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Flood Detection from Satellite Images Based on Deep Convolutional Neural Network and Layered Recurrent Neural Network

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Abstract: ***Satellite images are important for developing and protected environmental resources that can be used for flood detection. The satellite image of before-flooding and after-flooding to be segmented and feature with integration of deeply LRNN and CNN networks for giving high accuracy. It is also important for learning LRNN and CNN is able to find the feature of flooding regions sufficiently and, it will influence the effectiveness of flood relief. The CNNs and LRNNs consists of two set are training set and testing set. The before flooding and after flooding of satellite images to be extract and segment formed by testing and training phase of data patches. All patches are trained by LRNN where changes occur or any misdetection of flooded region to extract accurately without delay. This proposed method obtain accuracy of system is 99% of flood region detections.***

Keywords: ***Satellite imagery, flood detection, convolutional neural network, layered recurrent neural network.***

I. INTRODUCTION

The flood detection is important for protection of living things not only also environmental resources. Therefore, it is primary to monitor these flooding regions re to define prevention strategies and help the system in damage control. (LRNNs), has been achieved great success in many applications, including visual tracking and region segmentation, extraction. The following networks used to predict accurate detection when compared to other existing system. CNN is a process of preprocessing of extraction of dataset. Feature maps can be evaluated by input images and kernels. CNN is one of the important methods in machine learning. The sample can be preprocessing into signature signals. The preprocessing is in the form of spectral band such as R, G, B, NIR images. CNNs and L-RNN is combined to gives exact flood detection with high level accuracy. Dataset can be taken by USGS and NASA website, it will be explained in the below sections briefly. The source and input data cannot be changed during this process.

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II. METHODOLOGY

A. Dataset

They obtain two type of satellite imagery (Before-flooding and After-flooding from USGS website as input images. The potential of this approach is detecting interior flooded regions by deep learning methods. The differences obtain from before-flooding images (RGB, and three channels) and After-flooding images.

The input images can be segmented and extracted into training set and testing set. The images can be converted into 32×32 pixels to 1072×927 patches. In this work, satellite images are downloaded from the USGS website, which is mainly selected according to different flood coverage and the underlying surface. According to the needs of the subsequent experiment, dataset from different regions taken as satellite images need to be classified into a test set and training set. And also download images from NASA website is mainly for India flood affected areas.

B. Deep Convolutional Neural Networks

It has 3 primary hidden parts can be used for identification of flooded region easily. Which means neuron is prearranged in three dimensions. Every layer will be more explained in the next part. In this method is used to calculate performance and regression value before-flooding, after-flooding. Automatically iterations changed 100 up to 1500 iterations ranges, they will be find a accuracy and detection flooded areas exactly. This network being a best part in flood detection method. Compare to other method, it gives less accuracy and they overcome by using L-RNN for improve high level accuracy.

C. Layered Recurrent Neural Network

An LRNN [8],[7] is otherwise known as machine learning . Layered recurrent neural network is designed as input, output and hidden layers. The hidden layer consists of (w,w,b) it will be to output layer (w,b). The flood affected region can be separated by layers.

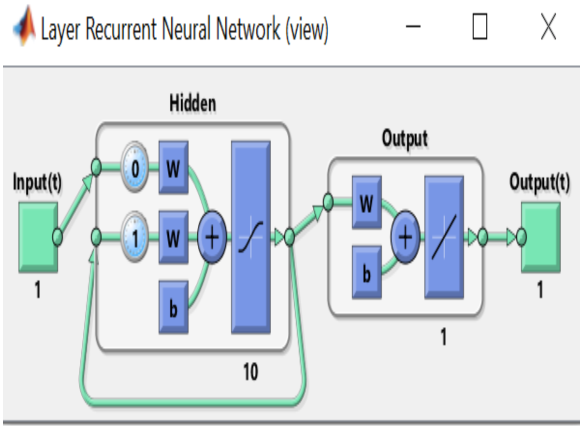

Fig .1.Layered recurrent neural network

D. Training set

The train set can be created into patches of before-flooding, after-flooding images extract from 1072×927 pixels images into 32×32 pixels by resized patches. Then, create a training patches label as "0" and "1" by the process of L-RNN. RGB images are used for finding parameter values and accuracy. L-RNN network can be extract the each pixel due to change rate <=10% or >10 of training patches. The following figure 2 can be explained detail. The dataset can be separated as train set and testing set in the process of training phases. The train set is selected a preprocessing images for feature extraction and segmentation process.

