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U- Net Segmentation Technique for Segmenting CT scan Liver Image

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ABSTRACT:As symptoms of liver cancer are hard to find at the early stage. In a point of fact, its hard to find the cancer at the early stage and give appropriate treatment. Hence detection at the early stage is chief strategy for the survival of deceased. With this regard, CT scans assists in knowing the organ which is present inside the body. Further treatment includes chemotherapy, Radiotherapy, Surgery. The difficulty arises in all these process as the region of the liver lies in between the joined tissues which, makes it hard to find the position of the liver. Hence, for any kind of treatment Segmentation is necessary to recognise the area effected. Many deep learning techniques have been introduced with respect to this regard like CNN. But, very few have shown the desired result. In this paper, we are going to discuss about U-Net segmentation. Which has proven to give highest accuracy in multiple areas of medical imaging.

KEYWORDS:Liver Cancer, U-Net segmentation, Segmentation.

I. INTRODUCTION

Growing excellence in the deep learning techniques have paved way for problem eradication in many fields. Such one is computer visions, and more precisely the bio-medical imaging. Assisting in pointing out the disease in the given CT scan images, MRI images have been highly useful in the field of medicine. Here, the discussion is about the liver and the disease with in it, specifically the liver cancer. Being the largest organ in the body, it also provides the essential function which cannot be replaced by any other organ. Like, removing the harmful substances within the blood. Hence, nourishing the healthy blood supply like, preventing clots, maintaining the blood sugar level fit as fiddle and other plenty of indispensable functions.

Generally, Cancer refers to the abnormal development of the cells. As cells are the basic unit of the whole body system, abnormalities would be disastrous to this point. Liver cancer is the atypical broadening of tissue with in the liver terrain. By this process, the particular lump of the tissue formed by this process which can be termed as cancerous are well known as the malignant tumors. There are high possibilities that they may grow up and localised to the near by tissues and manipulate them hence, deteriorating the problem in much larger scale. Primary cancers are the one that develop first and the secondary are the one which is caused by the localisation of the primary cells, these are also termed as metastasis. It regains its original name for example, lung cancer that spread to throat can be coined as, metastatic lung cancer regardless of where the symptoms are coming from.

Absence of initial symptoms makes it hard to identify the disease at primary stage and hence the prolonged internal symptoms make the condition even worse. The early stage symptoms encompasses of, fever, fatigue, nausea, pain in abdomen or right shoulder, loss of weight without any reason, ascites. Pale urine and dark urine. Itchy skin. Weakness and tiredness. But, these are the rarest to occur at the beginning stage. As liver cancer has been a global cause for numerous death. The diagnosis and treatment is essential. A typical abdominal CT scanned image is very complex, as



it has multiple organs with in the corss-sectional scanned image. It has multiple organs within it like, abdominal wall and plenty of other muscels along with them, Bones, peritoneal cavity and other soild organs. The soild organs around the liver within the abdominal regional makes it hard to read the image. These includes, liver, kidneys, pancreas, spleen, suprarenal glands. By this, it is a matter of fact that segmenattion of liver region in the field of treating liver cancer is crucial and much needed without which the task becomes exceptionally difficult. Many techniques such as fuzzy c-means, region grow and region merge have been experimented but all these comes with lest accuracy. In this paper we have discussed about the U – Net segmentation, an cnn arhitecture which has proven with highest accuracy till now in the field of medical image segmentation inpainting is a method for repairing damaged pictures or removing unnecessary elements from pictures. It recovers the missing or corrupted parts of an image so that the reconstructed image looks natural. In real world, many people need a system to recover damaged photographs, designs, drawings, artworks etc. damage may be due to various reasons like scratches, overlaid text or graphics etc. This system could enhance and return a good looking photograph using a technique called image inpainting. Image inpainting modify and fill the missing area in an image inan undetectable way, by an observer not familiar with the original image. The technique can be used to reconstruct image damage due to dirt, scratches, overlaid text etc. Some images contain mixed text-picture-graphic regions in which text characters are printed in an image. Detecting and recognizing these characters can be very important, and removing these is important in the context of removing indirect advertisements, and for aesthetic reasons. There are many applications of image inpainting ranging from restoration of photographs, films, removal of occlusions such as text, subtitle, logos, stamps, scratches, red eye removal etc.

