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AI, AR Enabling on Embedded systems for Agricultural Drones

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Abstract — The agricultural sector nowadays is facing a lot of manpower issues as it has a lower income compared with other sectors. By using AI/ML in agriculture we can eliminate financial losses and increase agricultural yield. For every crop, farmers have to bear a larger amount of loss due to pests, animal intervention with the crops, as well as the inaccurate choice of crop. Every time a farmer cannot identify the diseases with naked eyes accurately. Approaching agriculture experts is not always financially feasible. Hence, the use of technology in the agricultural sector to address the said problems becomes very important. The crop disease detection is done with the help of the CNN algorithm and using N, P, K, soil-type, etc. features we can easily predict the suitable crop with accuracy. Surveillance at the border is an issue of national interest, with help of machine learning in the autonomous drone we can detect illegal human trespassing, while this won't completely replace the current system of human surveillance, but can reduce the use of manpower. Moreover, by using augmented reality, we can visualize future developments in the area.

Keywords—Border Surveillance, Crop prediction plant disease detection Visualization, Future developments, Augmented reality.

I. INTRODUCTION

Since agriculture provides the majority of the world's food, it was one of the most significant professions. The ever-growing population and modernization, however, have created several challenges for agriculture recently. Due to the lack of consistent income, many people are switching to different occupations. These issues are largely impacting the production of agricultural crops both qualitatively and quantitatively. The demand for food is expected to continue to grow as a result of population growth. Demand for cereals (for food and animal feed) is projected to reach some 3 billion tons by 2050. Annual cereal production will have to grow by almost a billion tons (2.1 billion tons today), and meat production by over 200 million tons to reach a total of 470 million tons in 2050, 72 percent of which will be consumed in developing countries, which is 58 percent today. As compared to the past four decades there is an increase of 3.3 billion which is increased at 90 percent rate so WHO has predicted a minimum of 2.3 billion which will lead us to 9.1 billion feeding people by 2050 and that will eventually lead to massive shortage of food all over the world.

One of the most important tasks in agriculture is the proper identification of plant diseases and the timely application of the necessary pesticide, but not every farmer has the financial means to consult an agricultural specialist or neither they themselves can detect the disease accurately. But with the help of AI/ML techniques we can identify the disease at the earliest stage possible and by using certain features we have trained a ML model which can predict the proper crop for the available conditions. By using AR which is the emerging technology we can showcase the visuals of future developments.

We've integrated a border surveillance system, crop prediction system, plant disease detection system, and for visualizing futuristic developments we have implemented augmented reality using Raspberry Pi-4.

II. SURVEY

The most crucial duty in the area of national security and defense is border monitoring. A nation's borders need to be constantly monitored in order to preserve peace and guarantee the protection of its citizens. It is crucial to defend border regions from suspicious operations, in which terrorist infiltrations and the unlawful movement. A certain number of troops or other armed security professionals are stationed in border areas to achieve this. This involves a lot of human work and resources. Because of the very imbalanced climatic conditions and the extremely lengthy, mountainous boundaries that stretch for kilometers the job become very difficult for humans to handle. This autonomous drone uses a CNN-based person identification system, which not only recognizes people but also recognizes weapons and people carrying weapons, and alerts the surveillance team, thereby limiting manpower.

The primary problem with Indian agriculture is that the farmers don't select the appropriate crop based on the requirements of the land, which reduces soil fertility. In reference with [1] “Artificial Intelligence based Crop Recommendation and Plant Leaf Disease Detection System” We are now using an advanced and improvised dataset for training which includes N, P, K Values, pH values, humidity,

rainfall, temperature, and soil type which is most efficient with random forest algorithm.

For the purpose of identifying and categorizing various plant leaf diseases, we are using a machine learning solution, With the reference [1] "Artificial Intelligence based Crop Recommendation and Plant Leaf Disease Detection System" using Convolutional Neural Network (CNN) was quite successful. By extending that, we have expanded the dataset, increasing the number of diseases it can identify in each plant and the range of crops it may be used to.

