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A Proposed System based on the Cloud Computing for Managing Mobile Device Resources while using Educational Platforms

Elsaeed Elsaeed Mohamed Abdelrazek
Professor of Using Computer in EducationComputer Teacher Preparation Department Faculty of Specific Education, Damietta University

Hasnaa Eltabakh
Professor and Head of the Department of Education Technology, Tanta University

Hasnaa Eldesoky Eissa
Assistant Lecture in Computer Teacher Preparation Dep Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy Computer Teacher Preparation in Specific Education Computer Teacher Preparation Specialty using Computer in Education

ABSTRACT
Mobile devices are becoming very popular due to their portability and small size, but they are still not comparable to that of PC. Computational and network intensive applications cannot run efficiently on mobile devices due to their limited batteries and energy deficient systems. Recent works to improve mobile device efficiency include mobile cloud computing, mobile edge computing, and device to device communication. Shifting the computations on the cloud will reduce the burden of mobile device but at the same time, this implementation presents many challenges. In this paper, an algorithm is proposed which can deal with the resource acquisition from different sources by using a context aware system.

Keywords
Mobile Computing, Mobile Devices Resources Management, Mobile Devices Resources, Learning Platform

1. INTRODUCTION
Due to the wide spread of mobile devices (smartphones, tablets and IPads…etc.) and the emergence of 4G, 3G services in the networks of these devices as well as the platforms that support the process of distance learning based on Internet resources. Thus, the skills of dealing with mobile learning applications have become among the modern skills required to be acquired and developed by Students to modernize the educational system. (1)

The Egyptian state has been keen to take effective measures towards the digital transformation of the education system, providing digital educational content to help students use learning resources other than the traditional paper book, and launching a number of electronic educational platforms such as: The Egyptian Knowledge Bank platform, the electronic exam platform, the digital library platform, the platform. Edmodo to communicate and present research

By comparing smart mobile devices with personal computers, we find a gap between them, which is that the computer applications and the growing Internet services used in educational platforms cannot all work efficiently on mobile devices because of their operation systems, some of which still support these applications and others do not support them. Mobile devices suffer from limited resources, such as the device's battery that is consumed during the operation of the educational platforms and the practice of the learning process activities. In addition to the limited memory and processing of these devices, since all other applications loaded with the device share while using those platforms. (5)

It is worthy of mentioning that there is a rapid progress in the technology of smart mobile devices, which has become more demanded and used by personal devices and within the reach of most students. In recent times there has been an increasing trend to use educational platforms and educational mobile in all educational stages, and applications and educational platforms have become an additional burden on the resources of mobile devices. This requires research in technical ways to reduce the consumption of those resources without compromising their functions. The method of relieving the workload of the mobile cloud represents one of the modern technical solutions to reduce that burden and achieve the optimal use of these resources. (6)

The mobile cloud is defined as a technical model that combines cloud computing and mobile networks to alleviate the constraints of limited resources for mobile devices and to significantly overcome the limitations of traditional cloud computing as the mobile cloud has a location-independent account, high-capacity storage resources, reliability, and high efficiency. All these factors help overcome many challenges by allowing mobile devices to migrate tasks that require complex and multiple mathematical operations and complex data into high-performance and scalable computational resources. This is supported by the fact that mobile device applications exhaust the resources and capabilities of those devices, which places higher requirements on processor power, memory capacity and battery life. For those devices mobile computing creates virtual resources for users and is also highly. (9),(10)

The study problem was detected by the researcher via an explanatory study on a sample of (33) students in the final year. The sample belonged to computer teaching branch in the education technology department of the Faculty of Specific Education. The exploratory study aimed to identify the main problems they faced while using Education Platforms and Smart Devices during Covid-19 period. Where most respondents confirmed that there is a major problem represented in the depletion of the resources of mobile devices during the use of educational platforms. The operation of digital applications and educational platforms on mobile devices is affected due to the limited battery of these devices and their operational systems, which consume a large part of their electrical energy, in addition to sharing digital platforms and other applications. The device is equipped with other device resources such as the processor and memory, and this affects the continuation of digital learning activities, including electronic assessment and student performance for electronic tests due to the rapid depletion of battery power. Also, the lag periods that occur before the completion of the learning process.

