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A REVIEW ON HYDROPONICS BASED ON ARTIFICIAL INTELLIGENCE

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Overview of the reported work :

In order to keep up with the demands of the ever-increasing population, farmers and owners of commercial plantations are forced to resort to using harmful chemicals to produce more, but this affects the consumers in the long run. Hydroponics is the method of growing plants directly in a water medium, eliminating the use of soil, thereby taking away the high maintenance costs and side effects mentioned earlier. This paper covers several different metrics for managing plant growth using Internet of Things (IoT)and our objective is to derive a machine learning algorithm to optimize the values of all the metrics. Our future project is focuses on devising a hydroponics system that is robust and has increase deficiency. The soil is a valuable component of agriculture it provides support for the plants, it also provide nutrient to the plants and the soil provide a home to some of the micro bi-alorganism that forms a symbiosis relationship with the plants. However, all these ingredients can be provided with hydroponics. Hydroponics is the process of growing plants without soil. Evidence of hydroponics was found in the Egyptian wall painting. There are many benefits to hydroponics : 1) it does not require soil, 2) it is faster than traditional farming, 3)it requires less space and can be grown in any location, 4) it is unaffected by seasonal change, 5) little or no pesticides and herbicides are needed 6) Plants get complete range of nutrients they need at the quantity they need it, 7) Plants are protected against diseases and pests, 8) It can be used to isolate crops during experiments.

The objective of this research work on successful development of an IoT platform with various sensors, imaging devices, and automation controls which allows us to harvest data from the plants. Our end goal of creating a fully autonomous farm should also be able to predict crop yield, nutrient Thus,we would be able to combine our IoT system with the recent advent of Machine Learning. In this paper we are going to study three section: Section I describes the Introduction of Model, Section II describe about the related work in hydroponics system. Section III illustrates the finally presents the conclusion.

II RELATED WORK

In recent year Artificial Intelligence become popular research area. There has been some work in the area of Agriculture. The most relevant published papers that are analyzed are listed which is represented by table given below describe the overview of related work

Somchoke Ruengittinun et al. (2016) This paper proposed a Hydroponic Farming Ecosystem (HFE) that uses IoT devices to monitor humidity, nutrient solution temperature, air temperature, PH and Electrical Conductivity (EC). The HFE is made to support non-professional farmers, city people who have limited knowledge in farming and people who are interested in doing vertical planting in very small areas in the city such as building tops, balconies of small rooms in high-rise buildings, and in small office spaces. To make the system easy to control and easy to use, we have an android application to control IoT devices in the HFE and alarm users when their farm is in an abnormal situation.

Chavan Akshay A,et al.(2017) . The paper discusses the use of latest IOT technology used with efficient hydroponic systems which help to save environment. This paper discusses how IoT provides a sustainable approach in agriculture sector where various technological devices use sensors and other tools for all the process of production of crops This paper explores the future hydroponically grown plants are exposed to use of oxygen and water. The required nutrients are given to the plants with required amount of water. The Hydroponic cultivation is done for many other crops and is used widely in developed and underdeveloped nations. Water consumption is also less which has made this type of farming popular. The use of these systems is the are required by various countries of the world .It has already been have proved that this technology is completely practical and has many advantages over traditional methods of crop production. These systems can help small scale farmers to move large systems. The IOT enabled systems uses stream of less water and stores the dissolved nutrients required for plant growth . These systems can provide soilless farming a popular and help to achieve the sustainable development goal 2 which is No Hunger End hunger and achieve food security.

Ankita Patil et al.(2017) Through this paper, we introduce a concept for smart farming which utilizes wireless sensor web technology for moisture detection in the soil in conjunction with a smart phone application which plays a vital role in helping farmers. We introduce Arduino based automatic plant watering system and android application which will help to control Arduino via internet. Also, this android application provides farmers with agricultural related information such as costs of seeds, moisture level required, type of soil needed, weather forecast, fertilizers and pesticides to be used.

S.Charumathi et al.(2018)This model explain all the difficulties and demands using hydroponics we can go organic. Since it is done in the controlled environment, it can be done anywhere like room terrace, balcony etc. also large amount of plants can be planted in a less place. This type of agriculture could be high yielding if monitored and controlled efficiently. We propose a project that controls the necessary conditions required for the plant to grow hydroponically and also cultivators may control the agriculture remotely using IoT.

