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An IoT Driven Approach for Hydroponic Farming

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Abstract - *Hydroponics is a hydroponics branch, a technique that is a soil-free form of agriculture, by using mineral fertilizer solutions with an aquatic solvent. Terrestrial plants can be produced only with their roots exposed to nutritive liquids or the inert material, such as perlites, graves, or other substrates, may sustain their roots physically. Notwithstanding inert material, roots can induce pH rhizosphere changes, and root exudates can influence the physiology of the rhizosphere. The nutrients used in hydroponic systems can be obtained from a number of various sources, such as fish excrement, duck compost, pesticides and artificial nutrient solutions. Hydroponics offer many benefits, including a decline in farm water consumption. One of the basic techniques of plant biology research is that hydroponic systems are often used in industrial cultivation for many species, including lettuce and tomato. Most of the materials mentioned in the protocol can be purchased outside of science manufacturer firms, making it less costly and practical for hydroponic experiments. The use of a hydroponic method for growing the nutrient must be managed correctly and intact roots must be harvested for downstream applications. Owing to the scarcity of water required to manufacture goods, it will be possible in future to cultivate its own food in harsh conditions with no available water.*

Key Words: **Internet of Things, Working, Evolution, Sectors, IoT on Agriculture, Hydroponics, Improvement with IoT.**

1. INTRODUCTION

1.1 About Iot.

The Internet of Things (IOT) is a device that combines computing devices, living and non-living objects with a shared identity, and can transfer data through the network without human to person or person to machine interaction.
The Internet of Things is the networking of physical objects that are connected with the electronic structures to interact and sense relationships within themselves or with the world.
It's a link not only between computers, laptops and cell phones, but also with the everyday items you would use. With the support of device design, these objects

can connect and communicate over the internet, and can be remotely controlled and tracked. These devices use embedded technologies.

IOT does not only use the objects implemented, it also facilitates the data analysis. Data from various current systems can be gathered and further analyzed. On basis of study, the improvisation of the success of the item or technology was determined for that reason.

Objects that include wired surveillance systems, motorcycles, electrical equipment, kitchen lighting, alarm clocks, speaker systems, selling machines and more. These are some of the basic reasons we find in our everyday lives.

1.2 Working of IoT

It's really fascinating how IoT works. After we saw what IoT is, it is obvious that essential data was used to communicate with other devices. Such four considerations focus on the Internet of Things:

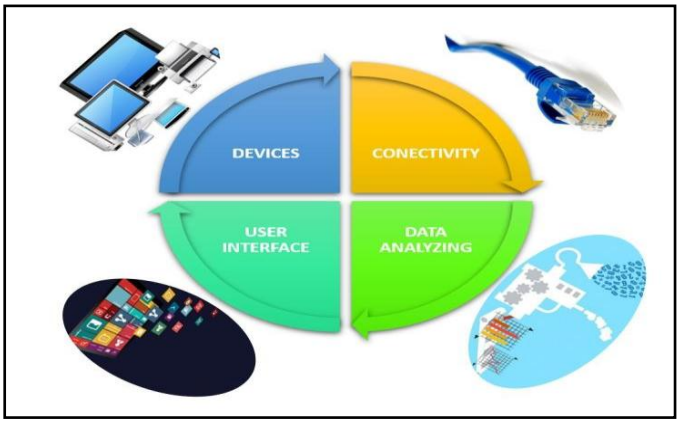


Figure 1-1: Working of IoT

Devices:

A computer may have several sensors, and can combine more than just sensing items. For example, our phone is an appliance which has multiple sensors like GPS, accelerometer or camera.

Connectivity:

Such sensors can be reached from different devices such as mobiles, satellite networks, Wi-Fi, Bluetooth, wide-ranging networks (WAN), low power large network, etc.

Data Analyzing:

The program conducts analysis on obtained data until data was gathered and entered the cloud. For eg, the testing on devices like AC or heaters of temperature readings within an appropriate range.

User Interface:

The details is made available to the customer by sending warnings or notifying by text or email on his telephones. Often consumers have an app, which helps them to test their IOT device actively. For instance, in his home a user has a camera mounted, he may want to check video records and feeds on a web server.