It is the most important post in this field (7) the effectiveness of a training program based on cloud computing applications in developing mobile learning skills for computer teachers, which aimed that the trend towards developing mobile learning skills has become an urgent necessity for the advancement of students and the educational process.

(11)Investigating students' self-efficacy and attitudes towards the use of mobile learning, which aimed to verify students' self-efficacy and their attitudes towards using mobile learning applications and the results indicated the effectiveness and efficiency of mobile learning in the educational process.

(10) proposes an algorithm for a mobile edge computing distribution system and its results show that the algorithm makes all seats free of errors with minimal rounds of message exchange and bears the maximum number of components allowed by the system.

2. OFFLOADING

Computational tasks are offloaded to the host through network (2). It is only viable if its efficient in every aspect like power consumption, network speed and mobile batteries. Before offloading any task to the cloud, one must properly compute the power efficiency for different components otherwise it may result in performance degradation. Internet connection must be reliable for task offloading which might not be the case with current network technologies as internet might not be available in all situations or is of very limited connectivity. The increase in number of mobile devices is giving rise to the revolution of mobile applications from which most are poor in resource handling. Shifting computation to the cloud consumes mobile batteries which also makes offloading less efficient. One other aspect of offloading is concerned with multi-users. Single user offloading might pose less challenges but what happens when multiple users want to utilize cloud computation on mobile device? (3) A solution is also needed to the problem of when and how a user should select a cloud computational resource instead of using his local mobile based services and through which network channel a user can get better efficiency.

3. DEVICE-TO-DEVICE COMMUNICATION (D2DC)

One other method to reduce load from the mobile device is to create a cloud of mobile devices in which a device to device (D2D) communication is performed. In this method, offloading benefit is achieved by sharing one device resources with other available devices. This sharing requires their users to agree upon a mutual decision of how and which resources they would like to share on the cloud. This technique is very efficient if there is no internet connectivity and users are willing to share their resources with each other. Many design frameworks have been proposed (4),(8) on mutual resource sharing of mobile devices on cloud, however, there is a point of concern that why would a user like to share its resources with anyone? Some of the major key issues faced in using heterogeneous computing resources and wireless networks to implement mobile cloud augmentation are given below:

a. Outsourcing Computation

How to outsource computation is one of the main challenges. It means how to select the best augmentation approach.

b. Unstable Wireless Communication

Wireless communications are unreliable, they are dependent on too many variables like channel interference, channel capacity and limitations of carrier packages.

c. Mobile Device Mobility

Smartphones are portable which is a big plus, but it is also a big negative regarding network connectivity. Network signals are strong in a certain area and are weak in others, a system is needed which can provide consistent computing capabilities across all areas.

d. Context Aware Augmentation Decision Making Strategies

Augmentation is affected by heterogeneity of cloud resources and applications. For example, code offloading may consume a high amount of battery as compared to if running locally on the device. Hence, intelligent augmented strategies need to be designed to cater such problems.

e. Data Security

Outsourcing computation and data increases security risks. The cloud on which these items are hosted must be secure, reliable and should handle privacy very efficiently.

All the techniques discussed so far focus on one aspect separately, but they don't provide a comprehensive solution to the problem of mobile cloud computation. In this research work, an algorithm is provided which deals with the computational problems of cloud, edge and D2D communication as well. Rest of the paper is organized that section II is about the related work done, section III is about all the augmentation techniques related to the MCC and section IV provides an overview of the design, section V provides detail of our proposed algorithm, section VI concludes our paper with some future directions. At the end acknowledgment and references are presented.

