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Challenging İssues in Automated Oil Palm Fruit Grading

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ABSTRACT

Late advancement in Agriculture segment utilizing Image preparing and fuzzy logic methods has empowered ranchers to expand the yield of harvest and served the nourishment needs of the whole people. Look into in horticulture is pointed towards increment in the profitability, quality and lessening the likelihood of blunder presented by people. The biggest oil palm creation is in Malaysia and Indonesia and they send out palm oil to different nations on the planet. The most outrageous enthusiasm for palm oil is in India. This came to fruition India into Palm Oil advancement and era in various states. With a specific end goal to expand the efficiency of palm oil organic products, palm oil industry and in addition analysts utilizes different machine-vision systems to review the natural products. Tragically, the information caught and prepared is confronted with restricted learning and accuracy. There are a few difficulties required with the outline and usage of palm oil organic product reviewing. This paper introduces an outline of different Image handling and fuzzy logic methods, distinguishes and addresses testing issues in computerized palm natural product evaluating.

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1. INTRODUCTION

Progressed get ready of palm oil natural product bunches into agreeable oil using distinctive Image Processing strategies is sharpened in a couple endeavors. The ordinary methodologies are similarly open, little scale mechanical units, medium and endless scale palm oil industrial facilities. It is agreed that ordinary systems for isolating palm oil were grim and inefficient for making oil accessible to be obtained. Henceforth present enthusiasm for little scale palm oil plants is moving from clear stay singular unit operational machines to a more joined and complex PC composed system which is definitely not hard to work and keep up. This assistants in addition in effectiveness and decreases the human effort which may achieve presentation of screw up. This papers reveiws the examination discoveries of different creators and finds the testing issues which are missed by specialists in mechanized palm natural product evaluating.

India has been represented to have the greatest region under oil seed improvement in the World yet the disjointedness is that the private creation is not adequate to meet the irrelevant agreeable oil necessities of the general population. The factors responsible for this consolidate poor land conditions and the creating population. The enthusiasm for palm oil has been creating. There has in like manner been discernible upward example in the per capital use of consumable oil among the Indian population. A lion's share of the Indian people encounters calorie deficiency. Inferable from the cost of edible oil, its usage is maintained a strategic distance from the ordinary menu of the fiscally blocked and tried populace. India has been acquiring boundless measures of oils from late nineteenth century as creation has stagnated or declined in the midst of the latest two decades. This is by virtue of the advancement of private oil creation doesn't proportionate with

relating populace improvement. Considering the future demands starting now highlighted a whole deal philosophy for a thorough progression of creation and taking care of advances ought to be produced to make India sure about consumable oils supply as by virtue of oats and so on. It has been represented that the oil seeds creation in India is significantly helpless against the whims of nature particularly the rainstorm. The moving case of precipitation which is outside the capacity to control of the agriculturists impacts the era and gainfulness of oil items unquestionably. Typical low effectiveness of oil seeds created in India could be taken after fundamentally to the dependence on the rainstorm. The oilseeds in India, which are yearly or periodic yields, are all the more unprotected to precipitation.

The natural products are normally round to ovoid or lengthened and protruding at the top. It is around two to five cm long and weight may change from 3 to 30 gram. As appeared in Figure 1, fuit comprises of an external thin skin (exocarp), oil bearing mash (mesocarp) and a shell endocarp. The shell together with portion frames the seed. The piece comprise of layers of hard oil endosperm, which is grayish white in shading encompassed by a dull cocoa skin secured with a system of filaments. Palm oil is extricated from the mesocarp.

