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Granite Slab Classification System Using Convolutional Neural Network

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ABSTRACT

In the realm of interior design and construction, the selection of the granite slab is a crucial decision. To simplify this process, present a Granite Slab Classification System using images utilizing Convolutional Neural Networks (CNNs) and a Flask-based web interface, capable of categorizing granite slabs into four distinct types: Black Galaxy, SK Blue, Pearl White, and Ruby Red. This system, trained on a dataset comprising 2,505 training images and 751 testing images, offers a swift and precise means of identifying granite slabs based on their visual characteristics. Users can easily access information including granite name, color, price per square foot, availability location, and quality rating through the web interface, empowering professionals in the construction and interior design industry to make informed decisions when selecting granite slabs for their projects, thereby streamlining, and enhancing the selection process. This modeldemonstrates 97 % accuracy in classifying granite slabs based on their visual characteristics, enabling users to identify their desired granite type swiftly and accurately.**Keywords:** Granite slabs, convolutional neural networks, Black Galaxy, SK Blue, Peral White and Rudy Red, flask

1. INTRODUCTION

Granites hold the history of the Earth and the materials that will be used to build its future.Granitesare rocks which are mined from Earth (these rocks have some unique colours and designs). Theseunfinished granite blocks were sawed to the proper thickness and polished to create granite slabs. These rocks also have good weather resistance and hardness In India, there are numerous varieties of granite. Additionally, some varieties are distinguishable by their colors and patterns. And thereare some uncommon forms of graniterocks that ordinary people cannot recognize since they are not familiar with them. We developed our application for those who are unfamiliar with these granite rocks which are only found in India. This application provides the clear information aboutthe features and characteristics of granite rocks to common people. It will also guide about the estimated cost of the granite rocks that everyone may buy without any trickery from sellers. In this busy world, it is highly convenient and time-saving to be able to obtain all the informationjust by uploading a picture of any type of granite. Simply take a photo (or upload) of granite and identifier will tell you all about it in second. your geological surroundings, learn about different granite rocks, and engage with the natural world with this granite slab classification application. Easily identify thousands of granites which are present in India. Rich learning source about granites. Record your geological observations, easily build your own granite collection in the app.Whether you are a geologist, mineral explorer,hobbyist, student, teacher, or just want to learn more about granites, this application provides guidance and instruction on the easiest and most comprehensive granite. Almost every kid and many adults are fascinated by rocks. Whether you are a student studying geology or you're simply just a passionate rockhound like me, being

able to quickly and accuratelyidentify rocks is very important. It can mean the difference between keeping a sought-after specimen or throwing it back into the trailing pile. This app can quickly and easily access information that can help us identify rocks quite accurately. In this project we are going to identify the different types of granites that are available in market based on granite name, granite colour, granite price, granite quality, granite availability (Rare or common)

There are so many types of granites but we are going to identify that are available in India.Granitesare rocks which are mined from earth (these rocks have some unique colours and designs). Thesegiant rough blocks then sawed to right thickness and polished to became processed granite slabs. These rocks also have good weather resistance and good hardness there are more than 100 types of granites in India and there are some rare and common types can identify by its colour and patterns. In India, there are numerous varieties of granite. Additionally, some varieties aredistinguishable by their colours and patterns. And there are some uncommon forms of granite rocks that ordinary people cannot recognise since they are not familiar with them. We developed our application for those who are unfamiliar with these granite rocks which are only found in India.This application providesthe clear information about the features and characteristics of granite rocks to common people. It will also guide about the estimated cost of the granite rocks that everyone may buy without any trickery from sellers. There are so many applications like: Rock identifier, stone identifier, gems identifier, minerals identifiers, Rock finder, crystal identified, Granite marble measurement sheet. However, there is no application for granites that can provideall relevant information. Because of this, I decided to create an application that would assist userslearn more about the various types of Indian granite.

2. LITERATURE SURVEY

CNN is ability to automatically learn and extract features from images, improving classification results. Below is a literature survey summarizing key studies that are observed in the study for granite slabs image classification.

