Greenhouse monitoring using Raspberry Pi

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Abstract - *Greenhouse is a controlled area environment to grow plants .In order to achieve maximum plant growth, the continuous monitoring and controlling of environmental parameter such as temperature, soil moisture ,light intensity, humidity etc. are necessary for greenhouse system. A greenhouse provides an environment to grow plants all year round, even on cold and cloudy days. The main aim of this project is to design a simple, low cost system to monitor the value of environmental parameter and they are continuously updated and controlled in order to achieve optimum plant growth. There are various techniques available for precision agriculture to monitor and control environment for the growth of many crops .Due to the unequal distribution of rain water, it is very difficult to full fill requirement needed by farmers to manage water equally , it requires some irrigation method that are suitable for any weather condition, soil types and variety of crops. It is more important to find method that give perfect analyzing and controlling to develop proper environment. Greenhouse is the best solution to control and manage this problem. DHT11, soil moisture sensor, LDR sensor are the main sensors used in this project which give the exact value of temperature, humidity, water content in soil and light intensity respectively [2]. A cooling fan, artificial light and motor pump are connected to Raspberry-pi. Here we will use Raspberry pi processor and IOT (Internet of Things). By using IOT we control devices or any environmental needs anytime, anywhere. Based on the characteristics of correct perception, efficient transmission and intelligent synthesis of Internet of Things. This research focuses on developing a system that can automatically measure and monitor changes of temperature, light intensity, humidity and moisture level in the greenhouse. This project will spilt into two parts: programming a raspberry pi using Python language to acts as the central hub that manages the various sensors such as DHT11, soil moisture, LDR and creating a app to allow the user to interact with the greenhouse controller [6].*

***Key Words*: Raspberry Pi, Android App, green house monitoring, DHT11 sensor, Two electrode sensor, Light dependent resistor**

1.INTRODUCTION

Agriculture is the spine of India's economic activity and our experience during the last 50 years has demonstrated the strong correlation between agricultural growth and economic prosperity. Agriculture in India is still carried out in conventional way lags behind in integrating modern technologies. If India has to emerge as an economic power in the world, we need a new and effective technology which can improve continuously the productivity, profitability, sustainability of our major farming system. One such technology is the green house technology. It is an old technique, but we will monitor it by using new technology to improve the system which can increase the yield and produce healthy organic food. Green house industry is the fastest growing sector. Greenhouses are controlled area environment to grow plants [2].

A greenhouse provides an environment to grow plants all year round, even on cold and cloudy days [6]. However, extreme environmental factors inside the greenhouse such as high temperatures and a high humidity can negatively impact the plants. Consequently, controlling this environment is essential in order for the plants to grow strong and healthy. The main aim of this project is to design and build a greenhouse controller that can maintain the environmental parameter, by acting upon live sensor readings and be able to display the status of the system to the owner [6]. Here we will use Raspberry Pi as a controller. It receives input from a variety of a sensors and it control motor, light and other actuators. The greenhouse separates the crop from the environment, thus providing some way of shelter from external environment. IOT is the network of physical thing embedded with electronic circuits, sensors, software and network connection which enables these thus to exchange data from one another. The main advantage of greenhouse is we can produce many crops at a time by manipulating environmental condition as per different crops require. It leads to higher crop yield, prolonged production period, better quality, and less use of protective chemicals.

LDR are used to measure light intensity [2]. Plant growth is purely dependent on light intensity falling on top of canopy [4]. DHT11 sensor measure temperature and humidity and are maintained by turning on fan or light. Two electrode moisture sensor are used to measure moisture level within soil and it is maintained by turning on water pump. The program has been written on to the raspberry pi for controlling all the parameters. This device is very helpful to the farmers to monitor and control environmental parameters at their farms. So farmers need not to go their farm. The IOT allows object to sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer based system and resulting in improved efficiency, accuracy and economic benefit. With

this system user can remotely monitor the greenhouse climatic conditions from anywhere which could save the human expenses.

We aim to have a real time remote control greenhouse monitoring system using Raspberry-pi which enables the user to track environmental parameters remotely. Raspberry-pi is a low cost ARM powered Linux based computer which acts as a server and it communicates with clients with Wi-Fi module which is inbuilt in pi. A fully automated greenhouse control systems along with improved monitoring system brings obvious benefit such as labor saving, but far more importantly, it enables improved quality of production and information gathering that will make difference between earning a profit and suffering substantial losses [7].