4. AUGMENTATION TECHNIQUES

Augmentation techniques are mainly divided into two categories i.e. computation augmentation and storage augmentation (10).

4.1. Computational Augmentation

Computation augmentation is further divided into the computational, decision and supporting techniques.

4.1.1 Computational Techniques

They are further categorized as the models and architectures.

4.1.1.1 Augmentation Models

Popular augmentation models include code offloading and service-oriented task delegation. Code offloading aims at migrating computationally intensive code from resource limited machines to remote computing resources to accelerate the running process of the computation

and reduce energy consumption on limited battery devices. There are multiple ways of code offloading such as Partitioned Offloading in which only sends computation intensive part to the remote servers either statically (hard code partitions) or dynamically (using flow-based programming, .NET common language runtime programming, Java Reflection and distributed shared memory), VM Migration which moves computations dynamically among machines in the distributed system without interrupting the ongoing execution mainly focusing to improve energy efficiency while considering network conditions, Mobile Agent-Based Offloading in which whenever an application using mobile agents needs to request a service from a remote server, like the cloud, it collects the application execution information and passes it to the execution environment of the agent for offloading and remote execution and Replication Based Offloading which benefit the network intensive applications by creating their replicas on remote servers. Service oriented task delegation augments resource-limited mobile devices by utilizing existing services on remote servers with remote process invocation rather than migrating part of the application to the server for execution. It can be implemented using Web Service Based Mobile Cloud in which there is no need to develop native mobile application but only a thin client to relay the service requests to the cloud servers or Open Service Gateway Initiative which is a Java module management system enabling applications to dynamically load and unload service bundles at runtime.

4.1.1.2 Augmentation Architectures

Utilizing parallel execution to distribute computation can significantly reduce the time overhead of handling big data applications by dividing the computation and related data into sub problems with a chunk of data, which are then processed simultaneously on multiple resources. Different frameworks such as GPU computing, OpenCL and MapReduce have been adopted to cope with the big data application. The opportunistic mobile collaboration network provides a solution for mobile devices to dynamically utilize other peer devices in the vicinity to overcome the issue of unstable wireless network connections. Many consider MANET as a mobile device cloud, which is a network of mobile devices connected wirelessly in either a centralized or distributed manner, but its performance can be affected by network congestion. Proactive and reactive fault tolerance techniques can be used to improve network stability.

4.1.2 Decision Making Techniques:

They help in making decision of when and where to offload the code. For making offloading decisions, three main categories are discussed: stochastic process, analytic model, and resource monitoring and profiling. For making task scheduling decisions, the techniques are classified into four categories: heuristic, combinatorial optimization, metaheuristic, and game theory.

4.1.3 Supporting Techniques:

These include the mobility impact and fault tolerance techniques caused by device's mobility.

4.2. Storage Augmentation

4.2.1 Mobile Storage Augmentation Techniques

Most commonly used mobile storage augmentation solutions involve public cloud storage services. To extend mobile storage, the solutions propose middleware's between cloud services and mobile devices to provide data offloading and data management functions.

4.2.2 Data Protection

Three major issues related to data protection are data security, accessibility and authentication. Data security can be ensured by using HTTPS, SSL/TLS, MD% and SHA to capture the original data signature and use of encryption techniques. Attribute Based Data Storage (ABDS) can be used for access control schemes and ALILI framework was proposed to solve the group file sharing problems in mobile cloud systems.

4.2.3 Data Interoperability

One solution is to apply standardized service frameworks and message exchanging techniques such as SOA, REST, XML, and JSON to mobile augmentation systems. Some have used a standard service API's for mobile and cloud device while others have developed some uniform mobile application platform to communicate between different devices.

