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IOT Based Wireless Networking Infrastructure for Greenhouse Management through Web Application Using ESP8266

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***Abstract** –Greenhouse deployment of farms gives hope for the farmers on higher crop yield, through lowering risks against pests, insects and adverse climatic conditions. The purpose of this project is to design and develop a smart greenhouse system that supports stand alone remote monitoring and control of residential greenhouses. To enable users to monitor and control vital crop factors based on their needs. Internet of Things (IoT) can enable a complete remote visualization and control of greenhouse environmental parameters in real time. Monitoring system that monitors and tracks environmental conditions, helping the plants thrive. Wireless Sensor Network that can monitor the temperature, humidity, soil moisture, incident light intensity in the greenhouse filed area. So farmers can recognize the environmental conditions and implement various methods to increase the greenhouse crop production. The Garden Sensors gather and analyze data about changing weather and soil moisture conditions and then connects to the user's Android phone with timely alerts. It continuously monitors the conditions and alerts the user to the changes that require immediate action. Unlike pre-set sprinklers, the Greeves Water Valve automatically controls the existing water system based on data collected by the Garden Sensor and adapts to every change in the plant's requirements. The resulting system is a user-friendly mobile application, a cloud-based storage service, and a responsive greenhouse system*

***Keywords-** Greenhouse, crop, Internet of things, sensor*

I- INTRODUCTION

According to the United Nations' Food and Agriculture Organization, food production must increase with 60 percent to be able to feed the growing population expected to hit 9 billion in 2050. The global population has grown from 1 billion in 1800 to 7 billion in 2012. It is expected to keep growing to reach to reach 11 billion by the end of the century. Modern farms can sprawl for hundreds of acres. Rising prices of fertilizer and electricity, combined with regulations limiting irrigation are placing increasing demands on farmers to more precisely utilize their resources. Reducing spoilage and food waste will require both better in-field monitoring as well as better monitoring and management within the field-toshelf supply chain. It is a world where deadline pressures, a lack of information and conquering the challenges of time and distance confrontindividuals on a daily basis. Agriculture has been a leader for years in automation many industrial farmsrely on harvesters guided by GPS. It is also an industry starving for more data. Fluctuations in rainfall or market prices can cause profits to quickly rise or plummet. Obtaining accurate, ongoing data on operations has historically also been a challenge. Unlike cars or microprocessors, you can't mass produce identical tomatoes. Companies like Clean Glow and Solum have begun to bring Big Data to the field with tools that can dynamically calibrate moisture and other metrics. Between efforts to eat more food grown locally, a younger generation of farmers and cheaper component- farming is getting an infusion of data and technology. As the concept of the 'Internet of Things' becomes increasingly prevalent, many systems are being devised to allow all manner of data to be gathered and analyzed, and devices controlled via wireless data networks. 10 connected devices such as smart thermostats and lighting systems are making their way into homes, but another big opportunity for the Internet of Things could be outdoors, in the area of agriculture.

Complexity involved in monitoring climatic parameters like humidity, soil moisture, illumination, soil pH, temperature, etc. which directly or indirectly govern the plant growth. Places like Punjab, which receive ample amount of water through river and canal irrigation system, faces problem of soil salinity due to excess irrigation. Places with limited water supply like Rajasthan, faces problem of acute water shortage for agriculture. Excessive use of fertilizers, insecticides and pesticides makes the soil dependent on them, erodes fertility, increases resistance in insects and pests, pollutes ground water and nearby water bodies whenever it rains. Different plants require different amount of moisture, humidity, temperature and light wavelength, and lack of awareness of this information or negligence of a person cultivating land can cause plants to die before maturing. 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. Keeping these issues in view, an IOT based monitoring and control system is designed to find implementation in the near future that will help Indian farmers.

1.1 Solar power conditioning unit

Solar Power Conditioning Unit (PCU) is an integrated system comprising of a solar charge supervisor, a Grid or a converter charger. It brings the capability to charge the battery bank also over Solar or Grid/DG Set. The PCU constantly observes the state of Battery Voltage, Solar Power yield and the loads. Due to continuous usage of power, when the Battery Power decreases below a preset level, the PCU will mechanically handover the load to the Grid/DG power and also charge the Batteries through the inbuilt Grid Charger. While the Batteries remain getting charge towards the preset level, the PCU cuts off from the (Grid / DG) power the existing system as well as stimulate to feeding the essential load from the battery bank & remain to charge the battery bank from the available Solar Power.

Fig. 1 Solar system

1.2 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. Places like Punjab, which receive ample amount of water through river and canal irrigation system, faces problem of soil salinity due to excess irrigation. Places with limited water supply like Rajasthan, faces problem of acute water shortage for agriculture. Excessive use of fertilizers, insecticides and pesticides makes the soil dependent on them, erodes fertility, increases resistance in insects and pests, pollutes ground water and nearby water bodies whenever it rains. Different plants require different amount of moisture, humidity, temperature and light wavelength, and lack of awareness of this information or negligence of a person cultivating land can cause plants to die before maturing. 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. Keeping these issues in view, an IOT based monitoring and control system is designed to find implementation in the near future that will help Indian farmers.

1.3 Objective of research work

This work is primarily aimed to the improvement of current agricultural practices by using modern technologies for better yield. This work provides a model of a smart greenhouse, which helps the farmers to carry out the work in a farm automatically without the use of much manual inspection. Green house, being a closed structure protects the plants from extreme weather conditions namely: wind, hailstorm, ultraviolet radiations, and insect and pest attacks. The irrigation of agriculture field is carried out using automatic drip irrigation, which operates according to the soil moisture threshold set accordingly so as optimal amount of water is applied to the plants. Based on data from soil health card, proper amount of nitrogen, phosphorous, potassium and other minerals can be applied by using drip irrigation and fertilization techniques. Further, the readings collected from storage containers are uploaded to cloud service and can be forwarded to an e-commerce company for analysis and monitoring.

