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Hydrophonic Smart Farming with IOT

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Abstract— **In a country like India agriculture is the basic livelihood for people. It contributes a major portion in the economy of the country. In traditional farming techniques, irrigation requires manual intervention and a lot of cost, which is minimized using the automated technology of irrigation. Hydroponics in Greek language means "Agriculture without soil" which means in hydroponics just water is essential to sustain the growth of plants and provide them a strong medium for nutrient transportation. It is well known that as the urbanization of the world taking place, the total net sowing area of agriculture decreasing rapidly due to illegal encroachment of builders and industrialists which poses a question mark on food security as well as environment balance and pollution. The more urbanization takes place the more incidents of encroachment of agricultural fields are happening rapidly which is unchecked till now because of the rising rate of population growth in case of the world in general and India in particular. It's time to think innovative as well as constructive in the direction of creating space for agriculture in manmade concrete jungles such as high rising buildings, mammoth size bungalows, congested societies, unhygienic and irregularly populated colonies and such spaces like this in urban areas, metro cities as well as small towns so that the high ending goals of food security as well as environment protection can be achieved together. Hydroponics could solve this problem and can help to achieve these two ambitious goals in single go. As hydroponics is a technique which doesn't require actual natural soil or humus to sustain the plant growth, rather it requires electronically controlled environment along with water solution of exact nutrient composition for exact type of crop and this plant can be installed anywhere. Now in this paper, the implementation of controlled hydroponics is described over the roof of high rising buildings as these spaces are not used for any of commercial activity and easy to sustain the growth of hydroponics plant using sensors and Internet of Things.**

Keywords— ***Agriculture, monitoring, sensors internet of things, Hydroponics farming, scarcity, urbanization***

I. INTRODUCTION

Now a days' people are migrating from rural to urban areas due to which there is obstruction in agriculture. The yield of crops along doesn't depend on monitoring the environmental factors. The productivity of the crop is affected by number of factors. Due to unwanted and gradual changes in climate and environment has led to indefensible usage of resources with a supply chain. It makes the farmers know about the growth of plants,

The work done in this uses temperature, humidity, soil moisture and crop cutting sensors for collecting the field data and is then processed. These sensors are combined with well-established web technology in the form of wireless sensor networks to remotely control and monitor the collected data. Vertical farming is a new farming technology adapted which consists of varied hydroponics, aeroponics combined with traditional method of soil farming as a prototype. Vertical farming is a technology of growing plants in vertical orientation which is well suited for urban culture where there are multi storied buildings and availability of land for cultivation is limited. Development in agrarian segment is fundamental for the improvement of financial state of the nation. Tragically, numerous agriculturists still utilize the conventional strategies of cultivating which brings about low yielding of harvests and natural products. Be that as it may, wherever robotization had been actualized and human creatures had been supplanted via programmed apparatuses, the yield has been enhanced and less diligent work required. Consequently, there is need to actualize and utilize present day innovation in the agribusiness part to increase the yield of harvest.

The greater part of the project means the utilization of remote sensor organize which gathers the information from various sorts of sensors and after that send it to principle server utilizing remote convention. The gathered information gives the data about various ecological elements which in swings screens the framework. Observing natural components are insufficient and finishes answer for enhance the yield of the harvests. Require robotization to make strides the yield of the harvests. There are number of different components that influence the efficiency to awesome degree. These components incorporate assault of bugs when product is at the phase of gathering. Indeed, even after gathering, ranchers likewise confront issues away of collected trim and some more. In this way, so as to give answers for all such issues, it is important to create coordinated framework which will deal with all components influencing the efficiency in each stage. In this particular project automation of hydroponics farming is to be done completely. In which, Automation of water supply, maintenance of farms temperature at required level, maintenance of nutrients pH level and EC (Electrical conductivity) at required level, automation in required sunlight for farm along with that alarms and indicators for unusual conditions for farms. Also related all information is to be displays on display panel and related info will be send to owner of that particular farm. This type of system utilizes a reservoir to hold the excess nutrient rich water. This water is pumped through a trough and gravity drains back into the reservoir. The growing plants sit in the trough and the roots grow down into the water to receive the desired nutrients. The nutrient level of the water changes on a weekly basis based on which week of the grow cycle the system is in. The user actions to maintain the system include daily chemical test, addition of chemicals as displayed on screen, and maintaining water level of the reservoir.

