Using Hybrid Cloud and Mobile Platforms to Enhance Online Education

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Introduction

- **Goal:** Make use of emerging cloud and mobile technologies to enhance education.

Background

- **vMoodle:** Novel educational system that seamlessly integrates virtual machine (VM) based education with convenient online learning environments
  - Supports widely used online-learning-systems/VMs (e.g., Moodle/VirtualBox)
  - Support different clouds (private e.g. VirtualBox/public e.g. Amazon EC2)

- **vMoodle Mobile:** Native mobile App for vMoodle that allows users to access this learning environment through mobile devices
  - Exploit the increasing popularity and power of smart phones and tablets
  - Allows direct communication between mobile device and VMs

vMoodle

- **Front-end: Integration with Online Learning**
  - Allows instructors to create VM-based course materials (e.g., projects, demos) online
  - Create & assign customized VM templates for course activities
  - Allows students to use VMs online
  - Create private clones of the VM templates
  - Conduct projects on the VMs

- **Back-end: Integration with Cloud**
  - Efficient resource usage & good performance
  - Primitive load balancing at VM creation time
  - Efficient VM storage using shared network storage
  - Instant VM creation using copy-on-write-based VM cloning

vMoodle Mobile

- **A native mobile app for vMoodle**
  - Allow instructors/students to access vMoodle at any time from anywhere
  - A mobile-friendly user interface for smart phones and tablets
  - Allow fast access to VMs and other online course materials

- **A prototype developed on Android mobile OS:**
  - Support widely used touchscreen smart phones and tablets (e.g., Samsung Galaxy, HTC Nexus, LG Optimus)
  - Allow secure communication between mobile devices and vMoodle server using HTTPS
  - Allow SSH connection to VMs using the ConnectBot app

Improvements: Architecture Diagram

- **Problem:** Individual servers that contain more popular VMs can overload and become unavailable
  - Solution: Offload Resources to Public Cloud
    - Perform live-migration of VMs between private cluster and public cloud
    - Maintain consistency on database regarding location of particular VMs
    - Cost-efficient use of resources on the public cloud

- **Problem:** Relying solely on cloud processing can potentially disappoint users because of slow responses from mobile device
  - Solution: Caching on mobiles devices
    - Achieve greater application responsiveness
    - Distribute load between cloud and mobile device to achieve faster interaction with VMs
    - Make efficient use of mobile device's storage

Conclusion and Future Work

- **Conclusions**
  - Make VMs more accessible to users
  - Support greater amount of VMs cost-efficiently
  - Proposed new techniques to take advantage of mobile devices local resources
  - Make online educational software extremely versatile by providing better accessibility and scalability

- **Future work**
  - Soon to be deployed for production use by FIU instructors and students
  - In progress integration of vMoodle with social networks (e.g., Facebook) in order to enhance instructor-student interactions