5. PROPOSED DESIGN

A new design paradigm for mobile cloud computing to increase computational capabilities with energy efficient models for mobile batteries is presented here. When this system will be implemented, it will provide variety of options to both smartphone manufacturers and cloud providers. Regarding user's point of view, users will be able to experience any type of service on their own unlike now-adays, where you need to purchase a new device, when you need to upgrade it specs. If cloud services are used, users can pay via subscription and experience the smartphone environment according to their requirement. Our design caters with all the possible conditions which can occur during a request handling from mobile to cloud. Our model consists four parts mainly as shown in fig 1. First component is the mobile device which is our main concern. Second level components include broker and network edge. At third level there is cloud server which is a main hub for the service provision. In case of broker communication, last level of contact will be other mobile devices available in the vicinity. Details of each level components is given below.

5.1. Mobile device

Mobile device are the main entity of our system which require resources from remote stores for a better performance. Mobile user can be using any mobile device like phone, PDA's, iPad's etc

5.2. Resource Manager

Resource manager is the second most important component of our model. There are two types of resource manager in our case. One, which is a broker responsible for the communication and managing of D2D resource sharing and second is the network edge. In case broker, local mobile connections will be used to avoid any delays and network connectivity issues. Network edge is anything between cloud and the mobile users which is managing the resource for fast entertaining of the requests. Network edge basically cache the most received requested data at its end to avoid direct connection to the cloud server. By using these resource managers, computation capabilities are enhanced.

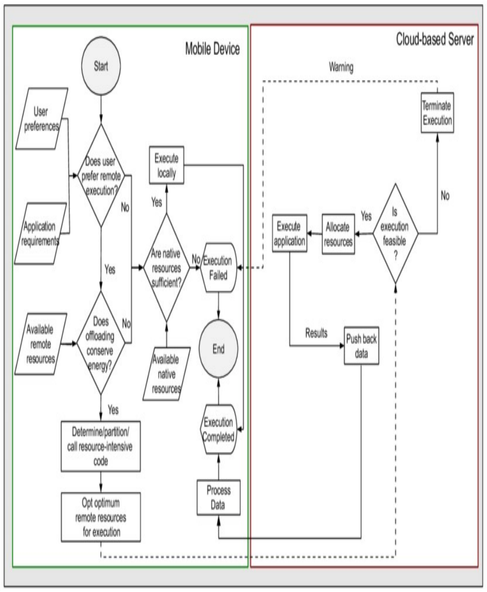

Fig.2. Flowchart for Resource Manager

Sudoku 1: Resource Manager

Input: application requirements.

Target: remote resources for execution.

Output: terminate execution.

Begin

replay the request with a SERVER_REJECTION:

if state = SERVER_MODE then

reply the request with a SERVER_ACCEPTANCE;

else if state= CLIENT_MODE then

reply the request with a SERVER_REJECTION, including server ID and its score;

else The node is still in transition

Fig 3. Resource Manager sudoku

5.3. End Devices

In our case, end devices are the other mobile users who share their resource with the broker in return for some incentive.

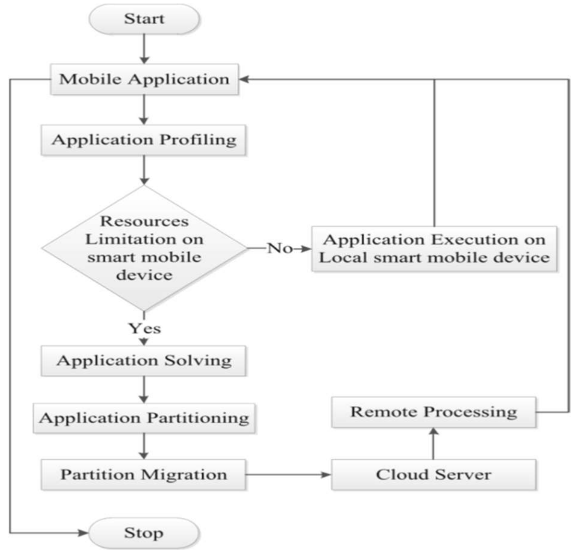

Fig. 4. Flowchart for application partitioning and offloading.

