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Using Machine Learning Models to Predict Growth of Plant and Output in Greenhouse Environments

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A B S T R A C T

Accurately forecasting how plants will develop and what kind of harvest they will produce is a crucial issue for greenhouse growers and farmers are general. In order to control the environmental improve higher production, match supply and market demand, and reduce costs, producers could benefit from the development of models that can properly model growth and yield. Recent advancements in ML, and especially Deep Learning (DL), can give potent analytical tools are new. This proposed research makes use of Machine Learning(ML) and DL methods to estimate production and plant growth variance in two greenhouse settings: tomato yield forecasting and Ficus benjamina stem growth. To improve upon traditional methods of making predictions, we make use of a brand new, state-of-the-art deep Recurrent Neural Network (RNN) based on the Long Short-Term Memory (LSTM) neuron model. The RNN design takes into account both the historical values for yield, growth, and stem diameter, as well as the microclimate circumstances, while modelling the desired growth parameters. In order to assess the efficacy of various ML techniques, such as Support Vector Regression and Random Forest Regression, a comparative analysis is presented that use the mean square error criterion. Extremely encouraging findings are given based on information collected from two greenhouses in Belgium and the United Kingdom as part of the EU Interreg SMARTGREEN project (2017-2021).

Keywords: Deep Learning(DL), Ficus Benjamina, Support Vector Regression, Random Forest Regression, Machine Learning(ML), Recurrent Neural Network(RNN), Long Short-Term Memory(LSTM).

1. INTRODUCTION

In this paper author is predicting ficus plant growth/crop yield by evaluating performance of various machine learning algorithms such as SVR (Support Vector Regression),Random Forest Regression (RF), and LSTM(Long Short-Term Memory) deep neural network algorithm. SVR and RF are the traditional old algorithms whose performance of prediction will be low due to unavailable of deep learning technique. To overcome from this problem author is using LSTM deep neural network algorithm to predict plant growth .

Deep learning extends classical ML by adding more “deep” (complexity) into the model, as well as transforming the data using various functions that create data representations in a hierarchical way, through several levels of abstraction. A strong advantage of DL is feature learning, i.e., automatic feature lower level features. DL can solve complex problems particularly well and fast , due to the more complex models used, which also allow massive parallelization. These complex models employed in DL can increase classification accuracy, DL includes different components , such as convolutions , pooling layers , fully connected layers , gates , memory cells , activation functions , encoding/decoding schemes , depending on the network architecture used, e. g ., Convolutional Neural Networks , Recurrent Neural Networks and Unsupervised Networks .

2. PROPOSED WORK

- We used ML algorithms like Support Vector Regression(SVR), Random Forest Regression(RF) DL algorithms like Long Short-Term Memory(LSTM), Convolutional Neutral Networks(CNN).
- We used ficus dataset
- We trained our model using the dataset and predict the result based on the input given.
- The Error rates are predicted in the form of Bar Graphs.
- The Output Yield is shown in graphical form.
- In addition to the above mentioned algorithms, we used some more algorithms like Decision Tree(DT), Logistic Regression(LR) and Multi-Layer Perception(MLP) techniques.

3. EXISTING WORK

- In previous works, different algorithms of ML and DL are used such as Random Forest Regression, ANN, RNN for prediction of yield.
- Different plants datasets like Tomato are used for Prediction of Yield.
- The yield is predicted in the form of percentages i.e., only text output.
- Tompousse model was used for simulation of weekly production of green house tomtoes.

4. IMPLEMENTATION

Modules of this Project

1) upload dataset: using this module we will upload FICUS plant dataset
2) Dataset cleaning: using this module we will find out empty values in the dataset and replace with mean or 0 values.
3) Train & Test Split: Using this module we will split dataset into two parts called and training and testing. All machine learning algorithms take 80% dataset to train classifier and 20% dataset is used to test classifier prediction accuracy. If classifier prediction accuracy high then Mean Square Error, Root Mean Square Error and Mean Absolute Error will be dropped.
4) Run SVR Classifier: Using this module we will train SVR classifier with splitted 80% data and used 20% data to calculate it performance
5) Run Random Forest Classifier: Using this module we will train Random Forest classifier with splitted 80% data and used 20% data to calculate it performance
6) Run LSTM Classifier: Using this module we will train LSTM classifier with splitted 80% data and used 20% data to calculate it performance
7) Predict Plant & Yield Growth: Using this module we will upload test data and then apply LSTM classifier to predict it growth value

5. PACKAGES USED IN PROJECT:

- Pandas :
  Pandas are used for reading CSP files that is comma separated valued files.
- Numpy :
  Evaluating Algebraic expression here we used calculating error rates.
- Sklearn :
  SKlearn is used for analyzing Machine Learning algorithms.
- Keras :
  Keras Used for analyzing Deep Learning algorithms.

6. CONCLUSION

An LSTM-based DL method was created in this study, and it was successfully applied to predicting the development of Ficus trees (as represented by the SDV) and the yield of tomatoes. The experimental results demonstrated that the DL method (with an LSTM model) beat the more conventional ML methods (MSE, RMSE, and MAE) in terms of accuracy. Therefore, our project's primary objective is to makes DL methods for forecasting occurs as the stems and roots lengthen and yield in greenhouse settings. Research into the long-term effects of a) greatly increasing the data collected is used number of the planned DL methods; and b) expanding the DL method so as to perform multistep (at a weekly, or a multiple of weeks basis) prediction of growth and yield in a wide range of greenhouses in the UK and Europe is warranted.

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