CLASSIFICATION OF CULTURAL HERITAGES IN THE MUSEUM COLLECTIONS ON CENTRAL SULAWESI, INDONESIA USING DEEP LEARNING

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ABSTRACT

This paper discusses the cultural heritages stored in the Central Sulawesi Museum in Palu, Indonesia. Typically, these collections are displayed in the collection room with relatively limited information. Museum visitors generally want to get more information regarding the origin, materials, or other aspects considering that collection. If the cultural heritage is systematically arranged, it is ensured that it will provide more exciting information. This research utilizes a deep learning framework to explore new ways to represent the museum collections. We focus on the classification of cultural heritages in the public Museum in Central Sulawesi, Indonesia. There are about 7.595 item collections classify into ten categories. In this research, we observed 8 of 10 categories only due to the very limited available data to be acquired. We confirmed that our approach shows adequate performance along with all the categories in sense of very little data to be trained.

Keywords: museum, collection, cultural heritage, classification, deep learning

1. INTRODUCTION

Museum of Central Sulawesi is a non-profit government organization destined for serving and open to the public. The main task of the museum is to store, care for, secure, and utilize the museum collection in the form of cultural heritage. While, the museum's function is to preserve (save, manage for and protect) and as a source of information (research, education, and entertainment). Since the various collections of the museum, including the cultural heritage, are valuable historical objects, it is necessary to make efforts to make these collections attractive to visitors but still maintained even though the public can witness them at any moment. One of the drawbacks of organizing these collections is the lack of information that visitors can acquire about the cultural heritage in the display gallery.

Nowadays, advance technologies in computer vision present a huge opportunity for many researchers, including cultural practitioners, to develop new ways of working with museum collections. Deep Learning as a powerful tool seeks to explore how machine learning can be employed to develop a deep neural networks model that can be helpful to classify the cultural heritages collection in the museum. Belhi et al. [1] introduced a very encouraging work based on deep learning using residual network to classify and annotated the cultural heritage data. In addition, they also utilized the advantage of adversarial network for completing missing data of the valuable cultural heritage collections.

2. OVERVIEW

In this section, we describe about the cultural heritages available in the Central Sulawesi Museum and our deep neural networks architecture for the classification method.

2.1. CULTURAL HERITAGES

In the Museum of Central Sulawesi, Indonesia, there are about 7.595 item of cultural collections [4]. All those cultural heritages are classified into ten main categories; geology, biology, ethnography, archeology, history, numismatic, philology, technology, ceramology, and art. In this research, we examined only eight out of ten collection categories because of the deficiency of collecting data to be processed in the deep neural network.

2.2. DEEP NEURAL NETWORKS

We present a deep neural network model as a classification tool for our research data in cultural heritages encouraged by the work of [1]. Moreover, an innovative training criterion of depth neural network for maximum interval minimum classification error has been proposed in [3] to boost the performance of the deep learning method. In our work, we propose a simple network architecture rather than a complex one but maintains to get reasonable accuracy perfor-

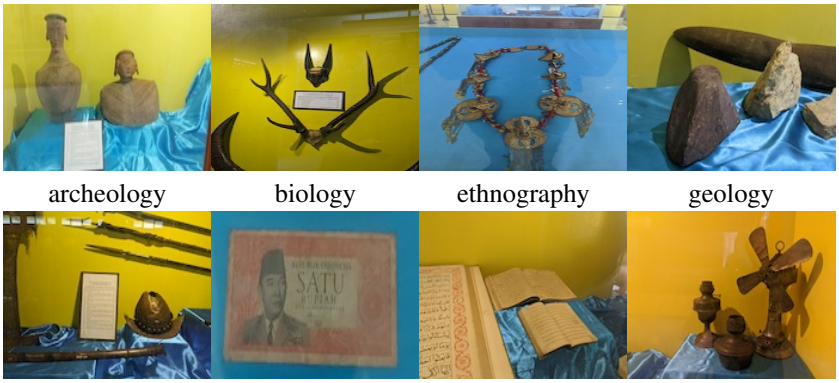

Figure 1: Sample original images and their class taken from Central Sulawesi Museum, Indonesia.

mance. since we have very limited data to be trained, we employ a small VGG-16 network, contains thirteen convolutional layers, which has been pre-trained on ImageNet. In addition, we take advantage of transfer learning without having to start the model from scratch by training a large model on a large dataset.

