International Journal of Research in Engineering, Science and Management
Volume 7, Issue 4, April 2024
https://www.ijresm.com | ISSN (Online): 2581-5792

A Survey on Soil Classification System

Rahul Ankalkoti[1*], Laxmi Giddapanavar[2], Vishwas Badiger[3], Priyanka Biradar[4], Chetana R. Shivanagi[5]
[1,2,3,4]B.E. Student, Department of Information Science and Engineering, Basaveshwar Engineering College, Bagalkot, India
[5]Assistant Professor, Department of Information Science and Engineering, Basaveshwar Engineering College, Bagalkot, India

***Abstract*: Soil classification is one of the major affairs and emanating topics in a large number of countries. The population of the world is rising at a majorly rapid pace and along with the increase in population, the demand for food surges actively. For proper crop yield, farmers should be aware of the correct soil type for a particular crop, which affects the increased demand for food. There are various laboratory and field methods to classify soil, but these have limitations like time and labor-consuming. There is a requirement of computer-based soil classification techniques which will help farmers in the field and won't take a lot of time. Here we talk about different computer-based soil classification practices divided into two streams. First is image processing and computer vision-based soil classification approaches which include the conventional image processing algorithms and methods to classify soil using different features like texture, color, and particle size. Second is deep learning and machine learning-based soil classification approaches.**

***Keywords*: Soil classification.**

1. Introduction

Soil classification is a means of organizing knowledge about soils. It is common to use hierarchical schemes because there are many soils and they have numerous physical, chemical, and biological properties. It classifies soils according to their engineering properties. Classification of soils consists of the division of soils into classes based on their genetic, textural, chemical, mineralogical, physical, or geotechnical characteristics. Soil classification deals with the systematic categorization of soils based on distinguishing characteristics as well as criteria that dictate choices in use. Classify soils by texture - percent of sand, silt and clay. The purpose of soil classification is to make possible the estimation of soil properties by association with soils of the same class whose properties are known.

2. Problem Statement

The classification of soil types is a fundamental aspect of agricultural planning, land management, and environmental conservation.

Traditional methods of soil classification rely heavily on manual observation, which is time-consuming, labor- intensive, and subject to human error. As a result, there is a growing need for automated systems that can accurately classify soil types based on various parameters.

The goal of this project is to develop an automated soil classification system using machine learning techniques. The system will analyze soil samples based on their physical, chemical, and biological properties to categorize them into different soil types. The classification will be based on attributes such as texture, pH levels, organic matter content, moisture content, and mineral composition.

3. Literature Review

In paper [1] they have used Three different methods Weighted K- NN, Gaussian Kernel based SVM and Bagged Tree in these three methods SVM shows better accuracy than other methods used here and it provides overall 92.93 average accuracy. For different kinds of soil, the number of independent attributes does not match with each other. It cannot normally find any linear feature that can classify the soil.

In paper [2] they have used the genetic algorithm method using this method the Average accuracy improves for larger decision trees with more nodes compared to smaller decision trees with fewer nodes. A decision tree with a population of 100 and an average size of 49 was generated. Result: The speed and accuracy of decision tree evolution increased, resulting in an average accuracy of 0.45.

In paper [3] they have used the method Prediction of soil type using image analysis. Soil type classifier based on images achieved a 100% match with the standard method. This breakthrough suggests the potential use of cell phones for soil image acquisition and real-time recording of field information.

In paper [4] they have discussed about the mobile application they have developed for soil classification The mobile app is useful for classifying large number of soils and reducing the tedious manual work. It also has some drawbacks but the major disadvantage is Missing input properties affecting the soil classification hence it couldn't work and implement 100% accurately.

In paper [5] the author has discussed about the two methods used for soil classification they are Laboratory soil analysis and Statistical analysis. Five major soils are locally classified. The study also identified two different altitudes with varying soils. It had some drawbacks they were the lack of analogous correspondence between other local and international systems.

