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Redefining Agriculture with Artificial Intelligence

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Abstract: Being passionate for tech he has seen the world around him transform digitally. But when it comes to agriculture, there's not much to see. Monoculture, a practice of growing just a single crop on a large chunk of land, is dominating much of the Indian agriculture. Along with that, farmers rely heavily on chemical-based fertilizers, which often converts into nitrous oxide, a greenhouse gas 300 times more potent than carbon dioxide due to lack of knowledge about the usage of organic fertilizers.

To prevent this, a farm management system has been created by him to ensure that crops and soil receive exactly what they need for optimum health and productivity. To make this possible at scale, Manas launched an initiative known as "Project Vasundhra" as a part of his startup. Project Vasundhra is a web-based no-cost app for farmers to analyze their soil online and find out suggestions from a tested and authentic database of more than 100,000 recommendations from experts in the agricultural industry.

The web app is easy to use and provides instant results. It predicts the crop to be planted, the type of organic fertilizer to be used based on the soil type, the pesticide to be used, and the storage process for each crop. It also provides a paragraph for suggestions explaining the prediction.

Keywords: Machine Learning, Precision Agriculture, Farming, Smart Predictions.

I. INTRODUCTION

Arthur Samuel, a pioneer in the field of artificial intelligence and computer gaming, coined the term "Machine Learning". He defined machine learning as – "Field of study that gives computers the capability to learn without being explicitly programmed".

In a very layman manner, Machine Learning (ML) can be explained as automating and improving the learning process of computers based on their experiences without being actually programmed i.e., without any human assistance. The process starts with feeding good quality data and then training our machines(computers) by building machine learning models using the data and different algorithms. The choice of algorithms depends on what type of data
do we have and what kind of task we are trying to automate.

Precision agriculture (PA), satellite farming or site-specific crop management (SSCM) is a farming management concept based on observing, measuring and responding to inter and intra-field variability in crops. The goal of precision agriculture research is to define a decision support system (DSS) for whole farm management with the goal of optimizing returns on inputs while preserving resources. [1]

Advantages of precision farming:

- Helps increase agriculture productivity in sustainable manner.
- Prevents soil degradation.
- Reduction of chemical application in crop production.
- Efficient use of water resources.
- Dissemination of modern farm practices to improve quality, quantity and reduced cost of production.
- Developing favourable attitudes.
- Precision farming changing the socio-economic status of farmer

Precision farming in India:

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- Some of the schemes like PMKSY's (Per Drop More Crop) involve Precision Agriculture practices.
- The Indian Council of Agricultural Research (ICAR) and the Indian Agricultural Research Institute (IARI) has formulated a project entitled "SENSAGRI: SENsor based Smart AGRIculture".
- The major objective is to develop indigenous prototype for drone-based crop and soil health monitoring system using hyperspectral remote sensing (HRS) sensors.
- Drone technology is also being used. It has ability for smooth scouting over farm fields, gathering precise information and transmitting the data on real time basis.
- Mobile apps are being used to provide farmers with weather information and provide early warning

Drawbacks of precision farming:

- High cost
- Lack of technical expertise knowledge and technology
- Not applicable or difficult/costly for small land holdings
- Heterogeneity of cropping systems and market imperfections Conclusion
- The need of the hour is to adopt state of the art technology to make agriculture sustainable and profitable.
- Agricultural renaissance can take shape on a strong digital foundation.
- Adoption of technology will help in sustaining food security and enhanced livelihood opportunities.
- In addition, the farming community needs to diversify and take up allied activities like fisheries, dairy and poultry as well to double the on-farm incomes

II. PROPOSED MODEL

Requirements of packages for the model:

- Flask==1.1.2
- flask_bootstrap==3.3.7.1
- flask_sqlalchemy==2.4.4
- numpy==1.19.4
- pandas==1.1.4
- scikit_learn==0.20.0

Train-Test Data Split: train_test_split is a function in Sklearn model selection for splitting data arrays into two subsets: for training data and for testing data. With this function, you don't need to divide the dataset manually.

```
X = data.drop('crop_type', axis=1).values
y = data.crop_type.values

# splitting data as X_train and X_test
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.2,random_state = 0)
```

Feature Scaling: Feature scaling is a method used to normalize the range of independent variables or features of data. In data processing, it is also known as data normalization and is generally performed during the data preprocessing step.

```
# Feature Scaling
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)
```

Machine Learning Concept (Support Vector Machine): Support vector machines (SVMs) are powerful yet flexible supervised machine learning algorithms which are used both for classification and regression. An SVM model is basically a representation of different classes in a hyperplane in multidimensional space. The hyperplane will be generated in an iterative manner by SVM so that the error can be minimized. The goal of SVM is to divide the datasets into classes to find a maximum marginal hyperplane (MMH).

