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Journal of Mobile Communication and Networking

Aims and Scope

Journal of Mobile Communication and Networking welcomes the original research papers, review papers, experimental investigations,surveys and notes in all areas relating to software engineering and its applications. The following list of sample - topics is by no means to be understood as restricting contributions to the topics mentioned.

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Mobile Phone for Library Management Enhancement with Reference to Academic Libraries

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ABSTRACT

Like all other areas of life, education too has been drastically affected by technologically advancement. With new inventions and evolution in technology everyone is looking forward to instance services. Similar is the case with library users. They are not only looking forward to pin-pointed, exhaustive services but to a media which makes the delivery of information and facts in the most quick and effective manner possible. The same has made it exigent for today's librarians and libraries to endorse the most preferred technology by the users all around the world and that is none other than the mobile technology for the conveyance of library and information services related to it. The coming of net banking, the option to pay bills and book tickets online and similar facilities has not only made our lives convenient but has also played a major role in making mobile technology as the most widely and quickly adopted technology by people. Library professionals and librarians have also started to take advantage of this technology and are probing new ways of how they can connect to their users by making their services more efficient and better. Present paper brings to light few of the new and exciting services libraries can offer on mobile devices to the patrons. To find out the usage of Smart Mobiles which can be used for the enhancement of library use personal interviews and questionnaire method was used among college students of South Delhi Colleges and randomly students were selected for the same. Around 200 students out of approximately 330 students were having the smart phones and were in favour of use of mobile technology but around 250 students were unaware of the usage for scholarly information can be available though downloadable various apps. The purpose of this work is to make library users understand the benefit of mobile computing usage.

Keywords: Mobile technology, ICT, Mobile Browser, Mobile services, Academic libraries

1. INTRODUCTION

Gone are the days when we were dubious and disinclined towards using the ICT (Information Communication Technology) in library affairs. Users of this modern society crave for more and this hunger is satisfied by the valuable and attractive package of services offered by the information centres and libraries by using the legacy of ICT designing. The fact is that ICT has come forward to rescue the

preset day libraries from the challenges of information explosion. Keeping in mind the colossal amount of information that is being generated, stored and disseminated, it is due to the ICT that the resource centres are able to quench the thirst of its users and satisfy them. The introduction of mobile technology will be another milestone application of technology in libraries to serve most effective and productive services to the users of today. In India, the technological use are more or less the same to the advanced countries and the use of mobile phones and mobile devices with internet access are commonly used for dissemination of knowledge.

Mobile Technology Applications

One of the most formidable outcomes of information and communication technology which provides access to information in peoples' own comfort and convenience is mobile technology which is growing like a forest fire all over the word. One of the many advantages of mobile technology is that it has no limitations of space and time. A lot of work now a day is being done on the net available in phones and other handy devices, keeping this in mind libraries have taken a major step by investigating ways to deliver their services to mobile and other small – screen devices so their users can access them anywhere and anytime. Library can take the initiative for its own mobile site with the use of different services that translate user website to mobile friendly interface. Libraries can also start using SMS services for its patrons.

By the use of technology, libraries can also facilitate the users e-books on their mobile phone. This would require a smart phone and downloadable appropriate applications. Nothing is impossible only thing is to take the initiative to provide educational services to the educationists. And libraries can start this service by motivating users by reaching them anywhere anytime.

Mobile Browser

The news in The Times of India on 24th January 2015 regarding EC exploring online, mobile voting shows that how important is mobile technology in today's scenario and for future use. Chief election commission H S Brahma said that “the world is changing at a fast speed and the situation will be different few years down the line. We need to see the infrastructure and technology needed for this”. Brahma said the poll panel is “thinking about allowing internet and mobile voting”, words that would be welcomed by millions of young Indians wondering why they can't use their smart phones or tablets to vote for an election. Talking about mobile technology it becomes necessary to cover the aspects of mobile browser. A browser is a computer program with a graphical user interface for displaying HTML files, used to navigate the World Wide Web. Browsers are systems which enable online browsing sites

and provide aid to the user to search endless information from all access points. A number of operating support systems like Java, Google Android, Palm OS, iPhone and Windows Mobile etc. are available in the market. The best ones out of these are apt in running most of the sites and offer features like compressed downloads for faster browsing, multiple tabs, zoom in, split screen mode and excellent touch-based user interface etc., while others can only display websites optimizes for mobile devices.
The variety and competition offered by the market makes the vendors to forage for the best. The changing needs of the consumers as it evolves from a lay man's internet to full-fledged web experience have led to vendors to adopt significant change. Unfettered browser software dealers such as Opera, Open wave and ACCESS have all been functioning on browsers that subsume the most up to the minute web standards and start to generate an experience that overpowers some of the innate blemishes of mobile devices.

Mobile Technologies and Academic Libraries

With emerging vogue of “Libraries in Hand”, our librarians and LIS experts are in move to ascertain how these devices are modifying information ingress and see to it that they are in touch with the users and providing web content in the most congruous and effective ways.

Library professionals must at this time grid up one's loins to take up this challenge and do their best to increase the market and stipulation for mobiles access to customized facts and information at any time of the day in one's own handheld device. We are not far from the day when these handy devices will replace our computers. Mass of the library users today are not only using their cell phones or other mobile devices such as PDAs, Smart phones etc. for talking and texting, but also for browsing and searching the internet, reading magazines and books, and generally doing things that recently were dome by computers. It would not be wrong to say that in the present era libraries are covering most of the technologies given by the mobile industry like Blackberry, iPod, PDAs, Ultra Mobile PCs etc. and assembling the library contents in a manageable form for small screen and delivering transient services in the form of information with device's multiple searching features. Research and academic libraries are interrelated and are not mutually exclusive. Library is one place where we can find all the required materials from data to information and literature etc. for research work. The academic libraries not only provide its users with resources and research facilities but also offer technical information services. Before starting on any research work the researcher must consult and discuss the research with librarian. According to Mosuro (2000), ICT has offered libraries better ways of acquiring, organising, storing and disseminating the information to the users and researchers. This paper also examines the impact of library ICT on research work and the impact of research on higher education and ranking.

Application of Mobile Technology in Libraries

Mobile devices as we all know are something without which life becomes difficult in today's world. Be it creating documents or making presentations what once used to be done on computers is now being done on cellular phones. Internet is also playing a key role in increasing the popularity of mobile phones since it is making our life so easy and convenient. In such a scenario how can libraries stay back? Several reasons support why libraries should welcome the application of mobile technology. Following are a few:

- Mobile applications are a very innovative and convenient way of connecting the libraries to its users. The small handy devices on one hand work just like a computer and on the same hand are very flexible to use. Various reasons are there to support the fact why people prefer using mobile phones instead of walking into a library or sitting in front of a computer, one is that probably they don't want to move, for instance while going off to bed one might suddenly want to check some books in the library or one might be too busy to sit in front of a computer or walk to down to a nearby library.

- Due to the inevitable trend started by the mobile devices, especially offered by the smart phones, like e- books, e-file readers have become famous among the techno savvy generation. Also, many publishers due to the same reason have started converting information in to e-form.

- Keeping in mind the lack of interest shown by the youngsters of today in reading books and more of their attraction to the new applications and gadgets which are available in the market, introducing the concept of libraries in the form of mobile applications might prove to be a good way of gaining their attention and building their interest in reading hence creating a “learning by playing” environment.

