



www.ijarcsse.com

## Self Learning Offloading scheme for Android Phones

Sheenam\*, Sugandha Sharma

Dept. of Computer Sciences & Engineering  
Chandigarh University, Gharuan  
Mohali (Punjab), India

Mayank Arora

Dept. of Computer Sciences & Engineering,  
CCET, Panjab University  
Chandigarh, India

**Abstract**— This paper includes discussion about the Cloud, Mobile Cloud Computing and the working of MCC. A new offloading scheme has been proposed in this paper which is self learning. This offloading scheme creates a database of previously taken offloading decisions which helps in avoiding the decision making each time an application runs.

**Keywords**— Cloud Computing, Mobile Computing, Offloading.

### I. INTRODUCTION

Today cloud computing is the most popular technology and is growing day by day. Cloud is a group of computers or servers which are interconnected to each other within a network providing on demand computing services to its users. It can provide large amount of computing resources on demand to solve big problems. Cloud provides various services such as management services, financial services, data storage services.

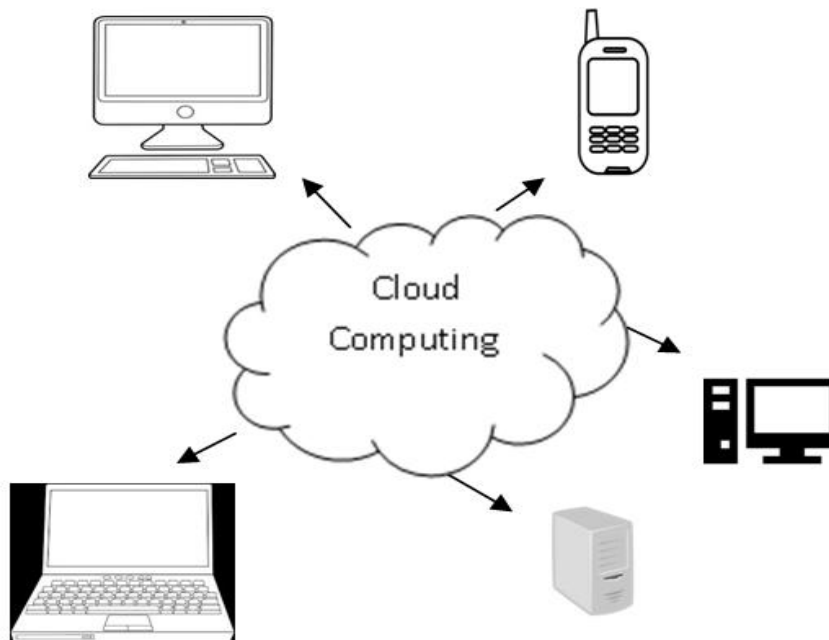


Fig.1 Cloud Computing

Types of cloud computing.

- Public cloud:- The Public cloud provide services to the general people on demand. It can be used by academic, business and governmental organization.
- Private cloud :- The cloud infrastructure is used by a single organization.
- Hybrid cloud:- Hybrid cloud means combination of public cloud computing and private cloud computing.
- Community Cloud:- The community cloud is specifically designed to cater the users belonging to a specific community such as education.

The user can use various services from cloud computing in accordance through 3 service models.

- Software as a Service (SaaS):- In this software services are provided to client on demand as per the client requirements. The services provided to the client are measured by the cloud provider and client may be charged as per usage.

- b.) Platform as a Service (PaaS):-This model is combination of the hardware and software. This model provide complete platform to the user to test or develop the applications.
- c.) Infrastructure as a Service (IaaS):- This model provide hardware, processing , storage, network and other computing resources to client on demand.

Characteristics of Cloud Computing:

- a.) Broad Network Access:- Cloud Computing provide broad network access to the client. By this the client can access anything anytime and anyplace.
- b.) On demand self services: The Client can access the services by cloud on demand through network.
- d.) Measured Services:- The services provided to the client are measured by the cloud provider and client may be charged as per usage.
- c.) Rapid Elasticity:- Services can be elastically provisioned and released. To the consumer, the services available for often appear to be unlimited and can be increased or decreased as per the user requirements in any quantity at any time.

