



Drug Recognition Based on Deep Learning Models to Enhance Medication Safety

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Introduction

Medication safety is a major concern in healthcare[1]. Prescription errors often occur due to inattention, leading to the use of incorrect drugs. Drugs with similar appearances—such as different dosages, same colors, or unclear labels—can easily be confused, especially by elderly or pediatric patients, increasing the risk of errors.

Motivation

Image recognition has improved drug identification, but prescription changes often require retraining the entire model, even for a single drug substitution—wasting time and resources. To solve this, we focus on recognizing visually similar drugs and apply continual learning to update the model without forgetting previous knowledge. This approach reduces retraining costs and enhances the system's practicality in clinical use.

Datasets

We used 20 visually similar drugs provided by hospitals. These drugs will be photographed as raw data under controlled conditions, including a fixed camera magnification and a consistent height between the camera and the drugs. A ruler will be included in the images to standardize pixel size across all scale markings during image preprocessing. After taking the photos, we use *anylabeling* to label the drugs in each image. The dataset comprised approximately 500 images, each size are 3024 × 3024 pixels.

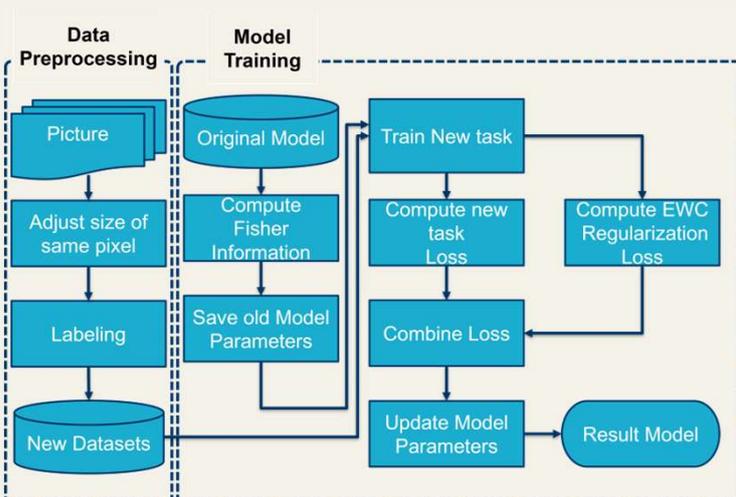


Figure 1. Raw Data that we photographed



Figure 2. Data labeling by anylabeling

Flow Chart



Method

For data preprocessing, we adjusted each image based on the scale included in the photo, setting 1 mm to correspond to 25 pixels. During initial model training, we observed that the model tended to confuse drugs with similar colors and no distinct textual features—such as those differing only in dosage Figure 3. Inconsistent magnification during image capture made it difficult for the model to establish a reliable association between size and category. To address this, we standardized the height between the drug and the camera, as well as the zoom level and angle, ensuring all images were captured at the same magnification.



Figure 3. Different dosages of the same drug

After the initial training, we address the challenge of adding new drugs and handling drug substitution through Continual Learning. However, this approach risks catastrophic forgetting, where the model forgets previously learned tasks while learning new ones.

To prevent this, we use Elastic Weight Consolidation (EWC)[2], which adds a term to the loss function during optimization to preserve important weights from the original task while learning new tasks. This method ensures the model retains prior knowledge while adapting to new data. With EWC, the model can effectively recognize new drugs and handle substitutions without losing performance on previously learned tasks.

$$\mathcal{L}(\theta) = \mathcal{L}_{new}(\theta) + \lambda \sum_i F_i(\theta_i + \theta_i^*)^2$$

$$F_i = \mathbb{E} \left[\left(\frac{\partial \mathcal{L}(\theta)}{\partial \theta_i} \right)^2 \right]$$

[3]

Conclusion

This study aims to reduce prescription errors and lower model training costs. We found that image preprocessing, like standardizing pixel dimensions, can significantly improve recognition accuracy, especially for visually similar drugs with different dosages. As for continual learning, we are still refining its implementation, and hope to enable efficient drug updates with minimal retraining efforts.

References

- [1] Slawomirski L, Auruana A, Klazinga N. The economics of patient safety. Organisation for Economic Co-operation and Development (OECD). 2017 Mar
- [2] AICH, A., 2021. Elastic weight consolidation (EWC): Nuts and bolts. *arXiv preprint arXiv:2105.04093*.
- [3] VAN DE VEN, G.M., 2025. On the Computation of the Fisher Information in Continual Learning. *arXiv preprint arXiv:2502.11756*.