Mobile Cloud Computing for M-learning Applications

*Yugesh Suresh Bhosale & #Dr. Jenila Livingston L. M.
*School of Computing Science and Engineering, VIT Chennai, Tamilnadu 600 127, INDIA
Associate Professor, *School of Computing Science and Engineering, VIT Chennai, Tamilnadu 600 127, INDIA

Abstract- **Mobile learning (M-learning) has been accomplished as associate degree economical manner of learning. With the increasing variety of users, services, education contents and resources, however, how to deploy M-learning applications become difficult and problematic. As a promising technology to beat the issues in M-learning, Cloud computing provides reliable, made-to-order and dynamic computing environments for end-users. This paper presents a brand new design for a mobile distance learning system in associate degree extended cloud computing atmosphere enriched with mobiles and wireless devices. Additionally to it, this paper conjointly discusses the offloading of M-learning applications, Networking problems and energy consumption; problems in cloud primarily based M-learning applications.**

Keywords – Mobile Cloud Computing (MCC), M-learning, Offloading, Energy Consumption.

1. INTRODUCTION

The digital revolution nowadays has carried education into a totally new era wherever teaching and learning happen not solely at faculties, however at homes and within the geographic point. Electronic Learning provides the flexibility to reap the ability of technologies to create the educational expertise more practical and pleasant. Nowadays we have a tendency to area unit witnessing the emergence of a connected, mobile society, with a range of data sources and mean that of communication on the market at anyplace. Inside this context, wireless mobile technologies also are adopted in academic fields. M-learning isn't solely a matter of learning or quality, however a completely different construct, that is a component of a replacement conception of quality of a connected society. E-learning has taken learning far from lecture rooms, and nonetheless M-learning is taking learning away anyplace and anytime. Whereas e-learning is another to schoolroom learning, m learning is that the complementary activity to each e-learning and ancient learning. Today's technology permits users to hold the big numbers of resources in their pockets and to access them where they realize it convenient in ways that of exploitation moveable devices like PCs, good phones and hand-held. whereas the probabilities equipped from the utilization of moveable devices for M-learning area unit utterly new, the challenges as a consequence of the little screens, restricted process power, inputting capabilities, resources and little memory capability, etc. area unit still current.

Together with the explosive and rising of the net, mobile networks, mobile applications, and cloud computing, cloud primarily based mobile learning is introduced as a possible technology for mobile devices. As mobile network infrastructures endlessly improve, their information transmission becomes progressively obtainable and cheap, and therefore they're turning into in style purchasers to consume any internet primarily based applications. Cloud computing is nothing but delivery of services from different cloud vendors, software package and process capability over web, reducing value, increasing automating systems, reducing coupling between services delivery from given technology, and providing flexibility and quality of knowledge. Wherever the mobile learners will get the information from centralized shared resources at anyplace and any time. Comparing with the traditional client-server model, in cloud computing the services and resources are no inheritable from a pool termed cloud. The cloud represents and hides the particular servers. From a straightforward perspective, cloud primarily based mobile learning are often thought of as an infrastructure wherever information and process may happen outside of the mobile device, enabling new kinds of applications like context-aware mobile social networks. As a result, several mobile cloud applications aren't restricted to powerful good phones, however to a broad vary of less advanced mobile phones and thus, to a far larger subscriber section [1].

This paper presents a new architecture of mobile Learning System in Cloud Computing Environment, with the help technologies related to mobile computing and wireless computing devices, pointing out the challenges and overcoming the current disadvantages and limitations of M-learning. The given proposed architecture beneficial for educational organizations and institutions with different learning styles in different learning contexts in order to facilitate distance learning and knowledge sharing accumulated through cloud based systems. As mentioned above, cloud-based education not only requires technology support but also requires a need to distil it into a practical, consistent, accessible architecture. Because of this, the contributions of this paper to the developers of the M-learning applications are considerable. To develop cloud based architecture by integrating different subsystems, which allow learners to study related activities anytime and anywhere. Describe the interactive learning mode in a cloud environment by using the proposed architecture in order to demonstrate the combined advantages of better interaction facilities of a new system. Explore the relationships between cloud-based learning and M-learning in order to gain more thorough understandings of cloud based learning.