Some of the commonly used IoT examples are:

Smart Homes

Imagine going home at the perfect time, lighting and music after work, and using only one computer to do all of that. The IoT software lets you monitor how your smartphone house functions at a single tap.

Figure 1-3: Smart Home Remote Control

Wearable Devices

Wearable are internet enabled apps that offer reliable information according to your needs. These devices also use sensors to detect and record data. After analyzing these devices, the correct information is provided.

Many of the wearables belong to health monitoring categories such as Fitbit, Adidas, Mio, Misfits and Apple mobile clockers or watches running on Ios smartphones.

Figure 1- 4: FitBit Device

1.3. Architecture of IoT

The IoT design relies on the flow and function of the 5 layers of IoT architecture for all five layers.

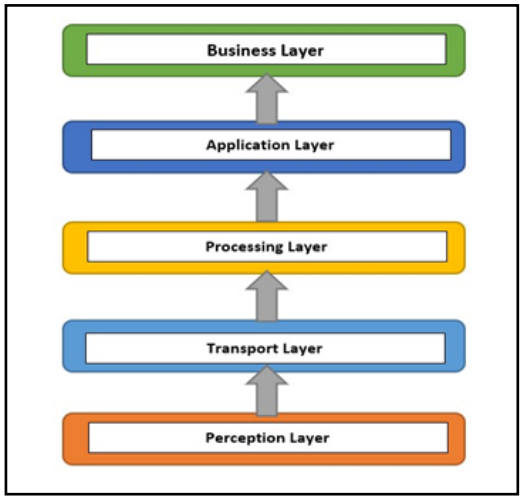


Figure 1-5: Architecture of IoT

Perception Layer:

The perception layer is also called as physical layer. The physical or perceptive layer is responsible for gathering knowledge or evidence and for understanding the real environment. The actuators in this layer operate according to the information obtained by the instruments and sensors for the precise activity of the respective objects.

Transport Layer:

The transport layer is responsible for bringing all the data and data obtained by the perceptive layer into the next stage, which is a database layer or data processing layer, and vice versa. This research is carried out across other networks, including LAN, broadband systems, 3 G and 4 G, etc. This research is carried out.

Processing Layer:

The processing layer is also called as data processing layer. This layer is responsible for performing essential and significant tasks in the architecture as this layer handles at the initial level all information gathered by perception. This layer uses techniques such as DBMS for the purposes of analysis of this massive volume of data. To order for the

data to be quicker to access the data from the source, this layer analyzes the formula to extract the data from the source or archive to execute the operation. Each layer is stored in a particular order.

Application Layer:

Application layer is responsible for successfully integrating the IoT function. Both sensors, equipment and actuators continue to work in this layer. In order to accomplish the particular mission, you would require an application with the correct software. This layer also contains the personalized program that actually uses the internet.

Business Layer:

The business layer is the last step of this architecture. The business layer is responsible for controlling the operation of the whole network and providing some other functions, such as privacy.

2. LITERATURE REVIEW

According to (Sharma & Tiwari, February 2016), Hydroponics and aeroponics are techniques of agriculture used in soil-free agriculture of plants. The distinction between hydroponics and aeroponics is that plants using the hydroponics technique are immersed in a trough of water containing nutrients while plants are sprayed by water containing nutrients through their roots using the aeroponics process. The roots of aeroponics are also suspended in the air and sprayed with an automatic timer at regular intervals. They will have everything they need to grow in their enclosed environment: oxygen, nutrients and water.

According to (Nachankar, Somani, Singh, & Katkar, Apr-2018), Hydroponics is the fastest growing agricultural sector, and in the future food production could very well be dominated. As populations increase and arable land decreases as a result of inadequate land usage, emerging technologies such as hydroponics and aeroponics will be used to establish alternative development networks. We also need to look at some of the early adopters of this technology for a hint into the potential into hydroponics. The surging population of Tokyo ensures the land is incredibly expensive. The country has switched to hydroponic rice cultivation to feed the population while retaining productive land area.