- Portability is another reason why libraries should join hands with applications of mobile technology as unlike mobiles libraries or computers cannot be carried everywhere. They are located at a specific place and restricted to a particular area, whereas, in the case of mobile devices, they can be put to use anywhere and at any point of time as per the convenience of the user especially important in the case of urgent messages. Also, in today's world people are getting more and more stagnant and lead a lazy lifestyle, many a times even if one wants to refer a book he won't. People are too busy to take out time from their busy life schedules and go visit a library physically, instead, they want the library to reach them. In such a scenario libraries in the form of mobile applications can prove to be a helpful step.

- Last but not the least; in our modern world where all countries are progressing at such a rapid rate we must keep in par with other countries. Libraries in most countries of the world are taking advantage of the available mobile technology and are thus successful in providing library services which satisfy and cater to the needs of their users.

Mobile Technology In Libraries and Library Services

Collapsing all barriers ICT has taken a step towards promoting faster communication across borders. Before the coming of ICT, the only means of communication in libraries was either through circulars or notices etc. This meant that whenever a user wanted to get updated about the events and activities taking place in the library the only way he could do this was by physically going to the library and checking it out. However, increase in the scientific knowledge and developments in the electronic communication systems have led libraries to inform its users about all upcoming events and activities only by a single SMS (Short Message Service). It's no longer required by the users to specially take out time to visit the libraries just to check out the notice boards and would also save time and energy of both the libraries and its users. Therefore, it won't be wrong to say that libraries in the modern world are "libraries without walls".

There are many important and effective services offered by the libraries today SMS as mentioned above is one such service. Since SMS facilities are easily available on all mobile devices it makes it easy to keep the users aware and updated about the upcoming events and new arrivals. Also, it helps to send reminders for overdue items by text.

Web OPAC available on mobile devices makes it possible for users to search information from anywhere and with the help of GPS library users can find multiple locations of the central library without much difficulty. Mobile users can also access the facility of digital libraries on their phones. The list of the facilities offered by the libraries goes on and on, renewals by text, more mobile-friendly web pages, information literacy programs and virtual tour to library are to name a few. Users can also subscribe to RSS feeds using software on mobile phones and thus whenever the library will update any new information the mobile phone will be able to receive it automatically.

Another attractive feature is that library software is capable to configure as automatically to send text message alerts for hold, overdue materials and the available reserved resources. User's feedback to enhance and improve the quality of facilities provided by the library is also possible due to the availability of libraries on mobile devices. There are many libraries on the list of Library Success which utilize a starting reference point for libraries that are working on their mobile offering, vendors and publishers to look into to provide guidance. (http:// www.libsuccess.org/index.php)

There are several items about libraries and mobile applications on ALA, including information about how it affects courses, public policies on what a library should know before developing an application. http://www.ala.org/offices/fi;es/contenet/oitp/publications/policybridefs/mobiledevices.pdf.

There is a presentation about mobile technology in libraries that would serve as a good introduction to mobile libraries. http://www.slideshare.net/ellyssa/libraries-to-go-mobile-tech-in-libraries-presentation.

Boopsie is a software that is commonly used by libraries use to create their mobile application. http//www.boopsie2.com. This site provides resources for creating an Android application .http://developed.android.com

Few Mobile Library Applications

- Free downloadable application for AC database developed for iPhone, iPod Touch, iPad and Android.
- Another mobile website is ASCE where one can search, read full text content on most iOS, Android and Blackberry devices.
- Book Myne provides tutorial and is available for iPhone , iPod Touch and iPad by leading library technology, SirsiDynix.
- EBSCO's new application is free for the java script enabled host mobles.
- Library of Congress Mobile
- Nature Mobile
- Science Mobile (Science's new app is free)
- Taylor and Francis online Mobile
- WorldCat Mobile.....
- And so on and so forth. The useful scholarly information is available anywhere anytime with the facility of Smart Mobiles.

Conclusion

In a nut shell, it can be concluded that mobile technology along with mobile devices have become one of the most important tools utilised by the libraries and library professional these days all over the world in order to provide their patrons with the best possible services available and also to keep abreast with the real time information. Mobile devices not only help libraries and library professionals to keep in

touch with their users by providing information on phones, but also, facilitate the users to reach out to the library resources and latest updates by sitting in the comfort of their houses. Therefore, in the present information society it is needed that LIS professional should keep a check as to the level of transformation in the society that can be made through this new technology. If all academic libraries motivate their users to use the library by use of mobile technology then the use of library resources would be maximum utilized and users would love to read also if not print but at least online scholarly material. This would not only save virtual space problem in library simultaneously shortage or non availability of physical books would also be sorted out.

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Data Mining: An Overview

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ABSTRACT

The present paper is deals with the concept of data mining and guidelines for successful data mining, data mining process as: State the Problem, Collect the data, Preprocess the data, Estimate the model, Interpret the model and draw conclusions. Describe the various data mining software: commercial software as well as free software in details. Different Data Mining Techniques like Classification, cluster analysis, Prediction, Association Rules Mining, Text and Web Mining has been discussed. The paper also discuss the application of data mining in library and information Science

Keywords: Data Mining, Data Mining Process, Data Mining Software, Mining Techniques

1. INTRODUCTION

Knowledge is the prime mover of human activity and social progress. Knowledge leaps over the geographical limitations and defies the physical boundaries of physical sciences. Knowledge can even enter the neural sets of reasoning. Knowledge discloses its beginning, when appropriately linked, but not its end; it is dynamic and vibrant (Ahamed, 2009). In the present technological era, the information overloading and the rapid increase in the amount of data results in the rapid change in information communication and retrieval process. The ubiquity of databases in every domain of knowledge has resulted in the large amount of data. For example:-Wal-Mart, the chain of over 2000 retail stores, daily uploads 20 million sale transactions to AT&T with 1000 processors (Sikora & Piramuthu, 2007).

Data Mining and Knowledge Discovery in Databases (KDD) are the emerging areas of research. The term data mining and knowledge discovery in databases is used as a synonym for the process of discovering useful information. There is an urgent need to convert this hidden, implicit and previously unknown data into potentially useful information and knowledge from databases, data warehouses or other such data repositories. The data mining is an interdisciplinary field that combines data visualization, machine learning, mathematic algorithms, statistics, artificial intelligence and database management. This technology provides different techniques for decision making, problem solving, analysis, planning, diagnosis, detection, integration, prevention, learning and innovation (Bramer, 2013). Piatetsky-Shapiro et.al (1996, p#) defines KDD as "… the non-trivial process of identifying valid, noble, potentially useful, and ultimately understandable patterns in data."

Data is collected from different sources. It is integrated and store in common data store. It is then pre-processed into standard format. This prepared data is then entered to a data mining algorithm which produces an output in the form of patterns, associations and relationships. The outcomes are then interpreted to provide-the Holy Grail for knowledge discovery-interesting and potential knowledge (Bramer, 2013).

Guidelines for Successful Data Mining

Gupta (2012) described some guidelines for data mining process to be successful. These guidelines are discussed below:

Availability of data

Relevant, adequate and clean data
Well defined problem

Problem should not be solved by means of ordinary query or OLAP tools

Results must be actionable.

Data Mining Process

Data Mining is defined by discovery through either automatic or manual methods. It is a supportive effort of humans and computers. The data mining process involves two goals: Prediction and description. Prediction includes the use of variables to find out the unknown. Description, on the other hand concentrates on finding the patterns describing the data that can be understood by humans. From this finding, it is possible to put data mining into two categories (Kantardzic, 2011):

Predictive data mining, which creates the model of the system described by the given data set,
Descriptive data mining, which develops, new, valuable and nontrivial information based on the available data set.

