information. However, developing a point cloud dataset is much more difficult than creating an image dataset, mainly suffering from three aspects, i.e., data collection, annotation, and sensor cost. First, it is time-consuming and cumbersome because lidar sensors need to be set up at several locations to obtain comprehensive data from different viewpoints. Moreover, lidar sensors should be located close to the target object to avoid large numbers of sparse points, which has potential safety risks and may affect ongoing construction activities. Thus, it is difficult to obtain point clouds of practical module installation processes. Second, the accuracy of data annotation may be impaired due to the uncertainties in calibrating the ground truth of 3D bboxes of modules. Researchers can quickly identify 2D bboxes of target objects in images, whereas the identification of 3D bboxes in point clouds depends on several factors, e.g., point cloud density, object similarity, and expert experience. Lastly, lidar sensors' prohibitive deployment cost in the current market also impedes the development of point cloud datasets.

To tackle

2.3 Dataset Generation Methods in Construction

As a high-quality dataset is fundamental to high-performance object detection tasks, many researchers have developed special image datasets for diverse construction objects. Apart from the direct use of public datasets, the identified dataset generation methods can be divided into three categories: site collection, online searching, and virtual modelling. Site collection aims to capture data from real-life construction sites using sensors (e.g., cameras and lidar sensors), while collecting point clouds of practical module installation processes is

rect use of public

al., 2022). A 3D digital model of MiC buildings is imperative to simulate

Figure 4

dimensions and location.

performance. Second, data augmentation is an important and useful method to improve object detection performance with a small-scale dataset. The AP of module detection in the 3D bird and the 3D view increased by 68% and 71%, respectively. Since only a small dataset was developed in this study, it is believed that the model could be further improved with more data produced.

Figure 8: Experimental results of model training and validation

Table 3: Object detection performance of F-PointNet model in different datasets

Dataset	Ours	Ours with data augmentation	KITTI (Qi et al., 2018)
AP (3D bird view)	53%	89%	83.53%
AP (3D view)	33.36%	57.11%	70.92%