II. Materials and Methods

The system described here is based upon the electronic sensor controlled artificial environment development in which humidity control, water level control, water flow regulation, temperature regulation and light intensity regulation has been done so that hydroponics can be implemented in minimum cost with greater efficiency. In the system the temperature is controlled using analogous circuitry so as the light intensity and humidity but as far as the flow of nutrient and its level is concerned, microcontroller has been used to regulate the process with greater efficiency. But in overall system development it is maintained that less component and programming is being used so that the overall design remain less expensive. There are various important modules that as core of the proposed system. There are various important modules that as core of the proposed system. A list of these prominent modules is mentioned below:

- ESP 32
- LCD
- Sensors
  - pH Sensor
  - EC Sensor
  - Temperature Sensor and Humidity

Arduino UNO

- Arduino
- NComparator
- Actuators
- Lights
- Water Pump
- Nutrient and pH Dozer

System Architecture

All the sensors will be connected to ESP32NodeMCU. ESP32 will be configured with wifi name, password and authentication key. The data sensed by the sensors will be preprocessed by the ESP32NodeMCU according to the value changes in the sensor data the Node MCU will send signal to the actuators to create a balanced environment to the plants. All the data will be send to the ThingsSpeek cloud and can be monitored remotely if there is any emergency, a notification will send to the respective person.It It consists of Arduino Uno board, Solar Panel, Battery, Temperature sensor, LDR, Water level sensor, pH level sensor for nutrients, EC(Electrical conductivity) sensor for nutrients solution, LED strip,LCD display, Fan for cooling, Motor for water & nutrients, GSM, Alarm & LED indications shown in Figure.As in hydroponics farming, Plants are grows in soil-less culture means only water along with nutrients in PVC pipe environment. So it is a very important thing to maintain water level along with maintaining pH level and EC of nutrient solution. For sensing water level in PVC pipe which is to be maintain in such a way that roots of plant goes under water. When level of water not maintains as prescribe motor used to pump water inside PVC pipe.

The optimum pH range for hydroponic nutrient solution is between 5.8 and 6.5 maintain using pH level sensor and The ideal EC range for hydroponics is between 1.5 and 2.5 dS/m maintain by EC sensor if values are not in prescribe range then nutrient solution along with water added to maintain that. In some cases complete water nutrient solutions are need to be replaced.

Temperature to be maintained healthy for plant by sensing temperature using sensor and cooling fan. LDR used to detect low light case for plant and maintaining healthy light condition for plant using LED strip. Solar panel to convert solar energy to electrical energy in battery.LCD display to display information about Temperature, Water level, pH level,EC level of nutrients. Alarm & LED used for indication. Each & every information regarding hydroponics farming to Owners mobile via GSM.

