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Land Cover Change Detection using M-Siamese Network

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Abstract*: Land cover change detection has been a topic of active research in the remote sensing community. Due to enormous amount of data available from satellites. The land cover change detection has often been performed by comparing two or more satellite snapshot images acquired on different time period. The image comparison techniques have a number of limitations. The traditional Convolution Neural Network (CNN) method has several problems, such as the weak generalization ability of the model and the difficulty of automating the construction of a training database. These methods generally have high land mapping accuracy but they are time-consuming, laborious, poor repeatability. When compared to the previous models such as U net, we will get more accuracy and also time consumption is minimum, by using this proposed approach. In this paper we will be Siamese so it is named as M-Siamese. To overcome the problem, we had used Siamese network in M-Siamese. The Siamese network is improved Accuracy and Enhanced Flexibility. In this paper we are using M-Siamese network which is effective than the previous Siamese networks. By using this type we will acquire more accuracy than that of previous networks. Finally, we had concluded the change of land cover in percentage.

Keywords: Land Cover Change detection; Convolution Neural Network (CNN); M-Siamese; U net.

I. INTRODUCTION

Land cover (LC) is characterized as the highlights that are available on the world's surface. Land use alludes to the human prompted changes for horticultural, modern, private, or recreational purposes. Land cover changes refer to conversion and modification of vegetation, changes in biodiversity, soil quality, runoff, erosion, and sedimentation and land productivity.

Land cover changes allude to the transformation and alteration of vegetation, changes in biodiversity, soil quality, overflow, disintegration, and sedimentation, and land efficiency. Land use has been changing since the time people initially started to deal with their condition. In any case, the changes that have occurred in the course of the most recent 50 years have been particularly significant and extraordinary as society is getting progressively urbanized, while regular biological systems become disintegrated. LULC changes are driven by the collaboration of natural, topographical, financial, and social factors during the time spent scene improvement the connection among biophysical and human measurements in existence is the principal driver of Land use change. The potential effects of land use/cover change on condition have propelled specialists to direct research so as to comprehend fundamental drivers and impacts of land-use change. Land use exercises in the case of changing over regular scenes for human use or changing administration rehearses on human overwhelmed lands have changed an enormous extent of the Earth's land surface. Because of freeing from tropical backwoods, rehearsing means agribusiness, expanding farmland creation, and extending urban focuses, the world's landscape is changing in unpreventable manners through human activities. In spite of the fact that land-use rehearses shift incredibly over the world, their ultimate result is commonly the equivalent, the accomplishment of normal assets for sure-fire human needs, regularly to the detriment of debasing ecological conditions. Land-use changes wipe out species locally and decrease normal living spaces and biological system working, influencing along these lines, biodiversity, and arrangement administrations of environment. Worldwide biodiversity is changing at an uncommon rate as a perplexing reaction to a few human-actuated changes in the worldwide condition and LULC. Land use land cover (LULC) changes are the significant wellsprings of natural surroundings misfortune, biological system adjustments, and biodiversity changes in timberland commanded landscapes. Natural surroundings misfortune because of change in LULC elements is normally viewed as one of the most significant variables causing the worldwide biodiversity emergency. Land-use (LCLU) change investigations and projection gives a device to evaluate biological system change and its ecological ramifications at different fleeting and spatial scale. Land use and Land cover (LULC) information gives useful data with respect to formative, ecological, and asset arranging applications at provincial just as a worldwide scale. LULC elements are investigated through changes in the condition of an article or marvel by watching it on various occasions. Precise and opportune detection of change in normal assets gives the essential comprehension of the connections and collaborations among human and characteristic wonders. Satellite Remote Sensing information, which is a useful wellspring of data and gives convenient and complete coverage of a particular territory, have demonstrated useful in evaluating the regular assets and observing the land use or land cover changes.

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The ghastly reaction of vegetation files will identify changes in pixel-level vegetation conditions. Land use/Land cover (LU/LC) is a significant part of understanding the connections of the human exercises with nature and consequently it is important to screen and identify the changes in LU/LC to keep up a practical domain.

Landsat-8:

Launched on February 11, 2013, Landsat 8 (formerly the Landsat Data Continuity Mission, LDCM) is the most recently launched Landsat satellite. It is gathering important information and symbolism utilized in horticulture, instruction, business, science, and government. It's gives tedious securing of high goals multispectral information of the Earth's surface on a worldwide premise.

M-Siamese Network:

This paper is aimed to propose M Siamese network. In Siamese Network we have two input images of different ones having same weight each. By applying Siamese network to these input images will get the difference between the images.