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The followings are important concepts in SVM –

- Support Vectors − Datapoints that are closest to the hyperplane is called support vectors. Separating line will be defined with the help of these data points.
- Hyperplane − As we can see in the above diagram, it is a decision plane or space which is divided between a set of objects having different classes.
- Margin − It may be defined as the gap between two lines on the closet data points of different classes. It can be calculated as the perpendicular distance from the line to the support vectors. Large margin is considered as a good margin and small margin is considered as a bad margin.

The main goal of SVM is to divide the datasets into classes to find a maximum marginal hyperplane (MMH) and it can be done in the following two steps –

1. First, SVM will generate hyperplanes iteratively that segregates the classes in best way.
2. Then, it will choose the hyperplane that separates the classes correctly.

Support Vector Machine (Model):
model = SVC(C=2.0, cache_size=200, class_weight=None, coef0=0.5, decision_function_shape='ovr', degree=3, gamma='auto_deprecated', kernel='rbf', max_iter=-1, probability=False, random_state= 50, shrinking=True, tol=0.11, verbose=False)
#model = SVC(kernel='linear', decision_function_shape='ovo', C = 0.02, gamma='scale', cache_size=200, coef0=0.0)
model.fit(X_train,y_train)
"""with open('crop_recommender.pkl', 'wb') as f: pickle.dump(model, f) pickle_in = open('crop_recommender.pkl', 'rb') clf = pickle.load(pickle_in)"""

Accuracy Metric Used (Confusion Matrix): In the field of machine learning and specifically the problem of statistical classification, a confusion matrix, also known as an error matrix, is a specific table layout that allows visualization of the performance of an algorithm, typically a supervised learning one (in unsupervised learning it is usually called a matching matrix). Each row of the matrix represents the instances in a predicted class while each column represents the instances in an actual class (or vice versa). The name stems from the fact that it makes it easy to see if the system is confusing two classes (i.e. commonly mislabeling one as another). If you have an imbalanced dataset to work with, it's always better to use confusion matrix as your evaluation criteria for your machine learning model. It gives you a very simple, yet efficient performance measures for your model. It also helps to provide a clear idea if the model you have created is performing well on your primary goal.

prediction_svm=model.predict(X_test)
#print(accuracy_score(y_true, y_pred))
print(accuracy_score(y_test, prediction_svm))
cm = confusion_matrix(y_test, prediction_svm)
print(cm)

III. CONCLUSION

Precision farming is still only a concept in many developing countries and strategic support from the public and private sectors is essential to promote its rapid adoption. Successful adoption, however, comprises at least three phases including exploration, analysis and execution. Precision agriculture can address both economic and environmental issues that surround production agriculture today. Questions remain about cost-effectiveness and the most effective ways to use the technological tools we now have, but the concept of "doing the right thing in the right place at the right time" has a strong intuitive appeal. In the light of today's urgent need, there should be an all-out effort to use new technological inputs to make the 'Green Revolution' as an 'Evergreen Revolution'. Ultimately, the success of precision agriculture depends largely on how well and how quickly the knowledge needed to guide the new technologies can be found. Precision farming provides a new solution using a systems approach for today's agricultural issues such as the need to balance productivity with environmental concerns. It is based on advanced information technology. It includes describing and modelling variation in soils and plant species, and integrating agricultural practices to meet site-specific requirements. It aims at increased economic returns, as well as at reducing the energy input and the environmental impact of agriculture.

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BIOGRAPHY

I am an IBDP (International Baccalaureate Diploma Programme) Year 2 student and hold the post of Head Boy at Sangam School of Excellence. Being a topper since always, I am also a guitarist, basketballer and a passionate programmer.

I am a natural leader and possess the ability to think clearly and maintain composure even in the most stressful times which helps me to carefully resolve any predicament that comes in my way. To make the best of any situation that life throws at me, I handle it with great dexterity.

Along with a strong command of international affairs in my arsenal, I also have a clever thinking and superb oration. Once I put my mind to a task, no impediment can deter me from reaching the goal. From whatever studied, and all the extra courses done, I aim to bring an impact in the world as I believe there is no significance of education until & unless it is used to bring a change in the world and help people across the globe.