Sudoku 2: partitioning and offloading

Input: student id

Target: resources limitation on smart mobile device

Output: cloud server

begin

if candidate Node = my ID then

state: = SERVER_MODE;

else

send request to candidate Node;

wait until (the candidate Node response or timer expires);

if the timer is expired then

go to line 8;

else if SERVER_ACCEPTANCE received then

server ID: = candidate Node;

state:= CLIENT_MODE;

else

if SERVER_REJECTION has additional information then

candidate Node: = calculate Best Node

end

Fig 5. Application partitioning and offloading sudoku

The previous figure shows has two types including static partitioning and dynamic partitioning. Static partitioning aims to partition the intensive portions of computation load, and dynamic The process of partitioning should identify the part uploaded to the cloud for running. The flowchart of the procedure of the application partitioning and offloading for mobile cloud computing is shown in Fig. Various algorithms have been proposed for partitioning the computation between mobile devices and servers. Nowadays, there are many methods for implementing application offloading. Generally speaking, the offloading frameworks can partition and offload computational load of different granularity levels to remote cloud servers. Partitioning partitioning can dynamically address.

5.4. Cloud Server

Cloud server requires connection to the internet to provide any resources to the mobile users according to their demands fig2.

Sudoku 3: Cloud server

Input: device running
Target: allocate resource
Output: request cloud for resource
begin
if (device is running out of resources)
contact broker:
Broker will request other devices for required resources
if (required resource found)
allocate resource;
else
contact network edge;
if (required resource found)
allocate resource;
else
request cloud for resource;

Fig 6: Sudoku for a Mobile Device to Acquire Resource Management in Cloud

An Sudoku is through which a mobile device which is running out of resources needs a resource from remote stores. According to our algorithm, when a mobile user requires any resource then first of all it will contact the broker to get some of the available resources. Broker is the manager of all the requests from suppliers as well from providers. Incentive mechanism is managed in such a way that if a user requests for a resource then he must be willing to share a resource whenever the broker will need. For example, a user with high storage capacity is running out of battery and he requests the broker to give him some energy harvesting resource, so that he can use his device without any intervention. In that case, broker will make a deal to take his storage to keep a stock of memory. Now, comes the second case, when broker is not able to entertain the user request. In that situation, request will be forwarded to the network edge. As network edge is only able to entertain a specific type of requests, therefore, it will see if the request can be entertained and it has available resources in its cache. Due to limited capacity of network edge devices, if a user requests some different type of request other than usual then that request will be forwarded to the cloud server. Cloud server request might take some time because there can be network connectivity issues, therefore, it is best to keep the cloud a last choice.

Our algorithm is efficient from the previous research that it is taking into account all the possibilities of connections instead of relying on a single source. This may take longer implementation time but once implemented will definitely change the mobile usage future.

5. Results and interpretation

-The goal of the experiment:

The study experience aimed at measuring the impact of using the proposed system through (students of the study sample(33)) in achieving the highest level of managing mobile device resources while using educational platforms applying the proposed system to the experimental group and then applying the observation card to this group.

-Preparing the experimental group:

The meeting was held with the students of experimental group and explained the goal of applying the observation card after using the proposed system for them, and then knowing their attitudes towards the proposed system.

The proposed system was opened by the researcher, then she explained how to operate the system, its components, and its uses. Students were also trained to use the proposed system.

-Actual application of the experiment:

After determining the time and place of conducting the study experiment, the use of the proposed system was applied to the students of one experimental group, then the observation card was applied to them.