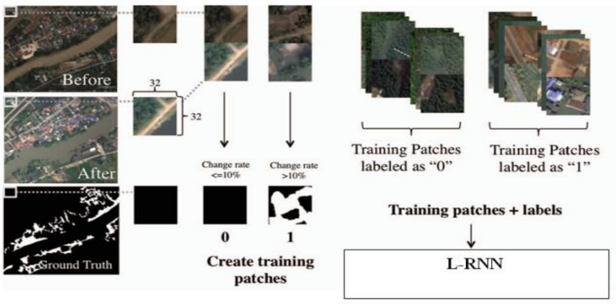

Fig.2.Training phase

E. Testing set

Testing phase is the process of merge the RGB images into pixels. It can be labeled values as 0, 1 and accuracy also predicted. Testing phase also, selected a highest prediction value of the process based on the knowledge in train patches.

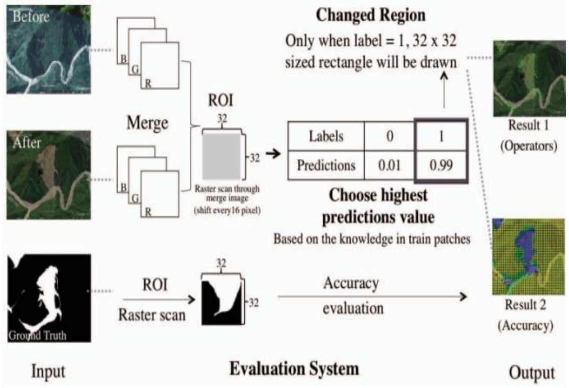

Fig.3. Testing phase

The testing process is a combination of RGB images into channels (12 channels) based on the train patches. It will be used to prediction of accuracy and evaluation. Region will be changed means the rectangular patches will be assigned as label '1' otherwise label as '0'. In this method also using ROI for accuracy and evaluation results taken from before-flooding, after-flooding input images.

III. RESULTS AND DISCUSSION

The high resolution images can be separately tested and trained by integrated CNN and LRNN. Also a process of extraction and segmentation is used for giving high accuracy compare to previous method of before-flooding and after-flooding area. The following parameters are used such as,

1. True positive (TP)
2. True Negative (TN)
3. False positive (FP)
4. False Negative (FN)

The above following parameters are used to calculating the accuracy of flooding regions by the values precision, recall, and f-score.

Precision (P)

$$\text{Precision} = \frac{\text{True positive}}{\text{False Positive+True Positive}}$$

Recall(R)

$$\text{Recall} = \frac{\text{True positive}}{\text{False Negative+True Positive}}$$

F-Score (F)

$$\text{F-Score} = 2\left(\frac{\text{Precision}\times\text{Recall}}{\text{Precision+Recall}}\right)$$

A. Training Rate and Testing Rate

The testing value and training values to be calculated at 1500 iteration randomly. The accuracy value is 0.99.

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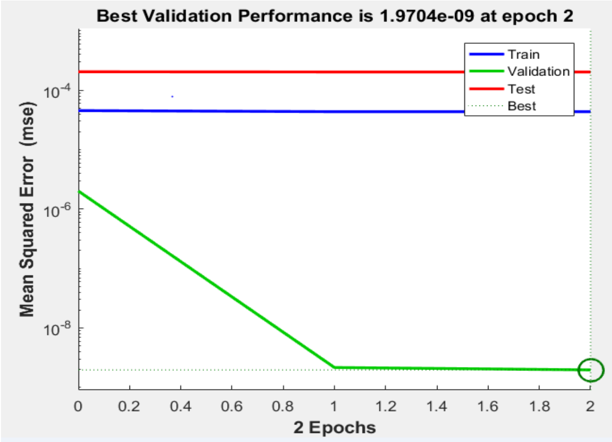

Fig .4.Training rate and testing rate

In this method, is encouraged from Alex Net shows capable training rate and testing rate without any loss rate of iterations.

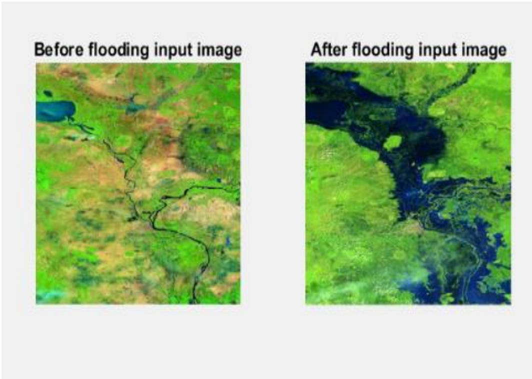

Fig.5. Input images of Cambodia.

