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The Intelligent Genuine Validation beyond Online Buddhist Amulet Market

Lawankorn Mookdarsanit

Department of Business Computer, Faculty of Management Science
Chandrakasem Rajabhat University
Bangkok, Thailand
lawankorn.s@chandra.ac.th

Abstract— As of the internet global coverage, online market is the most popular way for buying and selling many branches of amulets (both talismans and fetishes). How unfortunate that current e-Commerce does not have a genuine validation of the amulet originality. Either genuine or ungenuine amulets are randomly sold on the online market. The current solution is that an amulet must be physically validated/checked by the amulet expert(s) (Thai: เซียนพระ) that is not such a flexible transaction. To make the trustiness from amulet collectors (Thai: นักสะสมพระเครื่อง), this paper introduces an intelligent genuine validation of amulets on the online amulet market that changes from physical checking by the expert to logical checking by the intelligent validation. The seller can take an amulet image; the intelligent system autonomously checks the genuine validation of amulet as the product quality assurance. In view of start-up ideology, this system is one of a disruptive way to transform into the new business model that provides the online amulet validation as a service for those hundred-thousand amulet collectors around ASEAN. As the system is trained by the amulet collection as well as expert's experience, it provides high accuracy higher than 75%. It appears that the intelligent genuine validation based on deep learning can autonomously check the originality of an amulet with some service charge, instead of human's labor. ***(Abstract)***

Keywords- Online product validation; Quality assurance; e-Commerce intelligence; Deep learning; Object recognition

I. INTRODUCTION

Buddhist amulet collection [1] is a local interest to gather the traditional talismans/fetishes as originality that can be seen in ASEAN e.g., Myanmar, Laos, Cambodia and Thailand. Traditionally, there are so many ancient branches e.g., Luang Phu Chu (Thai: หลวงปู่จื่อ), Luang Phor Thuad (Thai: หลวงพ่อทวด), Phra Pid Tha Luang Phu Toh (Thai: พระปิดตาหลวงปู่โต๊ะ), Luang Phor Parn (Thai: หลวงพ่อปาน), Phra King Nong Sae (Thai: พระกริ่งหนองแส), Phra Rod (Thai: พระรอด), Phra Nang Phaya (Thai: พระนางพญา), etc., as shown in Fig.1.

(a.) Luang Phu Chu

(b.) Luang Phor Thuad

(c.) Phra Pid Tha Luang Phu Toh

(d.) Luang Phor Parn

(e.) Phra King Nong Sae

(f.) Phra Rod

(g.) Phra Nang Phaya

Figure 1. Some well-known Buddhist amulets

Economically, the amulet collectors (Thai: นักสะสมพระเครื่อง) always buy and sell these amulets [2] as if they trade in government bonds, stocks or any currencies [3-4]. It is not surprise that why the ungenuine originality of amulets is often forged [5] in the online market. Since the current amulet e-augment still lacks of the genuine validation.

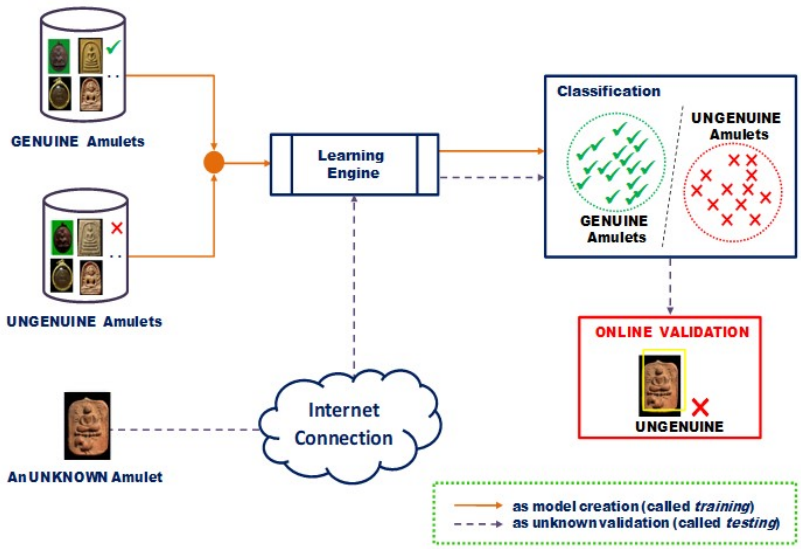

Figure 2. The workflow of intelligent genuine validation of Buddhist amulets

As the local faithfulness, the value of amulets depends on the holy water [6] and incantation rather than material. Even if either ungenuine or genuine amulets are made from the same material [7], some different small scratches within those 2 amulets are still observable, because of the different melting machines.