According to (Mathurkar, Lanjewar, Patel, & Somkuwar, 2014), The use of hydroponic growth is particularly effective in conditions where nutrient media must be managed and where intact roots are to be harvested for downstream applications. Hydroponic systems are a common tool for plant biology research and also in agricultural cultivation for a variety of plants, including lettuce and tomato. We have also demonstrated how nutrient levels can be altered to cause plant responses to both essential and harmful non-critical nutrients.

3. ABOUT THE STUDY

3.1 Objective of the Study

Below is the purpose of the project:

- To recognize IoT use in the agricultural sector.
- To learn how the conventional hydroponic system can be strengthened.
- To consider India's smart agriculture reach and potential.
- To evaluate conventional practices in order to support our farmers by means of modern smart farming methods.

3.2. Scope of the Study

The Scope of the project is mentioned below:

- The fundamentals of IoT for beginners will help us understand.
- It's going to help us appreciate the different possibilities that IoT already has to explore.
- It should help us appreciate the need for growth and development in agriculture sector.
- It's going to allow us to understand IoT use in hydroponic farming and how agricultural productivity is changed.

3.3. Limitation of the Study

The Limitation of the project is mentioned below:

- The lack of realistic information in the gathering of evidence from academic papers, books and journals.

4. METHODOLOGY OF THE STUDY

4.1. Primary Data

The key data gathered for this paper was the human assessment of the use of Hydroponics and its advantages.

4.2. Secondary Data

The secondary data was obtained from the numerous research reports, books and websites providing IoT and agricultural information.

Mobile phones: Wireless networking, via social apps, which we connect and live on the laptop / PC: the interface we use to interpret data so we can anticipate stuff from those results. some of the tools are cell phones.

Sensor Temperature: Sensor temperature allows the temperature regulation.

5. AGRICULTURE

5.1. About agriculture

Agriculture is the Indian economy's most significant field. The Indian agricultural industry makes up 18% of India's GDP and provides jobs for 50% of the working population of the India gross domestic product (GDP). India has made peas, corn, wheat, spices and spice goods the largest producer in the country. India has various areas to choose from for industries such as milk, beef, poultry, fish and fruit, etc. India is the second largest fruit and vegetable producer in the world.

The 2013-2014 production of food grains is 264 million tons as to 257 million tons (2012-2013), according to data given by the Department of Economics and Statics (DES). This is a positive sign for the growing Indian economy.

In the major three regions, India continues to grow various agricultural products such as paddy, maize, pulses, groundnut, rodents, natural foods, fruits, sugar cane, tea, jute, cotton, tobacco leaves and so on.

On the other hand Indian agribusiness has yet to tackle promotional problems such as low rates of unity and convergence of market sectors and the scarcity of accurate and realistic knowledge that farmers require on different agricultural issues.

5.2. Agriculture in India

India, where more than 50% of the population relies on agriculture, is a country dependent on agriculture. The primary source of sales is this system. The agri-business contribution to Indian national income is furthermore stated as an indigenous backbone of agriculture.

In the first two decades, agriculture has contributed between 48 and 60 percent to the overall national production. The contribution fell to just around 26 percent between 2001 and 2002. Total share of agriculture and the allies including livestock, domesticated, ranger and fishing divisions as far as GDP levels in 2013-14 are at 2004-05 values, is 13.9 per cent in 2013.

Quarter of the country's overall exports are agricultural exports. The collection and support of agricultural data assume enormous value in view of the dominant role of the agriculture industry.

6. Application of IoT in Hydroponics Agriculture.

Various software and tools for efficient farming are available, and such agriculture is called smart agriculture. With the aid of sensors and the automation of the irrigation system, an intelligent IoT-based farm is created to track the crop area. Farmers are able to track the condition from everywhere. In contrast to the conventional approach, IoT-based intelligent farming is very effective.

In order to encourage the production of other agricultural crops and emerging developments like organic farming, family farming and highly transparent agriculture, the implementations for IoT-based Smart Farming not only aim at traditional large farming operations, they may include new levers.

7. IMPROVEMENTS WITH IOT

7.1. How we can improve

Since we have seen various equipment used in agriculture, we may adjust some of them using IoT equipment to improve crop productivity and also the quality of the crops.

