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AN ANALYSIS AND PREDICTION OF MACHINE LEARNING APPLICATIONS OF AGRICULTURE

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Abstract:- Machine learning (ML) makes machines independent and self-learning component. Researchers applying machine learning algorithms to solve various real word problems in various domains. Nowadays agriculture affects by various factors such as global warming, climatic changes, lack of manpower, etc. To help the farmers from the above factors and increase agriculture production, recently many machine learning techniques are utilized in the agricultural field. In this paper, we studied different applications of machine learning techniques in the agriculture domain. We classified applications of machine learning algorithms in agriculture by four categories namely, machine learning in plant monitoring, machine learning in soil analysis, machine learning in detection (or) prediction process in agriculture, machine learning in animal monitoring. We also analyzed the important features of machine learning applications in agriculture.

Keywords- Machine Learning, Decision Tree Ensemble, Random Forests, Prediction, Hyper-spectral images, Agricultural health, Precision agriculture, Image recognition

I. INTRODUCTION:-

Nowadays, precision agriculture aims at increasing productivity and maximizing the yields of a crop. The entire crop cycle can benefit from an application of the correct amount of spray (such as water, fertilizers, pesticides or fungicides) at the proper time and place. In parallel, research on multispectral image analysis of agricultural fields is starting to detect diseases in plants [1]. Farmers generate maps of spatial variability's based on geo-located sensors. These sensors collect many variables and provide historical and real time information. Recently, Unmanned Aerial Vehicles (UAV) have enabled precision agriculture. These drones are equipped with multispectral or RGB cameras to collect aerial images and create maps of the selected region [2]. High precision agriculture applies mainly to yield monitoring or remote sensing. It is only started to be applied to vineyards on complex landscapes and difficult topographies. To provide better management of vineyards and other cultures, new services are under development around the world. For example, a service for the automatic collection of data related to culture for automatic spotting, designation of zones, and prediction of the evolution of a zone is in preparation [1].Currently, projects are based on satellites providing high quality images to automatically detect specific zones and generate advanced geographical data [3] [4]. Today, image recognition field massively uses Machine Learning (ML) algorithms, for online images matching or satellite image mapping [5] for example. The current research is based on the needs above and focuses on the detection of the vine and potential disease on images taken by Unmanned Aerial Vehicles (UAV). UAV are used for multiple reasons such as the price and the accessibility of this type of product, compared to satellites. With an auto generated flight plan, the drone can fly over a specifically defined zone of the field, carrying products and spraying it out to the designated area. The present paper will describe how the application of Machine Learning to images taken by a UAV improves the overall performance of automated drone plan generation