Jaideep Nuvvulaet al. (2017) This paper covers several different metrics for managing plant growth using Internet of Things (IoT) and our objective is to derive a machine learning algorithm to optimize the values of all the metrics. Our future project focuses on devising a hydroponics system that is robust and has increased efficiency. After studying the drawbacks of the conventional farming methods, a soil-less culture is described and a system to control and monitor it has been presented. As one of the typical applications, more and more people realize the application of the IoT (Internet of Things) will bring broad development to the smart life. As far as the machine learning model is concerned, the following conclusions can be derived: 1. The feed-forward neural network methodology was used as the main tool for the development of the model as it was capable of learning the physical and chemical interactions between the plants and the measured variables. 2. The one-hidden-layer architecture of neural networks proved to be more successful than the two hidden-layer one. 3. The basic training methodology used here was the Backpropagation Training Algorithm. Four different types of minimization algorithms were considered: steepest descent, quasi-Newton, conjugate gradient, and Levenberg–Marquardt algorithm. The quasi-newton backpropagation training algorithm with a fixed learning rate gave the best results.

T. Honjoet al. (2018) the overview of this paper is that land is quickly being urbanized and cities are expanding at a rapid rate this helps justify the study and implementation of hydroponic growing techniques because it does not require soil. Along with the many uses for hydroponic on earth, we can even begin seeing the usefulness of hydroponics in future space travel. Hydroponically grown plants have their roots dipped in nutrient solutions mixed with water. This allows them to get the required nutrients much easier compared to plants grown by the conventional method. The nutrient solution is the food source for the plants and hence the factors in it need to be controlled. There will be many devices interconnected to create such a system. The main component used is a microcontroller, since Arduino is the most accessible, it was chosen for the purpose of this project. The disadvantages of hydroponic systems are that it is expensive - it involves the cost of all the equipment you need—containers, pumps, lights, nutrients, and so on. There's also a certain amount of toil involved as hydroponics is more scientific and the plants are much more under your control, they need to be checked constantly to ensure they grow in favorable conditions. The system consists of three parts: 1. The first part is the detection sensors which include air temperature, humidity, PH, water temperature, and ultrasonic sensors. 2. The second part covers the control system which is implemented using IoT. The role of the control system is to manage plant growth by monitoring the values from the sensors. [2]
3. The last part focuses on selecting a machine learning algorithm to quantify plant growth. Artificial Neural Network (ANN) was considered for the same since it gives the best results when dealing with complex systems. In the future, we aim at improving the existing hydroponics systems to make them more efficieny.

Konstantinos P. et al. (2018) This model is used for predicting pH and Electrical Conductivity (EC) responses of a deep trough hydroponic system is developed. Artificial Neural Networks are used as the method of modeling. The Feedforward Neural Network Model has 9 inputs (pH, EC, nutrient solution temperature, air temperature, relative humidity, light intensity, plant age, amount of added acid and amount of added base) and two outputs (pH and EC of the next time step). The most suitable and accurate combination of network architectures and backpropagation training algorithms was the one- hidden-Iayer with 9 hidden nodes architecture trained with the quasi-Newton backpropagation algorithm. During the testing of the model using new input data, one step ahead predictions of pH were within 0.01 and EC within 5 microS · cm-I. The predicted pH and EC values are accurate enough that the NN model could be considered to be used in other systems that could use information of the possible future state of a process. A good example of systems is a fault-detection system. A system could read the current state of the process as well as a prediction of its future state, and compare them with the actual process status to detect a possible malfunction. Another example is a control system that "looks" not only into the current status of the process but also into its future state (provided by the NN model) and adjusts the control actions according to this future state too.

K.P. Ferentinoset al. (2019) Sahin et al. have presented a damage detection algorithm using a combination of global (changes in natural frequencies) and local (curvature mode shapes) vibration-based analysis data as input in artificial neural networks(ANNs) for location and severity prediction of damage in beam-like structures. Different damage scenarios have been introduced by reducing the local thickness of the selected elements at different locations along finite element model (FEM) of the beam structure. Which proposed a crack detection method by an artificial neural network (ANN) trained exclusively with frequency response spectra from finite-element simulations. The classification fails for some data sets of intact crates, due to experimental conditions not accounted for in the finite-element simulation. have presented a method considering the flexural vibration in based analysis data as input in artificial neural networks (ANNs) for location and severity prediction of damage in beam like structures. Finite element analysis has been used to obtain the dynamic characteristics of intact and damaged cantilever steel beams for the first three modes. The results from the proposed method have been validated with the results from experimental analysis. Neural network based damage detection generally consists of a training phase and a recognition phase.

W. Ke and Z. Xiong, et al (2008) In these paper we were studied in hydroponic experiments for the plant growth, copper accumulation and mineral nutrients content under excess copper and nutrient deficiency conditions. The results indicated that the CS population had evolved not only Cu tolerance but also tolerance to low nutrient supply. Under Cu treatments, the CS population had less Cu accumulation in roots than the UCS one, suggesting the root exclusion mechanism existing in the former. It was also found that general nutrient deficiency markedly promoted Cu uptake and transport in the two populations. But CS population had less Cu accumulation than UCS population did. Under Cu stress, the CS population had less change in nutrient composition than the UCS one. The similar result was observed in general nutrient deficiency experiment. The results indicated that the mineral composition homeostasis under the stresses was important in metal tolerance and colonizing normally in the Cu-enriched soils for the Cu-tolerant population.

