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Design of Low Cost Hydroponics System

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ABSTRACT: Hydroponics may be a technique to grow plants without using soil, especially in areas with unsuitable space and environment. This technique has no adverse effects on environment or quality of crops. In contrast, it provides better nutrient value via nutrient solutions. Its main aim is to avoid wasting water, improve quality of crops, control the adverse effects of pesticides and factors affecting quality of soil and save land. An outline about the cost- effective implementation of hydroponics for tiny farmers in India is provided in this paper. The current work covers the automated hydroponic system where all the variables like temperature, humidity and water flow are often controlled using various specific sensors and provide precisely without manual interface by using this technique.

KEYWORDS: Hydroponics, automation, growth, nutrients, crops, grow lights, sensors.

I. INTRODUCTION

The word "Hydroponic" is defined as a method of growing plants which involves no soil but inorganic nutrients or their solution. Gericke was the one who introduced the term hydroponics. Besides Gericke many attempts were made to adopt the methods of soil-less growing of plants.

However, technologies progress was too inadequate due to insufficient knowledge about the nutrients and high cost involved within the process. Hydroponic gardening may be a fast becoming popular choice for several growers around the world due to its more sustainable approach to resource usage than the standard growing methods.

One in all the essential principle for vegetable production both in soil and hydroponic systems, is to produce all the nutrients that the plant needs. Several chemical elements are essential for growth and production of plants which incorporates Carbon, Hydrogen, Oxygen, Magnesium, Magnesium, Manganese, Iron, Zinc, Nitrogen, Phosphorus, Potassium, Sulphur, Calcium, Boron, Copper, Molybdenum and Chlorine.

In hydroponics, absorption of crop is typically proportional to the concentration of the nutrients within the solution near the roots, being much influenced by the environmental factors like salinity, oxygenation, temperature, light sensitivity, photo-period and humidity.

II. OBJECTIVE

The most aim of this project is to produce better ways of farming methods by means of engineering. This includes automation using IOT concepts. This proposed system are often useful in draught and extreme climate conditional regions. Thus crops are often grown with limited resources regardless of the climate.

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III. STATEMENT

Preparation of automated sustainable small-scale hydroponic cropping system at low cost for limited resource growers to be used in draught prone areas. This also includes designing a system that may grow crops without looking on the skin climate.

IV. NEED

In keeping with the globe Population Prospects, India ranks second within the list of nations by population. This population is growing at a speed of 1.2% per annum. The first need of each soul is food. It is necessary to implement vertical gardening so as to satisfy up to the food demands of this growing population, which is able to provide an optimum produce in a very limited space.

If the above-mentioned techniques are implemented, then the farmers shall not remain dependent of the climatic changes, lack of water and challenges faced due to fluctuating moisture conditions.

V. EXISTING SYSTEM

The already existing hydroponic system consists of pump controlled manually. It involved manual switching on/off the pump. It withholds no data log. It needs manual monitoring periodically.

VI. PROPOSED SYSTEM

In our project the Hydroponics System are going to be automated in such ways; Use of sensors such as Temperature and Humidity, Water level indicators etc., displaying the temperature and humidity on a LCD screen. Automation for watering the plants is finished while the small details like how long and when should be they watered are notified. When the system faces some errors, it notifies the user with a red LED and perhaps a warning message on the LCD screen.

VII. EXPERIMENTATION

The soil acts as a mineral nutrient reservoir at natural conditions, which isn't actually essential for the plant growth. The plant roots are ready to absorb the mineral nutrients in soil which are dissolved in water. Thereby, the soil is not any longer required for the plants to thrive, when all the desired mineral nutrients are introduced artificially to the plant's water. Almost any terrestrial plant can grow like this.

Requirements

1. Plastic tubes.
2. Net pots, clay pellets and grow lights.

3. Pump (12V)
4. Fertilizers container (5 litre)
5. Humidity and temperature sensor
6. Water level sensor
7. Relay switch
8. Several Resistors and wires
9. Arduino board
10. Real Time Clock module (DS3231)
11. Push button x2
12. LCD module

Uses of sensor

Temperature and Humidity sensor-The DHT22 is basic, low-cost digital temperature and humidity sensor. To live the encircling air, a capacity humidity sensor and a thermistor is used, which spits out a digital data on the data pin (no need of analog input pins).

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Water level sensor- Level sensors are used to monitor and regulate levels of a specific free-flowing substance within a contained space. These substances are usually liquid.

DS3231 RTC module-precise **Real Time Clock Module** is a low-cost, extremely accurate, with an integrated temperature-compensated oscillator (TCXO) and crystal.

Grow lights

Although the sun is stated as the ideal lighting source for growing plants, artificial lighting in indoor systems can provide a descent substitute within the suitable spectrum outside which needs about 4 to 6 hours of "bright light" or indirect sunlight. With artificial lighting in your hydroponic garden, it's achieved. Following the ten to 12 hours of darkness, the system should be planned on having a minimum of 14 to 16 hours of bright artificial light, every day.

