A Literature Survey on Semantic Segmentation

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Abstract: Computer vision relies heavily on annotation, and segmentation is the most advanced form of annotation. An image segmentation procedure involves partitioning the image into multiple segments. Segmentation refers to the process of identifying objects and boundaries in an image. It is a process of assigning a specific object or class to each pixel of an image. A semantic segmentation is an image segmentation technique in which the algorithm divides the image into pixels based on categories. A number of methods can be used to analyze the visual content of an image and determine whether objects are similar or different in it Semantic segmentation shows boundaries between similar objects. In this paper, a brief overview of how semantic segmentation is accomplished using different architecturesis illustrated .

***Index Terms*—UNET, Semantic Segmentation, CNN**

I. INTRODUCTION (HEADING 1)

Annotating images is the most important task increating AI applications. Datasets for computer vision models are generated through image annotation task in which training sets are used to train models, and test/validation sets are used to evaluate their performance. For functional datasets, labelling is necessary because it enables the training model to identify the important parts of the image (classes) so that it can identify those classes later on in new, previously undocumented images.Image Annotation can be done manually or with computer assistance. An entire image can be manually labelled or regions on an image can be drawn by humans.Manual annotation is a time consuming process and also it is prone to more errors.These limitations led to the growth of automatic image annotation.Automated image annotation involves assigning labels to digital images that describe the picture's content in the best way..Automatic image annotation is a faster process and also results in greater accuracy compared to manual annotation process .It is possible to annotate images in several ways, but the most advanced way is through segmentation. The task of segmenting an image entails grouping together parts that share the same class of objects.Segmentation process involves assigning pixel to specific category to which they belong to. Different methods of segmentation can be utilized, but semantic segmentation is the most intensive form of segmentation.The semantic segmentation technique is a deep pixel-by-pixel classification technique, and a segmentation model is a special library that supports multiple architectures for semantic segmentation.
A review of different architectures used in the semantic segmentation process is presented in this paper in a broader perspective.

II. LITERATURE SURVEY

]1[In order to segment health-related medical images, UNet networks are commonly used, which consist of a contraction path (encoder)and a expansion path(decoder).The paper proposes an advanced version of UNET, UNET 3+, allowing for the organs to appear at various scales Skip connections at multiple scales combine low-level details with high-level interpretations of feature maps. Deep inspection, however, learns hierarchical representations from consolidated full-scale feature maps. The architecture proposed,not only reduces network parameters, but also increases computation efficiency.

]2[For segmenting rice regions in images from other parts of the country, researchers used UNET encoded with VGG16. Researchers have found that using images with different bands and also conditions impacts accuracy. An accuracy of 0.91 is obtained by using bright images as dataset.

]3[Segmenting the iris is a crucial step in the iris recognition process. Unlike other parts of the eye, the iris lies within a small, damp, and dynamic area due to uncontrolled movements of the eyelids.In addition, the iris pattern is obscured by eyelids, eyelashes, and reflections, which can lead to segmentation errors. Researchers are increasingly using convolutional neural networks (CNNs) to improve on the accuracy of existing iris segmentation techniques as a result of the success of deep-learning modelling. This paper highlights several deep learning models implemented in UNET and applied to the CASIA dataset to provide precise results.

]4[A detailed approach to pixel classification can be done based on the availability of satellite imagery which helps in detecting roads in poor urban areas. Specifically, this paper examines the power of deep neural networks to detect objects and, more precisely, to detect roads in poor urban conditions. Segmenting roads is done using UNET architecture. The results of pixel wise classification resulted in an accuracy of 97.7%.

]5[Researchers study cellular images from infected organs, using high resolution images from MRIs, CTs, etc. To facilitate the development of vaccines to treat and prevent such diseases. The use of image segmentation in medical research is a boon. Using different hyper parameters, this paper trains a network model to recognize nuclei automatically by analyzing medical images from standard databases. The evaluation of segmentation is provided in the form of matrix.

]6[Researchers are also exploring the underwater environment, which is a source for abundant genetic material as well as underwater life forms.By studying these ecosystems, humans can better understand climatic changes, pollution effects and many other environmental factors. Deep convolutional networks have led to rapid advancements in segmentation. In this paper, semantic image segmentation is used to explore objects under water. Underwater fish are segmented accurately based on employing UNET as the semantic segmentation framework. The architecture proposed, thus resulted in an IOU score of 0.8583.