III. METHODOLOGY

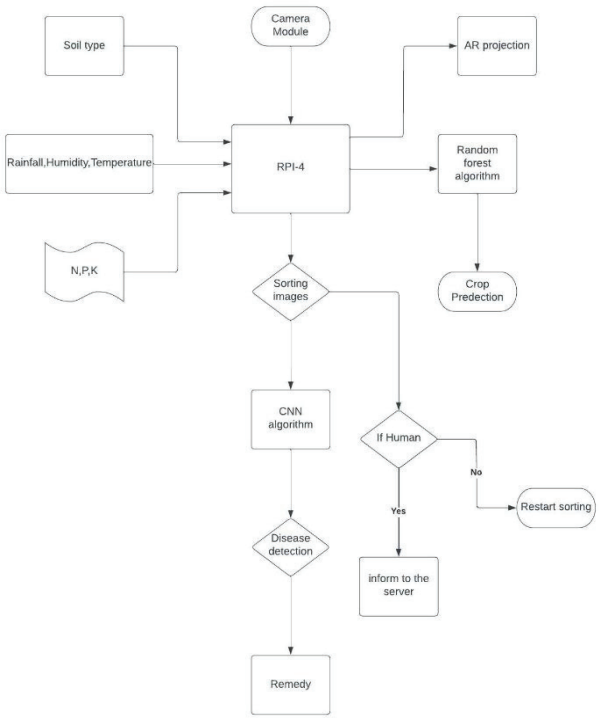

Fig. 1. Flowchart-1

A. Border Surveillance

Sensitive areas, like the country's border, are those that are least safeguarded. Trespassing is definitely a possibility. With the aid of a camera module, this autonomous drone continuously takes pictures of intruders and notifies the user.

Dataset - We used 3000 human photos to train the dataset, including images of people crawling, hiding in bushes, wearing ghillie suits, being armed, etc. Real-time collected photos will be added to the dataset and utilized for training to improve accuracy. Additionally, 200 various kinds of Weapon pictures were used to train the model.

The model is trained using 80% of the obtained data, and its accuracy is tested using the remaining 20%. In raspberry pi-4 CNN based mobilenetv1 neural network was used.

B. Disease Detection

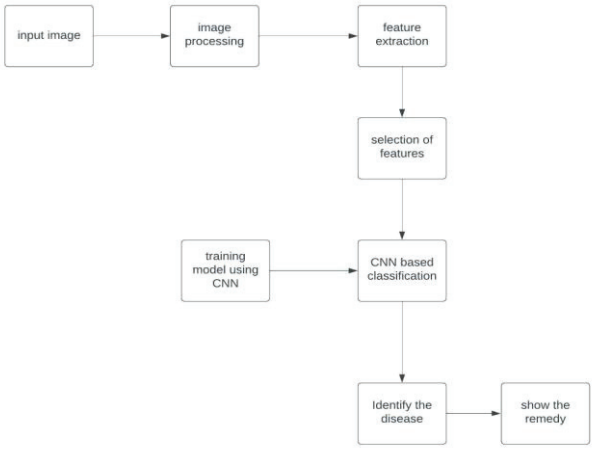

Fig. 2. Flowchart-2

Here, an autonomous drone will photograph every plant that differs from the original crop. It will then upload the photographs to a computer for image processing, feature extraction of just the sick leaves, and disease classification using a CNN-based model. This model will diagnose the condition and provide a cure. Drones will be able to address these problems early on, increasing crop output and productivity.

Dataset – Rice Yellow Mottle Virus (RYMV), Rice Blast, Sheath Blight, and other ten distinct forms of rice diseases are included in the data set that we are using. Each of them has 2000 pictures. Similar databases have been used to identify diseases in 20 more crops, including potato leaves and corn.

