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Survey Paper on Smart Cultivation and Prediction System for Agriculture

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ABSTRACT

A vast fraction of the population of India considers agriculture as its primary occupation. The production of crops plays an important role in our country. Bad quality crop production is often due to either excessive use of fertilizer or using not enough fertilizer. The proposed system of IoT and ML is enabled for soil testing using the sensors, is based on measuring and observing soil parameters. This system lowers the probability of soil degradation and helps maintain crop health. Different sensors such as soil temperature, soil moisture, pH, NPK, are used in this system for monitoring temperature, humidity, soil moisture, and soil pH along with NPK nutrients of the soil respectively. The data sensed by these sensors is stored on the microcontroller and analyzed using machine learning algorithms like random forest based on which suggestions for the growth of the suitable crop are made. This project also has a methodology that focuses on using a convolutional neural network as a primary way of identifying if the plant is at risk of a disease or not.

Keywords : Soil nutrient identification, Crop suggestion, Plant pathology, Nitrogen-Phosphorus-Potassium (NPK), Internet of Things (IoT), Machine Learning (ML), Convolutional Neural Network (CNN), K- Nearest Neighbour (KNN).

I. INTRODUCTION

Everyday we find that the environment is changing continuously which is harmful to the crops and leading farmers towards debt and suicide. In many cases like this with a growing population farmers are using more pesticides and fertilizers to maximize yield which leads to soil infertility and decrease in holding capacity of the soil. Farming land is used by growing industrialization, so again there is an increase in the rate of soil pollution which affects the quality of plants.

Achieving a maximum yield rate of crop using limited land resources is a goal of agricultural planning in an agro-based country. Prior

determination of the problems associated with crop yield can increase yield rate of crops. To get a good crop it is important that the land should have adequate fertilizer. Hence, Soil testing is used to do chemical analysis of soil and to find the level of fertility of soil. Based on which suggestion of appropriate crop and prediction of required nutrients of the crops can be done. Soil testing includes testing of soils for properties like pH, moisture, Nitrogen (N), Phosphorus (P), Potassium (K). These nutrients advance the growth of the plant/crop in various ways; Nitrogen promotes growth of leaves and vegetation, Phosphorus promotes growth of root and Potassium promotes flowering, fruiting and keeps regulation of nutrients and water in plant cells. Soil testing also includes monitoring temperature and humidity of soil as well as atmosphere. All the data of nutrients of the soil is sensed by various sensors is stored on the microcontroller and analyzed using Random Forest algorithm based on which suggestions are made for the suitable crop for the soil and additional nutrients to be used for good growth of the crop.

Pests and diseases affecting the crops/plants also cause a tremendous decrease in production of the crops. In the majority of cases pests or diseases are seen on the leaves or stems of the crop/plant. Therefore identification of plants, leaves,stems and finding out the diseases, percentage of pest or disease, symptoms of the pest or disease attack, plays a key role in successful cultivation of crops.
Hence, in order to increase crop productivity, farmers need to approach the experts to seek their advice regarding the treatment of incidence of pests and diseases to their crops and suggestions for control of the pests and diseases. To make it easier the crop images can be scanned and uploaded which will be analysed using image processing and Convolution Neural Network. CNN will identify and predict if the plant is at a risk of a disease or not. If a plant is at a risk of some disease the model can suggest ways to the farmer to curb the spread of the disease. It will help the farmer to make effective decisions to increase crop yield and helps maintain crop health.

II. LITERATURE SURVEY

'Real-time and Low-cost IoT based farming using raspberry Pi' focuses on real-time observation with efficient use of the cheapest security system. The sensor data monitored is sent to the cloud for processing.

'Smart Agriculture, Using Internet of Things with Raspberry Pi' has all the sensors mounted in a box with connections done through breadboards. All the sensors are located in a single place which will make debugging easy.

'Precision agriculture monitoring system using wireless sensor network and Raspberry Pi local server ' focuses on the mechanism focusing on deploying a low-cost sensor system, gathering field data, and displaying the data through a graphical user interface (GUI).

"Seasonal Crops Disease Prediction and Classification Using Deep Convolutional Encoder Network" focuses on modified custom CNNs to achieve higher prediction accuracy. The proposed system has a hybridized deep learning neural network and named it a convolutional encoder network. It is a combination of both CNN and autoencoders but uses only the encoding part of the autoencoders to obtain useful features. This system uses immense processing power but compensates it with higher accuracy.

'Recent developments of the Internet of Things in Agriculture: A Survey' outlines recent insights in the development and advancement of the internet of things in agriculture. The paper also briefs about layered architecture of Agro-IoT, Multimedia

Internet of Things (MIoT), Industrial Internet of Things (IIoT). It also discusses hardware platforms along with the sensors based on their applications. It focuses on IoT based farm management systems, irrigation systems, crop monitoring and disease prediction.