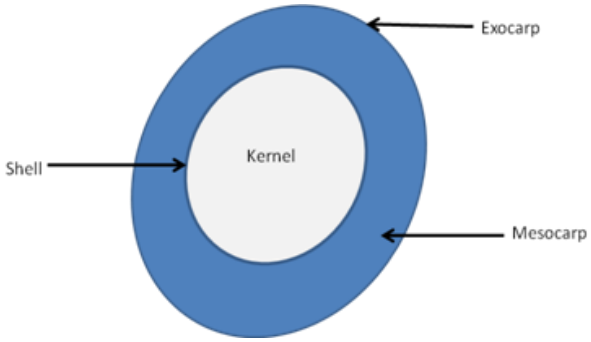

Figure 1. Structure of palm oil fruit

Kernel likewise yields oil known as kernel oil; however the amount is just around 1/4 of that acquired from mesocarp. Oil palm bundle comprise of external and inward natural products. The inward natural products are less pigmented, fairly level, undeveloped and non-oil bearing. Bundle weight different from a couple to 100 kilograms. Well set clusters convey 1000 to 3000 organic products. Aging is as a rule from tip downwards. A bundle takes around five to six months for aging. Oil development in the piece and mesocarp happens towards the end of a time of development amid which shell solidifies and afterward fetus gets to be noticeable. Three oil palm assortments have been distinguished in light of the distinction in organic product structure. They are Dura, Tenera and Pisifera. Dura has a thick shell (normally two to eight mm) with low to medium mesocarp content. This assortment is not monetarily developed at this point. Figure 2 demonstrates all the three assortments.

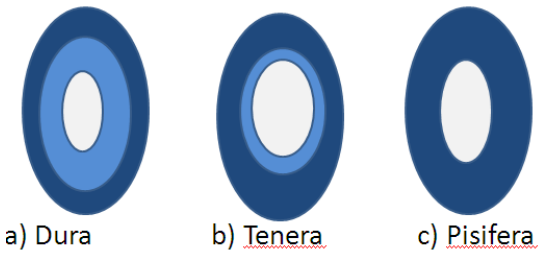

Figure 2. Three varieties of palm oil fruit

Tenera assortment is a crossover got by intersection Dura (female) and pisifera (male). It has a thin shell for the most part and a medium to huge mesocarp substance. There is unmistakable fiber ring in the mesocarp. This is the generally developed sort everywhere throughout the world because of the high

mesocarp substance and resultant oil yield. Pisifera assortment is described by a shell-less natural product pea like piece inside. Regularly the piece is likewise missing. Since a large number of the organic products don't have developing life, seed proliferation is practically unimaginable. Palm oil fruit changes shading as it achieves legitimate collecting period. There are add up to four phases unripe, underripe, ready and overripe. These four phases are appeared in Figure 3. It is seen that the shade of the organic product changes from base to pinnacle.

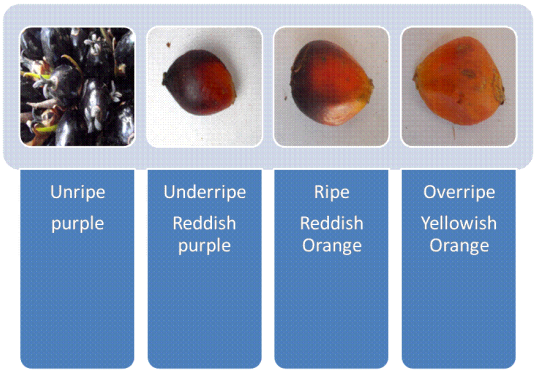

Figure 3. Four different stages of palm oil fruit as it ripens

2. IMAGE PROCESSING ND FUZZY LOGICMETHODS

T Z. May, M. H. Amaran [1] developed model of mechanized reviewing framework for oil palm organic product is created utilizing the RGB color model and fuzzy logic. The motivation behind this evaluating framework is to recognize the three distinct classes of oil palm natural product which are underripe, ready and overripe. This extend gives a decent strategy to institutionalize the oil palm organic product reviewing framework over a huge zone and the exploration will keep on normalizing the framework to have the capacity to use under various wellspring of lighting.

Meftah Salem M. Alfatni, [2] in their examination created robotized reviewing framework for oil palm packs utilizing RGB color model. This evaluating framework is produced to recognize three classes of palm organic products bunch. The development shading record depended on various shading intensity. The evaluating framework utilizes Computer and camera to dissect and translate images. The Computer program created and utilized mean shading force to separate between various shading and readiness of natural product.

