



Survey on Computational Offloading In Mobile Cloud Computing Environment

Anupam Bonkra
UG Student

Department of Computer Science
Sri Sukhmani Institute of Engineering and Technology, Derabassi, Punjab, India

Abstract:

In the modern technology mobile devices (Smartphone) are become imperative tool for communication. Compared to desktop devices, mobile devices (Smartphone) are mostly used for sharing data over the network. But when we transfer these data they consumes great amount of energy and time. With the promulgation of mobile cloud computing, researches are looking for new elucidation for resolved energy consumption and time problem. In this paper we focused on very sophisticated technology defined as mobile offloading and mash up. This paper also described the computational offloading scheme for mobile devices to perk up the energy and time consumption for any kind of application. We also represent how this computational offloading is works with the client and server distributed system. For this offloading, in this paper we also defined the optimal partition algorithm for find out the optimal solution for our problem. At last there are some evaluation shows significant improvements of energy consumption and time for the android mobile device with the help of offloading.

Keyword: Mobile cloud computing, computational offloading, decision making algorithm, energy, time and weighted model, virtual machine

I. INTRODUCTION

With the advancement in the IT industry, the use of mobile devices has changed spectacularly. Every people are now totally depending upon the mobile devices for performing any kind of activity. Mobile devices are pay attention of user for performing number of task simultaneously. All mobile devices are battery powered and when we execute number of task at a same time, it may be affected by lying down the power capacity of mobile phones. The Smartphone provide multi-core processors, sharper screens, larger memory, multiple sensors and radios as well as enormous application. With some positive point Smartphone and tablet PCs having some constraints also such as battery fortitude, computational performance and portability. Each mobile application having more powerful function but for complex calculation it consume more power and time , for resolve this problem of all mobile devices we introduced a basic terminology is offloading computation in mobile cloud computing. In the mobile cloud offloading we integrate the cloud computing into mobile devices and overcome the problem in mobile like performance, energy and security also. There are three basic component defined in mobile computing, first one is hardware, second is software and last one is communication link. The cloud intangible for reduce the complexities of computation and storage infrastructure. Offloading play very important role in the mobile cloud computing research and it also similar as emerging cloud computing exemplar. The offloading technique used to overcome the limitations of mobile phones in terms of computation, memory and battery. Basically in this method we work on the virtual machine. In addition each mobile device acts as an individual resource, but some external resources are also applicable for offloading the data. In this paper we pertain this

computational offloading on the Android platform. We introduced the client and server task for operate offloading techniques easily. Our hand-outs include amalgamation with the established Android application model for development of offload able application and provide great environment for user to fastest access. For the Android application very popular service is used named as Mobile Augmentation Cloud Services (MACS).

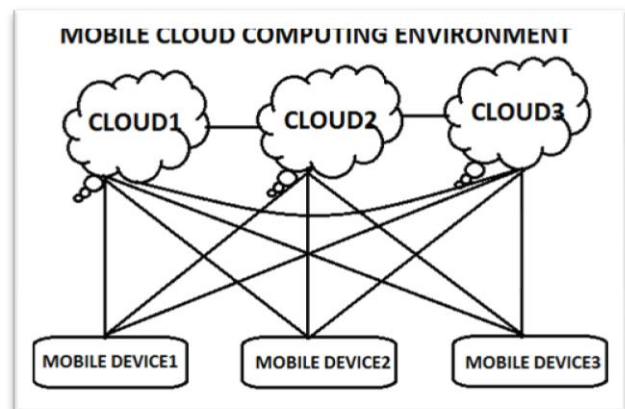


Figure.1. Basic structure of Mobile Cloud Computing Environment

II. COMPUTATIONAL OFFLOADING SCHEME

For performing computational technique on the mobile environment, we divide the computation of whole program into different modules and task. Those tasks are known as server and client task. Each server task run on the particular server and client task is executed on any kind of handheld devices. There

are number of offloading method available in advertise, but in this paper we go through two basic technique of offloading is named as **cyber foraging** and **surrogate computing**. The term Cyber foraging is insidious computing technique where mobile devices offload some of philosophical work to stronger surrogate machines in the environs. The concept of cyber foraging was introduced by M. Satyanarayanan in the year of 2001. Cyber foraging is used to transfer heavy computational tasks from one resource limited device to one more powerful server for execution and return back the result to the initial device. The term Surrogate computing is a method to design problems require experiments and simulations to evaluate design objective and constraint functions as function of design variable. In this model we may find out the number of simulation solution for complex problem.

