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TITLE: DEFORESTATIOM ANALYSIS USING MACHINE LEARNING

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INTRODUCTION:

Forests are the most important and essential natural resources used by mankind for various usage. Loss of these forests has emerged as a major environmental concern in recent years. But for the purpose of development, many forests are being cut resulting in deforestation. Due to this cutting of forests, deforestation rate is increasing day by day and the world is facing severe disasters. Therefore, this continuous clearing of forests has a major degraded impact on the soil quality, climate change, hydrological cycle and ecosystem etc. In this work, we implement and analyse an Attention U-Net deep network for semantic segmentation using Sentinel-2 satellite sensor imagery, for the purpose of detecting deforestation within two forest biomes in South America, the Amazon Rainforest and the Atlantic Forest. The performance of Attention U-Net is compared with U-Net, Residual U-Net, ResNet50-SegNet and FCN32-VGG16 across three different datasets (three-band Amazon, four-band Amazon and Atlantic Forest). Results indicate that Attention U-Net provides the best deforestation masks when tested on each dataset, achieving average pixel-wise F1-scores of 0.9550, 0.9769 and 0.9461 for each dataset, respectively. Mask reproductions from each classifier were also analysed, showing that compared to the ground reference Attention U-Net could detect non-forest polygons more accurately than U-Net and overall it provides the most accurate segmentation of forest/deforest compared with benchmark approaches despite its reduced complexity and training time, thus being the first application of an

Attention U-Net to an important deforestation segmentation task. This project concludes with a brief discussion on the ability of the attention mechanism to offset the reduced complexity of Attention U-Net, as well as ideas for further research into optimising the architecture and applying attention mechanisms into other architectures for deforestation detection.

OBJECTIVES

- To detect the areas and activities of deforestation.
- To deliver a dedicated system that provides the data that is accessible to the public.
- To provide the information about the areas where urbanization can be done.
- To create the awareness among the public on the effects of deforestation. To encourage the people about reforestation and its benefits
- To use Attention U-net for the detection of land cover segmentation problems
- To test generalizability and to evaluate the performance of attention U-net over the multiple locations.
- To reduce the complexity of land cover segmentation.
- To improve the performance and efficiency of land cover segmentation over multiple scenarios.
- To provide necessary data for reforestation purpose.
- To provide data to utilize the land cover for sustainable development purposes.

METHODOLOGY

The development of an attention-based U-Net for detecting deforestation within satellite sensor imagery can be achieved through the following methodology:

1. Data Collection: Collect a large dataset of satellite images of forested and deforested areas. The images should cover different seasons, lighting conditions, and angles to ensure the model is robust to variations in environmental conditions.

2. Data Preprocessing: Preprocess the dataset to prepare it for training. This may include resizing, normalization, and augmentation techniques such as rotation, flipping, and shifting to increase the diversity of the dataset.

3. Model Architecture: Design an attention-based U-Net architecture that can effectively detect deforestation in satellite images. The U-Net architecture is a popular choice for segmentation tasks, and adding attention mechanisms can help the model focus on relevant features in the input image.

4. Training: Train the model using the preprocessed dataset. Use a suitable loss function such as binary cross-entropy or Dice loss and optimize the model using an algorithm such as Adam or stochastic gradient descent. Experiment with different hyperparameters such as learning rate, batch size, and number of epochs to find the best combination.

5. Evaluation: Evaluate the performance of the model using appropriate metrics such as precision, recall, F1 score, and accuracy. Use a separate validation set to avoid overfitting and assess the model's generalization capabilities.

6. Fine-tuning and Deployment: Fine-tune the model if necessary and deploy it for real-world use. This may involve integrating the model into a larger software system or deploying it as a standalone application.

Overall, developing an attention-based U-Net for detecting deforestation within satellite sensor imagery requires careful planning, data preparation, model design, and evaluation to ensure a robust and accurate solution.

RESULTS AND CONCLUSION

In this project, we will do a quantitative analysis of the performance of Attention U-Net at the detecting deforestation in Indian forest imagery. We found that the addition of an attention mechanism to a less complex version of U-Net provides greater performance than the standard U-Net architecture, as well as several other state-of-the-art methods. The attention mechanism enables the network to retain high levels of spatial information despite containing layers of much lower dimensionality than U-Net. Due to the successful application of an attention mechanism to a deep neural network for this task, we can recommend the use of an Attention U-Net for other land cover segmentation tasks in the field.

Satellite monitoring is currently used to understand if the forests are changing and what the causes for those changes are. Therefore it is necessary to study the methods by which we can predict the deforestation rate and suitable areas for reforestation. Also this system will predict the areas for

urbanization. We have used remote sensing and satellite image processing to detect all these consequences and its solutions. Finally our proposed system will give accurate solution to this problem for the public.

We implement and analyse an Attention U-Net deep network for semantic segmentation using satellite sensor imagery, for the purpose of detecting deforestation through the satellite images. The main advantage of our project is the accuracy level in detection of deforestation areas through these semantic segmentation technique.

FUTURE SCOPE:

Attention U-Net is a deep learning algorithm that has shown promise in improving the accuracy of deforestation analysis using satellite image processing. This algorithm uses a combination of convolutional neural networks and attention mechanisms to identify important features in satellite images. By incorporating attention U-Net into the deforestation analysis process, researchers can improve the accuracy of their results and reduce the risk of false positives or negatives. This could lead to more effective strategies for preventing deforestation and protecting natural habitats.

Since the addition of the attention mechanism allows Attention U-Net to perform to such a degree despite having very few parameters, we believe that others may have success implementing attention mechanisms into less complex versions of other models to a similar effect. One such possibility is the use of a Residual Attention U-Net which would contain more parameters than Attention U-Net, and perhaps longer training time, but may improve upon the Residual U-Net.

Finally, we suggest that transfer learning could be used with either of the 4-band Attention U-Net models by training on both 4-band training datasets. This could allow for greater transferability to images from a wider set of locations. It was shown that the models trained on a single location were transferable, so it is sensible to suggest that transfer learning would further improve this and allow for successful applicability to forest imagery from around the world.