II- LITURATURE REVIEW

In the paper by Satyam Kumar Sinha,. et al in 2017 on IOT based smart garden monitoring system which sense the requirement of the plant and provide it with water as the soil loses its moisture has so drawbacks where the requirement may have been fulfilled by the system for survival but didn’t detect the other reasons like disease, climate changes which are equally important factors which should be prevented for the plants survival.

Devika CM in 2017 used a simple Arduino to introduce automation in watering plants. The drawback of it being that it was restricted in terms of its resource sharing as the information could not be accessed globally. Today, we have much better options other than GSM such as cloud computing which will be much beneficial in maintaining a database and uploading each and every real time updates.

Smart Green House Monitoring based on IOT : Sahana B and D. K. Sravani Green house is used to protect plants from extreme environmental conditions and also growing plants in controlled environment. Greenhouse monitors the extreme environmental conditions in favor of plant growth. Greenhouse can be made smarter by using different techniques. This project presents wireless IoT based smart greenhouse. A smart greenhouse based on IoT is implemented using Cisco packet tracer and the output is verified with the expected results

Wireless sensor networks for greenhouses by Aarti Kochhar, The paper presents an end to-end survey; starting from the layout of crops in greenhouses, wireless technology used for communication of sensors, techniques to choose transmission interval or rate. Layouts and sampling techniques are also classified and compared. Other than these, the paper also studies various prediction models and decision supporting techniques adopted in greenhouses for efficient integration and management of WSN. These prediction models are also comprehensively analyzed in this work.

Shrihariprasath.B., et al in their paper the solar PV PCU observing using Internet of Things has been experimentally demonstrated to work agreeably by monitoring the parameters effectively through GPRS. The intended system not only monitors the factors of solar PV PCU, but it also controls the data and yields the report conferring to the requirement. It also stores all the parameters in the cloud in a suitable mode. This will help the user to analyse the state of various constraints in the solar PV PCU.

Abid Rahimet., et al In this paper, a design concept of wireless sensor network is achieved using low-cost transceivers and Arduino UNO microcontroller. The system is well suitable for environmental monitoring. As per necessities, the sensor nodes are made as minor as possible. The proposed system is protected; each node has its own data buffer acknowledged by a 64-bit address along with Onion protocol which boosts the data encryption among nodes. This root the sniffing of the packet very problematic. And also, an ultra-low power consumption system with suitable Arduino optimization, 3000mAh Li-Po or Li-ion batteries can maintenance a node for more than fifteen months. This makes nRF4L01 (+) module an economical substitute to XBee modules.

III- EXISTING WORKING SYSTEM

Light from sun is directly converted to electric energy when it hits the solar panels. Almost every day, sun light falls on these solar panels. The solar panel transforms this energy into direct current ("DC") electric energy. This energy then flows out of the solar panel andgoes into an inverter. The inverter converts that "DC" power (commonly used in batteries) into “AC" power. AC power is the electrical energy that our TV, desktop monitors, and toasters use when plugged into the wall outlet. Solar Cells:-Solar cells are small, square-shaped panel semiconductors produced using silicon and other conductive materials, fabricated in thin film layers. At the point when daylight strikes a solar cell, chemical reactions discharge electrons, generating electric current. Solar cells are also called photovoltaic cells or "PV cells" Solar Photovoltaic (PV) System Components:-A PV system components incorporate PV modules (groups of PV cells), which are usually called PV panels; one or more batteries; a charge regulator or controller for a stand-alone system; an inverter to covert solar power from direct current (DC) to the alternating current (AC)

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of the utility grid-connected system; wiring; and mounting hardware or a framework. The individual solar cells are grouped in a PV module, and the modules are then assembled together in a cluster. Some of the arrays are put on special tracking gadgets to follow sunlight throughout the day and improve solar efficiency. Existing methodology includes a lot of researches in the domain of solar power. Remote monitoring of solar power inverter (An application of IoT) :

1. Solar energy analytics using internet of things
2. Smart power monitoring and control system through Iot using cloud data storage
3. Management of solar power in micro grids using Iot based dependable control
4. Design and development of a remote monitoring and maintenance of solar plant supervisory system.

IV- PROPOSED SYSTEM

Solar power is becoming best source of energy day by day because of depleting nature of fossil fuels and the disastrous demerits such as pollution they contribute to atmosphere. So maintaining solar power system, solar panels is an increasing need for the researchers and scholar concerned. Solar power needs to be monitored for optimum and efficient output. This helps to retrieve efficient power from solar plants while monitoring for faulty solar panels, connections, and dust accumulated on panels which lower output and also many critical concerns affecting solar efficiency. So in my research , I propose an automated IOT based solar power monitoring system that allows for automated solar power monitoring from anywhere over the internet. We use Arduino based system to monitor a solar panel (say 10 watt) parameters. Our system constantly monitors the solar panel and transmits the various outputs to IOT system over the internet. Here in practical we can use IOT Gecko to transmit solar power parameters over the internet to IOT Gecko server. It then displays these parameters to the user using an effective GUI and also gives alarm to user when the o/p goes below specific limits. This makes remotely monitoring of solar plants very efficient and easy and gives best power output. We performed the simulation of research on simulator- Proteus design suite. It is a software used generally for electronic design automation. It is commonly used by electronic design engineers to create schematics and electronic prints for manufacturing PCBs. It was created in Yorkshire, England by Lab center Electronics Ltd and has versions in English, French, Spanish and Chinese languages. The circuit diagram of the model is shown below:

