Tracking Moving Objects on Video Analytics

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Abstract— Object tracking is the process of locating moving objects over time using camera. It has wide number of applications like security and surveillance, traffic control, video editing, medical imaging etc. It can be a time consuming process due to the large amount of data contained in video. The objective of tracking is to associate target objects in consecutive video frames. To initiate object tracking an algorithm analyzes video frames and outputs the movement of targets between the frames. There are a number of algorithms each having its own strengths and weakness. Considering the intended use is important when choosing the algorithm. Our aim in the Video Analytics (VA) project is to address obstacles in both image-retrieval and research that uses extreme-scale archives of video data that employs a human-machine hybrid process for analyzing moving images. This project proposes kalman filter based methods for object tracking, addressing two major issues such as places more interpretive power in the hands of the human user through novel visualizations of video data and uses a customized on-demand configuration that enables iterative queries. The purpose of this project was to demonstrate how a real time system for image registration and moving object detection can be used to track objects over frames of video. This project uses Open CV (Open Computer Vision) routines and visual c++ to implement the object tracking.

Keywords: Video Analytics (VA)

I. Introduction

Video surveillance systems integrate one or more layers of algorithmic analytics that mediate the flow of information between the operator(s) and the camera(s). This intermediate video processing, which may start at the camera but continue long after information has been recorded and stored, is referred to here as Video Analytics (VA).

The basic tracking task consists in estimating the trajectory of a moving object by consistently assigning a label over frames considering noisy measurements. Therefore, tracking can be considered as a filtering process that eliminates the noise from measurements to derive its motion. In this context, enhanced tracking algorithms have been investigated for many applications such as human computer interaction, automated surveillance, traffic monitoring, and automotive preventive safety. For example in, complex industrial surveillance systems are presented pointing out the paramount importance of reliable tracking accuracy to ensure acceptable performances in the monitoring task.

Visual tracking is one of the fundamental tools necessary in the development of video analytics applications. Some illustrative examples where visual tracking represents a fundamental step are presented the following:

1) Human identification by gait recognition.
2) Gaze recognition.
3) Object action recognition by subpart tracking
4) Monitoring scene for unauthorized access
5) Monitoring scene for suspicious activities
6) Monitoring for estimating traffic statistics
7) Traffic monitoring for speeding and law enforcement
8) Automatic person tracking using multiple cameras
9) Abandoned object detection
10) Crowd behavior analysis
11) Pedestrian counting.

Aim in the Video Analytics (VA) project is to address obstacles in both image-retrieval and research that uses extreme-scale archives of video data that employs a human-machine hybrid process for analyzing moving images.

II. Literature Survey

Recently, researchers focused on developing accurate trackers able to obtain a rich object description with the aim of accomplishing advanced scene interpretation tasks. This trend is driven by the growing interest in developing video analytics systems for helping and supporting humans in many assignments. To achieve this, a versatile, flexible, and expressive framework is required where the differences between algorithms can be easily understood. Additionally, coherent and consistent paradigms should be employed to obtain robust, reliable, and efficient algorithms. In this regard, the application of Bayesian filtering algorithms to PGMs (Probabilistic Graphical Models)[1][2] can provide useful tools for visual tracking.

PGMs are able to provide an appropriate theoretical framework where object dynamics and appearance can be combined and the motion estimation problem can be efficiently solved. As a matter of fact, PGMs can represent, learn, and compute complex probability distributions by explicitly defining statistical dependencies between the elements of the probability model. Then by combining graph theory and probability theory, PGMs aim to deal with the uncertainty in problem description and the complexity in computational implementation. These capabilities have been widely exploited in many domains as computer vision, pattern recognition, and signal processing. Moreover, several technical papers and special issues in major journals have been published.

In particular, in computer vision and video processing numerous algorithms have been developed based on different types of PGMs as Markov random fields (MRFs), hidden Markov models (HMMs), dynamic Bayesian networks (DBNs), Kalman filter, and so forth(figure 1) . The interest on these mathematical tools is motivated by the following three main reasons:

They enable to consistently formalize and handle the uncertainties affecting target visual observations.

They provide a statistical framework suitable to handle complex object representation.

They allow efficient solutions to complex problems to meet real-time requirements.

