Cloud3DView: An Interactive Tool for Cloud Data Center Operations

Jianxiong Yin
Nanyang Tech. Univ.
50 Nanyang Avenue
Singapore 639798
jxyin@ntu.edu.sg

Peng Sun
Nanyang Tech. Univ.
50 Nanyang Avenue
Singapore 639798
sunp0003@e.ntu.edu.sg

Yonggang Wen
Nanyang Tech. Univ.
50 Nanyang Avenue
Singapore 639798
ygwen@ntu.edu.sg

Haigang Gong
Univ. of Elec. Sci. & Tech. of China
Chengdu 610054,China
hggong@uestc.edu.cn

Ming Liu
Univ. of Elec. Sci. & Tech. of China
Chengdu 610054,China
csmliu@uestc.edu.cn

Xuelong Li
Center for OPTical IMagery Analysis and Learning
Xi'an 710119,China
xuelong_li@ieee.org

ABSTRACT

The emergence of cloud computing has promoted growing demand and rapid deployment of data centers. However, data center operations require a set of sophisticated skills (e.g., command-line-interface), resulting in a high operational cost. In this demo, to reduce the data center operational cost, we design and build a novel cloud data center management system, based on the concept of 3D gamification. In particular, we apply data visualization techniques to overlay operational status upon a data center 3D model, allowing the operators to monitor the real-time situation and control the data center from a friendly user interface. This demo highlights: (1)a data center 3D view from a First Person Shooter (FPS) camera, (2)a run-time presentation of visualized infrastructures information. Moreover, to improve the user experience, we employ cutting-edge HCI technologies from multi-touch, for remote access to Cloud3DView.

Categories and Subject Descriptors

C.2.3 [**Computer Communication Networks**]: Network Operations

General Terms

MANAGEMENT, HUMAN FACTORS, DESIGN

Keywords

Data Center Operation; Data Visualization

1. INTRODUCTION

Owing to the popularity of cloud computing, IT industry has seen a growing demand of data centers, in particular, to provide cloud infrastructure in big organizations (e.g., university, government, telecos, etc). This demand triggers a rapid deployment of data centers in various sizes. For example, in Singapore alone, more than 60 data centers have been deployed and by 2015 this number will reach 100. However, given its complexity, data center operations has not been an easy task, often requesting specially trains IT staff and highly sophisticated software (e.g., DCIM). This operational overhead adds to the cost of total ownership (CTO) of private cloud, defying the original purpose of having cloud on premise. Moreover, this portion of operational cost increases convexly as the size of the data center increases.

In this research, we propose and develop an interactive data center management system, aiming to reduce the complexity of monitoring and controlling data center for system administrators. Specifically, we adopt the concept of gamification. Aiming to integrate user centric computing into IT system management, we develop a 3D game interface (GI), replacing the conventional user interfaces, to manage the data center. We call this data center management system as Cloud3DView. It leverages a 3D model of the data center to provide three key functions, including:

- Status Monitoring: in this game, the administrator can monitor the status of the three subsystems in the data center (e.g., ICT, power and cooling). Data can be visualized via dash panel, overlay and PIP.
- Performance Assessment: in this game, the administrator can assess the performance of the data center, in respect to different data center benchmark protocols.
- System Controlling: in the game, the administrator can dynamically control the operations of the data center, via intuitive HCI and mobile devices.

In this demo, we present Cloud3DView as follows. In Section 2, we outline the system architecture for Cloud3DView. In Section 3, we illustrate two alternative HCIs. Section 4 briefly introduces its system monitoring function.

2. SYSTEM ARCHITECTURE

Fig. 1 illustrates the software architecture for Cloud3DView. Hierarchically, Cloud3DView consists of three logical components, including:

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the Owner/Author.
SIGCOMM'13, August 12–16, 2013, Hong Kong, China.
ACM 978-1-4503-2056-6/13/08.

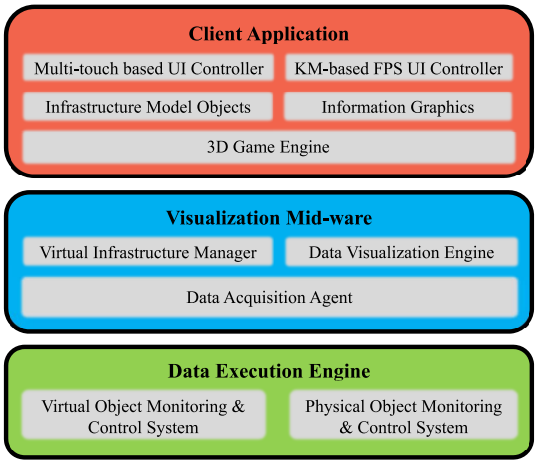

Figure 1: Software Architecture of Cloud3DView.

