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SURVEY ON SOIL CLASSIFICATION USING DIFFERENT TECHNIQUES

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Abstract - *Soil has a vital part in successful agriculture. The main role of the soil is to support the growth of agriculture and horticulture crops. There are several kinds of soil, each type of soil have distinct features and have different kinds of crops that can grow on. Therefore it is needed to know the characteristics and features of soils to know which crop can grow better on a particular soil. In this case, machine learning technique can be useful. Soil classification system has been introduced to help people predict soil behavior and provides a common language for soil scientists. For engineering purposes, the soils should be mainly classified based on mechanical properties e.g.:-permeability, stiffness, strength.*

***Key Words*: Convolutional Neural Network, Decision tree, Hyperspectral Data, K-Nearest Neighbor, Naive Bayes, Support Vector Machine.**

1. INTRODUCTION

The word soil has divergent meaning for different people, it represents the product of past surface process for a geologist. It represents chemical and physical processes that happens currently. For an engineer, soil is a useful material for the foundations of houses, factories, buildings, roads etc. Different people expound soil in different ways for their different purposes. Soil study means the study of outermost distinguishable patterns of soil. Grouping of soil is essential for agricultural purposes or business. Understanding the properties of soil is the key feature to decrease the quantity losses. It is decisive for countries that export various agricultural commodities. For engineering purposes, soil classification should be based on mechanical properties such as permeability, stiffness, strength. Permeability is the property of soil that allows movement of air and water through the soil. The permeability of soil is important because it affects the root-zone air, nutrients and moisture available for plant uptake. Identifying the type of soil is very helpful for cultivation, construction etc. For plantation, knowing the characteristics of soil is very important for its success. Power of hydrogen (pH), exchangeable sodium percentage, moisture content etc. are some of the factors that influence soil nature. Based on the quantity of these factors in soils, they exhibits different characteristics that varies for different region. Different methods are used to classify different soil types of a particular geographical area. In preparation manual segment and classification, method is monitored, which is a time consuming process, expensive and requires skilled people. Automating the procedure is the main task. With the burgeoning of machine learning and image processing, the soils can be efficiently classified into different groups which it belongs to.

In India, soils can be classified into various groups based on either where the soil is available or based on the dominating size of particles in the soil.

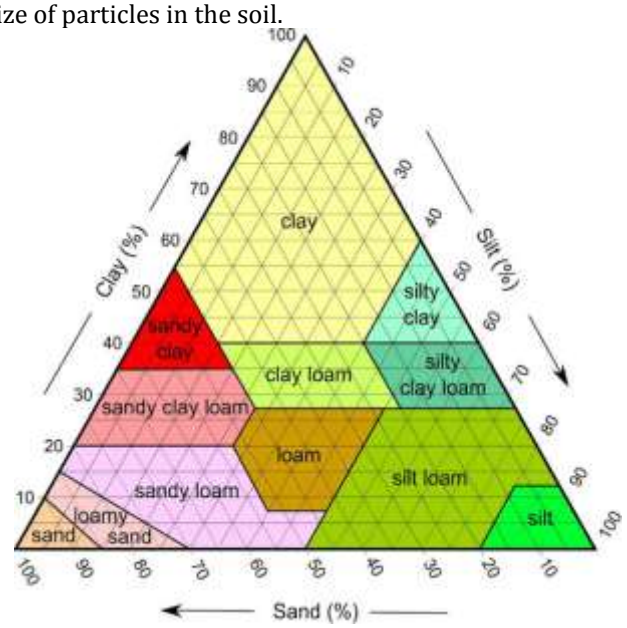

Fig-1: Soil textural classification

Based on the location, soils can be classified into red soil, black soil, forest soil, alluvial soil, laterite soil, arid or desert soil, peaty or marshy soil etc.

Fig-2: Types of soils in India

Soil is one of the vital resources.Classiication of soil with its mapping is very important for agricultural purposes. Different soils can have different kinds of features and different types of crops can be grown on each type of soil. The features and properties of various soils are required to know, in order to understand which crops can be grown better in specific type of soils. In this case machine learning technique can be used. Even now, machine learning is an emerging and

demanding research field in agricultural data analysis. Soil is a vital part in agricultural field for yielding crops. Soil classification philosophies follow the existence knowledge and practical circumstances. Soil classification can setup a link between soil samples and different types of natural entity. In site soil classification helps to evaluate the general suitability of the site.to obtain the physical and mechanical properties and for construction it helps to decide the suitability of materials for adequate and cost effective design.

On the basis of dominating particle size, soil can be classified as peat, clay and sand. Some soils can be further classified as combination of two soils such as clayey peat, clayey sand, sandy clay, humus clay, silty sand etc.

