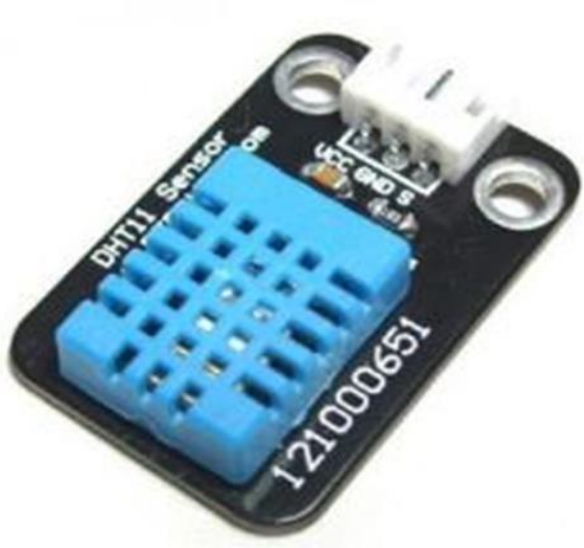
Block Diagram



Block Diagram

3.1 Components Description

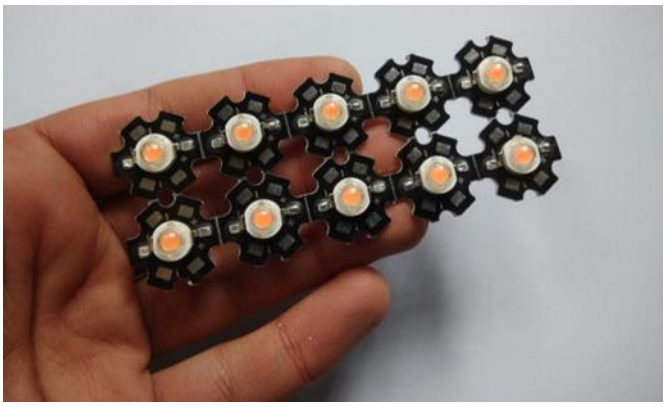
3.2.1 DHT 11 Humidity & Temperature Sensor



DHT 11 Digital Temperature & Humidity Sensor

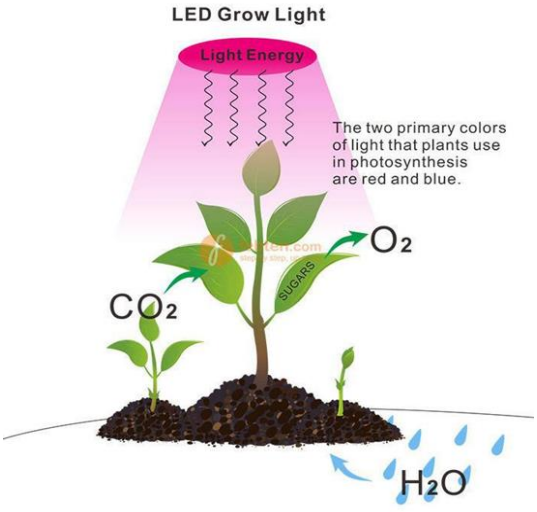
This DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high-performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness. Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programmers in the OTP memory, which are used by the sensor's internal signal detecting process. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those most demanding ones. The component is 4-pin single row pin.

LED Lighting Systems



LED Lighting System

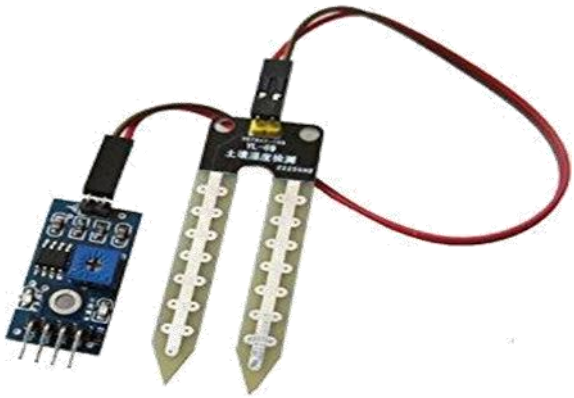
- Change the traditional single color led with Full spectrum 430nm ~840nm same as sunlight.
- These Full spectrum LED can be used for plant at all stages, that solves the problem which is previously LED grow lights been unable to act as the sole light source for the indoor garden and planted aquarium.
- Suit for plant all stage, so solve the trouble change different grow lamp at different plant stage.
- Full spectrum led is cover 400nm~840nm, similar with sun-light, but 1w red blue only single color, so 3w full spectrum = red +blue + orange + infrared + UV etc.
- 3w full spectrum led chip is newest led grow chip, similar with sun-light, it not only provide red and blue for grow but also provide a little far red and UV and other light for supplement plant grow and flowering.
- Suit for plant all stage seeding/growing/flower/fruiting, as the led cover all color the plant need, so you will don't need change the lamp at the every plant stage .



LED Grow Light

Moisture Sensor

This Moisture Sensor can be used to detect the moisture of soil or judge if there is water around the sensor, let the plants in your garden reach out for human help. They can be very easy to use, just insert it into the soil and then read it. With the help of this sensor, it will be realizable to make the plant remind you: hey, I am thirsty now, please give me some water. This is a summary of the moisture sensor which can be used to detect the moisture of the soil. When the soil moisture deficits, the sensor output value will decrease. You can know whether a Plant needs water or not by observing the results that the sensor outputs. The following sketch demonstrates a simple application of sensing the moisture of the soil. Connect this module to one of analog port A0 of Grove - Base Shield with the 4 pin Grove cable, and then insert the Sensor into the soil or place it anywhere you want.



