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Multi-Dimensional Hydrophonic Farming

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Abstract

Using hydroponics, plants or the crops can be grown without any need of soil at all. Instead, producers employ water to provide the dissolved nutrients and minerals that plants need. The society applauds this strategy since it addresses the issue of a lack of productive land. In this work, we create a prototype using the Internet of Things (IoTs) named Hydrostorms. The IoT sensors use the Cloud to send environmental data from the farm's smartphone app over the network. The Hydrostorms app gives farmers access to a wealth of information about their hydroponics, including the GPS coordinates of the farmer's present location, a detailed profile of each hydroponic, including information about its nutritional requirements, fertilization schedule, ambient conditions (such as temperature, humidity, etc.), historical information from earlier data collection, and warnings of any adjustments or unusual values. The prototype's initial evaluation findings indicate a high degree of farmer acceptability (80.5%), this might convince more of them to use this ground-breaking agricultural technique.

I. INTRODUCTION

The "internet of things" (IOT) is capable of communicating data over the network without requiring any kind of communication, whether human or machine to machine, and is typically coupled to electronic equipment and mechanical machinery using unique identifiers (UIDs). IOT broadly refers to anything that is connected to the internet. The absence of the internet is equivalent to the absence of IOT in this reality. Thanks to IOT exchanging the data with it, other internet-connected computer devices can access the data from the cloud server. Everything can be changed with the IOT, from small objects like tablets to massive structures. It has sensors, some of which are wired and some of which are wireless.

An IOT ecosystem consists of web-enabled smart devices that make use of embedded systems like CPUs, sensors, and communication hardware to collect, share, and act on the data they collect from their surroundings. IOT devices communicate with other edge systems of the IOT gateway through links, sharing sensor data they collect there that is either sent to the cloud for analysis or is processed locally. These devices often communicate with one another and operate in response to the shared data. A large portion of research is carried out by machines, such as those used to set up, instruct, or retrieve data, without the involvement of humans. People can live and work better and have total control over their life thanks to the internet of things.

IOT offers intelligent home automation equipment and is essential for business. IOT provides businesses with real-time insights into everything from computer performance to supply chain and logistics operations, improving their comprehension of how their systems actually function. IOT enables businesses to streamline operations and cut labour costs. Along with decreasing waste and improving service quality, this also keeps customer purchasing open and lowers the cost of manufacturing and supplying goods.

The Internet of objects (IoT) is a system of interconnected computers, electronic devices, home appliances, living objects, and people that allows data to be exchanged via a network without direct human or electronic interaction.

In hydroponics, nutrients like vitamins and minerals are supplied to plants through water rather than soil. Plants grown hydroponically require less water than plants grown using traditional techniques that use soil. Hydroponics is a good option for places with a shortage of agricultural land because it uses little water and requires no soil. Numerous plant species, such as the tomatoes, greens such as mustard, broccoli, celery, the spinach plant, chilli peppers, and lettuce, are suited for hydroponic growth. Although hydroponics has numerous potential benefits, for the plants to reach their full potential they need ongoing attention and care. Plants will swiftly flourish, blossom, and produce fruit if the water quality, lighting magnitude, vitamins and minerals, climate, and oxygen supply are all maintained. In order to preserve quality and make sure that there are no bugs that could make the plants wither, hydroponics needs controlled settings. Manual tools can be used to care for the hydroponic plants, albeit this can take some time. Hydroponic farmers can effectively care for their plants using our suggested technique without the requirement for ongoing direct observation. We provide a mobile app for farmers to download on their cellphones in order to enable them to get real-time information about their hydroponic farms in various geographic locations.

These are the contributions we made:
1) To remotely monitor each hydroponic plant, we develop an IoT (Internet of Things) platform that makes use of sensors to collect data that is subsequently transferred to the cloud and the farmer's smartphone.
2) To start, we created a prototype software called the Hydrostorms app for smartphones, which takes data and gives farmers usable, simple-to-understand information on each hydroponic system. The program uses machine learning to forecast potential outcomes by using algorithms and learning from historical data.
3) In the area of expertise, we innovate a complete hardware platform made up of environment sensory units coupled with a number of Arduinos, which are then coupled with a NodeMCU CPU that has a capability to create a bridge to the Cloud database through a 4G connection.

