D.K.T.E. Society's Textile and Engineering Institute, Ichalkaranji.

(An Autonomous Institute, Affiliated to Shivaji University, Kolhapur)

Department of Computer Science & Engineering

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Project Synopsis On

Segmentation of retinal fundus images using U-net model

Under The Guidance Of

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❖ INTRODUCTION:

Domain Introduction:-

One of the most powerful ideas in deep learning is that sometimes you can take knowledge that neural network has learned from one task and apply that knowledge to other task if both tasks are related. In this project we are going to segment blood vessels from retinal fundus images using transfer learninto increase the accuracy and get good results.

Deep Learning :-

- **Deep learning** (also known as **deep structured learning**) is part of a broader family of machine learning methods based on artificial neural networks with representation learning
- Deep learning is a class of machine learning algorithms that uses multiple layers to progressively extract higher-level features from the raw input.
- Deep learning excels on problem domains where the inputs (and even output) are analog. Meaning, they are not a few quantities in a tabular format but instead are **images of pixel data, documents of text data or files of audio data**.
- In deep learning, each level learns to transform its input data into a slightly more abstract and composite representation
- Importantly, a deep learning process can learn which features to optimally place in which level *on its own*. But this does not completely eliminate the need for hand-tuning; for example, varying numbers of layers and layer sizes can provide different degrees of abstraction.

What is segmentation :

image segmentation is the process of partitioning a digital image into multiple segments .The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze.

Transfer Learning: -

- Transfer learning is a machine learning method where a model developed for a task is reused as the starting point for a model on a second task.

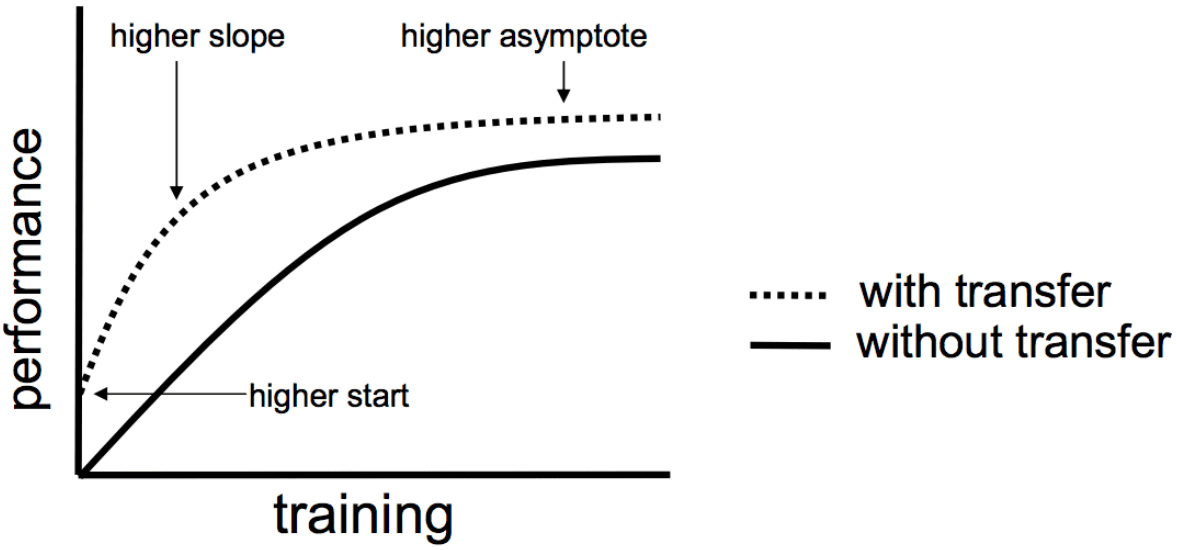
- Transfer learning is an optimization that allows rapid progress or improved performance when modelling the second task.
- Transfer learning only works in deep learning if the model features learned from the first task are general.

When to Use Transfer Learning?

Transfer learning is an optimization, a shortcut to saving time or getting better performance.

Three Possible benefits to look for when using transfer learning:

1. **Higher start**. The initial skill (before refining the model) on the source model is higher than it otherwise would be.
2. **Higher slope**. The rate of improvement of skill during training of the source model is steeper than it otherwise would be.
3. **Higher asymptote**. The converged skill of the trained model is better than it otherwise would be.



- Some problems where you may not have very much data, transfer learning can enable you to develop skilful models that you simply could not develop in the absence of transfer learning.
- The choice of source data or source model is an open problem and may require domain expertise and/or intuition developed via experience.

❖ RELATED WORK:

- Jason Yosinski, Jeff Clune, Yoshua Bengio and Hod Lipson proposed a paper on “How transferable are features in deep neural networks?” which was published on November 2014[1]. Proposed research paper on quantifying the generality versus specificity of neurons in each layer of a deep convolutional neural network. It describes that Transferability is negatively affected by two distinct issues: (1) the specialization of higher layer neurons to their original task at the expense of performance on the target task, which was expected, and (2) optimization difficulties related to splitting networks between co-adapted neurons, which was not expected. Paper also document that the transferability of features decreases as the distance between the base task and target task increases, but that transferring features even from distant tasks can be better than using random features. A final surprising result is that initializing a network with transferred features from almost any number of layers can produce a boost to generalization that lingers even after fine-tuning to the target dataset.
- Davood Karimi, Simon K. Warfield proposed paper on “Critical Assessment of Transfer Learning for Medical Image Segmentation with Fully Convolutional Neural Networks” which was published on May 2020[3]. The experiments performed show that although transfer learning reduces the training time on the target task, the improvement in segmentation accuracy is highly task/data dependent. We observe that convolutional filters of an FCN change little during training for medical image segmentation, and still look random at convergence. We further show that quite accurate FCNs can be built by freezing the encoder section of the network at random values and only training the decoder section.
- Maithra Raghu, Chiyuan Zhang, Jon Kleinberg, Samy Bengio proposed paper on “Transfusion: Understanding Transfer Learning for Medical Imaging” which was published on October 2019[7]. It explore properties of transfer learning for medical imaging. A performance evaluation on two large scale medical imaging tasks shows that surprisingly, transfer oers little benet to performance, and simple, lightweight models can perform comparably to ImageNet architectures. Investigating the learned representations and features, we nd that some of the differences from transfer learning are due to the over-parametrization of standard models rather than sophisticated feature reuse