1.1 Literature Survey

Vimal P V and K S Shivprakasha proposed IOT based Greenhouse environment monitoring and controlling system using Arduino platform. They have used GSM (Global system for mobile communication) modem to send SMS (short message service) which display present status of the environmental parameters and Ethernet. Arduino is the heart of the system. Here pH sensor also used to measure pH of the soil. The pH indicate a solutions acidity or alkalinity. The pH sensor consist of pH probe and a pH sensor module. The Arduino Ethernet shield allows Arduino board to connect to the internet. The GSM sends SMS to the user when sensor value exceeds a defined level. The user turn on the actuator by sending another SMS. All environmental parameter are sending to server through Ethernet and stored in the database. So the user can monitor and control parameter through android mobile application.

Ravi Kishore Kodali, Vishal Jain and Sumit Karagwal suggested IOT based smart greenhouse system for improvement in farming. They have used microcontroller for controlling the output of various sensors. Fogger have used which will sprinkled tiny water droplets of size micron which will remain suspended in the air and bring the temperature down. Underground tank is made for storing the water and that is used for plants through drip irrigation. Apiculture is also integrated inside the setup because it does not receive any breeze or insects from outside which can aid the pollination. Bee hive boxes are fitted with ultrasonic sensor to estimate the current level of the honey and e-mail would be sent to procurement unit whenever the level reaches a threshold at value. The storage house would be there for storing fruits or vegetables and farmer will swipe RFID tag and the data from all containers will be updated on Google spread sheet and e-mail will be sent to an e-commerce website to save farmer from middleman. To avoid involvement of middleman and their adverse effect on farmers they proposed and IOT based solution to inform the buyers about the goods produced by farmers. The farmer just have to swipe his authorized RFID card and then automatically it will send an e-mail to the buyer sharing the information of quantity of goods produced at that instant of time.

Sandip Khot, Dr. M. S. Gaikwad proposed Green House Parameters Monitoring System. They have used raspberry pi, Wi-Fi, web server in their system .Light intensity based most of the devices can be controlled. Most of the time to differentiate between day and night time, measuring light form sunlight is essential. Where, light measurement and analysis is an important step in ensuring efficiency and safety. Plant growth in farming is purely dependent on the light intensity falling on the top of canopy. This paper introduces real time remote Light intensity monitoring system using Raspberry Pi which enables the user to track the lighting system in green house remotely for improving plant growth .By gathering all data it uploads to cloud based server from which the data is accessible to user via wireless internet connection to cloud from smart phone or tablet.

Kiran Ganesan, Uzma Walele suggested Raspberry-Pi Based Automated Greenhouse A greenhouse provides an environment to grow plants all year round, even on cold and cloudy days. However, extreme environmental factors inside the greenhouse such as high temperatures and a high humidity can negatively impact the plants. Consequently, controlling this environment is essential in order for the plants to grow strong and healthy. The aim of this project is to design and build a greenhouse controller that can maintain the environment, by acting upon live sensor readings and be able to display the status of the system to the owner.

Prerana Chaudhari1,Aparna Kamble2 suggested Crop Monitoring System using Raspberry Pi Today in green house people have to look at each and every crop which is planted in green house and if any changes in the environment takes place that will damage that crop this people will come to know when they will see that crop. Crop Monitoring System is a light intensity based used to control the devices and monitor the crops. Most of the time to differentiate between day and night time, measuring light from sun light is essential. Where, light measurement and analysis is an important step in ensuring efficiency and safety. Plant growth in farming is purely dependent on light intensity falling on the top of canopy.

