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IoT Based Enhanced Deep Learning For Sugar Cane Yield Production

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Abstract—Crop plant diseases are a important threat to productiveness and sustainable development in agriculture. Early infection of disease attacks is useful for the effective control of the disease by taking proactive actions opposed to their attacks. Modern Information and Communication Technologies (ICTs) have a predominant purpose in Precision Agriculture (PA) applications to support sustainable developments. There is an immense need for solutions for the early infection of the disease attack for proactive control against the plant disease attack. This project focus to propose a DeepLearning (DL) approach for the early prediction of the chances of disease attack based on Internet of Things (IoT) directly sensed crop field environmental conditions. Plant disease lifecycles are strongly correlated with environmental conditions.The crop field environmental conditions are used to predict the occurrence of plant diseases. Internet of Things (IoT) based crop field environmental conditions help to exactly predict the occurrence of plant infection using the DL approach.

Keywords—machine learning, classification, image processing, deep learning, convolutional neural networks, disease classification, disease detection.

I. INTRODUCTION

In Indian economy the agricultural field plays an essential role. The aim of this agricultural field is to increase the agricultural yield without considering surrounding effects which causes environmental degradation. In today's world, agricultural land is farmore valuable than just the food industry. The Indian economy is heavily dependent on agricultural products. Whenever the leaf of any plant gets infected, this infection gets spread in all parts of that plant which will results in to decreasing the farmer's income. Therefore, the detection of plant leaf disease is very essential in agricultural sector [1- 2]. On a global scale, the various diseases inplant are not just warnings for food security but, it has catastrophic influences for emerging farmers whose daily bread depends on healthy crops. More than 80 percent of agricultural production in the developing world is produced by small holder farmers and reports of more than 50% of crop losses due to pests and diseases [3-4]. Plant germs include fungus, organisms, pathogens, germs, microbes, viruses, etc. Three nutrients are definitely required for appearance of diseases in plants and can be transmitted to all over the plant tissues such as leaves, shoots, trunks, canopy, roots, berries, beans, arteries etc. Therefore, diagnosis and disease detection is very important task [5]. A specialist eye examination is a majorly usedmethod in the diagnosis and treatment of plant illnesses. Still, this requires professional attention, which can be very expensive in large farms [6]. Using an auto-diagnostic method is beneficial in diagnosing plant disease early. One can examine the picture of the leaf with disease by using monitor image processing research and extracting the features from leaf image like color, appearance, andother features to detect the leaf diseases [7- 8]. As a result, the traditional method of diagnosing leaf diseases by a knowledgeable person is more costly and time consuming. In such a situation, the proposed process seems to favor large plantations. The automatic fetching of diseases just by looking at the indications on the leaves of the plant is easy and cheap. Visual verification of plant illness is very difficult and at the same time a little precise process and canonlybedoneinrestrictedareas.AlthoughwhentheleafdiseasesofAs a result, the traditional method of diagnosing leaf diseases by aknowledgeable person is more costly and time consuming. In such a situation, the proposed process seems to favor large plantations. The automatic fetching of diseases just by looking at the indications on the leaves of the plant is easy and cheap. Visual verification of plant illness is very difficult and at the same times a little precise process and can only be done in restricted areas. Although when the automatic detection method is used, even it takes less effort, it estimates time and greater accuracy [9]. In plants, other common infections are brown and like yellow spots, or premature or late extinction, or other fungus diseases, affected by microbes and viruses. Image processing is a method used to measure an infected area, as well as to determine the color differences of the infected area [10].

In earlier days the farmers were relying on the expert's inspection for detection of plant diseases. But this method is cost and time ineffective. Researchers have started using the techniques of Artificial Intelligence and Machine Learning to detect the plant leaf diseases faster and more intelligently. The techniques of Machine learning are successful in case of specific setups only; certain variation in some conditions may results into performance degradation of Machine Learning models. So, now the researchers are using the Deep learning with CNN in leaf disease detection as with CNN they can use huge amount of image data and can find out the distinguishing features from those images, avoids image processing and reducing the memory requirement. CNN detects the plant leaf diseases more accurately. So, in smart agriculture CNN is now popularly used for detection of plant leaf diseases [11].

Compared with various models of deep learning like Alex Net GoogLe Net. Researchers have used the dataset of apple leaves and they have achieved better accuracy than existing models. The training time and memory requirements of this framework are less. In future researchers can assess the other deep learning model like RNN with upgradation [1].