Fertilizer Spreader V/S Drones

The spreader of the fertilizer makes us spray fertilizer on the farm. It is a sort of tube that is connected to a spray pot. Farmer wears the fertilizer-filled bottle on the back, and sprays it onto the seed sheet. In some situations, this may be harmful for farmers and the crop, so when the sprinkles are sprayed, farmers are treated and fertilizers are sprayed on certain crops that lack product quality. Drones can be used to spray the fertilizer correctly and without any health concerns on the crop for this problem.

Manual Irrigation V/S Automatic Irrigation

Manual irrigation shall be done to irrigate the crops manually. But it happens often that people forget or lose water. The water is also applied in addition to r in fewer amounts. Automatic irrigation can also help to schedule irrigation and crops will get water in the right amount they need.

Manual Monitoring Greenhouse V/S Automated Monitoring Greenhouse

A individual will control the crop through personal movements across the field and make manual

registrations in the manual monitoring greenhouse. The guy, however, using Automatic Greenhouse Monitoring, monitors the entire greenhouse without moving manually in fields using IoT devices and Smart Phones.

Normal Farming V/S Greenhouse Farming

In green house agriculture, the water irrigation system will regulate the temperature to satisfy the crop needs and keep the field moist. It can't always be in regular farming because the plants have direct sunshine, which will lead certain leaves to burn because there isn't enough water source. A good quality of crops, which will increase production and get good money for farmers, can be grown on different plants and fruits in green house farming.

7.2. Benefits

Owing to their more natural approach to use of water than the usual growing methods, hydroponic gardening is becoming an significant option for multiple growers all over the world. Two of its other benefits are here:

- Hydroponics allow plants to grow up to 50 percent faster than in the field by offering consistent, readily available nutrients. Fresh produce can also be harvested during the year from a hydroponic system.
- Hydroponic gardening is great for the environment and for the cultivated product; in comparison to traditional soil gardening it almost removes the need for herbicides and pesticides.
- Any water used for hydroponic gardening remains in the system and can be reused to reduce the continued need for a supply of fresh water.
- Arable land is still in short supply and there is much less planting area. If you do not have a yard or a wide balcony, the hydroponics will even be used for indoor gardens.

Better forecast and surveillance –

Climate and water and soil sensors lead to a perfect climate and the atmosphere, constantly tracking and regulating, for optimum plant production.

Strong internal process management –

This helps reduce the risk involved with output. The ability to predict the success of growth helps producers to schedule a smoother delivery of goods.

Process automation –

The productivity of the company is improved by automating the process from inventory monitoring to delivery and analytics. process management. The authenticity, origin, date of shipping and logistics details was checked by a monitoring device.

Improved efficiency –

Farmer regulation of the production cycle is enhanced and the high level of crop efficiency and growth capacity can be sustained by automation. It also helps farmers to increase returns with the minimal quantity of capital available, including soil, fertilizers, seeds and pesticides.

Improved productivity –

Precise planting, irrigation, application of chemicals, the use of precise fertilizer and harvesting impact production rates directly.

Enhanced livestock agriculture-

Sensors and devices should be applied to monitor as many things about the cattle as they can, for example the replication of their health-related activities, location, etc.

Remote tracking –

Regional and commercial farmers may track many fields from an Internet link in many places across the globe. In real time and from all points, choices can be made.

7.3. Disadvantages

While hydroponic cultivations provide obvious advantages over soil-based systems, other factors need to be considered in the analysis of these results. Hydroponic systems, for instance, expose plants to non-physiological environments. Thus, when plants are grown in alternative systems (e.g. in land or agar-based medium), the observed phenotypes and plant reaction using hydroponic systems can differ in magnitude. Such factors are not specific to hydroponic systems. If plants are grown in multiple types of soil, different answers can also be found.

8. Design

In the agriculture sector, IoT is designed to allow farmers to track important information such as moisture, air temperature and solid quality through remote sensors and to increase yields as well as prepare and make harvest forecasts more effective irrigation.

In order to maximize efficiency and farm yield along with minimal waste, IoT helps biologists analyse how genomics and micro-climates impact crops and their development. Agricultural IoT has an climate and crop growth tracking and screening program. Data from pest control sensors are also available that can forecast the pest's activity and damage from that insect. The farmers will use this

knowledge to reduce large-scale harm caused by the insect.