System Process Flow

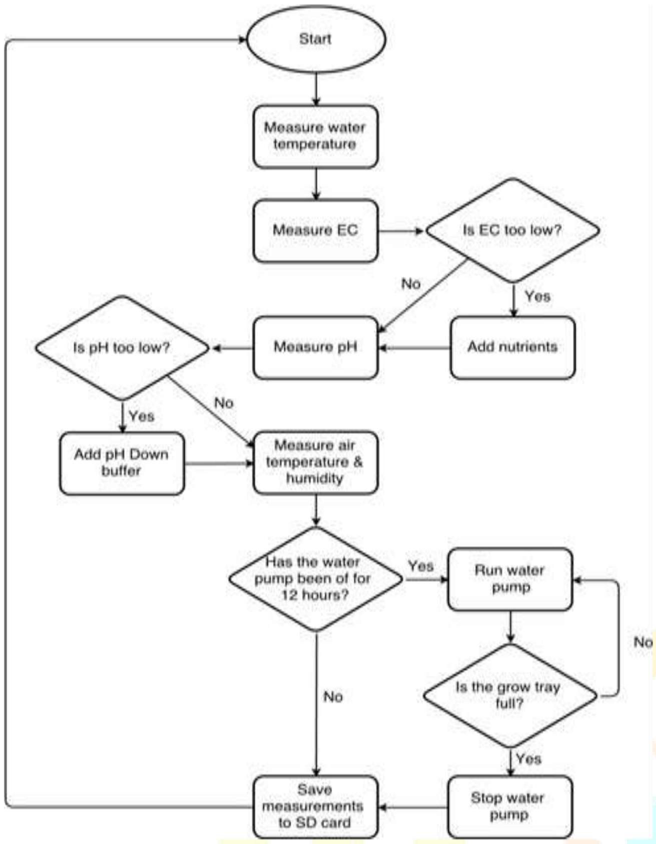

Figure 1. System Process Flow

Measures the EC value the EC is too low the sensor release nutrients. Then measures PH. the pH value management which is done by reading the PH Sensor. After receiving data from the sensors, the system will compare it to the threshold range. If the value is not in range, the solenoid valve will be turned on to release a substance, reducing the basicity/alkalinity in the nutrient solution and vice versa. The solenoid valve will adjust the pH value until it reaches the set threshold. If PH is low it add PH down buffer if not it measures air temperature and humidity It starts by reading the temperature and humidity from the DHT22 (Temperature and Humidity Sensor). The temperature value has more importance over the humidity because it has a stronger effect on the plants than humidity. After that, the values will be checked that they are within the threshold. If the values aren't within the threshold, the system will turn on the water pump (by the relay) to water the setup and reduce the temperature. When the value comes into the range of the threshold, the system checks the water pump has been off for 12 hours in this case runs the pump or else saves the measurements of EC and PH. The data or value read will be shown in the application. The unit of temperature will be in Degrees Celsius ( ) and humidity will be shown in a percentage (%), and can also can be set via mobile phone. All of data in this part will be shown on the smart phone application. In addition, the processes can also be controlled via mobile phone.

III. Results & Discussion

Agriculture done using traditional methods need lot of water for irrigating in the fields and depend on non renewable resources of power which needs time, money and man power. The economy of nation depends on food production which is the main source of agriculture in improving the nation's Gross Domestic Production (GDP).The land is getting degraded and its fertility is decreasing. This is one of the factors for using an indoor farming system such as vertical farming which will increase the quality and more production of crops. As the technology is changing there is a need for smart system in all areas in which agriculture is one. The number of seeds germinated for 3 days was 80 in pot cultivation method and 100 in hydrophonics farming method using IoT technology. The efficiency was 20% more.

Table. 1 The number of primary branches for 10 days interval was recorded

No. of days of Germination	Pot-3 days			Hydrophonics-2 days		
Parameters	Pot Cultivation			Hydrophonics using IoT		
Plant height	10 Days	20 Days	30 Days	10 Days	20 Days	30 Days
	3 cm	10 cm	16 cm	7.5 cm	14 cm	30 cm
No. of branches	2	3	5	2	5	7

The work presented here is helpful in automation of irrigation in agricultural fields using IoT so that the amount of water required, temperature under which crops are to be maintained by tracking the climatic conditions is developed. The various sensors connected in the field helps in tracking the growth of crops from remote places more easily and comfortably.