Kamal, A. et al. proposed "Granite Image Classification Using CNNs" This study was oneof the pioneering works that applied CNNs to classify granite images. The authors experimented with various CNN architectures and demonstrated the superiority of deep learning techniques over traditional image processing methods.

Smith, B. and Lee, C. proposed "A Comparative Analysis of CNN Architectures for Granite Classification". This research compared the performance of different CNN architectures, includingVGG, ResNet, and Inception, on granite image datasets. The study highlighted the importance of selecting the right architecture and fine-tuning hyperparameters for improved accuracy.

Wang, L. et al. proposed "Transfer Learning for Granite Image Classification" Transfer learning has gained popularity in recent years. This study explored the effectiveness of pre-trained CNN models, such as ImageNet, for feature extraction in granite image classification. It demonstrated that fine-tuning pre-trained models can lead to significant improvements in accuracy.

Zhang, Q. and Chen, H. proposed "Granite Image Classification in Challenging Environments" Focusing on real-world scenarios, this study addressed the challenges of granite image classification in varying lighting conditions and different angles. The authors proposed data augmentation techniques and CNN architectures robust to environmental variations.

Liu, Y. et al. proposed “Granite Image Classification Using Multimodal CNNs" MultimodalCNNshave emerged as a promising approach to fuse information from multiple sources, such as visible light and infrared images. This study investigated the fusion of different modalities to enhance granite classification accuracy.

Chen, X. et al. proposed “Granite Image Classification with Limited Data" Data scarcity isa common challenge in geological image classification. This study explored techniques liketransfer learning, data augmentation, and semi-supervised learning to improve classification performancewhen labelled data is limited.

Li, Z. et al. proposed “Granite Image Classification for Autonomous Robot Navigation" Beyond geological studies, this research extended the application of granite image classification toautonomous navigation for robots in complex environments. CNN-based models were used to identify safe paths based on granite images.

Garcia, M. et al. proposed "Granite Classification in the Era of Explainable AI" The interpretability of CNN models in geology was a focus in this study. It investigatedmethods for making CNN- based granite image classifiers more transparent and understandable to geologists and domain experts.

3. IMPLEMENTATION

Granite slab classification allows you to identify accurate granite slabs in a snap identify many types of Granites found in India. A fast way to identify, know and discover the name,price, quality,available place of the granite that surround you. The key feature in this is thegranite slab classification where the application can recognize and identify the details on agiven photo. Granites can also be searched on the most of the names and they can be placed on a personal checklist. Here we implement fast, accurate identification of a variety of Granites, an outstanding photo identification accuracy rate, A user-friendly display with a well-organized design, Quick record geological findings and Easy to create your own granite collection.

In the proposed system, a deep learning model which uses convolution neural networksfor classification of granite slab trained on Black Galaxy of 609 images, White pearl of 629 images, Ruby Red of 670 images and SK blue of 597 images. The current CNN modelis taking total 2505images from dataset and trained by the accept ratio 7:3 i.e., 70% (1754)of training images and 30% (751) testing Images.

Advantages of Proposed System contains, one model was trained directly based on original images, while the other was created using image data produced by data augmentation and Using CNN model, it is most efficient in weed detection when compared to other algorithms.

