

**Digital Image Processing**

**23.2F**

**Farm Animal Filtering Based on Wool Color**

**ASPN**

Higher National Diploma in Software Engineering - 23.2F

**Team Member Details**

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1.0 Introduction

Efficiently managing and categorizing farm animals can improve the profitability and productivity of a farm. We aim to develop a farm animal filtering system that analyzes the color of the wools of the sheep and thereby classify them according to wools value and usage. By utilizing image processing techniques, we can categorize sheep into different groups based on the color of their wool such as white, black, grey, and brown, each having different commercial value and usage.

We can use image processing techniques such as image enhancement, restoration, and color image processing to ensure accurate color analysis and categorization.

By implementing this method farmers can manage their flocks more effectively and this will also help to enhance farms productivity and profitability by ensuring that wool is processed properly and marketed according to its highest value. This project demonstrates how Digital Image Processing can help the modernization of farming practices.

2.0 Objectives of the Project

1. Color image processing to identify the color of the sheep

The primary objective of this system is to develop a system that can recognize the color of the sheep and thereby classify them according to the usage and value of their wool. This will be achieved through color image processing techniques. With this, we can classify sheep as follows.

* **White Wool Sheep**: These are the most common and widely bred for commercial wool production due to their wool's ability to be dyed any color.
* **Black Wool Sheep**: Less common and often used for specialty products, black wool is prized for its natural color and is often blended with other wool to create specific shades.
* **Gray or Mixed Color Wool Sheep**: Some sheep have wool that is a mix of colors, such as gray or brown. These natural colors are often used in specialty markets where the wool's natural color is a desirable feature.
* **Brown Wool Sheep**: Another natural color variation, brown wool can be used in its natural state or blended with other wools.

1. Enhancing captured images to increase color accuracy

Even though the main objective of this system is to classify sheep based on their color we increase the quality of the image for the achievement of good color accuracy by using image enhancement techniques.

1. Restoration of captured images if there is quality loss

Degradation can occur during the capturing and transmission of images. This can cause some serious issues when extracting information for further processing. To prevent this kind of situation, we can recover the degraded image to its original form using image restoration techniques such as noise reduction and other deblurring algorithms. This will ensure that the processed images are so close to their original form, providing reliable data classification.

3.0 Expected Deliverables

1. Functional color-based sheep classification system

The main objective of this project is to develop a system that can accurately analyze the color of the sheep wool and thereby classify them accordingly. We will use color image processing which is one of the digital image processing techniques to accurately analyze the color of the sheep.

1. Image Enhancement Module

We are going to develop an image Enhancement module to improve the quality of images as necessary and to improve the color accuracy so we can improve the accuracy of the classification process.

1. Image Restoration module

Image degradation can occur during the capturing and transmission of images, and this can affect the final result of the classification process. To avoid those kinds of issues we are going to develop an image restoration module to bring degraded images close to their original form.

4.0 Project Team Composition

Our team consists of 4 members and each of them will contribute to the team equally based on their skills, knowledge, commitment, and dedication to the achievement of the final goal of this project which is the animal filtering system based on the wool color. The team composition is as follows,

* Writing:

One team member is responsible for writing the project proposal while the other 3 members will help to find information related to the project.

* Development of the Project:

All team members are responsible for the development of the system and it's their responsibility to provide their knowledge and skill

* Research:

Two team members will carry out research on digital image-processing techniques relevant to the project's objectives. Those include RGB to HSV conversion, image enhancement, and restoration techniques.

* Presentation:

All team members will provide their contribution to the presentation. However, only 2 members are responsible for the creation of presentation slides

Working as a team will improve teamwork skills, dispute management among team members, and collaboration toward the achievement of the final goal

5.0 Project Description

5.1 Study on Previous Projects

To ensure that our project is based on the latest and well-established image processing techniques we reviewed some past research papers. Those include,

* **Classification of tomato (Lycoersicon Esculentum Miil) ripeness levels based on HSV color using digital image processing (fmalind, n.d.):**

The above study is focused on the classification of tomatoes ripeness level based on the HSV color model which is directly applicable to our project. This article highlights the usage of digital image processing for the classification of tomato ripeness levels based on HSV color values of the skin of the tomatoes. This research paper also explained how the conversion of RGB to HSV color space improves the accuracy of color-based segmentation.