Supposing that a required number of the genuine "A" amulets (a.k.a. the originality of "A" amulets) are produced by one melting machine; the machine is finally destroyed. Out of the blue, the "A" amulet is interesting and required from the collectors. Any other melting machines are absolutely unable to produce the "A" amulet which has the same scratch as the previous machine. The genuine originality of "A" amulet is visionally and manually checked (or proven) using the different scratches by the amulet experts (Thai: เซียนพระ). For that reason, it is feasible to transfer the human's knowledge to make an intelligent computer for autonomous validating the genuine of amulet from an image. Concretely, image analytics have been successful in many intelligent applications e.g., image forensics [8-9], facial attribute [10-11], place recognition [12-14], remote sensing [15-17], GPS-based tagging [18-19], gesture recognition [20-22], plant identification [23-24], animal recognition [25-26], food recognition [27-29], etc.

For the online amulet market, the lack of validation can be perfectly solved by image analytics. Even if the authors in [30] and [31-34] proposed the Buddhist arts and amulets as image retrieval, they are not proposed to check the genuine originality of amulet under the product validation of e-Commerce requirement.

This paper firstly provides the meeting between "e-Commerce" and "object recognition" that turns an "intelligent system" from the laboratory into the "business innovation". Also, it is one of the cultural heritage observation way.

The proposed system based on Residual network (ResNet) architecture (with ImageNet pre-training) [35] is modeled by 50,560 (genuine/ungenuine) amulet images that are already classified as the collection. Those images are sent into the computer knowledge that can be used to build the genuine validation over the online amulet market, as shown in Fig.2. Moreover, the ResNet architecture also has knowledge transfer to be trained some amulet images at the first time. And more images can be retrained at the next time.

The organization of this paper consists of 4 sections. ResNet architecture from an image is explained in Learning engine as section 2. Genuine validation talks about training and testing in section 3. Finally, the conclusion is in section 4, respectively.

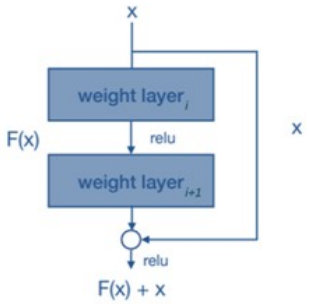

Figure 3. A skip connection (ResBlock) in ResNet

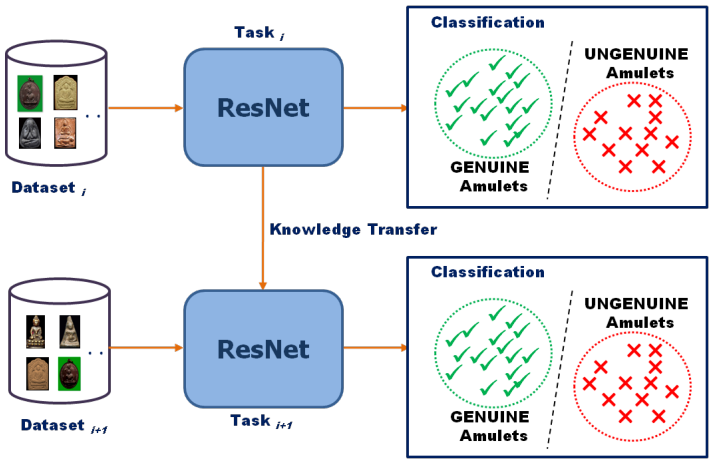

Figure 4. A visualization of knowledge transfer

II. Learning Engine

Although Visual geometry group (VGGNet) has already showed that gradient vanishing is the main problem in the deeper networks [35], the skip connection was introduced in Residual network (ResNet) that totally defeated the vanishing problem. The main concept is to send the previous feature maps to the next convolutional layer. The skip connection (a.k.a. ResBlock, as shown in Fig.3) is mostly used in image classification.

Instead of a single supervised model, knowledge transfer (as Fig.4) is also provided in deep learning that can be firstly trained by small amount of amulet images. And more images can be retrained to the same model again.

A. 2D Convolutions

The concept of convolution is an inverse Fourier transform based computation between an amulet image and many windows (a.k.a. 3X3 filters). A convolution between an image and a window can be computed by (1).

$$2DCONV(I_{(amulet)}, w_{3x3\ at\ i}) = I_{(amulet)} * w_{3x3\ at\ i} \quad (1)$$

where I_{amulet} denotes as an amulet image, $w_{3x3\ at\ i}$ as the *i-th* window with a 3X3 size and $2DCONV(.)$ is a convolution function between an amulet image and the *i-th* window

B. 2D Max Pooling

After a convolution, some pixels may be negative. The Rectified Linear Unit (ReLU) is used to transform the value (a.k.a. Batch normalization). The output of a ReLU is called a "feature map". For the redundancy reduction, the feature map is further to be backpropagated by 2×2 Max pooling with the stride as 2.