Nursuriati Jamil, Azlinah Mohamed, Syazwani Abdullah [3] In this paper, external surface shades of palm oil crisp natural product bundles are broke down to consequently review the organic products into over ready, ready and unripe. They looked at two strategies for shading reviewing: 1) utilizing RGB computerized numbers and 2) colorsc classification prepared utilizing a managed learning Hebb method and evaluated utilizing fuzzy logic.

W.I. Wan Ismail, M.Z. Bardaie, and A.M. Abdul Hamid [4] The trial was led to decide the Hue optical properties of the three classifications of Fresh Fruit Bunches in particular unripe, underripe and ripe.Nikon Coolpix 4500 advanced camera with tele-converter zooming and the Keyence vision framework were utilized to catch the pictures in genuine oil palm ranch. The relationship of the oil content for mesocarp oil palm organic products with the advanced estimation of Hue was dissected.

A.Nureize, J. Watada [5], the destinations of this paper is to fabricate a fuzzy multicriteria assessment model that describes the criteria of oil palm organic products to choose the fuzzy weights of these criteria in light of a fuzzy regression display.

Z Abdullah, L.C Guan and B.M.N Mohd Azemi [6] The quality element of a standard Elgaeis guineensis oil palm was evaluated utilizing a PC vision demonstrate as a part of request to assess and grade the oil palm bunches by a robotized creation framework. The element considered was shading, and the review criteria depended on the Palm Oil Research Institute of Malaysia. The relationship between oil substance and shading was investigated in HSI (Hue, Saturation and Intensity) space for readiness assurance.

Manza R.R., Gaikwad B.P. and Manza G.R. [7] some researchers used different edge detection operators and proved that they can be used to categorize the mango fruits to evaluate the quality and grade. Same concept can be used in oil palm fruit grading. The Simulink based adjustable structure is intended for fast reenactment, execution, and check of video preparing frameworks. In this work the similar examination of different mangoes video edge identification techniques resemble Sobel, Prewitt and Canny is exhibited. Figure 4 gives the overview of different researchers.

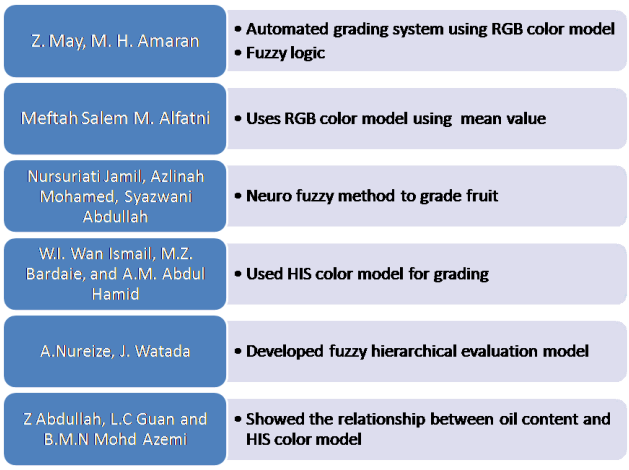

Figure 4. Vertical block list showing researchers and their findings

Norasyikin Fadilah, Junita Mohamad-Saleh [8] this paper exhibits the use of shading vision for mechanized readiness characterization of oil palm Fresh Fruit Bunches. Pictures of oil palm Fresh Fruit Bunches were gathered and broke down utilizing advanced picture preparing strategies. Then the shading elements were removed from those pictures and utilized as the contributions for Artificial Neural Network learning. The execution of the ANN for readiness characterization of oil palm FFB was examined utilizing two strategies: preparing ANN with full elements and preparing ANN with decreased elements in light of the Principal Component Analysis information lessening strategy. Results demonstrated that contrasted and utilizing full components as a part of ANN, utilizing the ANN prepared with lessened elements can enhance the characterization accuracy. The created readiness classifier can go about as a sensor in deciding the right oil palm Fresh Fruit Bunches readiness classification.

