

A Survey on Change Detection in High Dimensional Image

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Abstract— The dynamic dissimilarities occurring in the multi dimensional data's attracts many of the researchers concentration which leads to the required concerns to be taken on that fields. Change detection in images are defined as an occurrences of dissimilarities based on its behavior in an periodic time interval. There are many of the application are present for change detection in the areas like sensing urban areas, machine vision, compression/ decompression of data's, military reconnaissance, etc. which makes it to an demanding research area. However detecting changes in the image processing is an critical process which needs to be concentrated more. Various applications like differentiating data's, PCA, object oriented methods, graphical analysis, etc. have been deployed successfully. However these techniques cannot act well on the high dimensional data's like images. These existing approaches cannot find an minor changes occurs in the data's accurately. The new method has to be proposed and deployed in order to support the high dimensional data effectively and as well as it has to detect the minor changes also. This paper analysis the various existing approaches for detecting changes in the images and explores a new suitable method for an effective change detection process.

Keywords—change detection; supervised learning; unsupervised learning ; hopfield neural network ;

I. INTRODUCTION

Identification of changes in the images makes an important consideration in the many of the research areas health monitoring applications, development areas, geo change monitoring applications and military fields etc., [1] [2]. In olden days these change detections are done manually whereas in today world it will be very difficult to do manually due to increase in the amount of data's [3]. Therefore, the automated methods has to explored in order to reduce the burden of users and increase the accuracy of change detection. The new technologies need to incorporated with the change detection applications in order to support the high resolution images [4]. This research discusses about the various techniques that are already explored for change detection in the high dimensional data's. These research shows views of different authors in the change detection application in which some of the applications produce the better results while some of them affects the results. There are two types of approaches are present for change detection in the images. Those are supervised and unsupervised approaches. .

A. UnSupervised approach

The images with native tetra com file only will be considered by the unsupervised approach. It will first do preprocessing on the multi spectral images which will eliminate the redundant/irrelevant features and improve the image quality based on the pixels and features of an images. The resultant image after the preprocessing technique will be used for the change detection. Some of the examples of unsupervised approaches are change vector analysis (CVA), image rationing, expectation maximization, etc.

B. Supervised approach

The supervised approaches will do any process based on the learning results. Before doing any processes on image data's it wil first do learning process by using the training data's. By learning before any processing on images, it will be very easy find out the changes occurs in the images[5]. The supervised approaches will be better than the unsupervised approaches due to its robustness property. And also the supervised approaches can process any images from multiple type of sources. However, the supervised learning approach will be very difficult, if the suitable training sets are not present [3] [4] [6].

These traditional techniques cannot be applied on the higher complex systems which requires to have an some newly improved technologies. Thus the new technologies have to be implemented in order to produce the better accurate results as like in the traditional approaches on low dimensional data's.

In this research work, the various existing works that are developed to support the change detection are discussed. As there are many of the approaches are available, this paper mainly intends to find out the advantages and disadvantages present in the existing change detection approaches. By discussing the pros and cons of the existing approaches, the effective way for detecting the changes in the images can be found. There are many of the research papers are available discussing on these issues, even it becomes more important to analyze again due to the invention and arrival of types of images and its complexities. This work aims to find out a new way for detect changes in the high dimensional data's with better results which will eliminates the drawbacks occurred in the all existing approaches.

II. CHANGE DETECTION

Generally change detection is defines as the process of finding the varying changes of particular feature over the image in particular interval time. The main focus change detection approach is to give an information about the deviation information and the spatial distribution properties like category of change and number of changes occurred in the image [7]. There are many fields present in the today's world which make use of the change detection approach. The fields which needs an change detection approaches essentially are medical field, military field, geographical change identification, disease identification, environmental issue discovering etc., [8].

Technically change detection algorithm is defined as the processing of more input image sequence $\{IM1, IM2, \dots, IMn\}$ where n is a number of images and produces an output image.

$$D(i) = \begin{cases} 1, & \text{if } i\text{th pixel is changed in } IMn \\ 0, & \text{otherwise} \end{cases}$$

The more number of changes occurs in the image also makes it difficult to explore an better technique. The features that may affect the results are normalization, approaches used, etc., Change detection algorithms must satisfy the following criteria in order to produce an accurate results.

- **Generality:** The changes occurs in the data's will be different from one source of application to other source of applications. The type change occurs must be identified clearly first to decide an better approach.
- **Scalability:** The approach decided for change detection should not limit the amount data's that can be processed. It should be scalable in every environmental factors. And also the decided approach can be capable of processing any type of data's like multi dimensional data's.

Statistical soundness: Some of the applications may be undergrounded to the significant changes due to its capabilities. The significant changes occurs in the images need to be identified in order to choose the better approach

A general approach that are used for detecting changes are distribution of data. This can be done by comparing the linear regression models with the interactions among the data distributions. The traditional approaches can find the changes effectively when it is distributed in the specific locations. Parameter estimation is one of the most deploys approach which is used to identify the estimations of distributions.

III. STATISTICAL REQUIREMENT OF CHANGE DETECTION

Most traditional method to find out the changes are having two sliding windows over the distributed high dimensional data's. By introducing the sliding windows over the data's, we can avoid the task of finding the data origin's. That is instead of concentrating on whether the data is from same or different distributions, we can just detect the changes occurred on those data's.