4.1 Circuit Diagram

In this current value , voltage value and power are displayed on LCD by using current sensor for measuring current and voltage sensor for measuring voltage anywhere over the internet. Similarly, humidity sensor is used to detect and calculate humidity on nearby solar panel. Temperature sensor is al and measure temperature on solar panel. Also, dust accumulated on solar panel can be detected by dust sensor. We can also address the dust accumulated on solar panel by cleaning it automatically with the help of water power are displayed on LCD by using current sensor for measuring current and voltage sensor for measuring voltage anywhere over the internet. Similarly, humidity sensor is used to detect and calculate humidity on nearby solar panel. Temperature sensor is also used to detect and measure temperature on solar panel. Also, dust accumulated on solar panel can be detected by dust sensor. We can also address the dust accumulated on solar panel by cleaning it automatically with the help of water measuring current and voltage sensor for measuring voltage anywhere over the internet. Similarly, humidity sensor is used to detect and calculate humidity on nearby solar panel. Temperature sensor is al and measure temperature on solar panel. Also, dust accumulated on solar panel can be detected by dust sensor. We can also address the dust accumulated on solar panel by cleaning it automatically with the help of water pump controlled by a motor. We can find light intensity by LDR sensor which helps us maintaining optimum power. We can also address the low intensity light on solar panel by turning the solar panel with the alignation of sun (i.e., solar panel will rotate automatically towar of another motor. We can also detect fault on connections or on load by displaying 'efficiency low' signal on LCD. We can all control this over the internet. Which is time savvy, efficient and power. We can also address the low intensity light on solar panel by turning the solar panel with the alignation of sun (i.e., solar panel will rotate automatically towards the sun where intensity of light is more) with the help of another motor. We can also detect fault on connections or on load by displaying 'efficiency low' signal on LCD. We can all control this over the internet. Which is time savvy, efficient and smart mode concept? power. We can also address the low intensity light on solar panel by turning the solar panel with the alignation do the sun where intensity of light is more) with the help of another motor. We can also detect fault on connections or on load by displaying 'efficiency low' signal on smart mode concept.

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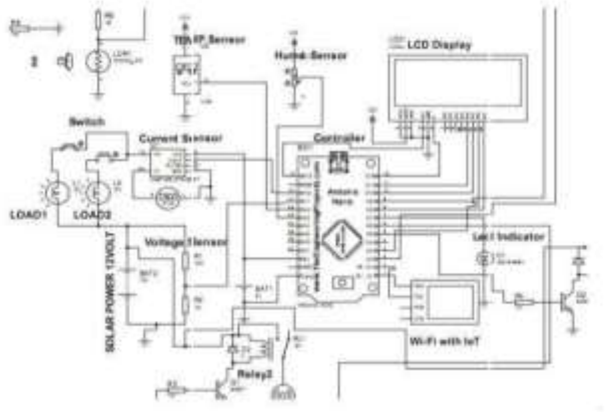

Fig. 2- Circuit diagram

4.2 Block Diagram

The basic block diagram of greenhouse system is as shown in figure 3.1. The system is a greenhouse system in which there are four sensors. These sensors act as input to the micro controller system. The input feed provided to the micro controller is in the form of analog data. This data is converted by the controller into digital format. The data is shown on the LCD display and also on the android phone via Bluetooth. Thus the monitoring of temperature, moisture and other parameters is done automatically. Once the parameter values are monitored they can be controlled by the embedded system which is built with coding. This is automating controlling system. The android phone is operated by the user. The android application is used for controlling as per the user knowledge and required output

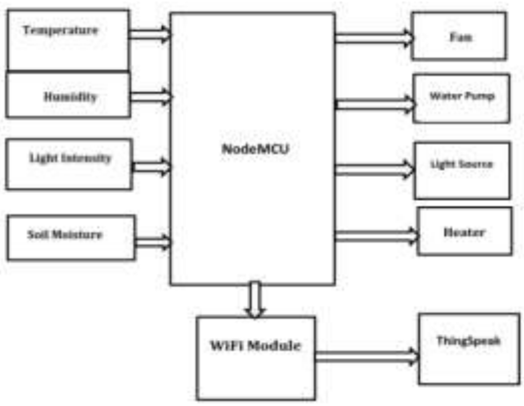

Fig. 3- Circuit diagram

4.3 Project Execution Steps

i) The IOT greenhouse monitoring system employs PC or phone base system for keeping the owner continuously informed.

ii) This is a micro controller-based circuit which monitors ad records the values of temperature, humidity, soil moisture and sunlight of the natural environment that are continuously updated as a log in order to optimize them to achieve maximum plant growth and yield.

iii) The system constantly monitors the digitized parameters of the various sensors. Monitoring and controlling of a greenhouse environment involves sensing the changes occurring inside it which can influence the rate of growth in plants.

iv) The important parameters are the temperature inside the greenhouse which affects the photosynthetic and transpiration process, humidity, moisture content in the soil, the illumination etc.

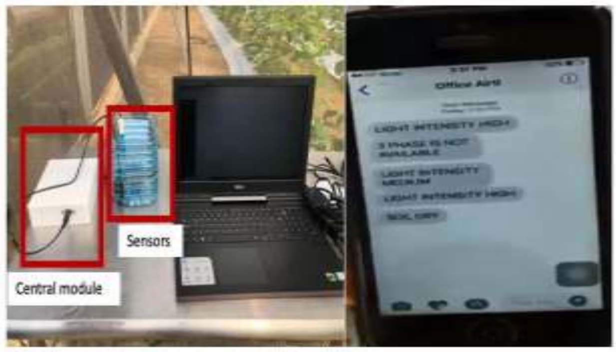

Fig. 4 - Project execution process

Table 1- Comparison between state of art motor

S.N	Methods	Existing	Proposed
1	Temperatur e monitoring	Sensor monitorin g	Sensor monitoring and controlling with Arduino
2	Solar power usege	Nil	The solar panel is used
3	Controlling system	Nil	DC motor monitoring and controlling by water
4	Humidity monitoring	Sensor monitorin g	Sensor monitoring and controlling with Arduino
5	Pressure monitoring	Sensor monitorin g	Sensor monitoring and controlling with Arundino
6	Whether forecasting	Nil	With Things speak platform

Table I portrays the comparison between the state of the art methods. In temperature monitoring in the proposed model utilizes sensor monitoring and controlling with Arduino microcontroller. Power usage the Solar panel is used for power saving purpose. In this work, the sensor monitoring and controlling with Arundino controller is used for monitoring the pressure. Finally, the weather conditions and all the above said monitoring plots are done with the Thing Speak platform.