Ahmed Jaffar, Roseleena Jaafar, Nursuriati Jamil [9] this paper introduces a PC helped photogrammetric approach which corresponds the shade of the palm oil fruits to their readiness and in the end deals with them physically.The framework and the approach planned in this work have built up a finish robotization reviewing arrangement of oil palm FFB and along these lines radically expanded the reviewing efficiency.

Fatma Susilawati Mohamad, Azizah Abdul Manaf and Suriayati Chuprat, [10] this paper uses the utilization of Distance Measurements for histogram based oil palm readiness identification. In this study, HSV color model is investigated its capability of colors.Four Distance Measurements are chosen and looked at in this study. Sunilkumar and D. S. Sparjan Babu [11] Stated The present study was embraced to assess diverse development phases of oil palm fruits as far as shading and oil content, set up their bury relationship and to create expectation models in light of shading qualities so that non dangerous readiness assessment could be accomplished. Correlation of RGB and L*a*b shading model is done.The L*a*b* based model would be perfect for fusing in contraptions like colorimeters with the end goal of shading based reviewing of FFB and expectation of oil substance. This study explores the connection between oil content in the oil palm fruit against the shade of the oil palm organic product. The finding of this study is helpful for deciding readiness of oil palm for gathering and at the last will use in building up the business shading meter to gauge organic product readiness utilizing non-contact estimation procedure. [12].

Choong *et al*. [13] the oil substance of the tissue of mesocarp has coordinate association with shading groups red, green and blue. By running escalated tests, it was observed that oil content related with the red shading band, with a relapse estimation of 0.86. The finding of this study might be valuable for deciding the readiness of oil palm for collecting and for the utilization in the operation and control of nonstop sterilizer in palm oil process. However, a later study by Ghazali *et al*. [14] discovered that the red components for unripe and underripe categories were almost the same. The summary of research finding is shown in Figure 5. The test comes about demonstrate that [15] Fuzzy Moving K-implies has characterized the remote detecting picture more precisely than other three calculations. Rather than utilizing single component bunching calculation, [16] this paper introduces different element grouping calculation with three elements for every pixel, for example, pixel power, separate from the focal point of the spot and middle of encompassing pixels.

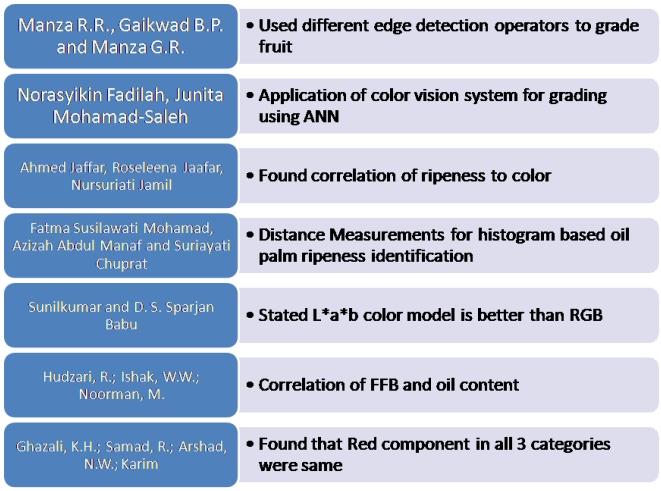

Figure 5. Vertical block list showing researchers and their findings

3. CHALLENGING ISSUES IN PALM FRUIT GRADING

After starting examination of the writing review it is found that there are numerous issues which must be talked about and sorted to get the best results. There are add up to seven testing issues which were not considered in the past research. There are situations where the organic product is harmed by nuisance in light of which the natural product shading may change and prompts wrong reviewing of organic product. There are distinctive variables which need to consider when the way toward evaluating is computerized. A portion of the key components which is found and recognized are appeared in Figure 6.