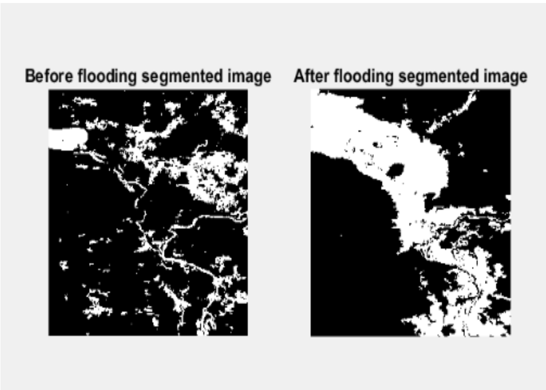

Fig. 6.Before and after flooding segmentation

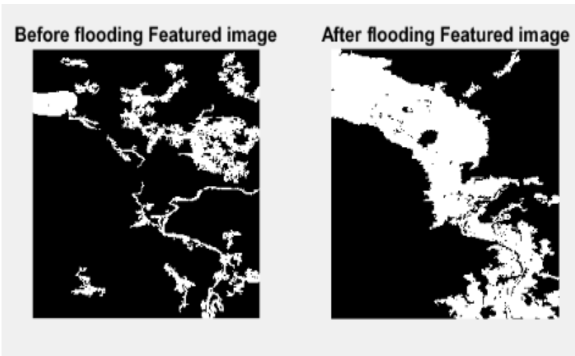

Fig. 7. Featured images

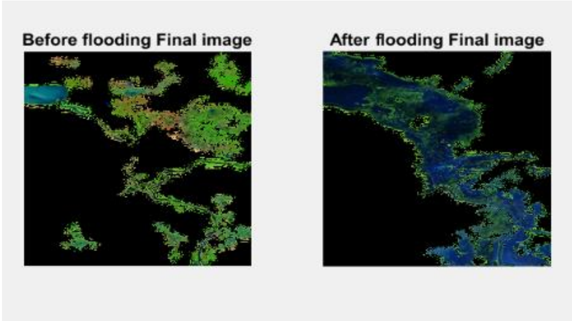

Fig.8. Before and after final flooding

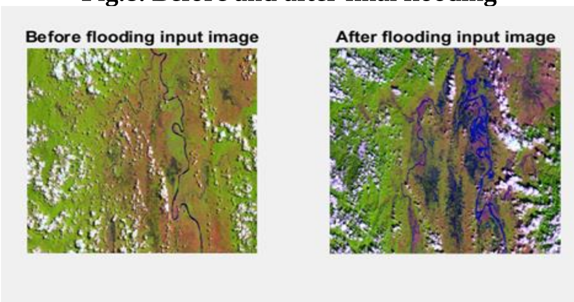

Fig. 9. Input images of Philippine

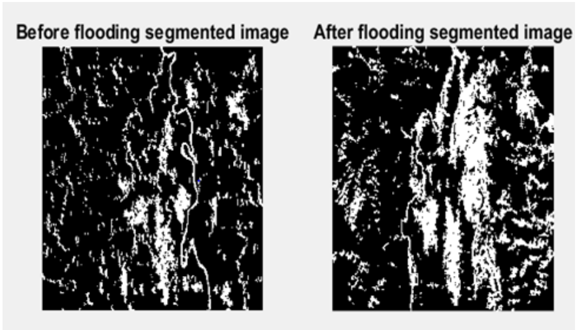

Fig.10. Before and after flooding segmentation

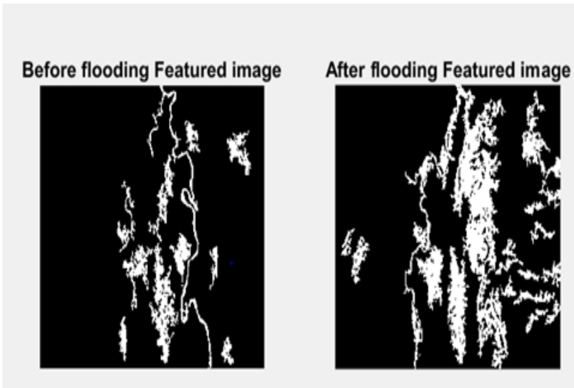

Fig.11. Featured images

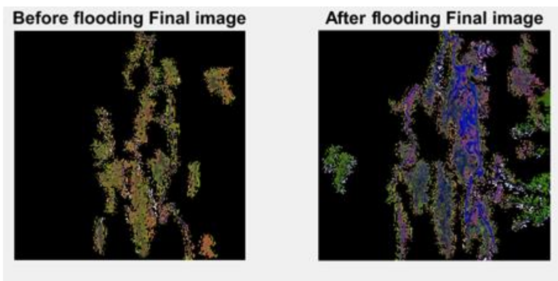

Fig. 12.Before and after final flooding

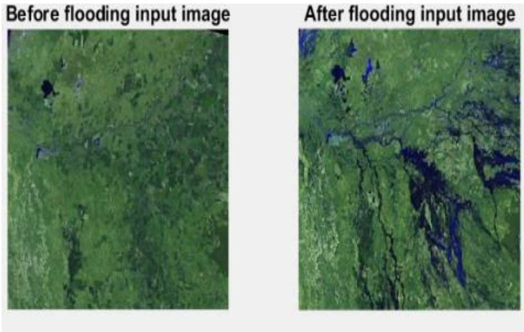

Fig.13. Input images of South Australia

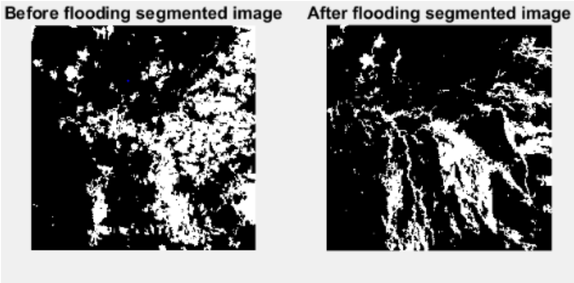

Fig. 14.Before and after flooding segmentation

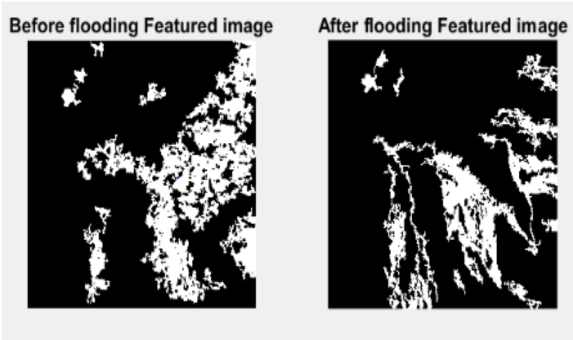

Fig.15. Featured images.