Data Mining Software

There is number of data mining software available in the market. The software's are available in commercial and open source category.

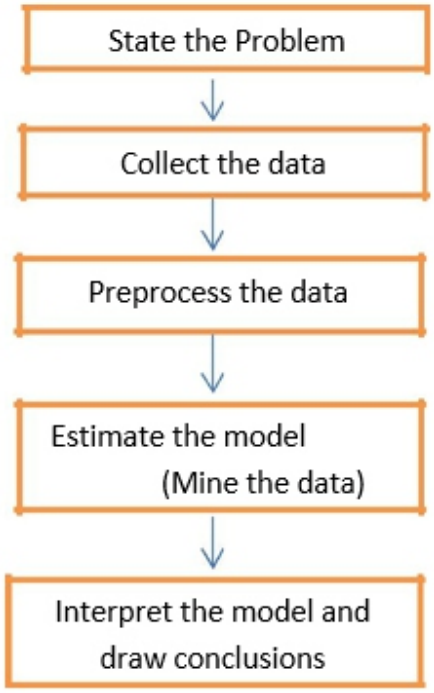

Figure-1: The data mining process

Commercial Software

ANGOSS' Suite

Vendor-Angoss Software Corp. (www.angoss.com)
ANGOSS' Suite entails of Knowledge STUDIO and Knowledge SEEKER. Knowledge STUDIO is used for predictive analytics for all phases of the model development and deployment cycle-profiling, exploration, modeling, implementation, scoring, validation, monitoring and building scorecards. Knowledge SEEKER is Client/server tool depend on decision tree based approach.

Bayesia Lab

Vendor: Bayesia (www.bayesia.com)
It is based on Bayesian networks, data clustering and supervised and unsupervised learning.

Data Engine

Vendor: MIT GmbH (www.dataengine.de)

Data Engine is a multiple strategy tool with fuzzy technology, neural networks. It works on the Windows platform.

Oracle Data Mining

Vendor: Oracle (www.oracle.com)
Oracle Data Mining (ODM) builds integrated business intelligence applications and develops predictive information.

Synapse

Vendor: Peltarion (www.peltarion.com)
Synapse provides application for neural networks and supports the entire development cycle from data import and processing, evaluation and deployment as .NET components.

Knowledge Miner

Vendor-Knowledge Miner Software (www.knowledgeminer.com)
Knowledge Miner uses GMDH neural sets and AI to identify knowledge from data.

Viscovery Data Mining Suite

Vendor- Viscovery (www.viscovery.net)
The Viscovery Data Mining Suite provides predictive analytics to report the needs of technical and business users. It comprises the modules i.e. Profiler, Predictor, Scheduler, Decision Maker, One (2) One Engine-for the realization of predictive analytics and other data mining applications.

Free Software
Data Lab

Publisher- Epina Software Labs (www.lohniger.com/datalab/en_home.html)DataLab is equipped with data exploration process, with emphasis on marketing and interoperability with SAS. Public version for students is also there.

GenIQ Model

Publisher-DM STAT-1 Consulting (www.geniqmodel.com)
GenIQ Model practices machine learning for regression tasks, variable selection automatically, variable construction.

Rapid Miner

Publisher- Rapid-I (http://rapid-i.com)
Rapid-I provides applications in the field of predictive analytics, data mining and text mining. The focus is on automatic intelligent analyses on a large scale base like database systems and unstructured data like texts. Rapid-I develops base for other companies to use the cutting edge technologies for data mining and business intelligence.

TOOLDIAG

Publisher-http://sites.google.com/site/tooldiag/Home
TOOLDIAG consists of programs in C for statistical pattern recognition and primarily slanted towards classification. It is publicly available tool for data mining.

Weka

Publisher- University of Waikato (http://www.cs.waikato.ac.nz/ml/weka/)
Weka is software that provides machine learning tools within a common framework and a uniform GUI. Weka supports data mining tasks of classification and summarization.

Data Mining Techniques

Data Mining employs following techniques

Classification: involves the grouping of data according to pre-defined attributes.

Cluster Analysis: It is a process in which data sets are gathered in clusters. Clusters are having many characteristics divided into meaningful disjoint subgroups so that each group is more similar to each other than that of those among groups (clusters) (Thuraisingham, 2000).

Prediction: This technique helps to forecast trends, pattern matching and classification. Prediction involves the analyses of past event; on that basis predicts the success or failure of the forthcoming event, product or process.

Association Rules Mining: Association rules discover the correlation in a set of objects that occurs simultaneously in a database. For example:-When a customer buys bread, he also buys milk (bread->milk) is an example of association rule in a supermarket database.

Text and Web Mining: Web mining techniques involves the use of data mining techniques to automatically extract the useable information from the vast ocean of the web.

Application of Data mining in Library and Information Science

The web is an ever growing ocean of the hypertext documents and millions of the pages are added to it each day. Unstructured nature of the web adds to the problem for retrieval of any information. Data mining tools are used to solve this complexity. The data mining techniques are widely used in the field of library and information science. Web mining techniques are widely used in finding the web content of the pages, link analysis of the web pages etc. Data mining techniques identifies the hyperlink-Induced topic search and page rank. Citation analysis and author co-citation analysis has been widely used to identify the same authors or authors having similar interest areas.

Conclusion

There is enormous data generated in the organizations due to number of applications. It is essential to handle this data due to its dynamic nature. The data mining techniques have wide applications in e-commerce, analysis of scientific data, banking and finance, healthcare and telecommunications. It opens wide avenues for research in these areas.

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A Comprehensive Study on Mobile Cloud Computing

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A B S T R A C T

Mobile Cloud Computing (MCC) which combines mobile computing and cloud computing, has become one of the industry buzz words and a major discussion thread in the IT world since 2009. As MCC is still at the early stage of development, it is necessary to grasp a thorough understanding of the technology in order to point out the direction of future research. With the latter aim, this paper presents a review on the background and principle of MCC, characteristics, recent research work, and future research trends. A brief account on the background of MCC: from mobile computing to cloud computing is presented and then followed with a discussion on characteristics and recent research work. It then analyses the features and infrastructure of mobile cloud computing. The rest of the paper analyses the challenges of mobile cloud computing, summary of some research projects related to this area, and points out promising future research directions.

Keywords—Mobile Cloud Computing; Mobile Computing; Cloud Computing and Challenges.

1. INTRODUCTION

Over the past few years, advances in the field of network based computing and applications on demand have led to an explosive growth of application models such as cloud computing, software as a service, community network, web store, and so on. As a major application model in the era of the Internet, Cloud Computing has become a significant research topic of the scientific and industrial communities since 2007.

Commonly, cloud computing is described as a range of services which are provided by an Internet-based cluster system. Such cluster systems consist of a group of low-cost servers or Personal Computers (PCs), organizing the various resources of the computers according to a certain management strategy, and offering safe, reliable, fast, convenient and transparent services such as data storage, accessing and computing to clients. According to the top ten strategic technology trends for 2012 [1] provided by Gartner (a famous global analytical and consulting company), cloud computing has been on the top of the list, which means cloud computing will have an increased impact on the enterprise and most organizations in 2012.

Meanwhile, smart phones are considered as the representative for the various mobile devices as they have been connected to the Internet with the rapidly growing of wireless network technology. Ubiquity and mobility are two major features in the next generation network which provides a range of personalized network services through numerous network terminals and modes of accessing. The core technology of cloud computing is centralizing computing, services, and specific applications as a utility to be sold like water, gas or electricity to users. Thus, the combination of a ubiquities mobile network and cloud computing generates a new computing mode, namely Mobile Cloud Computing.

