Automation of Hydroponics Green House Farming using IOT

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Abstract— **Recently, hydroponics refers to the art of growing plants in water (either saline) without soil (land). Nutrients for the plants are supplied to the roots in the form of solution that can be either in the form of static or flowing. Hydroponics can be cultivated both in green house and glass house environment. The limitation in green house environment is to maintain the temperature, pressure, humidity value at a particular level. In addition to that, monitoring on PH value and electrical conductivity in hydroponics is another challenge that has to be monitored and maintained. Manual monitoring is in practice which is a very trivial task else the plants may die out. This project, focuses on two tasks, the first one is to automate the green house environment monitoring. The subsequent is automation of PH level and electrical conductivity maintenance. IOT is used to transfer the retrieved data to the internet (mass storage) and mobile app is used to communicate the current status to the user through the use of internet to their mobile phones, so that monitoring & maintenance will be easier.**

Index Terms—**Hydroponics, IOT, Green House Environment, mobile app.**

I. INTRODUCTION

Hydroponics is the science of growing plants without soil. The nutrients or the plant are supplied to the roots in a solution which can be either static or flowing [1]. The method is called hydroponics, a Latin word that means working water although historians believe that the ancient Babylonians worked with hydroponics through their hanging gardens, it was john Woodward, in 1699 who became the first documented scientist to successfully grow plants using hydroponics. According to Ryder and Whitaker (1976), the lettuce (Lactuca sativa L.) has probably originated from Southern Europe and Western Asia. After being disseminated throughout Europe, it was introduced to the Americas, becoming one of the largest cultivated vegetable in the world [2]. World production of lettuce [3] for the year 2009 was approximately 24 million metric tons, with a cultivation area of 1 million hectares (USDA, 2011).

The major milestone in the development of economic and commercial hydroponics was the NFT concept, which stands for Nutrient Film Technique, developed by Allen Cooper in 1965. According to Bernardes (1997), the NFT system is a water cultivation technique in which plants grow with their roots within a channel (impermeable walls) through which a nutrient solution (water and nutrients) circulates. Most hydroponic crops are unsuccessful, mainly due to the lack of nutritional aspects in this production system, which requires adequate preparation and management of the nutrient solution and the chemical content of the hydroponics. The use of hydroponic growth conditions for broccoli and the application of stress factors (elicitors) at head induction and during development may serve the purpose of enhancing its nutritional quality to deliver a health-promoting food [4]. The intelligent computational tools of feedforward neural networks and genetic algorithms are used to develop a real-time detection and diagnosis system of specific mechanical, sensor and plant (biological) failures in a deep-trough hydroponic system [5]. Hydroponics is optimized using artificial neural networks and genetic algorithm [6-9]. Section II introduced the Nutrient Film Technique. Section III described the green house farming using IOT and Section IV discussed the Results and Section V ended with conclusion.

II. NUTRIENT FILM TECHNIQUE

In classical hydroponics with a flowing nutrient solution each plant grows in a container, which is filled with an inert material such as pumice-stone, wood chips, glass wool or sand. The nutrient solution permeates this material. The plant roots also penetrate the material and the plant stands upright supported on its root system . With this system the mass transfer of the nutrients from the fresh incoming solution to the extended root system is more efficient than a similar system growing in soil ; nevertheless the transport by convection and diffusion still leaves much to be desired . The solution around the roots becomes depleted of the vital nutrients including, in particular, oxygen [10] . Mass transport to the roots can be improved by doing away with the container and its filler material . Cooper (1976) at the Glasshouse Crops Research Institute (GCRI) in Littlehampton, invented the nutrient film technique (NFT) .

With this system the roots are bathed in a thin film of flowing nutrient solution The plants grow in gently sloping gullies . A pump feeds nutrient solution to the high end of the gully, from where it flows by gravity over the roots of the plants down to a catchment pipe . This pipe slopes in a direction which allows flow to the storage tank. It is this tank that supplies the pump with solution, thus closing the loop . A float valve regulates the liquid level in the storage tank, and the correct level of nutrients is maintained by a control system. The following advantages of the nutrient film technique compared to classical hydroponics have been discussed in an excellent review by Graves (1983) :

(i) as discussed above, the chemical environment of all the roots is more closely controlled ;

(ii) nutrient supply is uniform and can be matched to the plants' needs as they grow (Richardson, 1982 ; Winsor, 1980) ;

(iii) instead of heating the whole greenhouse, good results can be obtained by simply heating the nutrient solution (Orchard, 1980 ;Moorby, 1982) ;

(iv) it is easy to disperse chemicals required at low concentration for crop protection throughout the whole system (Price & Dickinson, 1980) ;

(v) there is a quicker turn round between crops because the growing medium does not have to be sterilized ;

(vi) greater crop densities can be achieved .

