Mobile application devices for MATAG coconut variety detection based on spectral signature analysis: A review

Mobile application devices for MATAG coconut variety detection based on spectral signature analysis: A review

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Abstract. A smartphone is a high-speed technology with many new features available. Users can install games, education, health, financial, safety, and even agriculture apps. Some smartphones can detect plant species based on the processed images from RGB and its algorithm. MATAG hybrid process including fermentation is being described. This review also shows the current trend of MATAG variety identification based on spectral signature differences between MATAG hybrid. It can be linked via mobile applications to detect the species. This review then elaborates the image segmentation in the smartphone for the segregation of digital images into several segments and locates the objects and the bounding lines of the pictures. Applications of computer vision techniques such as machine learning and support vector machine to identify MATAG variety based on spectral analysis is being reviewed. As a user-friendly approach, the mobile application is essential for farmers to capture the MATAG information from smartphones' cameras with all the processing links to the server and finally will help farmers identify the species using the mobile apps.

Keywords: image, matag, mobile applications; spectral signature analysis

1. Introduction

Coconut is also known as *Cocos Nucifera* Linn is one of the important crops in Malaysia since the demand is high and Malaysia still imports the coconut from our neighbour country. It is a monoecious perennial monocotyledon in the family Aracaceae (Palmaceae) [1]. According to [2], 70% of the production is from Indonesia, India and the Philippines. There are many varieties of coconut in our country depending on the different tastes and applications. The most famous variety is MATAG because the kernel can devour beverages and the height of the tree is also smaller than other varieties [1]. According to [1] *Cocos Nucifera* Linn. Var. MATAG is a Dwarf coconut variety that had high demand

in Malaysia but low supply. This is because of the complicated of hybrid the variety to get the pure MATA variety. Most farmers sometimes have a problem checking the originality of the variety.

In Malaysia, MATAG hybrid is widely used in the agriculture production, and the the Ministry is always attempting to increase the number of coconut trees planted [3]. With roughly 25,000-30,000 nuts per hectare per year, MATAG is a particularly high-yielding cultivar compared to regular coconut or other hybrids in terms of production rate [4]. Unforfortunely, the seedling producers are struggling to meet the high demand due to low supply is constrained by few farmers planting MATAG's new hybrid seeds [5]. The complicity and high chance to get true-to-type coconut hybrids are very challenging. Furthermore, owing to erratic water supply, unoptimized fertilisation rate, insect and disease assault, poor germination percentage, non-uniform seedling development, and abnormal/weak seedlings are key concerns at the nursery centre. In Malaysia, only several centres (Department of Agriculture Johor, Perak and Selangor) can produce the pure MATAG variety and this led to the lacking the supply and heading to the fake variety from another supplier. Thus, by using precision management and a decision support system to optimise these aspects would improve the process, cut input costs, and boost the output of high-quality coconut seedlings from the nursery.

The production of coconut seeds for Jorak Agricultural Center (DOA, Jorak) in 2017 was 69,543 trees and increased to 112,100 trees in 2018. While in 2019 the total production of coconut tree seeds was 89,000 trees and continued to increase by 124,300 trees in 2020. Total production of MATAG coconuts in a fluctuating manner is because the Jorak Agricultural Center does not keep any seed stock in a given year. The price of one MATAG coconut seed plant is RM15 after being subsidized. Figure 1 shows the MATAG variety at the nursery.

Figure 1. Center of MATAG nursery at DOA, Jorak.

2. MATAG Hybrid process

The hybridization process for the MATAG variety needs highly skilled labor. Fermentation is one of the processes in hybridization, which needs to be done in-situ. Working environments including hot weather exposure and safety-related issues (especially when a tall variety is involved) are part of the challenges. Coconut hybrid production is a laborious process that involves frequent climbing, especially during the pollination process, and the rate of success is highly dependent on this factor.

Figure 2 shows the Male coconut flowers from the Tagnanan coconut type that must be removed before opening and Female flowers of Malayan Dwarf type coconut to produce the MATAG variety. Again, even though, after the pollination process, not all the coconut successfully become the MATAG variety. That is the challenge in the MATAG variety producer. The workers need to work under the sun

and climb high on the tree. That's also one of the reasons why the price is a bit expensive compared to the other variety.

Figure 2. a) Male coconut flowers from the Tagnanan coconut type that must be removed before opening
b) Female flowers of Malayan Dwarf type coconut
c) Plantation workers are removing male flowers from Malayan Draft coconut trees

Figure 3. Pure MATAG hybrid

3. Spectral signature to detect the MATAG variety

Currently, seedling colour recognition using human eyes is the traditional method of determining hybridization success, in which certain colours represent the hybrid or parent variety (DOA, personal communication, April, 2021). This method is time intensive and exposed to human mistake. As a result, an extensive study need to conduct employing computer vision techniques to identify MATAG variety using spectral analysis to aid in decision making.