Relevance to our project

The findings from the above article are very similar to our project, which aims to filter

animals such as sheep based on wool color. By using similar color space conversion techniques and pre-processing techniques such as image enhancement and restoration, we can achieve precise classification of wool colors.

Key Takeaways:

* The effectiveness of HSV color space for color analysis
* The importance of image enhancement and restoration for improved color accuracy

The above article provides a solid foundation for our project by explaining the practical application of the HSV color model insights into image processing techniques that we can adapt to our farm animal filtering system.

* **A Review of Target Recognition Technology for Fruit Picking Robots: From Digital Image Processing to Deep Learning** (Xuehui Hua, 2023)**:**

The above article provides an overview of traditional image-processing techniques used for fruit-picking recognition robots. This article also includes the usage of HSV color space for the fruit recognition system.

Relevance to our project

The findings from these studies such as using similar color space conversion techniques, we can achieve precise and consistent classification of wool colors. This will help to overcome the limitation of manual inspections, ensuring more reliable results in our animal filtering system

Key Takeaways:

* The effectiveness of HSV color space for color analysis
* The importance of image enhancement and restoration for improved color accuracy
* The challenges posed by varying light conditions and background complexities

Note: This article also includes the transition from traditional digital image processing techniques to deep learning approaches. However, as deep learning is not in our project scope, we focused only on traditional processing techniques.

5.2 Project Area & Title

* 5.2.1 Specific Requirements Relevant to the Domain:

The agricultural industry can benefit significantly from digital image processing technology. Specifically, when it comes to sheep farming, categorizing sheep based on the color of their wool can help in optimizing wool production. The specific requirements relevant to this domain include:

* + Accurate Color Differentiation: Subtle color variations in sheep wool need to be distinguished by the system, such as differentiation between black, white, gray, and brown wool.
  + Image Quality Enhancement and Restoration: You need excellent images for an accurate color analysis. Therefore, the system should contain some techniques to enhance and restore images for better reliability.
* 5.2.2 Application of Previously Studied Knowledge:

Segmentation:

By using segmentation techniques, we can isolate sheep from the background. This step is very important to ensure that the color analysis is only performed on targeted object.

Color Image Processing:

We will color space conversion which is a technique belonging to color image processing to convert RGB to HSV to accurately differentiate wool colors. These conversions are very important for isolating specific colors and ensuring precise color classification.

Image Enhancement and Restoration:

Use of image enhancements and restoration techniques to improve image quality by reducing noise and adjusting contrast. This will improve the quality of the image and thereby the accuracy of animal(sheep) classification based on wool color.

* 5.2.3 Project Area:

When it comes to project area our project falls within the domain of livestock farming and our project helps to classify animals such as sheep based on the color of the wool. Will enhance traditional livestock farming practices by improving efficiency, productivity, and profitability.

* 5.2.4 Project Tile: Farm Animal filtering based on wool color

This title reflects the primary objective of our project which is developing a system that filters and categorizes animals with wool such as sheep using image processing techniques.

* + **Why this topic should be accepted?**

Our project addresses a real-world problem faced by farmers, providing them with a tool that enhances their ability to manage and classify sheep based on their wool color. This can improve the efficiency of resource allocation, and targeted breeding practices, and optimize the wool production process.

We believe our project meets the criteria for acceptance as we are using modern digital image processing techniques to benefit agriculture and livestock farming. We seek the lecturer's approval, confident that our project will make a valuable contribution to the agricultural sector.

5.3 Methodology & Technology Stack

* 5.3.1 Image Processing Techniques
* Image Enhancement

Image enhancement techniques will be used to improve the quality of the images by dealing with brightness contrasts and noises. This will help to optimize the input image before the color analysis and thereby will also increase the accuracy of color analysis.