This paper is organized as follows. Section1 introduces the topic. Section2 summarizes the Background and History of the E-learning and M-learning. Section3 presents the new architecture of m- learning system in a cloud computing environment. Section4 gives detail information of Offloading concept. Section5 describes the role of Energy Saving in M-learning applications. Finally, Section6 provides information about future work and concludes the paper.

2. E-LEARNING AND M-LEARNING: BACKGROUND

2.1 Background

The evolution in education and coaching at a distance means distance learning may be characterised as a transition from D-Learning (distance learning) to E-Learning (electronic learning) to M-learning (mobile learning). These 3 stages of development correspond to the influence on society of the Economic Revolution of the eighteenth to nineteenth centuries, the Technological Revolution of the Eighties and also the Wireless Revolution of the last years of the twentieth century. Naturally the M-learning could be a type of existing D-learning and E-learning (Fig. 1.).

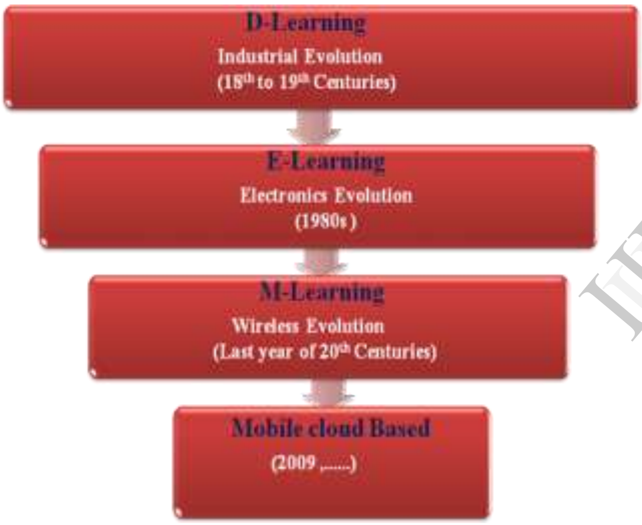

Fig. 1. Evolution of M-learning.

Traditionally the distance education has over 100 years of expertise and traditions. Its main characteristics are the distance and time separation between lecture and students [2].

It is clear that M-learning is a subset of E-learning and the E-learning and M-learning concepts derived from distance learning (Fig. 2.).

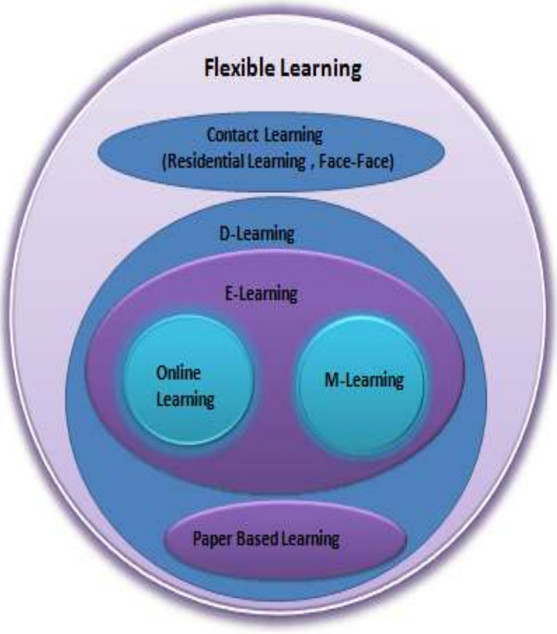

Fig. 2. M-learning is Subset of E-Learning.

