

# Transparent Object Detection Using Faster R-CNN

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**Abstract** – Recently, object detection has become a popular area in computer vision and object recognition. In many robotic researches, the most basic step is to perform object detection so that the reaction can be taken after detecting object location and its category. One of the main tasks for domestic robots is household object detection. In this paper, we intend to detect transparent objects such as glass in images. Compared with other kinds of objects, the detection of transparent object is very difficult to be performed using classical computer vision algorithms. Most of the classical computer vision algorithms implement the object detection based on their appearance such as colour or texture of the objects. However, the appearance of transparent objects changes according to different backgrounds and illumination conditions. With the popularity of object detection researches, deep learning algorithms now offer a high performance in detection of objects. Therefore, we apply one of the deep learning models called Faster R-CNN (Regions with Convolutional Neural Network) to perform detection of transparent objects and evaluate the performance of the system. According to experimental results, the system achieves 89.8% mAP in the detection of transparent objects.

**Keywords** – Computer vision and object recognition, Deep learning, Domestic robots, Faster R-CNN, Transparent object detection

## I. INTRODUCTION

Nowadays, the computer vision researchers focus on the object detection and recognition on various kinds of objects. Among various kinds of objects, the detection of opaque (i.e., non-transparent) objects can be performed based on their colour or texture information. However, the transparent objects do not have such kind of information. And that leads to difficulty in the application of regular image segmentation methods for detecting transparent objects in images. Therefore, we intend to take the advantages of deep learning techniques for detecting transparent objects.

For the segmentation of transparent objects, many of the computer vision researchers had previously considered some features such as colour similarity, texture distortion, blurring cues, and so on. And, transparent object detection is performed based on these features. In addition to transparent object detection, finding the location of transparent object in the image was also a hard problem. These previous works were only based on traditional machine learning for the purpose of segmenting transparent object regions in an image. Comparatively, in deep learning techniques, the useful representations or features are learned directly from the given training images.

In this research, we use Faster R-CNN for the detection of transparent object. With Convolutional Neural Network (CNN) in Faster R-CNN, there is no need to do manual feature extraction which means the convolution layers of CNN extract the object features directly from the input image. Therefore, the features of transparent objects are not needed to be considered during the detection process. CNN learns to

detect different features in layer-by-layer where the lowest layer starts with the simplest shapes such as edges of the transparent object and then simple shapes, complex shapes, more complex shapes and finally the shapes of the target transparent objects. By using the learned features of the transparent objects, a deep learning model is created to detect transparent objects in images. An illustration of machine learning object detection vs. deep learning object detection is shown in Figure 1.

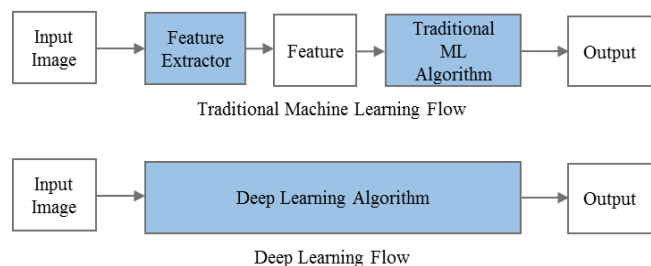


Fig. 1 Machine Learning Object detection vs. Deep Learning Object Detection

As the outline of this paper, this section provides an introduction of object detection using deep learning. Section 2 describes the aims of the system. Section 3 presents the previous works related to the research. In section 4, the theoretical background related to this topic is included. Section 5 gives details of our proposed system and section 6 shows experimental results. Finally, Section 7 describes the conclusions of this paper.

## II. AIM

The aims of this system are

- To do a research on the detection of transparent object in an image
- To replace the complex pipeline of previous transparent object segmentation researches with deep learning neural network
- To understand the application and work flow of deep learning technique in the transparent object detection task
- To give a considerable result by detecting exact location of transparent objects in images

## III. RELATED WORKS

For the detection of transparent objects, the special features of transparent objects had been used in previous researches. In 2003, Osadchy et al. [1] applied the specular highlights feature of transparent objects for detection of transparent objects. In addition to highlights feature, McHenry et al. [2] introduced other kinds of transparent object's features such as colour similarity, blurring, overlay