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Research Article

Soil Health Analysis for Crop Suggestions using Machine Learning

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Abstract

The use of computers in many engineering fields is widely accepted. The field of geotechnical engineering is not far behind. The use of computers not only automates the process of soil classification, but also makes it more objective. The chances of human error are minimized, thus saving a lot of energy, time and most importantly, money. Identification of the soil type helps to avoid agricultural product quantity loss. A classification for engineering purpose should be based mainly on mechanical properties. This work explains support vector machine based classification of the soil types. Soil classification includes steps like image acquisition, image preprocessing, feature extraction and classification. The color features, edge detection features and texture features of soil images are extracted. Using support vector machine (SVM) classifies the soil features to find the type of soil. Using the final soil type we can recommend which crop is suitable for this type of soil.

Keywords: *Image preprocessing, Feature Extraction, EdgeDetection, Texture Features, SVM*

Introduction

Soil is the term which has different meaning for different people: for a geologist it represents the products of past surface processes. To a penologist it represents physical and chemical processes occurring currently. For an engineer soil is the solid thing up on which foundation for houses, factories, building, roads, etc can be built. Soils may be described in different ways by different people for their different purposes. Soil study means the knowing of externally identifiable patterns seen on soil. Grouping of soil is particularly basic for reasonable agricultural business. Recognizing the characteristics of soil is the key feature to reduce the product quantity losses. It is crucial for countries that export several agricultural commodities. A classification for engineering purposes should be based mainly on mechanical properties, e.g. permeability, stiffness, strength. The class to which a soil belongs can be used in its description. Knowing the type of soil is very useful for cultivation, construction..etc. As far as plant is concerned plantation according to the soil characteristics is very much important for its success. The nature of soil is influenced by many factor, some of them are power of hydrogen (PH), Exchangeable sodium percentage, moisture content...etc. depending on their amount in soil they show different characteristics and that varies for different region.

Soil type of a particular geographical area is analyzed by collecting samples of soils and classifying them in to different type using different methodologies. In preparation manual segmentation and classification method is monitored. This is time consuming, requires efficient people and expensive also. The main task is to automate the procedure. With the emerging of image processing and machine learning we can efficiently classify the soil sample in to groups which it belong to. This paper describes classification of the found segments using Machine Learning (ML) method Support Vector Machines (SVM).

A. Motivation

Soils may be described in different ways by different people for their different purposes. Soil study means the knowing of externally identifiable patterns seen on soil. Grouping of soil is particularly basic for reasonable agricultural business. Recognizing the types of soil is the key feature to reduce the product quantity losses. It is crucial for countries that export several agricultural commodities.

B. Objectives

- To find the exact type of soil using image processing
  - To implement the feature extraction technique to extract the features of soil image
  - To implement the classification technique to classify the features of soil image
  - To recommend the crop based on soil type

C. Problem Statement

Soils may be described in different ways by different people for their different purposes. Soil study means

the knowing of externally identifiable patterns seen on soil. Grouping of soil is particularly basic for reasonable agricultural business. Recognizing the types of soil is the key feature to reduce the product quantity losses. It is crucial for countries that export several agricultural commodities.

Review of Literature

S.M.Mohidul Islam [1] conducted a study to predicting soil series and providing suitable crop yield suggestion for that specific soil. The model has been tested by applying different kinds of machine learning algorithm. Bagged tree and K SVM. SVM shows good accuracy but among all the classifiers, SVM has given the highest accuracy in soil classification. The proposed model is justified by a properly made dataset and machine learning algorithms.

Pramudyana Agus Harlianto, Noor Akhmad Setiawan, Teguh Bharata Adji [2] conducted a study of machine learning algorithms applied for automating soil type classification. Such as neural network, decision tree, naive bayes, and SVM are used to automate soil type classification with satisfactory accuracy (70%). algorithm, SVM is the best performance for classifying soil type. Attribute selection did not improve SVM's accuracy, as well as class reduction did not improve significantly.

Jay Gholap [3] conducted a study of Soil fertility is considered to be one of the critical attributes fo cropping pattern in particular area. J48 algorithm's accuracy for predicting soil fertility was highest. For increasing accuracy of J48 they use some other meta attribute selection and boosting.

K. K. Deshmukh [4] conducted a study of evaluate the soil fertility status from Sangamner area, Ahmednagar district, Maharashtra.. Classification of soil in different categories based on different quality of soil by evaluation of the soil attributes. soil samples were analyzed for various soil fertility parameters by standard procedures. Improper agriculture knowledge loss the productivity. So, overcome the adverse effect, complimentary use of fertilizers, organic manures in suitable combination of chemical fertilizers were suggested.

Vrushali Bhuyar [5] conducted a study of of soil fertility rate using J48, Na¨ıve Bayes, and Random forest algorithm. J48 algorithm gives mostly good result than other algorithms. J48 algorithm in decision tree helps the farmer and decision makers to identify the the fertility rate of soil and on the nutrients found in the soil sample different fertilizers can be recommended.

