Toward a Biometric-Aware Cloud Service Engine for Multi-Screen Video Applications

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ABSTRACT

The emergence of portable devices and online social networks (OSNs) has changed the traditional video consumption paradigm by simultaneously providing multi-screen video watching, social networking engagement, etc. One challenge is to design a unified solution to support ever-growing features while guarantee system performance. In this demo, we design and implement a multi-screen technology to provide multi-screen interactions over wide area network (WAN). Furthermore, we incorporate face-detection technology into our system to identify users' bio-features and employ a machine learning based traffic scheduling mechanism to improve the system performance.

Categories and Subject Descriptors

H.4.3 [**Communications Applications**]: Videotex; C.2.1 [**Network Architecture and Design**]: Network Communications

Keywords

Cloud; Internet Video; Second Screen

1. INTRODUCTION

Owing to the popularity of mobile devices and online social networks, the traditional video watching experience has been dramatically changed, from a "laid-back" behavior into a "lean-forward" social engaged experience. In particular, two delightful features, including multi-screen and socialization, have been offered to video consumers. Multi-screen technology [2], also known as second-screen, provides a parallel companion device, whereby the user can engage in some other activities without interrupting the video watching. Socialization technology integrates social networking, including chatting, commenting, engaging OSNs, and so forth, into the video consumption.

However, it is a big challenge to build a unified solution to support the ever growing set of video-related features, while guarantee the efficiency and scalability. First, existing multi-screen technologies are only available in a limited local area network (LAN), lacking of a full-fledged multi-screen support. Second, user behavior under different video related applications varies case by case, resulting in performance degradation when the traditional access pattern based optimization mechanisms are applied.

In this work, we design and develop a multi-screen technology to provide multi-screen interactions over WAN. Our solution leverages cloud-based distributed service architecture and advanced virtual machine migration algorithm to provide scalable and economical multi-screen services for application deployment. Based on this invention, we implement a machine learning based system optimization mechanisms for content caching or prefetching, traffic classification, and virtual machine consolidation by utilizing users' bio-features in terms of gender, age, smile-degree, etc. The principal of our optimization mechanism is based on the observation that people with same gender or age will perform similarly in various applications [3][1]. For example, adult women are more likely to watch videos or post tweets that are related to fashion or personal topics, whereas men are more likely to enjoy sports or philosophical topics.

2. CLOUD CLONE BASED MULTI-SCREEN PLATFORM

Fig. 1 illustrates the system architecture of our multi-screen platform, which consists of three participants, including content sources, content consumers, and a cloud centric media network, serving as the multi-screen service engine to enable rich-media applications across multiple screens.

On the user side, one consumer typically has multiple associated screens, including mobile phone, pad, PC, TV, etc. In the case that the first screen (e.g., TV) does not have sufficient onboard resources for intelligent control and management, the second-screen devices will be attached to

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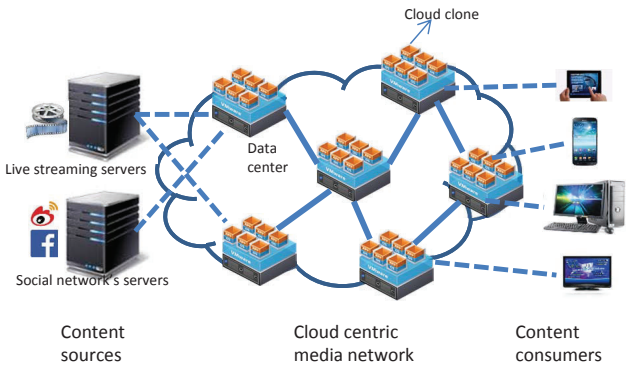


Figure 1: System Architecture and Deployment of Cloud Clone based Multi-Screen Solution

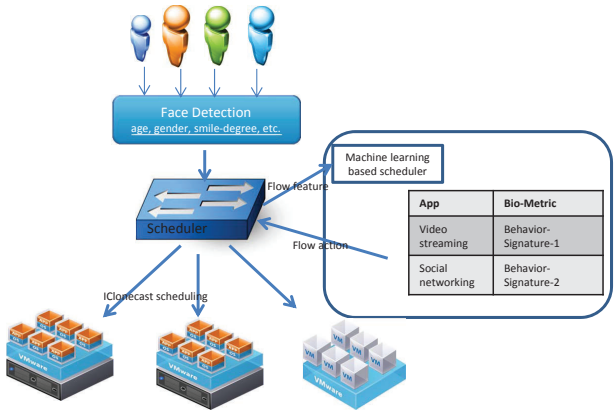


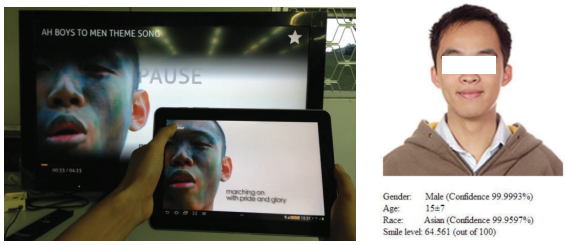
Figure 2: Bio-Inspired Network Traffic Scheduling

the first-screen device to provide the required intelligence. In the media cloud, each consumer will be incarnated by a dedicated virtual machine (called cloud clone) to control all the devices and orchestrate the multi-screen interactions. Specifically, the cloud clone manages all the real-time session information associated with the application session and migrate its location dynamically to best serve all the screens as the consumer switches the usage of active screen. Moreover, the set of cloud clones forms a stable P2P network for fast retrieval and convenient maintenance. It can also facilitate the multi-screen interactions among different consumers.

Since multiple screens from the same user are all connected to the same cloud clone, our multi-screen paradigm can work in both WAN and LAN. On the source side, the cloud clone gets different contents (e.g., live streaming contents, social media) according to its user's requests, and corresponding analysis. For example, when the user requests to watch an episode, the cloud clone not only streams the episode content itself, but also pre-fetches related social media data. Moreover, the set of cloud clones can collaborate for content sharing, media transcoding, etc.

3. BIO-INSPIRED SYSTEM OPTIMIZATION

Our multi-screen solution supports various video related applications, resulting in extremely complicated network dynamics. In addition to traditional system optimization mechanisms, we utilize users' bio-features to further improve



(a) Video transportation across multi-screens (b) Face detection

Figure 3: Typical Features

the system performance. In particular, when a user logs into the system using a specific screen, the companion camera will take a snapshot of his face. We then employ the face detection technology to identify the age, gender, smile-degree of this user. Our system will automatically record the user behavior as well as the user bio-profile. These log data serve as the training set to mine the bio-related patterns. For example, how long an adult female will spend in watching a fashion video, and what topic she is browsing from online social networks. In this way, a flow table, consisting of three-item-tuple <bio-metric, application, signature>, can be generated for decision making. One potential strategy is to consolidate cloud clone corresponding to users with similar signature for power saving and content caching.

4. DEMO DESCRIPTION

Two features, including multi-screen video watching and face-detection based cloud clone initialization, of our demo in shown in Fig. 3. Using the first feature (as illustrated in Fig. 3 (a)), video transportation can be accomplished across multi-screens bi-directionally by just a flip action. In the second case (as shown in Fig. 3 (b)), we illustrate the face-detection results for subsequent cloud clone scheduling. Interested readers are referred to our online demo [1].

5. ACKNOWLEDGMENTS

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