Convolution Neural Network (CNN) - We have categorized leaf diseases using Keras' Sequential models. Sequential aids in the layer-by-layer construction of the model. The photos were first loaded from the dataset before being resized. 20% of the photos are utilized for testing, while the other 80% are used for training. In order to generate new data from an existing dataset, we have also employed data augmentation techniques. The model's performance will be enhanced as a result. Rotating photographs, shifting them horizontally, zooming in up to 20%, flipping them horizontally, resizing images, and other factors were altered to gain this new data.

C. Crop Predictions For Soil

Crop selection is crucial in agricultural production. Finding crops that thrive in the local climate and environment is essential. Before planting crops, it's crucial to evaluate the soil fertility, the nutrients and chemicals present in the soil. The technique suggested in the study takes into account each of these factors and recommends the best crop.

Dataset - The dataset is a csv file which includes 8 factors, including soil type, temperature, rainfall in the area, soil pH, and humidity. The parameters are: nitrogen, phosphorus, potassium, soil type, temperature, and humidity. The database contains information on a total of 48 crops as well as the levels of the a four mentioned criteria for each of these crops. The dataset contains a total of 200 data points for each of these crops. Consequently, the dataset has 9600 unique data points. We utilized the average of all 200 data points for each crop instead of null values. As a result, for each crop, the optimal level of each parameter is found to be most appropriate. Algorithms for supervised learning are employed to advise the

crop. Data is divided into test train ratios of 80:20. Other methods, like Decision Tree, Random Forest, Logistic Regression, and K-Nearest Neighbor, are used to train the model.

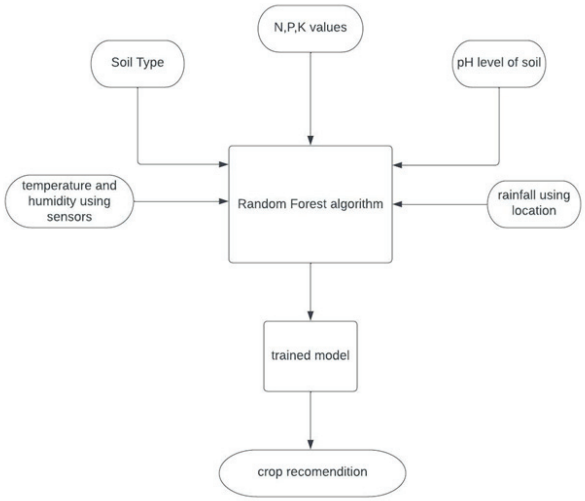

Fig. 3. Flowchart-3

The Random Forest algorithm proved to be the most effective after examining the outcomes of the training and testing phases. It is a classifier that uses several decision trees on various dataset subsets and calculates an average to increase accuracy.

D. AR Projections Of Upcoming Developments

Augmented reality is a very new technology and is in the development stage. We have used Vuforia, Unity-hub to design an application which projects augmented projection. The main aim to use this technology is we can visualize the future developments in the area without any 3D models. The usage of lidar sensor here will give the projection accurately.

IV. RESULTS

CNN has been utilized by us to monitor the Border surveillance and look for diseases in plants. contrasted with alternatives like KNN, logistic regression, etc. In order to anticipate crops, we employed the random forest method, which provided excellent and accurate results.

TABLE I. HUMANS AND ANIMALS DETECTION ACCURACIES

Types	**Accuracy**
Humans	85-90%
Goats	90%
Humans hiding in the bushes	75-80%
Armed humans	80-85%
Buffaloes	90%

Table–1 demonstrates the accuracy rates for recognizing people and animals.

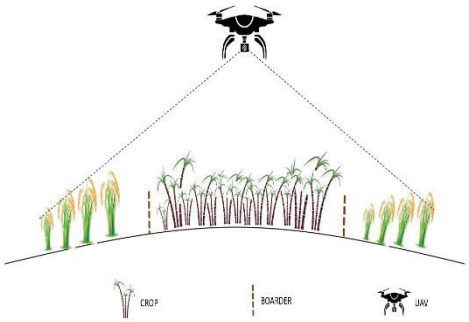

Fig. 4.

