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Automatic Hydroponic Farming System

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Abstract - The goal of this study is to design and construct an automation system for managing and monitoring plant growth in hydroponics, as well as to assess the impact of employing this prototype. Sensors in the system automatically monitor and control environmental events such as pH, water temperature, and relative humidity. The system's humidity and temperature are controlled by a DHT11 humidity sensor. We also employed a pH sensor, which is a scientific tool that measures acidity or alkalinity and reports it as pH. The mobile app is used to transmit the current state of the hydroponic system to the user via the internet to their mobile phones.The application system mixes the selected solution automatically to obtain the desired value and also collects information about the amount of solution mixed at the time of planting. It can be used to estimate the cost of growing vegetables and calculate the profitability of each vegetable to make the decision to grow. Hydroponics is a type of farming in which plants are grown without the use of earth. Furthermore, because no soil is required, hydroponic systems can grow stacked vertically to conserve space.

KeyWords:Internet of things ,Mobile application ,hydroponics

I. INTRODUCTION

Agriculture is the backbone of human society, and it is responsible for producing high-quality food for the world's population. Hydroponics is a subset of hydro culture, which is the method of growing plants without utilizing soil and mineral nutrient solutions in a water solvent. Plants in a hydroponics system are cultivated without the use of soil, as the name implies. Plants get all of their vital nutrients from a nutrient-rich water-based solution, which is made up of water mixed with the solutions needed to grow the plant. We created a system that tracks and regulates all of the parameters required for proper indoor plant development.It produces a high yield and is easier to grow than soil, and the plant has a high nutrient value and regulates output quality. As a result, the automated hydroponics farming system was created to make cultivation easier, and the system can change and control key environmental elements that influence plant growth, such as temperature, humidity, and water. It's possible to see it in real time. The capacity to make decisions and issue commands from a friendly user interface based on the displayed real-time parameters is one of the system's primary characteristics.

II. LITREATURE REVIEW

This section goes through the research that was conducted for this project. All connected research papers provide a notion for this project, which is also explained in a straightforward manner.

This part shows the associated works applied to this study, which are founded on academic concepts and contribute to the researcher's thoughts. Temperature, humidity, and water are just a few of the environmental parameters that can be controlled by this system. The software system is It can be used to estimate the cost of growing vegetables and calculate the profitability of each vegetable to make the decision to grow it by automatically mixing the selected solution to obtain the desired value and collecting information about the amount of solution mixed at the time of planting. It can also be used to estimate the cost of growing vegetables and calculate the profitability of each vegetable to make the decision to grow it by automatically mixing the selected solution to obtain the desired value.This research shows how plants cultivated in hydro culture can help increase pH sensor stability, and the system performs well in Automated mode. With the use of low-cost, easy-to-install sensors and an abundance of insightful data they provide for future research, the Internet of Things has greatly expanded the opportunity to improve agricultural products. As the system evolves to include more useful and versatile related devices, data mining techniques will be used to analyse and predict information about quantity, quality, and time aspects.

The increasing global food consumption, as well as the necessity for a market for novel sustainable agricultural methods leveraging the Internet of Things, are the issues that this system must address. The system has increased its performance and is now capable of achieving the overall system's goal. The experiment demonstrates that carefully monitored and managed hydroponic systems produce faster rates of development while also reducing human dependency.This technique not only enhances the entire process by breaking through traditional agricultural methods, but it also makes it self-sufficient enough to produce anything at any time of year. The software is connected with the hardware of the actual system, allowing it to show various parameters such as temperature, humidity, and pH levels on a smartphone application.

The goal of this literature research is to look into the possibilities for implementing a hydroponic system, to investigate the technology's potential uses, and to come up with a design and functionality that works. Hydroponics is the science of growing plants without the use of soil. As soil conditions become more difficult, the business is likely to increase rapidly in the future.In a country like India, where urban concrete conglomerate is expanding by the day, there is no choice but to embrace soil-less culture to help enhance yield and quality of produce in order to secure our country's food security. Many researchers discovered that plants can absorb and consume critical minerals in simple water, but they also discovered that plants can absorb these ions straight from nutrient-rich water solutions. They discovered that dirt isn't even required for plant growing.