II. RELATED WORK

Huiyan Jang, Tianyu Shi, Zhiqi Bai, and Liangliang Huang [1] Based on liver localization proposed design of an Attention Hybrid Connection Network architecture that combines the hard and the soft attention mehanism and short and long skip connection aslo proposed a cascade network, segmentation network and liver segmentation network to subsist with the segmentation provocation. In this method the accuracy of the lession segmentation is weak. Xiaomeng Li, Hao Chen, Xiaojuan Qi, Qi Dou, Chi-Wing Fu, Pheng-Ann Heng [2] proposed a experimental hybrid densely connected Unet (H-DenseUNet), which comprise of a 2D denseUNet for efficacious spin out intra-slice features and a 3D equivalent for gradationally summing gravimetric contexts under the sprit of the self –context algritm for tumor segmentation However, model complexity is restricted by GPU memory. Nadja Gruber, Stephan Antholzer, Werner Jaschke, Christian Kremser, Markus Haltmeier [3], To chunk out liver lession, U-Net architecture is designed. In this system an image of likeness is sent to Covolution, Maxpooling then upsampling. Pre- processing steps like filtering areabsent as a result the result is unclear. Yongohang Zheng, Denni AI, Pan Zhang, Y efei gao, Likun Xia, Shunda Du, Xinting Sang, Jian Yang [4], worked Abdominal CT scan image automated segmentation, by making use of the Learning-ground deployed model. The results are established on cautious feature designing. But, it is not steady sufficient to distribute with all the impersonal outline due to towering responsiveness to assemble attribute.

III. METHODOLOGY

Figure 1 depicts block diagram of detection of liver cancer using CNN and SVM.

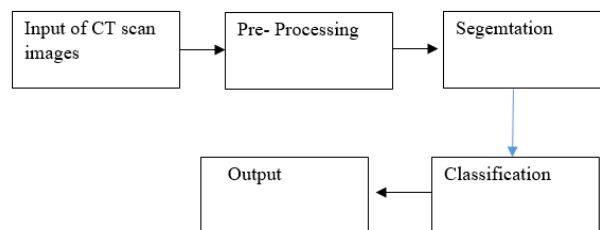


Figure-1 : Methodology of the proposed system

The process starts by taking Abdomen CT scan images as input then, it proceeds by pre-processing stages and the segmentation then, the clasification phase where, it is classied into wheather its diseased or not. Finally to classify into

different stages. In this paper, segmentation process is detailed out.

Segmentation

Segmentation is the process of extracting the desired portion from the given image. Medical image segmentation plays a vital role in the field of medicine. Specifically in chemotherapy, Radiotherapy, performing surgery at the where, a particular part needs to be portioned out for the sake of clarity. Here, we are particularly citing about image segmentation in Liver tumor. As the placement of liver among the other tissues is complicated and portioning out have always stood as challenge with this regard. U-Net have given the proven results compared to many other technique.

