Distinguish Garnet Mineral from Pulmuddai Beach Sand Using Image Processing Techniques

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Beach sand is one of the major minerals producing source in Sri Lanka. *Pulmuddai* Beach, rich in Ilmenite, Rutile and Zircon and Garnet and it is the largest mineral processing plant in Sri Lanka. It's a great necessity to explore high mineral localities for production. In the industrial level, the percentage of a specific mineral is calculated using a visual inspection through a microscope which is manual and time-consuming. The research introduces an innovative method to distinguish *Garnet* mineral from sand using image processing techniques. In this study, 1125 visible light *RGB (Red, Green, Blue)* images and 1125 Infrared (*IR)* images of beach sand were captured in a controlled light environment. RGB color composite images and IR images were analyzed separately to identify *Garnet* mineral from the gang and to calculate *Garnet* percentage. For the *machine learning classification* purpose, *contrast*, *variance*, *mean*, *median*, *min*, *max*, *range*, *kurtosis*, *skewness*, *standard deviation* and *correlation* were extracted from sand grains images. Then *RGB, HSV (Hue, Saturation, Value)* and *RGBIR (Red, Green, Blue and Infrared) color models* were used through a *machine learning* model. The highest accuracy of 63% of separation accuracy was given by the *HSV* color model. The accuracy could be increased by introducing more images to the *machine learning* process. The final model was built based on the *HSV* color model since it has the high accuracy of separation. Then the *HSV* model subjected to *object counting model*, *area-based counting model* and *volume based counting model* to identify the most suitable method for the percentage calculations. Among these three methods, an *object counting model* produced the more accuracy results with 57%. Thus, the *HSV* color model incorporates with *object counting model* produces the best combination to identify Garnet and calculate its percentage.

Keywords: Image processing, Garnet mineral, Machine learning, Color model