The use of mobile applications to increase knowledge of the species and identify the species in a user-friendly way, using a machine learning approach to recognise plant species with an accuracy of 90% [6]. While in India, illness detection with a smartphone was carried out using image processing and visible and infrared light [7]. This approach used illness symptoms, colour, area, and a number of lesions to evaluate the degree of the disease infecting a plant and displayed the final result on a smartphone [7]. [8] were able to diagnose illness in cassava leaves by utilising the cassava symptom recognition assessment instrument (CaSRAT) to grade photographs of cassava leaves.

A similar idea can be applied to MATAQ hybrid identification utilising a smartphone. If the user understands how to analyse the photos, the camera on a smartphone may be used to identify any plants or illnesses. [9] were effective in identifying illnesses in plants using RGB pictures from a smartphone. The method based on the RGB-image database is used to identify sugar beet leaf diseases. The approach comprised of picture acquisition and image processing on the smartphone utilising a segmentation procedure based on texture parameters such as colour, intensity, and gradient values. The disorders are categorised using a support vector machine with a radial basis function kernel. The categorization accuracy was 82%. A spectral signature is an effective tool for distinguishing plant species. Figure 4 shows the example of how the spectral signature was different for each plant, in this case, is the variety of weeds. Recently, [10] developed mobile apps that can show the spectral signature of weeds and this

is one step closer to identifying the species using mobile apps through the cloud processing based on the RGB imagery and it shows high potential and possibility to use the smart phone in the future (Figure 5).

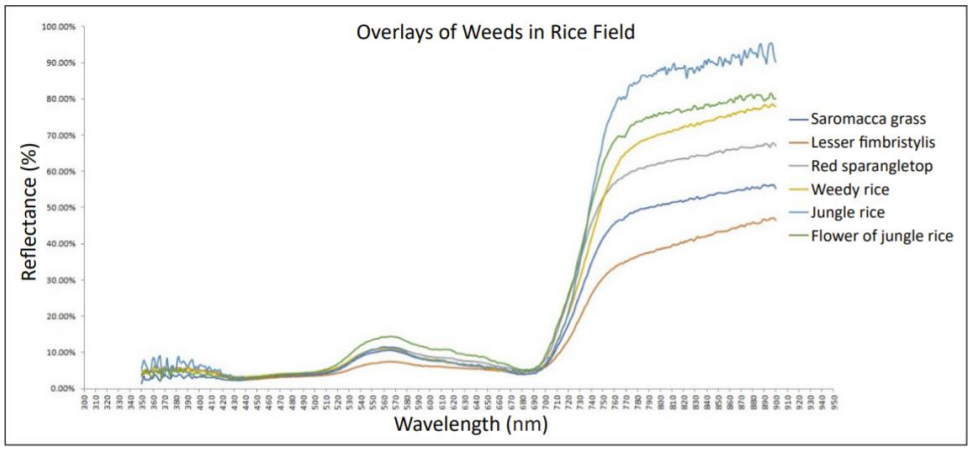

Figure 4. The spectral signature for different weeds [10]

