AI in Business

AI Robotic Automation and Vision for Office Assistant
(Consultancy Project with Applied-Research and Joint-Research Paper Publication)
Using a Novel Logic Gate with EfficientNets to Solve Fine-Grained Problem of Object Identification and Classification

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(https://dslab.saas.hku.hk/cgi-bin/application1.cgi/)

Figure 1 Project Meeting with Marvel Digital AI Limited at Hong Kong Science Park. From left to right: Dr Patrick Ma, , Prof G.S. Yin, Dr Herbert Lee, and Dr Adela Lau
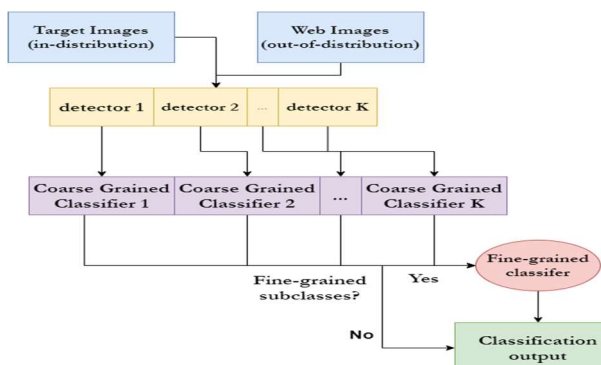

Figure 2 Our proposed novel logic gate architecture with multiple EfficientNets for solving the fine-grained problem of object classification.
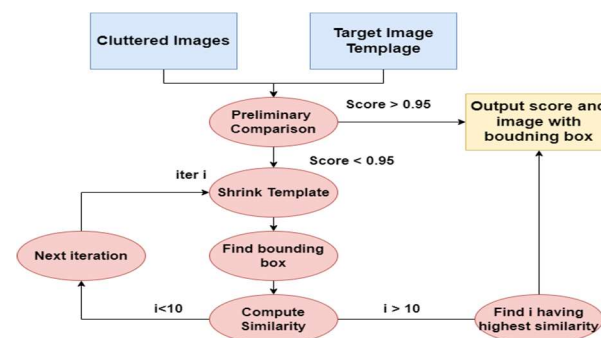

Figure 3. The object template mapping algorithm

"Your team did an amazing work! The novel object identification and classification model with high accuracy rate and has high potential to be used in other image/video analytic problems and commercialization," said Dr Herbert Lee, Chairman of Marvel Digital AI Ltd, and Dr Patrick Ma, CEO of Marvel Digital AI Ltd .

Marvel Digital AI Limited is a high-tech company that focuses on developing innovative AI and Big Data Analytics solutions. In 2021, it offered Data Science Lab two object identification and classification consultancy projects. These projects aim to identify and classify the fine-grained objects. The challenges of the object identification and classification are how to determine the variation of scale, view-point, intra-class, occlusion, illumination and background clutter of the object.

The HKU SAAS Data Science Lab developed a novel **Logic Gate with EfficientNets** for differentiating the tiny difference of the object classes (see Figure 2), and trained the models in different layers based on the object's unique features. It used the geometric and simulation approaches to simulate the distorted and similar object images for training images with scale, view-point, intra-class, and illumination variations. The accuracy rate of the model can achieve around 95%, which outperforms the existing model with 90.5% accuracy rate for solving the fine-grained image classification problem.

To solve the image occlusion and background clutter variation problems, we developed a novel template matching algorithm (see Figure 3) to match the target image template (user updated image) from the image templates with a sliding window. We compute the similarity of the target template and the matched template. The flow of the template identification was shown in Figure 2. The program iteratively shrinks the template and uses match_template in openCV to compute the region of the target template that can best match the template in the cluttered image. The matched template is then cropped out and similarity score is computed for this iteration. This process are repeated several times to outline the bounding box with the highest similarity score.

"It is excited working on an applied research project with MDAI Ltd for knowledge transfer, innovation discovery, and academic publication with our faculty staff and postgraduate students," said Prof Yin, HKU SAAS Department Head.