As an inheritance and development of cloud computing, resources in mobile cloud computing networks are virtualized and assigned in a group of numerous distributed computers rather than in traditional local computers or servers, and are provided to mobile devices such as smart phones, portable terminal, and so on. (see Fig. 1). Meanwhile, various applications based on mobile cloud computing have been developed and served to users, such as Googles Gmail, Maps and Navigation systems for Mobile, Voice Search, and some applications on an Android platform, MobileMe from Apple, Live Mesh from Microsoft, and Moto Blur from Motorola. According to the research from Juniper, the cloud computing based mobile software and application are expected to rise 88% annually from 2009 to 2014, and such growth may create US 9.5 billion dollars in 2014.

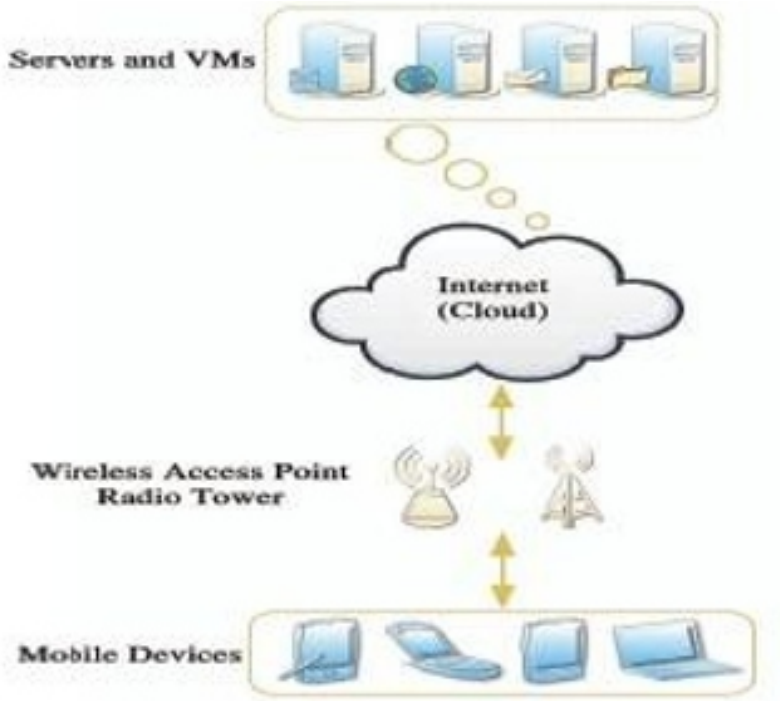

Fig. 1: Mobile Cloud Computing

While mobile cloud computing make a great contribution to our daily lives, it will also, however, bring numerous challenges and problems. In short, the core of such challenges and problems is just how to combine the two technologies seamlessly. On one hand, to ensure that mobile devices adequately make best use of advantages of cloud computing to improve and extend their functions. On the other hand, to overcome the disadvantages of limited resources and computing ability in mobile devices in order to access cloud computing with high efficiency like traditional PCs and Servers. Thus, in order to solve the mentioned challenges and point out further research, getting a thorough understanding of the novel computing paradigm - mobile cloud computing, is necessary. This paper introduces the basic model of mobile cloud computing, its background, key technology, current research status, and its further research perspectives as well.

II. BACKGROUND

As a development and extension of Cloud Computing and Mobile Computing, Mobile Cloud Computing, as a new phrase, has been devised since 2009. In order to help us grasping better understanding of Mobile Cloud Computing, let's start from the two previous techniques: Mobile Computing and Cloud Computing.

A. Mobile Computing

Mobility has become a very popular word and rapidly increasing part in today's computing area. An incredible growth has appeared in the development of mobile devices such as, smart phone, PDA, GPS Navigation and laptops with a variety of mobile computing, networking and security technologies. In addition, with the development of wireless technology like WiMax, Ad Hoc Network and WIFI, users may be surfing the Internet much easier but not limited by the cables as before. Thus, those mobile devices have been accepted by more and more people as their first choice of working and entertainment in their daily lives.

So, what is Mobile computing exactly? In Wikipedia, it is described as a form of human-computer interaction by which a computer is expected to be transported during normal usage [2]. Mobile computing is based on a collection of three major concepts: hardware, software and communication. The concepts of hardware can be considered as mobile devices, such as smart phone and laptop, or their mobile components. Software of mobile computing is the numerous mobile applications in the devices, such as the mobile browser, anti-virus software and games. The communication issue includes the infrastructure of mobile networks, protocols and data delivery in their use. They must be transparent to end users.

1) Features: the features of mobile computing are as follows:

a) Mobility: mobile nodes in mobile computing network can establish connection with others, even fixed nodes in wired network through Mobile Support Station (MSS) during their moving.

b) Diversity of network conditions: normally the networks using by mobile nodes are not unique, such networks can be a wired network with high-bandwidth, or a wireless Wide Area Network (WWAN) with low- bandwidth, or even in status of disconnected.

c) Frequent disconnection and consistency: as the limitation of battery power, charge of wireless communication, network conditions and so on, mobile nodes will not always keep the connection, but disconnect and consistent with the wireless network passively or actively.

d) Dis-symmetrical network communication: servers and access points and other MSS enable a strong send/receive ability, while such ability in mobile nodes is quite weak comparatively. Thus, the communication bandwidth and overhead between downlink and uplink are discrepancy.

e) Low reliability: due to signals is susceptible to interference and snooping, a mobile computing network system has to be considered from terminals, networks, database platforms, as well as applications development to address the security issue.

2) Challenges: Compared with the traditional wired network, mobile computing network may face various problems and challenges in different aspects, such as signal disturbance, security, hand-off delay, limited power, low computing ability, and so on. due to the wireless environment and numerous mobile nodes. In addition, the Quality of Service (QoS) in mobile computing network is much easier to be affected by the landforms, weather and buildings.

B. Cloud Computing

In the era of PC, many users found that the PCs they bought 2 years ago cannot keep pace with the development of software nowadays; they need a higher speed CPU, a larger capacity hard disk, and a higher performance Operation System (OS). That is the magic of 'Moores Law' which urges user upgrading their PCs constantly, but never ever overtaken the development of techniques. Thus, a term called 'Cloud Computing' burst upon our lives. Cloud Computing has become a popular phrase since 2007. However, there is no consensual definition on what a Cloud Computing or Cloud Computing

System is, due to dozens of developers and organizations described it from different perspectives. C. Hewitt [3] introduces that the major function of a cloud computing system is storing data on the cloud servers, and uses of cache memory technology in the client to fetch the data. Those clients can be PCs, laptops, smart phones and so on. R. Buyya [4] gives a definition from the perspective of marking that cloud computing is a parallel and distributed computing system, which is combined by a group of virtual machines with internal links. Such systems dynamically offer computing resources from service providers to customers according to their Service level Agreement (SLA). However, some authors mentioned that cloud computing was not a completely new concept. L. Youseff [5] from UCSB argue that cloud computing is just combined by many existent and fewnew concepts in many research fields, such as distributed and grid computing, Service- Oriented Architectures (SOA) and in virtualization.

In this paper, we consider the cloud computing is a large scale economic and business computing paradigm with virtualization as its core technology. The cloud computing system is the development of parallel processing, distributed and grid computing on the Internet, which provides various QoS guaranteed services such as hardware, infrastructure, platform, software and storage to different Internet applications and users.