3. ARCHITECTURE

3.1 Existing Architecture: Smart Mobile client with server Connectivity

This is the most popular and today's very efficient architecture to develop M-learning applications. Basically this is the combination of two basic application development methodologies. One is simple downloading M-learning application from the server to client mobile device through the wireless internet connectivity and another is online applications in which server always provide a service to the clients through the mobile browsers. But when we download whole heavy M-learning application from server to client mobile device the memory requirement is more and learning content is in very large scale and the storage capacity of the mobile device is very less. On the other hand because of the limitations of the mobile browsers we cannot deliver the multimedia based heavy M-learning content on the mobile browsers. Mobile browsers can understand only simple easy mark-up languages like HTML [3]. See Fig. 3.

3.2 Proposed Architecture

The proposed architecture for the M-learning application which is based on the mobile cloud computing environment is totally based on the offloading concept which is discussed in section4 and two important concept first one is virtual network computing and second one is remote desktop access

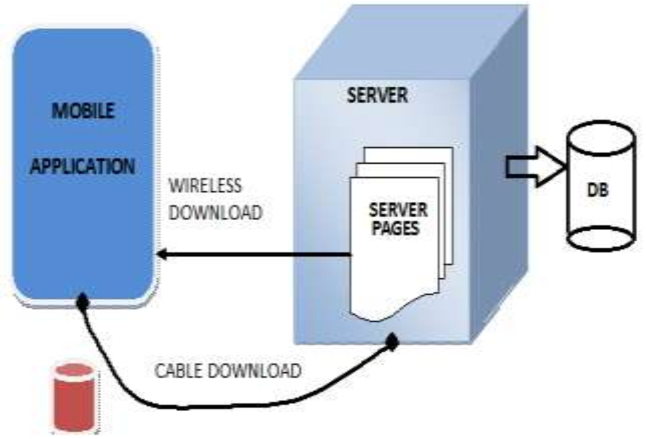

Fig. 3. Smart Mobile Client with Server Connectivity.

protocol. See the Fig.4 as shown in the figure all mobile clients are connected to the cloud through the Virtual Networking and using remote access protocol. The M-learning application is running on the remote desktop server using the offloading concept. Mobile clients or devices are connected to the network using any wireless connection like 3G cellular radio, Wi-Fi, Bluetooth, etc.

External database is connected to the remote Desktop Sever to store and retrieve the M-learning content and educational material of the students. Because of the limited storage capacity of the mobile devices we cannot store the M-learning content on the mobile devices. But we can store the M-learning content in to the cloud and retrieve that material at any time and at anywhere by requesting to the remote desktop server.

The thin part of the application is which is downloaded at the mobile devices can request by touching the particular button and this request is accepted by the remote desktop server via remote access protocol and all processing and computation is happened on the remote desktop server. Remote Desktop Server is continuously receives the request from the multiple clients for the different purpose so, the server creates the multiple clones to handle the multiple request from the client. And each cloud clone is now responsible to handle the request from the mobile client and if necessary clone stores and retrieves the M-learning content and all other education material. When remote desktop server receives request from the mobile client server creates the multiple clones and maps the each request to particular clone. All the internal details of the offloading concept are deeply discussed in the Section4.

4. OFFLOADING

Conceptually, our system provides a way to boost a Smartphone application by utilizing heterogeneous computing platforms through cloning and computation transformation. For doing so, our system (semi)-automatically transforms a single-machine execution (e.g., Smartphone computation) into a distributed execution (e.g., Smartphone plus cloud computation) in which the resource-intensive part of the execution is run in cloud clones which are more powerful. An additional benefit of cloning is that if the Smartphone is lost or under repair, the cloud powerful clone may be used as a backup. Fig.5 shows the detailed system architecture of our model. Augmented execution is performed in four steps: 1) At the first, a clone of the Smartphone is created within the cloud (desktop, laptop or server nodes); 2) The state of the mobile device (phone) and the powerful cloud clone is periodically or on-demand synchronized; 3) Application augmentations (whole applications or augmented pieces of applications) are executed in the powerful cloud clone, automatically or upon request; and 4) Results from clone execution are re-integrated back into the Smartphone state.

Fig. 4. Cloud Clone Based Architecture.