III. Architecture

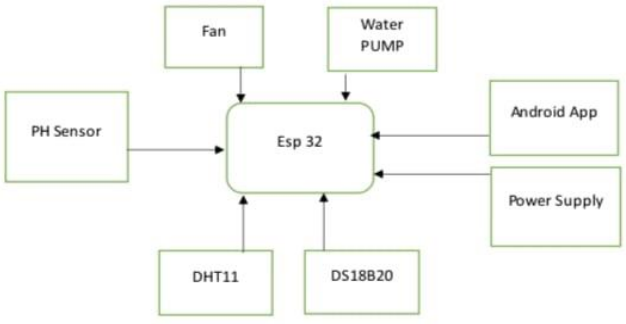

Fig-1: Block Diagram of Automatic Hydroponic Farming System

The automatic hydroponic farming system's block diagram includes the main power supply, water pump, sensors, ESp32 module, and internet database. Figure 1 depicts the overall block diagram. The IoT platform on any smart device can monitor all of the sensors attached to the autonomous hydroponic farming system. Sensors are used to control and monitor the system's data. In the following sections of the paper, each component of the block diagram will be described in detail.There are various characteristics in any hydroponic system that must be kept within a specified range, including pH, ambient temperature, and container water level. An autonomous hydroponic system should automatically alter and maintain these parameters within their appropriate ranges without the need for user intervention.The ESP32 is connected to a variety of sensors that monitor the various characteristics of the hydroponic system. A water pump is used to ensure that a sufficient amount of water is continuously flowing in the system. Finally, all of the collected data will be uploaded to the Firebase server, and this procedure will check and fetch data from the Firebase server to the Android app.

IV.METHODOLOGY

A. Hardware components:

Power Supply: Esp 32 is linked to the DC power supply.

ESP32: ESP32 is a family of low-cost, low-power system-on-a-chip micro controllers that include integrated Wi-Fi and dual-mode Bluetooth. With an operational temperature range of –40°C to +125°C, the ESP32 can perform reliably in industrial conditions. ESP32 can dynamically erase exterior circuit defects and respond to changes in external conditions thanks to improved calibration circuits.

DHT11- The DHT11 is a basic digital temperature and humidity sensor that is extremely affordable in price. These sensors have a chip that converts analogue to digital and outputs a digital signal that includes the temperature and humidity. As a result, they're quite simple to utilize with any micro controller.

DS18B20:The DS18B20 is a widely used digital temperature sensor with a digital signal output. DS18B20 can immediately read the measured temperature and realize the 9-12-digit digital value reading mode through simple programming according to actual requirements, as opposed to typical thermistors.

PH Sensor: The measurement and modification of the pH of the hydroponics reservoir is a key requirement of the automated hydroponic system. A pH sensor continuously measures the pH to determine when the pH chemical needs to be introduced to the hydroponics reservoir. The pH sensor was utilized to determine the reservoir's acidity level.

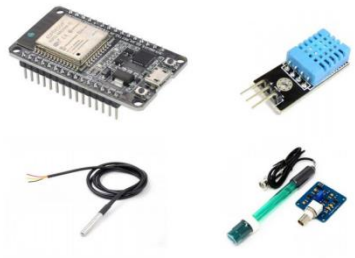

Fig-2: Sensors

B.Software:

Mobile Application: We designed an Android application to remotely monitor all system metrics. Humidity, temperature, and pH are also displayed in the aforesaid mobile application. The user can turn on or off the device based on the humidity, temperature, and pH value.