1) Framework: cloud computing systems actually can be considered as a collection of different services, thus the framework of cloud computing is divided into three layers, which are infrastructure layer, platform layer, and application layer (see Fig. 2).

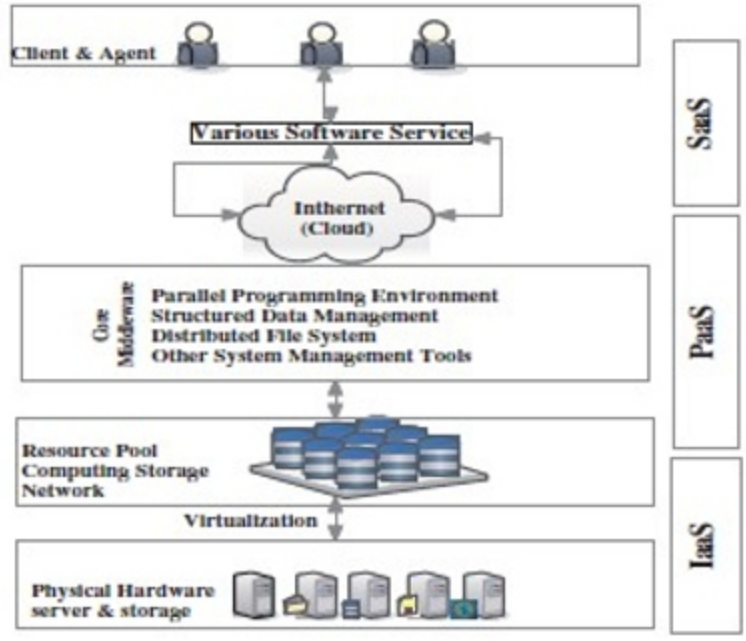

Fig. 2: The Framework of Cloud Computing

a) Infrastructure layer: it includes resources of computing and storage. In the bottom layer of the framework, physical devices and hardware, such as servers and storages are virtualized as a resource pool to provide computing storage and network services users, in order to install operation system (OS) and operate software application. Thus it is denoted as Infrastructure as a Service (IaaS). Typically services in this layer such as Elastic Computing Cloud of Amazon [6].

b) Platform layer: this layer is considered as a core layer in the cloud computing system, which includes the environment of parallel programming design, distributed storage and management system for structured mass data, distributed file system for mass data, and other system management tools for cloud computing. Program developers are the major clients of the platform layer. All platform resources such as program testing, running and maintaining are provided by the platform directly but not to end users. Thus, this type of services in a platform layer is called Platform as a Service (PaaS). The typical services are Google App Engine [7] and Azure from Microsoft [8].

c) Application layer: this layer provides some simple software and applications, as well as costumer interfaces to end users. Thus we name this type of services in the application layer as Software as a Service (SaaS). Users use client software or a browser to call services from providers through the Internet, and pay costs according to the utility business model (like water or electricity) [9]. The earliest SaaS is the Customer Relationship Management (CRM) [10] from Salesforce, which was developed based on the force.com (a PaaS in Salesforce). Some other services provided by Google on-line office such as documents, spreadsheets, presentations are all SaaS.

2) Features: the features of Cloud Computing are as follows:

a) Virtualization: the 'Cloud' can be considered as a virtual resource pool [11] where all bottom layer hardware devices is virtualized. End users access desired resources through a browser and get data from cloud computing providers without maintaining their own data centres. Furthermore, some virtual machines (VMs) are often installed in a server in order to improve the efficiency to use resources; andsuch VMs support load migration when there is a server over-load.

b) Reliability, usability and extensibility: cloud computing provides a safe mode to store user's data while users do not worry about the issues such as software updating, leak patching, virus attacks and data loss. If failure happens on a server or VM, the cloud computing systems transfer and backup those data to other machines, and then delete those failure nodes from the systems automatically in order to make sure the whole system has normal operation [12]. Meanwhile, cloud can be extended from horizontal and vertical [13] in a large-scale network, to process numerous requests from thousands of nodes and hosts.

c) Large-scale: in order to possess the capability of supercomputing and mass storage, a cloud computing system normally consists of thousands of servers and PCs. Google Cloud Computing, for example, has already controlled 2% of all servers or about 1 million servers located in two hundred different places in the world, and will move upward to 10 million servers in the next decade [14].

d) Autonomy: a cloud system is an autonomic system, which automatically configures and allocates the resources of hardware, software and storage to clients on- demand, and the management is transparent to end users.

3) Challenges: first of all, cloud computing needs an improved mechanism to provide a safe and high efficiency service as the numerous invoked third-party software and infrastructures are implementing in computing. In addition, due to data centres of resource using a mass of electricity, efficient resource scheduling strategy and methods are required in order to save energy. Furthermore, as a Service Level Agreement (SLA) is established between users and service providers in cloud computing, so the performance and analysis of services are necessary to be monitored. Last but not least, simple and convenient application interfaces are indispensable for service providers in cloud computing, thus a uniform standard is required eagerly.

III. MOBILE CLOUD COMPUTING

Nowadays, both hardware and software of mobile devices get greater improvement than before, some smartphones such as iPhone 4S, Android serials, Windows Mobile serials and Blackberry, are no longer just traditional mobile phones with conversation, SMS, Email and website browser, but are daily necessities to users. Meanwhile, those smartphones include various sensing modules like navigation, optics, gravity, orientation, and so on. which brings a convenient and intelligent mobile experience to users. In 2010, Google CEO Eric Schmidt described mobile cloud computing in an interview that 'based on cloud computing service development, mobile phones will become increasingly complicated, and evolve to a portable super computer' [15]. In the face of various mobile cloud services provided by Microsoft, Apple, Google, HTC, and so on, users may be confused about what mobile cloud computing exactly is, and what its features are.

A. Concept and principle

Similar with Cloud Computing, there are a lot but no consensual definitions on what mobile cloud computing is. In this paper, we consider it is a novel computing mode consisting of mobile computing

and cloud computing, which provide cloud based services to users through the Internet and mobile devices. On one hand, the mobile cloud computing is a development of mobile computing, and an extension to cloud computing. In mobile cloud computing, the previous mobile device-based intensive computing, data storage and mass information processing have been transferred to 'cloud' and thus the requirements of mobile devices in computing capability and resourceshave been reduced, so the developing, running, deploying and using mode of mobile applications have been totally changed. On the other hand, the terminals which people used to access and acquire cloud services are suitable for mobile devices like smartphone, PDA, Tablet, and iPad but not restricted to fixed devices (such as PC), which reflects the advantages and original intention of cloud computing. Therefore, from both aspects of mobile computing and cloud computing, the mobile cloud computing is a combination of the two technologies, a development of distributed, grid and centralized algorithms, and have broad prospects for application.

As shown is the Fig. 3, mobile cloud computing can be simply divided into cloud computing and mobile computing. Those mobile devices can be laptops, PDA, smartphones, and so on. which connects with a hotspot or base station by 3G, WIFI, or GPRS. As the computing and major data processing phases have been migrated to 'cloud', the capability requirement of mobile devices is limited, some low-cost mobile devices or even non-smartphones can also achieve mobile cloudcomputing by using a cross-platform mid-ware. Although the client in mobile cloud computing is changed from PCs or fixed machines to mobile devices, the main concept is still cloud computing. Mobile users send service requests to the cloud through a web browser or desktop application, then the management component of cloud allocates resources to the request to establish connection, while the monitoring and calculating functions of mobile cloud computing will be implemented to ensure the QoS until the connection is completed.