Srunitha.k, Dr.S.Padmavathi[6]This work explains support vector machine based classification of the soil types. Soil classification includes steps like image acquisition, image preprocessing, feature extraction and classification. The texture features of soil images are extracted using the low pass filter, Gabor filter and using color quantization technique.

Małgorzata Charytanowicz, and Piotr Kulczyck[7]This work presents an image segmentation approach for detecting the soil pore structures that have been studied by way of soil tomography sections. In so-doing, a research study was conducted using a density-based clustering method, and in turn, the nonparametric kernel estimation methodology. This overcomes the rigidity of arbitrary assumptions concerning the number or shape of clusters among data, and lets the researcher detect inherent data structures.

Richard J. Flavel, Chris N. Guppy, Sheikh M. R. Rabbi, Iain M. Young[8]The objective of this study was to develop a flexible and free image processing and analysissolution, based on the Public Domain Image platform, for the segmentation and analysis of complex biological plant root systems in soil from x-ray tomography 3D images. Contrasting root architectures from wheat, barley and chickpea root systems were grown in soil and scanned using a high resolution micro-tomography system.

Karisiddappa, Ramegowda, Shridhara, S[9]This paper investigates the development of digital image analysis approach for estimation of physicalproperties of soil in lieu of conventional laboratory approach.The present research deals collecting soil samples for trail pits at designated site as per IS code procedure. The digital image database is prepared for the collected soil sample in the laboratory and physical properties(Y) are determined.

Anita Dixit, Dr. Nagaratna Hedge and Dr. B. Eswar[10]This work presents a satellite image classification system, which can classify between the vegetation, soil and water bodies. The objective of this work is met by subdividing the works into three important phases, which are satellite image pre-processing, feature extraction and classification. The image pre-processing phase denoises the image by median filter and the contrast is improved by Contrast Limited Adaptive Histogram Equalization (CLAHE) technique.

Proposed Methodology

- In this proposed work, we will use the soil image dataset to classify the soil type. classification includes steps like image acquisition, image preprocessing, feature extraction and classification.
- In image preprocessing, the image is converted in grayscale image and then using filtration techniques to removed the noise of that image.
- After that in feature extraction step, the color features, edge detection features and texture features of soil images are extracted.
- Using support vector machine (SVM) classifies the soil features to find the type of soil.
- Here we will use the training feature dataset for classification.
- Using the final soil type we can recommend which crop is suitable for this type of soil which used for farmers and agriculture related companies.

A. Architecture

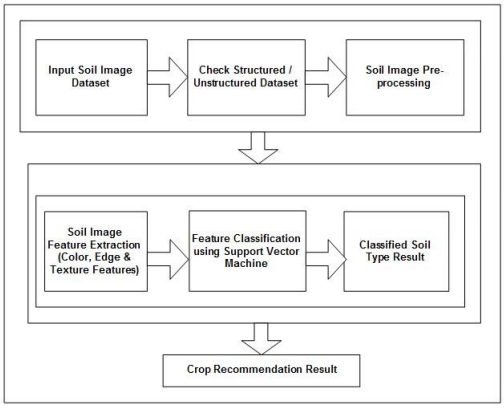

Fig. 1. Proposed System Architecture

B. Algorithm

1. Feature Extraction

1. Color feature is one of the most widely used visualfeatures in image retrieval, for its invariance with respect to image scaling, rotation, translation. In this work, an image is divided into four equal sized blocks and a centralized image with equal-size. For each block, a 9-D color moment is computed, thus the dimension of color comment for each image is 45. The 9-D color moment of an image segment is utilized, which contains values of mean, standard deviation and skewness of each channel in HSV color space.

2. Edge Detection: Most of the shape information of animage is enclosed in edges. So first we detect these edges in an image and by using these filters and then by enhancing those areas of image which contains edges, sharpness of the image will increase and image will become clearer.

Canny Edge Detection:

Canny edge detection is a technique to extract useful structural information from different vision objects and dramatically reduce the amount of data to be processed. It has been widely applied in various computer vision systems. Canny has found that the requirements for the application of edge detection on diverse vision systems are relatively similar. Thus, an edge detection solution to address these requirements can be implemented in a wide range of situations. The general criteria for edge detection include:

1. Detection of edge with low error rate, which means thatthe detection should accurately catch as many edges shown in the image as possible
2. The edge point detected from the operator should accuratelylocalize on the center of the edge.
3. A given edge in the image should only be marked once,and where possible, image noise should not create false edges.

The Process of Canny edge detection algorithm can be broken down to 5 different steps:

1. Apply filter to smooth the image in order to remove the

noise

2. Find the intensity gradients of the image
3. Apply non-maximum suppression to get rid of spuriousresponse to edge detection
4. Apply double threshold to determine potential edges5. Track edge by hysteresis: Finalize the detection of edges by suppressing all the other edges that are weak and not connected to strong edges.