❖ PROBLEM DESCRIPTION:

In the medical domain expert persons are less. So, to increase the availability of expertise we can use machines to help us out. Also annotated data available is also not available in large scale. So, we have to work on limited data set due to which we want to use transfer learning. We have to take pretrained weights from pretrained model and use its weight for initializing weights in initial layers to improve the accuracy for training on limited dataset. Then test U-net model for segmenting blood vessel from retinal fundus images.

We can use this segmented image for further analysis like clots in blood vessels, detecting diabetes, etc. Also, we can generalize this method if accuracy is high enough.

❖ PROBLEM STATEMENT:

To segment Blood Vessels of Retinal Fundus Image using U-net model Trained under scarce annotated data.

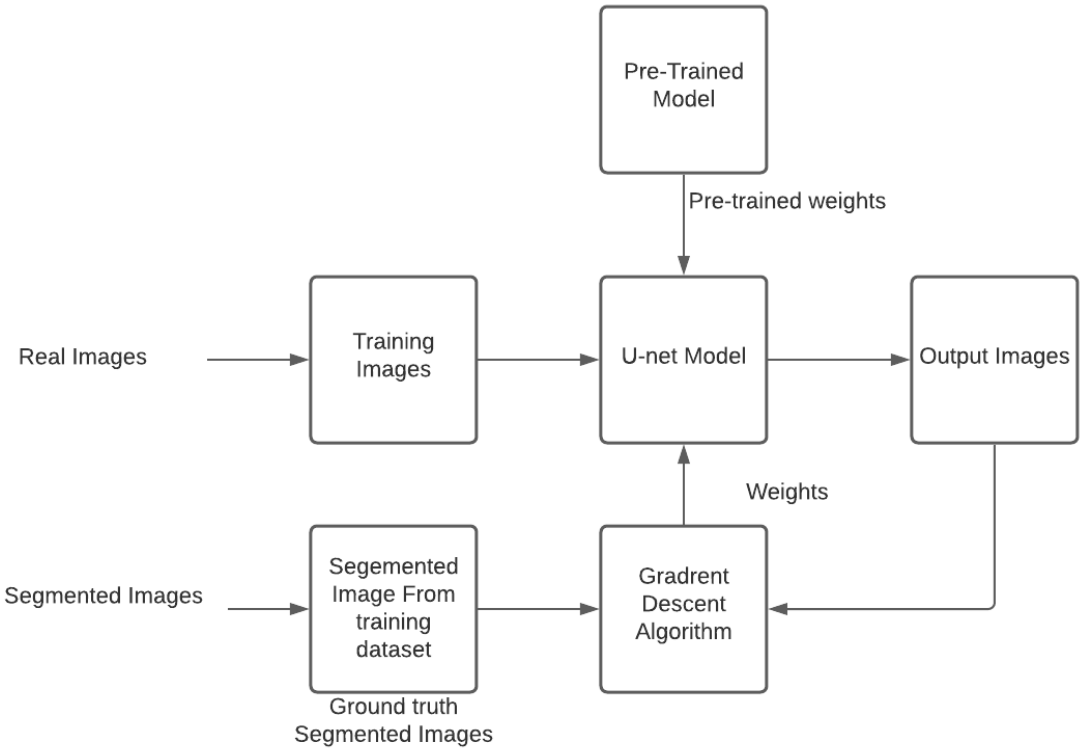
❖ OBJECTIVES:

- To select appropriate source image domain and segmentation models
- To transfer the source model weights selectively, layer by layer to target U-Net model.
- To fine tune model training the model with small subset of target real images (Retinal images from DRIVE dataset).
- To record performance parameters during training and testing at every stage.
- To resent the performance analysis showing the effectiveness of transfer learning for training the U-Net model using a small subset of real medical images (retinal images from DRIVE dataset)

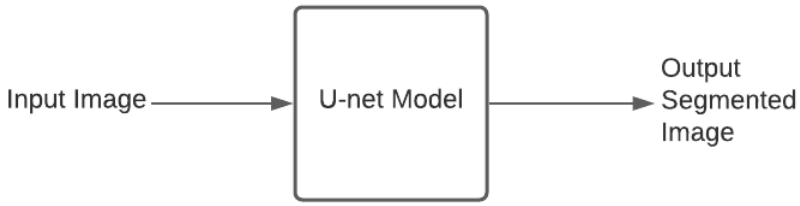
❖ METHODOLOGY:

- **Architectural Diagram:**

1.Training



2.Testing



Functional Requirements:

1.model should be able to segment retinal blood vessels from retinal funds images

2. segmentation should be carried out in less than 1 second.

3.model should be trained with as few as training samples

Constrains:

1.Image input size should be 512x512

2.Image should be coloured.

3.Image should be in jpeg format.

Primary requirements:

1.software should be able to segment blood vessels from retinal fundal images.

Additional

1.model should learn from limited training data set (required to carry transfer learning operation)

2. User should be in position to segment the given image

3. Segmented image should be stored in a file

Operational:

1.Doctor must be able to select a retinal fundus image for finding out blood vessels

❖ FACILITIES REQUIRED:

1. Personal computer with GPU

❖ REFERENCES:

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