Shetal Vatari, Aarti Bakshi and Tanvi Thakur has discussed Greenhouse by using IOT and cloud computing. The author has listed various methods to control the environmental parameters that has been implemented like programmable system on chip technology (PSoC) as a part of wireless sensor networks (WSN) to monitor and control various parameter of the greenhouse. PSoC technology with high-bandwidth spectrum or cognitive radio technology may

be the proper solution for smooth data traffic and remote control of greenhouse form long distance. This paper contains IOT with cloud computing. It contains embedding intelligence into sensors and actuator using Ardunio platform; networking smart things using ZigBee technology; facilitating interaction with smart things using cloud services; improving data exchanges efficiency using JSON data format.
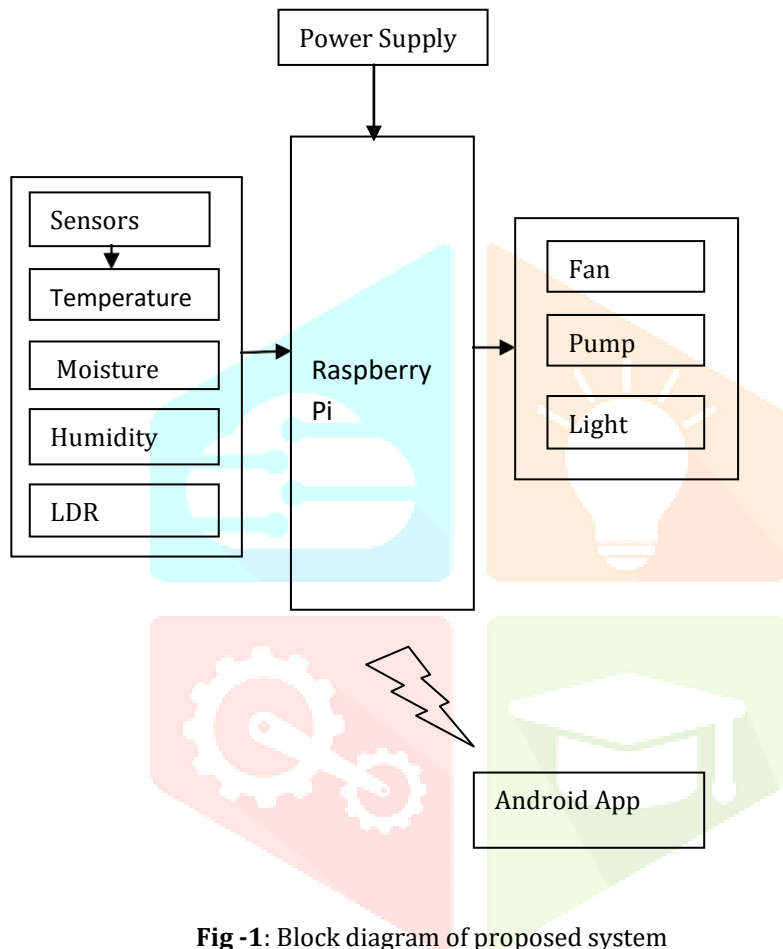
1.2 Block Diagram

Fig -1: Block diagram of proposed system

Temperature humidity sensor (DHT11): DHT11 sensor is used to measure both temperature and humidity [2].We place temperature sensor inside the smart greenhouse to measure humidity and temperature, which generate calibrated digital output. It has high reliability, high efficiency and long-time stability. When temperature rises above a certain level, Raspberry pi will trigger relay to turn on fan and bring the temperature down. It is a low cost humidity and temperature sensor. It has a thermistor for measuring the temperature and a humidity measuring component for measuring humidity. It uses a capacitive humidity sensor. A thermistor to measure the surrounding air, and spits out a digital signal on the data pin that means no analog input pins needed.
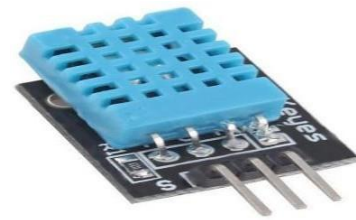

Fig -2: DHT11 sensor

Growing LED Light: Different wavelengths of light plays specific roles for plant growth [1]. Since various photosynthetic pigments within plants utilize different wavelengths. During morning, leaves receive it directly from sun but in order to boost up the rate of growth, we have provided the greenhouse with plant re-growing lights which will turn on when the reading from LDR sensor falls below threshold value. Advancement in LED technology have made it possible to build LEDs that emit the light in a very specific spectra to achieve plant growth.
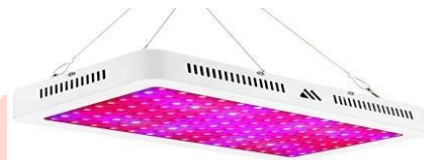