II. Related Work:-

In [1] paper investigates the author discuss about Zambia's Crop Forecast Survey (CFS) and its limitations. In this proposed method at the end of season harvest the data is collected. The data about crop yield and area of production is collected from the actual harvest from households in real time. Using this data a forecast model for yield is developed using Extreme Gradient Boost. To test the accuracy values RMSE is used. From results it is found that CFS accuracy is less compared to gradient boost. In [2] this paper, the corn yield prediction is made using deep neural network model from environment and genotype data. The dataset consist of 148,452 samples for training. Yield performance is calculated using yield and check yield using deep neural networks. Neural network in his paper is also used for weather prediction. The model accuracy is tested using RMSE 11 % error for single hidden layer with 300 hidden neurons. In [3] The paper compares the accuracy in forecasting the price of agricultural products using Auto ARIMAmodel and back propagation (BP) network method. A web crawler technology is also used to get prediction of price for the crop commodities. . The data is collected about the cucumber crop. The data obtained is normalized in order to scale it down to (0, 1) range. The dataset is consist of linear data on which ARIMA algorithm is applied for forecasting. The ARIMA model does not consider the rapid changes in the prize of the crop that arises due to instability in seasons. In order to consider such changes BP network model is applied to the data. BP network model contains set of input, hidden and output layers. The number of output layers is increased in order to check whether the price prediction for long-term is accurate or not.RNN model used to process sequential data is applied on the normalized data to obtain the price. The results show that the foresting for monthly, weekly and daily price of crop ARIMA does well if it is for short term but accuracy is not proper for long term. So, BP neural network is used for such issues which gives high accuracy. In [4] Agribusiness is the foundation of Indian economy. The agrarian yield is fundamentally relies uponclimate conditions like temperature, rainfall, biomass. The agriculturists essentially require an advantageous incite to anticipate the future yield profitability and an investigation to help the farmer's to enlarge harvest creation in their products. Despite the fact that a great deal of research has been led for building up the choice emotionally supportive network for agriculturists, the greater part of the examination centre around the harvest administration, edit illness administration and product yield estimating. The agriculturist's harvest determination at the prior stage is a standout amongst the most critical components since proper product choice at the prior stage will help ranchers to enhance edit administration and product yield. The results of Fuzzy C-Means is used for implementation which is using clustering method. It gives less error rate in terms of degree of membership means which data points have higher probability or how much similarity is there in between the data points. In [5] the study was done for Maharashtra zone for wheat, rice, jowar, bajra, pulses the main aim was to achive increased crop yield. The dataset parameters include min and max temperature, evop-transpiration, area under production, crop yield for previous years. Artificial neural network is used for prediction with multilayer preceptron. For the analysis of dataset Weka tool is used and confusion matrix was generated using multilayer preceptron. The three layer feed forward network is used for training the dataset and authors could achieve the accuracy of 97.54% An ANN with 10 fold cross validation function is used for subset of dataset. For training and testing the linear data linear regression is used and for non linear data ANN is used. The accuracy of the model is obtained using RMSE, RAE. In [7] In this paper, price forecasting for Mysore district is done. As farmers are not getting the expected price to improve this problem price forecasting is done using ANN with feed forward back propogation scheme. The attributes include pressure, temperature,soil type, humidity, seed variety. MSE is used to evaluate the accuracy of the model. The proposed model is compared with decision tre, genetic algorithm. The accuracy with proposed model is high. In [8] the proposed method mainly aims at creating a system which uses the new generation high computing technologies for detection of plant diseases. By using the fast GPU's and embedded processors we can considerably increase the accuracy and the rate of output results in image classification. Also, by making this image classification available locally on mobile phones, it will be very useful for farmers. The main method the paper focuses on is using the CNN with 'n' number of hidden layers, which would normally take days to train, and then training it on the new faster processors and CPU's. We are also able to observe that the model does considerably better than using other conventional methods. In [9] the proposes a deep learning technique using a jaya algorithm for classification of paddy leaf diseases, which uses a feedback loop system in the post processing step. The main methodology mainly includes five steps-Image acquisition, Pre-processing, Segmentation, Feature Extraction and Classification. And the feedback loop system takes the values from the classification back to the Segmentation unit. The Segmentation is based on k-means clustering. This gives an enhanced deep learning method where the error is reduced considerably. The method is formally called the DNN_JOA method of image classification

III. Literature Survey:-

Agricultural Drones Relatively cheap drones with advanced sensors and imaging capabilities are giving farmers new ways to increase yields and reduce crop damage

AUTHORS:- J C. Anderson

Relatively cheap drones with advanced sensors and imaging capabilities are giving farmers new ways to increase yields and reduce crop damage. These aircraft are equipped with an autopilot using GPS and a standard point-and-shoot camera controlled by the autopilot; software on the ground can stitch aerial shots into a high-resolution mosaic map. It is part of a trend toward increasingly data-driven agriculture. Farms today are bursting with engineering marvels, the result of years of automation and other innovations designed to grow more food with less labor. Tractors autonomously plant seeds within a few centimeters of their target locations, and GPS-guided harvesters reap the crops with equal accuracy. Extensive wireless networks backhaul data on soil hydration and environmental factors to faraway servers for analysis.

Self-Guided Segmentation and Classification of Multi- Temporal Landsat 8 Images for Crop Type Mapping in Southeastern Brazil

AUTHORS:- B. Schultz, M. Formaggio, A. R. Del' Arco Sanchez, L. Barreto Luiz and C.N Atzberger, Only well-chosen segmentation parameters ensure optimum results of object-based image analysis (OBIA). Manually defining suitable parameter sets can be a time-consuming approach, not necessarily leading to optimum results; the subjectivity of the manual approach is also obvious. For this reason, in supervised segmentation as proposed by Stefanski et al. (2013) one integrates the segmentation and classification tasks. The segmentation is optimized directly with respect to the subsequent classification. In this contribution, we build on this work and developed a fully autonomous workflow for supervised object-based classification, combining image segmentation and random forest (RF) classification. Starting from a fixed set of randomly selected and manually interpreted training samples, suitable segmentation parameters are automatically identified. A sub-tropical study site located in Sao Paulo State (Brazil) was used to evaluate the proposed approach. Two multi-temporal Landsat 8 image mosaics were used as input (from August 2013 and January 2014) together with training samples from field visits and VHR (RapidEye) photo-interpretation. Using four test sites of 15 × 15 km2 with manually interpreted crops as independent validation samples, we demonstrate that the approach leads to robust classification results. On these samples (pixel wise, n ≈ 1 million) an overall accuracy (OA) of 80% could be reached while classifying five classes: sugarcane, soybean, cassava, peanut and others. We found that the overall accuracy obtained from the four test sites was only marginally lower compared to the out-of-bag OA obtained from the training samples. Amongst the five classes, sugarcane and soybean were classified best, while cassava and peanut were often misclassified due to similarity in the spatio-temporal feature space and high within-class variabilities. Interestingly, misclassified pixels were in most cases correctly identified through the RF classification margin, which is produced as a by-product to the classification map.