For example consider the scenario of finding out whether the two high dimensional data's are from the same group or an different groups. To do this consider two high dimensional data's from different media samples. To find out the changes occurred over those data's we need to find out whether the data's are from the dame distribution or different distributions. The needed requirements for finding out this changes are as follows

- First requirement is to provide the two way guarantee, first guarantee is to assure the proposed mechanism can find out the changes with high probability (i.e., less false negatives)
- Second requirement is to have an notification only at the time of change detection. It needs to avoid the unnecessary notification at the time of no changes. (i.e., less false positive)

The general meta algorithm for change detection are given as follows:

1. for $i = 1 \dots k$ do
 - a. $c_0 \leftarrow 0$
 - b. $Window_{1,i} \leftarrow$ first $m_{1,i}$ points from time c_0
 - c. $Window_{2,i}$ next $m_{2,i}$ points in stream
2. end for
3. while not at end of stream do
 - a. for $i = 1 \dots k$ do
 - i. Slide $Window_{2,i}$ by 1 point
 - ii. if $d(Window_{1,i}, Window_{2,i}) > \alpha_i$ then
 1. c_0 current time
 2. Report change at time c_0
 3. Clear all windows and GOTO step 1
 - iii. end if
 - b. end for
4. end while

The meta algorithm reduces the problem from the streaming data scenario to the problem of comparing two (static) sample sets.

IV. METHODS FOR CHANGE DETECTION

There are many of the approaches are present in the today's world for detecting the changes occurred in the high dimensional data's. In olden days only conventional images are used which can be evaluated into change detection progress easily. However nowadays, due to the improvement in the technologies, need to invent the new technologies which can adapt to the high dimensional data whereas the conventional approaches cannot support the high dimensional data's. Some of the approaches available for changes detection in high dimensional data is explored in the sub topics below.

A. Remote Sensed Data

Remote sensed data's are the one which will have low quality in its pixels and as well as these data's will conserve the information likes spatial, and geo co-ordinates. These kind of data can be processed well by using the multi spectral change detection approaches

B. Threshold selection Mechanism

This mechanism is based on the threshold values. The changes occurred in the high dimensional data's are find out if it violates the threshold limitation fixed. By using this mechanism, the image regression, change detection, differentiation of images can be done. But it will be failed to detect the changes occurred in the program, if the threshold value fixed is not well good

C. Learning Mechanism

This mechanism is based on the training data's which is used to produce an more accurate results than the previous approaches. This mechanism will learn first by training the some set high dimensional data in which changes occurred already. With the help of knowledge gained from the trained data's, it will test the high dimensional data's by comparing it with the trained data's. But its necessary to select the good quality data for training, then only it can produce the better result.

D. Extracting Information

In this mechanism, the reflectance of images will be converted into the physical parameter values in order to the compare it with the original feature values. By doing this so, the changes occurred in the images can be find out efficiently. But this kind of approaches are very difficult to do and also high time consuming process.

E. Digitization

In this kind of approaches visualization will be done to identify the changes occurred in the high dimensional data's. This visualization will be done only by experts in the particular area of research. By using this visualization approach changes occurs in the size, shape and texture only can be find out.

F. 3-D image change detection

Its necessary to have an advanced technologies in order to find out the changes occurs in the 3-D images. Nowadays the 3-D images are increased in usage due to the dynamic nature of cities. Its required to capture the high quality images in the 3D motion in order to better view the modern cities. As the number of increasing in the 3D images, the change detection approach should be very flexible and should detect the changes accurately and appropriately.

V. HYPERSPECTRAL IMAGES

Hyper spectral imaging is the process of finding objects, identifying materials and detecting processes by using the information collected from the electromagnetic spectrum. It will identify the material s by using each and every pixel present in the images. The change detection process in the hyper spectral images are very difficult to do due to its complex nature. The above mentioned approaches are not well enough to detect the changes occurred in the images. The advanced approach which is based on the learning process need to be developed in order to detect the changes occurred in the hyper spectral images in the accurate manner.

From the analysis made above with the reference of various existing approaches, there is no effective mechanism are available for detecting the changes occurred in the hyper spectral images. The learning mechanism need to be developed in order to detect the changes accurately. The Hopfield neural network can be the effective mechanism to find out the changes occurred in the high dimensional data's.

In the Hopfield neural network, leaning is done by modeling spatial correlation between different images based on its neighboring pixels. In this approach, neuron is represented as connectivity between pixels from the different images. After representing the neurons, the weights will be assigned to the each and every neuron based on the spatial correlation. This is done with the help of trained data sets. In this approach, the information about the network status will be defined as the energy functions. A threshold based approach can be combined with the Hopfield neural network approach in which, the threshold value can be used to classify the pixels into the changes and unchanged pixels.

VI. CONCLUSION

In this paper, the various conventional and advanced techniques that have been explored and analyzed for change detection in images. Choosing the appropriate approach for any kind of task will be very difficult due to the nature of varying changes in the environmental conditions. The better selection of the appropriate approach for supporting any kind of changes occurred in the high dimensional data are need to be explored. By studying and analyzing the various technologies used for detecting the changes occurred in the high dimensional data's, finally concluded that the hop field neural network approach will be very efficient to find out the changes. Hopfield neural network is the one which can be dealt with the detection of continuous changes and as well it can adapt to the any kind of changes. By combining the hop field neural network with the threshold approach, the better classification of changed and unchanged detection can be done.

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