V-WORKING OF THE SYSTEM

Solar panel is mounted at roof of the green house and it connected to the battery through diode. Battery charged by solar power. Solar panel able to charge 12V and 7Amph. All devices are operated in 12Volt DC supply from battery. In this system peripheral interface controller (PIC) microcontroller place a major role by controlling and monitoring the green house system. Controller is interfaced with the 16*2 character LCD display. It helps to show parametric values and user can set or reset the values of parameters. Inputs are connected to I/O ports of controller. Soil moisture sensor is used for measure water content in soil. This is working under the principle of dielectric. Sensor will fix at 3cm depth of soil. When the soil moisture level is low sensor should give signal to the controller and the solenoid valves are actuated through relay. If moisture level is attained the maximum value solenoid will be stopped. In this method we controlled the required water level for crops.

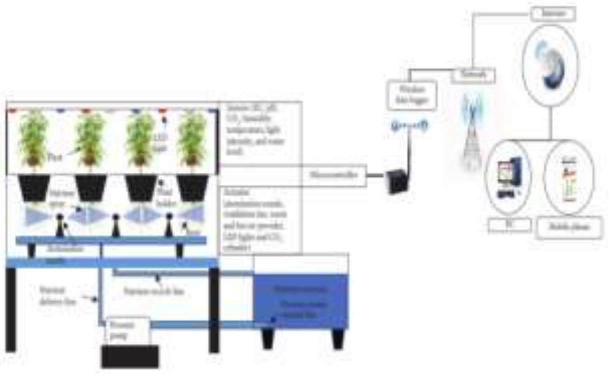

Fig. 5- working structure diagram

Humidity sensor is used to measure water content in atmosphere. Humidity level maintenance is important for healthy crops so we controlled humidity by using sprayer. The sprayer is used to spray water in mist form. This will be maintaining humidity. This is maintain a humidity level from minimum to maximum level Sprayer is actuated by submersible pump. Temperature sensor (LM 35) is used to measure the temperature inside green house. This is used to maintain certain range of temperature inside green house. Whenever temperature rise at high then sprayer is actuated to reduce temperature. If the temperature is low then artificial light will glow to increase temperature. In our project we maintain temperature at optimum level Submersible pump is used to increase discharge of water from tank. So there is no human resource often required to monitor and irrigate the field. Through maintaining optimum conditions inside the greenhouse yield of the crop is increased.

Fig. 6- System structure

VI- SENSOR AND MODULE OF THE SYSTEM

Proposed system consists of following sensors and modules:

6.1 Arduino Micro Controller: Arduino is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC- to-DC adapter or battery to get started.

6.2 ESP8266: The ESP8266 is a low-cost Wi-Fi microchip, with a full TCP/IP stack and microcontroller capability. The ESP8285 is and ESP8266 with 1 KB of built-in flash, allowing the building of single chip devices capable of connection to Wi-Fi. These microcontroller chips have been succeeded by the ESP32 family of devices, including the pin-compatible ESP32-C3.

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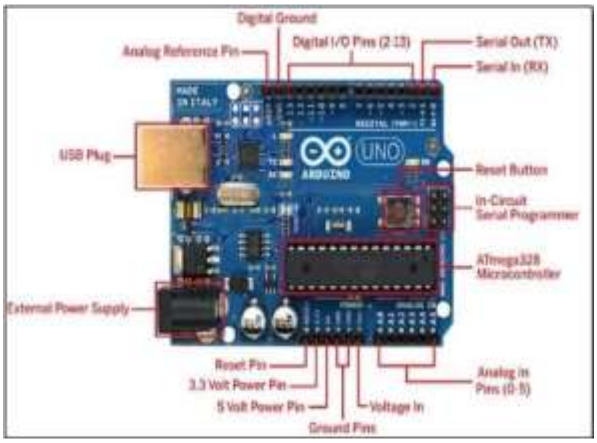

Fig. 7 - Arduino Micro controller

Fig. 8- ESP8266 Wi-Fi microchip

Memory: 32 KB instruction, 80 KB user data CPU: Ten silica Diamond Standard 106Micro or 160 MHz Power: 3.3 V DC

6.3 LCD Display: A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizer's. Liquid crystals do not emit light directly instead using a backlight or reflector to produce images in colour or monochrome LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden. For instance: present words, digits, and seven-segment displays, as in a digital clock, are all good examples of devices with these displays. They use the same basic technology, except that arbitrary images are made from a matrix of small pixels, while other displays have larger elements. LCDs can either be normally on (positive) or off (negative), depending on the polarizer arrangement. For example, a character positive LCD with a backlight will have black lettering on a background that is the colour of the backlight, and a character negative LCD will have a black background with the letters being of the same colour as the backlight. Optical filters are added to white on blue LCDs to give them their characteristic appearance.

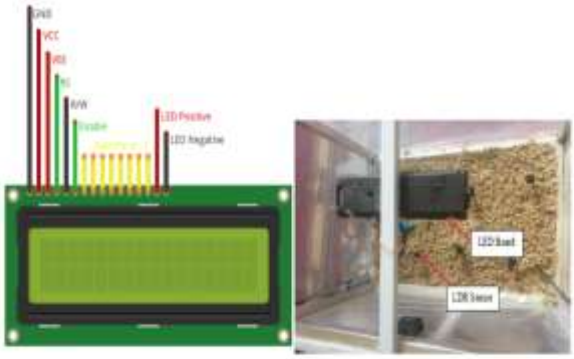

Fig. 9 - LCD Display

6.4 Arduino UNO : The Arduino Uno is an open-source microcontroller board based on the Microchip Atmega328P Microcontroller and developed by Arduino. The board is equipped with sets of digital and analog input/output pins, It has 14 digital input/output pins, 6 analog input, a 16 MHZ crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button."UNO" means one in Italian and is named to mark the upcoming release of arduino 1.0. The Uno is the latest in a series of USB Arduino boards and reference model for Arduino platform. The Arduino Uno can power via the USB connection or with external power supply. External power can come either from an AC to DC. The Arduino are programmed using dialect of feature from programming language C and C++. In addition to using traditional compiler tool chains, the Arduino provide integrated development environment (IDE) based on processing language project.