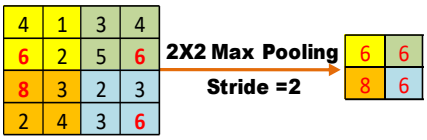

Figure 5. A visualization of 2×2 Max pooling of a feature map

III. Genuine Validation

Prior to the amulet validation, both genuine and ungenuine amulet images are collected and trained to ResNet. And the source-code of this system is implemented on Python Caffe. As a concept of supervised learning, the engine is necessary to be trained by samples before the real-time usage on the online market.

A. Dataset and Training

All 50,560 (genuine/ungenuine) amulet (tagged) images are taken by Sony E PZ 16-50mm F3.5-5.6 OSS and separately trained to 7 engines for the genuine of 7 categorization Luang Phu Chu (Thai: หลวงปู่จู๋), Luang Phor Thuad (Thai: หลวงพ่อทวด), Phra Pid Tha Luang Phu Toh (Thai: พระปิดตาหลวงปู่โต๊ะ), Luang Phor Parn (Thai: หลวงพ่อปาน), Phra King Nong Sae (Thai: พระกริ่งหนองแส), Phra Rod (Thai: พระรอด) and Phra Nang Phaya (Thai: พระนางพญา). Both genuine and ungenuine amulets for each branch are already classified. We can say that the proposed intelligent genuine validation can be used instead of the expert's physical check.

B. Testing

The unknown (untagged) amulets are used to test the correctness of learning engine. This system can be used in the real cloud server.

TABLE I. MEASUREMENT AND RESULTS

Amulet	Accuracy in Training: Testing		
	70:30	***80:20***	***90:10***
Luang Phu Chu (Thai: หลวงปู่จื่อ)	0.75	0.80	0.84
Luang Phor Thuad (Thai: หลวงพ่อทวด)	0.88	0.90	0.92
Phra Pid Tha Luang Phu Toh (Thai: พระปิดตาหลวงปู่โต๊ะ)	0.82	0.85	0.90
Luang Phor Parn (Thai: หลวงพ่อปาน)	0.80	0.83	0.86
Phra King Nong Sae (Thai: พระกริ่งหนองแส)	0.79	0.83	0.84
Phra Rod (Thai: พระรอด)	0.85	0.87	0.90
Phra Nang Phaya (Thai: พระนางพญา)	0.83	0.86	0.90

For the engine measurement, we use the accuracy to measure the engine that can be computed by (2).

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

where *TP* is the ugenuine image in both reality and validation, *TN* is the genuine image in both reality and validation, *FP* is the genuine image in reality but wrong detection as ungenuine one and *FN* is the gunenuine image in reality but wrong detection as genuine one

The results are shown in Table 1. We divided the results as training: testing as 70:30, 80:20 and 90:10, respectively, of each amulet type. It is obviously seen that the more training samples make the higher accuracy.

IV. CONCLUSION

From the genuine validation problem on the online amulet market, this paper introduces an intelligent amulet checking using ResNet architecture. We can say that object recognition meets e-Commerce. Since the system is modeled by 50,560 amulet images. Those images cover cover Luang Phu Chu (Thai: หลวงปู่จื่อ), Luang Phor Thuad (Thai: หลวงพ่อทวด), Phra Pid Tha Luang Phu Toh (Thai: พระปิดตาหลวงปู่โต๊ะ), Luang Phor Parn (Thai: หลวงพ่อปาน), Phra King Nong Sae (Thai: พระกริ่งหนองแส), Phra Rod (Thai: พระรอด) and Phra Nang Phaya (Thai: พระนางพญา), respectively. For the measurement, the system provides the accuracy higher than 75%. The more image data is provided, the more accuracy is done. For the business chance, this system can be implemented in a new business form of online amulet market that can help the sellers and buyers for checking the genuine originality of amulets as a flexible e-Commerce. The amulet collectors (Thai: นักสะสมพระ) do not take time to physically validate the genuine by amulet experts (Thai: เซียนพระ). The genuine can be approved by amulet image itself on the online market. For future work, the semi-supervised model can be modeled for the open world problem, especially in unlimited amulet types. Moreover, this system will be able to combine with digital watermarking and blockchain to generate the certification of amulet using only an image as the product trustiness.

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As object recognition meets e-Commerce, this paper firstly proposes a system to validate the genuine of an amulet on the online market by object recognition. All images from the collection and paper are taken by Sony E PZ 16-50mm F3.5-5.6 OSS and watermarked and copyrighted. The readers can request the source code or collected dataset for any experimental comparison via the author's email. All computational hardware and software for running the code are supported by Chandrakasem Rajabhat University

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