Abstract Guano are an important factor affecting the cleanliness of photovoltaic modules on floating solar power plants at sea.It can lead to a decrease in photoelectric conversion efficiency, power loss, and even the occurrence of "hot spots", thereby causing damage to the components. Therefore, the segmentation and detection of guano are crucial for visual automation in the cleaning and inspection processes. However, the composition, density, and thickness of guano naturally vary, leading to inconsistent levels of transparency and color. The uneven intensity of guano images greatly reduces the accuracy of segmentation and detection. Addressing this issue, this study proposes a segmentation algorithm based on combining different color channels to segment guano on the surface of photovoltaic modules. The mean shift method is used for adaptive segmentation to facilitate the detection of guano. Furthermore, the segmentation results obtained by this method are introduced into the input space to improve the traditional Mask RCNN. In addition, this study successfully produced a dataset of guano on the surface of photovoltaic modules using on-site data collection and with the help of a platform built in-house in the laboratory. The experimental results on the self-constructed dataset demonstrate that the enhanced Mask R-CNN model has shown an approximate increase of 5.9% and 6.0% in mAP values for object recognition and segmentation compared to the traditional Mask R-CNN model. This indicates the effectiveness of the methodology proposed in this study. Introduction Achieving the "dual carbon" goal not only represents China's solemn commitment to the world but also is an inevitable requirement for the country's socio-economic development.We extend our sincere gratitude to the editor and the anonymous reviewers for their professional comments and corrections.However, when utilized for guano identification on the surface of photovoltaic modules in offshore floating photovoltaic power plants, Mask RCNN faces unique challenges such as complex marine environmental backgrounds, extreme variations in lighting conditions, and the diversity of guano shapes and sizes, all of which greatly increase the difficulty of the detection task [21].Furthermore, an innovative separation algorithm is devised, incorporating aspects such as color space, optical image processing models, The devices and strategies employed in the training of models The experiments s based on a unified hardware and software environment configuration, the specific configuration is shown in Table.Countries worldwide are realizing the immense potential of offshore photovoltaics, as developing photovoltaic power plants at sea allows for more efficient utilization of sunlight resources while overcoming challenges posed by limited land resources [7].Moreover, by inputting the segmented grayscale images and original RGB images into the Mask RCNN network model, clear color and texture features are introduced to accurately identify and segment guano of various sizes and shapes as well as clean photovoltaic modules.The color image segmentation method used by Navon et al. [16] integrates edge and region-based techniques, while considering local factors to adaptively derive local thresholds, ensuring that any threshold is associated with a specific region, thereby improving the quality of segmentation.This transformation will inject strong momentum into the adjustment of China's energy structure and the promotion of green and low-carbon development, driving economic transformation and upgrading, promoting ecological civilization construction, and achieving sustainable development goals [2].By the end of 2023, the global installed capacity of renewable energy had reached 3870 GW, with solar energy occupying the largest share at 1419 GW. The offshore floating photovoltaic (FPV) industry has shown significant growth globally in

recent years [5].In this context, China's 18,000 km coastline and approximately 710,000 km2 of available offshore photovoltaic area present a theoretical capacity to develop nearly 700 million kilowatts of offshore photovoltaic power, showcasing significant development potential [8].Zhang et al. [14] improved the extraction speed significantly by utilizing a fast texture feature extraction method based on the similarity between adjacent pixels while keeping distortion within a reasonable range.Additionally, Li et al. [23] proposed a photovoltaic modules guano detection method based on transfer learning from visible light images collected by drones, achieving intelligent detection of guano.Firstly, by combining different color components to form the feature space, and using the mean shift method to adaptively separate the guano, so that the CRediT authorship contribution statement Xifeng Gao: Conceptualization, Writing – original draft.In order to enhance the efficiency and reduce the operation and maintenance costs of offshore photovoltaic power generation systems, it is necessary to develop an efficient and accurate method for guano detection.The combination of these two models will provide diversified solutions for optimizing and upgrading China's energy supply system, advancing the improvement of the clean energy industry chain, and promoting sustainable economic development [4].With the advancement of computer vision, researchers have utilized technologies such as unmanned aerial vehicles and sensors to perform target detection using traditional image segmentation methods.As one of the leading deep learning network, Mask Region-based Convolutional Neural Network (Mask RCNN) has demonstrated outstanding performance in object detection and instance segmentation tasks in numerous fields.For example, Han et al. [22] discussed the challenges of deep learning models in handling high-resolution images in their research and proposed the Feature Pyramid Network to improve the detection performance of small objects.Through the development of offshore floating photovoltaic power plants, China can better harness sunlight resources at sea while addressing challenges associated with limited land resources [9].Mengmeng Liu: Conceptualization, Investigation, Supervision, Validation, Funding acquisition, Writing – review & editing.Lina Yu: Visualization.1.2.