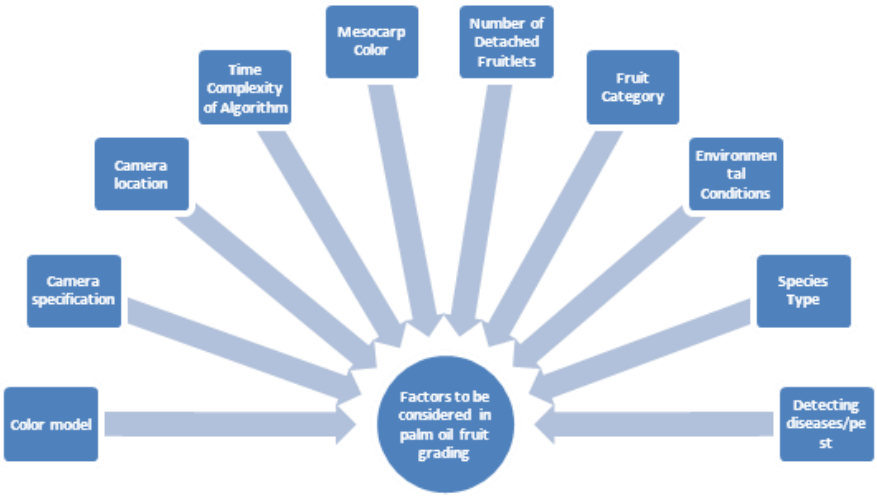

Figure 6. Different parameters to be considered in palm oil fruit grading

1. Color model: Some of the researchers have proved that RGB color model or HIS color model is the best for grading oil palm fruit. But after literature survey it is found that the color model to be used depends on the environmental condition which is unpredictable. Also the color of the fruit is different and varies from region to region so there is a need for investigation and detailed study. The purpose of a color model is to facilitate the specification of colors in some standard generally acceptable way.
2. Camera specification: When the image is captured from the tree for real time processing, the camera resolutions and pixel data also plays major role in deciding the complexity of algorithm to be designed.
3. Camera location: The location of camera also plays very important role in decision making because the color of fruit is not uniform from base to apex. The location, orientation and mode of operation of each camera need to be carefully chosen to ensure well-covered scene.

4. Time complexity of algorithm: In the previous research there is no time complexity given for the proposed algorithm. Not even a single algorithm says that its time complexity is linear or quadratic.
5. Illumination: Most of the previous research is carried out in controlled environment. The algorithm should work in all the environmental conditions, irrespective of cloudy or sunny weather.
6. Species type: Till now no research has been done on categorizing the palm oil fruits into their three species dura, tenera or pisifera.
7. Detecting diseases/pest: Detecting the type of disease/pest the oil palm fruit affected with is also very important for farmers to take precautions against the pest. Figure 7 shows different diseases and pest. It is found after literature survey that automated detection of disease and pest has not been done by researchers.
8. Exocarp color: Exocarp color varies from region to region. Through study is required to find out the different color in different regions. We cannot generalize the mesocarp color. Figure 8 shows the relationship between color and category of fruit.
9. Fruit category: Some researchers have taken only three categories namely Unripe, Ripe and Overripe. But the truth is there are total four categories Underripe, Unripe, Ripe and Overripe.
10. Percentage of FFA: Finding the percentage of free Fatty Acid (FFA) content from the fruit is also very important in automated grading. More the FFA content less healthy will be the oil. The relationship between fruit category and FFA content is shown in Figure 9.
11. Number of Detached fruits: This is the main element which is utilized as a part of manual evaluating. So there is some connection between number of natural products tumbled from trees to the reviewing. Till now this element has not contemplated. This technique has been rehearsed till today since it is possible if the tree is tall.

It can be observed from Figure 10 that the number of detached fruitlets has direct relationship with the FFB category. The data is compiled from statistical data, Godrej Agrovet Pvt. Ltd.- Goa. The manual harvesting works with the number of detached fruits fallen down on the ground from the tree. Since the trees are very tall, and farmers cannot climb the trees because of the thorns, this is the only feasible method for them to find out the correct harvest time of oil palm fruits.