Fig -3: LED light

Soil Moisture sensor: The moisture sensors are deployed in the field which measures the soil moisture and turn on pump whenever moisture is below threshold and closes it when moisture has reached optimum value. This soil moisture sensor consists of two metal rods held apart at a fixed distance by some insulating material.
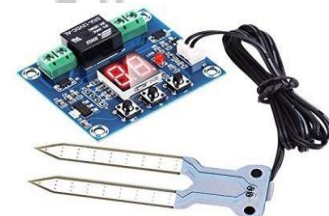

Fig -4: Soil moisture sensor

Android App: Android App is used to display all the value according to the Raspberry pi output.

Channel relay module: This 4-Channels Relay module requires 5V, the controllers like Raspberry-Pi, AVR, PIC, ARM and MSP430 can be connected [6]. 4 relays are consisted in this module, with "NC" ports mean "Normally connected to COM" and "NO" ports mean "Normally open to COM". It has 4 LEDS to show the status of relays.

Fig -5: 4-channel relay module

Raspberry-Pi 0 version 1.3: The **Raspberry Pi** is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that is used to enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. Version 1.3 (V 1.3) is updated to include a camera port. **The new Pi Zero camera port only works with a Raspberry Pi Zero Camera Cable.** It **doesn't** work with a standard Raspberry Pi Camera cable.

- A Broadcom BCM2835 application processor
- 1GHz ARM11 core which is 40% faster than Raspberry Pi 1
- 512MB of LPDDR2 SDRAM
- A micro-SD card slot
- A mini-HDMI socket for 1080p60 video output
- Micro-USB sockets for data and power
- An unpopulated 40-pin GPIO header
- Identical pin out to Model A+/B+/2
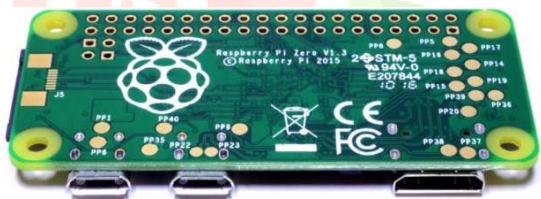- An unpopulated composite video header

Fig -6: raspberry pi 0

Table -1: Comparision with existing techniques

Sr. No	Authors	Paper	Advantages	Disadvantages
1	Vimal P V, DR. K S Shivprakasha	2017 International conference on Intelligent computing , Instrumentation and control technology	Reliable, less power consume,	Circuit become more complex due to use of GSM modem and Ethernet
2	Ravi Kishore Kodali, Vishal Jain and Sumit Karagwal	National Institute of Technology	Direct connection between farmer and buyer, honey production	Speed of controller is low , high maintenance
3	Prerana Chaudhari, aparna Kamble, Snehal More, Nmrata Savnt, Archana Chaugule	International Journal of advance Reasearch in science and engineering 2017.	Low cost, less response time	Unfeasible
4	Sandip Khot, Dr. M. S. Gaikwad	International Journal Of Innovative reasearch in science, engineering and technology 2016	Satisfactory result as per crop need, healthy plant growth.	Time consuming System, cost increased

2. CONCLUSION

The advantage of Smart Greenhouse over conventional farm is that we were able to produce insecticide free and pesticide free crops and create a climate for the proper growth of plants [1]. Moreover, this system can be installed by any individual in his house (Rooftop greenhouse), who doesn't have knowledge about farming. Since we can maintain any climatic condition in this type of Greenhouse, it is possible to expand any type of crop. Hence, we grow plants like Hibiscus which are imported to India. We can reduce 70%-80% water requirement. It also increases yield and rate of growth and produces organic agricultural products. Most vital' we are able to connect farmer directly to consumer using IOT. It reduces effort and time of farmer for making farming efficient and profitable activity. The Smart Greenhouse can be further upgraded in many way and can be used in wide agriculture applications. It can be placed as well

as operatedin any of the environmental conditions to grow any kind of vegetation. Non- conventional energy sources such as solar panels, wind mills are used to supply power to the automatic greenhouse equipment [7]. Smart greenhouse has a blazingscope of future in agriculture field and it will create a revolution in the way the agriculture is carried out in India.This project could be beneficial as it will help in advancing the assets in the nursery.

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