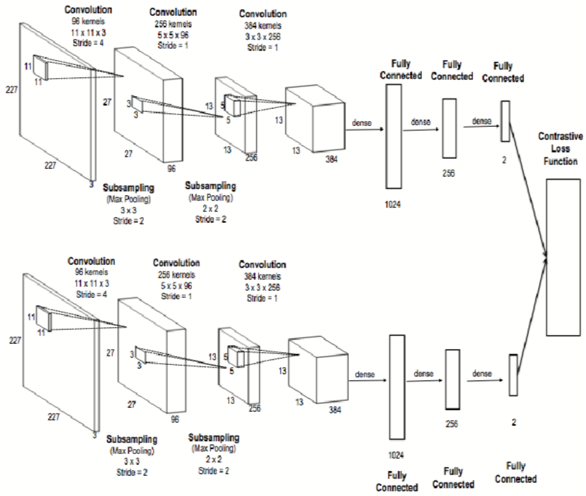

Fig. 1 M-SIAMESE Architecture [6]

In M-Siamese network we had chosen three layers such as Convolution layer, maxpooling and softmax. In previous paper there is no maxpooling layer. By introducing the maxpooling layer in this network we get more accuracy than the previously used network. This network is called M-Siamese network. The following diagram is the pictorial representation of layers used in this process fort change detection.

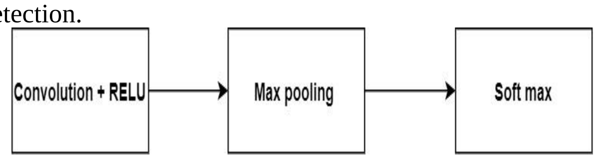

Fig. 2: Representation of Network Layers

In Convolution layer we will rectified linear to it and values will be zero and flattering is done. In max pooling we will apply data set filters. In soft max the output is derived. The above shown layers is done by step by step continuous process. Even the missing layers in the process are regained back to the process. By using this type of process we will accuracy of the image more than compared to that of the previous models.

II. RELATED WORK

Land-use (LU) represents the human use of the natural environment for economic, urban, recreational, conservational and governmental purposes [1]. Land-cover (LC) represents how a region of the earth surface is covered by physical features such as vegetation, water, forest or other. In modern history, the worldwide growth of population has brought significant challenges to society and the environment, such as the increasing demand for housings, food, natural resources and basic services. These have resulted in land-use and land-cover (LULC) changes that have caused adverse effects on the natural environments [2][5]. The need for efficient land-use planning and management is increasing, not only to eliminate the negative effects of historical LU decisions but also to make future communities healthier and more sustainable [4]. Therefore, there is a need for more advanced computational methods to analyse geospatial data from the Earth's surface to quantify and better understand the complex dynamics of LULC change processes.

Remote sensing (RS) datasets provide significant information documenting the land-use and land-cover processes. RS datasets provide coverage's from regional to global scales. Interpretation of RS datasets is a major way to understand the status and changes in both the natural and built environments. In recent decades, RS sensors and techniques have become increasingly sophisticated[1]. They can provide a large volume of datasets with high quality and fine spatial resolution. Deep learning reignited the pursuit of artificial intelligence towards a general purpose machine to be able to perform any human-related tasks in an automated fashion. This is largely driven by the wave of excitement in deep machine learning to model the high-level abstractions through hierarchical feature representations without human-designed features or rules, which demonstrates great potential in identifying and characterizing LC and LU patterns from VFSR imagery. In this thesis, a set of novel deep learning methods are developed for LC and LU image classification based on the deep convolutional neural networks (CNN) as an example. Several difficulties, however, are encountered when trying to apply the standard pixel-wise CNN for LC and LU classification using VFSR images, including geometric distortions, boundary uncertainties and huge computational redundancy [3]. These technical challenges for LC classification were solved either using rule-based decision fusion or through uncertainty modelling using rough set theory. For land use, an object-based CNN method was proposed, in which each segmented object (a group of homogeneous pixels) was sampled and predicted by CNN with both within-object and between-object information. LU was, thus, classified with high accuracy and efficiency [2]. Both LC and LU formulate a hierarchical ontology at the same geographical space, and such representations are modelled by their joint distribution, in which LC and LU are classified simultaneously through iteration. These developed deep learning techniques achieved by far the highest classification accuracy for both LC and LU, up to around 90% accuracy, about 5% higher than the existing deep learning methods, and 10% greater than traditional pixel-based and object-based approaches.

This research made a significant contribution in LC and LU classification through deep learning based innovations, and has great potential utility in a wide range of geospatial applications [6]. With the development of remote sensing technology, every day, massive amounts of remotely sensed data are produced from a rich number of space borne and airborne sensors; e.g., the LANDSAT 8 satellite is capable of imaging the entire Earth every 16 days in an eight-day offset from Landsat 7. For the Sentinel-2 mission alone, to date, about 3.4 petabytes of data have been acquired. Triggered by these exciting existing and future observation capabilities, methodological research for multitemporal data analysis is of great importance. Change detection is very crucial in the field of multitemporal image analysis, as it is able to identify land use or land cover differences in the same geographical area across a period of time and can be used in a diversity of applications.

III. METHODOLOGY

In our proposed system, firstly, the dataset: UCMerced land use is being collected and pre-processing technique are applied to the respective data set. The results that are obtained from pre-processing technique, the model is trained using Siamese network in M-Siamese. Then from the same trained model we have to do change detection. The detected change is shown. After the change detection it will be shown in the form of percentage. For change detection images are taken from the LANDSAT 8. Finally, change detection is to be done. The output image accuracy will be more than that of previous U net model. This process is also very fast than compared to the previous models.

