Machine Learning Approach for Agriculture IoT using SVM&ANN

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Abstract:- **The rapid growth of Internet of Things (IoT) devices in cities, homes, buildings, industries, health care, automotive and also in agricultural farms have paved the way for deployment of wide range of sensors in them. In return IoT turns out to be the major contributor of new data in any of these fields. A data driven farm management techniques will in turn help in increasing the agricultural yield by planning the input cost, reducing loss and efficient use of resources. IoT on top of increasing the volume of data it also give rise to big data with varied characteristics based on time and locality. To increase the agricultural yield by smart farm management astute analysis and processing of the data generated becomes imperative. With high performance computing at machine learning has created new opportunities for data intensive science. Machine learning will help the farm management system to achieve its goal by exploiting the data that is continuously made available with the help of Agricultural IoT (AIoT) platform and helps the farmer with insights, decisive action and support.**

Keywords: Agricultural IoT, Big Data, Internet of Things, Supervised Machine Learning.

INTRODUCTION:

The One of the long-standing objectives of computing is to simplify and enrich human activities and experiences. The Internet of Things (IoT) is the talk of the town now and has made a massive inroad in the last decade in the field of modern wireless telecommunications. IoT is an integration of various embedded technologies such as the physical object, sensing and actuating, networking and computation connected to the internet. The strength of this technology will be its ability to have an impact in a simple decision making in everyday life to something as consequential as health monitoring and there by enriching human life and endeavors. It is predicted that by 2025 billion of devices ranging from a simple

paper document to a complex industrial machine will be connected to an internet node.
This paves way to greater contribution to the economic growth by bridging the gap in various technologies given the advancement in technology. While making quite an impressive contribution in smart cities, industrial IoT, data driven Agricultural IoT(AIoT) is the next big thing. With the ever increasing population, upward mobility and depleting environmental condition has made feeding in 2050 a challenge. By 2050 farm yield can be increased by at least by 67% while reducing the agricultural losses with data driven agricultural techniques as reported by International Food Policy Research Institute. A sensor based precision agriculture for sub-surface drip irrigation system indicated water saving by 35.7% while an increase in farm yield by at least 45%. Furthermore data driven techniques can be equivalently applied to various other farm inputs like seeds, climate, soil nutrients, etc. to bridge the yield gap. Precision agriculture has gain popularity with the rapid development of IoT techniques and it has made remarkable contribution in monitoring plant health, yield predication, irrigation planning, fertilizer usage, etc. there by contributing to increase in yield and reducing loss. Notably AIoT doesn't limit its support in the agriculture filed whereas it can make immense contribution to the agro-industrial production chain. In the field it helps in monitoring and controlling field variables like soil condition, environmental conditions, and biomass of plants or animals.

It further contributes during the produce transport by analyzing and managing temperature, humidity, disturbance and pest. While using various data analytic techniques it is important to understand the various data characteristics and apply a suitable algorithm to make an efficient AIoT data analysis. In this article the need for data driven farm management system with the help of AIoT is underlined and the architecture of AIoT is described in detail.The shelf life and demand of the produce can be monitored and predicted based on the origin and properties of the produce, the end users or consumers will be greatly benefited by these information. The IoT based agro-farm and agro-industry as whole can bring in a smart rural community. To make the AIoT more intelligent system it's important to apply data science to the data generated from the various parts of the Agro-farm and Agro-industry.