Different Plants, Different Needs

An electronic timer is particularly necessary if you're growing a range of various plants. Although you'll follow the overall guidelines above and have success, some plants do far better with longer or shorter periods of "daylight." If you've got a mixture of those in your garden, you may must work out a custom schedule. an electrical timer allows you to require care of this hassle-free and alter it in step with your needs as your garden evolves.

Short day plants: These require a protracted period of darkness to photosynthesize and produce flowers. If they're exposed to over 12 hours of sunshine per day, they'll not flower. Poinsettias, strawberries, cauliflower, and chrysanthemums are short-day plants. The short-day cycle mimics the environment in nature for plants the flower within the spring.

Long day plants: Eighteen hours of sunlight per day is very important for these plants. They include plants such as wheat, lettuce, potatoes, spinach, and turnips. The natural environment of summer-flowering plants is mimicked by the long- day cycle.

Day-neutral plants: These are the foremost flexible. They produce fruit regardless of what proportion light they're

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exposed to. Some examples include rice, eggplant, roses, and corn.

VIII. HYDROPONICS NUTRIENTS

The plants take nutrient elements at different rates.

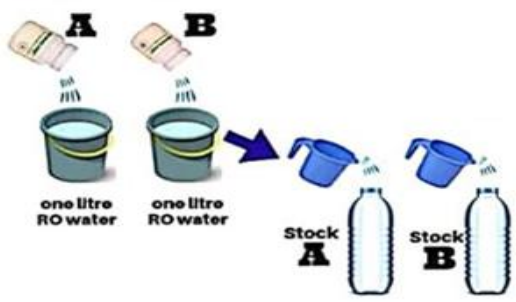
- A fertilizer is comprised of several elements like N, P, K,Ca, Mg, S and micro nutrients like Fe, Zn, Mo, Mn, B, Cu.
- The nutrients like N, P, K and Mn are rapidly taken from the solution.
- Ca and B: taken very slowly.
- Other elements have intermediate uptake rates.
- Elements like Ca, Mg and S accumulate within the recycledsolution. These have high ionic conductivity and should significantly affect EC values.
- we have got observed up to fifteen reduction in lettuce growth thanks to accumulated elements.

Procedure:

There are three steps to be followed to create and supply a hydroponics solution which are as follows:

Step 1:

Dissolve each bottle of A and B separately in one litre RO water each. Then transfer into bottlessuch that these are STOCK solutions which can be used for months.



Step 2:

For leafy plants and Vegetables, to make a FULL STRENGTH hydroponic solution:

1. Take water = volume of hydroponic solution you need.
2. Add 10 ml of STOCK A, per litre of water taken.
3. Then add 10 ml of STOCK B, per litre of water taken.

To make HALF STRENGTH hydroponics solution, just reduce the dosage of stock A & B by half.

Step 3:

1. Make bottom drain holes in Flower pot. Fill pot with 1 inch high layer of gravel / small stones.

2. Then, Mix and put 70% Coco peat + 30% Perlite, in the flower pots. Soak it using plain water.

3. Sow seeds in the bed. In winters, cover pot with transparent plastic to retain moisture and warmth. Seedlings will come out soon. Remove the plastic. Keep spacing of about 6 inch between plants.

4. Use Hydroponic solution (as per step 2) to soak the bed slowly and occasionally – once in 3 days. Ensure water drain

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out from bottom, to prevent nutrient build-up. Use plain water for watering in between.

5. Alternatively, you can make further lesser strength hydroponic solution and use daily.

6. This method suits nearly all leafy, veggie and flowering plants. Once a week, use plain water to soak bed, to prevent nutrient build-up. You may also choose nutrient composition as per advanced method.

Note: keep the stock solutions away from sunlight and keep it in shade, so that they remain good for months.

Composition of Hydroponics Nutrients

so as to grow, a plant requires sufficient nutrition and an acceptable pH balanced platform which may be provided artificially in an exceedingly measurable balanced quantity when required. With Hydroponics the grower (the one that grows the plant) has complete control over the implementation of fertilizer, regarding type and concentration. he composition of the nutrients is vital. For a plant growth, there are over twenty elements. From air and water the elements such as Carbon, hydrogen and oxygen. The remainder of the weather, called mineral nutrients, are dissolved within the nutrient solution.

Composition of elements to be present in 1 g of dry leaves for healthy growth

N	P	K	Ca	Mg	S	Fe	Zn	Mn	B	Cu
4.5%	0.5%	5%	0.5%	0.3%	0.3%	0.0015%	0.0005%	0.0005%	0.0003%	0.0002%

Note: With Hydroponics there's no soil to urge the weather from, therefore the plants grown with soil and without soil are very different in composition because they're not designed to be a whole chemical and that they might not water-soluble. for instance, Nitrogen, within the kind of urea isn't immediately available to a plant in hydroponics because urea isn't soluble in water. For this reason, Nitrogen must be delivered in its Nitrate form so as to be utilized in hydroponics.

