Mobile Cloud based Compiler: A Novel Framework For Academia

Mahendra Mehra, Kailas.k.Devadkar, Dhananjay Kalbande

1Computer Engineering, Sardar Patel Institute of Technology, Mumbai, India; 2 Computer Engineering, Sardar Patel Institute of Technology, Mumbai, India.
Email: mahendra_mehra@spit.ac.in, kailas_devadkar@spit.ac.in, drkalbande@spit.ac.in

ABSTRACT

Cloud computing is a rising technology which enables convenient, on-demand network access to a shared pool of configurable computing resources. Mobile cloud computing is the availability of cloud computing services in a mobile ecosystem. Mobile cloud computing shares with cloud computing the notion that services is provided by a cloud and accessed through mobile platforms. The paper aims to describe an online mobile cloud based compiler which helps to reduce the problems of portability and storage space and resource constraints by making use of the concept of mobile cloud computing. The ability to use compiler application on mobile devices allows a programmer to get easy access of the code and provides most convenient tool to compile the code and remove the errors. Moreover, a mobile cloud based compiler can be used remotely throughout any network connection (WI-FI/ GPRS) on any Smartphone. Thus, avoiding installation of compilers on computers and reducing the dependency on computers to write and execute programs.

Keywords: Mobile cloud computing; mobile web services; JASON; Compiler; Academia

1 INTRODUCTION

The classroom is changing. From the time school bell rings to study sessions that last well into the night, students and faculty are demanding more technology services from their schools. It is important not only to keep pace with their evolving needs, but also to prepare them for the demands of the workplace tomorrow. The education ecosystem in the country today is looking for communication and collaboration tools that enable the faculty, students, the administrators and the alumni stay in touch and enable virtual learning platforms at minimum costs and that allows for better IT management. Cloud computing is a correct choice for providing flexibility for all educational institutions. Based on the academic organization’s needs, the platform and applications in cloud computing may be on the institution campus, off campus, or a combination of both. It should provide effective infrastructure and deployment model for their dynamic demands. They bring to education a range of options not found in traditional IT models. In fact, the integration of software and assets you own with software and services in the cloud provides you with new choices for balancing system management, cost, and security while helping to improve services. Both public and private institutions are doing a makeshift to the cloud in order to deliver better services, even as they work with fewer resources. By sharing IT services in the cloud, your education institution can outsource noncore services and better concentrate on offering services, teachers, faculty, and staff the essential tools to help them succeed. As a result, teaching and learning can take place from more places and at flexible times. Students and teachers can access the content they need from home, park and library. Using any Internet connected device, including thin clients, notebooks, tablets, slates, pads, smartphones, and desktops. The cloud helps ensure that students, teachers, faculty, parents, and staff have on-demand access to critical information using any device from anywhere. More and more individuals are carrying smartphones and utilizing tablet PCs for business and personal use. Energy efficiency is a fundamental consideration for mobile devices. Cloud computing has the potential to save mobile client energy but the savings from offloading the computation need to exceed the energy cost of the additional communication. While the most energy efficient setup for many current mobile applications is local computing, there clearly are workloads that can benefit from moving to remote infrastructures because these workloads demand higher resources [1]. Though latest mobile devices use high speed processors, with clock frequencies up to 1 GHz, power consumption is still a problem [2]. Cloud computing offers a solution by making computations offline on the “cloud” thus reducing the power consumption on the device and allowing more elaborate and accurate algorithms to be performed on the server [3],[4]. An obvious solution to the resource poverty of mobile devices is offloading of processing to the cloud. Mobile cloud computing is the art of or delicate balance of offloading various data, processing capabilities, and even Operating System (OS) tasks into the cloud. The 2010 IBM Tech Trends survey predicted that cloud computing will overtake on premise computing and mobile software application development will emerge as the most in demand software application development through 2015. Accordingly, it is reasonable to predict that mobile cloud computing, the niche where these two areas merge, will also transpire as a dominant force in both the develop-
ment and research arenas through 2015 with the convergence of smartphones, tablets, and cloud computing. The following sections focus on mobile cloud computing concepts and the benefits of mobile cloud computing for e-learning solutions. Also, the proposed framework applying the concept of REST based mobile web services to execute programs on mobile cloud using smartphones.

2 MOBILE CLOUD COMPUTING

Mobile cloud computing is a technique or model in which mobile applications are built, powered and hosted using cloud computing technology. Think of mobile cloud computing as a mashup of mobile development and cloud computing. It provides a mobile user a feature rich application delivered over the Internet and powered by cloud-backed infrastructure. Most applications built for smartphones requires intensive computing power and software platform support for application execution. Many low-end but browser-enabled mobile phones are unable to support such applications. With the advent in mobile cloud computing, the resources in terms of computing, storage and platform support required to execute these applications are available through the cloud and, in theory, a greater number of devices can be supported [5].