III. RELATED WORK

Dejan Kovachev and Ralf Klamma[1] present the Mobile Augmentation Cloud Services (MACS) middleware which enables adaptive extension of Android application execution from a mobile client into cloud application s are developed by using the standard Android development pattern. Two prototype applications used to demonstrate the benefits of MACS. The proposed model and corresponding algorithm is applied to computational offload the mobile cloud. Overall the energy and execution time is reduced and which prove that overhead of framework is small. **Kumar.K, Lu.Y[2]** suggest a program partitioning based on the estimation of the energy consumption (communication energy and computation energy) before the program execution. **Gabriel Orsinia,, Dirk Badaea, Winfried Lamersdorfa[3]** present the prominent solution regarding energy and time in the computational offloading. It also described the requirement list for MCC applications and provides a design guideline for the selection of suitable concepts for different classes of common cloud augmented mobile applications. The centralized offloading and opportunistic offloading is also explained for reached at a final solution. At last it conclude extensive list of requirements, based on ISO criteria for software quality and a set of typical use cases. **Kuljeet Kaur and Dr. Pankaj deep Kaur [4]** present an emerging technology for manage the basic aspects such as time, energy and memory is popular as mobile offloading and mashup. It also describes the quality of services parameters used for offloading in mobile applications and also describes the existing approaches for mobile cloud computing. It also represent Cuckoo programming model for mobile environments. This model supports both local and remote execution of application technique to keep applications working when cloud resources are not available. It gives paper literature survey was reviewed to know about quality of services and offloading in mobile application. **Saeid Abolfazli, Zohreh Sanaei, Ejaz Ahmed, Abdullah Gani, Rajkumar Buyya[5]** present comprehensively surveys the mobile augmentation domain and taxonomy of CMA approaches. The objective of this study is to highlight the effects of remote resources on the quality and reliability of augmentation processes and discuss the challenges and opportunities of employing varied cloud-based resources in augmenting mobile devices. We described deficiencies of current mobile devices as a motivation for augmentation. In this we comparing surrogates as traditional servers with

contemporary cloud based infrastructures advocates adaptability of cloud computing and principles as appropriate back end technology in mobile augmentation domain. **X. Feng, D. Fangwei [6]** Phone2Cloud, a computation offloading-based system is devised for energy saving on smart phones in the context of mobile cloud computing. This system is a semi-automatic offloading system. In this two sets of experiments are conducted and the results demonstrate that our system is of great effectiveness. **Pummy Dhiman, Kamal Kumar[7]** we represent a computational offloading scheme on mobile devices to improve the performance and energy consumption. We apply the optimal partition algorithm to find the optimal program partition for given program input data. We use EM algorithm for optimal partition the application running on smart phone. This system is fully –automatic system. **Afnan Fahim, Abderrahmen Mtibaa, and Khaled A. Harras[8]** represent the highlight gain in computation time and energy consumption that can be achieved by offloading tasks to nearby devices inside a mobile device cloud. We describe four basic model in this system named as analytical modeling, network simulation, network emulation, and real world experiments. We also provide an API that allows algorithms for offloading decisions to be tested on an actual mobile device cloud consisting on multiple devices. **Rajesh Krishna Balan, Darren Gergle, Mahadev Satyanarayanan, and James Herbsleb[9]** describe a solution that combine a “little language” for cyber foraging with an adaptive runtime system. In this we show the comparison between the qualities of novice-modified an expert modified application in some cases. **Roopali, Kumari.R [10]** presented the challenges with offloading such as latency rate which mainly depends on factors like code to be offloaded, distance between smart phone device and the remote server, network bandwidth, heterogeneous environments and results of computations. **N. Jeevitha, Dr. G.Kesavaraj[11]** present a mobile computation offloading problem where multiple mobile services in the workflow can be invoked to fulfill their complex requirements and makes decision on whether the services of a workflow should be offloaded. The proposed system is used to offload the system in cloud. Moreover the effects of limited bandwidth, intermittent connectivity and frequent changes of available resources cause further obstacles to the widespread of MCC.