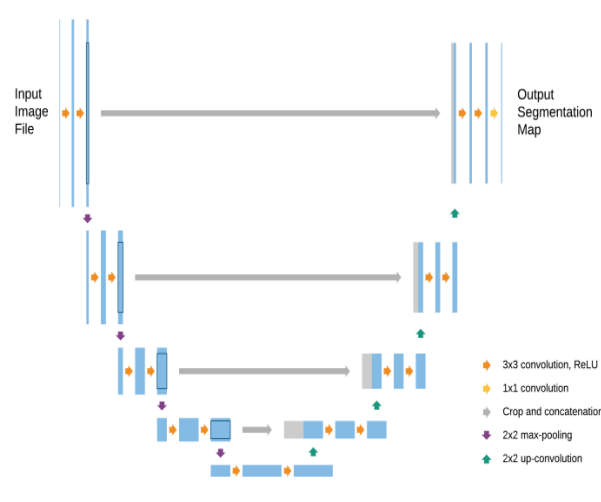


Figure 2 : Architecture of U-Net

Figure-2 depicts the architectural diagram of U-Net. As seen the architecture is U shaped having two different paths. U-Net is architecture of the CNN Hence, we have steps which are similar to CNN. It has two paths the Contracting path and the expanding path. The sub-steps of both the paths are detailed out below.

1. The contracting Path
 - a. Convolution
 - b. ReLu
 - c. Max Pooling

2. The expanding path.
 - a. Upsampling
 - b. Convolution

In contracting path, three operations are performed, two successive 3x3 convolution followed by ReLU activation unit and then the image is pooled. Here, maxpooling is used these marshalling recurrences persistently. U-Net draws its uniqueness from the expanding path at which, using 2x2 up convolution the image is upsampled. Further the feature map from the corresponding layer in the contracting path is cropped and concatenated into the upsampled feature map. Later, two successive 3x3 convolution and ReLU activation function is induced. Eventually, one single 1x1 convolution is enacted to bring down the feature map to requisite number of channels and finally fabricate segmented image. The cropping is obligatory since pixel features in edges have the bare minimum information and hence, needs to be rejected. The final outcome in a network resonates U shape and principally, breeds contextual information by side of the network which authorize segment objects in an area utilizing the context from a bigger overlapping boundary.

The step by step procedure is mentined below.

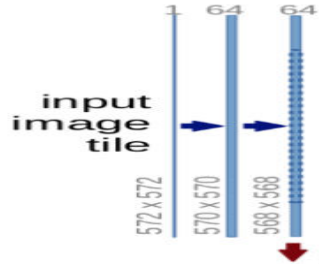


Figure 3 : Input image tile.

Figure -3 illustrates the primary part of the code. As shown above every process add up to two convolutional layers, and with each convolution process the depth of the image is increased from 1 to 64. The size of the image reduces from the 570x570 to 568x568 this happens due to padding, nevertheless the padding here is kept zero. The red arrow dsceding downwards is the maxpooling where, size of the image is halves down.

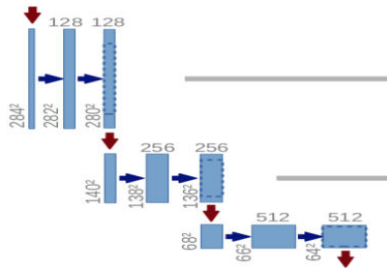


Figure-4 depicts the recurrency of the process where the steps

are duplicated for three more counts. As shown the size of image goes on reducing for every step as the convolution steps extracts the features at every step and finally reaches the terminal step as shown in figure 5 at this point two convolution layers are developed without the maxpooling layer. With reference to figure -5 but this time the size of the image have been reduced to 28x28x1024.



Figure 5 : Terminal step of the process

The expansive path:



Figure 6 : The beginning of the expansive path.

Figure – 6 shows the final output of the expansive path will be resized image. The size of the image will be similar to the initial input. Here, we use transposed convolution technique. Transposed convolution is the technique which helps in upsampling of the image i.e., to resize the image to its original one. The logic applied here is of padding and then a convolution operation. The image is up sized to 28x28x28 to 56x56x512 by using transposed convolution further, the



concatination is done to the image with the corresponding image which is in the contracting path finally, all together the image is made into size of 56x56x1024. This happens as the details from the previous layers are combined to get more specified prediction. Later two convolutions are added, agin as done in contracting path the process is again replicated for 3 more times.