Smart IoT systems have allowed farmers to use tremendous data produced in their farms. The technology has been related. The hydration level will help farmers make smarter choices in areas such as accurate irrigation, real-time data about soil, the atmosphere, air quality and its flow levels. Agricultural IoT is a system for control of water requirements and for provision of irrigation for crops built into the WMS and the SOS (Sensors Observation Service). It also intelligently analyses the demands for farm water and exploits the existing water supply to reduce pollution.

The cultivated water management feature of the agricultural IoT can be of great use in the areas where there is less water available or drought zones, and the reason behind this is that the restricted water supplies may be handled smartly by measuring the time for demand service, and the best irrigation plan can be developed, resulting in better practices to preserve water availability.

IoT helps farmers to connect with their field in real time such as weather prediction, planting, harvesting in a detailed and productive manner. Climate predictions, soil efficiency, mobility and labour costs. Farmers who have access to this critical real-time knowledge will plan their course of action even more effectively before and in the future.

For livestock management, IoT also plays an important role for fostering animal welfare by tracking devices, such as cattle ear tags that identify respiratory illnesses. If a disease is detected, an alarm is given to the patient so that it can be removed from the herd so so the disease does not spread to other animals. IoT sensors track weather and also control soil and acidity moisture while farmers control their animal moment and activity remotely via embedded devices.

IoT lets farmers determine whether they can spray and where to spray, IoIs make agricultural land competitive and build a virtuous circle that makes food goods more available and more cost-effective, saves farmers money, and saves their energy, by bringing sustainability into this process, and decreases the environmental impact of agriculture.

9.Workflow
(Plant care with laser sensor and PH monitoring device).

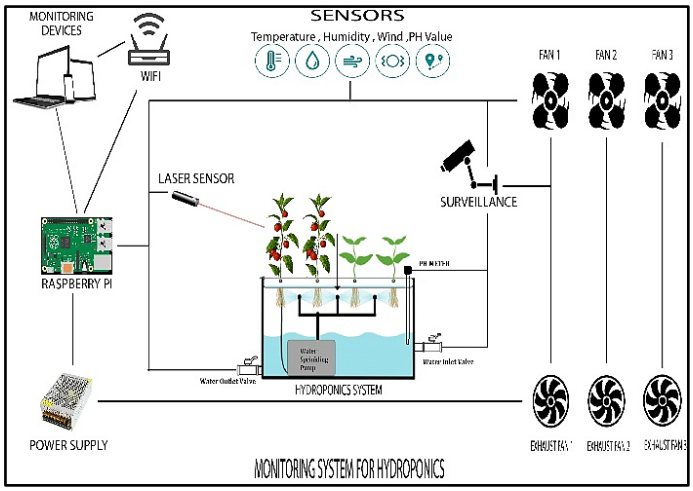


Figure 9.1 Monitoring System

Working:

Laser Sensor- Laser Sensor transmits visible laser light to an installation through a lens. Laser beam is used to reflect laser light on the plant. We may track the exact plant height, this information is sent to the application from the raspberry pi and the user knows the correct harvest date.

PH Meter- A PH meter measures the acidic, alkaline or neutral content of water. The PH meter tests the hydrogen ion concentration. If the water is acidic or alkaline, the condition is indicated to the user.

Valve Controller- Once your application has an indicator from the PH Meter, the valve automatically transfers water from the tank through the inlet and outlet valve and maintains the water level.