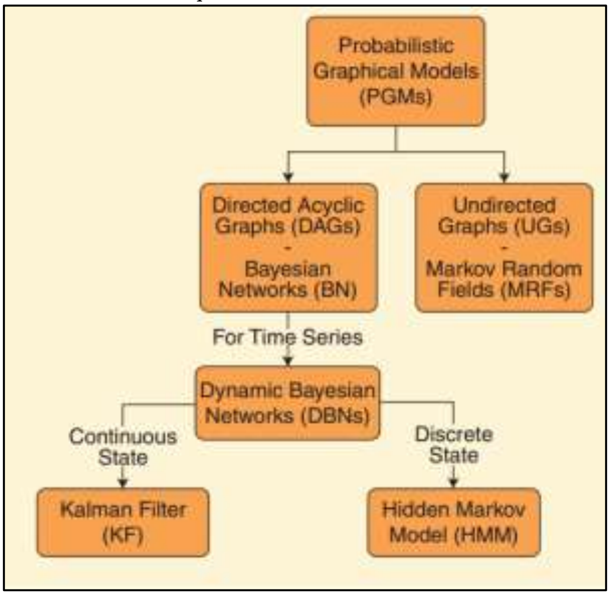


Fig. 1: Graphical model for video analytics tracking

A. Survey & Taxonomy of Video Analytics

1) Signal Processing

Signal processing is itself a robust engineering area of research that includes a range of strategies to analyze and improve the quality of an image or video. Signal processing also referred to as digital signal processing[3], is used to refer to a range of software and hardware systems that reduce signal noise, improve contrast and picture quality or improve data compression or transmission.

2) Object Recognition

Tracking an object between frames is compounded by the challenge of trying to 'recognize' dimensionally shifting shapes. Object recognition within images is a key part of real-time event detection and response. Research in this area is moving to object recognition on mobile devices to help with augmented reality applications.

3) HUMAN TRACKING

Object tracking and recognition [3] are only a few of the modules that contribute to Human tracking, a basic requirement for analyzing human behaviors in retail settings for example. When the object tracking and classification modules code an object or objects in the foreground as human or parts of a human, then other modules take over to perform such tasks as tracking the individual across frames, between cameras and record and analyze information like gender, age and even ethnicity in addition to other biometrics such as gait and physiological or behavioral based identification.

III. SYSTEM ANALYSIS

A. Existing system

CCTV systems are used for surveillance, security and protection of strategic installations such as airports, railway stations, power stations. They are also used for commercial buildings (offices, retail, warehouse and manufacturing facilities), housing (apartments, cottages) and transport infrastructure.

Many on the market today for surveillance use a tandem, which includes a video surveillance system as such and the operator.

If you use non-intelligent video surveillance systems with a large number of cameras installed, the chance to pay attention to emergency situations and at all tends to zero.

B. Proposed system

Video analytics (video analysis) as a way of solving problems Called video analytics technology, computer analysis of video data in order to obtain systematic information about the object of observation without intervention. Typically, video analytics software algorithms that can be run on computers and embedded in the camera.

Video analytics can efficiently solve problems such as detection of intrusion into the guarded area, counting, the recognition of violations of traffic, detection of human activities and many others. More complex tasks, which include such as face recognition, abandoned objects, detecting suspicious behavior.

IV. SYSTEM ARCHITECTURE

Embedded video analytics (video analysis system)(Fig 4.1) is called the software that recognizes streaming video directly into the camera or encoder in the system of surveillance. This increases the recognition accuracy by processing video at a higher resolution and higher frame rate.

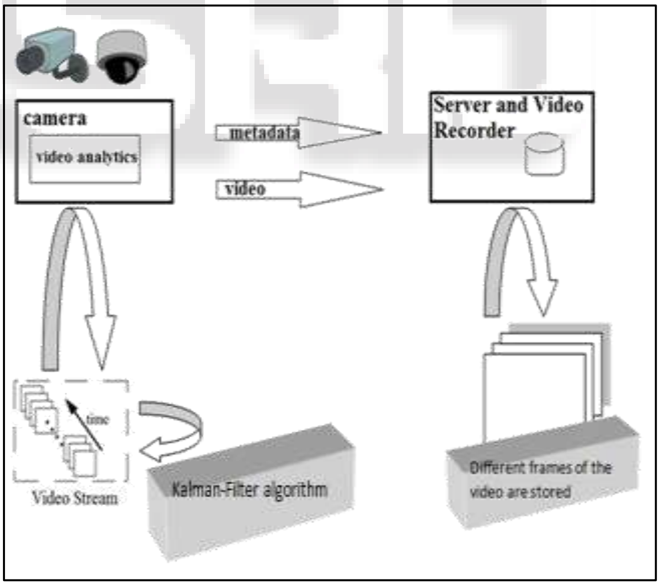


Fig. 2: The system architecture of the video analytics.

The result of video analytics algorithms is the flow of metadata, ie, structured description of what is happening in the surveillance zone. The metadata includes information about moving objects, their trajectory and speed signs for the automatic classification on the server, information about the video quality and damage the camera (the status of service detector).

Thus, the smart camera simultaneously transmits real-time media data (compressed video and audio) and metadata (the result of video analysis). Video analytic device (IP-camera or encoder) can work independently and to write to local memory or buffer transfer.