Fig. 5 shows our system architecture in a high-level view. This is one of the possible model designs, and we are giving details of the design space of different system architectures.

We achieve this by combining whole-system replication through incremental pointing, partially automatic partitioning and invocation of augmented execution, and cooperation and coordination of computation between the mobile devices (phone) and the cloud clone [4]. The system elements are running in the operating system. The *Replicator* is in charge of synchronizing the changes in phone software and state to the cloud clone. The *Controller* running in the mobile client device retrieves an augmented execution and combines its results back to the mobile client device. It interacts with the Replicator to synchronize states while coordinating the augmentation. The *Augmenter* executing in the cloud clone handles the local execution, and returns a result to the primary. Once a computation block for remote execution is determined, the bellow sequences are performed for the preliminary functionality outsourcing augmentation type. We eliminate the sequence for other augmentations because of storage or memory limitations. First, the Smartphone application process goes in a sleep mode. The process gives its state to the cloud clone VM. The VM allocates a new process state and overlays what it received from the phone with hardware description translation.

The clone executes from the beginning of the computation block until it reaches the ending point of the computation block unit. The cloud clone sends its process state back to the mobile client device phone. The mobile client device phone receives the process state and combines it, and mobile device wakes up the sleeping process to resume its execution. This description information removes much detail, and other augmentation categories can be not straightforward.

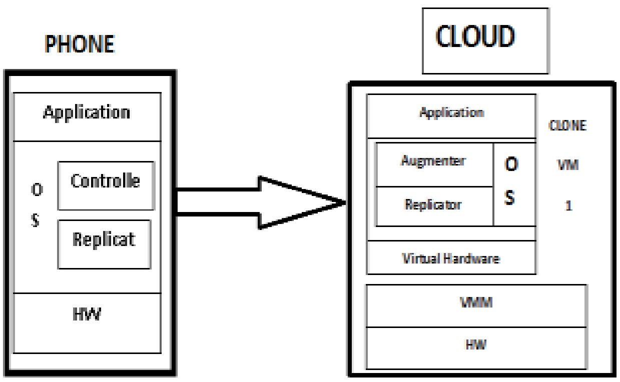

Fig. 5. Offloading: Clone Architecture.

From the end user perspective these all technical things are abstracted because they don't bother about what is happening behind the each and every action they just want the output on their mobile phones. When user touches to any button on the mobile for getting some event to be happen it called as input event as shown in Fig. 6 recording of the touch event on the mobile device the input is transfer from mobile device to the server and the event is traced out at the server side and result is send back to the end users mobile device. End user feels that this background process is executed on his mobile phone but actually this event was handled by the server which is connected through the internet.

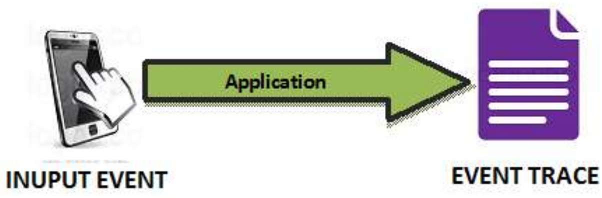

Fig. 6. Recording of touch events on the mobile device.

Same way, after tracing the event at the server side which is located in the cloud server sends the response to the mobile device as shown in the Fig. 7.

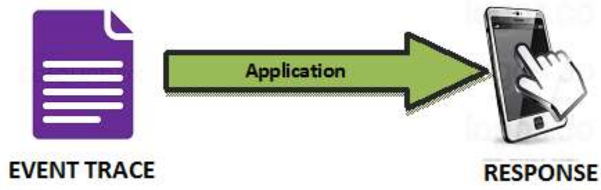

Fig. 7. Replaying of touch events on the mobile device.

5. ENERGY SAVING

Energy is a primary constraint for mobile systems. Mobile devices or mobile phones are not only used for voice communication; instead, they are used for acquiring and watching videos, gaming, web surfing, and many other purposes. As a result, these systems will likely consume more power and shorten the battery life. Even though battery technology has been steadily improving, it has not been able to keep up with the rapid growth of power consumption of these mobile systems.