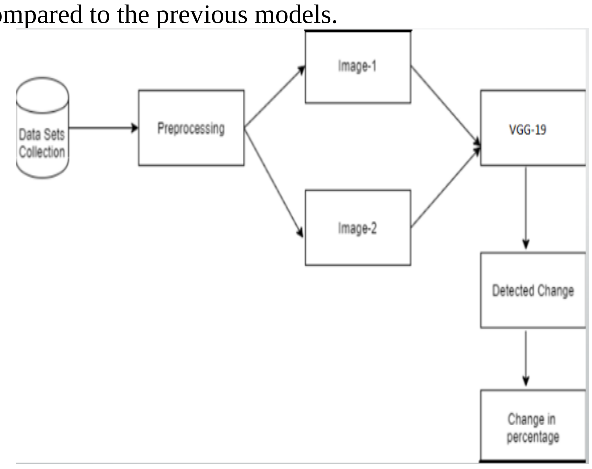

Fig 3: Methodology

IV. DATASETS

For this experiment we have taken data sets from the United States Geological Survey. To detect the change we have to compare the images. The following images are the one we have taken to detect the change. For notifying the change there must be certain time gap between the images taken. In this paper the time period difference between the Image 1 and Image 2 is nearly 5 years. By taking the old and new image from the satellite only we are capable to detect the change. The following are the two images that are taken for the change detection.

Image 1

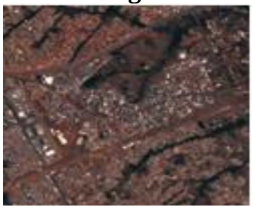

Image 2

Fig. 4: Images taken for change detection

V. EXPERIMENTS:

Here we present the result of our experiment, in which we taken sample satellite images to detect the change in them. As already mentioned that satellite image are taken from Earth Explorer. From that the Data sets are collected from USGS (United States Geological Survey). From those data sets the images are taken in the ratio 255:255 format. Satellite images that taken for change detection are as shown in Fig. 5

Fig. 5: Images taken for change detection.

After inculcating those images in the program which we developed to detect change, then the both images will be adhere to the trained model which we had saved by training them with the dataset and teaches them how the change is recognized by providing the Group Truth dataset images to them. Then we gets the output which we are in need of. The output contains of two colors i.e., white and black, in which black color represent the area which is not changed with the time which images are taken. Similarly, white color represents the land area which is changed in the image.From the above image with compared to the image that is our output from program as shown in Fig.6.

Percentage change:16.072591145833332

Fig. 6: Detection of change.

The above is the percentage of change detected from the above output image. This number depicts the numerical value for the change detected for the given input.

Network	Accuracy
U-net Model	46%
Siamese Network	50%
M-Siamese	57%

Table 1: Comparative analysis between

The above table shows the percentage of accuracy derived from the networks. By using M-Siamese network we had output accuracy than that of previous networks. From the results and discussions above, the trends and changes of land use and land cover we are taken the sample satellite images.

VI. CONCLUSION

Land cover classification and change detection is very important during planning and development of any nation. In our algorithm i.e., M-Siamese it had performed training with dataset which had provided. Output, which we get from implementation by using M Siamese network consist of Image and Percentage. Image is black & white picture in which white indicates the change that taken place. And percentage is the proportion of white spot in output. The work done on this paper would be to evaluate the change detection and also the percentage of the change. This type of networks will be easy to classify the change and also to depict the change percentage.

REFERENCES

1. Salman H. Khan, Xuming He, FatihPorikli, and Mohammed Bennamoun "Forest Change Detection in Incomplete Satellite Images with Deep Neural Networks", 2018.pg:1-17.
2. Tejaswini. M1, Pranuthi.P2 Ravichand.S3, Anuradha. T4, "Land Cover Change Detection Using Convolution Neural Network", 2019.pg 791-794.
3. OumaymaBounouh, HoucineEssid, ImedRiadh Farah in RIADI Laboratory" Prediction of Land Use/Land Cover Change methods",2017,pg:1-7.
4. Christopher D. Storie1, Christopher J Henry2" DEEP LEARNING NEURAL NETWORKS FOR LAND USE LAND COVER MAPPING", 2018, pg: 3445-3448.
5. Lichao Mou1, 2, Xiao Xiang Zhu1, 2," A Recurrent Convolutional Neural Network for Land Cover Change Detection in Multispectral Images", 2018, pg.4363-4366.
6. WHIZ.AI, 28-01-2019 "Siamese Neural Network (With Pytorch Code Example) [ONLINE]. Available:https://innovationincubator.com/siamese-neural-network-with-pytorch-code-example/ [Accessed on 12-03-2020]
7. Shawm D Storiel, "Landuse Dataset," ucmerge.edu, 10-10-2010. [ONLINE]. Available: http://weegee.vision.ucmerced.edu/datasets/landuse.html [Accessed on 12-03-2020].
8. US govt. "Earth Ecplorer USGS Govt.," 21-05-2014. [ONLINE]. Available:https://earthexplorer.usgs.gov, [Accessed on 12-03-2020].

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