Fig–4 describes the usage of the depth sensor, i.e., the trained model can recognize what it should be even if there are obstacle in the way.

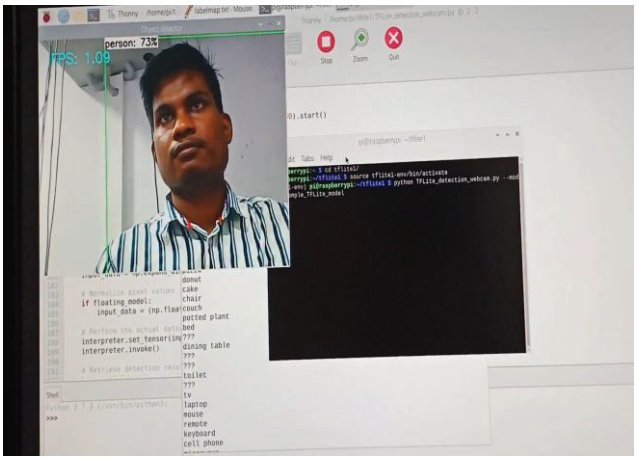

Fig. 5.

The fig–5 shows the detection of humans.

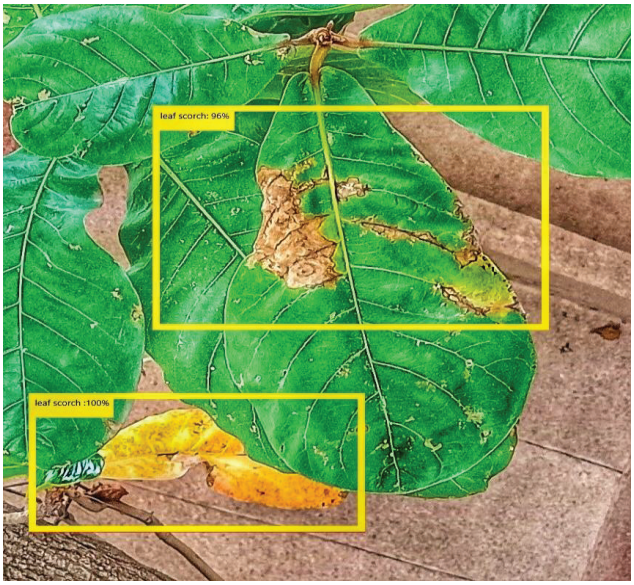

Fig. 6.

Here fig–6 shows the disease detection in an almond plant leaf which is infected with leaf scorch disease.

TABLE II. INTER CLASS ACCURACY OF RICE LEAF DISEASE

Disease Type	Accuracy
Rice Yellow Mottle Virus (RYMV)	100
Rice Blast	100
Brown spot	100
Sheath Blight	100
Sheath rot	100
Leaf scald	100
False smut	100
Kernel smut	100
Grain rot	100
Target Spot	80

The above table shows how accurately it can detect diseases of rice crops

TABLE III. RECOMMENDATION VALUES FOR WHEAT

Parameter	Value
Nitrogen (N)	264.55 lbs/ha
Phosphorous (P)	132.27 lbs/ha
Potassium (K)	66.14 lbs/ha
Soil type	Clay loam
Temperature	20-25 C
Humidity	50-60%
pH	6-7
Rainfall	25 to 150 cm/year

Table–3 Shows the average parameters values for a healthy wheat crop

Fig. 7.

Fig-5 represents AR projections for better interaction of farmers with AI tools. Here we have projected upcoming developments for better understanding.

V. .CONCLUSIONS AND FUTURE SCOPE

AR is an unexplored subject yet we know there are many uses with every field. Disease detection and crop recommendation are already explored fields, but with automation we can reduce human intervention. In near future we can explore water level in plants and warn farmer for watering the plants.

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