The disadvantages of embedded intelligence in comparison with the server are higher design complexity and less flexibility for a stand-alone device. However, despite the substantial capital costs, total cost of ownership system based on embedded intelligence is often lower than the cost of systems based on server-side analysts.

V. SYSTEM DESIGN

The DFD is also called as bubble chart. It is a simple graphical formalism that can be used to represent a system in terms of the input data to the system, various processing carried out on these data, and the output data is generated by the system.

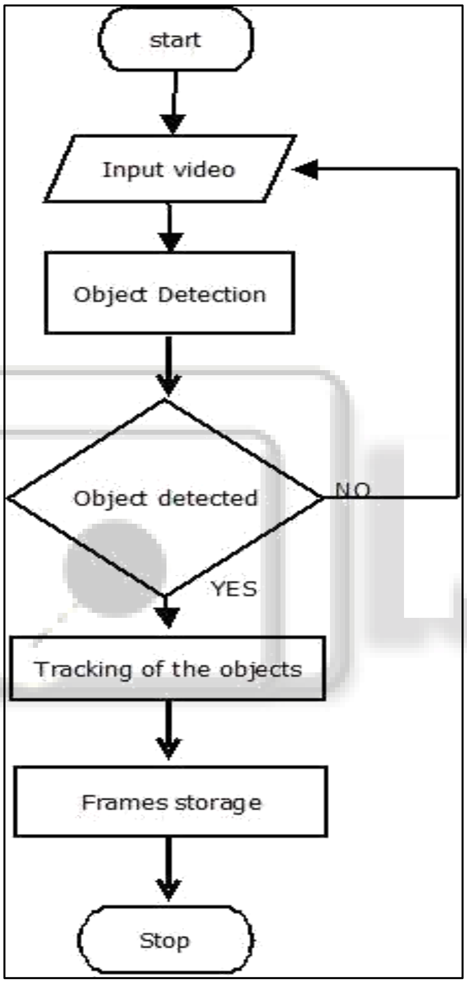


Fig. 3: Dataflow diagram

VI. RESULTS

A. *SNAPSHOT 1*

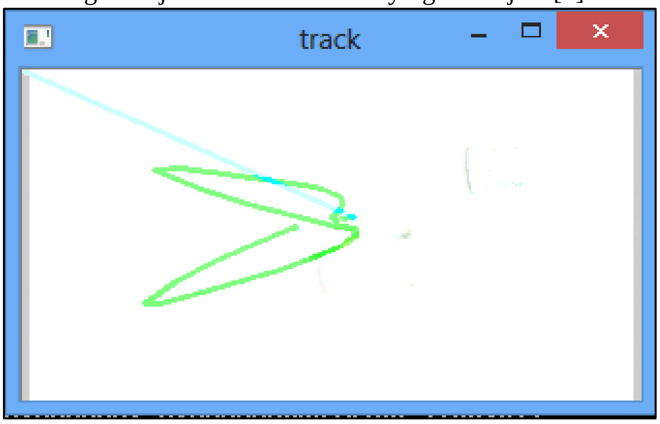
Capturing video from camera or from storage device [5].

B. *SNAPSHOT 2*

Object identification by using background subtraction method algorithm-Kalman-Filter algorithm [5].

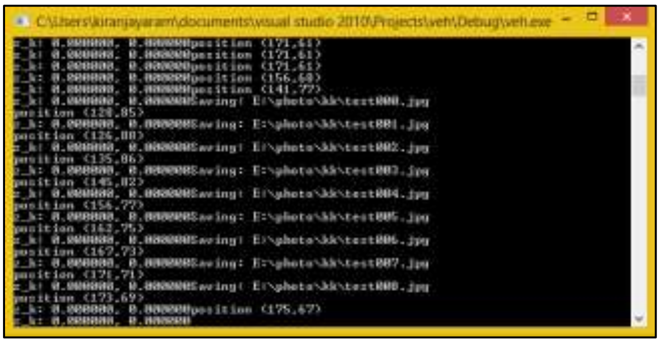
C. *SNAPSHOT 3*

Tracking of object done after identifying the object [5].



D. *SNAPSHOT 4*

Tracking sequence of frames from video I captured and stored in storage device.



E. SNAPSHOT 5

Storage of different frames of the video.

VII. CONCLUSION

Video Analytics (VA) project is to address obstacles in both image-retrieval and research that uses extreme-scale archives of video data that employs a human-machine hybrid process for analyzing moving images.

We propose an approach that places more interpretive power in the hands of the human user through background subtraction method of video data and uses a customized on-demand configuration that enables iterative queries.

Once the algorithm for multiple 3D object tracking works successfully, it can be applied for automated surveillance at Shopping malls, airports, highways, etc.

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