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Automation in Hydroponic System

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***Abstract*— The aim of this project is to develop automation in hydroponic system using arduino. Hydroponics is the knowledge of growing plants in water without soil. Hydroponics is a fresh agricultural invention system in which the production takes place in soil less mediums using either a simulated soil medium or water. Nutrients are supplied to the plant through the water. Hydroponic system requires organized environment for proper growth plants, less chance of diseases and faster growth. It includes Automated Monitoring and controlling parameters like temperature, humidity, light intensity etc. The parameters like Temperature, Humidity, and Light Intensity are read by the sensors. If these values exceed or decrease their corresponding set points, the system starts the monitoring and controlling action and set back to its idle value.**

Keywords— Agriculture; Automation; Hydroponics; Arduino

I. INTRODUCTION

Plants are among the few life form that can manufacture all the required metabolites from inorganic ions, water and CO_2 using the energy absorbed from the sun. Hydroponics is a method of rising plants without using soil. Hydroponic systems have been broadly used by scientists for exploring nutrient necessities and also the deadliness of some elements in *Arabidopsis* and other plant species [3]. Industrial applications of hydroponics have also been established for crops such as tomato and lettuce on large scale organic farm production.

The technique of hydroponics proves that soil isn't required for plant growth but the fundamentals, minerals and nutrients that soil comprises are. Conservative soil is simply the holder of the natural nutrients, a place where the plant roots traditionally grow and a base of support for the plant assembly. In hydroponics you provide the precise nutrients your plants need, so they can mature and grow in a controlled environment which is ideal for plants. The nutrients are fed directly at the root base, never underlining the plant due to lack of nutrients or water.

II. LITERATURE SURVEY

Rapid industrial development of the global economy and ominously increasing population forces countries like India to upgrade their agricultural techniques to meet the needs of the people. Soilless agricultural techniques like hydroponics[2] have gained a lot of importance over the years, one of the most popular hydroponic technique in which the crops are grown in nutrient solutions is now gradually being employed for commercial agriculture[1]. India, in spite of being an agro-based nation, has found it very stimulating to implement hydroponics on a commercial scale due to the lack of knowledge and special apparatus's required and other agriculture encounters. Sensitivity of hydroponics to technical faults is a major limiting factor when it comes to their commercially wide scale implementation.

In addition to this, agriculture in India is largely being practiced by unskilled farmers which makes imparting knowledge on hydroponics even more challenging. Considering the wide range of advantages which hydroponics offer over conventional agriculture techniques and increasing need to meet the goods requirements of the growing population with the limited agricultural land available, practicing hydroponic procedures has become the need of the hour.

The two major components in hydroponics is plant nutrient solution and growing medium. In water solution based system like Nutrient Film Technique (NFT), Deep Water Culture (DWC) and aeroponics, plants can be grown directly in rich mineral and nutrient based solution. These system-s works best for plants that have shallow roots and can be grown in short periods of time. The plants best suggested would be lettuce, radish, spinach and other herbs and flowers.

Plants like tomatoes, cucumbers, peppers, strawberries, celery that have deep roots and need support, either Wick systems or Ebb and Flow systems which is also called as flood and drain system are preferable. In these systems growing medium such as clay pebbles or Hydroton are used which help to provide support to the root system and ideal for big plants. Many vegetables, herbs, fruits and flowering plants are best suited in this design system.

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TABLE I. Nutrients deficiency.

Sr. No.	Nutrients Deficiency Symptoms	Deficiency
1	Plant colour is light green; yellow leaves.	Nitrogen
2	Plant colour is bluish-green, leaves are yellow, growth may be stunned.	Phosphorous
3	Dead areas along the edges of the leaves; growth is stunted.	Potassium
4	Lower leaves turn yellow along the tips and margin and between the veins; the lower leaves wilt.	Magnesium
5	Young and new leaves die	Calcium
6	Leaf tissue is lighter in colour; yellowed; papery in appearance.	Zinc
7	Leaf tissue may be yellow in colour, veins are green.	Iron
8	Leaf edges may be dark green or blue in colour; young leaves wilt	Copper
9	Young leaves may change to pale green. Older leaves remain green; plant is stunted.	Sulphur
10	Growth is stunted; lower leaves may have yellow and green coloured pattern.	Manganese

Fig. 1. Nutrients Chart

Types of Hydroponics

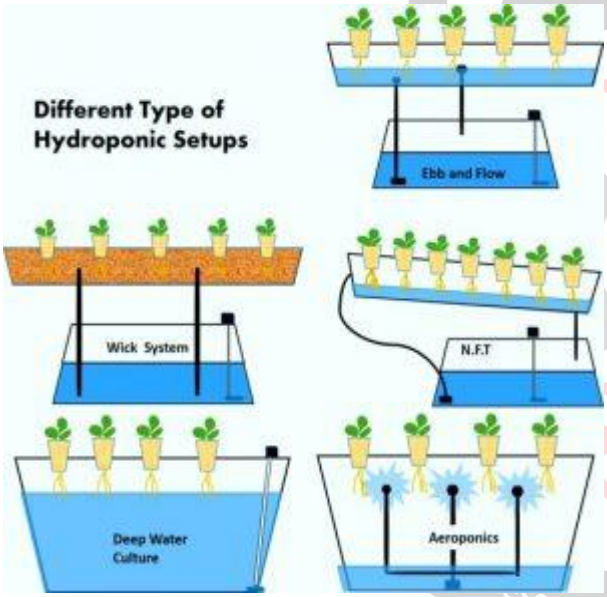

Fig.2. Different types of hydroponic systems

III. EBB AND FLOW SYSTEM

One of the most common systems using an appropriate media is the Ebb and Flow method also called as flood and drain method. A water-holding container, such as a plastic box tank, is filled with the mandatory nutrients. The container is flooded periodically with the nutrient solution. The solution is drained back into the nutrient reservoir by opening a valve at the bottom of the container. During each cycle, the roots should be flooded in the solution for no more than 20 to 30 minutes.