IV. ALGORITHM FOR COMPUTATIONAL OFFLOADING

The algorithm play very important role when we optimize the mobile applications. The main motive of this algorithm is executing the application in the cloud, without draining the battery. The novel offloading approach is described in this paper which combines the advantages of the earlier state of application and execution target fluctuations in network conditions. The EM algorithm is applied for obtain the best result for offload the network. An expectation-maximization algorithm is an iterative method to find out the maximum likelihood (posteriori) (MAP) estimates of arguments in statistical model and the model depend upon unobserved latent variables. Where E stands for Expectation step and M stands for Maximization step.

$$P(\text{Model} | \text{Data}) = \frac{P(\text{Data} | \text{Model}) P(\text{Model})}{P(\text{Data})}$$

The EM algorithm is also used in various motion estimation frameworks and variants such as multi frame, super resolution, restoration methods which combine motion estimation along the line of. This algorithm proceeds from the observation whose are used to solve two sets of equation with numeric numbers. In this we picked up the arbitrary values for two unknown sets, and use them to find the best one among form those two. This algorithm having two basic steps to find out the best solution The Expectation step used current best guess for the parameters of

the data model, we develop an expression for the log likelihood for all data, observed and unobserved and outline the expression with respect to the unobserved data. The maximization step is generating the result from the previous step, for the next guess we choose those values for the model parameters that maximize the expectation expression. That provides the best result for model parameters. The below flowchart shows the working structure of EM algorithm

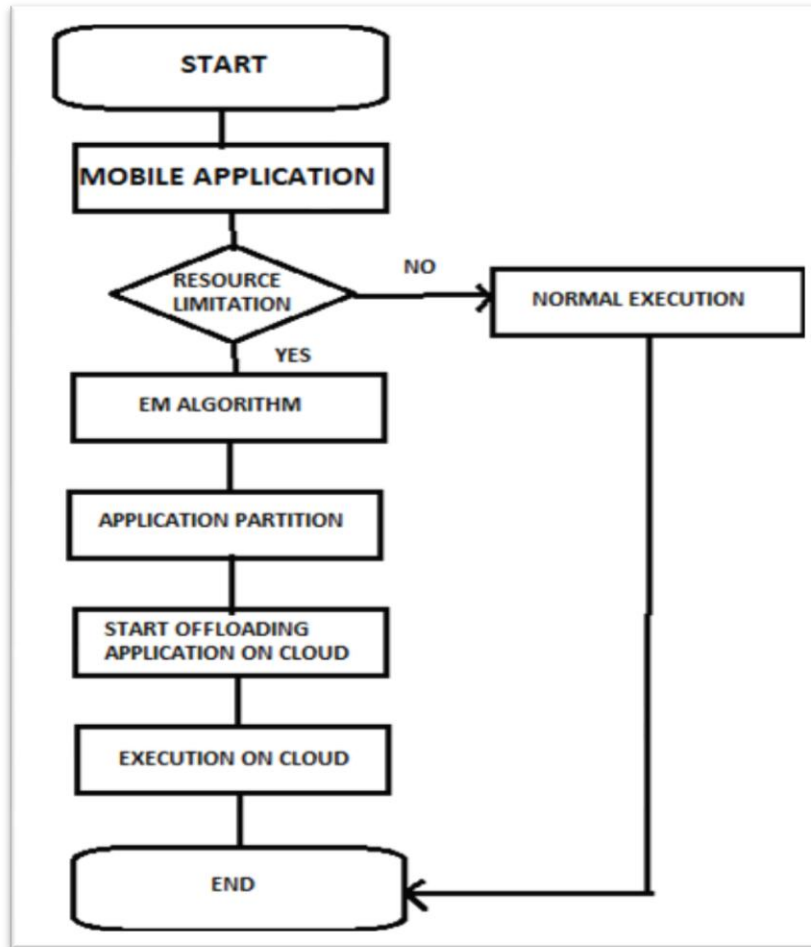


Figure.2.Flow chart for EM algorithm

PERFORMANCE METRICS

The performance metrics is used to measure the behavior, activity and performance for the offload network. In this paper, we measure the energy consumption by mobile devices before and after offloading. And also optimize the response time which is used to perform any kind of operation. At last also estimate the total application cost for offload the devices over the cloud network. These metrics are very valuable in the field of cloud offloading for mobile devices. Now we are going to tell about how those metrics optimize the data with the help of research methodology.