- Client Application: Client application serves as user interface which responses to the user operation and updates user view. At the same time, it delivers request message to the underlying layer, and presents visualized data. Client Application is developed with Unity3D game engine.
- Visualization Mid-ware: VMW has two major roles, managers of the mappings between virtual and actual equipments, and bridges between Data Execution Engine and Client Application.
- Data Execution Engine: This module collects and aggregates IT resource status. In this demo, Ganglia[2] is employed as DEE to extract information of equipments, such as CPU usage, network traffic.

3. GAME INTERFACES

The GI for Cloud3DView is built from two aspects, creating virtual scene and designing navigation mechanisms.

We demonstrate operations of a modular-based data center(MDC) with Cloud3DView. For immsersive experience, environment in and out of MDC is transformed into virtual scene in details. Moreover, 3D models for more than three hundred Information Communication Technology(ICT) equipment are created to mimic real rack spaces. To reflect network connectivity, the virtual scene also presents actual network topology in detail.

The navigation mechanism aims to enable free virtual scene exploration. Cloud3DView employs two collections of movement control user interfaces(MCUI) to support operations using desktop web or mobile devices. In particular, we employ a three-mode multi-touch based MCUI for mobile devices as is show in Fig 2. The default mode is based on two virtual joysticks which commands movement direction and view orientation respectively. The second mode translates finger gestures, e.g., swipe, pinch or stretch, into movement commands. The third mode uses mapview to allow movement to navigate view points instantly.

4. SYSTEM MONITORING

Capturing some subset status of system components and visualizing in graphics often cues for better understanding of the system behaviors. For example, doppellab [1], an immersive sensor data browser, presents an intuitive environment changes of the monitoring area.

ICT equipment model is selected, dashboard contains the status of the selected equipment is displayed as an overlay as is shown in Fig 3.

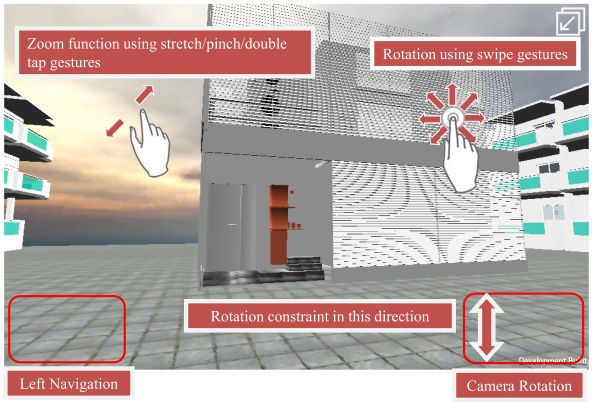

Figure 2: Multi-touch based User Interface.

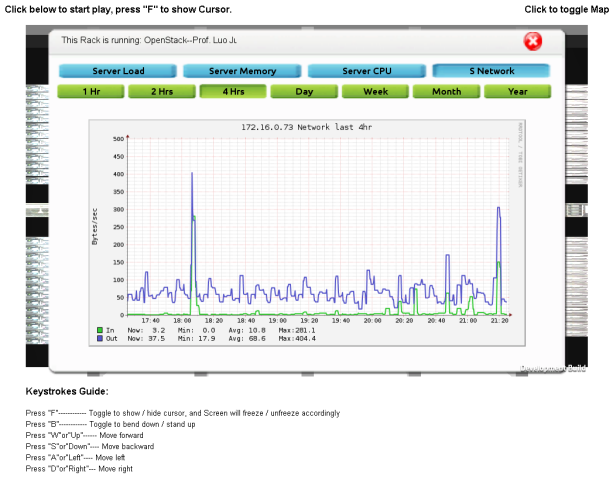

Figure 3: Per Server Network Traffic Monitoring.

5. ADDITIONAL AUTHORS

Additional authors: Haipeng You, Jinqi Gao and Cynthia Lin(Nanyang Technological University, email: {n1207998e, gaoj0006, cynt0004}@e.ntu.edu.sg).

6. REFERENCES

[1] Dublon, Gershon, et al. Doppellab: Tools for exploring and harnessing multimodal sensor network data. In *Sensors, 2011 IEEE*, pages 1612–1615. IEEE, 2011.

[2] Massie, M. L., et al. The ganglia distributed monitoring system: design, implementation, and experience. *Parallel Computing*, 30(7):817–840, 2004.