SUNAR
Surveillance Network Augmented by Retrieval

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Abstract. The paper deals with Surveillance Network Augmented by Retrieval (SUNAR) system – an information retrieval based wide area (video) surveillance system being developed as a free software at FIT, Brno University of Technology. It contains both standard and experimental techniques evaluated by NIST at the AVSS 2009 Multi-Camera Tracking Challenge and SUNAR performed comparably well.

In brief, SUNAR is composed of three basic modules – video processing, retrieval and the monitoring interface. Computer Vision Modules are based on the OpenCV Library for object tracking extended by feature extraction and network communication capability similar to MPEG-7. Information about objects and the area under surveillance is cleaned, integrated, indexed and stored in Video Retrieval Modules. They are based on the PostgreSQL database extended to be capable of similarity and spatio-temporal information retrieval, which is necessary for both non-overlapping surveillance camera system as well as information analysis and mining in a global context.

Keywords: SUNAR, wide area, surveillance, video analytics, retrieval, similarity, tracking, trajectory, integration.

1 Introduction

Nowadays, there is a lot of data produced by wide area surveillance networks. This data is a potential source of useful information both for on-line monitoring and crime scene investigation. Machine vision techniques have dramatically increased in quantity and quality over the past decade. However, the state of the art still doesn’t provide the satisfactory knowledge, except some simple problems such as people counting and left luggage or litter detection.

Justin Davenport in Evening Standard [6] showed statistics of crime-fighting CCTV cameras in Great Britain. The country’s more than 4.2 million CCTV cameras caught (in 2007) each British resident as many as 300 times each day. BBC News [1] informed that half a million pounds a year was spent on talking cameras helping to pick up litter. Yet 80% of crime is unsolved. Well, we agree that high quality crime investigation is the best prevention.

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The idea was to create an automated system for object visual detection, tracking and indexing that can reduce the burden of continuous concentration on monitoring and increase the effectiveness of information reuse by a security, police, emergency and firemen (or military) and to be useful in the accident investigation. The task is to perform the analysis of the video produced by a camera system with non-overlapping field of views. The analysis, based on cleaned, integrated, indexed and stored metadata, is of two types – on-line used for identity preservation in a wide area; and off-line to query the metadata of the camera records when an accident, crime, a natural or human disaster (war) occurs.

In 2006, we have started to develop an IR-based multi-camera tracking system to be at the top of the state of the art. We have taken part in several projects (CARETAKER [4]) and evaluations (TRECVid [19]) concerning similar problems. However, the AVSS 2009 Multi-Camera Tracking Challenge [20] was the first evaluation campaign that used the annotated Multiple-camera Tracking (MCT) Dataset from the Imagery Library for Intelligent Detection Systems (i-LIDS) provided by Home Office Scientific Development Branch (HOSDB) of the UK [16]. We have used the MCT video data and annotations to train and evaluate the SUNAR performance and it performed comparably well.

The paper is organized as follows. The introduction presents our motivation and ideas. An overview and design of the SUNAR system is described in the following section. Computer vision methods are described in section 3. Object identification, search and analysis techniques are described in section 4. The NIST performance evaluation of the SUNAR system is in section 5. State of the art is situated at the beginning of each section. The paper is concluded in section 6.

2 System Design

Although there are many multi-camera surveillance systems [10,11,12,13], we believe our approach outperforms the others, because those described in literature were not evaluated successfully [10,12], while those in praxis make many simplifying presumptions (e.g., traffic monitoring). Moreover, in there is no need for a central or primary module [7] or some special hardware such as camera sensors [13]. Moreover, it is able to derive various useful information concerning the entire area under surveillance.