VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI - 590018

Mini Project Report

On

"SOIL ANALYSIS USING COMPUTER VISION AND MACHINE LEARNING"

A report submitted in partial fulfilment of the requirements for

COMPUTER GRAPHICS AND IMAGE PROCESSING LABORATORY (21CSL66)

In

Computer Science and Design

Submitted by

BHAVISH MK	**4AL21CG012**
DARSHAN RAI	**4AL21CG015**
HARSHITH	**4AL21CG027**
SARVESH ACHARYA	**4AL22CG402**

Under the Guidance of

Dr. Pushparani M K

Senior Assistant Professor

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ALVA'S INSTITUTE OF ENGINEERING & TECHNOLOGY MIJAR,

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Approved by AICTE, New Delhi, Recognized by the Government of Karnataka.

Accredited by NAAC with A+ Grade

Shobavana Campus, Mijar, Moodbidri, D.K., Karnataka 2023-2024

ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY MIJAR, MOODBIDRI, D.K. -574225

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CERTIFICATE

This is to certify that the Computer Graphics and Image Processing Laboratory with Mini Project entitled **"SOIL ANALYSIS USING COMPUTER VISION AND MACHINE LEARNING"** has been completed by

BHAVISH MK	4AL21CG012
DARSHAN RAI	4AL21CG015
HARSHITH	4AL21CG027
SARVESH	4AL22CG402

The Bonafide students of the Department of Computer Science and Design, Alva's Institute of Engineering and Technology in the **DEPARTMENT OF COMPUTER SCIENCE AND DESIGN** of the VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI during the year 2023–2024. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the report deposited in the departmental library. The Mini Project report has been approved as it satisfies the academic requirements concerning the Mini Project work of Computer Graphics and Image Processing subject prescribed for the Bachelor of Engineering Degree.

Dr. Pushparani M K
Mini Project Guide

Prof. Jayantkumar A Rathod
HOD, Dept of CSD

EXTERNAL VIVA

Name of the Examiners	Signature with Date
1. Suvitha NV	7/8/24
2. J.A Rathod	

ABSTRACT

Soil analysis is a crucial aspect of agricultural management, influencing crop yield, soil health, and environmental sustainability. Traditional methods of soil analysis are often labor-intensive, time-consuming, and require specialized equipment. This study proposes an innovative approach utilizing computer vision and machine learning to automate and enhance soil analysis. High-resolution digital images of soil samples were captured under controlled conditions, ensuring consistent quality and illumination. These images underwent preprocessing steps such as grayscale conversion, resizing, and noise reduction to standardize and enhance the data for analysis.

Feature extraction was conducted using the Scale-Invariant Feature Transform (SIFT) algorithm, which identified key points and computed descriptors invariant to scale and rotation. The extracted descriptors were clustered using the KMeans algorithm to classify soil textures into categories such as sandy, loamy, and clay. Additionally, the mean pixel intensity of grayscale images was analyzed to estimate soil moisture content, while nutrient deficiencies were detected by identifying yellow regions in the HSV color space.

Soil pH levels were estimated through hue value analysis in the HSV color space, and soil color composition was assessed using mean RGB values. Plant health was evaluated by isolating green pixels in the HSV color space, and weed detection was performed based on specific color ranges. Further analyses included estimating organic matter through brown pixel proportion, assessing soil compaction via edge density from Canny edge detection, and evaluating erosion risk through combined texture and edge analysis.

This multidisciplinary approach demonstrates the potential of computer vision and machine learning in providing efficient, accurate, and scalable solutions for soil analysis. The results indicate that these technologies can significantly enhance the precision of soil property assessments, offering valuable insights for agricultural management and environmental conservation.