Fig. 10 - Arduino UNO

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source isselected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by

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plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

6.5 Solar Panel : A solar cell panel, solar electric panel, photo-voltaic (PV) module or solar panel is an assembly of photo-voltaic cells mounted in a framework for installation. Solar panels use sunlight as a source of energy to generate direct current electricity. A collection of PV modules is called a PV panel, and a system of PV panels is called an array. Arrays of a photovoltaic system supply solar electricity to electrical equipment.

Fig. 11 - Solar Panel

A solar panel is a collection of solar cells. The solar panel converts the solar energy into electrical energy. Output of the solar panel is its power which is measured in terms of Watts or Kilo watts. Solar power uses multiple reflectors to collect more sun's thermal energy. Thermal energy collected through the day to perform different operations. Performance of the solar panel depends on a number of factors like climate, conditions of the sky, orientation of the panel, intensity and duration of sunlight and its wiring connections.

6.6 Soil moisture sensors: Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighing of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content.

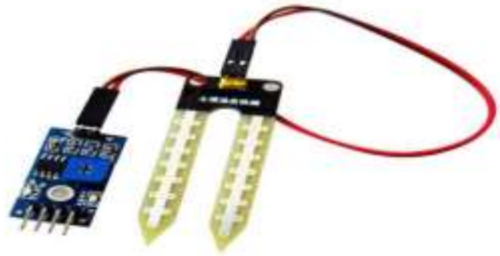

Fig. 12 - Soil Moisture Sensor

This moisture Sensor uses Immersion Gold which protects the nickel from oxidation . electrodes nickel immersion gold (ENIG) has several advantages over more conventional (and cheaper) surface plantings such as HASL (solder),including excellent surface planarity (particularly helpful for PCB's with large BGA packages), good oxidation resistance , and usability for untreated contact surfaces such as membrane switches and contact points. This moisture sensor can read the amount of moisture present in the soil surrounding it . it's a low tech sensor , but ideal for monitoring an urban garden, or your pet plant's water level. This is a must have tool for a connected garden.

Fig. 13- Actual photo of Soil Moisture Sensor

The 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 to use , just insert it into the soil and then read it. With 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 moisture sensor uses two probes to pass current through the soil , and then it reads hat resistance to get the moisture level. More water makes the soil conduct electricity more easily (less resistance) , while dry soil conducts electricity poorly (more resistance) . it will be helpful to remind you to water your indoor plants or to monitor the soil moisture in your garden It consists of two probes which are used to measure the volumetric content of water. Two probes allow the current to pass through the soil. Then it gets the resistance value to measure the moisture value. It connected in two modes analogue and digital mode. The two copper leads act as the sensor probes. They are immersed into the specimen soil whose moisture content is under test. The conductivity of soil depends upon the amount of moisture present in it. It increases with increase in the water content of the soil that forms a conductive path between two sensor probes leading to a close path to allow current flowing through.

6.7 GSM Module : GSM stands for Global System for mobile communication. Here in this project by using GSM module we can keep information about the effects of climate on plants. It sends the information about Temperature, Humidity, Light Intensity, soil moisture and status of appliances that are connected with circuit for controlling Green house parameters. Its operating voltage is 3.3V to 5V. It can transmit voice, SMS, and data information.

Fig. 14- GSM Module

GSM modem or GSM module is a hardware device that uses GSM mobile telephone technology to provide a data link to a remote network. From the view of the mobile phone network, they are essentially identical to an ordinary mobile phone, including the need for a SIM to identify themselves to the network. GSM modems typically provide TTL-level serial interfaces to their host. They are usually used as part of an embedded system.

6.8 Light Dependent Resistor (LDR):

When light falls on such a semiconductor the bound electrons [i.e., Valence electrons] get the light energy from the incident photos. Due to this additional energy, these electrons become free and jump in to the conduction band. The electron - hole pairs are generated. Due to these charge carriers, the conductivity of the device increases, decreasing its resistivity. The way an LDR works is that they are made of many semi-conductive materials with high resistance. The reason they have a high resistance is that there are very few electrons that are free and able to move because they are held in a crystal lattice and are unable to move. When light falls on the semi-conductive material it absorbs the light photons and the energy is interfered to the electrons, which allow them to break free from the crystal lattice and conduct electricity and lower the resistanceof the LDR.

Fig. 15 - Light Dependent Resistor

The way an LDR works is that they are made of many semi-conductive materials with high resistance. The reason they have a high resistance is that there are very few electrons that are free and able to move because they are held in a crystal lattice and are unable to move. Light dependent resistors have many uses , many of the uses to do with objects that have to work in certain levels of light. Some of the uses of the LDR are in photographic light meters, streetlights and various alarms' light burglar alarms, re alarms and smoke alarms.

6.9 Water Level Sensor: This method of the plant cultivation by providing a small mist of the nutrient solution in the growth chamber. Thus, there is no any use of soil; just water is required to cultivate the plant throughout the germination to harvest time. Therefore, the water nutrient solution reservoir is one of the major components of the aeroponic system which should be monitored throughout the growth period. In the conventional aeroponic system, the farmer checks the water nutrient level in the nutrient solution reservoir, and if he founds water level less than the desired level, he maintained accordingly. However, by adopting the precision agriculture techniques, the farmer will be able to monitor and control water nutrient level through the intelligent methods such as wireless sensors. The water nutrient level sensors detect the liquid level in the reservoirs and facilitate operator in collecting water nutrient level data in real time. The sensors will alert the operator about any potential property damage that results from any leaks and also allowing to know when a container is nearing empty.

