Soil Moisture and Sunlight Monitoring-Controlling using Raspberry Pi for Greenhouse

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Abstract - The field of Cloud computing is helping in leaps and bounds to improvise our age old business- Agriculture. Practical applications can be built from the economic consumption of cloud computing devices that can create a whole computing ecosystem, from sensors to tools that observe data from agricultural field images and from human actors on the ground and accurately feed the data into repositories along with their location as GPS coordinates [1]. In reality, sensors are now able to detect the position of water sources in a subject that is being investigated. Issues related to farmers are always hampering the course of our evolution. One of the answer to these types of problems is to help the farmers using modernization techniques. This project proposes an approach combining the advantages of the major characteristics of emerging technologies such as Internet of Things (IoT) and Web Services in order to construct an efficient approach to handle the enormous data[2].

Keywords - Monitoring, Controlling, Soil Moisture, Greenhouse, Raspberry Pi.

1. INTRODUCTION

The field of agriculture, as well as horticulture can benefit excessively by automating various stage of the whole process. The plants in a greenhouse require extensive care around the clock. Factors like soil moisture, intensity of sunlight and humidity levels play a huge role in such environments. These factors can easily be kept in check by deploying various sensors strategically in the greenhouse or an agricultural field. The most important factors on which the yield depends are soil moisture levels, intensity of the light provided and humidity levels. Each plant or crop has it's own unique requirements of moisture levels. For example rice (or paddy fields) often require very large quantity of water than other crops and plants. Similarly the requirement of intensity of each plant is different. If more sunlight is provided, the chlorophyll will deteriorate due to huge exposure, similarly in case of lack of sunlight the deterioration of chlorophyll leads to change in color of leaves from green to brown and plant eventually plant dies out. If provided with optimum levels of sunlight, the plant can thrive in that environment and the yield is improved. Therefore, deploying various sensors for continuously monitoring these factors and fulfilling the requirements can improve the process. The sensors will monitor soil moisture levels, intensity of sunlight and humidity continuously. This is the biggest advantage that the process of automation can provide in the field of both agriculture and horticulture. Since monitoring the plants would eventually require large manpower, automation can provide cost effective and efficient system for it.

During our survey we also found a system which is already in place for automation in agriculture. It uses PIC microcontroller. This system often proves to be costly in comparison and limits future scope. In this type of system of more autonomous which resulted in its limitations. Each sensor used in this system has its own microcontroller which was tasked to controlling only that particular sensors and respective output. This resulted in use of multiple microcontrollers for multiple sensors. For example the humidity sensors sends the data to the PIC microcontroller which if the values were below threshold would kick start the exhaust fan connected to it. But in our system we will be using only one Raspberry Pi to control all the sensors. This will also allow us to collect live data, and with that huge amount of data we can analyze and provide advice to the farmer or the caretaker about better management of crop.

Also we came across an initiative of the Indian Government to help farmers by providing them with suitable advice related to the fertility of the soil on their land. The employees come and collect the samples of the soil from each farm. They take it to the lab and analyze the samples. The most common factors playing a role in this analysis is the NPK levels of the samples apart from other things. NPK is an abbreviation for Nitrogen (N), Phosphorous (P) and Potassium(K). These are the macro-nutrients which are most essential for the fertility of the soil. The higher the number, the more concentrated the nutrient is in the fertilizer. The farmers are therefore provided with crucial details about the fertility of the soil and also tips on the type and amount of fertilizers to be used. With the help of this information our system can provide better solutions to the farmers to obtain a better yield.

2. SYSTEM MODEL

Most common problem faced by caretakers of greenhouse across the globe is the continuous monitoring of the plants of their greenhouse. From watering these plants time to time, supplying them with sufficient light and also keeping humidity and temperature to optimal levels is itself a

cumbersome task. It takes a toll on the yield due to continuous human intervention required in this process. The proposed project topic is Soil Moisture and Sunlight Monitoring-Controlling using Arduino for Greenhouse.