One thing that's often over looked when it involves nutrients is the nutrient solution temperature. The roots of plants grow underground in nature and to duplicate what they'd receive in nature it's important to stay the foundation zone to 68-72 degrees. If the nutrient temperature reaches 73 or 74 degrees the plants will die, but it should be kept as near 68-72 degrees as you'll. Plants with nutrient temperature too high, can have problems including (but not limited to) flowers turning yellow and deterioration, damaged fruits and an absence of latest growth.

Elements needed for plant growth:

- Nitrogen
- Phosphorus
- Potassium
- Magnesium
- Calcium
- Sulphur
- Iron
- Manganese
- Zinc
- Copper
- Boron
- Molybdenum
- Chlorine

Implementation

This is done by controlling the various factors that affect a plant's growth through the use of a sensor and a micro-controller such as Arduino. We will be using small plastic pipes with holes drilled on one side. The seeds are placed in the net pots and the net pots are fixed in the holes. The water flow is controlled by a pump fixed in the water reservoir. The water goes from the reservoir to the top level and flows to the other levels and will be reused.

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Fig.2 Hydroponics setup

Note: The water flow pipe which holds the net pots have a blockage at the terminal such that the water can fill the pipe till the blockage level and then flows to the next pipe which is the extension of the first pipe.

This concept acts successful as it prevents overflow and stagnant water so that the plant roots are fed with fresh nutrient water routinely.

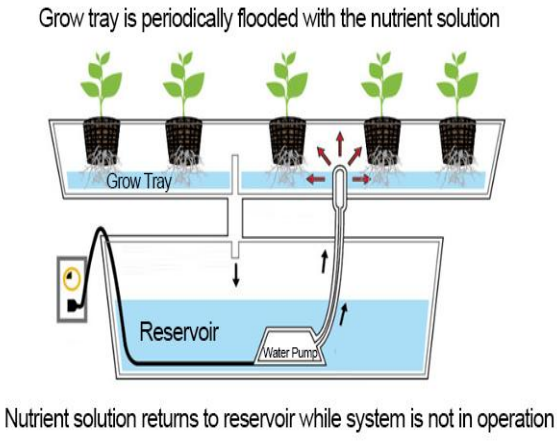


Fig.1 Diagrammatic representation

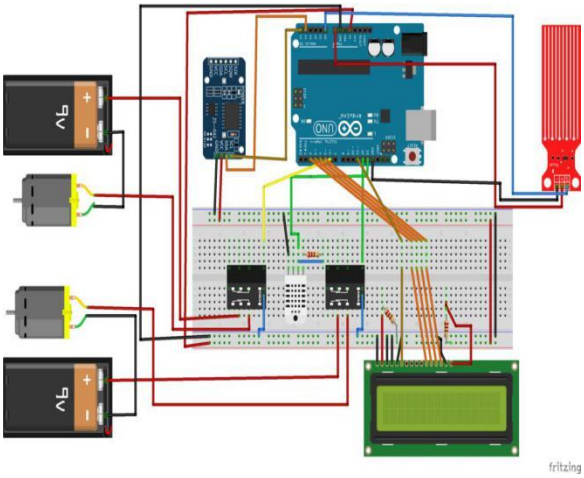
Circuit Diagram

The circuit diagram is shown below. It depicts the fundamental connections of the Arduino board with the temperature, humidity, water level indicator sensors, a motor, relay switch and a 16x2 LCD display. The final wiring and the protocode is shown.

Wiring:

VCC -> Arduino 5V SCL -> SCL or A5

SDA -> SDA or A4 GND -> Arduino GND



Advantages

- The main advantage of this project is anybody can grow plants at any weather conditions and at any unfavorable conditions without soil at low cost.
- The soilless indoor agriculture paved a new way to the ease of living with healthy and harmless food cultivation which influentially creates confidence in their valuable eatables.
- It only takes a less amount of water to grow the vegetables as it is in continuous motion.
- It is cost effective and it requires absolutely minimal labor.
- Land preservation
- Water conservation
- Faster growth and maturity
- Contamination free
- Minimal use of Fungicide and Pesticide
- Less labor and maintenance costs
- Control over growing environment
- Time saving
- Perennial production

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- Highly palatable and Nutritious food

Disadvantages

- The role of pesticides and fertilizers is quite a threat as it opposes the concept of harmless cultivation.
- The fertilizers are not suitable to mix in water.
- The amount of nutrients should be a measurable quantity.

IX. FUTURE ENHANCEMENTS

The adding of a real time clock module and making of alert, when it is needed to warn the user, is the final step of this project. In future, this can be further developed by creating an application to intimate the water level, humidity measure, temperature and the time interval to run the motor etc.,. So that the grower can be aware of each detail, no matter wherever he/she is away and whenever the time they return to their place.

X. CONCLUSION

Nowadays, hydroponics emerges as a promising strategy for growing different crops. it's necessary to develop low cost hydroponic technologies that reduce dependence on human labor and lower overall startup and commercial costs. The system are going to be automated with an Arduino board. Being an easily constructable and cheap to create, the system is used by both home hydroponic growers and commercial growers.

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