THREE BASIC MODELS

In the cloud offloading three basic models are required named as cost model, energy model and weighted model. Offloading decision depends on the previous task, so we have also preserved the previous for further processing and its takes more time. Prediction is very important in offloading if we take some wrong prediction it generate some errors in processing. In this paper the

fully automatic offloading is used. Energy model is used to calculate the energy gain of offloading. It is defined as total amount of work performed over a period of time. In this we also calculate the time of offloading of given tasks. After this calculation perform offloading. Cost model we calculate the total cost used to offload the application and also calculate the memory gain of offloading. Weighted model is used to measure the weighted energy and time before and after applying offloading. So all above model are very useful in offloading and we apply the following algorithm for those model

Algorithm - Weighted model

For (I=1; I<k; I++)

{

Calculate the memory gain of offloading

Gain $\leftarrow \sum_{I=1}^n (\text{mobile}_I - \text{cloud}_I) - \text{input}_I - \text{return}_I$

End

$U_I \leftarrow \max \{ \text{gain}_{I \text{ to } 1} \mid 1 < I \leq k \}$

Integrating point $\leftarrow \text{EM} (\max (\text{gain}_{I \text{ to } 1} \mid 1 < I \leq k))$

For (j=2; j<k; j++)

Calculate the time of offloading of j^{th} task
 $X_j = x_{j-1} - (\text{mobile}_{j-1} - \text{cloud}_{j-1}) + \text{input}_{j-1} - \text{input}_j$
 }
 Offloading point

HARDWARE FOR OFFLOADING

As a part of hardware we use android handheld devices as client and the server is Acer having Intel(R) Core(TM) 2 Duo CPU 2.20 GHz. The eclipse used as application software for make connection with the server and client on cloud. The Cloud Sim is works as simulation platform, as it is modern simulation

framework aimed at cloud computing environments. The number of nodes varies from 5-500, 45 virtual machines are used having 500MB RAM and 5 MIPS processor frequency.

RESULT FOR 3- MODEL

According to the above detailed information, simulation is executed using the Cloud Sim simulator to scrutinize the effect of computation offloading. In this module we discussed the evaluation of different performance metrics like cost, response time and energy consumption.