Moisture Sensor

Solenoid valve

Solenoid valve

A solenoid valve is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid: in the case of a two-port valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold.

Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas.

Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design.

Besides the plunger-type actuator which is used most frequently, pivoted-armature actuators and rocker actuators are also used.

Types of Solenoid Valves

A. 2-Way Valves

Two-way valves have one inlet and one outlet pipe connection. They are used to allow or shut off fluid flow, and are available in either: Normally Closed – closed when de-energized and open when energized.

Normally Open – open when de-energized and closed when energized.

B. 3-Way Valves

Three-way valves have three pipe connections and two orifices (when one is open, the other is closed, and vice versa). They are commonly used to alternately apply pressure to and exhaust pressure from the diaphragm operator of a control valve, single-acting cylinder, or rotary actuator

Relay Board

Relay Board

- BMES 4 Channel Relay Board
- Input : 5V/GND DC
- On-Board Level Shifter
- Mounting Holes for easy Mounting
- LED Indication for relay status

Solar PV Panel & Battery

Fig. 3.2.6 Solar PV Panel & Battery

Rack and Tray System

Fig. Rack and Tray System

Solar Panel Specification

- Power: 20W,
- Voltage: 12V
- Pmax-20W;

- Imax-1.17A;
- Vmax-17.1V
- Voc - 21V;
- Isc-1.31A
- Polycrystalline Solar Panel

Battery Specifications

- Voltage: 12V
- Current: 7.5Ah
- Sealed Lead – acid battery

Non GMO Seeds

Seeds labeled GMO—the acronym for "genetically modified organism"—result from one of the industry's most controversial practices. GMO seeds are bred not in a garden but in a laboratory using modern biotechnology techniques like gene splicing. Scientists modify a seed's DNA to ensure the resulting plant produces desired characteristics. Seed Savers Exchange does not produce or sell GMO seeds.

Non-GMO seeds are cultivated through pollination. They can be bred two different ways: as hybrid seeds or as open-pollinated seeds. The term "hybrid" refers to a plant variety developed through a specific, carefully controlled cross-pollination of two different parent plants to produce new traits that can't be created by inbreeding two of the same plants. Hybrid varieties—also called F1 or "first-filial" hybrids—produce seeds that are not "true to type," meaning that they do not conform to the known characteristics of a given plant variety.

Open-pollinated seeds, by contrast, are produced from random pollination by wind, birds, insects, or other natural means. Gardeners who save seeds from open-pollinated plants can keep them genetically pure by isolating the plants from the pollen of other plants. They then save seeds from those plants to grow out the following season, confident that the seeds will possess the same characteristics as the parent plant, or grow "true to type." Seed Savers Exchange both saves and sells open-pollinated seeds, many of which are heirloom seeds that have been passed down through many generations.

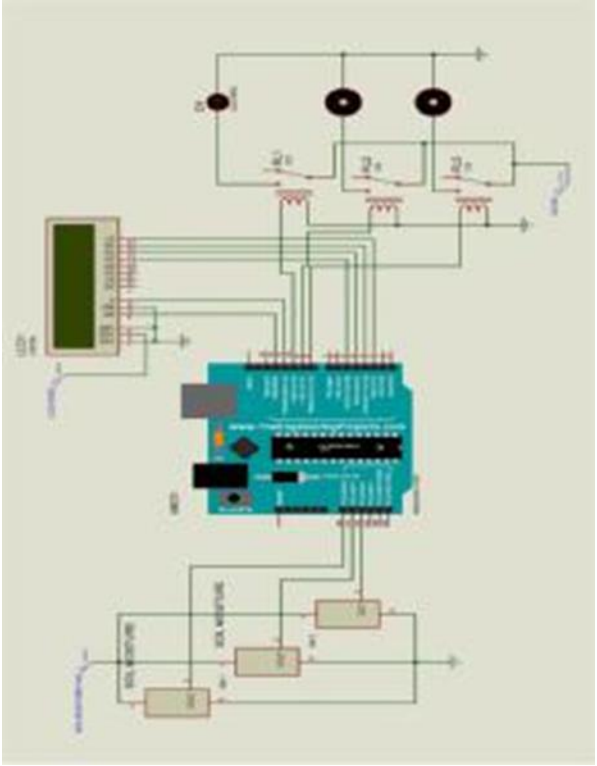
Arduino

Arduino Uno

Arduino Features Used

- Operating Voltage 5V
- Digital I/O Pins 14
- Analog Input Pins 6
- DC Current per I/O Pin 40 mA
- Flash Memory 32 KB
- Clock Speed 16 MHz
- Serial Communication Interface

Schematic Diagram



Schematic Diagram

4. CONCLUSION

By using the electronic farming method we can reduce the greenhouse gases, the overall quality of the food is increased due to the organic fertilizers being used to grow the plant and also the pesticides and the chemical fertilizers are not used in this type of farming. The water required for the electronic farming is much lesser than the ordinary traditional farming. We can save up to 70% of water. As it is completely indoor so that the atmospheric effect is not observed on the plant so we can take year round food production.

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