Mobile computing research is to study how portable devices sense and learn the status of devices and the context related to their mobility and networking in order to better support mobile applications in an ad hoc communication environment. Mobile cloud computing cannot be simply illustrated as merging mobile computing and cloud computing environments. An illustrative example of mobile cloud computing is how a smartphone can best utilize the cloud resource to reduce its energy consumption. A computing task can be either executed on the mobile device or outsourced to the cloud. Where to compute depends on the overhead tradeoffs between computation and communication while considering the requirements of applications’ Quality of Service (QoS) and users’ Quality of Experience (QoE) [6]. It’s important to emphasize the “in theory” aspect of the mobile cloud. While there is much potential, development in this area is still on the rise.

2.1 Salient Features Required for Mobile Cloud Computing

Some key features of Mobile Cloud Computing which makes it possible to implement consistent service delivery in across the network environment. From the perspective of the enterprise solution provider or web/mobile application developer, the objectives of the Mobile Cloud Computing platform are:

- Simple APIs offering transparent access to mobile services, and requiring no specific knowledge of underlying network technologies.
- The ability to deploy applications across multiple carrier networks, under a single commercial agreement.
- Seamless handling of each carrier’s specific network policy, such as chosen mobile subscriber confirmed opt-in / confirmed opt-out and privacy management principles.

2.2 Advantages of Mobile Cloud Computing

Following closely behind the growth of cloud computing is mobile cloud computing. While there are currently only a few well known mobile cloud applications for consumers, like Gmail and Google maps, many more are in development. Mobile cloud computing will become the predominant way that mobile applications function one day. The largest advantages to mobile cloud computing are:

One Application for All Devices: Applications hosted in the cloud eliminate the requirement that the application be tied to a single cell phone service provider (i.e. AT&T, Sprint, Verizon, or T-Mobile) or mobile device.

Capabilities Boost: Mobile devices do not have the processing power or memory space required on the device itself for intensive applications. Mobile Cloud computing provides a tremendous leap in functionality and the amount of data the application can access [7].

Data Not Tied to the Device: Mobile devices fail, are lost or sometimes destroyed. However with cloud computing critical data is preserved, because it is stored on the cloud, not on the device.

Low Cost for Set-up & Maintenance: Users only pay for the infrastructure they use. Organizations can easily scale applications and happily avoid the hassle of maintaining servers and equipment.

3 Mobile Computing for Education

Many Authors have pointed out the importance of mobile computing for education as in [8], [9], [10] provide many examples in which the teacher-student classroom interaction and learning process can be improved drastically with the proper integration of mobile computing in educational institutions. As well, with the evolution of tablet PCs, mobile computing is gaining popularity due to higher processing gains and longer battery life these devices offer.

In general, the potential of mobile computing is being demonstrated at several higher education institutions such as Open University of Catalonia, University of Waterloo, University of Texas-Dallas and Purdue University to mention a few. These institutions have already deployed many applications that students use on their mobile devices to contribute to dis-
cussions, ask and answer questions, and respond to teacher prompts through several channels, including Facebook, Twitter, the Hotseat mobile application, or any other web application. On the other hand, offline computing is crucial for computationally demanding mobile computing applications, such as catalog-search for libraries deployed at the North Carolina State University. This necessitates that mobile and cloud computing go hand-in-hand, which therefore improves the usability of such applications and amplifies its spectrum [11].

Although much has been done in mobile and cloud computing, however to the authors’ knowledge there is no work that has considered both mobile and cloud computing simultaneously in a dedicated application with an educational objective targeting code compilation. Since heavy computation is needed for this kind of application, current devices are incapable to handle this complexity so offline computation is a must. Although, the concept can be generalized further to incorporate other educational objectives, the paper treats solely the issue of code compilation for now.