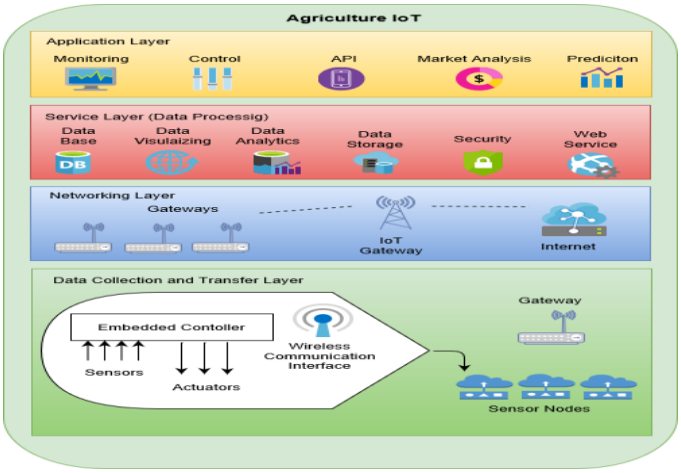
Data science is the field which is a combination of data mining.While using various data analytic techniques it is important to understand the various data characteristics and apply a suitable algorithm to make an efficient AIoT data analysis. In this article the need for data driven farm management system with the help of AIoT is underlined and the architecture of AIoT is described in detail. Taxonomy of machine learning is neatly illustrated and how the different types of machine learning algorithms are made used in an agrarian framework.

RELATIVE STUDY:

A IoT can be broadly classified into four layers Data Collection and Transfer Layer, Network Layer, Service Layer and Application Layer. The data collection layer houses the sensor nodes or WSN, each sensor node comprises of an embedded controller, various sensors ranging from a simple temperature sensor to camera, actuators like motors, sprinklers, etc. and any wireless communication interface which may can be WiFi. The various types of data collected should be made be available in the internet to make this possible, the local WSN gateways transmits them through an internet gateway which may be either a mobile network or an Ethernet based connection and this constitutes the network layer. To make sense of the collected data in the service layer it is necessary to do some data processing like data visualization, data analytics, data storage and protection, etc. Finally the application layer is where it all maters here is the end user can monitor and control the various process in the agro-farm and also make important decisions based on the predictions, market trends and local agricultural departments.

A IoT leads to an increase in wide variety of data generation from different sources in and around an agricultural farm in the form of voltage values to images, status of actuator to a position of robot, etc. The data generated may be of continuous value which will contribute to a greater increase in data volume, continuous data from GPS to hourly soil moisture and temperature value update. The data collected will be dynamic in nature for example a fertilizer spraying quad copter location varies instantaneously. The factors that affect the data quality are the redundancy of data, data accuracy, dynamic and crude nature of data. It is imperative that at all times the quality of data is maintained though the data generated are from heterogeneous sources. The factors that most likely influence the quality of the data are the noise from the environment, measurement errors, heterogeneous data scalability, data stream processing and sensor node failures.

Now applying machine algorithms to these improved data sets will result in better analysis and accurate prediction.



MACHINE LEARNING FOR AIOT

Machine learning is a part of Artificial Intelligence and can be classified under computer science. It has the ability to render machine to learn. Without definite computer programming and thereby enhancing machine performance with detection and characterize the consistencies and patterns in trained data. Machine learning can be classified into three different categories based on their learning method.

A. SUPERVISED LEARNING:

When data is available they can always be trained. For example let ‘x’ be the input data and ‘y’ be the output data, the mapping function from the output to input is learned using an algorithmy = f(X)

The mapping function is approximated such that when a new set of input ‘x’ is given the output ‘y’ can be predicted. Supervised learning can be subsequently categorized into regression and classification problems.

- Classification: A classification problem is when the output variable is a category, such as “Mango” or “Apple” and as “disease” or “no disease”.
- Regression: A regression problem is when the output variable is a real value, such as “dollars” or “weight”.

B. REINFORCEMENT LEARNING

For a given set of data ‘x’ the algorithm learning problem is to find the best possible actions based on the best possible action to be taken by which you get to maximize expected turnouts. Here the learning algorithm uses trial and error method to find the optimal output. A general feature of reinforcement learning is the trade-off between exploration, in which the system tries out new kinds of actions to see how effective they are, and exploitation, in which the system makes use of actions that are known to yield a high reward prediction of rice development process with the assistance from the Chinese weather station basic geographical information. Describes an efficient automatic coffee fruit counting technique, this information help the farmer to plan the agriculture process and efficiently reduce loss. Presents a crop yield prediction and pest control analysis system with neural network based on the environmental condition.