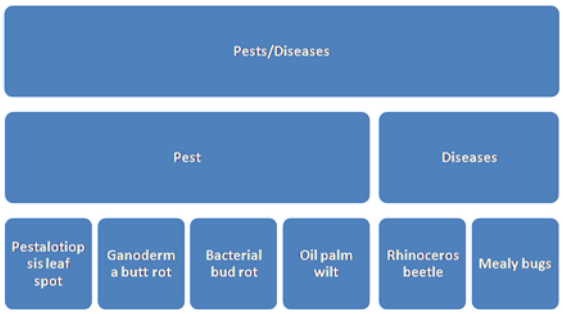

Figure 7. Diseases and pests in oil palm fruit

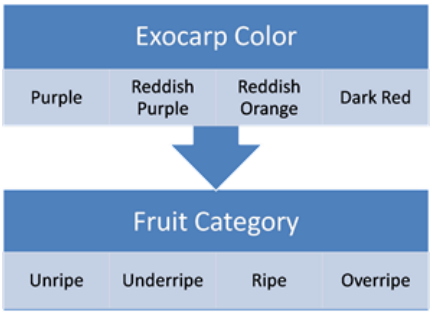

Figure 8. Correlation between color and category

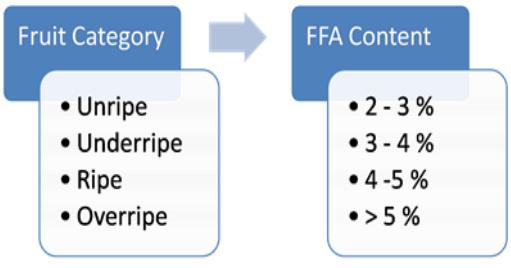

Figure 9. Relation between Fruit Category and FFA content

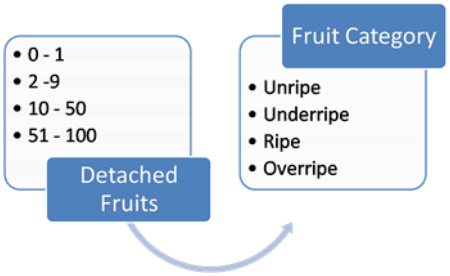

Figure 10. Relation Detached Fruit and Fruit Category

4. CONCLUSION

In this paper we introduced the diagram of various Image Processing and fuzzy logic methods utilized for Palm oil natural product evaluating and talked about the difficulties that ought to be met to get exact and substantial results. Despite the fact that a few scientists say that the calculation and strategies proposed by them is great and flawless yet at the same time there is extension for legitimate procedure and change. Till now there was no model indicated which can be utilized as plan for execution. Since shade of organic product changes from locale to district, same technique can't be received to every one of the cases. So there is a requirement for summed up model utilizing displaying strategies. Alongside shading there are more components which are expressed before can be utilized to build the exactness and precision while evaluating oil palm natural products. Presently a day's PC vision framework is utilized wherever to decrease the blunder and increment the proficiency and profitability, it is a need that Palm oil extraction factories ought to be received. In this manner image processing and fuzzy logic methods are intense instruments which will help in planning powerful machine-vision framework for farming space if the above issues are tended to effectively.

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REFERENCES

[1] Z. May, M. H. Amaran, *et al.*, "Automated Oil Palm Fruit Grading System using Artificial Intelligence", *International Journal of Video & Image Processing and Network Security* IJVIPNS-IJENS Volume.11 no. 03.

[2] Meftah Salem M. Alfatni, *et al.*, "Oil Palm Fruit Bunch Grading System Using Red, Green, and Blue Digital Number", *University Putra Malaysia, Journal of Applied Sciences*, Vol. 8, pp. 1444-1452, 2008.

[3] Nursuriati Jamil, Azlinah Mohamed, Syazwani Abdullah, *et al.*, "Automated Grading of Palm Oil Fresh Bunches (FFB) using Neuro -Fuzzy Technique", *Universiti Teknologi MARA, International Conference of Soft Computing and Pattern Recognition*, 2009.

