Improving Efficiency and Extending Battery Life by Offloading Mobile Computation to Cloud

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Abstract— Mobile cloud computing is fast taking over the world by storm as the spread of smart phones soar and have become the primary replacement for desktop for many users. Various studies have identified longer battery lifetime as the most desired feature of such systems. Computing resources such as processing, memory, and storage are not physically pres¬ent at the user's location. But in case of smart phones processing virtually reduces the battery life of the phone and also heats up the device. The cloud heralds a new era of computing where numerous application services are provided which enhances the capability of mobile devices but the major problem faced is the rapid energy depletion in the batteries. The focus is to provide a solution for extending the mobile battery lifetimes. Cloud provides application services through internet. Thus mobile cloud can enhance and extend the capability of mobile systems processing power. A cloud service provider owns and manages these resources, and users access them via the Internet. The primary constraints for mobile computing are limited energy and wireless bandwidth wherein vendors provide computing cycles to do such tasks by the devices applications installed on the cloud platform and thereby reduce computation on mobile devices and thus save battery energy. Thus, cloud computing can save energy for mobile users through computation offloading. By using mobile cloud computing platforms energy savings in mobile devices will be a reality. The study focuses on the process of mobile computation offloading to the cloud thereby extending battery life, reducing memory and cpu usage thus saving valuable resources.

Key words: Mobile Computation, Offloading, Cloud Computing

I. INTRODUCTION

Cloud provides application services through internet which enhances the capability of mobile devices computing. Mobile computing resources like processing, memory, data storage etc not present at the user's location can utilize a mobile cloud service provider which owns and manages such resources where users access via Internet. The primary constraints for mobile computing are limited energy and wireless bandwidth. Mobile cloud can be harnessed to provide energy savings as a service to mobile users by offloading computation. Existing systems are of two types Computational offloading and Data Binding. Computational offloading is an optional process where computation processes are offloaded to the cloud. A mobile operation requires high amounts of computational processing Also only few amounts of data can be sent in the message communication. A mobile application is partitioned into methods, classes etc and analyzed a priori (at development stages) or a posteriori (at runtime). The most computational expensive operations are identified and offloaded. A mobile offloading decision mechanism works on fuzzy logic. A repository of code offloading traces along with a cluster to analyze it. A cloud-based messaging framework pushes data to the handset asynchronously. So Mobile Tasks are delegated to the Cloud and hence energy is saved.

II. RELATED WORK

Antti P. Miettinen et al studied about measurements regarding the central characteristics of standard mobile handheld devices and defined the basic balance between local and remote computing. They proposed a concrete example, which demonstrated energy savings that showed that the trade-offs are highly sensitive to the mobiles workload and data communication patterns including technologies applied. Karthik Kumar et al analysed cloud computing capability of mobile systems and arrived at a result that ultimately such solutions are useful prolonging battery lifetimes.

Vijeyta Devi et al proposed an analysis of the critical factors affecting the energy consumption in mobile clients using cloud computing. They consider that the performance will be very fast when a faster tool is utilized to solve the bandwidth speed problems. Interestingly it is achieved by increasing throughput, minimizing response time, and simultaneously increasing resource utilization.

Byung - Gon Chun et al proposed CloneCloud, a system which transforms automatically computing intensive mobile applications to the mobile cloud. They proposed a flexible application partitioner architecture that enables unmodified mobile applications to run as virtual applications to seamlessly off-load part of the mobile execution from mobile devices onto similar mobile clone devices operating in the cloud. Thus CloneCloud uses a combination of static and dynamic analysis profiling to partition applications automatically by optimizing the execution time and extending the energy use for a mobile target computation and communication environment. Eduardo Cuervo proposed MAUI, which is a system that enables energy aware mobile code offloading to the infrastructure which decides at run-time what methods should be remotely executed. K. Akherfi et al reviewed the concept of Cloud Computing and Mobile Cloud Computing and proposed an architecture comprising a middleware with functionalities provided to mobile clients in order to overcome the problems of low battery power, slow CPU speed and little memory. Huber Flores et al proposed a fuzzy decision engine for code offloading involving a smart decision process based on evidence learning methods and by exploiting cloud processing capabilities over code offloading traces.

III. PROPOSED MODEL

Mobile computation offloading means the transfer of certain intensive computing tasks to an external platform, such as a cluster, grid, or a cloud. Mobile cloud offloading is necessary due to the hardware limitations of a mobile device

due to rapid loss of battery energy, less memory, cpu, less storage capacity and also heating. These computationally intensive tasks are offloaded to the mobile cloud. This is a computational decision making framework whereby computation offloading saves the devices energy by extending battery lifetime and also causes less heating. However there are certain constraints like limited energy and wireless bandwidth. Thus mobile offloading to the cloud and computing there can provide energy savings as a service to mobile users.

The most computational expensive operations are identified and offloaded to the cloud. The model uses graphics processing like grayscale conversion of images, noise removal, edge detection etc. as tasks. The mobile offloading architecture proposed decision mechanism repository of code offloading traces along with a cluster to analyze it. The system which is a framework pushes the data to the handset asynchronously. So Mobile Tasks are delegated to the Cloud and hence energy is saved.