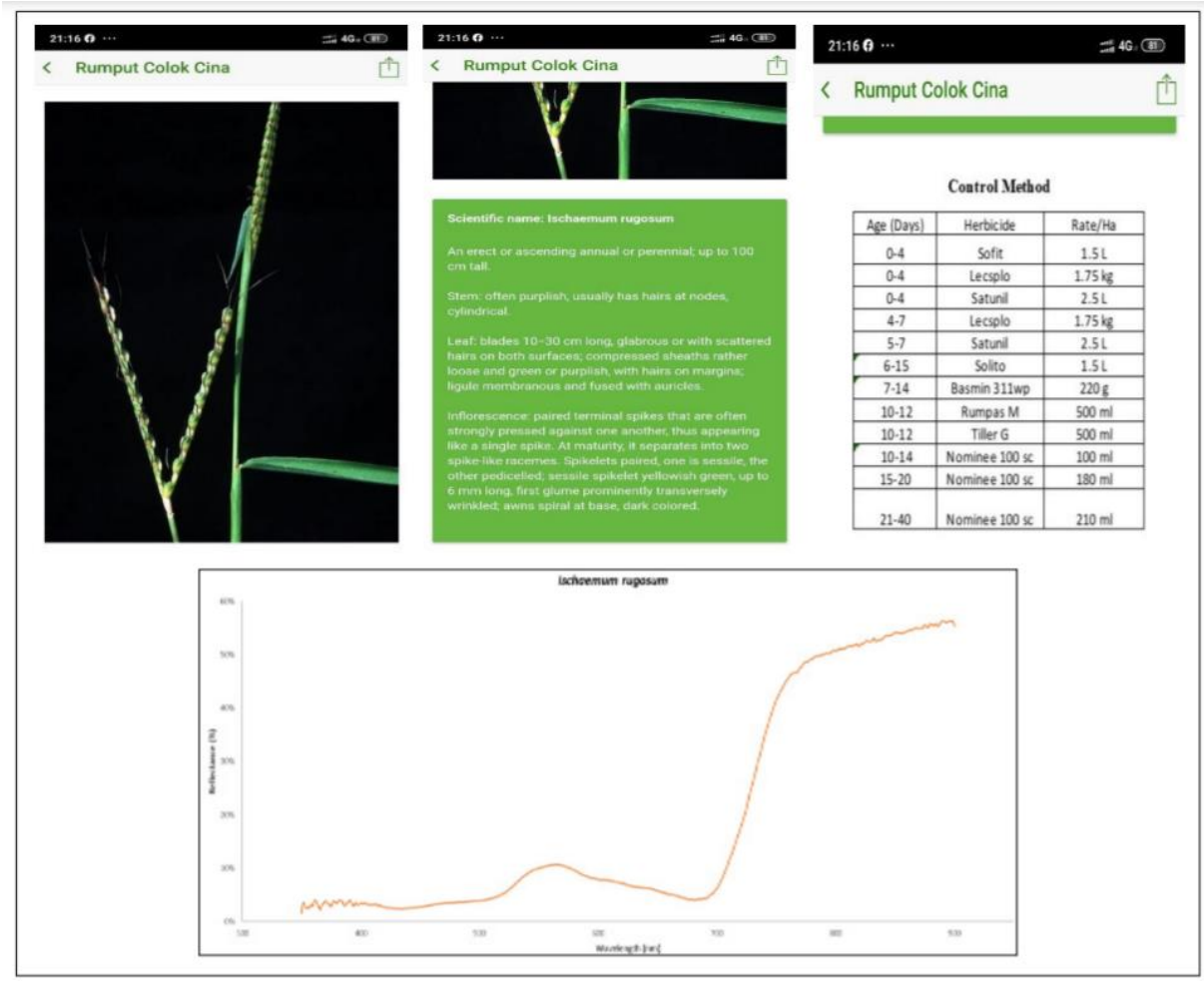

Figure 5. Mobile apps that provide the spectral signature of plants [10]

4. Conclusion

The invention of mobile application devices is an essential milestone toward more advanced agricultural practices and is beneficial for the agricultural community. Research has indicated that mobile application devices have improved agricultural productivity and farm practices. Mobile applications have become a useful tool in agriculture and essential for farmers because their mobility matches the nature of farming, user-friendly and their computing power allows a variety of practical applications to be created and capture MATAG's information. The mobile application can display the spectral signature of MATAG's variety using spectral analysis to aid in decision making. In conclusion, the mobile application integrating spectral signature analysis can be a platform to display information about MATAG's variety and species.

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References

[1]. Zawawi, D.D., M.F.A. Bakar, and S.N.A. Kadir, *Effect of 2, 4-Dichlorophenoxy Acetic Acid and Activated Charcoal on Callus Induction of Cocos Nucifera L. Hybrid MATAG Inflorescence.* Journal Of Agrobiotechnology, 2021. **12**(1S): p. 51-61.

[2]. Halim, H.H., et al., *Ergogenic attributes of young and mature coconut (Cocos nucifera L.) water based on physical properties, sugars and electrolytes contents.* International Journal of Food Properties, 2018. **21**(1): p. 2378-2389.

[3]. Sivapragasam, A., *Coconut in Malaysia-Current Developments and Potential for re-vitalization. MARDI.* IPICEX2008, Shah Alam, Malaysia, 2008.

[4]. Pressreader *Hybrid coconut: Its potential to help overcome proverty* 2016.

[5]. Man, N. and J.A. Shah, *Acceptance of New Coconut Seed Matag Among Coconut Growers in Bagan Datoh, Perak And Bachok, Kelantan.* 2020.

[6]. Begue, A., et al., *Automatic recognition of medicinal plants using machine learning techniques.* International Journal of Advanced Computer Science and Applications, 2017. **8**(4): p. 166-175.

[7]. Gajanan, D.E., G.G. Shankar, and G.V. Keshav, *Android based plant disease identification system using feature extraction technique.* Int Res J Eng Technol IRJET, 2018. **5**(1).

[8]. Mrisho, L., et al., *Evaluation of the accuracy of a smartphone-based artificial intelligence system, PlantVillage Nuru, in diagnosing of the viral diseases of cassava.* BioRxiv, 2020.

[9]. Hallau, L., et al., *Automated identification of sugar beet diseases using smartphones.* Plant pathology, 2018. **67**(2): p. 399-410.

[10]. Roslin, N.A., et al., *Mobile Application Development for Spectral Signature of Weed Species in Rice Farming.* Pertanika Journal of Science & Technology, 2021. **29**(4).