Fig. 16 – Water level sensor

6.10 Hardware Interfacing With Node MCU :

Express if systems' smart connectivity platform (ESCP) is a set of high performance, high integration wireless SOCs, designed for space and power constrained mobile platform designers. It provides unsurpassed ability to embed WiFi capabilities within other systems , or to function as a standalone application , with the lowest cost , and minimal space requirement NodeMCU is a low-cost open source IoT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Express if Systems, and hardware which was based on the ESP-12 module. Later, support for the ESP32 32-bit MCU was added.

Fig. 17 – Node MCU

NodeMCU is an open source IOT platform. It indicates firmware which runs on the ESP8266 Wi-Fi SoC from Expressive Systems, and hardware which is based on the ESP-12 module.. It is based on the eLua project, and built on the Expressive Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson, and spiffs. It is flexible in use and Wi-Fi supported for real time data acquisition.

ESP8266EX offers a complete and self-contained WiFi networking solution; it can be used to host the application or to afford WiFi networking functions from another application processor. When ESP8266EX hosts the application , it boots up directly from an external ash . in has integrated cache to improve the performance of the system in such applications. Alternately , serving as a WiFi adapter , wireless internet access can be added to any micro controller based design with simple connectivity(SPI/SDIO or I2C/UART interface) . ESP8266EX is among the most integrated WiFi chip in the industry ; it integrates the antenna switches , RF balun, power amplifier , low noise receive amplifier , iters ,power management modules , it requires minimal external circuitry , and the entire solution , including front-end module , is designed to occupy minimal PCB area. ESP8266EX also integrates an enhanced version of tensilica's L106 Diamond series 32-bit processor , with on- chip SRAM , besides the WiFi functionalities . ESP8266EX is often integrated with external sensors and other application specific devices through its GPIOs.

6.11 Temperature and Humidity Sensor: We place temperature and humidity sensor inside the smart greenhouse to measure humidity and temperature. If the temperature exceeds beyond the limit set then a fan will be automatically switched ON as a coolant to reduce the temperature. When it reaches the desired temperature the fan will be switched OFF automatically with the help of ULN2003. But if the temperature decreases below the optimum temperature a bulb as a heater will be switched ON to set the temperature within the desired range. Humidity sensor is used for sensing the vapors in the air.

Fig. 18 –Temperature and Humidity Sensor

The change in RH (Relative Humidity) of the surroundings would result in display of values. It uses a capacitive humidity sensor and a thermostat to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds. This sensor includes a resistive-type humidity measurement component and an

NTC temperature measurement component, and connects to a high performance 8-bit micro controller, 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 programmes 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 upto 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 package. The DHT11 is a basic , low-cost digital temperature and humidity sensor. It uses a capacitive humidity senor and a thermistor to measure the surrounding air , and spits out a digital signal on the data pin (no Analog input pins needed). Its fairly simple to use , but requires careful timing to grab data . the only real downside of this sensor is you can only get new data from it once every 2 seconds.

6.12 ULN2003 : It is basically a relay driver IC and it is a darlington array having high voltages and high currents as well. It is made up of seven open collector darlington pairs having common emitter which shows ULN2003 has a capability of handling seven different relays at a time. A single darlington pair consists of two bipolar transistors and it operates on the current range of 500mA to 600mA. ULN200X is a well known series of IC's. ULN2003 is also the part of this series. ULN2003 operates on 5V and TTL (Transistor Transistor Logic) and CMOS (Complementary Metal Oxide Semi Conductor). Its pin configuration is designed so that the input pins are at the left side of the IC whereas the output pins of it are on right side in front of the corresponding input pin. This IC has a very wide range of applications. They are commonly used as relay drivers in order to drive different kinds of loads.

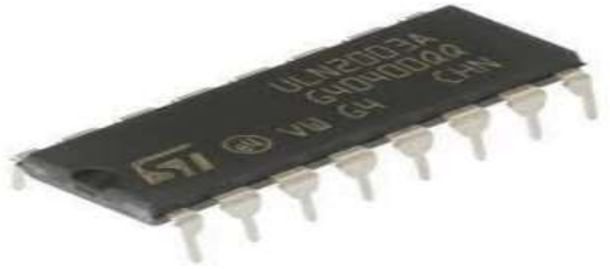

Fig. 19 – ULN 2003

ULN2003 can also be used to drive different motors (e.g. DC Motors or Stepper Motors) with Microcontrollers (like Arduino, PIC Microcontroller or 8051 Microcontroller etc.). Some of the other applications of ULN2003 include logic buffers, lamp drivers, line drivers, LED display, motor driver circuits etc.

VII- DEVICE WORKIMG PROCESS

Work is primarily about the improvement of current agricultural practices by using modern technologies for better yield. This work provides a model of a smart greenhouse, which helps the farmers to carry out the work in a farm automatically without the use of much manual inspection. Greenhouse, being a closed structure protects the plants from extreme weather conditions namely: wind, hailstorm, ultraviolet radiations, and insect and pest attacks. The irrigation of agriculture field is carried out using automatic drip irrigation, which operates according to the soil moisture threshold set accordingly so as optimal amount of water is applied to the plants. Based on data from soil health card, proper amount of nitrogen, phosphorus, potassium and other minerals can be applied by using drip fertigation techniques. Proper water management tanks are constructed and they are filled with water after measuring the current water level using an ultrasonic sensor. Plants are also provided the requisite wavelength light during the night using growing lights. Temperature and air humidity are controlled by humidity and temperature sensors and a fogger is used to control the same. A tube well is controlled using cloud module. Bee-hive boxes are deployed for pollination and boxes are monitored using ultrasonic sensors to measure honey and send mails to the buyers when they are filled. Further, the readings collected from storage containers are uploaded to cloud service (Thing Speak) and can be forwarded to an e-commerce company. The sensing part of all the greenhouse parameters is being measured by the use of appropriate sensors. The sensed data is being stored in the database by the use of ThingSpeak software and also a comparative analysis isdone on the parameters based on the sensor data. Mobile alerts are also sent to the concerned people from time to time so that they keep updated on the real time greenhouse environment. The name Greenhouse Monitoring System is to both sense and monitor the environmental parameters from the sensor and also to stabilize the conditions if the conditions exceed the threshold. Actuators are used to control the parameters based on the sensor input. It can be done in both automatic and manual mode. In the manual mode, the actuators are controlled by he user