The plants have to be supported from above since the roots do not penetrate any solid material. The nutrient film technique is so efficient that, for instance, tomato plants will grow to a length of 25 ft with a cropping season of 10 months. Horizontal training is essential to accommodate the monster tomato plant in the average glasshouse. High cropping densities can thereby be achieved (Giacomelli et al ., 1982 ; Morgan & Tan, 1982) giving an increased yield.

III. GREEN HOUSE FARMING USING IOT

The system is now fully automated and the decision will be taken automatically by the computer [11]. And the taken decision is automatically communicated to the users.

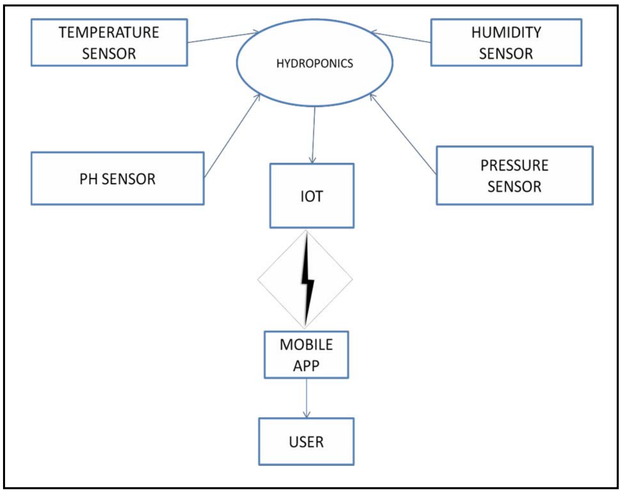

Fig. 1. Proposed Block Diagram of Green House Farming using IOT

Fig.1. shows clearly the block diagram of green house farming using IOT. Sensors such as temperature sensor, humidity sensor, Ph sensor and pressure sensor are connected to the Raspberry Pi board. Python is a programming language which is used in this work to connect all the sensors to the Pi board and communicate the data to the cloud. Android app is developed in this work to monitor the sensor levels.

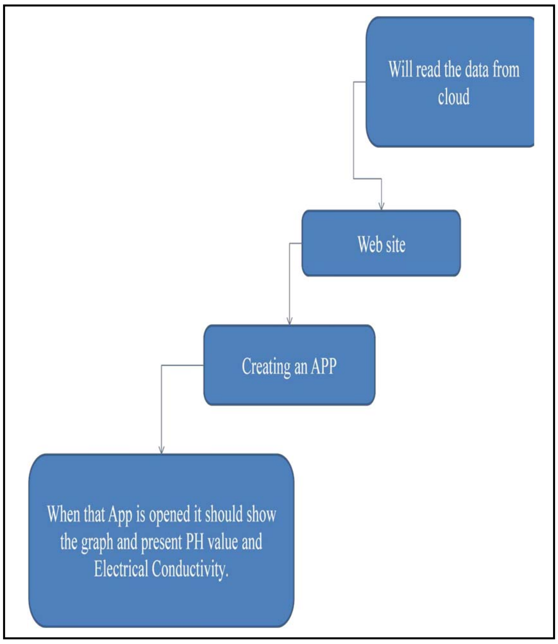

Fig. 2. System Model

Fig. 2. Clearly depicts the system model used in this work. The data acquired has been read from the cloud through the website. When the android app is opened, the graph and the present Ph value and Electrical conductivity.

