

# Proceedings

The 6th ACA

## Asia Color Association Conference : Color & Culture

**02-03** NOVEMBER 2021

YOGYAKARTA  
INDONESIA



ORGANIZED BY



Department of  
Agro-Industrial Technology  
Universitas Gadjah Mada



The Graduate School of  
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**6<sup>th</sup> Asia Color Association Conference 2021**

# **Proceeding**

“Color and Culture”  
2-3 November 2021 Yogyakarta, Indonesia

Department of Agro-industrial Technology  
Universitas Gadjah Mada

PROCEEDING OF THE 6<sup>th</sup> ASIA COLOR ASSOCIATION CONFERENCE  
COLOR AND CULTURE

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Editor-in-Chief: Dr. Adi Djoko Guritno

ISBN : 978-979-18918-7-5

Publisher:

Departemen Teknologi Industri Pertanian Fakultas Teknologi Pertanian  
Universitas Gadjah Mada

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Email : [tip@ugm.ac.id](mailto:tip@ugm.ac.id)      <http://tip.ugm.ac.id/>

1st Edition, November 2021 xiii + 187 pgs., 21 x 29,7 cm

## MESSAGE FROM CONFERENCE CHAIR



Greetings to all of us, may all be healthy and happy.

Praise and gratitude we pray to the presence of Allah SWT who has provided convenience and smoothness in the implementation of the Asia Color Association (ACA) Conference 2021 in Indonesia which will be held at Universitas Gadjah Mada whose implementation is managed by the Department of Agroindustrial Technology, Faculty of Agricultural Technology and Faculty of Postgraduate. The ACA 2021 conference uses the theme "Color and Culture" which represents the very broad role of color and its important application in relation to culture wherever it is located. Color is very important as a symbol that is understood by everyone but also has a psychological, religious, cultural effect that is naturally felt by everyone without realizing it.

The ACA 2021 conference involved 16 participating universities from Japan, Taiwan, Thailand, China, India and the host Indonesia. It is very interesting to observe the development of research that continues to develop regarding this color because in almost all human activities it is always related to color, both in the context of health, culture, perception and social values that are different in each country. Color is not only important to be managed and designed for the benefit of human beings but the color of nature which is a gift from God always surrounds our lives so beautifully and this encourages continuous research and understanding of the phenomenon.

The holding of the 2021 ACA Conference feels special because it will be held online due to the unfinished COVID-19 pandemic situation and due to health and safety considerations, it was decided to hold it in a virtual conference. But I hope that even though this conference is held virtually, it will not reduce its meaning, benefits and excitement for all of us who attend the conference.

On this auspicious occasion, I would also like to thank the executive committee of the Asia Color Association, reviewers, International Advisory Board and scientific committees that I cannot mention one by one, all of whom have played a major role in assisting the screening of the paper. Processing and providing constructive suggestions so that the ACA Conference 2021 can be held, starting from publishing abstract books, organizing conferences and publishing proceedings after the conference. In my welcome I would like to thank the committee members who have worked so hard for this conference, I am always proud of all of you. Thanks again for all of your hard work.

I also thank the Rector of Universitas Gadjah Mada, the Dean and Head of the Study Program from the Faculty of Agricultural Technology and the Faculty of Postgraduates who have been willing to support and host the 2021 ACA Conference. And of course, also thank those who are very valuable and I am always proud of colleagues and all conference participants who have jointly made this event a success.

Finally, I hope that this proceeding will be useful to support the smooth implementation of this conference. I really hope that the network within the Asia Color Association will continue to be well established so that we can all benefit from this conference.

Thank you very much

**Conference General Chair ACA 2021**

**Dr. Adi Djoko Guritno,**  
Department of Agroindustrial Technology  
Universitas Gadjah Mada

## KEYNOTE SPEAKERS



**Prof. Mitsuo Ikeda**

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**AssocProf. Pichayada Katemake**

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**Gregorius Stanley**

Konica Minolta Indonesia

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# PILL CLASSIFICATION BASED ON MACHINE LEARNING

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**Keywords:** Pill Image, Machine Learning (ML), Residual Neural Network (ResNet), Imbalanced Data, Classification

## ABSTRACT

Pill image classification has been widely used in commercial applications. In this paper, we propose a deep learning for pill image classification. The proposed pill dataset into separate training and testing sets. We find that neural networks need significantly less training data to obtain the state-of-the-art performance than previously proposed methods. This method is based on a residual neural network for pill image classification. The results show that the proposed classification model yields an accuracy of 97.27% in classification performance.