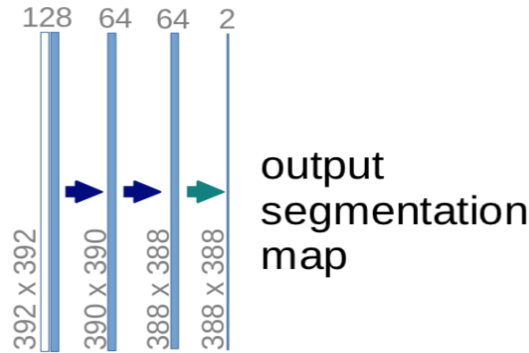


Figure 7 : Final layer in U-Net segmentation process.

Figure-7 shows the final and topmost of the U-Net architecture. Where, the image is reshaped to its desired size. This final layer is convolued with the image with the filter size of 1x1. What is remained is for the neural network training.

Below equation represents the energy function :

$$E = \sum w(x) \log(p_{k(x)}(x))$$

Where, p^k is the pixel-wise SoftMax function applied over the final feature map.

$$p_k(x) = \frac{e^{a_k(x)}}{\sum_{k=1}^k e^{a_k(x)}}$$

Here, $a_k(x)$ = activation
 k = channel

IV. EXPERIMENTAL RESULTS

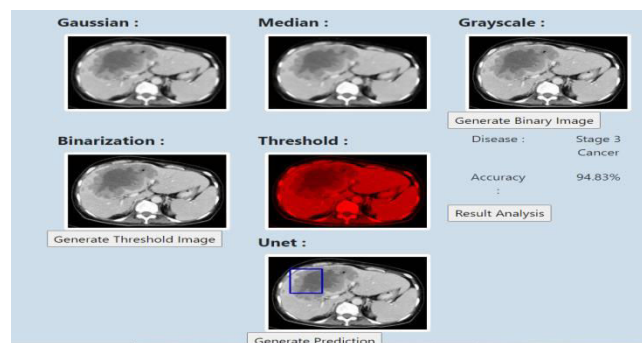


Figure 8 : detection of stage 3 liver tumor from the uploaded image.

Figure-8 shows the segmentation page. As shown segmentation occurs after all the pre processing steps. Initially the image is uploaded by clicking the choose file button. Then the filters are added to it to remove the noises. The gaussian filter and the median filter are used here. The image which is in RGB is converted to grey scale for the easy

computation. After which the thresholding is done to binarize the image, when the generate binarized image is clicked, the binarized image appears when the Generate binary image button is clicked. The segmented image is uploaded along with the binarized image. Figure 10 depicts the segmented image. And Figure – 9 the original image.

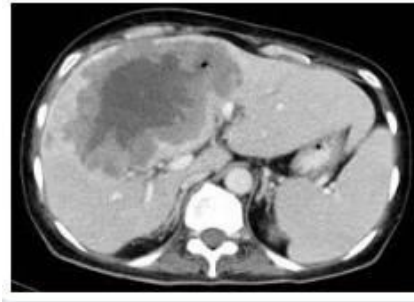


Figure 9 : The initial uploaded image.

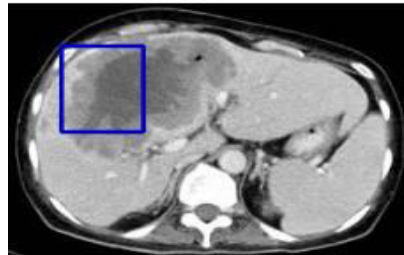


Figure 10 : Segmented image in Liver tumor Segmentation.

V. CONCLUSION

Segmentation of image in abdomen CT scans have always been a tedious job in the field of medicine. Which might cause problems like delaying in treatments and lack of early detection of the disease. This needs to be sorted out by using few techniques. Here, we have discussed about the U-Net architecture which is able to localize in the image pixel by pixel to find the disease region and segment it out. U-Net also carry many other applications in the field of segmentation

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