II. RELATED WORK

Bharti et al. created a computerised framework for the entire agricultural process using sensors and the NodeMCU ESP8266 microprocessor, one of the most well-liked microcontrollers in IoTs. The microcontroller enables IoT devices to establish a connection to the global web and broadcasts the data they gather to a MQTT Cloud server that is accessible by a smartphone's Android client. One of the automatic processes in this system is the control of the water level. If the fluid level drops below a particular threshold, the fluid source's valve opens, allowing fluid to flow into the tank until the level of interest is attained. The Android app also has a hydroponic farming community, official service connectivity, and TensorFlow neural network processing capabilities.
Firdaus et al. created a monitoring and controlling system for hydroponics to guarantee plant nutrient intake, pH levels, and climate. They use DIY and Ds18b20 sensors to measure the pH of the fluid and the surrounding temperature, and a Total Absorbed Solid (Tds) metre to monitor the amount of nutrients that are dissolved in the water. The sensors are connected to an Arduino Uno microcontroller.

Vertical hydroponic cultivation has been suggested by Tolentino et al. to enhance lettuce yields. The autonomous system is equipped with proactively managing the vitamins, minerals, daylight, water, and air plant life need without the need for human involvement. The knowledge has been collected by a variety of sensors and then sent to an Arduino for interpretation. The topology of the system is comprised of a central location and numerous nodes that monitor the user's health as well as several environmental variables like relative humidity, temperature, acidity, pH, etc. The solution gives its users access to and control from afar over their agricultural property at any point and from almost anywhere via the IoT gateway.

An IoT-based block diagram for greenhouse farming was put up by Saraswathi et al. A Raspberry Pi board was attached to a number of sensors that measured environmental factors like temperature, humidity, pH, and pressure. The Pi board is connected to all the sensors through a Python script, which enables the Pi board to transmit data to the cloud. The information can be retrieved via an Android app which demonstrates the electrical conductivity and pH present moment. To collect operational data from various facilities, the app is installed on production platforms.

III. PROPOSED WORK

Remotely turning off the water pump is the model's key feature. to regulate the pesticide and fertiliser system. The created model satisfies the demands of controlling systems by using a smartphone and a mobile application. The key feature is that we can monitor and operate it via an internet-connected browser while also utilising machine learning to forecast certain outcomes, such as how much water it will need in the future to maintain good health. The model offers total security. Only administrators and users who have been validated are permitted access to the control. This model minimises energy waste. If a pump is not turned off properly, it means that the motor has not been turned off properly as well. The system's condition is updated over a specific time by the server.

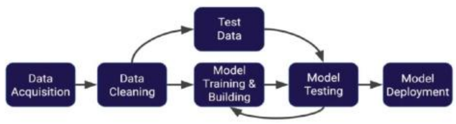

Figure 1: Proposed Flow

IV. METHODOLOGY

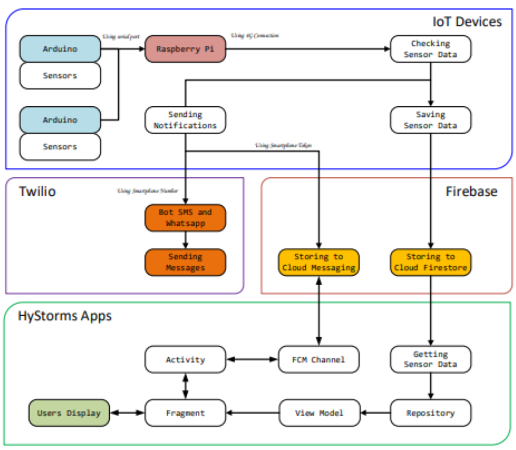

Figure 1: Architecture of the Hydrostorms Monitoring System.

The Hydrostorms system's architecture is depicted in Figure 1. It has a front and a back. The Hydrostorms app for Android smartphones serves as the front end. The pH (the acidity and alkalinity of hydroponic nourishment solutions), °C (an a prior ambient temperature of the surrounding the environment), and other crucial environmental data have been captured by hydroponic farmers via this software in order to track their plants.

