CROWD DETECTION FROM AERIAL IMAGES

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Dedicated, in thankful appreciation for support and encouragement to
my beloved husband Azizal bin Adnan, my daughter Arissa El-Zahrah bt
Azizal, my mother, my grandmother,
families and friends.

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ABSTRACT

The detection of crowd from surveillance imagery is important to monitor public places and to ensure public safety. Hence, this work proposes crowd detection from static image captured from Unmanned Aerial Vehicle. The proposed methodology consists of three steps: FAST feature extraction, Gray Level Co-Occurrence Matrix (GLCM) feature computation and the use of Support Vector Machine (SVM) for classification. The use of FAST corner detector is to obtain regions of interest where possible existence of crowd. The application of GLCM is to extract second order statistical texture features for texture analysis. The result of GLCM then, will be classified to crowd and non-crowd using SVM. For evaluation, ten different images were used taken in various crowd formation, event and location. The accuracy of the proposed method is obtained and the classification results are shown visually.

ABSTRAK

Pengesanan orang ramai daripada imej pengawasan adalah penting untuk memantau tempat-tempat awam dan untuk memastikan keselamatan awam. Oleh itu, kerja ini mencadangkan pengesanan orang ramai daripada imej statik ditangkap dari Udara Tanpa Pemandu Kenderaan. Kaedah yang dicadangkan terdiri daripada tiga langkah: pengekstrakan ciri FAST, Gray Tahap Bersama Kejadian Matrix (GLCM) ciri pengiraan dan penggunaan Sokongan Mesin Vektor (SVM) untuk klasifikasi. Penggunaan FAST pengesan sudut adalah untuk mendapatkan kawasan-kawasan yang menarik di mana wujud kemungkinan orang ramai. Penggunaan GLCM adalah untuk mengeluarkan perintah kedua ciri tekstur statistik untuk analisis tekstur. Hasil GLCM kemudian, akan diklasifikasikan kepada orang ramai dan bukan orang ramai dengan menggunakan SVM. Untuk penilaian, sepuluh gambar yang berbeza telah diambil yang digunakan dalam pelbagai pembentukan orang ramai, majlis dan lokasi. Ketepatan kaedah yang dicadangkan diperolehi dan keputusan klasifikasi ditunjukkan secara visual.

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LIST OF ABBREVIATIONS

FAST	-	Features from Accelerated Segment Test
GLCM	-	Gray-level co-occurrence matrix
HWT	-	Haar wavelet transform
RGB	-	Red Green Blue
SIFT	-	Scale Invariant Features Transform
SVM	-	Support Vector Machine
UAV	-	Unmanned Aerial Vehicle

LIST OF SYMBOLS

p	-	pixel
t	-	threshold
σ	-	Bandwidth of Gaussian kernel
l	-	Mean of distance
I_p	-	Intensity
n	-	Set of contiguous pixels
i	-	Spatial coordinates - horizontal
j	-	Spatial coordinates – vertical
p_{ij}	-	The matrices
K	-	Gray tone

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Crowd has been defined as a large number of people gathered together in a disorganized or uncontrollable way (The Free Dictionary). A crowd may be described through a mutual purpose or set of reactions, such as at a sports event, political rally, or religious event, or simply be made up of many people going about their business in a busy area such as shopping mall and market. Frequently, these large gatherings of people occur without serious problems. Occasionally the combination of insufficient facilities and deficient crowd management results in disasters, injury and death.

Nowadays the crowd phenomenon has been more common due to the steady population growth along with the worldwide urbanization. Therefore it is not surprising if there are a lot of research disciplines and analysis has been made in this field. The crowd phenomenon could be applied in several applications such as crowd management, public space design, virtual environment as well as visual surveillance (Zhan et al., 2008). In order to avoid crowd related disasters and ensure the public safety, crowd analysis has been applied in developing management strategies especially for large and well-known events such as concerts and sport matches. Besides that, public space design applications practise crowd analysis to provide rules and procedures for public design. Furthermore, virtual environment application models crowd as mathematic model in virtual environment to enhance the simulation of crowd phenomena and this will lead to the improvement of human life experience and knowledge. Visual surveillance application uses crowd analysis for automatic detection of irregularities, anomalies, alarms as well as panics. As a result, this project will focus more to visual surveillance crowd analysis application since monitoring and detecting large crowds is an important topic in this field and it can provide information for decision making by the local security forces.

1.2 Background

Crowd detection has been studied since many years ago and had attracted many researchers. The initial works in this field, several researchers tried to solve crowd detection problem using street or indoor cameras which are known as close-range cameras (Davis et al., 1995), (Regazzoni & Tesei, 1994). By using these types of cameras, it is not possible to monitor and detect crowd at bigger events. However, nowadays a lot of work had been done using outdoor and moving camera such as airborne camera (Sirmacek & Reinartz, 2011), (Meynberg & Kuschk, 2013), aerial camera mounted on helicopters (Hinz, 2009) as well as satellite images (Sirmacek & Reinartz, 2011). Unmanned Aerial Vehicle (UAV) is an aircraft without human pilot on board. Image from UAV can be used to monitor bigger events.

Hence using a visible image from UAV can be an effective approach for monitoring, detecting and tracking crowds in large events. This thesis focuses on using visible image from UAV to detect and track crowd as well as develop algorithms which can work on image from UAV.

1.3 Problem Statement

The detection of crowd from image is very important to ensure safety of people. This information is very crucial especially for police departments and crisis management teams. There are several key challenges which are, limited resolution of images, occlusion, illumination changes, and any other obstacles that could influence detection process, as well as there are some difficulties in analysing crowd event.

From previous study (Meynberg & Kuschk, 2013), there are still ~10% misclassification between crowd and non-crowd due to poorly chosen parameters of global classifier. Hence, this project will emphasize on getting the optimum crowd detection from similar images used by previous studies.

1.4 Objectives

This following are the objectives of this study:

1) To detect crowd of people from visible image.

2) To use an aerial image sequence derived from moving platform such as UAV.

3) To achieve high detection rate of crowd from aerial images.

1.5 Research Scope

The research scope of this project is as follows. Firstly, this project is implemented using MATLAB for offline processing.

Secondly, this project utilizes images from UAV as input crowd images. In order to evaluate the effectiveness of the proposed method, images containing crowd during day time with good weather are considered. The images used in the project were obtained from the internet.

1.6 Thesis Organization

This study includes five chapters. Chapter two provides a comprehensive literature review on the methods on how to detect crowd based on previous studies. Finally, based on the literature review the problems are identified.

Chapter three proposes the methodology. In this chapter the methods and steps that are proposed in order to perform crowd detection are described. The methods consist of; Features from Accelerated Segment Test (FAST) feature extraction, further features extraction using Gray Level Co-occurrence Matrices (GLCM) and Support Vector Machine (SVM) to classify between crowd and non-crowd.

In chapter four the results of the crowd detection is provided. Discussions on the results of the project are also included in this chapter.

Last but not least, chapter five concludes this work. Some comments and suggestions for future improvements are provided in this chapter.

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