**Mobile Cloud computing**

Despite the increasing usage of mobile computing, exploiting its full possibility is difficult due to its inherent problems such as resource scarcity. The mobile cloud computing can solve these problems by executing mobile applications on cloud by using the resources provided by cloud. Mobile cloud computing is a combination of cloud computing, mobile computing and internet. It provide real time information to the different people anywhere and anytime. It is used to enhance the capability of mobile applications. Mobile internet technology is a combination of mobile and internet which provide network services and network resources.

Features of mobile cloud computing

- a) Convenience of sharing data:- Mobile cloud computing store huge amount of data on heavy back end servers. This will help the user to access the data from anywhere in the world at any time. Thus reducing the dependency of the user on the specific mobile device.
- b) Effectiveness of task processing:-. If the input and output interface is good, then we can see the result of tasks directly by cell phones.
- c) Elimination of regionality:- Mobile cloud computing eliminate the regionality for accessing the internet. The client can access anything at any place and at any time.
- d) Extending battery lifetime:- The size of battery cannot be increased to maintain the mobility of mobile device. The various hardware devices such as CPU and LCD are the major consumers of the battery power. A lot of solutions have been proposed to improve the CPU performance and the management of disk and display in a manner resulting in reduced power consumption. Most of such solutions are not feasible due to the need of very costly and specialized hardware which will result in increasing the cost and complexity of mobile devices. The offloading technique is proposed with the objective to migrate the large computations and complex processing from resource limited devices[15] to resourceful machines thus reducing the load of CPU from the battery and increasing the battery life.
- e) Improving reliability: The reliability of application and data stored in the mobile devices could be improved by using cloud computing because the data will be stored on the cloud and the application will be running on cloud. In case, the mobile is lost or damaged, no data lost or application lost will be faced because the application and data is backed up on the cloud.

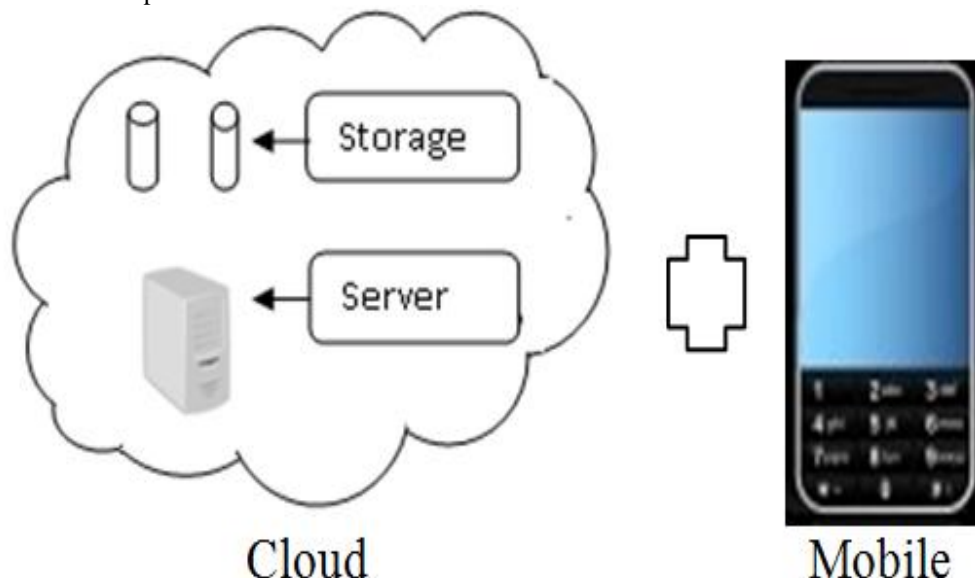


Fig.2 Mobile Cloud Computing

### Smartphones

Smartphones are the phones with feature rich operating system. They are different from basic features phones because of advanced functionality such as good internet connectivity, media player, GPS , wifi, web browsing and other application. In the recent years demand of smart phones is increasing rapidly. Thus the need of application is also increasing. Due to this more and more developers are attracted to market of smart phones. High end application in the fields of gaming, banking, image processing, natural language processing etc. is being developed. The mobile device are advancing technological very fast but still lagging in meeting the resource requirements by the application. The clouds on other hand have a great potential due to huge amount of resources. If the resources provided by the cloud are used by the mobile devices to meet the requirement of the heavy application.