'Security and Privacy for Green IoT-Based Agriculture: Review, Blockchain Solutions, and Challenges' presents research challenges on security and privacy issues in the field of green IoT-based agriculture. In addition, it analyzes the privacy-oriented blockchain-based solutions as well as consensus algorithms for IoT applications and how they will be adapted for green IoT-based agriculture.paper link

“Automated disease classification in (Selected) agricultural crops using
transfer learning” is based on different CNN based architectures namely AlexNet,VGG16, VGG19, GoogLeNet, ResNet, DenseNet, etc.,Which have been developed and adopted for solving the problem of disease classification in various crops to achieve higher prediction accuracy. The augmented image dataset was used for training and validation of the six deep learning models. These trained and validated models were deployed to classify the given image. This system uses immense processing power but compensates it with higher accuracy.

“Smart Sensing System for Precision Agriculture” is based on a sensing system using proximity sensors and low-cost smartphones to utilise all its sensors like accelerometers, gravity sensors, GPS,etc.
This paper concludes that new technologies need to be adapted as they arise and overlooked technologies resurrected. Large sections of the electromagnetic spectrum are being used, as well as ultrasonic, electrical resistivity, and physical measurements but others, such as magnetic susceptibility, seem to be underexploited, which might be useful for future investigation.

'A Survey on the Role of IoT in Agriculture for the Implementation of Smart Farming' aims to develop a complete precision agriculture system based on IoT and cloud computing. A lot of sensors are used in the system to monitor real time data of crops/ plants, animals, gases and climate. It can be also used in the greenhouses. The complete system is of great use for collection and organising the data.

'Internet of Things in Smart Agriculture: Enabling Technologies’ proposed an IoT technology research and innovation roadmap for the field of precision agriculture (PA) is presented. Many important objectives for hybrid technology research in smart agriculture are described. Effective internet of things based networks and sensing methods to mitigate challenges in the area of precision agriculture are presented.

'IoT Applications in Agriculture: A Systematic Literature Review’ provides farmers and researchers with a clear perspective of IoT applications in agriculture. It offers a literature review of IoT tools and applications for agriculture. The objective of this research paper is to focus on IoT applications in agriculture through topics such IoT-based software applications for agriculture available in the market, IoT-based devices used in agriculture, as well as the benefits provided by this kind of technologies.

'How Can Heterogeneous Internet of Things Build our Future: A Survey’ proposes a four-layer HetIoT architecture consisting of sensing, networking, cloud computing, and applications. It also suggests several potential solutions to address the challenges facing future HetIoT, including self-organizing, big data transmission, privacy protection, data integration and processing in large-scale HetIoT.

'Integrated optical sensor for NPK Nutrient of Soil detection' uses The mechanism uses colorimetry. The wavelengths of suitable colors are measured and thus we find respective nutrients. Fibre Optic sensors give precise readings in an enclosed space.

"Machine Learning-based Grape Leaf Disease Detection", is imagined to aid the identifying and arranging leaf illnesses utilizing a Multiclass Support Vector Machine (SVM) grouping system. The influenced area is calculated by K-means clustering, and later highlights like surface and shading are extricated. The framework can effectively characterize the analyzed infection with an accuracy of 88.89%.

In the Research paper "Detection of Leaf Diseases and Classification using Digital Image Processing", the segmentation of leaves is done using the K- Means algorithm. Texture features are extracted using GLCM(gray-level co-occurrence matrix)and then classification is done using SVM. The Framework is fairly simple as opposed to deep neural networks, yet it achieves an accuracy of more than 90%.

"Tea Leaf Diseases Recognition using Neural Network Ensemble" proposes a tea leaf disease recognizer (TLDR)an initiative to recognize diseases of the tea leaf. In TLDR, at first the image of the tea leaf is cropped, resized and converted to its threshold value in the image processing.Then feature extraction method is applied. Neural NetworkEnsemble (NNE) was used for pattern recognition. The extracted features are passed to the ANN along with the disease type and the ANN is trained.After going through the testing process 91 % of accuracy was found.

From all of the above papers we can infer that there are a lot of drawbacks when collectively viewed. Drawbacks like the system cannot survive through water splashes or rains, online as well as offline application working, centralised cloud database, updating the data with fresh records.

The system which we are proposing has 4 modules viz. Sensing module, Soil nutrient identification module, Crop/ plant suggestion module and disease prediction module.

III. CONCLUSION

We will be able to detect macronutrient levels and other soil parameters from the soil. We can predict suitable crops/plants according to the nutrient levels present in the soil. We will be able to predict if any diseases may or may not affect the crop as well as show suggestions to prevent the diseases.

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