SPECIMEN FORMAT FOR THESES OF MONTH

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Title of the thesis	:	Automated External Skin Defect Detection System for Mangoes using Computational Intelligence and Machine Learning Techniques
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Abstract within 300 words:

Detection of defects in mango fruit is a challenging problem in automatic inspection process and is heavily used by the food industries, particularly by the import/export companies worldwide. It is an important task of quality control which helps to reduce rejection of fruits and time spent on manual inspection. Fruit quality analysis is often based on its appearance using characteristics of skin or surface. Based on this fact, this research work is designed to identify skin or surface defects in mango fruit. The main objective of the research work thus is to design an automated external skin defect detection system for mango fruit using image processing and machine learning techniques in an accurate and time efficient manner.

i) Major objectives:

- To improve the quality of the mango images using denoising methods to reduce the impulse noise for further processing.
- To perform clustering based segmentation on mango images to segment the defected regions.
- To perform feature extraction techniques to identify and extract characteristics that represents a mango image for quality classification.
- To design and develop classification model that uses the features extracted to detect the defects.

ii) Methodology:

The main aim of the research work is to design and develop an automatic defect detection system for mango fruits. External skin defects, namely, bruises, russet, blemish and shrink on four types of mangoes, namely, Alphonso, Banganapalli, Neelam and Sendura, were analyzed. The methodology combines and enhances various image processing and classification algorithms and the contributions made in each step are presented in this section. The research work combines each of the enhanced algorithm from each phase and combines them to form a ADDS for mango fruit.

Mango fruit images are often corrupted by the presence of impulse noise. The enhancement phase (Phase I), proposes techniques to remove / suppress this noise from mango image. For this

purpose, a denoising algorithm that enhances switching median filter is proposed. The enhancement is brought forward by the inclusion of Adaptive fuzziness and Particle Swarm Optimization.

In order to improve the classification process, the segmentation algorithm is used to group similar pixels into clusters. For this purpose, a clustering-based segmentation algorithm is proposed. This algorithm enhances Fuzzy C-Means algorithm for this purpose. The enhancement operations include the usage of a more advanced Modified Fuzzy Possibilistic C-Means algorithm which is optimized through the use of Artificial Bee-Colony algorithm for automatic initial centroid selection.

Feature extraction is performed to extract two categories of features, namely, color feature and texture feature. The research work, in order to improve the accuracy of the classifier, proposes the use of combined color and texture features.

iii) Findings

- The proposed AFSF-PSO noise removal method was efficient in removing impulse noise from both defect free and defective mango fruits. This was evident from the high PSNR values obtained (40.94 dB with Alphonsa, 38.98dB with Banganapalli, 39.95dB with Neelum and 41.90dB with Sendura).

- The inclusion of preprocessing with AESDDSM framework showed improved efficiency during defect detection. Average efficiency gain of 0.62% was envisaged by the SA-RVM classifier while using the proposed noise removal algorithm.

- The proposed FPCM-ABC segmentation algorithm divided the fruit image into similar regions in an accurate fashion. This was evident from the high values obtained by stability criterion (overall average value of 73.31) and anti noise criterion measures (overall average value of 72.74).

- The fused feature vector combining the merits of color and texture feature improved defect detection performance. An overall average efficiency gain of 1.07% and 0.60% was observed by the fused vector over color feature and texture feature respectively when used with SA-RVM classifier.

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