Fig-3: Different types of soils for planting

Soil classification has another advantage that, if an engineer aims at a low budget investigation, later if any undiscoverable inimical conditions are encountered, it may cause additional costs. At site, laboratory and in situ techniques are used for necessary investigation. The in-situ techniques may require examining of soil properties at the ground level or below the surface. For surface in-situ investigation, density replacement test provides the measurement of in-situ density of soil and geological mapping gives the soil profile. The sub- surface test of in-situ investigation involve measurement of specific forces of soil or physical properties of soil such as moisture evaluation, magnetic susceptibility, conductivity etc.

2. RELATED WORKS

Amol D Vibute [1] proposed a method for identification, mapping and classification of several types of soil using support vector machines (SVM) .This methods uses high spectral resolution hyper spectral data. By applying support vector machine classifier on hyper spectral data. By applying support vector machine classifier on hyper spectral data gives precise results in the case of small set of data samples. It has been found that, support vector machine algorithm is advantageous for high dimensional datasets with less number of training samples. Field data collection (ground truth points) was done by using a digital camera of Sony Experia smartphone and GPS (Global Positioning System).This obtained field data (ground truth points) were matched with Google map and Google earth. The disadvantage of the system is to rectify atmospheric error which usually exist in hypersion data and only a small dataset can be used.

Srunitha.K [2] proposed a system for classification of the soil types based on support vector machine (SVM).Image acquisition, image pre-processing, feature extraction and classification are the steps involved in this procedure. Low pass filter, Gabor filter and color quantization techniques are used to extract texture features of soil images. Here, mean amplitude, HSV histogram, standard deviation are taken as the statistical parameters. The main drawback of the system is, it takes long training time for large dataset and choosing a good kernel function is not easy.

Xiang Gao [3] Introduced a soil moisture classification model based SVM. The atmospheric temperature and soil temperature sensors are used. The foundation of classification is model is built, according to the variation of soil temperature and atmospheric temperature in a day. When the changes of soil temperature is compared with air temperature, then the heat capacity of dry soil is lower than the heat capacity of moist soils, which is the fundamental basis of the soil moisture classification model proposed in this paper. Based on the soil moisture classification model, select parameters which can represent the changes of heat in air and heat in soil, which is taken as the input vector of SVM. The parameters are the maximum of temperature of soil, the minimum temperature of soil, maximum temperature of air and the linear fitting slope value and air in the rising stage. In this proposed system, sensors used are of high cost, there may be maintenance issues and data loggers used within sensors are expensive.

Monali Paul [4] introduced a system, in order to categorize the analyzed soil datasets. The category will indicate the yielding of crops. Soils are classified into low, medium, high category by adopting naive Bayes and K-Nearest Neighbor methods. Data is obtained from the Soil testing laboratory in Jabalpur, Madhya Pradesh. The tuples of dataset expound the amount of nutrients and micronutrients available in soil. Yielding capability of soil can be decided by classifying these nutrients and micronutrients into two different category. According to the soil science department of JNKW Jabalpur, soils that comes under medium category indicates good yielding capability. Soils falling under the category high (H) and very high shows a modern yielding capability and the soils under low category and very low category shows poor yielding capacity. The experiments are performed using Rapid Miner 5.3.The problem of this proposed system is that, algorithm must compute and sort all training datasets at each prediction, therefore a small dataset is used.

Chandan [5] proposed a system for image classification of soil based on soil images. The initial step is to gather soil test pictures which is the first important step in soil classification based on image processing, because it needs to consider factors such as scale and characteristics of soil under study. The images of soils are captured using color camera and provided as input to the system. The features of each type of soil is collects and stored in a separate database.

This database is later used in the final stage for soil classification. While selecting a training samples, certain conditions are to be considered, they are availability of ground reference data, complexity of data being studied, spatial resolution of the collected images. The drawback related to the system is, it takes long training time for large datasets and choosing a good kernel unction is not easy.

F.M.Riese [6] introduced a classification model for soil texture based on hyper spectral data. Here three 1-dimensional (1D) convolutional neural networks (CNN) are developed and implemented, they are:-the LucasCNN, the LucasResNet which contains an identity blocks as residual networks, and the CoordCov with an additional coordinate layer. The performance of the CNN approaches are compared to a random forest classifier. Land/Use and Cover Area Frame Statistical Survey (LUCAS) soil dataset is used in this paper. It includes hyper spectral and soil texture data .It is necessary to correct atmospheric error which is usually present in hyper spectral data, which is a disadvantage of the proposed system.

P.Bhargavi [7] proposed a system that use small number of traits, which is contained within the dataset to analyze, to determine the performance when compared with standard statistical techniques. The agricultural soil profiles that were selected with the aim of completeness and for ease classification of soils.