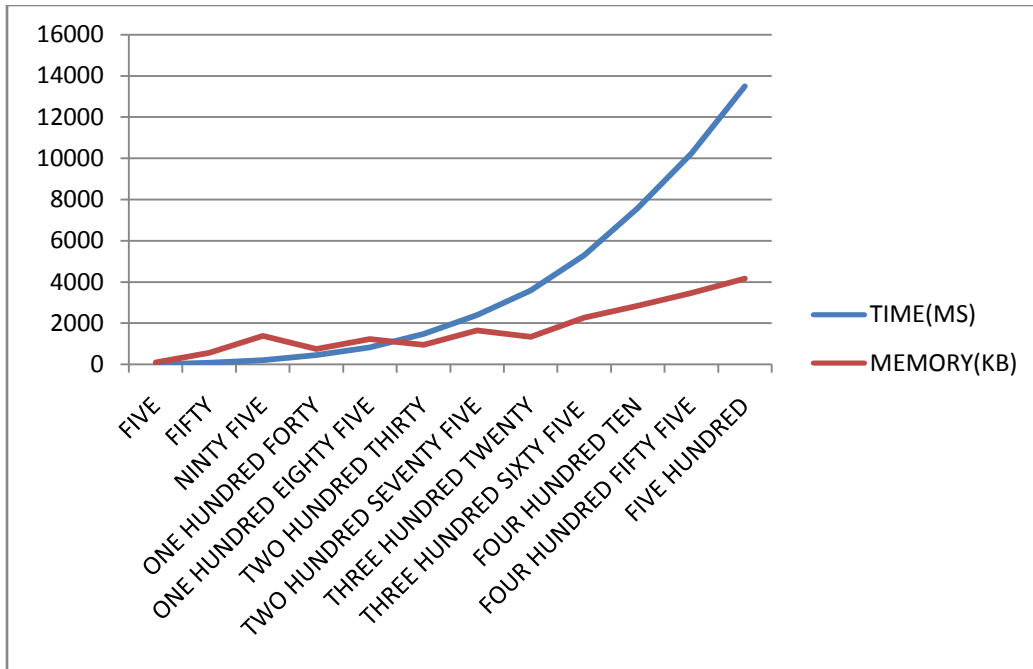


Figure.3. Time and Memory used in Cost Model

The above figure shows simulation graph between response time and memory in cost model.

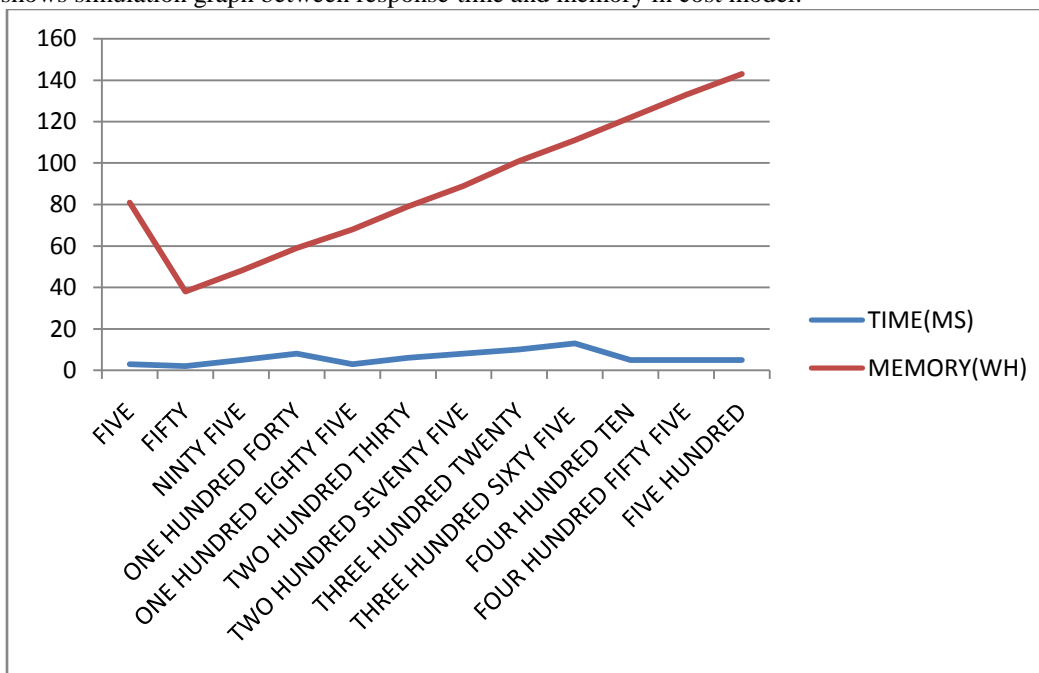


Figure.4. Simulation graph for Energy model

The above energy model is used to represents the battery power consumed by the mobile device.