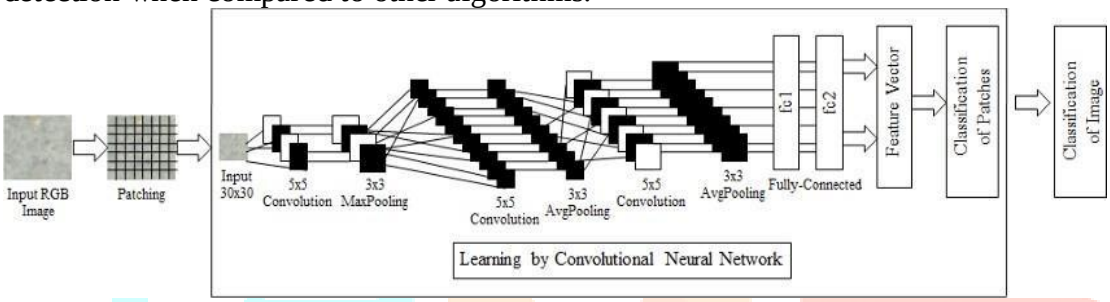


Figure 1: System Architecture

Architecture of CNN shown in figure 1 that consists with two main parts: feature extraction and classification. In the feature extraction layers, each layer of the network receives the output from its immediate previous layer as its input, and passes the current output as input to the next layer. The CNN architecture is composed with the combinationof three types of layers: convolution, max-pooling, and classification. Convolutional layerand max-pooling layer are two types of layersin the low and middle-level of the network. The even numbered layers work for convolution and odd numbered layers work for max- pooling operation. The output nodes of the convolution and max-pooling layers aregrouped in to a 2D plane which is called feature mapping. Each plane of the layer usually derived with the combination of one or more planes of the previous layers.

The node of the plane is connected to a small region of each connected planes of the previous layer. Each node of the convolution layer extracts features from the input images by convolution operation on the input nodes. The max-pooling layer abstracts features through average orpropagating operation on the input nodes. The higher-level features are derived from the propagated feature of the lower-level layers. As the features propagate to the highest layer, the dimension of the features is reduced depending on the size of the convolutional and max-pooling masks. However, the number of feature mapping usually increased for mapping the extreme suitable features of the input imagesto achieve better classification accuracy. The outputs of the last feature maps of CNN are used as input to the fully connected network which is called classification layer. In the classification layer, the desired number of features can be obtained usingfeature selection techniques depending on the dimension of the weight matrix of the final neural network, and then the selected features are set to the classifier to compute confidence of the input images. Based on the highest confidence, the classifier gives outputs for the corresponding classesthat the input images belong to.

4. DATASET:

The dataset consists 4 different categories of the granite slab images namely Black galaxy,white pearl, Ruby red and SK blue. The main objective of this dataset to classifications of thegiven graniteslab. This dataset is gathered by different sources from different places in southIndia.

Figure 2(a): Ruby red granite

Figure 2(b): SK blue granite

Figure 2(c): Black galaxy granite

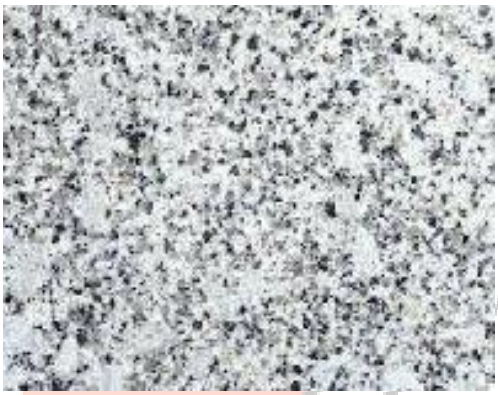


Figure 2(d): Pearl white granite

In this dataset tconsists of 3,256 jpeg images of granite images, black galaxy – 609 images, pearlWhite – 629 images, Ruby red – 670 images and SK Blue – 597 images shown in figure 2.

5. RESULTS:

This paper utilizes CNN model to classify images. The model is trained for 50 epochs using graniteslab images depicted in Figure 4. At every iteration loss $\boldsymbol{L}$ is calculated by comparingthe predictedaspect labels with the ground-truth labels using the cross-entropy loss function.The loss can be calculated as follows:

Where n is the number of examples in the source data, $\boldsymbol{y^i}$ is the ground-truth aspect tag for the i[th] example, and $\boldsymbol{f}$

$$\boldsymbol{L} = -\sum_{i=1}^{n} \boldsymbol{y^i}\ \boldsymbol{\log(f\ \ (X^i\ ))}$$

($\boldsymbol{X^i}$) is the predicted aspect tag for the i[th] example. Next, the computation of thegradients of the loss function with respect to the model parameters canbe expressed as follows:

$$\boldsymbol{\nabla\theta L} = \frac{\boldsymbol{\partial L}}{\boldsymbol{\partial\theta}}$$