A Comprehensive Review on Pixel Oriented and Object Oriented Methods for Information Extraction from Remotely Sensed Images with a Special Emphasis on Cryospheric Applications

AUTHORS:- S. D. Jawak, P. Devliyal and A. J. Luis

mage classification is one of the most basic operations of digital image processing. The present review focuses on the strengths and weaknesses of traditional pixel-based classification (PBC) and the advances of object-oriented classification (OOC) algorithms employed for the extraction of information from remotely sensed satellite imageries. The state-of-the-art classifiers are reviewed for their potential usage in urban remote sensing (RS), with a special focus on cryospheric applications. Generally, classifiers for information extraction can be divided into three catalogues: 1) based on the type of learning (supervised and unsupervised), 2) based on assumptions on data distribution (parametric and non-parametric) and, 3) based on the number of outputs for each spatial unit (hard and soft). The classification methods are broadly based on the PBC or the OOC approaches. Both methods have their own advantages and disadvantages depending upon their area of application and most importantly the RS datasets that are used for information extraction. Classification algorithms are variedly explored in the cryosphere for extracting geospatial information for various logistic and scientific applications, such as to understand temporal changes in geographical phenomena. Information extraction in cryospheric regions is challenging, accounting to the very similar and conflicting spectral responses of the features present in the region. The spectral responses of snow and ice, water, and blue ice, rock and shadow are a big challenge for the pixel-based classifiers. Thus, in such cases, OOC approach is superior for extracting information from the cryospheric regions. Also, ensemble classifiers and customized spectral index ratios (CSIR) proved extremely good approaches for information extraction from cryospheric regions. The present review would be beneficial for developing new classifiers in the cryospheric environment for better understanding of spatial-temporal changes over long time scales.

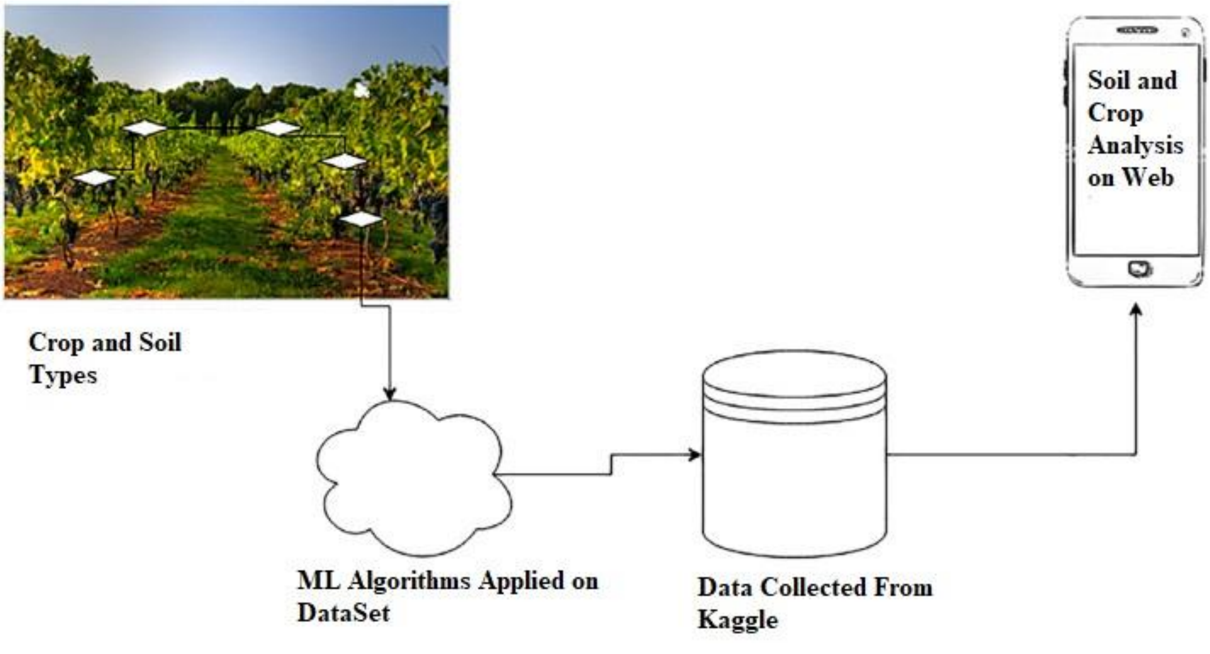
Segmentation Performance Evaluation for Object Based Remotely Sensed Image Analysis