Mobile Application to Monitor And Control Hydroponic System

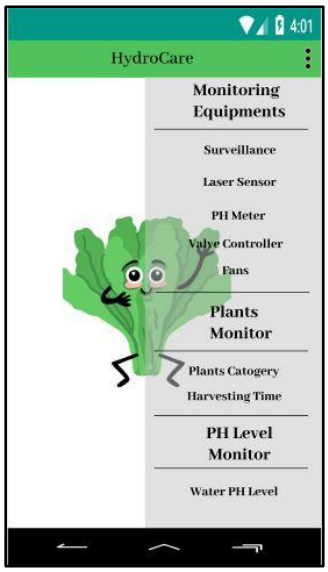


Fig 9.2 Home Page

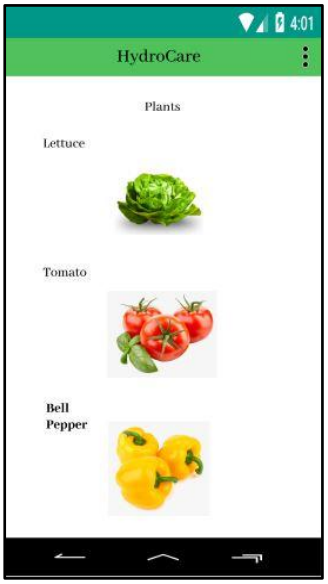


Fig 9.3 Laser Sensors

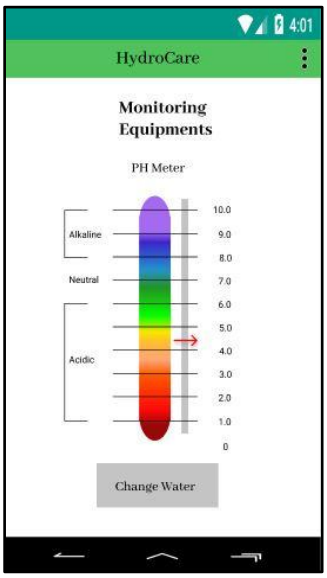


Fig 9.4 PH Meter

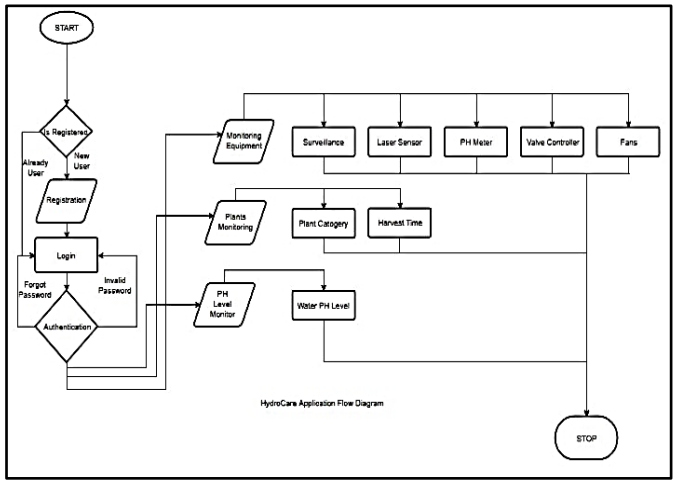
Fig 9.5 Plants Page

Future Scope:

If the world's population continues to expand, the goal is to produce more food and becoming more sustainable. To help with that, more technology is coming into play. Nevertheless, having a growth in population goes hand and hand with the need to produce more food to feed them. Some estimates suggest that 70 per cent more food will be needed. However, 80 per cent of the cultivated land already in use and the rapid urbanization of countries set to continue, the challenge of producing more food in a sustainable manner will become ever more pressing. Hydroponics is the solution to this problem.

Despite these advantages, there are few problems with this system as crops need to be monitored on a regular basis. Here is where this Iot-driven approach will help us to monitor the growth and also the water condition of the plants. This method, together with hydroponics, would allow us to achieve productivity in production by maintaining the quality of food crops.

APPLICATION FLOW CHART



10. CONCLUSIONS

Various methods can be used to farm like crop rotation, organic cultivation, etc., but IoT instruments can make it simpler for farmers to do so. IoT tools such tracking software will help achieve good production efficiency and quantity. The crop is often difficult to pick because of soil, such as potatoes and onions. It is simple and also useful for tracking product ripening when we speak in hydroponic system.

It is not easy to conserve minerals on the soil and to test soil fertility, it is however also very easy to manage in the hydroponic system. The Hydroponics disease control program is fine, too. Many farmers do not have an education and do not know how applications might be used to buy these goods. But farmers don't get rich some of them are employed in other farmers on regular wages, and farmers who don't have their own land can lose their jobs.

There are many benefits and drawbacks of IoT because it is the vision of the planet now. The awareness of the devices in farmers should be created. Encourage farmers

to gain basic education and to be conscious of the way goods operate.

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