### Offloading

Today's smartphones will suffer from battery life problems due to highly resource exhaustive application running on the mobile devices which are draining out of the battery power of the mobile devices. To overcome these problems the offloading concept came forward. If an application on a smartphone needs some heavy computation, it might make sense to shift the burden of smartphones to some remote servers. There are various offloading techniques proposed which require an application need to be installed on phone which make offloading decision to the other applications. The application which makes decision for the other application is compute intensive and it has some overhead on phone. It requires changes to be made on operating system which is not practical. There are two types of offloading

- a. Partial offloading
- b. Complete offloading

Partial offloading: - The application is offloaded partially which is compute intensive and needed to be offloaded thus for reducing the load of the smartphone. In this the compute intensive part is being executed on the clone and remaining part is executed on smartphone. After the clone has finished the execution of the compute intensive part of the application, it returns the results to the actual smartphone. The smartphone collect all the results and provides to the user in the required format.

## II. MODEL OF MOBILE CLOUD COMPUTING

Mobile cloud computing provide real time information to the different people, anywhere and at any time. The mobile cloud computing is used to enhance the capability of mobile applications and devices. Mobile internet technology is a combination of mobile and internet which provide network services and network resources. The mobile device could connect to cloud through any internet connection i.e. 3G, 2G, or wifi and avail different services such as storage, applications, CPU computation by servers.

