Chapter 12
Challenges in Video Analytics

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Abstract Video analytics technology has matured and found application in a variety of fields over the past decade. This chapter discusses the current state-of-the-art, and describes challenges for future video analytics implementations. Current applications and markets for video analytics are described in the context of a processing pipeline. Application-specific challenges are described with potential solutions to those challenges. This chapter also lists some implementation considerations for embedded video analytics and concludes with future and emerging applications of video analytics.

12.1 Introduction

Video analytics is an industry term for the automated extraction of information from video for a variety of purposes. It is a combination of imaging, computer vision, pattern analysis, and machine intelligence applied to real-world problems. Its utility spans several industry segments including video surveillance, retail, and transportation. Video analytics is distinct from machine vision or machine inspection and is similar to automotive vision. Some applications of analytics include the detection of suspicious objects and activities for offering better security, in license plate recognition and traffic analysis for intelligent transportation systems, and in customer counting and queue management for retail applications.

The past decade has seen the maturation of algorithms and the adoption of analytics solutions in these markets. Analytics has progressed from research labs, with algorithms running on powerful workstations and PCs to current real-time embedded implementations on consumer-grade embedded processors. At the same time, the range of applications for analytics has also grown, with current trends indicating
continued growth in the capabilities of this technology, its installed base, and its continued application to new markets.

This chapter provides an overview of current video analytics technology and its applications, introduces a processing framework amenable to embedded implementations, and describes possible future applications for embedded video analytics. There are several challenges to wider adoption of video analytics. These challenges are not just technical or scientific in nature. Practical, mass market adoption of vision and learning technologies demand economically viable, and robust implementations. Analytics is poised to enter a new era of expansion that will push applications into the mainstream and into regular use. Solutions to the challenges presented here will be critical to that expansion.

Section 12.2 provides an overview of applications. In Section 12.3, we describe the building blocks of a video analytics system with technical challenges for each block. The issues faced by embedded implementations of analytics are covered in Section 12.4, followed by a discussion of new problem areas and future applications in Section 12.5.

12.2 Current Technology and Applications

Video analytics in its most general form is concerned with visual scene understanding from a sequence of pictures in temporal order. In a manner similar to web analytics, which attempts to derive intelligence from web logs, video analytics treats video as a data source with the goal of extracting meaningful information. The output of video analytics is generally quantitative and structured information that summarizes some aspect related to the content of video. Therefore, it is also called video content analysis (VCA) or video intelligence.

Techniques in video analytics draw from multiple disciplines, with the goal of scene understanding. In most instances, video analytics does not have a cognition aspect, and is not expected to act or respond autonomously; it is, however, expected to adapt and learn. Video analytics is also distinct from machine vision used in the context of visual inspection. The difference is in the range of conditions, both environmental and illumination, and the relatively unconstrained camera setup that must be handled by analytics. For instance, video analytics systems employed for video surveillance are expected to work uninterrupted in real-world illumination over multiple seasons and weather conditions using a wide range of camera and lens combinations. Analytics applications also frequently run in unattended or unmanned settings without a human in the loop, with little or no intervention or control available for tuning. This poses a challenge to techniques and algorithms in that they need to adapt and learn over extremely long periods of time.

Applications of video analytics vary in the type of analysis and in the level of performance and robustness expected. Economic and computational considerations also impact the choice and complexity of algorithms employed. Comparison of video analytics implementations is therefore challenging. Further, comparisons