ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 4, April 2017

Enhancing Energy Proficiency in Resource Constrained Devices through Selective Cloud Offload Data Computation

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ABSTRACT: In this ultra modern era, Mobile technology has become perfervid and a highly intrinsic component of daily human lives. Especially the rise of mobile phone advancement from feature phones to Smartphone running on different operating systems such as Android and iOS made life so much easier. Despite the significant evolution and advancement in mobiles, users raise a high demand for optimal performance of computational intensive applications due to energy constrained nature of mobile computing devices.

The need for increased performance of mobile device directly conflicts with the desire for longer battery life. The existing system is based on several hardware solutions that put an effort to make every network layer more energy efficient say green network which lead to high time and space complexities. Also lacks precise method to handle service failures. Therefore, the proposed system mainly focuses on decreasing the working time of mobile device through selective, fault tolerant offload computation decision algorithms in mobile cloud computing, ensuring energy proficient, reliable and optimal system performance.

KEYWORDS: Mobile cloud computing; Resource constrained devices; energy proficient; selective decision algorithms; dynamic task partition.

I. INTRODUCTION

Mobile and cloud computing are converging as the prominent technologies which have expanded the usage of computers from desktops and mainframes to a wide range of mobile and embedded applications. Mobile cloud computing (MCC) as a new paradigm for mobile applications whereby the data processing and storage are moved away from the mobile device to powerful and centralized computing platforms located in clouds. These centralized applications are then accessed over the wireless connection based on a thin native client or web browser on the mobile devices, bringing applications and mobile computing to not just smart phone users but a much broader range of mobile subscribers. Directly or indirectly most of the businesses use SaaS applications for their business via mobile. So MCC will an integrated part of business economy in near future.

Most of mobile applications use wireless networks and their bandwidths are orders-of-magnitude lower than wired networks. Meanwhile, increasingly complex programs are running on these systems-for example, video processing on mobile phones and object recognition on mobile robots. Thus there is an increasing gap between the demand for complex programs and the availability of limited resources. So the concept computation offloading technique is proposed with the objective to migrate the large computations and complex processing from resource-limited devices (i.e., mobile devices) to resourceful machines (i.e., servers in clouds). This avoids taking a long application execution time on mobile devices which results in large amount of power consumption thereby ensuring system more energy proficient with optimal performance.

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II. RELATED WORK

Selective data computation offloading technique is proposed with the objective to migrate the large computations and complex processing from resource-limited devices (i.e., mobile devices) to resourceful machines (i.e., servers in clouds) which helps in reducing the running cost for compute-intensive applications that take long time and large amount of energy when performed on the limited-resource devices. Rudenko *et al.* [1] and Smailagic and Ettus [2] evaluate the effectiveness of offloading techniques through several experiments. The results demonstrate that the remote application execution can save energy significantly. Especially, Rudenko *et al.* [1] evaluates large-scale numerical computations and shows that up to 45% of energy consumption can be reduced for large matrix calculation. In addition, many mobile applications take advantages from task migration and remote processing. For example, offloading a compiler optimization for image processing [3] can reduce 41% for energy consumption of a mobile device. Also, using memory arithmetic unit and interface (MAUI) to migrate mobile game components [4] to servers in the cloud can save 27% of energy consumption for computer games and 45% for the chess game. Mobile applications as typical mobile app will just be on the back-end where the end users won't even notice a difference. The mobile applications will begin to store your data in the cloud as opposed to on the mobile device, and the applications will become more powerful as processing power is also offloaded to the cloud [5]. A novel min-cost offloading partitioning (MCOP) algorithm that aims at finding the optimal partitioning plan (determine which portions of the application to run on mobile devices and which portions on cloud servers) under different cost models and mobile environments with low time complexity which can significantly reduce execution time and energy consumption by optimally distributing tasks between mobile devices and cloud servers, and in the meantime, it can well adapt to environmental changes[6]. Another example is Image Exchange which utilizes the large storage space in clouds for mobile users [6]. This mobile photo sharing service enables mobile users to upload images to the clouds immediately after capturing. Users may access all images from any devices. With the cloud, the users can save considerable amount of energy and storage space on their mobile devices because all images are sent and processed on the clouds.

III. EXISTING SYSTEM

The mobile user practice of using remote servers hosted on internet to store, manage and process data has become enormous in day to day human life. With the computing operations and mobile device technologies expanding to great extent, it has become immediate necessity to provide unlimited computing power and storage to the resource constrained mobile devices. The concept of MCC helps in reducing the running cost for compute-intensive applications that take long time and large amount of energy when performed on the limited-resource devices. But lacks appropriate offload computation decision algorithms that influence application structuring, partitioning choice and code portability with reliable data security. More over the existing offload computation algorithms has considerable impact on fast battery drain, making device energy deficient which in turn slows down the desired performance. Consider the example of Gaming on smart phone which is the most draining application on device since graphic engines are massive energy drainers. This also depends upon the applications the internet being used such as video streaming, audio streaming, and other graphics-intensive activities will drain the battery faster. Today, there are already some good examples of mobile cloud computing applications including mobile Gmail, Google Maps, mobile commerce, mobile wallet and some navigation apps. However, the majority of applications today still do most of the data storage and processing on the mobile devices themselves and not in the cloud.