Implementing this system in Greenhouses it will solve the above problem i.e. reduction in yield of plant in Greenhouse due to human intervention by automating the process of controlling the water and sunlight requirements. This system will improve plant life within the greenhouse by providing a constantly monitored atmosphere, producing a more uniform product.

As every time treating the plants manually could restrict the yield of the plant as human interventions can lead to significant errors which will not be the case if the plants are monitored automatically. This will significantly increase the yield of the plant and its growth will be much more efficient.

3. PROPOSED METHODOLOGY

The plant is fitted with various sensors (soil moisture sensor, LDR) and automatic irrigation system (irrigation kit, motor pump, fluorescent bulb) and Raspberry Pi board. The Arduino will receive information from the various sensors and continuously keep a check on the user defined appropriate threshold value. This information is sent to the cloud database where it is continuously compared with the threshold value. These threshold values are calculated after taking various environmental factors in account related to the plant this model is being implemented for.

When the level of water falls below the desired threshold value or the increase in soil temperature decreases the water level in the soil in that case the command will be issued to start the irrigation and continue it until the level of water increases by a certain amount from the threshold value.

4. LITERATURE SURVEY

After discussing with professors on various aspects related to plant and its surrounding environment and the parameters to be considered while selecting a particular plant. Also they suggested us to visit the greenhouse for more clarity about the subject. The major thing which we come to know at environmental college is the importance of sunlight for plants. It should be deeply observed that which portion of the plants are getting sunlight and which are not because it determines the efficient growth of the plant.

Various important aspects like humidity, light intensity and water level can easily be monitored in a greenhouse. Also low technology greenhouse are cost efficient but require manual inspection of all these parameters which eventually leads to just satisfactory results. But in a high tech greenhouse, this whole process can be automated and a system like ours can prove to be very efficient. High tech greenhouses have an exhaust to control humidity level, florescent bulbs to provide ample light to plants, temperature can also be maintained to optimum levels and the plants can be provided with water by drip irrigation when need be. This whole process require a lot of sensors which collect and transmit data, and when reading of these data fall below optimum levels, appropriate action is taken. This process reduces the human intervention to a much greater degree, which directly results in better yields.

We finally decided to use Gerbera Daisy as our plant for the proposed system. Gerbera is an exotic/ornamental flower plant grown throughout the world and known as “African Daisy” (or) “Transwal Daisy”. This flower originated from Africa and Asian continents and belongs to “Composite” family. In Indian continent, Gerbera is well distributed from Kashmir to Nepal at altitudes from 1200 meters to 3000 meters. The freshness and long lasting characteristics of this flower made it to use as decorative flower in parties, functions and flower bouquet. Market commercial value of this flower is excellent in India.West Bengal, Maharashtra, Andhra Pradesh, Orissa, Karnataka, Gujarat, Uttar Pradesh, Uttaranchal and Arunachal Pradesh.

Immediate Irrigation is required after planting and continue to irrigate for a month to enable a good root establishment. Thereafter, drip irrigationshould be done once in 2 days @ 4 liter/drip/plant for 15 minutes. An average requirement of water is up to 700 ml/day/plant.

Gerbera Daisy plant grows best at around 75F/24C. At night temperature of 68 to 70 degree F is preferable until plants establish a root system, usually in the first 3 to 4 weeks. Temperatures can then be reduced to 65 to 68 degree F at night for the next 2 to 3 weeks, followed by 60 degree F to finish. Ventilation can begin during the day at 75 degree F. Slightly warmer or cooler temperatures can be used to speed or slow the crop, but extremely higher or lower temperatures will delay finish. Elongation of the flower stalk is sensitive to positive or negative DIF either applied generally or as an early morning application. Humidity: Relative humidity should average 65%, with exposure.

5. SYSTEM REQUIREMENTS

Soil moisture sensors to keep a check on the moisture level of the soil. Photoresistor, specifically a LDR, for measuring the intensity of light that the plant is provided with. Raspberry Pi board to work as the brain of this project and the programming for Raspberry Pi is done in Python 2.7.x. Software requirements include Android Studio to make an android application for the farmer to

keep track of the process. Basic knowledge of JavaScript is also required.