* Image Restoration

Image degradation can occur during transmission and capturing affecting the accuracy of color analysis. To avoid this, we can use an image restoration technique that uses noise reduction techniques and deblurring algorithms to bring the image closer to its original form

* Segmentation

Segmentation is very important to isolate the sheep from the background to perform accurate color analysis only on the targeted object and thereby increase the accuracy of classification of animals.

* Color Image Processing
* RGB to HSV conversion

We are going RGB to HSV conversion which is one of the critical aspects of color image processing techniques to make it easier to isolate and analyze specific colors This conversion is beneficial for color-based segmentation and filtering where distinguishing color is important.

* HSV to Lab conversion

Lab color space is designed to mimic how humans see color and ensure that colors are measured and compared accurately. By converting to lab color space, we can more easily detect the color differences of sheep.

By using this conversion, we can effectively analyze and classify sheep based on wool color. We can define specific HSV colors for the identification of wool colors.

For example, HSV ranges,

* + White Wool Sheep: Hue: 0-180, Saturation: 0-30, Value: 200-255
  + Black Wool Sheep: Hue: 0-180, Saturation: 0-255, Value: 0-50
  + Gray Wool Sheep: Hue: 0-180, Saturation: 0-30, Value: 50-200
  + Brown Wool Sheep: Hue: 10-20, Saturation: 100-255, Value: 20-200
* 5.3.2 Technology Stack and Tools
* OpenCV: We will Utilize OpenCV for implementing image processing tasks such as color space conversion, segmentation, enhancement, and restoration.
* Python: Use Python as the programming language to write and integrate these algorithms into a cohesive system.
* 5.3.3 Data Acquisition / Source of Image

The source of images is online and as these images may vary in quality, there will be a need for image enhancement and restoration.

* 5.3.4 Coding Procedure
* Image Acquisition:

First, we obtain images from online

* Image Enhancement and Restoration:
  + Then we perform image enhancement techniques to improve image quality by adjusting brightness, and contrast, and reducing noise.
  + We will perform image restoration techniques to mitigate any degradation that may have occurred during image acquisition or transmission.
* Segmentation

By performing segmentation, we can isolate sheep from the background and thereby we ensure that our color space conversions are only focused on the targeted object.

This will also improve the accuracy of the color analysis classification process.

* RGB to HSV Conversion:

After performing Image enhancement and restoration techniques we will convert images from RGB color space to HSV (Hue, Saturation, Value) color space.

* Sheep Classification Based on HSV Values:
  + In the last step we will define specific HSV ranges corresponding to different wool colors (e.g., white, black, gray, brown) and classify sheep based on these predefined HSV ranges to categorize them according to the color of their wool.

5.4 Timeline & Milestone

* Phase 1: Initial Setup, Research and Planning (2 days)
  + Choosing a project and title for the project
  + Carrying research relating to the project title and Image processing techniques that going to be used in the project
  + Defining project scope and objectives
* Phase 2: Image acquisition, Development of Image Enhancement and Restoration Modules (2-3 days)
  + Choose images from an online source
  + Implementation and testing of enhancement techniques
  + Implementation and testing of restoration techniques
* Phase 4: Development of Color Image Processing Module (4 days)
  + Implementation of color space conversion
  + Development and testing of color analysis and classification algorithms
* Phase 5: Integration and Testing (1-2 days)
  + Integrating all modules
  + Comprehensive testing and validation
* Phase 6: Finalizing and Presentation (2-3 days)
  + Integrating all modules
  + Comprehensive testing and validation

6.0 Team Declaration

We declare that the work presented in this project “Farm Animal Filtering Based on Wool Color”, is entirely our original work. We have not copied or replicated any existing solutions or highly utilized AI tools to generate content and have strived to develop a unique approach to address the chosen problem.

This project represents a collaborative effort undertaken by all team members,

* L.P.N.R.R. Pathirana
* A.J.A.P.N. Fernando
* A.C.S.C. Wijayarathne
* P.P. Senevirathna

Each member actively participated and contributed their expertise to the various stages of the project, from concept development to final implementation.

# References

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