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based on the inputs obtained throughSMS which is not implemented in our project. In the automatic mode, based on the database of the previous event the actuators are being controlled.

7.1 Interfacing Sensors with Arduino : The proposed system uses four sensors to collect the data of the parameters required to monitor the greenhouse. The important parameters are the temperature inside the greenhouse which affects the photosynthetic and transpiration process, humidity, moisture content in the soil, the illumination etc.

7.2 Communication Process: Serial Interface (Single-Wire Two-Way) the interesting thing in this module is the protocol that uses to transfer data. All the sensor readings are sent using a single wire bus which reduces the cost and extends the distance. In order to send data over a bus you have to describe the way the data will be transferred, so that transmitter and receiver can understand what says each other. This is what a protocol does. It describes the way the data are transmitted. On DHT-11 the 1-wire data bus is pulled up with a resistor to VCC. So if nothing is occurred the voltage on the bus is equal to VCC.

7.3 Sending Sensor Data TO Cloud Via Wi-Fi Module: The next step in implementing is interfacing of wifi module with the Arduino. This is done to access the sensed data from the sensors to the cloud. ESP8266 wifi module is low cost standalone wireless transceiver that can be used for end-point IoT developments. ESP8266 Wi-Fi module enables internet connectivity to embedded applications. It uses TCP/UDP communication protocol to connect with server/client. Microcontroller communicates with the module using a set of AT commands. Microcontroller communicates with ESP8266-01 Wi-Fi module using UART having specified Baud rate. ThingSpeak is software that can monitor our data over the internet from anywhere, and we can also control our system over the Internet from anywhere, and we can also control our system over the Internet, using the Channels and webpage's provided by ThingSpeak. ThingSpeak 'Collects' the data from the sensors, 'Analyze and visualize' the data and 'Acts' by triggering a reaction. Working of this project is based on serial communication for fetching data from the sensors. First Arduino sends a start signal to sensor and then it gives a response signal with containing data. Arduino collects and extracts the data and then sends it to ThingSpeak server. ThingSpeak displays the data in the form of graphs.

7.4 ThingSpeak: ThingSpeak is an internet of things (IOT) platform that lets you collect and store sensor data in the cloud and develop IOT applications. ThingSpeak IOT platform provides apps that let you analyse and visualize your data in MATLAB , and then act on the data . internet of things (IOT) describes an emerging trend where a large number of embedded devices (things) are connected to the internet. These connected devices communicate with people and other things and often provide sensor data to cloud storage and cloud computing resources where the data is processed and analyzed to gain important insights. Cheap cloud computing power and increased device connectivity is enabling this trend. IoT solutions are built for many vertical applications such as environmental monitoring and control, health monitoring, vehicle fleet monitoring, industrial monitoring and control, and home automation.

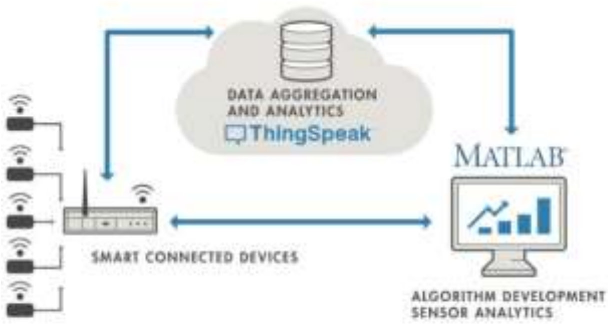

Fig. 20 – ThingSpeak

On the left, we have the smart devices (the "things" in IoT) that live at the edge of the network. These devices collect data and include things like wearable devices, wireless temperatures sensors, heart rate monitors, and hydraulic pressure sensors, and machines on the factory floor. In the middle, we have the cloud where data from many sources is aggregated and analyzed in real time, often by an IoT analytics platform designed for this purpose. The right side of the diagram depicts the algorithm development associated with the IoT application. Here an engineer or data scientist tries to gain insight into the collected data by performing historical analysis on the data. In this case, the data is pulled from the IoT platform into a desktop software environment to enable the engineer or scientist to prototype algorithms that may eventually execute in the cloud or on the smart device itself. An IoT system includes all these elements. ThingSpeak fits in the cloud part of the diagram and provides a platform to quickly collect and analyze data from internet connected sensors.

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ThingSpeak Key Features : ThingSpeak allows you to aggregate, visualize and analyze live data streams in the cloud. Some of the key capabilities of ThingSpeak include the ability to:

- Easily configure devices to send data to ThingSpeak using popular IoT protocols.
- Visualize your sensor data in real-time.
- Aggregate data on-demand from third-party sources. Use the power of MATLAB to make sense of your IoT data.
- Run your IoT analytics automatically based on schedules or events.
- Prototype and build IoT systems without setting up servers or developing web software.
- Automatically act on your data and communicate using third-party services like Twilio or Twitter.