Various studies have identified longer battery lifetime as the most desired feature of such systems. Longer battery life to be more important than all other features, including cameras or storage. Short battery life to be the most disliked characteristic of Apple's iPhone 3GS battery life was the top concern of music phone users.

There are some ways by using that we can reduce the battery power consumption:

1. Semiconductor technology which is used in mobile devices should be new generation.
2. Keep mobile phone in idle or sleep mode when it is not in use.
3. Applications which are running on mobile should execute slowly.
4. Offloading the application.

Now, we try to find out whether offloading the M-learning application on the cloud increases the battery life [5].

Offloading may extend battery life by migrating the energy-intensive parts of the computation to servers. The following analysis explains the conditions when offloading saves energy.

Without loss of generality, we can divide a program into two parts: one part that must run on the mobile system and the other part that may be offloaded. The first part may include user interface and the code that requires the heavy computation of the M-learning content. Let *sm* be the speed of the mobile system. Suppose *w* is the amount of computation for the second part. The time to execute the second part on the mobile system is

$$\frac{w}{s_m}. \qquad (1)$$

Suppose p_m is the power on the mobile system. The energy to perform the task can be obtained Equation (1).

$$p_m \times \frac{w}{s_m}. \qquad (2)$$

If the second part is offloaded to a server, sending the input data *di* takes *diB* seconds at bandwidth *B*. Here we ignore the initial setup time for the network. The program itself may also need to be sent to the server. We assume the size of the program is negligible, or the server may download the program from another site through a high-speed network. Offloading can improve performance when execution, including computation and communication, can be done very high speed at the server. Let *ss* be the speed of the server. The required to offload and execute the second part of the application is

$$\frac{di}{B} + \frac{w}{s_s} \quad . \tag{3}$$

Let *pc* be the power required to send data from the mobile system over the network. After sending the data, the system needs to poll the network interface while waiting for the result of the offloaded computation. During this time, the power consumption is *pi*. Incorporating these parameters in Equation (3) gives

$$p_c \times \frac{di}{B} + p_i \times \frac{w}{s_s} \tag{4}$$

. Offloading saves energy when Equation (2) > Equation (4).

$$p_m \times \frac{w}{s_m} > p_c \times \frac{di}{B} + p_i \times \frac{w}{s_s} . \tag{5}$$

To make offloading save energy, heavy computation (large *w*) and light communication (small *di*) should be considered. Instead of transmitting the data from the mobile system to the server, the mobile system needs to provide *links* to the server and the server may download the data directly from the hosting sites. In this case, the bandwidth *B* can be substantially higher, allowing offloading to improve performance and save energy.

6. CONCLUSION AND FUTURE WORK

As we know that we cannot run our M-learning application which is very heavy in the sense of processing power, computation capabilities, high energy requirement and storage capabilities, we cannot use the existing architecture for developing and executing M-learning application on the mobile phones. Today's technology changing very rapidly and mobile phones popularity is increasing day by day and new features in mobile device like powerful processors, storage capacity, Screen size is increasing rapidly. Even though we cannot run M-learning application on today's mobile devices because our M-learning application contains multimedia content, graphics, learning games, animations and high computation mathematical problems. In this paper we solve this problem by giving the new model and architecture for developing M-learning applications which is fully based on the mobile cloud computing environment. We proposed a new architecture of MCC which is based on Virtual Network Computing, Remote Desktop Access Protocol and offloading concept. This model is very much suitable to run M-learning application in today's mobile phones. We can easily deliver E-learning material and efficiently run an application which is energy saving to the student or learner.

But still there are many issues which till are not considered like security issues related to end user application.
In this paper we not provided any programming model for developing such M-learning application in the mobile cloud environment. By providing a suitable programming model to develop M-learning applications developers can easily develop such applications in very convenient manner and rapid development can be possible.

7. REFERENCES

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