Arunabha M. Roy and Jayabrata Bhaduri have done the diagnosis of apple leaf disease using Advanced Reading, CNN. The current work allows an effect full and efficient way to diagnose a variety of plant diseases below complex conditions and could be enlarged tothe acquisition of a variety of fruits and vegetables, the diagnosis of common diseases, and automatic agricultural diagnostic procedures [2].

Me like Sardogan et.al. has presented CNN model and LVQ algorithm for detection of leaf diseases of tomato plant. Researchers have used 500 images of tomato leaves and identified the improvement of disease recognition rate. Various filters and distinct convolution sizes can be applied in classification phase [3].

Nikita Goel et.al has presented a method for automatic detection of diseases in plants. The main target of this work is detection of diseases in pomegranate leaf. Initially the initial processing was done.

The second stage occurs when the K- Means algorithm is used for all images available in image database. The third category involves the removal of features which combines color and shape features. This method helps in detection of various plant leaf diseases accurately. Researchers have compared Peng Jiang et.al has proposed the model which uses deep learning with CNN for leaf disease detection of Apple plant in real time. Author have used around 26000 images of apple leaves and detected 5 leaf diseases with great accuracy [6].

The deep learning models have become another attractive andeffective way to detect leaf diseases compared to the traditional models / techniques. The main reason behind this is the deep learning models are able to handle the huge amount of data withthe support of previously trained deep learning models [1- 3]. For input leaf images are taken from dataset and classification by using leaves like inserts, in depth research models examining different crops in agriculture. Accuracy rates in deep learning methods are higher than the traditional methods. And the traditional method is dependable on the character of the database; hence it shall not be the norm. The deep learning is very effective in classifying images [11-12].

II. METHODOLOGY

A. DATASET

The dataset contains 1,675 images in total, including 1,188 images of sugarcane leaves affected by one of five diseases (brown spot, yellow spot, yellow rust, orange rust, and red rot), and 487 images of healthy sugarcane leaves. The images are in JPEG format and have a resolution of 256x256 pixels. The dataset is split into training, validation, and test sets. The training set contains 1,244 images, the validation set contains 211 images, and the test set contains 220 images. Each image is labeled with its corresponding disease or "healthy" if it is a healthy leaf**.**

B. PREPROCESSING

The primary objective of using augmentation is to expand the dataset size and provide minor deformation to the images, it aids in the prevention of over-fitting during the training procedure. The image augmentation includes one or more transformation procedures, such as flipping, rotating, and so on. Pre-processing are keras functions that are used to produce and export augmented multiple images to a folder in order to create a large data set of changed photos. Additionally, the image pre-processing, method comprises manually cropping all of the images and squaring around leaves to highlight the area of interest.

C. TRAININGTHEMODEL

We develop an image classification model using the data set and a deep Convolutional neural network. Faster Region-based Convolutional Neural Network is one of many well-known state-of-the-art deep learning-based pre trained models that can be used in both research and industry. Deep learning models with thousands of variables (weights) frequently require a vast quantity of data and computational resources to train from beginning. Transfer learning is a method for speeding up this process by reusing a chunk of a model which has already been trained on a similar task in a new model.

D. DEPLOYMENTMODEL

Model obtained in the form of a stored model is in compatible with Android application integration. The stored model is transformed into .tflite format using the TensorflowLite framework. It is converted so that the .tflite format can only be deployed into android application. TensorflowLite is composed of two components. TensorflowLite interpret and TensorflowLite converter. Tensor Flowmodels into an efficient version (.tflite) for use by the interpreter, using optimizations to reduce binary size and enhance speed.

III. SYSTEMANALYSISPROBLEMDEFINITION

A. EXISTINGSYSTEM

The existing system is based on the detection of sugarcane leafdiseasesbyglancingatitwiththenakedeye. It canbeunreliableandtime-consuming.Practically,ithasanumberofcomplications like arranging for an expert eye to look at theleaves, waiting till help arrives, relying merely on an intuitivedeductionofthediseaseetc

B. PROPOSEDSYSTEM

In this project, we are trying to create a solution to fix the sugarcane leaf disease detection problems. We have collected a large dataset consisting of images of healthy and diseased leaves. We build an iPhone app for the detection of the disease a crop sugarcane leaf is afflicted with, based on a picture of the sugarcane leaf. The app will make use of DL algorithms to analyze and predict the disease a sugarcane leaf. It will use a model that has been trained on pre-identified diseased sugarcane leaf images. Based on it, any newly encountered diseased sugarcane leaf will be identified by its disease. We can give the input image as an uploaded image or we can photograph through the phone camera. The output will be the disease name it has been identified with. Hence we are able to classify and identify the disease. An option to lookup remedies for the disease will also be provided. An additional option for a front-end is also made-a RestApi service that hosts a website to allow entering of a picture name and display its output class.