4 Proposed Architecture

4.1 Need for Project

The main advantage of mobile cloud computing over the other non network methods is of faster processing. Scalability is another factor as many processors can be used remotely, without the knowledge of the user’s in order to expedite the processing. Thus, keeping this main advantage in mind, the main reason for creating this framework is to provide a centralized compiling scheme for organizations or institutions. Also, it will act as a centralized repository for all the codes written. The other major advantage this system is that it will make the users system lightweight i.e. there will be no need to maintain separate compilers/SDK’s at the client-side as users can use their smartphones or tablets anytime anywhere to compile and execute their programs by just using the mobile cloud based application. Another advantage of this system is that the compiler is hosted a REST based webservice on the cloud infrastructure retrieved using HTTP client code which sends the text in JASON string format which is very lightweight and hence reduces the unnecessary bandwith consumtion. Thus, for educational institutions this will prove to be highly efficient. Also, the process of maintenance and distribution of dynamic usernames and passwords will be greatly simplified. Also, authentication and personalized task distribution will be made possible along with that incase of version change the updation has to be made on the cloud server avoiding updation of compilers on every client node ultimately saving time and resources.

4.2 Design Consideration

The system uses three tier architecture. The first layer consists of clients, which are mobile devices having lower configuration. The middle layer consists of the server which actually is on cloud platform. The important components of the middle layer are described as below:

1. A Management module that looks after user authentication and manages user session with the compiler
2. A compiler module which handles the work of scripting and compilation of code
3. An offline App module for auto sync and push purpose.
4. Database which stores the client information.
5. The ‘cloud hard disk’ is a shared resource.

The last layer is the cloud infrastructure where the compiler is deployed and the processing of program files takes place.

4.3 System Architecture

The system architecture consist of three layers

1. Management Module
2. Compiler Module
3. Offline App support
Management Module looks after user authentication as every user has a dedicated account and only authenticated users are allowed to use the compiler web service this is also required to maintain logs and to prevent unauthorized person from flooding the system with fake request leading to DoS. It also has a storage manager which maps the storage space with respective logins. The session manager keeps track of the user’s availability once he has submitted the program code for execution and keeps the track of the job submitted.

Compiler module looks after compiler web service deployed on cloud infrastructure, we have used the REST over SOAP here as REST defines a set of architectural principles by which you can design Web services that focus on a system’s resources, including how resource states are addressed and transferred over HTTP by a wide range of clients written in different languages. If measured by the number of Web services that use it, REST has emerged in the last few years alone as a predominant Web service design model. In fact, REST has had such a large impact on the Web that it has mostly displaced SOAP and WSDL-based interface design because it’s a considerably simpler style to use.

A concrete implementation of a REST Web service follows four basic design principles:

- Use HTTP methods explicitly.
- Be stateless.
- Expose directory structure-like URIs.
- Transfer XML, JavaScript Object Notation (JSON), or both.

Offline App support module has the feature of auto sync which synchronizes new files on the local storage with that of in the cloud storage allocated to the registered users. The auto push concept pushes the output to the user screen if in case the user had gone out of range.

5 IMPLEMENTATION

![Create new file window of Client App](image1)

Fig. 5 Create new file window of Client App.

Fig. 5 shows the graphical user interface (GUI) tested on the Nexus using the Android SDK. The user will first create a new program or load the available program and then send it for compilation and execution of the program. An Android Java activity will be executed once the Run button is pressed and the program file data will get wrapped into JSON object. Then the program is sent in JSON string format to the server program application. The device will wait for the server to compile and execute the sent program.

A Java application is hosted onto the server which will accept the program file data which is in JSON string format. Then it will retrieve the required data and make two files viz. one for program code and other for its respective input file. Then the program file with its respective input file is compiled on MinGW compiler and the result is stored in a file. The results of the compiled and executed program file is wrapped in JSON format and transferred back to android device in JSON string format. The received result is displayed on the device.

![Program editor window](image2)

Fig. 6 Program editor window

![Output window](image3)

Fig. 7 Output window

6 CONCLUSION

Cloud services offer higher education and research institutions the power to choose the opportunity to rethink which services are needed to support education and research and what will be the best way to deliver those services. Many services are readily available in the public cloud. Some services need to be procured through the institution’s IT department. Only a few services will require custom development, either alone or in partnership with other institutions. Technological advances have made it not only possible, but desirable to have ubiquitous access to information. More and more individuals are carrying smartphones and utilizing tabletPCs for business and personal use. By integrating and enhancing the capabilities of these essential technologies, we have introduced the ‘mobile cloud based compiler’ which can contribute to the education system. There would be a cloud based server which would have the power to compile the student’s code stored on smartphones or written on the go through Client App. As
compared to the current scenario where each machine should have the C/C++ compiler installed separately and every student needs a machine to write programs. This would eliminate the need to install compilers separately, the students can use their smartphones and can store the codes at the centralized cloud server as well as each students record is maintained for future references. Another advantage of such a system is that whenever the compiler package is to be upgraded it can simply be done on the cloud server.

References