Justification for the proposed research work

1. In the past, researchers in biology and palynology were dependent on the traditional methods of pollen classification, which includes various skilled techniques that can only be performed by experts from the field of biology.
2. In the reported related work, other researchers used sufficiently large-sized datasets for training their classifiers. However, in the real-world situation, the size of the pollen dataset might be small.
3. In many cases, researchers reported three or four different NN architectures.
4. None of the researchers had tested their pollen classifiers in view of noise-tolerance. It was also noticed that, issues in relation to reliability and noise-sustainability were not addressed.
5. In the related reported work, the design of pollen classifier was neither aimed at reducing time-complexity nor space-complexity of the system.

Therefore, the major thrust of this research was given on accurate and easy classification of pollen grains by using Computational Intelligence (CI) approach including neural network approach supported by new image acquisition techniques such as SEM. This will serve the very need of humankind to improve knowledge of the past and to conserve earth environment.

The algorithm suggested here will address the issues involved in the previous reported research, where different techniques were adopted for classification of pollen grains. Most of the approaches based on neural network reported classification accuracy ranging from 90 to 100%, but such work was reported by a particular group of researchers and they were working on plant pollen grains found in one particular country i.e. having a geographical boundary. But our approach of CI based classifier supported with neural networks has employed optimal parameters with respect to reduction in time and space complexity. Such a classifier is capable to classify concerned pollen species found anywhere in the world that makes it simple and cost effective. Also the sample size required in our approach can be made smaller in size without compromising the classification accuracy. Most of the research work reported the use of Light Microscopy (LM), which gave lesser, and inaccurate information that was insufficient for the pollen analysis, while in this study more sophisticated approach of image acquisition using SEM is adopted. A certain group (Zhang, 2004) was working on automation of pollen identification, but here CI based approach is considered for

classification of pollen grains. Also the combination of transform based coefficients, statistical parameters and geometrical shape descriptor with NN classifier for classification is itself unique and peerless attempt for such purpose.

Problem definition : The problem of automatic classification of pollen grains is not new to the field of computer vision. Many researchers had contributed towards automation of pollen classification by various methods, but the work presented in the study is a unique, as it attempted to classify pollen grains using Computational Intelligence (CI) approach which includes neural networks (NNs), image acquisition, image processing etc In the past, researchers in Biology and Palynology were dependent on the traditional methods of pollen classification, which includes various skilled techniques that can only be performed by experts from the field of Biology.Therefore, the major thrust of this research was given on accurate and easy classification of pollen grains by using Computational Intelligence (CI) approach including neural network approach supported by new image acquisition techniques such as SEM.

Specifications: A successful development of an IoT platform with various sensors, imaging devices, and automation controls allows us to harvest data from the plants. Our end goal of creating a fully autonomous farm should also be able to predict crop yield, nutrient usage, variance in growing conditions and water usage. The data harvested can be used to predict these major factors. For this purpose, we wish to integrate Machine Learning algorithms into our system. This would not only provide macro-level data and insights into the user's farm but also enable the hydroponic system to become fully autonomous and eliminate the need of human interference to keep the farm up and running under the most efficient conditions. A scalable, centralized system architecture would enable multiple farms to access data from other farms, thereby making the algorithms more efficient and accurate. Thus, we would be able to combine our IoT system with the recent advent of Machine Learning.

Research Objectives : The aim of this research is to develop an in order to keep up with the demands of the ever-increasing population, farmers and owners of commercial plantations are forced to resort to using harmful chemicals to produce more, but this affects the consumers in the long run. Hydroponics is the method of growing plants directly in a water medium, eliminating the use of soil, thereby taking away the high maintenance costs and side effects mentioned earlier. This paper covers several different metrics for managing plant growth using Internet of Things (IoT) and our objective is to derive a machine learning algorithm to optimize the values of all the metrics. Our future project focuses on devising a hydroponics system that is robust and has increased efficiency.

III.CONCLUSION

After studying the drawbacks of the conventional farming methods, a soil-less culture is described and a system to control and monitor it has been presented. As one of the typical applications, more and more people realize the application of the IoT (Internet of Things) will bring broad development to the smart life.

As far as the machine learning model is concerned, the following conclusions can be derived:

1. The feed-forward neural network methodology was used as the main tool for the development of the model as it was capable of learning the physical and chemical interactions between the plants and the measured variables. The one-hidden-layer architecture of neural networks proved to be more successful than the two hidden-layer one.The basic training methodology used here was the Backpropagation Training Algorithm. Four different types of minimization algorithms were considered: steepest descent, quasi-Newton, conjugate gradient, and Levenberg–Marquardt algorithm. The quasi- newton backpropagation training algorithm with a fixed learning rate gave the best results.

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