## INTRODUCTION

Image identification and life-saving medical improvements are all powered by recent advances in artificial intelligence (AI). Machine learning, particularly reinforcement learning, scientists and medical personnel in analyzing medical data in order to better treat diseases. Deep learning improves clinicians' capacity to estimated medical images, and AI advances personalized medicine's future.

Nowadays, there are a lot of elderly recipients who take medicine every day. The recognition of pill is a difficult task for low vision elderly based on information from imprint. The elderly can avoid mistaking pills and keep a safe medication. These recognition tools [1, 2] require elderly to classify pills images using shape, color and imprint.

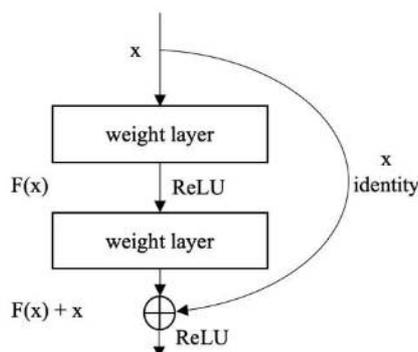
In this study, we proposed and developed a computer vision technique based on convolutional neural networks [3, 4, 7]. In addition to shape features of pill images. We compare our proposed and convolutional neural networks (CNNs) architectures: VGG16 [5], VGG19 [5], InceptionV3 [6], Resnet 50 [7], Densenet [8], Xception [9], and MobileNet [10]

## METHODS

In this study, we proposed convolutional neural networks based on the ResNet model. As shown in Fig 1., The stacked layers perform a residual mapping by creating shortcut connections which perform identity mapping ( $x$ ). Their outputs were added to the output of the stacked layers' residual function  $F(x)$ . The residual learning structure composed of several layers in a network as in Eq. (1).

$$\begin{aligned}y_l &= h(x_l) + F(x_l + W_l) \\x_{l+1} &= f(y_l)\end{aligned}\tag{1}$$

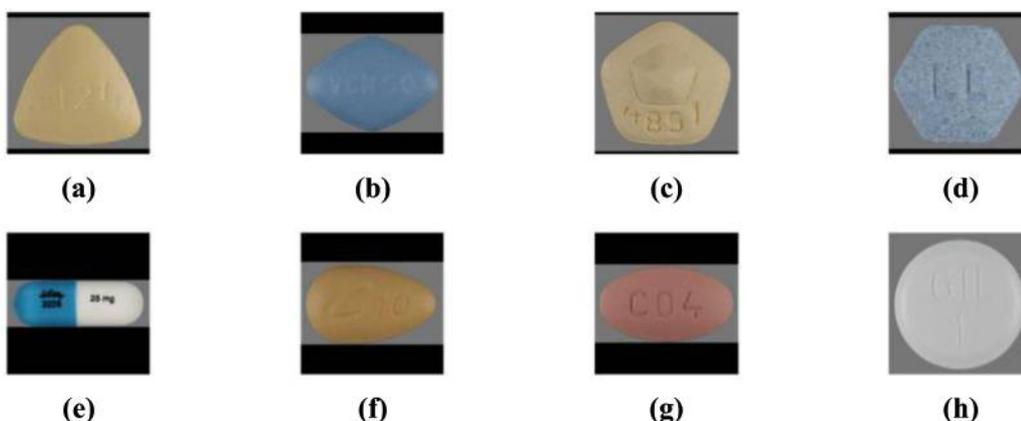
when  $h(x_l)$  is the identity mapping,  $F$  is the residual function,  $x_l$  is the input, and  $W_l$  is the weight coefficient. The identity mapping can be written as  $h(x_l) = x_l$ .  $f(x)$  is ReLU of the activation layer.