3. IMPLEMENTATION

To demonstrate our approach's performance, we present several experiments exploring different aspects of our approach. We train our model using a dataset of cultural museum collections. Since the number of data for each class is not quite the same, we trained our model using 350 images and validated on 50 images for each class.

3.1. DATASETS

Experiments were performed on dataset museum collection of Central Sulawesi, which was acquired using a camera with resolution 4032×3024. Since several objects are included in one shoot picture, we crop the original image into some small images and resize them into 175×125 while training the input image. Some sample data from each class we use in this research are shown in Fig. 1.

3.2. TRAINING DETAILS

We train our model on deep learning *Keras* [2] framework using Tensorflow backend. Since we use a smaller network architecture and the data to be trained is relatively small, we train our model on macOS Catalina 10.15 without need an expensive GPUs. We also apply data augmentation via a number of random transformations to help the model generalize better.

3.3. RESULT AND DISCUSSION

We trained our network for 55 epochs, and the approach gets us to a validation accuracy of around 0.82 which is pretty good for such a small dataset. We observed that from all classes, the archeology class reach the highest accuracy (0.84), and the second place is geology (0.81). While the lowest accuracy is the class of ethnography collection (0.72).

We analyzed the result and observed several limitations to our model approach. Our concern is to be overfitting since we only have very few sample data to be trained. Another concern to be affected the accuracy performance is the similarity of the object, either color or/and their shape, from different category collections. We observed that our model is likely predicting the significant amount of brown color (soil color) in our input image as archeology class in these types of situations. So, the ethnographic collection (i.e., machete) mostly wrong classified due to the similar shape and color of the history collection (i.e., sword). We also provide an example of correct and incorrect predicted class In Fig. 2 to demonstrate our proposed approach and show the limitation to our image classification in the museum collections in Central Sulawesi, Indonesia.

4. CONCLUSION AND FUTURE WORKS

In this paper, we proposed a new approach in working with the cultural data in Central Sulawesi Museum of Indonesia in the term of classification using a deep learning architecture. Our model achieves a moderately good performance considering the very little data use to train our network. In addition, we observed the limitation of our approach due to the characteristic of the object's color or/and shape.

Our result accomplished a promising performance, which is encouraging our future work will improve the performance and develop a simple and robust application for clas-

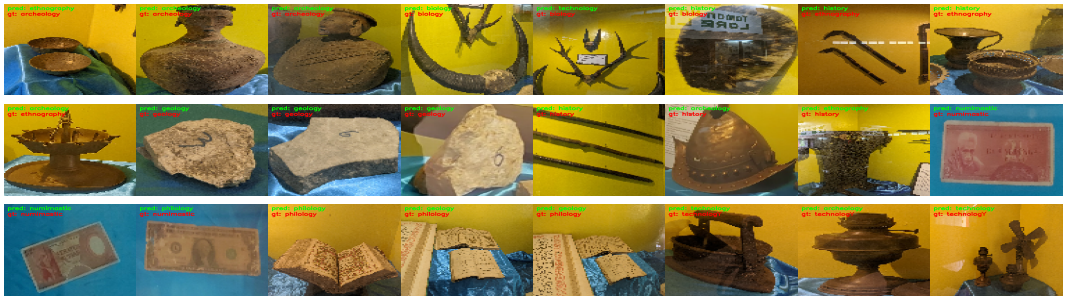

Figure 2: Random sample predicted class of the cultural data in Central Sulawesi Museum, Indonesia. The green text is the predicted label, while the red text is the ground truth label.

sifying and annotating the precious cultural heritage in the Central Sulawesi Museum, Indonesia.

5. REFERENCES

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