University of Victoria | Graduate Studies

Notice of the Final Oral Examination
for the Degree of Doctor of Philosophy

of

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MSc (King Abdul Aziz University, 2007)
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"Computer Vision-Based Detection of Abnormal Events in Videos Acquired with Handheld Devices"

Department of Computer Science

Friday, June 3, 2016
11:00 A.M.
Engineering Computer Science Building
Room 660

Supervisory Committee:
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Dr. Kui Wu, Department of Computer Science, UVic (Co-Supervisor)
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Dr. Michael McGuire, Department of Electrical and Computer Engineering, UVic

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Abstract

Advances in social networks and multimedia technologies greatly facilitate the recording and sharing of video data on violent social and/or political events via Internet. These video data are a rich source of information in terms of identifying the individuals responsible for damaging public and private property through violent behavior. Any abnormal, violent individual behavior could trigger a cascade of undesirable events, such as vandalism and damage to stores and public facilities. When such incidents occur, investigators usually need to analyze thousands of hours of videos recorded using handheld devices in order to identify suspects. The exhaustive manual investigation of these video data is highly time and resource-consuming. Automated detection techniques of abnormal events and actions based on computer vision would offer a more efficient solution to this problem.

The first contribution described in this thesis consists of a novel method for fire detection in riot videos acquired with handheld cameras and smart-phones. This is a typical example of computer vision in the wild, where we have no control over the data acquisition process, and where the quality of the video data varies considerably. The proposed spatial model is based on the Mixtures of Gaussians model and exploits color adjacency in the visible spectrum of incandescence. The experimental results demonstrate that using this spatial model in concert with motion cues leads to highly accurate results for fire detection in noisy, complex scenes of rioting crowds.

The second contribution consists in a method for detecting abnormal, violent actions that are performed by individual subjects and witnessed by passive crowds. The problem of abnormal individual behavior, such as a fight, witnessed by passive bystanders gathered into a crowd has not been studied before. We show that the presence of a passive, standing crowd is an important indicator that an abnormal action might occur. Thus, detecting the standing crowd improves the performance of detecting the abnormal action. The proposed method performs crowd detection first,

followed by the detection of abnormal motion events. Our main theoretical contribution consists in linking crowd detection to abnormal, violent actions, as well as in defining novel sets of features that characterize static crowds and abnormal individual actions in both spatial and spatio-temporal domains. Experimental results are computed on a custom dataset, the Vancouver Riot Dataset, that we generated using amateur video footage acquired with handheld devices and uploaded on public social network sites. Our approach achieves good precision and recall values, which validates our system's reliability of localizing the crowds and the abnormal actions.

To summarize, this thesis focuses on the detection of two types of abnormal events occurring in violent street movements. The data are gathered by passive participants to these movements using handheld devices. Although our data sets are drawn from one single social movement (the Vancouver 2011 Stanley cup riot) we are confident that our approaches would generalize well and would be helpful to forensic activities performed in the context of other similar violent occasions.