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Predicting Water Bodies from Satellite Images

Mrs.P.Shyamala, M.Kavya, G.Lohitha, A.Lokesh, C.Jayanth

Guide, Department of Computer Science & Engineering, Malla Reddy University, Maisammaguda, Hyderabad,
Telangana, India

Department of Computer Science & Engineering, Malla Reddy University, Maisammaguda, Hyderabad,
Telangana, India

ABSTRACT: With significant development of sensors and Internet of things (IoT), researchers nowadays can easily know what happens in water ecosystem by acquiring water images. Essentially, growing data category and size greatly contribute to solving water pollution problems. In this paper, we focus on classifying water images to sub-categories of clean and polluted water, thus promoting instant feedback of a water pollution monitoring system that utilizes IoT technology to capture water image. Due to low inter-class and high intra-class differences of captured water images, water image classification is challenging. Inspired by the ability to extract highly distinguish features of Convolutional Neural Network (CNN), we aim to construct an attention neural network for captured water images classification that appropriately encodes channel-wise and multi-layer properties to accomplish feature representation enhancement. During construction, we firstly propose VGG 19 model with channel-wise attention gate structure and then utilize it to construct a hierarchical attention neural network in local and global sense. We carried out comparative experiments on an image dataset about water surface with several studies, which showed the effectiveness of the proposed attention neural network for water image classification. We applied the proposed neural network as a key part of a water image-based pollution monitoring system, which helps users to monitor water pollution breaks in real-time and take instant actions to deal with pollution..

I. INTRODUCTION

Water ecosystems including rivers, lakes, and seas are facing great threats brought by fast development of human society. With development of sensor technology [1] and Internet of things(IoT) [2], category, volume, and body of collected relevant data have been continuously increased and improved. With the help of collected data, researchers can develop systems to instantly monitor, control, and abate pollution, thus protecting water ecosystems. As an important research topic in water ecosystem monitoring, utilizing artificial intelligence to theoretical understand relevant data under the environment of IoT thus has been widely developed in areas of water resource management and environmental protection. Thanks to deployment of drones, surveillance cameras, and other technologies of IoT [3,4], many relevant water data are easy to obtain. Involving big data technologies [5], water pollution monitoring system is thus greatly modified, transforming from methods of manual sampling to instant and automatic monitoring and analyses. The advantage brought by much modification is that government users can effectively know where and when pollution is happening without obvious time delay. Core challenges of such monitoring system are thus to effectively analyze data captured by IoT technologies for detailed pollution information. Among multiple water-relevant data types,

understanding to achieve goal of water pollution monitoring. More precisely, we aim to construct a novel water pollution monitoring system, which could perform two classification tasks under the environment of IoT. First, such system can classify input water images into basic type, i.e., clean or polluted, thus knowing where pollution is happening. On the basis of general type of water images, the system should decide subcategories of input water images, which could provide sufficient information for users to take further actions. In other words, such system can not only classify clean water images into four subcategories, i.e., fountain, lake, ocean, and river, but also know what type of water pollution is happening, such as fungus, dead animals, industrial pollution, oil, and rubbish

II. THE DEVELOPMENT

EXISTING SYSTEM

Traditional methods for water body extraction often involve manual digitization or the application of thresholding techniques on spectral indices like NDWI (Normalized Difference Water Index). Shallow machine learning models such as decision trees or SVMs have been used but fail to generalize across varying landscapes. Conventional CNN architectures also struggle with maintaining spatial details when segmenting water bodies. Furthermore, these methods are computationally expensive and less efficient for large-scale analysis.

DISADVANTAGES OF EXISTING SYSTEM

Existing system works under image processing and cloud-based approach
In existing system vgg16 is used with less layers of training.

III. PROPOSED SYSTEM

The proposed system leverages the Unet architecture, a fully convolutional neural network designed for image segmentation tasks, to accurately predict water bodies from satellite images. By using a combination of contracting and expanding paths, Unet can capture both global context and precise boundaries. Data augmentation techniques and multi-scale feature extraction further enhance the model's robustness to diverse environmental conditions. This approach improves segmentation accuracy, ensuring reliable and efficient identification of water bodies from high

Modules

Data COLLECTION:

This project we use water images dataset collected from online which has three categories of five categories. Pixel values from images are taken as input and labels are used as output and each folder has 50 images which are used for training.

Pre-processing:

Pre-processing is a procedure adopted to enhance the quality of images and increase visualization. In water quality imaging, image processing is a crucial phase that helps to improve the images quality. This can be one of the most critical factors in achieving good results and accuracy in next phases of proposed methodology. Water quality images may contain a different issue that may lead to poor and low visualization of the image. If the images are poor or of low quality, it may lead to unsatisfactory results.

During preprocessing phase, we performed background elimination, elimination of non-essential blood supplies, image enhancement, and noise removal

ADVANTAGES OF PROPOSED SYSTEM

Automates process of prediction of water quality images with out human interface.

Enable the identification of water bodies of interest

Accuracy of the model is increased compared to existing methods.