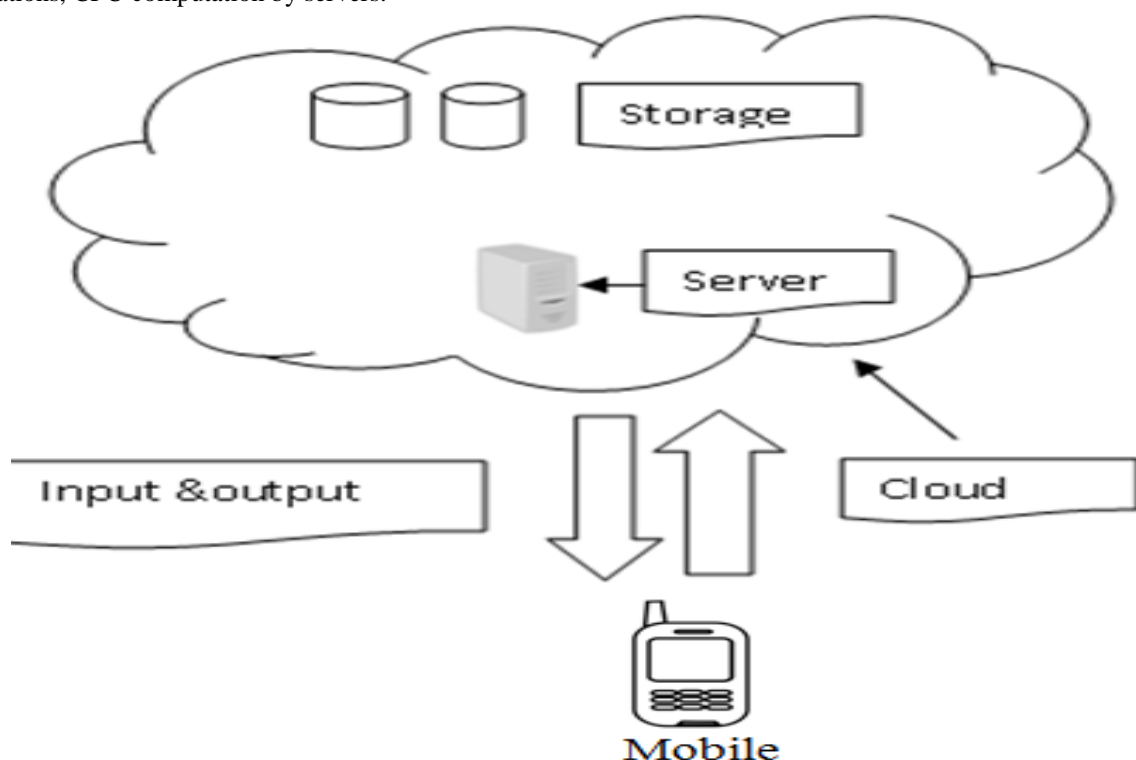


Fig.3 Basic Model of Mobile Cloud Computing [2]

## III. ARCHITECTURE OF MOBILE CLOUD COMPUTING

In this architecture the mobile devices are connected to the mobile networks via base transceiver station (BTS), access point, or satellite.

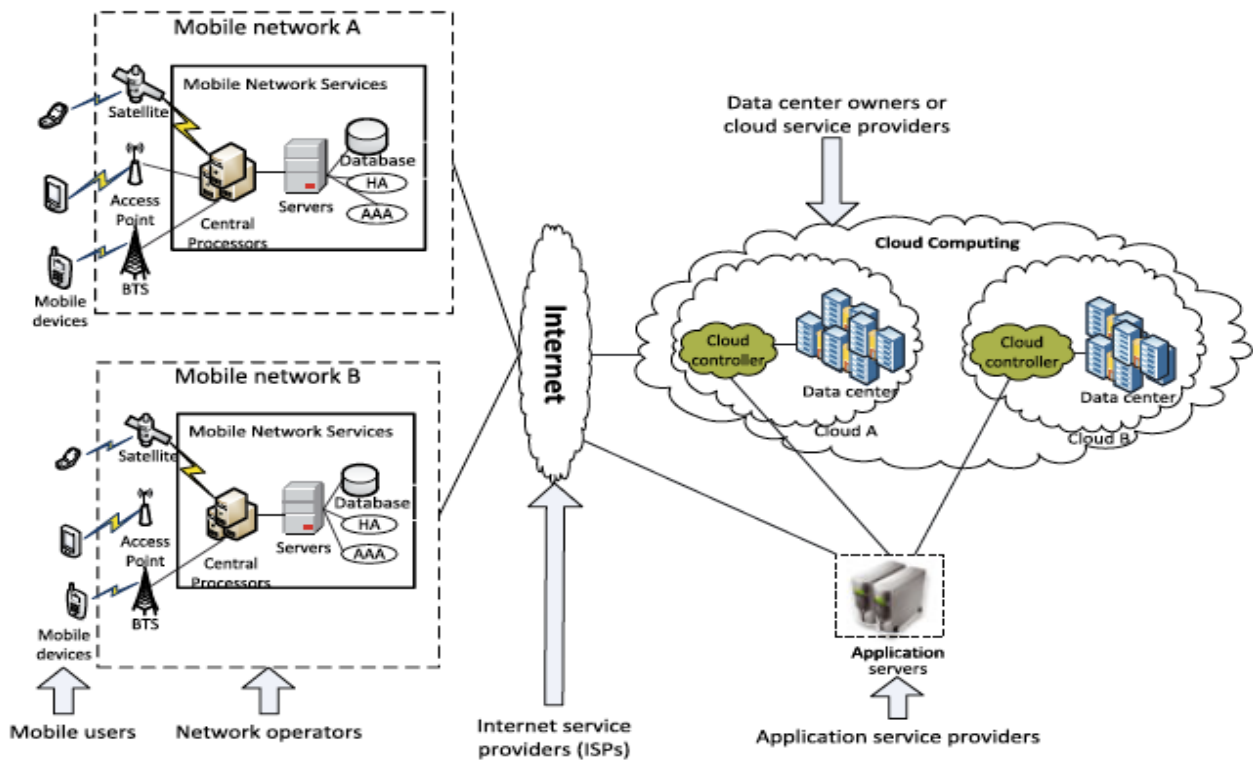


Fig.4 Mobile Cloud Computing Architecture[15]