**Figure 1. Residual learning: a building block**

We used the publicly available NLM dataset [11] consisting of 1,000 reference pill images were used to train model and 2,000 consumer-grade pill images were used to test the performance our model. As show in Fig 2., we performed training on eight classes that had different pills’ shapes of classes and images: Three-sided (3 sided), Four-sided (4 sided), Five-sided (5 sided), Six-sided (6 sided), Capsule, Oval, Round, and Other.

The training dataset is divided into two out of which the first one contains 90% training images 10% of images are used for validation and testing dataset. The images are resized to  $224 \times 224 \times 3$  (224 pixels by 224 pixels by 3 channels) before they are applied to various networks. Then we perform data augmentations including random rotation, random cropping and random horizontal flipping were used on the training, validation and testing dataset. We normalize all the image pixel values to between  $[-1,1]$  for training dataset.



**Figure 2. Example images of eight classes; (a) Three-sided. (b) Four-sided. (c) Five-sided. (d) Six-sided. (e) Capsule (f) Oval. (g) Round. (h) Other.**

The classification model is implemented by Python on Google Colab Pro with NVIDIA Teala P100. We train the model with a batch size 32 using Adam with learning rate of 0.0001 without weight decay or dropout. The accuracy of the model has not been improved when the number of epochs exceeds 10.

We use the trained models to classify the test images and calculate the overall classification accuracy. The classification accuracy is the ability to predict correctly and guess the value of predicted attribute for new data. The accuracy is calculated as in Eq. (2), It is defined as the ratio of sum of true positives (TP) and true negatives (TN) to the total number of trials.

$$Accuracy = \frac{TP + TN}{TP + FP + FN + TN} \times 100 \quad (2)$$

where TP and TN are outcomes produced when the model correctly classifies the positive class and the negative class, respectively. While FP and FN are outcomes produced when the model incorrectly classifies the positive class and the negative class, respectively.

## RESULTS

We evaluate the classification performance using the eight trained models and summarize our results in Table 1. The proposed has better performance as it achieved an accuracy of 97.27% and loss of 0.0650 on validation data. We compare our proposed and convolutional neural networks architectures: VGG16, VGG19, InceptionV3, Resnet 50, Densenet, Xception, and MobileNet. Figure 3 show accuracy and loss performance for the proposed model.

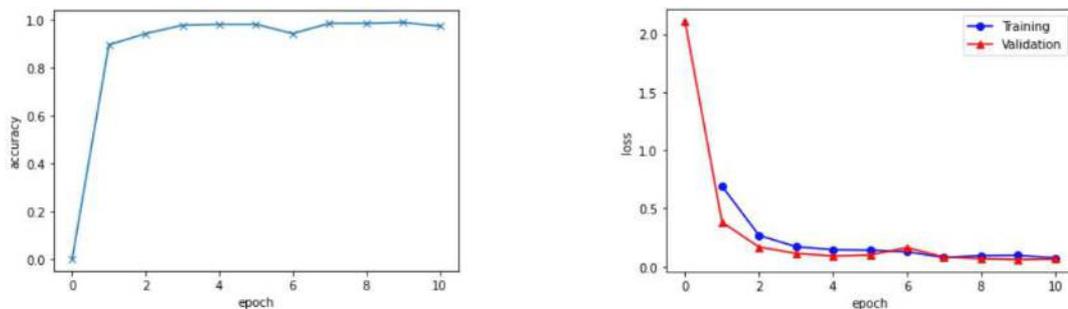


Figure 3. Accuracy and Loss of the proposed model.

Table 1. The compare between proposed and some other models.

Models	Accuracy (%)
Our proposed	97.27
VGG16	90.90
VGG19	87.44
InceptionV3	90.14
Resnet 50	89.65
DenseNet	90.53
Xception	90.07
MobileNet	90.87

## CONCLUSIONS

We presented a study pill classification based on residual networks. The residual networks are several times faster to train. Pill classification allows pharmacist to verify the pill before dispensing them and allows the elderly patient to verify it before taking it. The pill shape analysis can be used in the Pharmaceutical Industry for classification and crack detection. In the future, it will be important to extend

the usability of the application to the general population, and to update the database to increase its accuracy.

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