In paper [6] the authors discussed the method of image analysis prediction of soil type that has been made. Based on soil images matched 100% of the classification predicted according to the standard method. It opens the possibility of

*Corresponding author: rahul.ankalkoti@gmail.com

employing cell phone for image acquisition and instant record of information on the field.

In paper [7] the author has discussed about the cloud based agricultural framework to soil classification based on hybrid support vector machine here they have mentioned about the efficiency the performance improvement is in the range of 2 - 43%, 4-35 and 1 -11% in the observation the drawback was the development of mobile agricultural app with sophisticated functionality is required because it has less efficiency.

4. Present System

There are a number of systems and methods used to classify soils. The most common of these systems are the American Association of State Highway and Transportation Officials (AASHTO) soil classification system, the Unified Soil Classification System (USCS), and the United States Department of Agriculture (USDA) soil classification system. This manual will not provide details of these classification systems. Each of the referenced classification systems was developed to fill a specific need and purpose. As a result, each has some strengths and some limitations. It is limited to classifying soils based on three main characteristics, and may not be suitable for more complex or specialized soil classification systems. It is not always accurate in different regions and climates. It might not be suitable for classifying soil with large amount of organic matter.

5. Proposed System

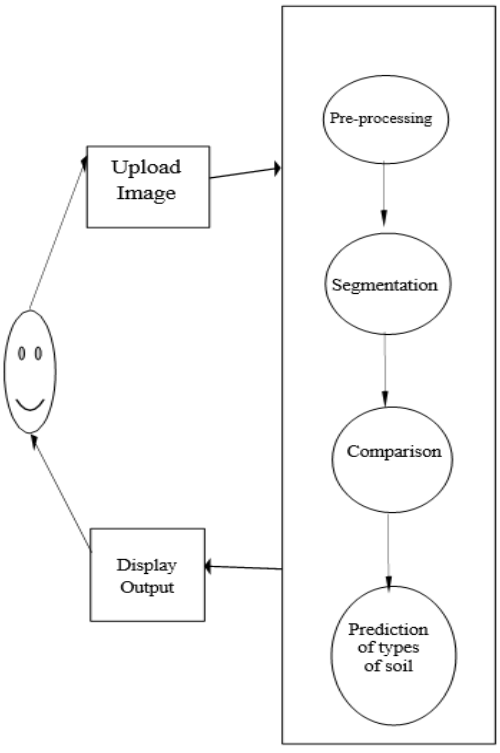

Fig. 1. Soil classification system

The existing approach for soil classification and crop prediction has some drawbacks such as lot of manual involvement, time consuming, chances of creeping of human errors, uncertain prediction are always invasive in nature. Our method proposes investigation of, the development of digital image analysis approach for estimation of physical properties of soil that overcomes the problems of existing method. The soil type are classified using color, texture, boundary features. These three are the primary values necessary for identification of the crop to grow well and produce an efficient yield. The soil samples in the form of soil sample image are collected and divided into seven classes' i.e. clay, peat and sand being the main classes and Clayey Peat, Clayey Sand, Humus Clay, Sandy Clay and Silty Sand being the mixture classes.

6. Methodology Used

- Step-1: First the person has to register into the system by providing the details like name and password.
- Step-2: If already register then go for login.
- Step-3: Take an image of the soil to be classified.
- Step-4: Upload the image into the system.
- Step-5: The image will get pre-processed.
- Step-6: Then the image will get segmented.
- Step-7: Then the system will compare it will already existing data.
- Step-8: Later it will show what type of soil it is and what are the uses.

7. Conclusion

A robust soil classification system is essential for understanding and managing diverse soil types. By categorizing soils based on key properties, such as texture, structure, and composition, this system facilitates effective land use planning, agriculture practices, and environmental management. The classification provides a foundation for soil scientists, researchers, and policymakers to make informed decisions, promoting sustainable land use and resource conservation. Ongoing research and advancements in soil classification continue to enhance our understanding of this crucial component of the Earth's ecosystem.

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