# Mobile Cloud Computing & Mobile Battery Augmentation Techniques: A Survey

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*Abstract*—Energy efficiency of mobile devices is paramount after the tremendous advancement in technology while the explosion of smart mobile applications such as, YouTube, Facebook, Twitters and Google maps makes Smart Internet Devices (SIDs) the first choice of communication. On the other hand, multiple sensors and wireless interfaces drain battery swiftly, thus reducing the operational time of SIDs. Therefore, extending battery life problem has become of crucial research importance, at hardware and software levels, both alike. This paper firstly, makes contribution by reviewing different techniques at software level used to enhance battery life of SIDs in particular Smartphones. At the end, suggestions and opinions related to energy efficiency of SIDs are given, based on the comparative studies.

*Keywords- Mobile Cloud Computing; Mobile Computing; Cloud Computing; Augmentation*

## I. INTRODUCTION

The usage of computer is expanded from desktop and mainframes to the current shape of wide range mobile devices. Multiple power hungry mobile applications such as GPS navigation, sensing apps, online games, video/audio players are residing in resource limited devices (battery powered) as a result the lifetime of battery curtail to few hours only.

Limited power storage of these devices is a core problem; reducing operational time of SIDs/Smartphones. In 2005, a survey conducted in 15 countries found that extended battery time is the most important feature than any other feature of smartphones, including; storage and cameras [1]. A similar survey conducted in 2009, by Change Wave Research, found that short battery timing is the most dislike feature of smartphones, including iPhone 3GS(RFF). Likewise, in 2009 Nokia poll discovered that battery life is one of the greatest concerns for users. On the other hand, most of the developers are concerned with the application side and physical enhancement of smartphones only, for example, processing speed and memory capacity [2], while battery conservation is largely ignored. As a result, smartphones/SIDs sometime fails to provide the reliable functionalities.

In addition, real time systems that belongs to information either feed by users or nonhumans sensors needed high level of response which in turns demand high level computing resources, such as GPS system, mobile embedded sensor's data processing etc. Such systems are costly in terms of energy and they cause limiting the mobile phone in providing the reliable services. Furthermore, the emerging of high computational intensive applications [3] i.e. speech recognizers, natural language translators, online video games, and wearable sensor devices etc., in the mobile computing environment increased the user's expectations, while they need a high computing power, battery lifetime and storage memory in the resource constrained devices (SIDs).

It is vital for the current cloud service providers and infrastructure/application developer to focus on energy issues and challenges. Thus, it is important to study and analyze the current research on energy conservation in mobile cloud computing. This paper is written to portrait the techniques used at different level to energy saving of mobile devices by using the resources resides in remote cloud.

The paper is structured as; Section-II describes a short background of MCC and Cloud Services utilization. Section-III refers to different techniques used to augment mobile battery. Section-IV includes suggestions and opinion based on the comparative studies. Section-V concludes the paper.

## II. BACKGROUND

### A. Mobile Cloud Computing

Due to diverse interpretation of researchers' Mobile Cloud Computing can be defined at many ways. By Eric Schmidt (CEO Google) in 2010 "based on Cloud Computing services development, mobile phones will become increasingly complicated and evolve to a portable super computer [4]" Aepona defines MCC as [5] "a new distributed computing paradigm for mobile applications whereby the storage and data processing are migrated from SID,s to powerful centralized computing data centers in computational clouds.

By Satyanrayanan [6], the mobility feature of devices inherent problems such as, low connectivity, resource scarceness and finite energy. To deal with the low capabilities of devices cloud computing turned to a ruling model which efficiently overcomes the resource scarceness problems by remote computation and utility services. So, by offloading and