These base stations establish and control the connections between mobile devices and networks and it also control the functional interfaces between the networks and mobile devices. In this architecture the user request for the cloud's service to the internet and internet communicate with the cloud and provide services to the user. In the cloud, the cloud controller provides services to the mobile user via internet. These services are virtualization, data centers, application services, web services etc. The cloud architecture has 4 layers

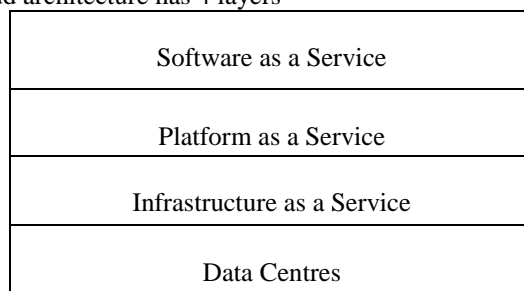


Fig. 5 Service oriented cloud computing

- a.) Software as a Service:- Software as a Service (SaaS):- In this software services are provided to user on demand as per the user requirements. In this user don't have to install an application on phone or computer; user can directly access the application via internet and only per usage basis.
- b.) Platform as a Service (PaaS):- This model provides combination of the hardware and software. This model provide platform to the user to test, build or deploying the applications. The example of PaaS is Google App Engine.
- c.) Infrastructure as a Service (IaaS):- This model provides hardware, processing, storage, network and other computing resources to client on demand.
- d.) Data Centres Layer:- In this layer large number of servers are connected with high speed networks which provide services to the users or customers.

#### IV. APPLICATIONS OF MOBILE CLOUD COMPUTING

1. Mobile Commerce:- M-commerce is defined as "the delivery of electronic commerce capabilities directly into the consumer's hand, anywhere, via wireless technology [17]." It is a business model application for commerce using mobile devices. The M commerce provides applications like mobile transactions, mobile messaging, and mobile ticketing, mobile shopping. The m-commerce applications can be categorized into a some classes like finance, advertising and shopping.
2. Mobile Education:- Now a days, more and more mobile applications are coming up to provide educational content. As, these applications are running on cloud servers they solve many problems faced by the conventional mobile learning such as high device cost, less educational resources etc.

- Mobile Healthcare: - The Mobile Cloud Computing in medical applications is used to reduce the limitations of traditional medical. Mobile healthcare provides mobile users to access resources easily and fastly. Beyond, m-healthcare provides hospitals and healthcare organizations a variety of on-demand services on clouds rather than owning standalone applications on local servers [15].

## V. PROPOSED WORK

The main problem which is identified through survey is that offloading a compute intensive application partially can improve the battery life of a smartphone, but the offloading system will incur some overhead on the phone. The problem being faced now is that every time an application is running the offloading decision is being taken depending upon the input size and other parameters needed by the cost model[21-22]. It is possible that the same decision is being taken again and again but after checking all the parameters. It is proposed that if the offloading system is made self learning i.e. if the offloading system keeps a record of the previously taken decisions then it could take the future decisions with the help of that data thus enabling the offloading system to self learn and making the system more reliable, fast and energy efficient.