Figure 4. Crop growth using both methods

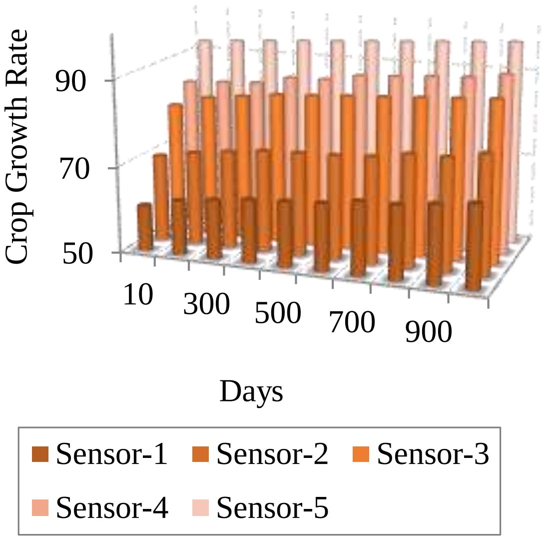

Figure 5 Crop Growth Rate vs. Days

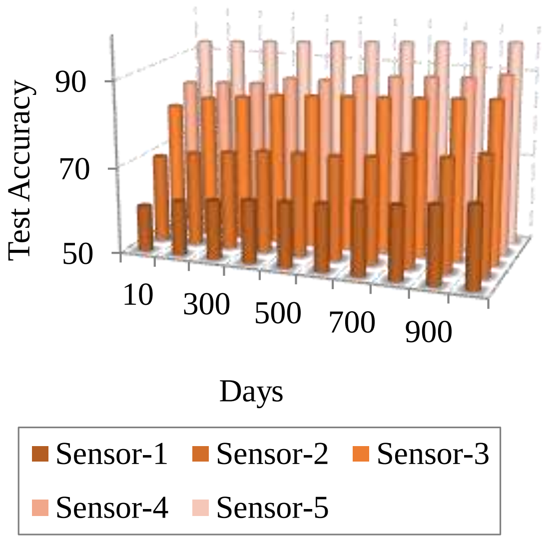

Figure 6 Test Accuracy vs. Days

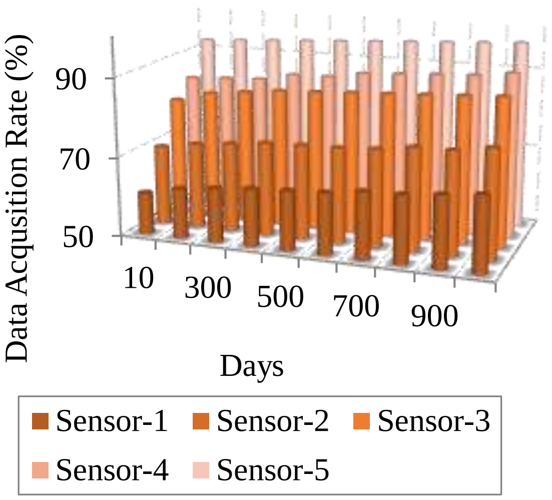

Figure 7 : Data Acquisition Rate vs. Days

Figure 5, 6 and 7 shows the performance of crop growth rate, test accuracy, and data acquisition rate, respectively.

IV. Conclusion

The proposed hydrophonics farming system developed in which are interfaced with sensors for wireless monitoring. Every sensor used provides a suitable actuation due to which the crop field is maintained well without intervention of humans. The implementation of the system proposed, we achieve

- Vast data collection-The various parameters required for plant growth like progress of crops growth, efficiency of equipment's used can be tracked from time to time.
- Better production -The automation method helps to foresee the amount of crop that is going to be harvested so that it can be properly distributed and the harvested crop is sold without wastage.
- **Cost effective and reduction in waste**-The loss of yield is drastically reduced as the growth of crop is constantly monitored.
- **Improved product quality**-High yield of crop and excellent quality of crop is achieved for better production in a controlled manner due to automation.
- Minimum 2 day was taken for germination in hydrophonics farming using IoT.
- Maximum plant height of 30 cm was recorded for 30 days after sowing in vertical farming using IoT plot where as it was recorded a 16 cms in pot cultivation.
- This indicates that the system is efficient
- Reduced time for germination and increased plant height with in a same period of time.
- **Efficient automation**-The technology used monitors the farm using mobile app and sensors helps in using best irrigation methods, usage of good fertilizers and better pest control.

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