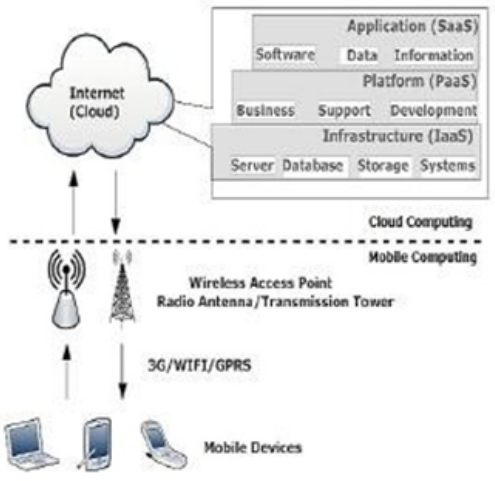

Fig. 3: Architecture of Mobile Cloud Computing

B. Challenges and solutions

The main objective of mobile cloud computing is to provide a convenient and rapid method for users to access and receive data from the cloud, such convenient and rapid method means accessing cloud computing resources effectively by using mobile devices. The major challenge of mobile cloud computing comes from the characters of mobile devices and wireless networks, as well as their own restriction and limitation, and such challenge makes application designing, programming and deploying on mobile and distributed devices more complicated than on the fixed cloud devices [16]. In mobile cloud computing environment, the limitations of mobile devices, quality of wireless communication, types of application, and support from cloud computing to mobile are all important factors that affect assessing from cloud computing. Table 2 gives an overview of proposed challenges and some solutions about mobile cloud computing.

1) Limitations of mobile devices: While discussing mobile devices in cloud the first thing is resource-constrain. Though smartphones have been improved obviously in various aspects such as capability of CPU andmemory, storage, size of screen, wireless communication, sensing technology, and operation systems, still have serious limitations such as limited computing capability and energy resource, to deploy complicated applications. By contrast with PCs and Laptops in a given condition, these smartphones like iPhone 4S, Android serials, Windows Mobile serials decrease 3 times in processing capacity, 8 times in memory, 5 to 10 times in storage capacity and 10 times in network bandwidth.

Normally, smartphone needs to be charged everyday as dialling calls, sending messages, surfing the Internet, community accessing, and other internet applications. According to past development trends, the increased mobile computing ability and rapid development of screen technology will lead to more and more complicated applications deployed in smartphones. If the battery technology cannot be improved in a short time, then how to effectively save battery power in smartphone is a major issue we meet today. The processing capacity, storage, battery time, and communication of those smartphones will be improved consistently with the development of mobile computing. However, such enormous variations will persist as one of major challenges in mobile cloud computing.

TABLE I: Challenges and Solutions of Mobile Cloud Computing

Challenges	Solutions
Limitations of mobile devices	Virtualization and Image, Task migration
Quality of communication	Bandwidth upgrading, Data delivery time reducing
Division of applications services	Elastic application division mechanism

2) Quality of communication: In contrast with wired network uses physical connection to ensure bandwidth consistency, the data transfer rate in mobile cloud computing environment is constantly changing and the connection is discontinuous due to the existing clearance in network overlay.

Furthermore, data centre in large enterprise and resource in Internet service provider normally is far away to end users, especially to mobile device users. In wireless network, the network latency delay may 200 ms in 'last mile' but only 50 ms in traditional wired network.

Some other issues such as dynamic changing of application throughput, mobility of users, and even weather will lead to changes in bandwidth and network overlay. Therefore, the handover delay in mobile network is higher than in wired network.

3) Division of application services: In mobile cloud computing environment, due to the issue of limited resources, some applications of compute-intensive and data- intensive cannot be deployed in mobile devices, or they may consume massive energy resources. Therefore, we have to divide the applications and use the capacity of cloud computing to achieve those purposes, which is: the core computing task is processed by cloud, and those mobile devices are responsible for some simple tasks only. In this processing, the major issues affecting performance of mobile cloud computing are: data processing in data centre and mobile device, network handover delay, and data delivery time.

For a given standard, providing a quality guaranteed cloud service should consider the following facts: optimal division of application between cloud and mobile device, interaction between low-latency and code offload, high- bandwidth between cloud and mobile device for high speed data transmission, user-oriented cloud application performance, self- adaptation mechanism of mobile cloud computing, and optimal consumption and overhead of mobile devices and cloud servers. The following strategies can be used to response to the challenges:

1. Upgrade bandwidth for wireless connection, make the web content more suitable for mobile network using regional data centres.
2. Deploy the application processing node at the 'edge' of cloud in order to reduce data delivery time.
3. Duplicate mobile devices to cloud using virtualization and image technologies, to process Data-Intensive Computing (DIC) and Energy-Intensive Computing, such as virus scanning in mobile devices.
4. Dynamically optimize application push in cloud and the division with mobile terminals.

C. Related work

So far, industrial and scientific communities have been doing various researches for responding to the above challenges. Some typical research projects and cases are presented in the following.

1) Augmented Execution: So far, industrial and scientific communities have been doing various researches for responding to the above challenges. Some typical research projects and cases are presented in the following.

CloneCloud is introduced by B. Chun [17] in 2011. The core method is using virtual machine migration technology to offload execution blocks of applications from mobile devices to Clone Cloud seamlessly and partly, in order to fully or semi-automatically extend or modify the smartphone-based execution to a distributed environment (smartphone computing plus cloud computing). In a CloneCloud system (see Fig. 4),the 'Clone' is a mirror image of a smartphone running on a virtual machine. By contrast with smartphones, such a 'clone' has more hardware, software, network, energy resources in a virtual machine which provides more suitable environment to process complicated tasks.

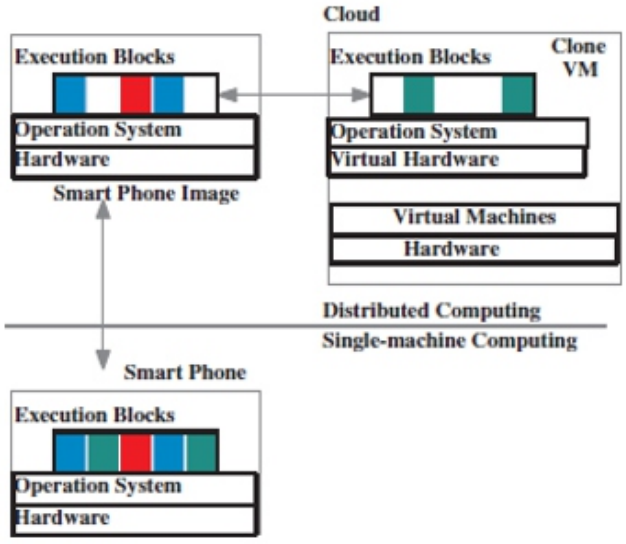

Fig. 4: Cloue Cloud System Architecture

In the diagram, a task in smartphone is divided to 5 different execution blocks (we mark them as different colors), and the smartphone is cloned (virtualized) as an image in distributed computing environment. Then the image passes some computing or energy-intensive blocks (the Green blocks) to cloud for processing. Once those execution blocks have been completed, the output will be passed from CloneCloud to the smartphone. A major advantage of the CloneCloud is enhanced smartphones performance. Byung takes a test by implementing a face tracking application in a smartphone with and without CloneCloud. The result shows that only 1 second is spent in CloneCloud environment but

almost 100 seconds in the smartphone without CloneCloud. Another advantage of CloneCloud is reduced battery consumption as smartphones do not use its CPU as frequently. The disadvantages of CloneCloud are handover delay, bandwidth limitation. As we know that the speed of data transmission between smartphones and base station is not consistent (according to the situation), therefore, the CloneCloud will be unavailableif mobile users walk in the signal's blind zone.