Zhongzheng [8] Hu proposed an empherical model, which is based on convolutional neural networks to analyze daily retrieval of soil moisture for passive microwave remote sensing. To train Convolutional Neural Network (CNN), the ASMR-E brightness temperature is used for the prediction of the European Centre for Medium Range Weather Forecast (ECMWF) Model. The deep learning is the appropriate method for global soil moisture retrieval. To deal with the massive data inversion, it is supported by Graphical Processing Unit (GPU) acceleration. A global moisture map can be predicted below 10 seconds, once the model is trained. The soil moisture retrieval model, which is based on deep learning, can learn complex features from big remote sensing data

Ashwini Rao [9] developed a grading model for classification of soil samples based on support vector machine (SVM) using distinct scientific features. Different algorithms and features and filters are used to obtain and process color images of the soil samples. Color, texture etc. are the different features extracted using these algorithms. Support Vector Machine (SVM) uses only some of the training samples which lies at the edges of the class distribution in feature space and fit an optimal hyperplane between the classes. The correctness of the supervised classification is dependent on the training data used.

Hemant Kumar Sharma [10] proposed an enhanced model, which has more features than the existing system like suggested crop list, suggested urea and nutrients of soil. These features are highly demanded by the farmer. Image processing methods can be used to classify soils in which color, energy and HSV can be seen.

3. METHODS IMPLEMENTED

3.1Neural Networks

Generally a neural network is comprised of three layers: input layer, hidden layer and output layer. There is only one hidden layer in this paper. Sigmoid is used as activation function. As per the number of attributes, the input layer is comprised of 10 input with one attribute as the class type. As per the number of classes, the output layer consist of 12 outputs. A package called back propagation neural network software program, based on the back propagation procedure. Networks with arbitrary layers, nodes per layer, link connections between layers and other basic network design components can be generated using this package.

3.2 Decision Tree

Decision tree model is represented as binary tree. A single input variable (x) is represented on each node and a split on that variable. The output variable (y) containing on the leaf node of the tree is used to make a predictions. Predictions are made by walking the split of the tree till entering at a leaf node. Decision trees are very fast for making predictions and very fast to learn. For a broad range of problems, decision trees do not need any special preparation for data and is also error free.

3.3 Naive Bayes

In Naïve Bayes, the input variable is independent, i.e. a Naïve Bayes classifier surmise that, an articular feature of a class which is present is unrelated to any other feature. It is based on the Bayes theorem. The method of maximum likelihood or Bayesian method are used for the parameter estimation for Naïve Bayes. The supposition that input variable is independent is unpractical for real data. Naive Bayes classification can be efficiently trained in a supervised learning setting. For wide range of complex problems, naive bayes is very successful.

3.4 Support Vector Machine (SVM)

SVM is a heuristic algorithm, which comes under supervised learning. In SVM, a hyper plane that optimally separates two classes is determined. Between two classes, there is only one hyper plane that produce maximum margin. Nonlinear mapping functions are used to map the data into a higher dimensional space (H) for nonlinear equations. Classification function can be solved using kernel function.

4. CONCLUSION

In the field of engineering, soil classification is one of the foremost concerns. The process of soil classification have boosted to a great extent using machine learning techniques. SVM is one of the most commonly used machine learning algorithm to classify soil.

REFERENCES

[1] Amol.D.Vibhute.K.V.Kale, Rajesh.K.Dhumal, S.C.Mehro - tra, "Soil Type Classification and Mapping using Hyperspectral Remote Sensing Data", International Conference on Man and Machine Interfacing (MAMI), IEEE 2015.

[2] 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), IEEE 2016.

[3] Xiang Gao, Tancheng Lu, Peng Liu,QiyongLu,"A Soil Moisture Classification Model Based on SVM used in Agricultural WSN",The National High-tech R&D Program of China,IEEE 2014.

[4] Monali Paul, Santosh K. Vishwakarma, Ashok Verma, " Analysis of Soil Behavior and Prediction of Crop Yield using Data Mining Approach", International Conference on Computational Intelligence and Communication Networks, IEEE 2015.

[5] Chandan, Rituala Thakur, "An Intelligent Model for Indian Soil Classification using Various Machine Learning Techniques", International Journal of Computational Engineering Research (IJCER), Volume-08, Issue-09, September 2018.

[6] P.Bhargavi, Dr.S.Jyothi,"Applying Naïve Bayes Data Mining Technique for Classification of agricultural Land Soils", International Journal of Computer Science and Network Security (IJCSNS), VOL.9 NO.8, August 2009.

[7] F.M.Riese, S.Keller,"Soil Texture Classification with 1D Convolutional Neural Networks Based on Hyperspectral Data", ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Science, Volume IV-2/W5, 2009.

[8] Zhongzheng Hu, Linlin Xu, Bowen Yu,"Soil Moisture Retrieval using Convolutional Neural Networks: Application to Passive Microwave Remote Sensing", The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Science, Volume XLII-3,2018

[9] AshwiniRao, Janhavi.U, AbhishekGowda.N.S, Manjunatha, Mrs.Rafega Beham.A, "Machine Learning in Soil Classification and Crop Detection", International Journal for Scientific Research and Development, Vol.4, Issue 01, 2016.

[10] Hement Kumar Sharma, Shiv Kumar, "Soil Classification and Characterization using Image Processing", Proceedings of the Second International Conference on Computing Methodologies and Communication (ICCMC),IEEE,2018.