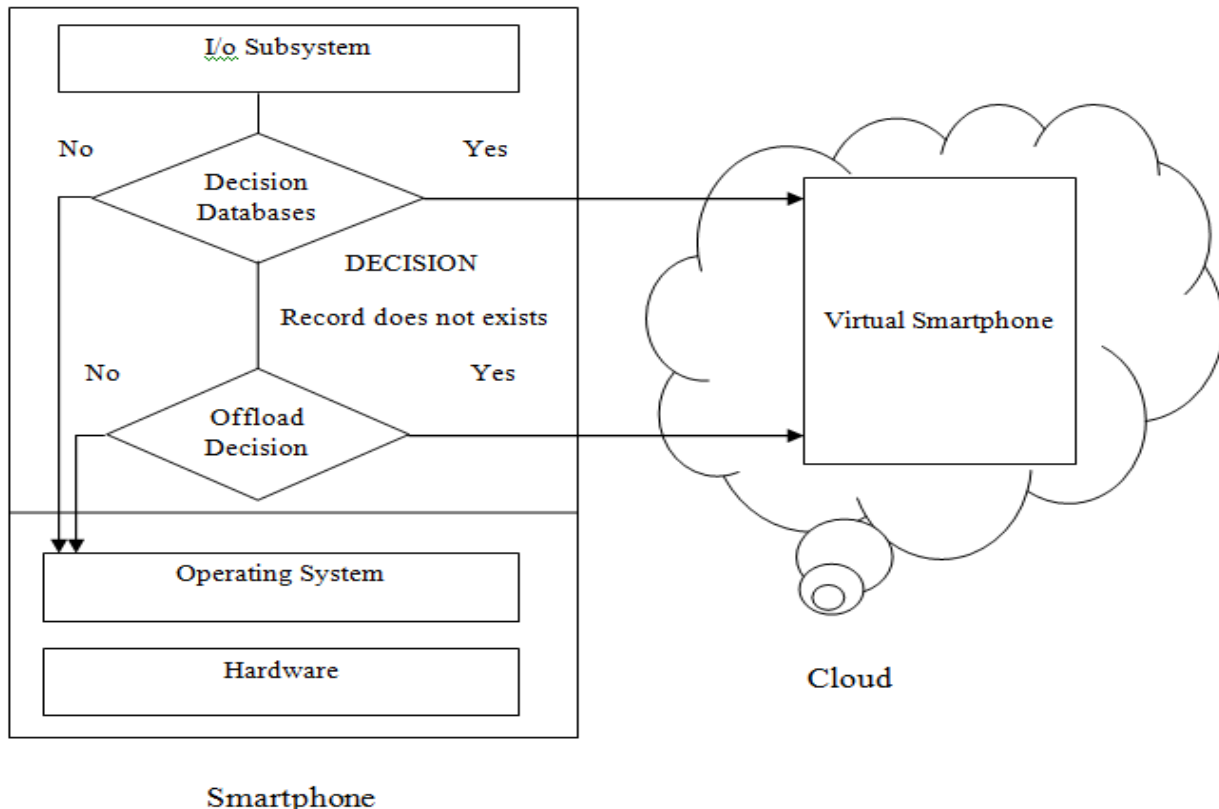


Fig.6

The figure 6 shows the working model of the proposed architecture. The I/O Subsystem collects the inputs and extracts the parameters from those inputs and pass them to the decision database. If an previous decision entry is there containing the same parameters the decision is taken as it is. If an entry is not located then the parameters are passed to the offloading decision unit which takes the offloading decision. Depending upon that decision the application is either offloaded or not. The information about the decision is also saved in the decision database.

## VI. CONCLUSIONS

This paper includes discussion about the Cloud, Mobile Cloud Computing and the working of MCC. A new offloading scheme has been proposed in this paper which is self learning. This offloading scheme creates a database of previously taken offloading decisions which helps in avoiding the decision making each time an application runs. It is proposed that if the offloading system is made self learning i.e. if the offloading system keeps a record of the previously taken decisions then it could take the future decisions with the help of that data thus enabling the offloading system to self learn and making the system more reliable, fast and energy efficient.

## REFERENCES

- National Institute of Science and Technology , "The NIST Definition of Cloud Computing," July 2010. Available:<http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf>.
- Weygand SONG and Xiaolong SU, " Review of Mobile Cloud Computing" in IEEE 3'rd international conference on Communication Software and Networks, May 2011,pp1-4.
- Niroshinie Fernando , Seng W. Loke Wenny Rahayu,"Mobile Cloud Computing: A Survey.