IV. PROPOSED SOLUTION

A presumptive solution to the problem stated above is presented by selective and fault tolerant offload mobile cloud computing decision algorithm. This soft mobile computing architecture is aimed at sharing information and applications in ease without the need of complex and costly hardware/Software because most complicated large computations and complex processing jobs get migrated from resource-limited devices (i.e., mobile devices) to resourceful machines (i.e., servers in clouds) for computation. This enhances mobile device energy proficiency without

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compromising performance and reliable services. For instance: Devices like high end navigators store maps and routes locally where they need cloud just to receive real time information on route planning and traffic updates.

The architecture can be implemented and incorporated on mobile client side which invokes a local performance analysis code to decide what modules to run at the client and what to run at the server dynamically at a runtime by automatically discovering and composing services for user. Then the system will choose a suitable partitioning policy so that the total energy consumption is minimized. Modules containing sensitive data will be executed locally for security reason. The code portability is provided to create two versions to support interoperability. The performance analysis algorithm involved takes care of making decisions on whether to compute data locally or offload data to remote servers or re-offload the data on failures. After selective execution of some operations on the cloud, reintegrating the results back into the smart phone is assured for output presentation. Therefore the mobile devices need not have a powerful configuration to perform high compute intensive operations and can extend a battery lifetime for better performance.

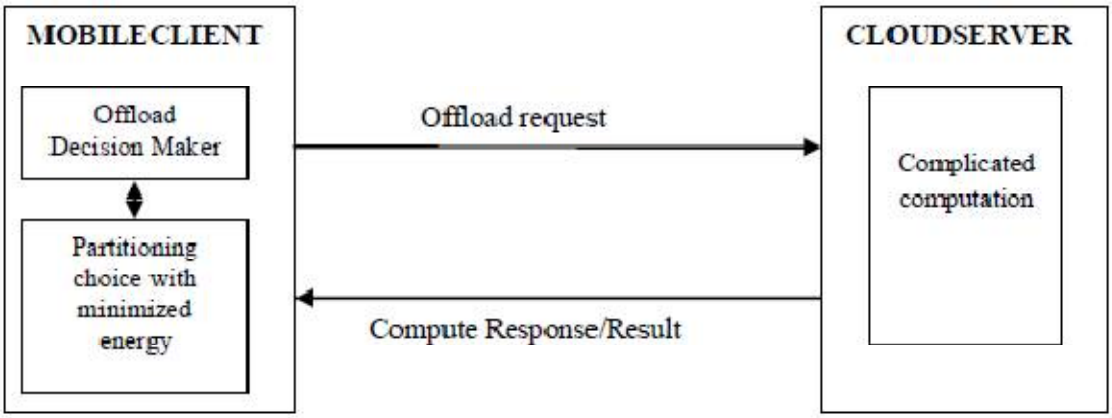

Fig.1. Proposed System Conceptual View

V. PROPOSED ALGORITHM

Step 1: User logs into application and submits request.
Step 2: Check database for case based reasoning of submitted request.
Step 3: If avail in database, Extract partition modules plan. Go to step 6
Step 4: The offload decision maker collects a device & wireless connection status and off loadable code features.
Step 5: Create dynamic partition of application into several task modules.
Step 6: Check the below condition,

```
If (Data modules are sensitive OR Less compute intensive)
    Make the parts run locally
Else
    Offload the data module to remote host in cloud
End
```

Step 7: Calculate the energy consumption of a device.
Step 8: Update the local database with partition information for respective application.
Step 9: Receive computed response or result from remote cloud.
Step 10: End.

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VI. RESULT

To demonstrate energy proficiency in resource constrained devices, a simulated experiment was conducted with several applications ranging from numerical calculations, matrix multiplication, image processing to high complex gaming components. The performance was measured in terms of local mobile run time and cloud run time by processing them separately which lead to the observation (Fig.2.) that, as application complexity level increases cloud run time decreases comparatively. So offload computation results in energy savings with proper selective distribution of tasks between local and remote processing area.

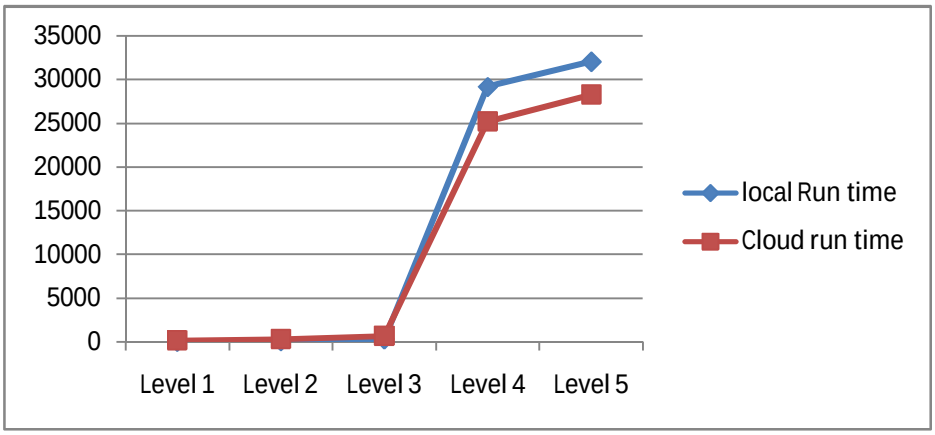

Fig.2. Local Run time Versus Cloud Run time in milli seconds at different levels of complexity.

VII. CONCLUSION AND FUTURE WORK

An approach of selective offload computation in resource constrained devices leads effective dynamic partition of a given application into local and remote parts which incur significant reduction in overall execution time and energy consumption by optimal distribution of tasks to be performed. This solution runs with low complexity and well adapts to environmental changes such as network perturbation. The code portability and security to sensitive data can be better implemented in future.

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BIOGRAPHY

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