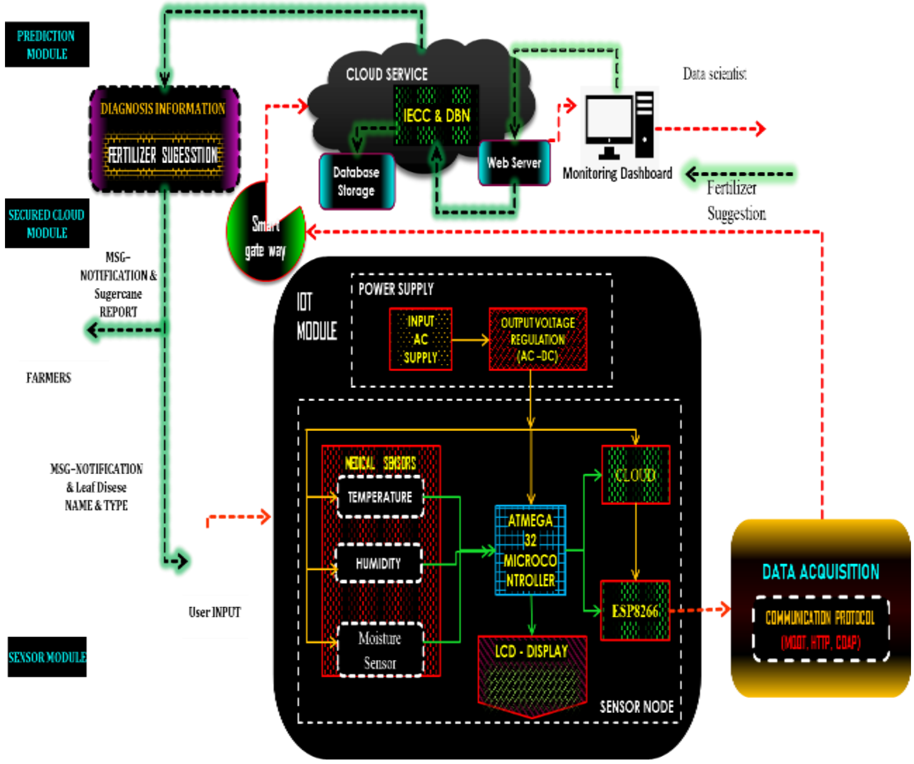

Fig1 SYSTEM ARCHITECTURE

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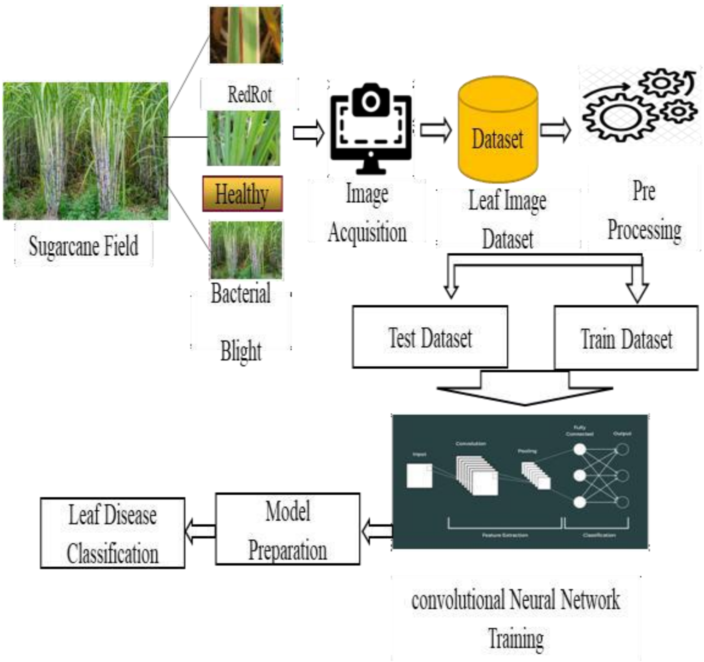

Fig.2. Convolutional Neural Network

IV. LITERATUREREVIEW

K. Renugambal et al. [1] has proposed an artificial intelligence fashion auto-discovery and sugarcane bracket splint conditions based on image processing have been proposed. Images of diseased leaf sugarcane are taken/captured by the camera. To reduce neighbor infection of leaves, pre-process the image using histogram image equalization, filter, color-changing, and/or segment methods. Using the Support Vector Machine classifier, the infected splint was also employed for the bracket. This might be accomplished by using the K-means clustering approach to join the splint area with theimpacted area in the diseased neighborhood of a splint. Finally, the impacted area's GLCM texture point is calculated to classify the situations. Both point analysis and segmentation fashions were used on various infected sugarcane shops during the development of this technique.

