A Framework for Change Detection in Social Community *

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ABSTRACT

From ancient time, the damages or the destructions to the countries caused by the natural disasters were the major issues. Recently, through the improvement of image change detection technologies, social media and the high-resolution images, the damages caused by natural disasters can be analysed in more details to identify the situations in the cities or towns. Many researchers approached to analyse the damage by using the aerial images and the satellites images, but these images are often published to the public after the things settle down. However, when the disasters happen, people want the information of disasters as soon as possible. This research proposes to investigate how the social media images and the image change detection techniques can be used to identify the damages caused by the natural disasters. We propose a framework that takes advantages of fast clustering and image near duplicate identification for the change detection in disasters.

Keywords

Change detection; social image

1. INTRODUCTION

Before, during and after the natural disasters, information about the damages and the current situations are vital for people to make decisions for their next actions. For example, the Nepal earthquake in 2015 did a huge damage to everything, including buildings, roads, infrastructure, and people, which resulted in 8,019 people died and 17,866 people injured; in a Tokyo earthquake, people are still able to walk back home since the earthquake damage the infrastructure, but not the buildings and paths. A recent study [4] found that people would like to know earthquake size and epicentre. Moreover, knowing these information could prevent the secondary and tertiary disasters. It is also found that in Tokyo, only 67.8% of people managed to get back their house on the day of an earthquake, and the rest 32.2% had to become "*homeless*", among them 2% failed to going back home only because they could not find the safe path. People want the information about earthquakes, but there is always the question "How should the people get the information of earthquakes?".

Recently, there are lots of researchers had approached to detect the damages caused by the natural disasters by using the change detection techniques with the aerial images. However, the aerial images consume longer times retrieve and harder to get compare to the other images. On the other hand, social media is pervasive, and updates very quickly especially on large events, e.g. natural disasters, by millions of people all the time. Thus, we investigate the problem of change detection from social media images, so as to let the public aware of the latest situations of natural disasters on the spot. One of the challenges here is the large-scale of the social media images, which makes current change detection techniques infeasible if not impossible. One of the limitation of using the large-scale images with current change detection techniques is the time cost. As existing techniques detect changes without index support or query optimization, the time cost for image comparison is high. When applying them to large scale social images, the efficiency issue becomes even unacceptable. Another challenge is the unavailability of some special features, like building shady, used in traditional change detection approaches [3]. In sharing communities, most of social images donot have shady, thus the shady-based matching can not be conducted. Forcing the existing techniques on the social images will cause low detection quality. Finally, traditional change detection over arial images suppose the image pairs to the same location points are known, which is not true in media sharing communities.

To address these issues, we propose a framework for change detections in sharing communities. The framework includes three important parts: (1) concept-level clustering; (2) image-level copy identification; and (3) object-level change detection. The first two parts effectively and efficiently finding the images referring to the same objects, while the last part assesses if a particular object has been damaged or not during natural disasters. We have analyzed the strong points of our proposed framework.

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The rest of the paper is structured as follows: Section 2 presents the framework proposed in this study; Section 3 concludes the paper.

2. THE ARCHITECTURE

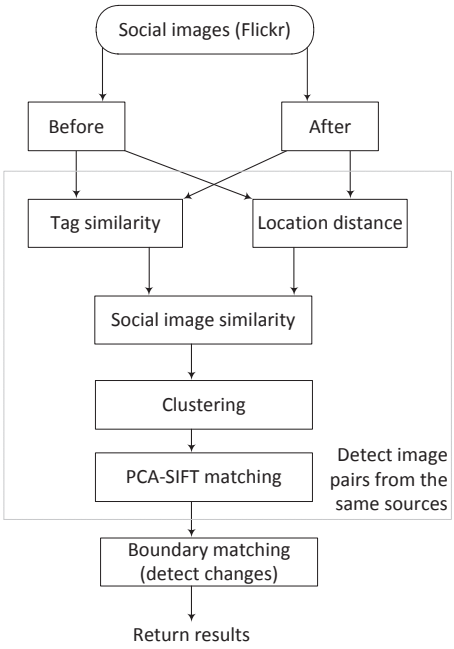

Figure 1: Framework of our change detection

In this section, we first define two terms, *change* and *change detection*, and then present the overview of the change detection framework for social images.

Definition 1. In image processing, *change* is defined as the difference between two pixels or the objects in different images. The *difference* varies in different situations. In this paper, the *difference* is limited to the damages to the roads, the buildings or the infrastructures, which are caused by natural disasters. For instance, when a bridge breaks down during an earthquake, the damage to the bridge will be the *change* in this situation.

Definition 2. Change detection is a process of finding the damages which have been caused by certain natural disasters such as earthquake and flood.

Figure 1 shows the architecture of our change detection system, which includes the following two components: (1) detect image pairs from same sources; and (2) detect changes from image pairs.

- **Detect relevant image pairs:** The proposed change detection framework accepts a set of keywords as input, which are used to retrieve images from the social media community (e.g. Flickr). While the images are retrieving, the images are separated into the before and the after natural disasters. The information about retrieved images include the photo ID, tags, and location features. Firstly, we model them to numeric data, then deploy two metrics, the Jaccard-based tag set similarity and the $GreatCircleDistance$, to measure the similarity between tags and that between locations respectively. Finally we fuse these two similarities to obtain the final similarity between two social images, which is terms *Social Image Similarity* here. Then, the recursive 2 means algorithm [2] is applied to cluster similar images into groups, which significantly reduce the complexity of the problem of change detection based on large-scale social images. After the similar images are grouped together, a OOS(One to One Symmetric matching) with a cosine distance based partial similarity matching over PCA-SIFT descriptors of image pairs is applied here to find the similarities between the before and the after images. OOS has been applied to near duplicate video detection, and approved the high effectiveness of detection [5, 6]. The image pairs with high similarity are detected and used for the next step change detection.

- **Detect changes:** For each relevant image pair, we extract the object boundaries of each image, and conduct shape-based matching [1]. If the objects from two images are not matched, a damage has been identified. Otherwise, no damage has happened to the objects contained in the image pair.

With the support of our framework, the comparison between local image descriptors is only performed over the pairs in the same cluster or neighboring ones, which greatly reduces the time cost of relevant image identification. In addition, we can decide which pairs should be considered for the final change assessment.

3. CONCLUSION

In this paper, we have presented a framework for change detection over social communities by exploiting image analysis techniques. This is the first effort for detecting changes from social images. In the future, we will study new techniques on social media data modelling, indexing and query processing for effective and efficient change detection over social images.

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