Based on the CloneCloud, X. Zhang has introduced an Elastic application programming model for mobile cloud computing in [18] to remove the constraints of mobile platforms by extending these mobile terminals to cloud through a distributed framework. This model divides a single application into a range of elasticity patterns called weblets, and dynamic adaptation of configuration running on internet-based cloud and mobile devices. Thus, the capability of mobile device can be enhanced to process for more comprehensive tasks. Furthermore, a cost model is applied in Zhangs research to adjust the patterns execution configurations. However, in this model, we still need a mechanism to manage the communication between weblets in mobile devices due to such devices changing their communication channel (such as 3G to WIFI or GPRS). Another challenge for this model is that a high-speed bandwidth or media channel is required to ensure the quality of communication between weblets.

Although the above methods can reduce power consumption on smartphones effectively, they may still meet a potential long interaction response in data transmission between a cloud and terminals. Therefore, offloading all applications from smartphones to the cloud cannot be justified for power consumption, especially for some lightweight applications which are suitable to be deployed in local smartphones. (But is not worth to be delivered to cloud). Y. Lu [19] proposed a solution, called Virtualized Screen, to move screen rendering from smartphones to a cloud as a service. In his method, only part of smartphone's screen is virtualized in cloud, which involves a collection of data in display images, text contents, video and audio, input of keyboard, touching, and pen on smart phones. The other applications with energy-intensive computing run on cloud. Therefore, parts of applications and interactions are offloaded and executed in cloud, and some light power consumption operation or applications are deployed in local smart phones, which could effectively reduce power consumption and interaction delay. There still remains a future research topic in this area: creating an optimal mechanism to decide which application is deployed in cloud, and which one in local smartphones. In addition, some other issues such as privacy, security or trustworthiness also need to be considered in the migration process.

2) Elastic Applications: In order to provide a more effectively mobile cloud application, researchers have developed and extended CloneCloud-based algorithms using dynamically migrating partition of applications to the remote server in cloud.

AlfredO [20] is a middleware platform to automatically distribute different layers of application in smartphones and cloud, respectively, by modelling applications as a consumption graph, and finding the optimal modules. The test result shows that such platform improves the performance of applications in cloud computing effectively.

AlfredO system consists of three bundles (the interface encapsulation on Java classes and services): AlfredOClient and Renderer on the client and AlfredOCore on the server (shown in Fig. 5).

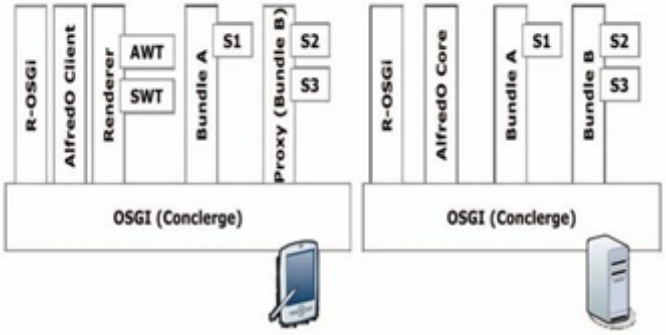

Fig. 5: AlfredO Architecture

When a client requests an application, AlfredOCore first models such application and computes the optimal deployment, and then send application descriptor and the list of services to AlfredO Client. Renderer uses the descriptor to generate the corresponding AWT or SWT interface, while AlfredO Client fetches the specified services via R- OSGi [21].Similar with [19], AlfredOexecutes parts of application remotely to save battery energy and extend resource of the mobile device effectively. However, such models do not support platform-independent cooperative interaction in an open network, and this issue is needed to be considered in future research.

S. Jeong [22] from Samsung introduces a novel elastic application model which provides a seamless and transparent use of cloud to extend and solve the limitation of mobile devices. This model enables a partition to a single application into multiple components called Weblet, and dynamically deploys these Weblets in execution according to a configuration strategy at cloud and mobile terminals. However, some overhead is generated in the communication among Weblets, between the Internet and Weblets, and the implementing Weblets during the model processing. In order to minimise the above extra overhead and optimise the cost of elastic applications, the authors presented a cost model in their framework, which collects sensor data (such as battery life, loads of devices and cloud, network conditions and so on.) from both mobile devices and cloud as input, and implements the optimal algorithm to dynamically output an execution configuration for the applications, such as deployment of Weblet, resource allocating of cloud, selecting of different network connection, and so on.

3) Migration Optimization: As the mobility feature in mobile devices, provide a seamless migration environment for data transmission or service guarantee has becoming another hot issue in mobile cloud computing research. An optimal migration mechanism can reduce interaction delay, enhance processing capability, and improve user's experience effectively.

Fig. 6: Concept and Infrastructure of Cloudlet [23]

Cloudlet is presented by M. Satyanarayanan [23] from Carnegie Mellon University, which provides rapidly instantaneous customized service to mobile devices using virtual machine (VM) technology for solving bandwidth-induced delay between devices and cloud, and so on. The author argued that although cloud computing is a good solution to mobile device's resource-constraint, long WAN latent delay is an obstacle for its performance. In a mobile cloud computing environment, the different accessing bandwidth between mobile devices and cloud may lead to different scales of delay, especially when mass data is being transferred and processed, users do feel the existence of such delays. Unfortunately, some kind of delay, such as data checking or firewall filtering for security is inevitable. Therefore, the authors deployed Cloudlet as a 'Micro Cloud' to be accessed by mobile devices with high bandwidth and low delay. Fig. 6 shows that mobile devices use WIFI or WLAN to access Cloudlet which is located in a coffee shop, and then rapidly provides customized service using VM technology.

As for the features of resource-constrains in mobile devices, many researchers are seeking how to solve it. Hyra is a system developed by E. Marinelli [24] from Carnegie- Mellon University, which deploysAndroid-based (an open source system) mobile phones as nodes to create a mobile cloud computing platform. This system transplants a modified Hadoop (a framework of cloud from Apache)

into Android so that these smartphones can be like PCs to deploy a real cloud computing system. The infrastructure of Hyrax is shown as Fig. 7.

In order to improve the whole performance of Hyrax, smartphone acts as Slave in Hadoop network, but Master is still deployed on PC, Name Node and Job Tracker are implemented as background services, and Hadoop Distributed File System (HDFS) is used to store data. In order to evaluate the performance of Hyrax, authors took a lot of tests in Sort, Random Writer, Pi Estimator, Grep, and Word Count using 10 Android G1 phones and 5 HTC Magic phones. The result shows that the performance of smartphones is much worse which took 15 times as long as PC in Map and Reduce procedures. As the first mobile phone based cloud computing system, Hyrax argued that the feature of resource-constraints in mobile phones is the main reason affecting cloud performance, and it also indicated the direction for further research.

Fig. 7: Hyrax Infrastructure

IV. OPEN RESEARCH ISSUES

Although some projects of mobile cloud computing have already been deployed around the world, there is still a long way for business implementation, and some research aspects should be considered in further work.

A. Data delivery

Due to the feature of resource-constrains, mobile devices have potential challenges in cloud accessing, consistent accessing, data transmission, and so on. Such challenges can be solved using: special application (service) and middle-ware (provide a platform for all mobile cloud computing systems).