IV. IMPLEMENTATION

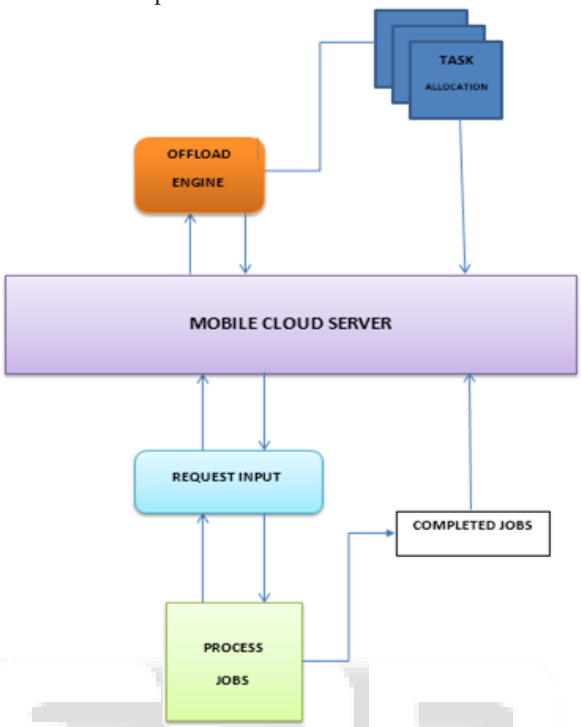
Several analysis show that the energy saved by mobile computation offloading depends on the wireless network bandwidth B, the computation load C, and the data transmitted D. Existing studies focus only by prediction models whether to offload mobile computation which is a fundamental assumption underlying this analysis with the client-server model since the data does not reside in the server and all data must be transferred to service provider. The client must offload the program and data to the server. The cloud stores data and performs computation on it.

V. PROBLEM DEFINITION

Data outsourcing means sending personal data to the cloud for processing which is a security concern. As data transfer to the cloud information like healthcare, criminal, personal banking records tax payments etc makes security and privacy in the cloud a critical concern but it is altogether a different issue corresponding to the cloud. Multimedia content like images and videos have significant redundancy. The offloading techniques can be used to transform the data so that operations can be performed without exposing them. Performing other techniques before sending data to the cloud requires some additional processing capacity on the mobile system and consumes additional energy.

Another potential concern with mobile cloud computing is bandwidth. Whenever a mobile user performs computations in the mobile cloud the data and has to be transferred using internet and mostly it is a wireless network provider. Such dependence on the wireless network with limited connectivity implies that code offloading to cloud computing may not even be possible, let alone being energy saving. This makes it difficult to transform the data and still perform operations. It is hard to check a document that has characters mapped onto symbols. If the mapping is a one to one and onward, alphabet frequency can be easily used to determine the words.

Similarly, other computations like meaningful mathematical ones, image processing is also difficult. Performing computation on encrypted or data still remains an open research problem. In some rare cases for very small computational tasks considering the additional energy for privacy and security it is insignificant to perform the task in the cloud and might not give the desired energy savings comparatively. Therefore it is more prudent and energy efficient to do operations in the mobile device, since processing power is almost nought when the device performs the computation.

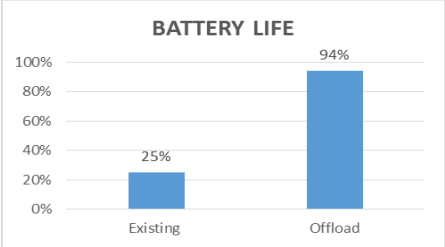


VI. PERFORMANCE EVALUATION

Low-power design has been an active research topic for many years. While searching low and power in produces more than 5,000 results. The model eliminates computation in the mobile device and instead computation is performed in the mobile cloud which extends the mobile system's battery lifetime.

Methods	Work	Consumption	Battery Life
Existing	Grayscale Conversion	75 units	25%
Offload	Grayscale Conversion	6 units	94%

The results when grayscale operation was performed without offloading and subsequently the same operation when offloaded shows the battery consumption in units.

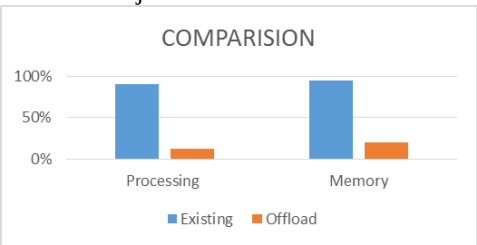


The above graph shows that the battery life is extended significantly when jobs are offloaded to the cloud instead of the traditional model. It is nearly 4 times than the existing model when processed locally.

Methods	Processing	Memory

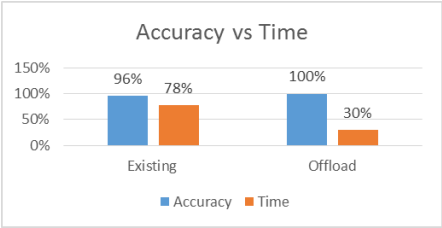
Existing	90%	95%
Offload	12%	20%

Similarly the RAM and processing power is significantly high when processed locally. But is less significant when the jobs are offloaded to the mobile cloud.



Methods	Accuracy	Time
Existing	96%	78%
Offload	100%	30%

Accuracy is almost the same wherever the job is processed. But the time taken is less in the proposed model.



VII. CONCLUSION

In the cloud, computing and storage space resources are virtualized. The study proposed that offloading code from the mobile to the cloud can potentially save valuable energy and resources for mobile users. However not all applications are energy proficient which moves around to the cloud. Mobile cloud computing services is considerably dissimilar from cloud services for desktops suggest energy savings. This research work is finished in the area of mobile image computation processing and offloading to cloud. The procedure uses images to process the data and has been tested with different procedures combination in different orders before arriving at the solution. The final solution of the study is offloading reduce the computational load in the device thereby saving energy. It is concluded that the mobile offloading architecture is tested very well and saves energy efficiently.

VIII. FUTURE ENHANCEMENTS

The project can be enhanced further to all mobile and computer based applications as well in the future. If implemented as web services the entire project is rescheduled to work in the web without installing any applications in the client and users can seamlessly work with their projects in the future without any overloading.

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