Evy Kamilah Ratnasari et al. [2] has proposed that this disease detection approach is based on a work digital image to determine the type of spot illness supported by a classified model. Rice disease and infection identification is achieved with the help of texture analysis (TA) utilizing descriptor fractal and "S" 4 color of spaceof HSV as a component with a minimum of 83 percent and infection leaf picture categorization. Technique categorize is an add-on that will not prevent fungal disease on sugarcane plants. With a precision of 95.25 percent, the determined segment location of a disease image.

K.Kavithaetal. [3] has proposed some image processing techniques to detect sugarcane disease, the system collects leaf images, processes the musing adaptive histogram equalization (AHE), anduses the k-means clustering algorithm for segmentation. It will bereplaced, according to the document. Gray Level Co-occurrence Matrix (GLCM) and Principal ComponentAnalysis are used to extract statistical variables such asvariance,skewness,standarddeviation,mean,andcovariance (PCA). Ultimately, the creator of the projectdecided on (SVM) for detection and classification with95%averageaccuracy.

Shima Ramesh et al. [4] has proposed using Random Forest in relation between diseased and healthy splint from the information created the sets during the article. That study includes a colorful depiction of the perpetration phase videlicet generate dataset, point birth, bracket, and or classifier. The illness and health plant part leaf information is combined with Random-Forest training to provide a more accurate image depiction of health and disease. Histogram-Acquainted-Grade was used for the image's features router. The use of an overall machine to educate a large set of data that was proven to be intimately transparent resulted.

Arpan Kumar et al.[5] The color degradation analysis of diseased leaves or plants, as shown in their study utilizing Processing Image, is an important step in manual identification of the disease and thus the type of disease. Soft computing approaches are frequently used to build expert systems and are crucial in the development of knowledge-based systems. Farmers will be ready to use this technology to find answers to their farming problems. Visual tools for disease detection are created by analyzing the leaves of sugarcane plants.

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Sammy Militante et al. [6] has proposed in their research that one of the issues in the sugar assiduity is sugarcane conditions that produce increased growth plants overran with complaint performance within the fiscal small scale farmers are conditions that aren't treated detecting earlier. The employment of depth literacy methods by a machine to study vision provides a solution to this challenge. This result was graded and tested in a shallow literate sugarcane sample predicting the datasets of complaint in damaged leaves and undamaged (health) leaves, yielding 95 percent accuracy. His working model was trained to detect and categorize infected and un-diseased sugarcane leaves in images. As a result, this work proposes a paradigm for assisting growers in detecting and classifying pests using deep literacy methods.

Snehal Pawar et al. [7] has presented a model to find out kinds of conditions, but the three most common are rust spots, unheroic spots, and ring spots. Although the complaint can be identified with the naked eye, the identification method will provide the best-estimated outcome. The current technique employs a digital imageof a splint to describe the discomfort, but not everyone will be able to obtain a high-detail digital image. Using are tired Markov model and a non isotropic prolixity method, we proposed a new approach to describe and classify the complaint. The stoner will be able to use a mobile camera to capture an image, and the image will be able to be named from the gallery.

V. RESULT

A Deep learning model for the sugarcane disease prediction of plants is proposed by directly sensing environmental conditions from crop fields. Regression line models are developed to identify the relationship between the environmental conditions and the development rate of the disease. Temperature, humidity, and rainfall are directly captured from the crop field using Internet of Things (IoT) capabilities.The crop field environmental data is used for training, testing, and validation of the proposed solution. The Deep learning model shows high prediction accuracy when tested against the test data set. The predictions made by the proposed solution are also judged by direct observation from the field data. Each year the observation is also incorporated into the model as a training data set to improve the performance of the proposed model. It is observed that the prediction accuracy increased year by year. The proposed solution aims to support sustainable development in agriculture.