AUTHORS:- P. Corcoran, A. Winstanley and P. Mooney

Remote sensing imagery needs to be converted into tangible information which can be utilised in conjunction with other data sets, often within widely used Geographic Information Systems (GIS). As long as pixel sizes remained typically coarser than, or at the best, similar in size to the objects of interest, emphasis was placed on per-pixel analysis, or even sub-pixel analysis for this conversion, but with increasing spatial resolutions alternative paths have been followed, aimed at deriving objects that are made up of several pixels. This paper gives an overview of the development of object based methods, which aim to delineate readily usable objects from imagery while at the same time combining image processing and GIS functionalities in order to utilize spectral and contextual information in an integrative way. The most common approach used for building objects is image segmentation, which dates back to the 1970s. Around the year 2000 GIS and image processing started to grow together rapidly through object based image analysis (OBIA - or GEOBIA for geospatial object based image analysis). In contrast to typical Landsat resolutions, high resolution images support several scales within their images. Through a comprehensive literature review several thousand abstracts have been screened, and more than 820 OBIA-related articles comprising 145 journal papers, 84 book chapters and nearly 600 conference papers, are analysed in detail. It becomes evident that the first years of the OBIA/GEOBIA developments were characterised by the dominance of 'grey' literature, but that the number of peer-reviewed journal articles has increased sharply over the last four to five years. The pixel paradigm is beginning to show cracks and the OBIA methods are making considerable progress towards a spatially explicit information extraction workflow, such as is required for spatial planning as well as for many monitoring programmes.

IV. SYSTEM DESIGN

1. ARCHITECTURE DIAGRAM



IMPLEMENTATION

MODULES:- Implementation is the stage of the project when the theoretical design is turned out into a working system. Thus it can be considered to be the most critical stage in achieving a successful new system and in giving the user, confidence that the new system will work and be effective. The implementation stage involves careful planning, investigation of the existing system and it's constraints on implementation, designing of methods to achieve changeover and evaluation of changeover methods.

Pixel-based and Object-oriented classification:- Image processing most basic operation is image classification. Two classification process are mainly used: (1) the pixel-based classification (PBC) and (2) the object-oriented classification (OOC). The PBC uses conventional statistical techniques. All pixels are categorized into a specific class or thematic. This classification is based on features extracted from the pixel, such as the spectral information and spectral estimated signature. The OOC classifies objects presents on the picture. Spatial spectral features of the high-resolution (HR) satellite data Information is used as the main feature. Last research projects and development for the OOC focuses on the rule-based classifier and the nearest neighbor classifier.

Object-based image analysis by application of nonlinear scale-space filtering This research project presents a second powerful and widely used methodology for image recognition. This method analyses images through nonlinear scale-space filtering. Classification of different pictures and various aerial images is provided_through a recently developed platform . This framework demonstrates the importance of the qualitative properties and classifier such as multilevel object representation and Support Vector Machine classifier (SVM). Furthermore, it eliminates the need to tune several parameters during the segmentation. These platform algorithms outperform the previous development regarding the final graphical representation and the overall accuracy shows the precision and visualization obtain with the explained framework.

Vineyard analysis from very High-Resolution Satellite Data:- The research focuses on the development of automated and efficient agriculture methods. It is presented as a framework and it is based on multispectral data analysis for object classification. Even if multiple research projects are focusing on aerial images analysis for specific zone detection because of the complexity of vineyard fields very few of them address this specific use case. The number of analysis regarding precision agriculture is reduced. This complexity depends on:

- The landscape (vines in the mountains for example)
- The paths and roads going through the vineyards
- Leaves and trunks mixed with metal to maintain the vine

V. Conclusion:-

Decision-making tool has been developed for selecting suitable agricultural crop to be cultivated in the given experimental land. Twenty-six input variables are selected and grouped into six main variables such as soil, water, season, input, support and infrastructure. The evaluation scores of alternatives in the form of main variable sequences are obtained by dominance-based rough set approach and simple additive method. Johnson's reduct classifier algorithm is used in the developed tool to generate classification rules for three agricultural crops such as paddy, groundnut and sugarcane. The validation results showed that the developed tool has sufficient predictive power to help the farmers to select suitable crop for agriculture development. Although illustrations are based on the three agricultural crops, namely paddy, groundnut and sugarcane, the developed decision-making tool can act as a multi-class classification tool to select any agricultural crop for cultivation. The limitations of this tool are as follows: Johnson's classifier produces satisfactory results for smaller training datasets. Discernibility based attribute reduction system has input number restrictions in the dataset. As it supports maximum data set with 12 input variables and 120 alternatives, it needs extreme storage area. Therefore, Johnson's classifier algorithm is suitable for MCDM problems with limited datasets like the one we have considered.Further, the research can be extended by using other classifiers for larger training datasets. The programs in MATLAB were designed in a flexible, modular fashion, and it can be easily adapted to other horticulture crops.

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