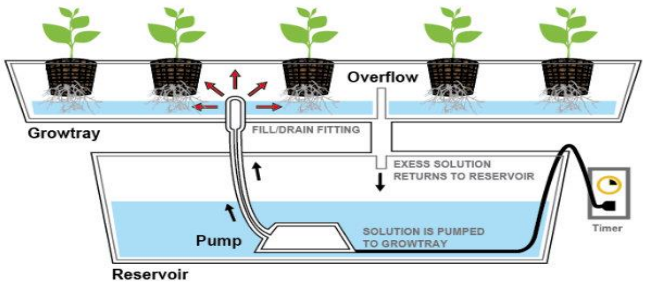

Fig. 3. Block diagram of Ebb and Flow system

IV. CONTROLLING PARAMETERS

Temperature control

Digital temperature sensor is used. Temperature is sensed and after that this signal is send to Arduino for processing. In Arduino program a particular set point is given and if it is below or above it take action likewise. If the temperature exceeds the maximum value, the Arduino will then turn on the fan. If the temperature drops below the minimum value, the bulb will turn on.

Light intensity control

In certain areas where natural light is absent or very low, illumination for plants may be provided by artificial sources. Glowing bulbs generate excessive heat and are inacceptable in most instances are controlled by the Arduino.

Humidity control

The digital humidity sensor joined to water circulating pump and light bulb to control the humidity of atmosphere. Here we maintain the humidity of atmosphere. Humidity sensor will detect a change in humidity levels in atmosphere and send a signal to the Arduino. If the humidity level is not within the required range, the water supply or light bulb will be turned on or off.

V. SYSTEM DESIGN

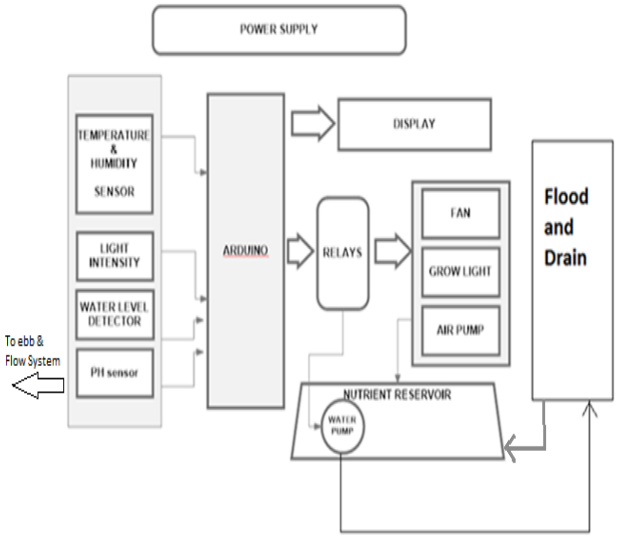

Fig .4. Block Diagram of controlling system using Arduino

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The block diagram above is a basic representation of how the automated hydroponics system will work. It starts off by taking the data from the sensors such as temperature and humidity sensor, LDR, and Ph sensor located in the system. Then, with the settings for the grow system that are programmed into the microcontroller, it will find the difference between the desired value and the actual value for the PH and nutrient levels. With this calculation the software will know the approximate amount of Acid/Base or nutrients that is needed to be added to the system. The last step will display the updated PH and nutrient levels on the LCD display along with the temperature and humidity.

The power supply will give power to a central unit that will house the Arduino and relays which we will be using for this project. The Arduino will receive data from the hydroponic system via many sensors located throughout the system. Using this data, the microcontroller will control parameters such as temperature, humidity, light intensity and run time of pumping motor.

The solution is pumped into the grow tray where plants are grown with suitable supporting cups. The roots of the plants directly absorb water and minerals. Overflowing solution is collected in recycle tank and is pumped back to mixing tank for reuse. The temperature, pH and conductivity of the solution can be monitored simultaneously for control. The automation enables easy graphical user interface based programmable timing control and other monitoring of system. The system can be scaled as per requirement to add new features.

VI. APPLICATIONS

1. It is useful in areas having infertile and dry soils.
2. It is useful to cultivate plants in the areas deficient in one or more nutrient.
3. It provides better nutrition yield
4. Can provide complete automation for a large organic farm.

VII. FUTURE SCOPE

1. Hydroponics is the fastest growing sector of agriculture, and it could very well lead food production in the future.
2. As population increases and arable land declines due to poor land management, people will turn to new technologies like hydroponics and vertical farming to create additional stations of crop production.
3. The system can be made completely automated for food industries where freshly prepared yield can be provided directly to the industries. System can also be designed to house a GSM module which will notify the user, also zigbee technology can be implemented.
4. Instead of using batteries and power supply the system can completely powered by solar.

VIII. CONCLUSION

The system designed in this project fulfills the primary need of every person's indoor farming need. As we see, now a day's drought is major problem in front of us. In this condition this system will be more helpful as it uses less amount of water and gives more yield in less time interval. This system also help crops to grow where soil is unsuitable and also Reduces plant disease generated due to soil. If automation is introduced in hydroponics, no more attention is required. Thus using this system will be considered wise.

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