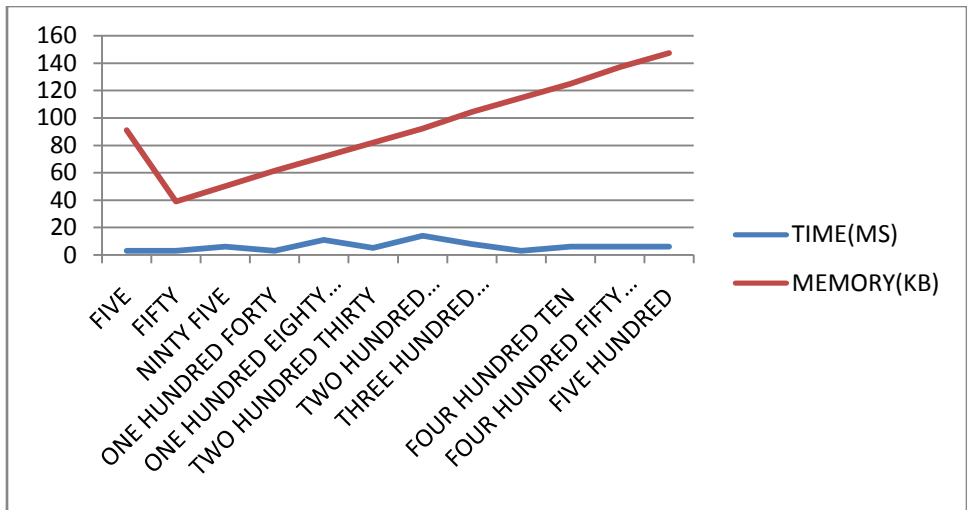


Figure.5. Simulation graph for weighted model

The above figure shows the time and memory used by task after optimal partitioning for computation offloading, and it clear that it uses less time and memory as compare to the other models.