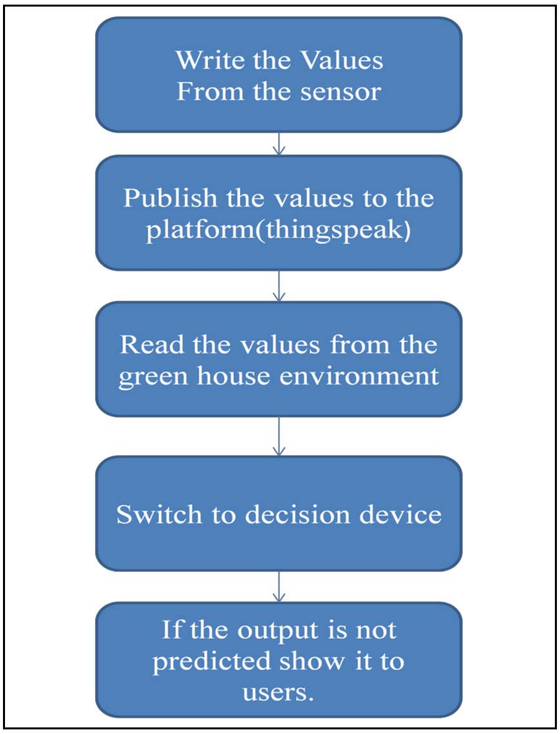

Fig. 3. System Architecture

Fig. 3. is clearly explaining the system architecture used in this work. The values fron the sensor are written in the cloud

sytem. The values are geting published in the cloud platform (Thingspeak). Then the values are read from the green house environmnent and switched to the decision device. If the output is predicted, it will be shown to the users.

IV. RESULTS AND DISCUSSION

In this work, the prorotype model is built using Raspberry Pi board. Fig. 4 shows the protoype working model.

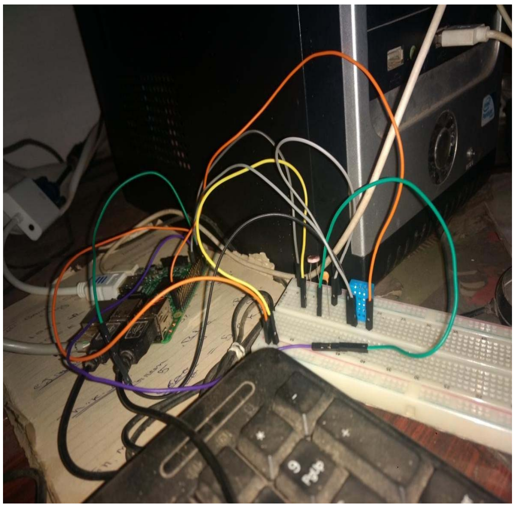

Fig. 4 Working model Protoype

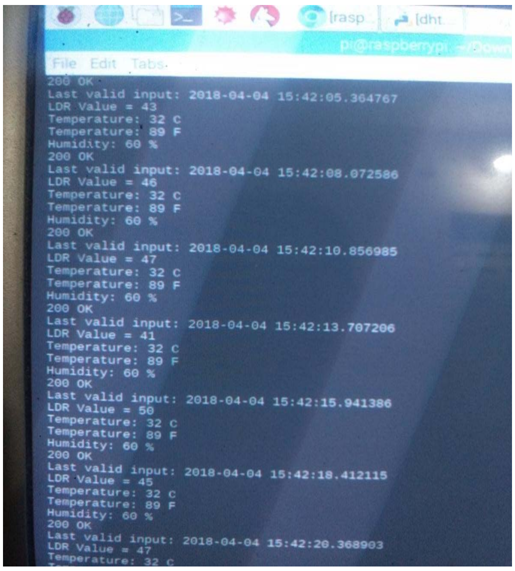

Fig. 5 Results in the PC Screen

Fig. 5 clearly depicts the results displayed in the screen which includes the LDR value, temperature value in degree celcius and farenheit, humidity value of the green house plant. The output of the dht11 and LDR sensor is shown and the connection is given as per the basics knowledge of the sensor. Now the PH sensor is connected to the Raspberry pi 3 board and the value is noted now.

V. CONCLUSION

The preliminary tests of the irrigation control method show that it is good alternative to the currently available techniques used for irrigation and nutrient supply control. Irrigation tuning is achieved in a purely feed forward loop. Instability problems due to the delay in the feedback loop are avoided since feedback is used only for tuning the model parameters. Compared with robust control design, the proposed technique requires virtually no effort for its application on a specific is solved in a very straight forward manner. Another significant advantage control techniques is its simplicity and transparency to the user. Thus, the method achieves the same accuracy with the other methods that directly monitor the water level, in rock-wool substrates. A sudden large error is expected drain or a sharp change in the model parameters can be attributed to faults in the hydro-mechanical gear or the plant physiology itself and run fault diagnosis. Currently the development is applied on commercial production sites to evaluate growers responses and operational data from different crops.

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