Table (1): Shows Frequency, Percent, Mean, Std, Deviation, x2, Sig, and general direction of the suggested of the proposed system skills observation card scores

NO	Skills	Responses	N	Frequency	Percent	Mean	Std. Deviation	X2	Sig.	General Direction
1	Reuse cache buffers.	Greatly achieved	33	30	90.9	1.88	0.415	49.27	0.000	Greatly achieved
		Achieved moderately		2	6.1					
		Not fulfilled		1	3					
2	Manage multiple memory groups efficiently.	Greatly achieved		27	81.8	1.76	0.561	35.1	0.000	Greatly achieved
		Achieved moderately		4	12.1					
		Not fulfilled		2	6.1					
3	Erase temporary files quickly and efficiently.	Greatly achieved	33	24	72.7	1.64	0.653	23.5	0.000	Greatly achieved
		Achieved moderately		6	18.2					
		Not fulfilled		3	9.1					
4	Accurate memory allocation.	Greatly achieved		18	54.5	1.33	0.816	6.8	0.000	Greatly achieved
		Achieved moderately		8	24.2					
		Not fulfilled		7	21.2					
5	Respond immediately to low memory wartime warnings.	Greatly achieved	33	30	90.9	1.91	0.292	49.6	0.000	Greatly achieved
		Achieved moderately		3	9.1					
		Not fulfilled		0	0					
6	Respond immediately to low bottary wartime warnings.	Greatly achieved		26	78.8	1.73	0.574	31.1	0.000	Greatly achieved
		Achieved moderately		5	15.2					
		Not fulfilled		2	6.1					

7	Get things done quickly to conserver resources.	Greatly achieved		28	84.8					Greatly achieved
		Achieved moderately		3	9.1					
		Not fulfilled		2	6.1	1.79	0545	39.5	0.000	
8	Unload applications to ease resource constraint.	Greatly achieved	33	27	81.8					Greatly achieved
		Achieved moderately		4	12.1	1.76	0.561	35.1	0.000	
		Not fulfilled		2	6.1					

It is clear from the previous table that the results of the assessment of skills are statistically at the significance level of (0.05), as it is clear that the average scores of the study sample are close to the application of the observation card towards a response that was largely achieved with degree of 2, and the skill of choosing the appropriate level of insurance when storing in the clouds based on the degree of importance was obtained. The data had the highest average score with a power of 1.91, while the skill preparing a strong password (symbols, letters and numbers) to deal with the lowest level of security levels got the lowest average score and an ability of 1.33.

6. CONCLUSION

Mobile cloud computing is gaining popularity due to increase in mobile applications. This increase has led to the concept of mobile cloud computing. In this work, different techniques and architectures proposed in the literature for MCC are studied. All the techniques presented are until now being used for one type of resource sharing. By keeping the previous research works in consideration, an algorithm is provided which should be able to deal the requests of different users in different situation. A context awareness is introduced to reduce the delay time and network burden. Context is very important as it is the only thing that determines the point of contact for a mobile to use available remote resource. Our proposed algorithm is efficient in the sense that it tries to fulfil some user request at the lowest possible level. If it does not find the required resource at a certain level, only then the requested should be forwarded which in turn reduce the overall network traffic and increase response time.

7. FUTURE DIRECTIONS

Implementation of this algorithm might present many challenges as it will be complex. It should be further investigated that how to this algorithm will be able to accommodate all the connections. In future, practical implementation of this algorithm on small scale will be presented. Our proposed algorithm is using a broker middleware for the device to device communication but in future, a mechanism can be devised that will enable the devices to contact with each other without any third-party intervention. Some of the points which should be further explored are:

a. Heterogeneous Mobile Cloud Service

A variety of smartphones are available in the market having different Operating systems and different types of sensors. The proposed cloud system should be able to handle requests and data from all these types.

b. Context Awareness

Additional information such as device mobility, network info, sensors being used can provide additional info on how to handle the cloud system across a variety of different types of devices. 3. Quality of Service Management: An efficient system should be designed which should have a small server response time, can scale resource according to current app usage and provide constant wireless communication.

c. Reliability of Mobile Cloud Augmentation Systems

As smartphones are mobile devices, the environment always keeps changing. This can affect the availability of computing resources which are dependent on network. So, a reliable system needs to be designed which provide proactive fault tolerant systems

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