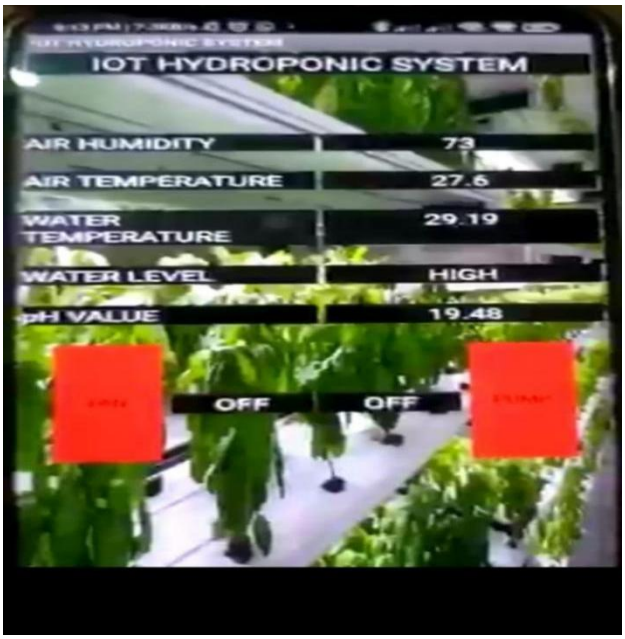

Fig-3: Screenshot of application

V.ADVANTAGES

- Hydroponic gardening can help you save a lot of water.
- Hydroponics allows plants to grow faster and larger.
- Hydroponics systems, unlike traditional gardens that require outdoor space for plants, may be easily accommodated into many homes, regardless of size or location.
- Because soil isn't an issue with hydroponic farming, farmers can cultivate whichever crops are most helpful to their society without worrying about soil degradation.

VI.OBSERVATIONS AND RESULTS

The outcomes of hardware and software will be reviewed in this section, with a focus on the automatic hydroponics farming system, which has been successfully deployed as shown in Figure 4. The automated hydroponics farming system is used in this study to facilitate the growing of hydroponic plants. The system may be measured and information can be shown on a mobile phone in order to manage and regulate connected sensor equipment such as temperature, humidity, PH, and water supply systems. Every 10 minutes, the application will record data from the related sensors. Furthermore, the prototype retrieves data from the database every minute, as well as plants produced under normal conditions. The suggested system includes the steps of sending data from sensor devices, receiving data from a data storage intermediary, and sending data to a mobile application. The system will then examine the value that was sent.

The temperature is controlled and maintained with the help of a fan. When the pH value exceeds the set value, the pH control is activated, and the system releases the pH solution until the pH value falls below the set value. The water is circulated by using a water pump to pump water to and from the plants. The environment's temperature and humidity are detected via a temperature sensor, and the results are shown in the mobile app.

The water level sensor will alert the system of the value, and when the water level is lower than the indicated value, the application will release water into the pipe until the water level is equal to or higher than the specified value. Every hour, the system receives

sensor data and records it. Also, a mobile application can be used to access and control the system.

To access the mobile application, which provides all of the requirements for the hydroponic system, the user must have a unique login ID. The user's login name and password are retained in the firebase allowing him to continue working on his crop field without interruption. This mobile application allows the user to select which seeds to plant in the agricultural bed, as well as control the water flow.

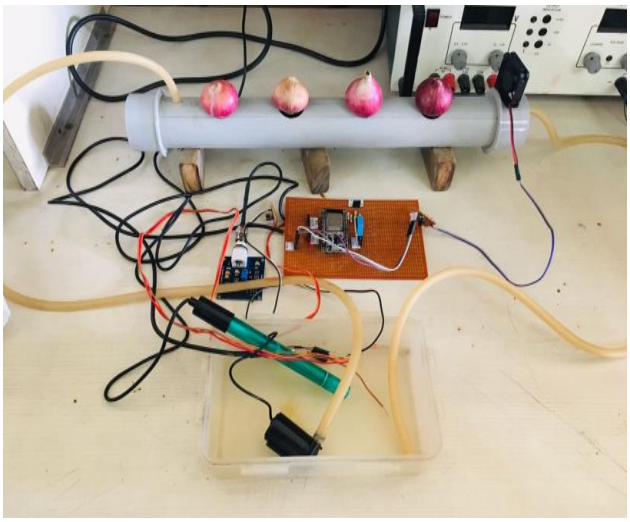

Fig-4: Hardware set-up

Fig-5 : Hydroponic system used to grow onion

VII. CONCLUSIONS

Hydroponics can enable individuals to grow crops in a more cost-effective, efficient, and environmentally friendly manner in any location. In addition, combining hydroponics with IoT can make farming more convenient for farmers by automating and pre-cising every process in the farm. The proposed hydroponic system is capable of operating in a variety of environments and has demonstrated good performance under test conditions. This technique not only enhances the entire process by breaking through traditional agricultural methods, but it also makes it self-sufficient enough to produce anything at any time of year.

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