X-RAY 응용을 위한 원시 이미지와 모의 이미지 간의 성능 비교

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Performance comparison between raw and simulated image for x-ray applications

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ABSTRACT

This study presents the comparison between the raw and simulated images for x-ray applications. From many applications of X-ray, we chose the colorization application in X-ray images, using the Compass-XP dataset. We trained two models for colorization using a network inspired by U-Net architecture, with two different input images for each model, the raw image from the Compass-XP dataset and the simulated raw image, which is a grayscale converted image. We measured the PSNR value for each one of the simulated and raw images in the colorization application, showing that the simulated image produces similar PSNR to the raw image.

Ⅰ. INTRODUCTION

Airports face several dangerous security threats. For that reason, security at an airport should be taken seriously. In all airports, there are many phases of security, which can include utilizing workers, machines, and even trained dogs. One of the best technologies used in airport security is the X-ray machine. It is considered the most common tool in an airport; it can show an image with the various radiation doses that the materials have absorbed based on their atomic number. Based on the density and atomic number (Z) of the material, the x-ray scanner produces an image that displays the various objects inside the luggage with various levels of grayscale. The result is a grayscale image with different intensities of each pixel based on the X-ray wave observations of the object.

Image generated by the X-ray scanner is applied to a lot of applications [3] such as object detection or segmentation or material discrimination. Also, in material discrimination tasks, they color the raw image produced from the x-ray to produce colored image based on the type of z atomic number of materials, to clearly display the different materials in the luggage.

One of the problems in this field is that there are not a lot of open-source datasets available, which is one of the challenges that academics and industry researchers are interested in. The expansion of this subject is the focus of this study. we prove that we can use the simulated image instead of the raw image and we will prove it by using the colorization approach based on deep learning.

Ⅱ. PROPOSED METHOD AND RESULTS

We use Compass-XP dataset [2] which are images generated by a Gilardoni FEP ME 536 mailroom X-ray scanner. This dataset contains 1928 sets with a different single item, it contains raw images and colored images.

we evaluate the performance of two experiments using the same network inspired by U-Net [1] architecture We added an image reconstruction layer using 1x1x3 convolution with a linear activation to U-Net [1] in place of the last segmentation layers, and different inputs. For the first training, we used the raw images as input, and for the second training we used the converted grayscale image from the colored image, we consider this image as a simulation of the raw image.

Our training was on computer equipped with intel core i7-9700 3.00 GHz processor, 16GB RAM, an NVIDIA TITAN RTX GPU with 11.0 CUDA version, and the Adam optimizer. 500 epochs are used in the training process. We split the dataset into 80% for training and 20% for testing and validation. We measure the peak signal-to-noise ratio (PSNR) value between the predicted and ground truth images from each training. The result of the PSNR was too similar, as shown in Table 1, with a minimal difference of 1,8. Visually, we validate the result in Figure 1 which shows the comparison between the colorization result using the raw image and the simulated image, by

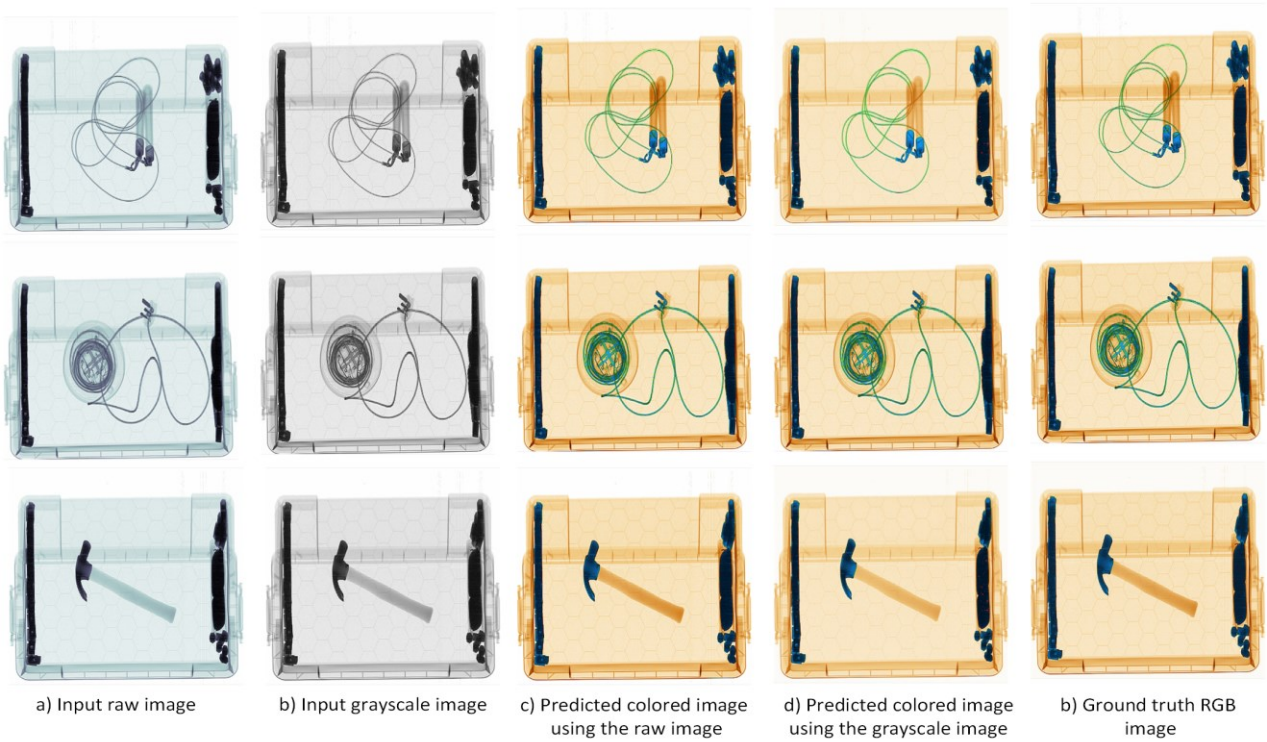

Figure 1. Comparison between the result of colorization from the grayscale and the raw image

comparison between (c) and (d), predicted colored image using the raw image and the predicted colored image using the grayscale image, respectively, in Figure 1. The images are much similar.

Table 1. comparison between raw and simulated images in terms of peak signal-to-noise ratio (PSNR)

	Input type	PSNR
Experiment 01	Raw image	31.8
Experiment 02	simulated raw image,	33.6

Ⅲ. CONCLUTION

The work presented in this paper proves that the raw image can be simulated using a converted grayscale image from the colored image in x-ray applications as the colorization results from each one are very similar.

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