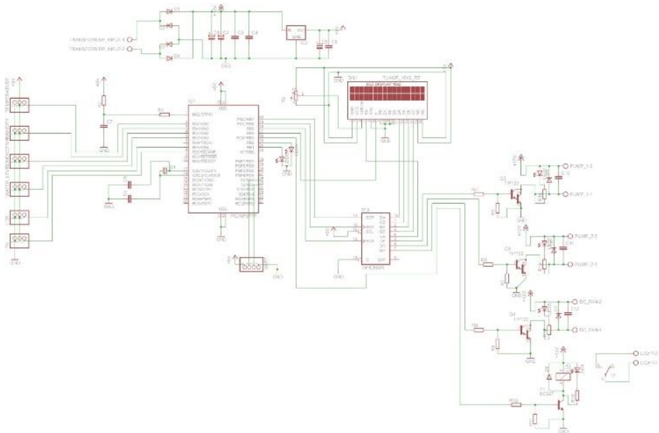

Figure 2: Circuit Image

Additionally, The Hydrostorms app also provides useful features for farmers, including the current GPS location, A record of all snapped up information, statistics on the elements and nutrients of that plant, potential hypotheses using machine learning algorithms and the Internet of Things, reminders to fertilise, and alerts in the event that adverse circumstances are found. the app's primary features and user interface. Each hydroponic system has IoT ambience sensors for the temperature, humidity, pH of the water, and light intensity that are connected to an Arduino in the field and surround the plant. Multiple hydroponic systems with their Arduinos are connected in serial to a hub, which then sends the data to Google Cloud Firebase over 4G. All further data collected by the hydroponics sensors is stored in the cloud's back end using the Firebase database, while enrollment, the authentication process, and user settings remain intact in local storage on the operating system of the mobile device.

V. EVALUATION

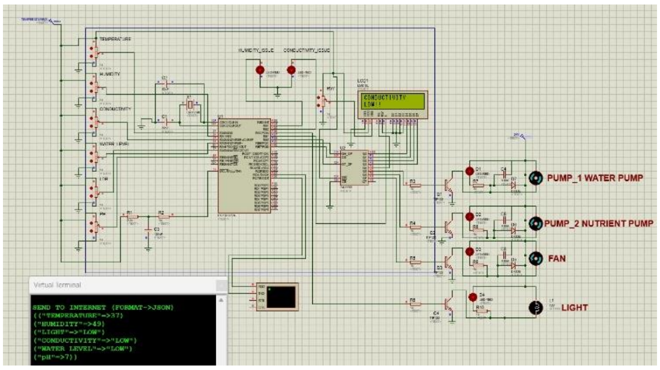

Figure 1: Working simulation model

We examined the Hydrostorms system on two distinct scales: The effectiveness (is the system useful?) and the user interface (is the system visually appealing and straightforward to use?). To that end, 56 potential participants (farmers) each received a questionnaire with a Likert-based scale. 45 people

responded. The results of the questionnaire were compiled. Respondents were asked to score the system using the Likert scale with the ordered sentiment values of Strongly Disagree (SD), Disagree (D), Agree (A), and Strongly Agree (SA). Based on equations (1) and (2), the weighted sentiment score for each assessment test is determined: Sentiment Score is equal to SD*1, D*2, A*4, and SA*4 (1). Score/(Max*Score) x 100 is the sentiment index (2). Sentiment Index of Effectiveness is calculated as follows: 726/900 multiplied by 100 is 80.6%
UI/UX Sentiment Index = 723/900

VI. CONCLUSION

By segmenting the required domains and examining how and what the necessary purpose to be dealt with is, it may be possible to better understand how agriculture might change towards the smarter face. The process of assessing soil characteristics, such as nutrients, temperature, and a further overview for long-term practises, is a part of soil sampling and mapping.

For precise decisions to be made, the physical, chemical, and biological variables must be investigated. The next step is to inspect the irrigation systems, where factors including water quality, rainfall patterns, and air moisture levels must be taken into account. Crop disease and pest management, which uses fertilisers and insecticides for optimal crop raising, comes next. The last phase in the inspection process is to keep an eye on the yield and the harvest ratio. In order for the machine learning algorithm to use a small set of data as the training set and the remaining data as test set so that it can learn from the data, the culmination of all these processes is carefully scrutinised and documented for subsequent analysis, ability to predict and minimise even the slightest chance of failure by learning from the data set that affects growth and other elements.

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