[4] W.I. Wan Ismail, M.Z. Bardaie, and A.M. Abdul Hamid, *et al.*, "Optical properties for mechanical harvesting of oil palm FFB", *Journal of Oil Palm Research*, Volume. 12, no. 2, pp. 38-45, Dec 2000

[5] A. Nureize, J. Watada, *et al.*, "Multi-criteria Fuzzy Regression Model for Evaluating Oil Palm Grading", *Graduate School of Information, Production and System*, Waseda University, 2-7 Hibikino, Wakamatsu, Kitakyushu, 808-0135 Japan, 2009.

[6] M.Z Abdullah, L.C Guan and B.M.N Mohd Azemi, *et al.*, "Stepwise Discriminant Analysis For Colour Grading of Oil Palm Using Machine Vision System", *University Science Malaysia, Institute of Chemical Engineers, Trans ICheme*, Vol. 79, Part C, 2001.

[7] Manza R.R., Gaikwad B.P. and Manza G.R. *et al.*, (2012) "Use of Edge Detection Operators for Agriculture Video Scene Feature Extraction from Mango Fruits", *Advances in Computational Research*, ISSN: 0975 -3273 & E-ISSN: 0975-9085, Volume 4, Issue 1, pp.-50-53.

[8] Norasyikin Fadilah, Junita Mohamad -Saleh, Zaini Abdul Halim, Haidi Ibrahim and Syed Salim Syed Ali, *et al.*, "Intelligent Color Vision System for Ripeness Classification of Oil Palm Fresh Fruit Bunch", *Sensors* 2012, 12, 14179-14195; doi:10.3390/s121014179, ISSN 1424-8220.

[9] Ahmed Jaffar, Roseleena Jaafar, Nursuriati Jamil, Cheng Yee Low and Bulan Abdullah, *et al.*, " Photogrammetric Grading of Oil Palm Fresh Fruit Bunches", *International Journal of Mechanical & Mechatronics Engineering* IJMME-IJENS Vol: 09 No:10

[10] Fatma Susilawati Mohamad, Azizah Abdul Manaf and Suriayati Chuprat, *et al.*, "Exploiting Distance Measurement for Ripeness Identification", *IJCSI International Journal of Computer Science* Issues,Vol.9, Issue 3, No 3,pp 107-108, May 2012.

[11] K. Sunilkumar and D. S. Sparjan Babu, *et al.*, "Surface color based prediction of oil content in oil palm (Elaeis guineensis Jacq.) Fresh fruit bunch", *African Journal of Agricultural Research*, Vol. 8(6), pp. 564-569, 25 February, 2013.

[12] Hudzari, R.; Ishak, W.W.; Noorman M., *et al.*,"Parameter acceptance of software development for oil palm fruit maturity prediction", *Journal of Software Engineering*, 2010, 4, 244–256.

[13] Choong, T.; Abbas, S.; Shariff, A.; Halim, R.; S., M.H.; Yunus, R.; Ali, S.; ahmadun, F.R. *et al.*, "Digital image processing of palm oil fruits", *International Journal of Food Engineering*, 2006, 2, 1–4.

[14] Ghazali, K.H.; Samad, R.; Arshad, N.W.; Karim, R.A. *et al.*, "Image Processing Analysis of Oil Palm Fruits for Automatic Grading", International *Conference on Instrumentation, Control & Automation*, Bandung, Indonesia, 20 October 2009.

[15] B. Saichandana, K. Srinivas, R.Kiran Kumar, "Clustering Algorithm combined with Hill Climbing for Classification of Remote Sensing Images", *International Journal of Electrical and Computer Engineering (IJECE)*, vol 4,
No. 6, pp 923-930.
[16] J. Harikiran, P.V. Lakshmi, R. Kiran Kuma," Multiple Feature Fuzzy c-means Clustering Algorithm for Segmentation of Microarray Images ", *International Journal of Electrical and Computer Engineering (IJECE)*, vol 5, No. 5, pp 1045-1053.

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