] 7[With the current development in image processing and the growth of biometrics systems, real-time applications are at the forefront of research. There are many challenges associated with these applications, primarily related to training, detection performance, and accuracy of segmentation. There is also the problem of visual noise among biometric indicators.This paper deploys a CNN model using UNET and applies it to the MMU dataset. Thus, the proposed architecture achieved 91.7% accuracy.

]8[The use of deep learning techniques to solve a variety of image recognition and segmentation problems has demonstrated promising results in recent years. Automated segmentation speeds up the processing process by processing more images in a shorter amount of time. CNNs are considered the best models for deep learning, and they outperform earlier techniques for detecting faces and objects in images. The proposed research evaluates medical image processing using CNNs and UNet models. The proposed work is thus implemented on lungs dataset and results in an accuracy of 82.61%.

]9[The most difficult aspect of manual inspection is finding cracks in buildings. Visual inspection of cracks on the other hand is considered to be faster. Various Convolutional Neural Networks (CNNs) have been recently developed to detect concrete cracks .Of these, UNet, using CNNs, is one of the most popular method for segmenting cracks. Compared to other architectures, the authors have developed a U-Net-like structure that has a contracting path and an expansive path that outperforms the others. By down sampling multiple feature maps, the proposed architecture obtains higher pixel-level segmentation precision.

]10[The most prevalent type of cancer worldwide is liver cancer. Nowadays, deep learning is used for segmenting the liver and its tumour from CT scan images. This research aims to develop a deep learning algorithm for segmenting liver and tumour from abdominal CT scan images, thereby reducing the time and effort required for diagnosis of liver cancer. This algorithm relies upon UNet. In this study, researchers reduced the number of convolutional filters per block, and then they added a batch normalization and dropout layer after every convolutional block in a contracting path.

]11[Segmenting brain tumours semantically would enable better diagnosis and treatment. A number of CNN based architectures have been proposed to improve the efficiency of brain tumor sub-region segmentation. BU-Net, a 2D image segmentation method, is proposed here as a contribution to brain tumour segmentation research. The modifications increase the valid receptive field by discovering more diverse features. The proposed BU-Net was tested on high-grade glioma (HGG) datasets. The dice score was computed to compare the performance. The BU-Net performed better than other architectures.

] 12[In order to accurately assess diabetic retinopathy's severity, segmenting lesions in fundus images is essential. Manual grading becomes extremely time consuming and challenging due to the variation in lesions' shapes, numbers, and sizes. An automatic segmentation system is therefore needed that can clearly define the region of interest boundaries and assist ophthalmologists in the diagnosis and grading of diabetic retinopathy severity. In this paper, a new U-Net architecture, using residual networks, is presented that uses random shuffle with pixel-level convolution initialized with the nearest neighbour size.The proposed architecture thus outperforms other architectures.

] 13[A wide variety of brain tumours occur at different locations within the brain, each possessing their own unique characteristics (such as size, shape, and contrast) over different time intervals. Medical images (especially brain MRIs) can greatly aid in the identification and categorization of these tumours. The proper diagnosis of this life-threatening disease relies on the careful analysis and segmentation of these lesions. For the multi-class semantic segmentation of brain tumours, generative deep learning-based encoder and decoder structures are used. BRATS-2015 multi-modality brain MRI image dataset is used for training the proposed architecture. The proposed architecture outperformed other architectures by achieving a dice score of 86.45%.

]14[A number of eye diseases and heart conditions can be diagnosed based on the state of blood vessels present in the retina. Therefore, blood vessel segmentation has gained wide popularity among researchers. A new method for segmenting blood vessels using U-net Convolutional Neural Networks (CNNs) is proposed in this paper. Compared to existing methods, the proposed method is more accurate, specific, and sensitive.

]15 [Segmenting brain tumours by hand is not only time-consuming, but prone to error. An automated tumour segmentation method based on the modified inception module (IMU-Net) is proposed. Modified inception modules (IM) provide more accurate segmentation because they collect all relevant features. The architecture proposed consists of 40 layers of convolution and incorporates data augmentation and intensity normalization operations.

III. CONCLUSION

Semantic image segmentation, however, proves extremely useful for deep learning, which requires additional analysis of images during machine learning training. The process of segmentation is crucial for image analysis. It refers to the process of assigning a class label to each pixel in an image. Thus, this paper reviews some papers, explaining semantic segmentation in greater detail.

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