MACHINE LEARNING MODELS IN AGRICULTURAL FRAMEWORK

Machine learning application in agro-farm can be widely found in areas like yield detection, disease detection, weed detection, irrigation planning, soil condition, quality of crop and weather prediction. After yield one can find machine learning used in analysing the produce freshness (fruit and vegetable freshness), shelf life, produce quality, market analysis, etc.

A.CROP AND YIELD MANAGEMENT

Yield monitoring and prediction in agriculture plays vital role by giving information to the user to make decisive action and thereby reducing loss. Proposes a SVM based system makes use of actions that are known to yield a high reward prediction of rice development process with the assistance from the Chinese weather station basic geographical information. Describes an efficient automatic coffee fruit counting technique, this information help the farmer to plan the agriculture process and efficiently reduce loss. Presents a crop yield prediction and pest control analysis system with neural network based on the environmental condition. An Artificial Neural Network (ANN) based generalized agriculture yield forecast was presented.

B.WATER MANAGEMENT

Water being a depleting resource in most part of the world it is important to store and use the available water resources optimally. An ANN based weekly evapotranspiration forecast with at least the data of minimum and maximum air temperature from local meteorological department for better water management in arid region. Another water management model is based on the input of various weather data like the average air temperature, relative humidity, atmospheric pressure, etc. to forecast the daily dew point temperature with the help of ANN.

RESULT AND DISCUSSIONS

The survey uses dataset of three varieties of wheat kernels and they are Kama, Rosa and Canadian. 70 samples of each variety were arbitrarily selected for this survey work. A non-destructive method which uses soft X-ray for better visualization is used to identify the interior structure of kernel.

SUPPORT VECTOR MACHINE (SVM)

SVM is another dynamic supervised learning algorithm for precise solving of classification problems. It aims at creating a model to predict the output data value with the given input data sets. A hyperplane splits the input sets with a wide margin on either sides of the binary class to improve the accuracy. Now the predicted output data value of the new unseen input datasets is determined by finding on which of the hyperplane it falls. If the data are non-linear in nature which is likely in most cases, kernel is used to map them to high dimensional space. SVM algorithm was applied to the wheat dataset and it resulted with an accuracy of 88.57%. Fig.1 shows the confusion matrix of the SVM model.

FIG.1 CONFUSION MATRIX OF KNN

	KNN			
True Label	1	0.56	0.06	0.039
	2	0.00	1.0	0.00
	3	0.07	0.00	0.93
	Predicted Label			

A. ARTIFICIAL NEURAL NETWORK

To solve highly analytic models Artificial Neural Network is used, which mimics the human neural system . ANN consists of three layers namely Input layer, Hidden layer, Output layer. In ANN weights and learning rates are initialized with some small values near to zero . Input is fed to the input layer and output is calculated by feed forward through the hidden layer. The output is then compared to the expected output, and the error is calculated. This error is feedback to the hidden layers and the weights are updated accordingly. The decrease in the error can result in the convergence of the algorithm with the termination of learning process. With slower learning rate it is possible to get accurate results. An accuracy of 94.8% was obtained when applying ANN to \the wheat kernel dataset, the confusion matrix for the ANN model is show in fig.2.

FIG.2 CONFUSION MATRIX OF ANN

	Random Forest			
True Label	1	0.92	0.01	0.07
	2	0.05	0.95	0.00
	3	0.05	0.00	0.95
	Predicted Label			

CONCLUSION

While AIoT is the next big thing in the modern agricultural farm management system, applying machine learning algorithm to the data generated from the different inputs of a farm set up with the help of AIoT makes the system more intelligent, provides decisive information and predicts the upcoming outcome. In this study various machine learning algorithm were analysed, each have their own pros and cons from the process to the outcome. This means that the user have to understand each models before applying them to their application to get best out of the model used. For example ANN though being very complex and has a very high training time, but is probably the most stable model for uncorrelated data. SVM has a very long training time though it boost of better performance, the training period can be reduced by improving the data quality.The various machine learning models can be improved using appropriate performance enhancing algorithms. With depleting resource it is evident that artificial intelligence in the field of agriculture is the future for decision making and production improvement. Artificial intelligence together with AIoT can be called data driven farm management system.

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