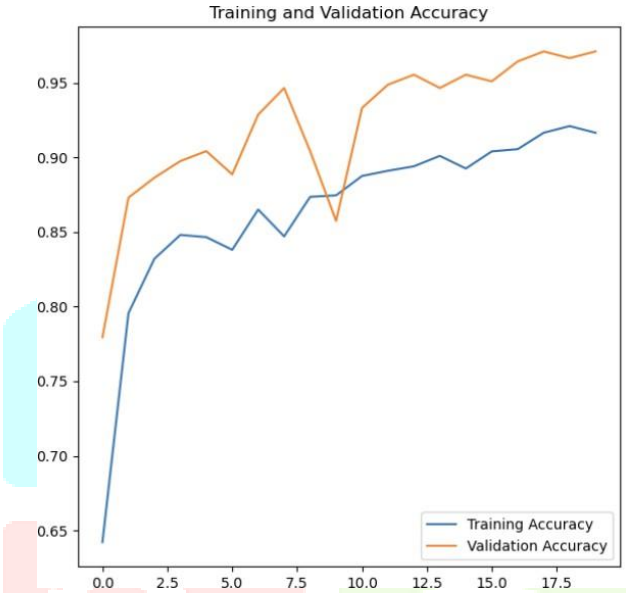
Then backpropagate the aspect loss $\boldsymbol{L_{as}}$ and update the parameters of $\boldsymbol{f_s}$. Back-propagatethe gradients through the layers of the model to update the model parameters($\boldsymbol{\theta}$):

$$\theta\_new = \theta - \alpha * \nabla\theta L$$

Here, α represents the learning rate, which determines the step size for parameter updates during optimization. Here we calculate train and validation accuracy by using formula:

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

The formula of the Accuracy considers the sum of True Positive and True Negative elements at the numerator and the sum of all the entries of the confusion matrix at the denominator. True Positives and True Negatives are the elements correctly classified by the model and they are on the main diagonal of the confusion matrix, while the denominator also considers all the elements out of the main diagonal that have been incorrectly classified by the model.



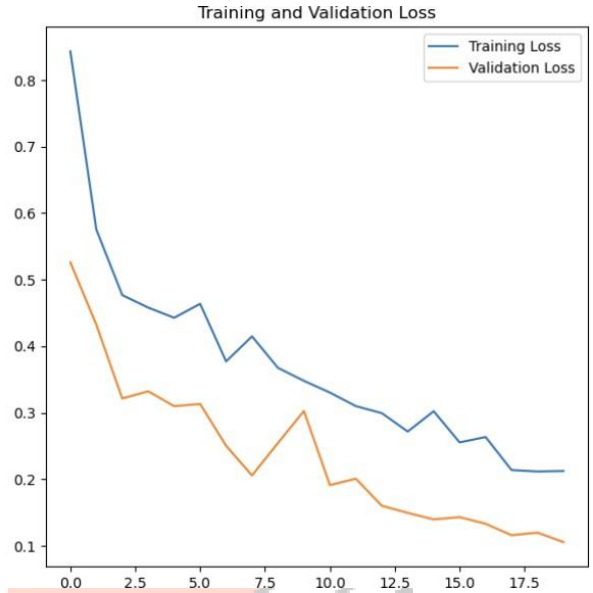


Figure 3(a): training and validation accuracy **Figure 3(b): training and validation loss**

The training data yielded a training accuracy of 91%, while the validation accuracyreached 97%,as demonstrated in Figure 3(a). The progression of validation loss is depictedin Figure 3(b).

```
1/1 [==============================] - 0s 174ms/step
Name:     Ruby red granite
Colour:   Red
Price:    85/sq ft- 125/sq ft
Quality:  High Quality
Place:    Jaipur, Rajasthan.
```