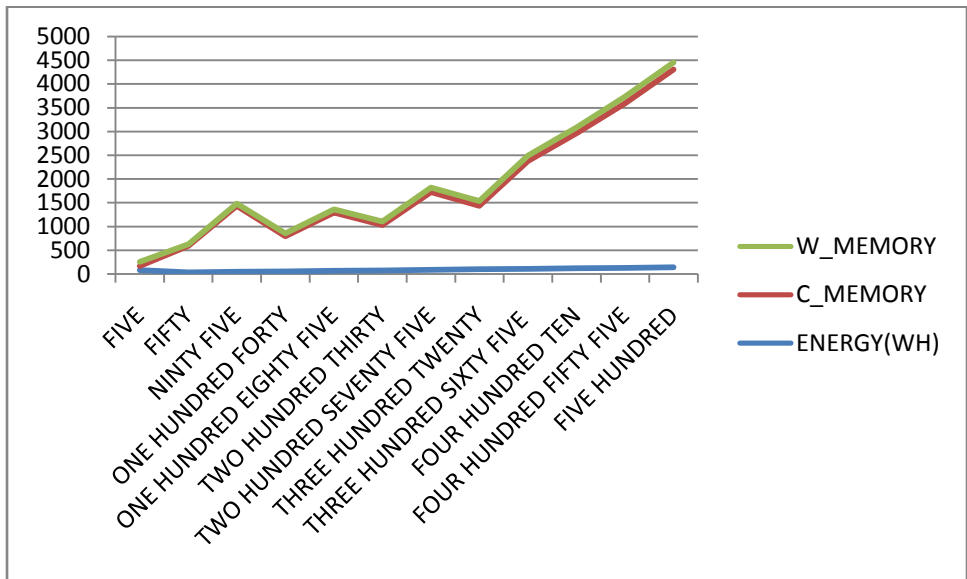


Figure.6. Energy used in cost model and weighted model

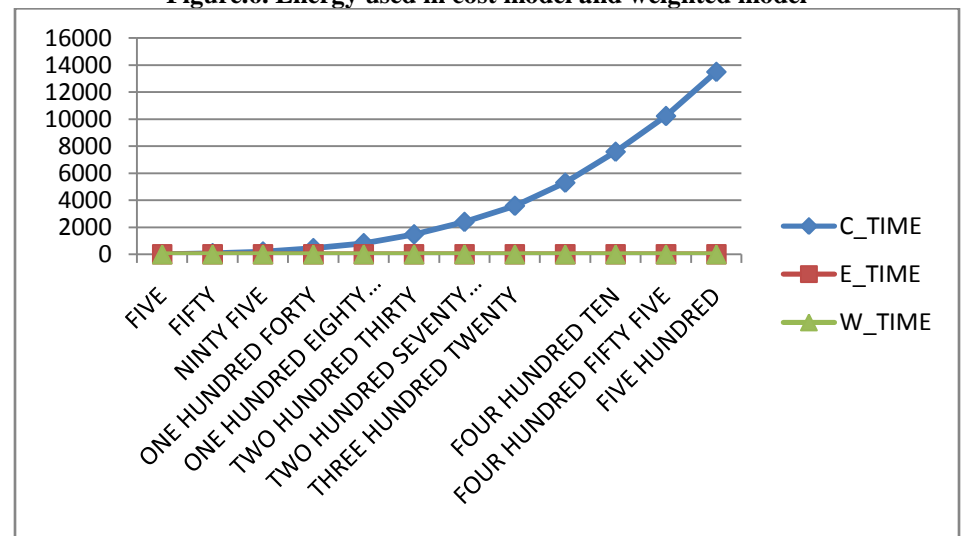


Figure.7. Time estimation in all model

The above figure shows the cost simulation graph for all the three models. It is the comparison of the response time of the all three models.

V. CONCLUSION

This paper has presented an energy-efficient mobile cloud computing system. We also presented a computation offloading techniques used on handheld devices. The computational partition algorithm is also defined in this paper for find out the optimal result for given input data. We also considered three basic models are cost model for find the response time for any activity , second one is energy model used for optimize the total power consumed by device and last weighted model which described the weighted result for energy and time. The performance metrics for those three models has been proved by experiment. In the present paper we described the EM algorithm for optimal partition for optimal partitioning for running application on smart phone, for the future we will use heuristic algorithm, which is the most practical approaches for solving hard optimization problems. This technique will be applicable for more complex instance and tasks. We will also take care about the hardware operations and solved the calculation delay and memory usage.

VI. REFERENCES

- [1]. Dejan Kovachev and Ralf Klamma “Framework for Computation Offloading in Mobile Cloud Computing”, Vol. 1, No 7, 2012
- [2]. Karthik Kumar·Jibang Liu·Yung-Hsiang Lu· Bharat Bhargava,”A Survey of Computation Offloading for Mobile Systems”, Springer Issue on Mobile Network Application,10 April, 2012.
- [3]. Gabriel Orsinia, Dirk Badae, Winfried Lamersdorfa, “Context-Aware Computation Offloading for Mobile Cloud Computing: Requirements Analysis, Survey and Design Guideline” 1877-0509, 2015.
- [4]. Kuljeet Kaur and Dr. Pankaj deep Kaur, “Computational Offloading for Mashup Services in Mobile Cloud Computing Environment” Vol. 8, No. 3, 2015.
- [5]. Saeid Abolfazli, Zohreh Sanaei, Ejaz Ahmed, Abdullah Gani, Rajkumar Buyya, “Cloud-Based Augmentation for Mobile Devices: Motivation, Taxonomies, and Open Challenges”, 1306.4956, 20 June, 2013.
- [6]. X. Feng, D. Fangwei, L. Jie, K. Xianglie, Y.Laurence and M. Jianhua, “Phone2Cloud: Exploiting computation offloading for energy saving on smartphones in mobile cloud computing” Springer Issue on Information Systems Frontiers, October 20, 2013.
- [7]. Pummy Dhiman, Kamal Kumar “ An optimal partition approach for mobile to cloud offloading”, volume 5, Issue -2, June 2016.
- [8]. Afnan Fahim, Abderrahmen Mtibaa, and Khaled A. Harras “ Making the case for Computational offloading in mobile device clouds” , June 2013.
- [9]. Rajesh Krishna Balan, Darren Gergle, Mahadev Satyanarayanan, and James Herbsleb , “Simplifying Cyber Foraging for Mobile Devices”, 07, June 11-14, 2007
- [10]. Roopali, Rajkumari,”Overview of Offloading in Smart Mobile Devices for Mobile Cloud Computing”,Vol 5, Number 6, 2014.
- [11]. N. Jeevitha, Dr. G.Kesavaraj, “An Analytical Study on Mobile Computation Offloading For Cloud Computing”, Volume-2, Issue-1, March – 2016
- [12].https://en.wikipedia.org/wiki/Surrogate_model dated 22/03/2017 10:39
- [13]. Satyanarayanan, Mahadev (2001). "Pervasive Computing: Vision and Challenges". IEEE Personal Communications. IEEE