4. Texture feature describes the structure arrangement of surfaces and their relationship to the environment, such as fruit skin, clouds, trees, and fabric. The texture feature in our method is described by hierarchical wavelet packet descriptor (HWVP). A 170- D HWVP descriptor is utilized by setting the decomposition level to be 3 and the wavelet packet basis to be DB2.

2. Support Vector Machine

• Support Vector Machine (SVM) is used to classify the soil quality. SVM Support vector machines are mainly two class classifiers, linear or non-linear class boundaries. • The idea behind SVM is to form a hyper plane in between the data sets to express which class it belongs to. • The task is to train the machine with known data and then SVM find the optimal hyper plane which gives maximum distance to the nearest training data points of any class.

Results and Discussion

Experimental evaluation is done to compare the proposed system with the existing system for evaluating the performance. The simulation platform used is built using Java framework (version jdk 8) on Windows platform. The system does not require any specific hardware to run; any standard machine is capable of running the application.

Positive (P) : Observation is positive

Negative (N) : Observation is not positive True Positive (TP) : Observation is positive, and is predicted to be positive.

False Negative (FN) : Observation is positive, but is predicted negative.

True Negative (TN) : Observation is negative, and is predicted to be negative.

False Positive (FP) : Observation is negative, but is predicted positive.

Accuracy = TP+TNTP+FP+TN+FN

Precision = TP TP+FP

Recall= TPTP+FN

F1-Measure = 2PrecisionRecall Precision+ Recall.

A. Classification Performance

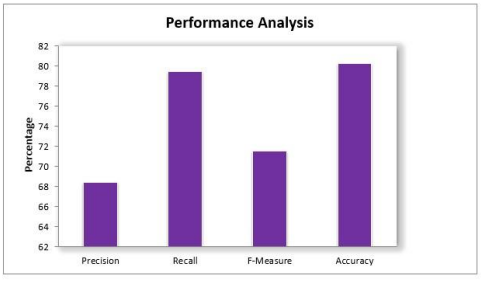

Fig. 2. Classification Accuracy

SVM	Parameter	Percentage
	Precision	69.07
	Recall	78.00
	F-Measure	72.03
	Accuracy	82.21

Conclusion

This proposed system we will use the soil image dataset to classify the soil type. Image feature extraction like color features; edge detection features and texture features of soil images are extracted. Using support vector machine (SVM) classifies the soil features to find the type of soil. Finally based on soil type we can recommend which crop is suitable for this type of soil. SO this work will help the farmer regarding crop and increase the productivity soil detection and suggestion according to it will help the farmers.

Future Scope-In future, we plan to test the methodology by increasing the size of the field data with more number of parameters in soil to identify more details.

References

[1]. Sk Al Zaminur Rahman, Kaushik Chandra Mitra, S.M.Mohidul Islam "Soil Classsification using Machine Learning Methods and Crop Suggestion Based on Soil Series", International Conference of Computer and Information Technology (ICCIT), 21-23 December, 2018.

[2]. Pramudyana Agus Harlianto, Noor Akhmad Setiawan, Teguh Bharata

[3]. Adji "Comparison of Machine Learning Algorithms for Soil Types Classifications", International Conference of Science And Technology Computer (ICST), 3, 2017.

[4]. Jay Gholap, "Performance Tuning Of J48 Algorithm For Prediction Of Soil fertility", Asian Journal of Computer Science and Information Technology,Vol 2,No. 8 2012.

[5]. K.K.Deshmukh, "Evaluation Of Soil Fertility Status From Sangamner Area, Ahmednagar District, Maharashtra, India", Rasayan Journal of Chemistry, 2012.

[6]. Vrushali Bhuyar, "Comparative Analysis Of Classification Techniques On Soil Data To Predict Fertility Rate for Aurangabad District", International

[7]. Journal of Emerging Trends Technology in Computer Science, Apr 2014.

[8]. Srunitha.k, Dr.S.Padmavathi, "Performance of SVM Classifier for Image Based Soil Classification". International conference on Signal Processing, Communication, Power and Embedded System (SCOPES)-2016

[9]. Małgorzata Charytanowicz, and Piotr Kulczycki, "An Image Analysis Algorithm for Soil Structure Identification". Springer International Publishing Switzerland 2015

[10]. Richard J. Flavel, Chris N. Guppy, Sheikh M. R. Rabbi, Iain M. Young, "An image processing and analysis tool for identifying and analyzing complex plant root systems in 3D soil using non-destructive analysis: Root1". Dragan Perovic, Institute for Resistance Research and Stress Tolerance, GERMANY. May 3, 2017

[11]. Karisiddappa, Ramegowda, Shridhara, S. "Soil Characterization Based on Digital Image Analysis". Indian Geotechnical Conference – 2010

[12]. Anita Dixit, Dr. Nagaratna Hedge and Dr. B. Eswar Reddy", Texture Feature Based Satellite Image Classification Scheme Using SVM". International Journal of Applied Engineering Research. ISSN 09734562 Volume 12, Number 13 (2017). pp. 3996-4003© Research India

[13]. Publications. http://www.ripublication.com