IV. OBJECTIVES

Among multiple water-relevant data types, we focus on one of the most common categories., water imagery. Furthermore, we perform image content understanding to achieve goal of water pollution monitoring. More precisely, we aim to construct a novel water pollution monitoring system, which could perform two classification tasks under the environment of IoT. First, such system can classify input water images into basic type, i.e., clean or polluted, thus knowing where pollution is happening. Based on general type of water images, the system should decide subcategories of input water images, which could provide sufficient information for users to take further actions. In other words, such system can not only classify clean water images into four subcategories, i.e., lake, ocean, and river, but also know what type of water pollution is happening, such as fungus, dead animals, industrial pollution, oil, and rubbish

Train-Test Split and Model FITTING:

Now, we divide our dataset into training and testing data. Our objective for doing this split is to assess the performance of our model on unseen data and to determine how well our model has generalized on training data. This is followed by

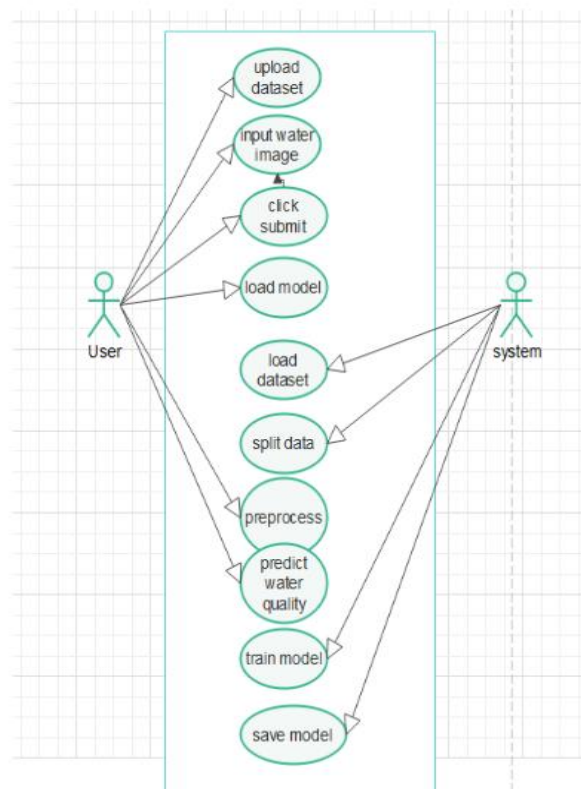
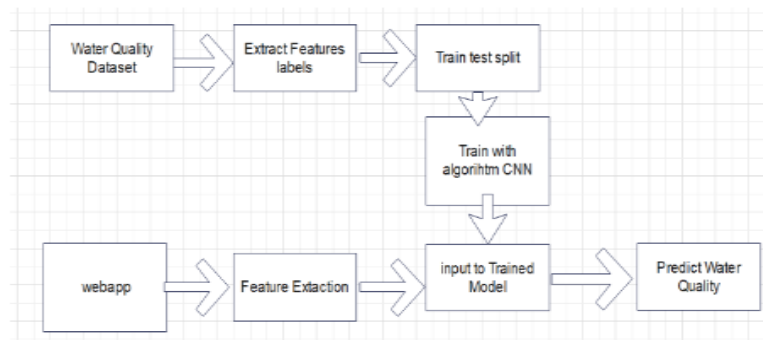
a model fitting which is an essential step in the model building process.

Model Evaluation and Predictions:

This is the final step, in which we assess how well our model has performed on testing data using certain scoring metrics, I have used 'accuracy score' to evaluate my model. First, we create a model instance, this is followed by fitting the training data on the model using a fit method and then we will use the predict method to make predictions on x_{test} or the testing data, these predictions will be stored in a variable called $y_{\text{test_hat}}$. For model evaluation, we will feed the y_{test} and $y_{\text{test_hat}}$ into the `accuracy_score` function and store it in a variable called `test_accuracy`, a variable that will hold the testing accuracy of our model. We followed these steps for a variety of classification algorithm models and obtained corresponding test accuracy scores

Architecture:-

Use case diagram



CNN VGG19 Algorithm

1. Enter a sample pictures of rice diseases. The pictures are extracted from the folder as a training sample set for input.
2. Pre-processing. In order to improve the training efficiency, the input image is standardized to a resolution of 224 * 224.
3. Construct new and improved models. using the VGG- 19 Net model, the 3 FC layers are optimized as 1 Flatten layer and 2 FC layers with reduced parameters. Replace the Softmax classification layer of the original model with a 2-label Softmax classifier.
4. Micro-transfer learning. Using the parameters of the 16 convolutional layers and pooling layers of the VGG pre-trained model, the parameters of the detection model were optimized by transfer learning.

Model training. To train and optimize the parameters of 2 FC layers and Softmax layers, it is necessary to freeze the parameters of 16 convolutional layers and their pooling layers and initialize the model parameters using a random method, set the momentum parameters, the learning rate, and the accuracy standard to iterate

V. CONCLUSION

We propose an VGG 19 for water images classification task, which dynamically modulates context of channel- wise and multi-layer characteristics to enhance feature map. During construction, we propose channel-wise attention gate at first and then utilize it to build hierarchical attention model. We carried out comparative experiments on an image dataset about water surface with several existing studies, which shows distinctive ability of the proposed attention neural network for water bodies classification. Accuracy of the model is 97.5 percent is is more compare to existing methods

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