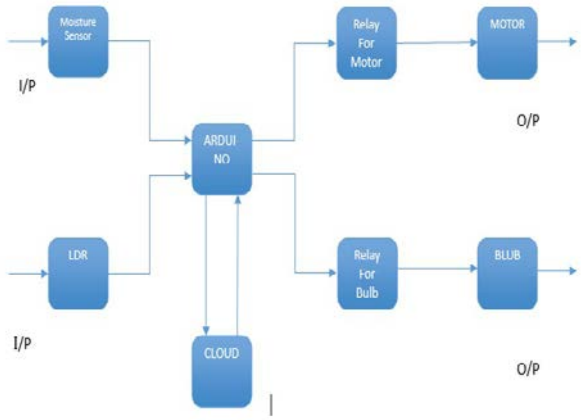

Fig.2. System Implementation

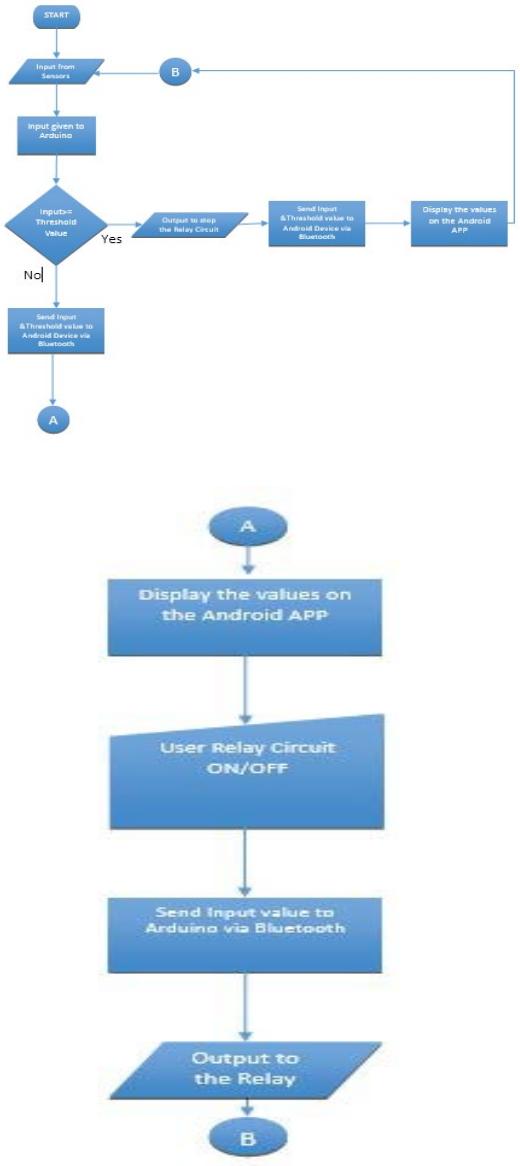

Fig.3. Flow Chart

6. ADVANTAGES

Wastage of water can be solved easily in areas with scarcity of water availability. Less maintenance and manpower is required as the whole system is automated leading to less chances of error, better crop health and thus better yield.

Monitoring of system on farmer's end becomes easy by providing android application for the said purpose. There will also be a 10-12 time better yield,marginor error. Future work can include data collection and smart application.

7. CONCLUSION

The yield obtained in such an environment would be better as compared to that obtained in an uncontrolled environment. The growth of the plant can be easily monitored. Our project gives a smart solution for automating the process of intensive care taking of plants by using various sensors that collect data from various sensors put in places and then takes appropriate action depending on the output. The smart greenhouse project can thus be used in various similar scenarios and this will directly result in a better yield as the whole process is automated and does not require much human intervention. Automating the process also leaves lessdevelopment. The feedback from the users will be used to improve the platform.

8. FUTURE SCOPES

Implementation in High technology Greenhouse. Similar system can also find application in multiprocessing units such as sugar and wine industries in India. Future work can include data collection and smart application development.

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