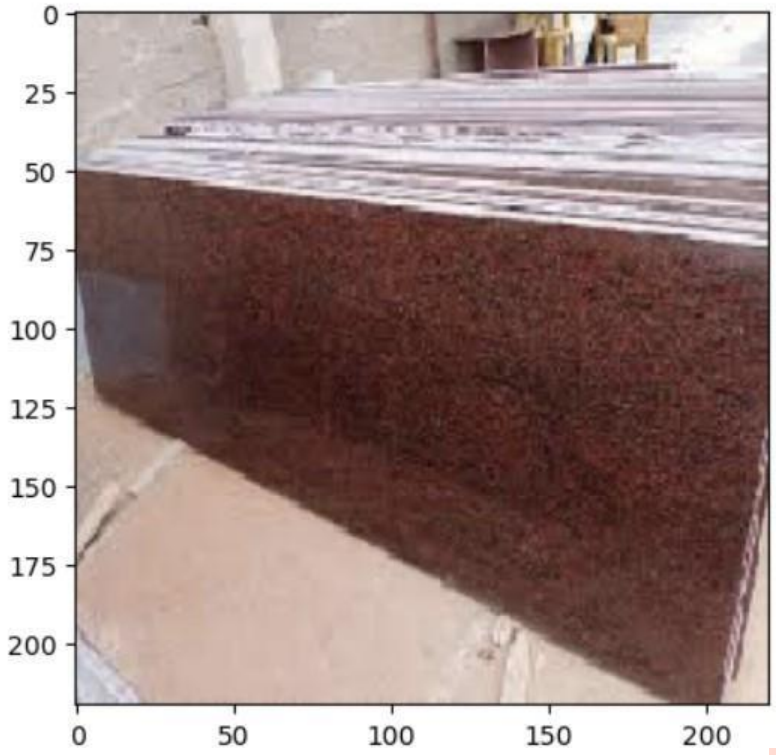


Figure 4: image prediction by using model

The paper also illustrates the prediction of granite name, colour, prize, quality, and placefor a given input image, showcased in Figure 4.

6.CONCLUSION

"Granite Identification Using Deep Learning" has been a significant step forward in the field of material recognition and classification of granites. By leveraging Convolutional Neural Networks(CNNs), successfully developed a robust and accurate system capable of distinguishing various types of granite. This model is not only contributing to the field of geology and material science but also has developed model in industries such as constructionand interior design. The developed CNN model performing multi-class classification i.e., Black galaxy, White Pearl, Ruby Red and SK Blue obtained better accuracy of 97 % and less error rate of 0.21. Additionally, implemented a user-friendly interface using Flask, HTML and CSS making our system accessibleand easy to use for a wide range of users. Thisuser interface enhances the overall user experience,enabling individuals with varying levelsof technical expertise to interact with our graniteidentification tool effortlessly.

7. REFERENCES

[1] Y. Zhang, M. Li, and S. Han, "Automatic identification and classification in lithologybasedon deep learning in rock images," Acta Petrologica Sinica, vol. 34, no. 2, pp. 333–342, 2018.

[2] C. Guo and Y. Liu, "Recognition of rock images based on multiple color spaces,"ScienceTechnology and Engineering, vol. 14, pp. 247–251+255, 2014.

[3] S. Niekum, ''Reliable rock detection and classification for autonomous science,'' M.S.thesis,CMU, Pittsburgh, PA, USA, 2005.

[4] M. Młynarczuk, A. Górszczyk, and B. Ślipek, ''The application of pattern recognition in the automatic classification of microscopic rock images,'' Comput. Geosci., vol. 60,pp. 126–133,Oct. 2013

[5] Blasik, Miroslava; Hanika, Bogdashka, eds. (2012). Granite: Occurrence, Mineralogy and Origin. Hauppauge, New York: Nova Science. ISBN 978-1-62081-566-3.

[6] Rock Types and Specific Gravities". EduMine. Archived from the original on 2017- 08-31. Retrieved 2017-08-27.

[7] "Rock Classification Scheme - Vol 1 - Igneous" (PDF). British Geological Survey: Rock Classification Scheme. 1: 1–52. 19991S:3316, 1965 methods of sampling and granitingstructural granite, indian standard institutions.