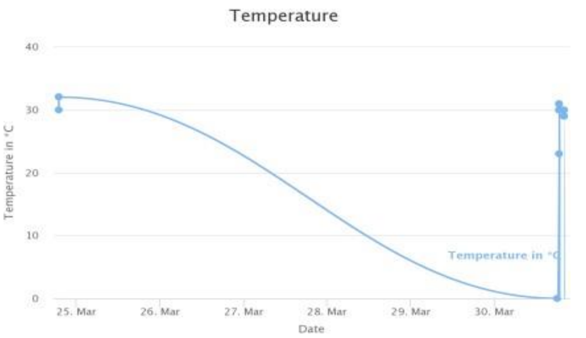

Fig.3. Temperature Value

Fig.4. Humidity Value

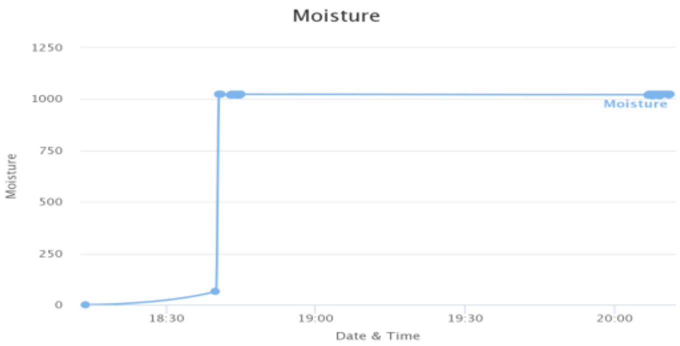

Fig.5. Moisture Value

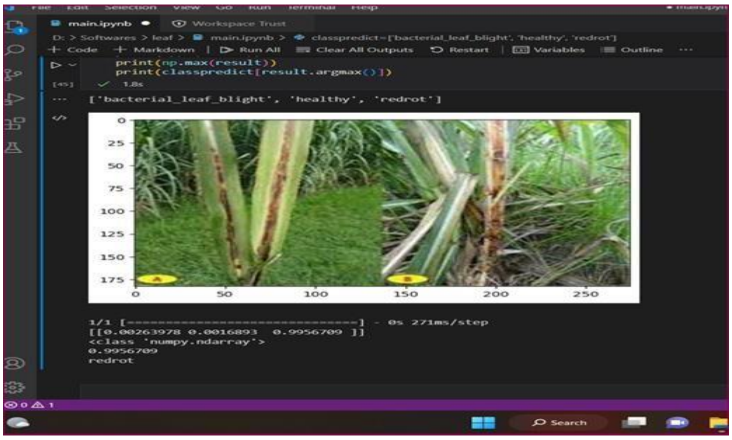

Fig.6. Leaves Diseases Detection

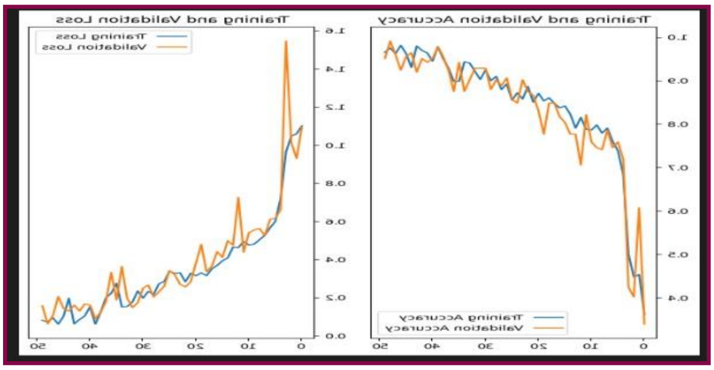

Fig.7.Training and validation Accuracy and loss

VI. CONCLUSION

This project proposes a CNN model to enable the detection of the disease that has affected a given sugarcane leaf image. A neural network is built and we train the neural network upon the data set. The generated model was saved and tested. The model is further deployed in 2 ways as a Webapp and as a RestApi. Python was used to develop the model. The dataset consisted of 7 classes of images, each of size 256x256. In total, there were 7000 images in the data set. In total, there were 7000 images in the data set. A user can upload the image to be checked on the Web app and view the predicted disease type and the suggested remedies too. Another alternative method to use the model is through the RestApi, where the user of the image file to check, on the site and the result is displayed on the site itself. The project model can be used to aid farmers in identifying the diseases that plague their crop/leaves and lead to a timely and convenient detection process and it is beneficial for botany students and people who take gardening as a passion.

These people can get real- time diseasedetection and remedy solutions provided to them. It saves up alot of time and money. It is beneficial in education people abouthow to take care of their plants in less time possible. Calling a specialist and waiting for him to analyze and then go ahead with a remedy can sometimes be too late and lead to major loss of crops.

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