

# INNOVATIVE APPLICATIONS OF IMAGE PROCESSING IN MEDICINE AND AGRICULTURE

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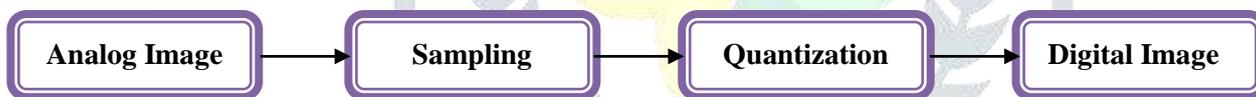
**Abstract:** Image processing has become an essential tool in various fields, particularly in medical and agricultural sectors. In modern healthcare, images are crucial throughout the clinical process, from diagnostics and treatment planning to surgical procedures and follow-up studies. In horticulture, detecting plant infections is essential, as it can significantly affect crop yield. Image-based methodologies utilize features such as size, shape, texture, colour, and location to identify diseased leaves or plants.

**Keywords:** Digital Image, Vector Image, Raster Image, X-ray, MRI, Medical, Agriculture.

## I. Introduction

A digital image comprises picture elements called pixels, each with a specific location and value. Converting an analog image into a digital image involves two important processes: sampling and quantization (S. Jayaraman).

Figure 1: Illustrates the conversion of an analog image to a digital image.



**Fig.1. Digital image from analog image.**

Digital image processing involves using digital computers to process digital images. These images play a significant role in everyday applications such as medical imaging and satellite television, as well as in research areas like geographical information systems.

A digital image is essentially a two-dimensional signal or an  $N \times N$  array of elements. Images can be converted to digital format using a digital camera or scanner. Digital image processing is a rapidly expanding technology with applications in various business aspects. One of its first uses was in the newspaper industry, where images were transmitted by submarine cable between London and New York (Rafael Gonzalez). Digital images are broadly classified into raster and vector images.

Raster images are mapped to grids and are not easily scalable. They are resolution-dependent because they contain a fixed number of pixels that create the image. When the image is zoomed, clarity is lost. Raster image formats include BMP, PCX, TIFF, JPEG, GIF, PNG, PSD, and CPT. In contrast, vector images, defined by objects made of lines and curves mathematically defined in a computer (S. Jayaraman), are easily scalable without losing detail or resolution. Fundamental steps in image processing include:

1. **Image acquisition:** Acquiring a digital image.
2. **Image pre-processing:** Improving the image to increase the chances of success for other processes.
3. **Image segmentation:** Partitioning an image into its constituent parts or objects.
4. **Image representation:** Converting input data to a form suitable for computer processing.
5. **Image description:** Extracting features that result in quantitative information of interest or features that differentiate one class of objects from another.
6. **Image recognition:** Assigning a label to an object based on information provided by its descriptors.
7. **Image interpretation:** Assigning meaning to an ensemble of recognized objects.

## II. Image Processing in the Medical Field: New Trends

The utilization of image processing is an emerging tool in the biomedical field, contributing to the improvement of the healthcare sector. Image processing tools offer a comprehensive set of reference arrangements for standard calculations, capacity, and applications in image processing. They support various image types, including high dynamic range, gigapixel resolution, embedded ICC profiles, and topographic images. In India, image processing technology is still developing and is mostly confined to institutional bases or research levels. With advancements in science and technology, the scope of images has broadened significantly due to their growing importance in scientific representation.

Before processing an image, it is converted into a digital format. Digitization includes scanning the image and quantizing the sampled values. Once converted into bit data, processing can be performed.

## III. Image Processing-Based Breast Cancer Detection Using Mammograms

In developed countries, breast cancer is a leading carcinoma. The American Cancer Society recommends mammography for every woman over 40 as a screening aid. Misinterpretation of breast cancer signs results in significant errors, often due to ignoring signs of abnormalities during mammography interpretation. The sensitivity of mammography varies with image quality and the radiologist's expertise. Efforts have been made to standardize results using automated techniques.

### Techniques Used for Breast Cancer Measurement:

**X-Ray Mammography:** - Widely used for diagnostic and screening purposes, providing high sensitivity for fatty breasts and excellent detection of micro calcifications, which indicate early malignancy.

**MRI of the Breast:-** MRI is an attractive alternative to mammography, capable of detecting cancers that mammography might miss. Additionally, MRI helps in determining the treatment plan for breast cancer patients by identifying the disease stage.

## IV. Image Processing in Agriculture: Current Trends

Precision agriculture incorporates growth techniques to enhance farm yield and improve farm inputs productively and sustainably. Irrigation, fertilizers, pesticides, and crop quality are major concerns in agriculture. Expertise is often required to analyze these issues, which can be time-consuming and costly in developing countries. Image processing is a tool that can measure agronomy-related parameters accurately and economically. Various techniques are applied to analyze these problems.

## V. Comparison of Visual Analysis and Image Processing

Sr. No.	Properties Techniques	Visual Analysis	Image Processing
1.	Complexity	Low	High
2.	Accuracy	Medium	High
3.	Flexibility	Low	High
4.	Cost	Medium	Medium
5.	Scope Of Research	Low	High
6.	Time Constraint	High	Low
7.	Components Required	Vehicle	Camera ,Network Equipment
8.	Software Required	No	Visual Analytics

The visual analysis method is the traditional approach to disease detection in plants, involving experts' visual inspection, which requires constant monitoring. This method is inefficient and cumbersome, especially for large farms. Additionally, some farmers may be unaware of certain diseases, making it costly and time-consuming to consult experts.

## VI. Application in Weed Detection

Weeds compete with crops for water, light, nutrients, and space, reducing yield and effective use of equipment. Weed control is vital from an agricultural perspective, and many researchers have developed image processing-based methods for weed detection. Techniques used include edge detection, colour detection, and fuzzy logic. Weed detection becomes more important at certain times of the year, depending on the climate, prevalent weed species, and farm type.

## VII. Application in Fruit/Food Grading

Accurate grading and sorting of fruits and vegetables or agricultural products are necessary due to increased expectations for food quality and safety standards. Image processing, a non-invasive method, is used to evaluate the quality of tomatoes based on colour, shape, size, and firmness. Techniques such as segmentation, pattern recognition, gray scale, and excess green have been explored and found to be effective, fast measurement methods comparable to lab testing.

Grading bakery products, fruits, vegetables, and grains involves considering attributes like colour, size, shape, and pre- and post-harvest conditions. Image processing techniques for grading include segmentation, shape analysis, morphology, texture analysis, noise elimination, 3D vision invariance, pattern recognition, and image methodology. Automated sorting of food and agricultural products provides rapid and hygienic inspection with computer vision.

## VIII. Conclusion

This paper has demonstrated that image processing is an effective machine vision system for both the medical and agricultural domains. The analysis of medical image processing and its application in healthcare, as presented in this paper, shows significant improvements. Image processing plays a crucial role in weed

classification, affecting yield and allowing for effective categorization. Therefore, we can conclude that image processing is a powerful tool applicable to both the medical and agricultural sectors with high accuracy.

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