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Application of Digital Image Analysis in Seed Science

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Introduction

The term "image analysis" refers to the extraction of numerical data from an acquired image. Machine Vision System is basically a computerized apparatus designed for Image Analysis (IA) which functions similar to the human observations. Fundamental approach in this technique is acquisition of data (shape, size, colour etc.) via a video or still camera followed by analysis of these data using suitable computer software.

Why image analysis?

Image Analysis shows many important advantages over manual techniques. It provides rapid analysis as compared to any of the conventional methods. Seeds are not subjected to any kind of treatment or damage. Once the system that works has been designed then the whole process can be automated. Imaging software provides an increasingly interactive and user-friendly environment to work. After the initial outlay for equipment and research unlike other systems, image analysis has very few additional costs.

How it works?

An automated image analysis system basically contains a digital camera or a flat-bed scanner to capture the images of the seed. These images are then processed using a suitable computer software package producing numeric data which are then used for further statistical analysis. This basic methodology varies with some minor modifications when used for different purposes *i.e.* germination studies, vigour assessment, grading and sorting etc. However, when this technique is applied for varietal identification or characterization studies, seed coat colour acquisition is also important because sometimes varieties show significant and characteristic seed colour differences among them due to developmental physiology. There are numerous softwares which have been used in different image analysis studies. Some analyzers used are *Biovis, LUCIA, KS 400, Delta-T© image analysis system having*

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software ''winDIAS', Image J software, Image Tool, Matrox image processing board, seed vigour imaging system.

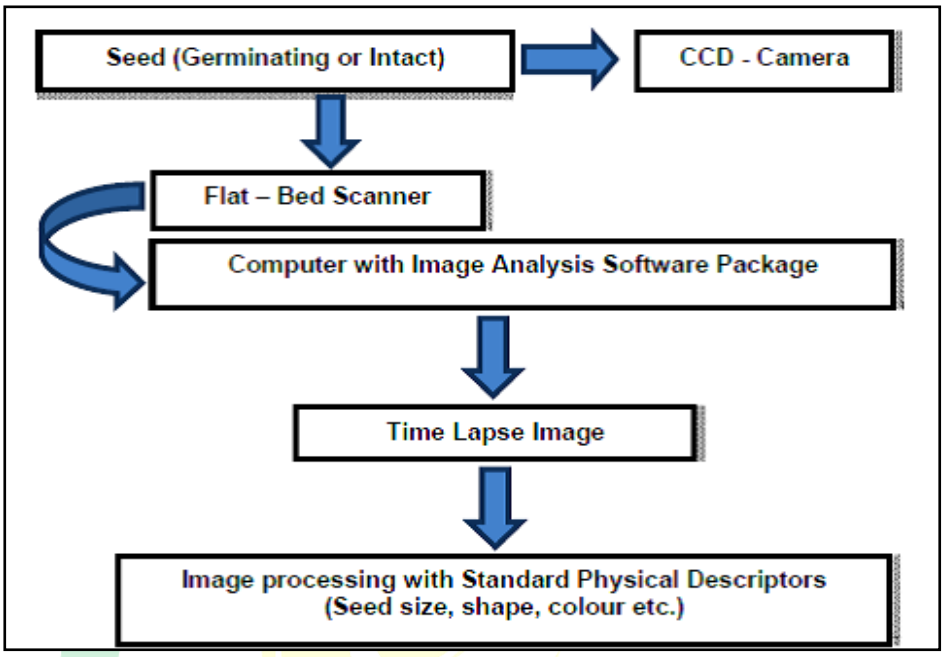

Fig. 1: Basic workflow of image analysis system by Dell' Aquila

Applications in Seed Science Research

a) Varietal Identification

Image analysis has potential use in the identification and characterization of different genotypes in various crops. It can also be used for testing of distinctness of a new variety. With the help of this technique, researchers are able to study seed surface features more closely and can differentiate among various lots accurately. Morphological, colorimetric and textural characterization measures of many types of grains have been reported for both cereals and legumes, in order to identify and classify grain types as well as for wild species. Varietal identification and characterization using image analysis is well documented for various crops like sorghum, lucerne, castor, sesame, phaseolus, mustard and oat.

b) Seed Vigor Estimation

Vigor tests can provide information closer to what occurs during seedling establishment in the field, because they are based on physiological and biochemical characteristics sensitive to changes in seed physiological potential before those identified in the germination test**.** The image analysis technique is found to be very effective for

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estimation of seed vigour. In this technique, the determination of the vigor is performed more quickly and without direct human interference. It was used initially by McCormac *et al*. to develop an automatic system for the determination of the average length of the primary roots of tomato seedlings. Later on, Sako *et al*. developed "Seed Vigor Imaging System®" (SVIS) to assess lettuce seed vigor by capturing images of three-day-old seedlings and determination of vigor and uniformity indices, hypocotyl and primary root length, and root/hypocotyl ratio. This software is found to be a promising tool for vigor estimation providing a rapid, accurate and objective measurement of seedlings and avoids human error during the evaluations.

c) Germination and Viability

Image analysis can be a significant system to monitor phases of seed germination in controlled environment and the changes associated with it can be assessed accurately; thus helps in seed viability and germination studies. With the help of this technique, germinated and non-germinated seeds can be easily distinguished and moreover, seed characteristics such as radicle length and seed area can also be measured. Behtari *et al*. used image analysis system for predicting germination of *Medicago sativa* and *Onobrychis viciifolia* seeds. In this study, images were processed by a computer to generate numerical red-green-blue (RGB) density values. These density values were significantly correlated with germination and it is concluded that the RGB values of the density-imaged seed tests are non destructive, practical, and can distinguish between high- and poor-quality seed lots.

d) Seed Processing

Geometric features of seed are very important in the design of processing equipments for handling, harvesting, transporting, cleaning, separating, packing and processing of seeds. Machine vision or image analysis can be a faster, non-destructive alternate to the traditional sizing equipment currently used in the seed industry. Digital image analysis technique has been developed and used to determine the physical dimensions of seeds and grains of various crop**.** Shahin and Symons developed a machine vision system for grading lentils based on flat-bed scanner, to assess seed size distribution using image analysis.

Conclusion

A major research work is needed in the area of seed image analysis for computing technology along with the sensory and central processing elements. Substantial improvements in this technology are needed so that human error can be minimized. There is a

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need to develop software and hardware which will help in better return on investment and reduced costs. New advances in pattern recognition and massive data processing should be included in future applications of computer vision to enhance the robustness and accuracy of decisions. In addition, work is also required for online sorting and grading systems to handle large quantities of seeds in seed industries. Thus the image analysis system can serve as a valuable means of studying seed biology and physiology with increased precision providing deeper insight into the biological process**.**

References

Kapadia, V., Sasidharan, N. and Kalyanrao, P. (2017) Seed Image Analysis and Its Application in Seed Science Research. Advances in Biotechnology and Microbiology. 7(2): 555709.

Hemender,T., Sushma, S., Virender, M. and Axay, B (2018). Image Analysis: A Modern Approach to Seed Quality Testing. Current Journal of Applied Science and Technology. 27.