- [4] A. Rudenko, P. Reiher, G. J. Popek, and G. H. Kuenning, "Saving portable computer battery power through remote process execution," in MCCR'98---ACM SIGMOBILE Mobile Computing and Communications Review Newsletter, Jan. 1998, Vol. 2,no. 1, pp. 19-26.
- [5] B.G. Chun, P. Maniatis, "Augmented Smartphone Applications through Clone Cloud Execution," in Proceedings of 12th conference on Hot topics in Operating systems, 2009, pp. 8-8.
- [6] B.G. Chun, S. Ihm, P. Manitis, M. Naik and A. Patti, "Clone Cloud : Elastic Execution between Mobile Device and Cloud," in Proceedings of 6<sup>th</sup> Conference On Computer Systems, 2011, pp. 301-314.
- [7] E.Y. Chen and M. Itoh, "Virtual Smartphone over IP," in Proceedings of IEEE international conference on World of Wireless Mobile and Multimedia Networks, June 2010, pp. 1-6.
- [8] E. Chen, S. Ogata and K. Horikava, "Offloading Android Applications to the Cloud," in Proceedings of IEEE International Conference on Pervasive Computing and Communications Workshops (PERCOM Workshops), Mar. 2012, pp. 788-793.
- [9] B.Zhao , Z.Xu, C.Chi , S.Zhu and G.Cao, Mirroring Smartphones for Good : A Feasibility Study. ZTE Communications.
- [10] Goran Kalic , Iva Bojic and Mario Kusek, "Energy Consumption in Android Phones When using the Wireless Communication Technologies" 2012
- [11] Karthik Kumar · Jibang Liu · Yung - Hsiang Lu Bharat Bhargava , " A survey of Computation Offloading for Mobile Systems" Springer 2012.
- [12] E. Cuervo, A. Balasubramanian, D.K. Cho, A. Wolman, S. Saroiu, R.Chandra and P. Bahl, "MAUI: Making Smartphones Last Longer with Code Offload," in Proceedings of the 8th international conference on Mobile systems, applications, and services, 2010, pp. 49-62.
- [13] Mobile Operating Systems. Wikipedia. Mar 2012.
- [14] Android (Operating System) , Wikipedia 2012. Available: <http://en.wikipedia.org/wiki/Android>
- [15] Hoang T. Dinh, Chonho Lee, Dusit Niyato, and Ping Wang, "A Survey of Mobile Cloud Computing: Architecture, Applications, and Approaches" in proceedings conference of Wireless Communications and Mobile Computing – Wiley.
- [16] R. Kakerow, "Low power design methodologies for mobile communication," in Proceedings of IEEE International Conference on Computer Design: VLSI in Computers and Processors, pp. 8, January 2003.
- [17] L. D. Paulson, "Low-Power Chips for High-Powered Handhelds," IEEE Computer Society Magazine, vol. 36, no. 1, pp. 21, January 2003.
- [18] J. W. Davis, "Power benchmark strategy for systems employing power management," in Proceedings of the IEEE International Symposium on Electronics and the Environment, pp. 117, August 2002.
- [19] <http://cryptome.org/jya/glomob.html>.
- [20] R. N. Mayo and P. Ranganathan, "Energy Consumption in Mobile Devices: Why Future Systems Need Requirements Aware Energy Scale-Down," in Proceedings of the Workshop on Power-Aware Computing Systems, October 2003.
- [21] Mayank Arora and Mala Kalra, "Autonomous Computation Offloading Application for Android Phones using Cloud ", In Proc Of SocProS 2012 Springer.
- [22] Mayank Arora, Mala Kalra and Dr. Sarabjeet Singh, "ACOF: Autonomous Computation Offloading Framework for Android using Cloud", In Proceeding of IEEE 2nd International Conference on Information Management in the Knowledge Economy, 2013.