VIII-APPLICATION OF THE SYSTEM

i) Increases the involvement of modern people in agriculture. Farmers no need to depend on the electricity.
ii) The uniform spread of water to all crops.

iii) Decreases the production cost by avoiding labor and power supply. Wastage of water is avoided. Crops get constant and required amount of water. Farmers can concentrate on other business side by side.

iv) Any plant can be planted outside t/he farming season.
v) Protect plants against rainy seasons, storms, wind and frost. Control pests and diseases. Total automation of greenhouses / nurseries / bio tech parks. Can be used domestically. Reducing fertilizers waste.

vi)Suitable for Tissue culture plants.

vi)Ask to use, install, operate troubleshoot.

vii)Useful for small scale farmers & green house owners. Low cost setup.

viii) Higher yields with space optimization, for instance planting vertically.

IX-RESULT AND ANALYSIS

Implementing this technology in the field a farmer is able to produce a yield of 25 to 30 tons in quarter acre of land in which the system is implemented. Before implementing this system they were able to produce only 5 to 6 tones yield in quarter acre of land. This technology not only reduces the man power it also increases the yield of the crop.

Specifications:

1. Solar Panel: Rated voltage=12v Rated current=0.6Ah

2. Battery: Rated output voltage=12v Rated output current=7.5Ah

3. Solenoid valve: Operating voltage=12v Operating current=0.3A

4. Submersible pump: Operating voltage=12v , Operating current=0.1A , Discharge =10L/min .

Fig. 21 - Actual Implementation Setup

We will obtain 10.8 watts power from solar panel of dimension (440 x 190 x 5) mm per hour. We have to install the battery of capacity 90 watts. Battery can be completely re- charged within 8 hours. And we used 2 solenoid valves. Each solenoid valve consumed 3.6watts. So 7.2 watts required for to actuate the solenoid valves. And submersible pump consumes 1.2 watts. And the circuitry consume negligible amount of power. So one complete recharge of the battery is used for 10 hours 45 minutes for continuous usage of pump and valves.

X-CONCLUSION

Implementing Renewable Energy technologies is one highly prescribed method of reducing the negative effect that other sources of energy introduce in the environment. Because of frequent power cuts it is important to make a use of renewable energy and monitor it. Monitoring helps the user in analysis of solar energy usage. This system is cost effective. The system efficiency is a of solar energy. Thus it is decreasing the electricity issues. This model/research can be further advanced, by using the results of this current project, i.e. the monitoring values obtained here are the future values of the parameters considered. The internet app can be developed to interface with the end user; the user can also predict values of the future events. In the same way we can go for android application also. During the

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prediction 2 or more models can be used for same data set, to calculate the accuracy of each model. Thus we conclude that by monitoring solar power system i.e., solar panels, we can analyze our system parameters easily and thus can increase efficiency and concerned power output. The primary applications for this project are for farmers and gardeners who do not have enough time to water their crops/plants. It also covers those farmers who are wasteful of water during irrigation. The project can be extended to greenhouses where manual supervision is far and few in between. The principle can be extended to create fully automated gardens and farmlands. Combined with the principle of rain water harvesting, it could lead to huge water savings if applied in the right manner. In agricultural lands with severe shortage of rainfall, this model can be successfully applied to achieve great results with most types of soil. The greenhouse parameter control system for desired conditions is implemented. The sensor devices available are integrated with Microcontroller board is very useful. The setting needs series of observations and study inter dependency of various parameters, such as temperature, humidity and sun light intensity. Arduino board makes it easy to install and maintain the system. The system deployment in test green house is studied implies need of poly house structures study, inside, outside environment study, crop needs etc. Simply controlling given parameters is not enough. DC supply can be given in the form of a battery bank easy to charge with solar system. There are limitation in terms of seasonal measurements and crop needs. The user awareness of how to check system operation is a basic need to be fulfilled.

REFERENCES

[1] *Dewi Kania ,(2020)Design and Prototype Development of Internet of Things for Greenhouse Monitoring System 2020, 3rd International Seminar on Research of Information Technology and Intelligent Systems, pp 389-393.*

[2] *Maria C. Moreno ,; (2021) ,IoT-based Automated Greenhouse for Deep Water Culture Hydroponic System , 2021 IEEE.*

[3] *United Nations; (2019) Department of Economic and Social A airs; Population Division. World Population Prospects 2019: Highlights; United Nations Department for Economic and Social A airs: New York, NY, USA.*

[4] *Satterthwaite, D.; The implications of population growth and urbanization for climate change. Environ. Urban.*

[5] *Kim Yunseop.; Robert G. Evans.; William M. Iversen.;(2008) "Remote sensing and control of an irrigation system using a distributed wireless sensor network", IEEE Transactions on Instrumentation and Measurement, vol. 57, no. 7, July.*

[6] *Timmerman, G. J., and P. G. H. Kamp.(2003) "Computerised environmental control greenhouses." PTC, The Netherland.*

[7] *Mois George.; Sanislav Teodora.; Silviu C. Folea.;(2016) A Cyber Physical System for Environmental Monitoring, IEEE Transactions on Instrumentation and Measurement, vol. 65, no. 6, June 2016.*

[8] *Remya Koshy.; M D Yaseen.; K Fayis.; Shaji Nisil.;N J Harish, M Ajay, Greenhouse Monitoring and Control Based on IOT Using WSN, ITSI.*

[9] *Greenhouse Automation System Using Psoc 3 - Journal of Information, Knowledge And Research In Electronics And Communication Engineering.*

[10] *Remote Sensing In Greenhouse Monitoring System - SSRG International Journal Of Electronics And Communication Engineering (SSRG-IJECE) – EFES April 201 Proposed Methodology. 9.*

[11] *Solar Powered Green House Monitoring and Controlling using AWS Cloud by Android Application - International Research Journal of Computer Science (IRJCS) ISSN: 2393- 9842, Issue 05, Volume 4 (May 2017).*

[12] *Ehret David L.; Hill Bernard D.; Helmer Tom.; Edwards Diane R.;(2011) Neural network modeling of greenhouse tomato yield, growth and water use from automated crop monitoring data. Computers and Electronics in Agriculture. 2011; 79(1): 82-89.*