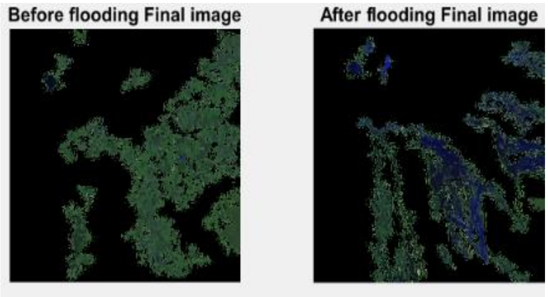

Fig.16. Before and after final flooding

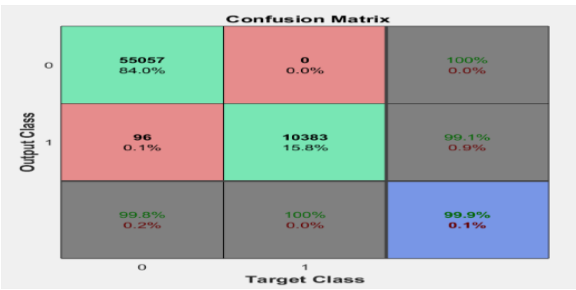

Fig. 17.Confusion matrix

IV. CONCLUSION

The execution result of integrated LRNN with CNN automatically dissimilarity for extraction of before flooding and after flooding. In the obtained result is shown in Fig. 4 to Fig 14, flood detection accuracy range is 99%. Based on the obtain results, they proposed method is automatically extract a flooded region with high accuracy. In this proposed method of integrated CNN and LRNN for satellite images is qualitatively and quantitatively semantic segmentation to be implemented. Compare to other method it gives high accuracy and flood detection.

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