B. Task division

Researchers divide tasks (applications) from mobile devices into multiple sub-tasks and deliver some of them to run in cloud, which is a good solution to the resource limited mobile devices. However, we do not have an optimal strategy or algorithm on how to divide these tasks, which one should be processed by cloud and which one by devices.

C. Better service

The original purpose of mobile cloud computing is providing PC-liked services to mobile terminals. However, as the existing different features between mobile devices and PCs, we cannot directly transplant the services from PCs' platform to mobile devices. Therefore, further research should try to identify the method on how to provide suitable and friendly interactive services for mobile devices.

V. CONCLUSION

With the high increasing of data computation in commerce and science, the capacity of data processing has been considered as a strategic resource in many countries. Mobile cloud computing (MCC), as a development and extension of mobile computing (MC) and cloud computing (CC), has inherited the high mobility and scalability, and become a hot research topic in recent years. We conclude that there are three main optimization approaches in MCC, which are focusing on the limitations of mobile devices, quality of communication, and division of applications services. Firstly, using virtualization and image technology can address it effectively, and immigrate task from terminal to cloud is also a good way to achieve better results. Secondly, as we know the quality of communication in wired network is better than in wireless network, so reducing the proportion of data delivery in wireless environment is an effective way to improve the quality. In addition, upgrading bandwidth is envisaged to be a simple way to increase performance but it incurs additional cost to users. Deploying an effective elastic application division mechanism is deemed to be the best solution to guarantee the application service in MCC; its complicated, but promising high impact results.

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Software Testing–A Study

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ABSTRACT

Software testing provides a means to reduce errors, cut maintenance and overall software costs. Numerous software development and testing methodologies, tools, and techniques have emerged over the last few decades promising to enhance software quality. While it can be argued that there has been some improvement it is apparent that many of the techniques and tools are isolated to a specific lifecycle phase or functional area. One of the major problems within software testing area is how to get a suitable set of cases to test a software system. This set should assure maximum effectiveness with the least possible number of test cases. There are now numerous testing techniques available for generating test cases.

KEYWORDS: *SOFTWARE TESTING, LEVEL OF TESTING, TESTING TECHNIQUE, TESTING PROCESS, TEST MANAGEMENT*

1. INTRODUCTION

Software testing comprises a major part of software development lifecycle. In past those software not tested resulted in social problems and financial losses. By one estimate defective software causes approximately US $ 50 B losses to USA each year [1]. This estimate suggests industry-wide deficiency in testing. According to Bertolino [2] testing is a general validation approach in industry, but it is still largely ad hoc, expensive, and its effectiveness is not predictable. Exhaustive testing is not possible as we face lack of time and resources. As there are limited resources available for testing we should select effective and efficient testing techniques. The lack of sufficient information about effectiveness, efficiency and cost of testing techniques makes difficult selection of a testing technique. Assessing effectiveness and efficiency of a testing technique is not easy as there are various operations involved in testing which depends on the subject that applies it, the programming language, software under test, the type of faults etc. Some advances have been made in evaluating effectiveness, efficiency of testing techniques but there is still a long way to go as results are very inconclusive.

2. THE HISTORY OF TESTING TECHNIQUES

CONCEPT EVOLUTION

Software has been tested as early as software has been written. The concept of testing itself evolved with time. The evolution of definition and targets of software testing has directed the research on testing techniques. The concept evolution of testing using the testing process model proposed by Gelperin and Hetzel [3] is as follows :

Phase I. Before 1956: The Debugging-Oriented Period – Testing was not separated from debugging

Phase II. 1957~78: The Demonstration-Oriented Period – Testing to make sure that the software satisfies its specification

Phase III. 1979~82: The Destruction-Oriented Period – Testing to detect implementation faults

Phase IV. 1983~87: The Evaluation-Oriented Period – Testing to detect faults in requirements and design as well as in implementation

Phase V. Since 1988: The Prevention-Oriented Period – Testing to prevent faults in requirements, design, and implementation

DEFINITION OF TESTING

The definition of testing according to the ANSI/IEEE 1059 standard is that testing is the process of analysing a software item to detect the differences between existing and required conditions (that is defects/errors/bugs) and to evaluate the features of the software item.

3. SOFTWARE TESTING TECHNIQUES

Testing technique is a method or approach that systematically describes how set of test cases should be created (with what intention and goals) keeping into consideration possible rules for applying test cases. Testing techniques aids in limiting the number of test cases that can be created [4].

Software testing techniques can be classified into two main categories based on the criteria whether the technique requires actual execution or not [5]:

Static Testing
Dynamic Testing

STATIC TESTING TECHNIQUES

Static techniques are concerned with the analysis and checking of system representations such as the requirements documents, design diagrams and the program source code, either manually or automatically, without actually executing the code [6].

Static techniques can be grouped under two categories:

Reviews
Analysis

REVIEWS

A software review is "A process or meeting during which a software product is examined by a project personnel, managers, users, customers, user representatives, or other interested parties for comment or approval"[7].

According to IEEE 1028 Phases of formal review [8] are : Planning, Kick-off, Individual Preparation, Review Meeting Rework and Follow-up. Roles and responsibilities are : **Manager ,Moderator, Reviewers and Scribe (Recorder)**

Reviews can be of following types :

INFORMAL REVIEW

A review done by peers in an informal fashion without any documented findings or process. An informal review involves two or more people looking through a document or codes that one or the other of them has written. The purpose is still to detect defects, but there are usually no check-lists used and the result does not need to be documented [9].

WALKTHROUGH

In software engineering, a walkthrough or walk-through is a form of software peer review "in which a designer or programmer leads members of the development team and other interested parties through a software product, and the participants ask questions and make comments about possible errors, violation of development standards, and otherproblems"[10]. The general goals of a walkthrough are : to present the document to stakeholders; knowledge transfer; to establish a common understanding and to establish consensus.

TECHNICAL REVIEW

A software technical review is a form of peer review in which "a team of qualified personnel examines the suitability of the software product for its intended use and identifies discrepancies from specifications and standards. Technical reviews may also provide recommendations of alternatives and examination of various alternatives".

INSPECTION

Inspection in software engineering of any work product is looking for defects using a well defined process, it is also called as peer review and done by trained individuals. An inspection might also be referred to as a Fagan inspection after Michael Fagan, the creator of a very popular software inspection process.

MANAGEMENT REVIEW

A systematic evaluation of a software acquisition, supply, development, operation, or maintenance process performed by or on behalf of management that monitors progress, determines the status of plans and schedules, confirms requirements and their system allocation, or evaluates the effectiveness of management approaches used to achieve fitness for purpose [11].

AUDIT

Audit is the most formal static testing technique. They are conducted by personnel external to a project to evaluate compliance with specifications standards contractual agreements or other criteria [12]. There are two types of Audit internal and external.

ANALYSIS

Static analysis is performed on requirements, design or code without actually executing the software artifact being examined. It is ideally performed before the types of formal review and unrelated to dynamic properties of the requirements, design and code, such as test coverage. The goal of static analysis is to find defects, whether or not they may cause failures. As with reviews, static analysis finds defects rather than failures. Static Analysis canreduce defects by up to a factor of six [12]. Static Analysis is done using approaches like Coding Standards, Code Metric and Code Structure.

DYNAMIC TESTING TECHNIQUES

Dynamic execution based techniques focus on the range of ways that are used to ascertain software quality and validate the software through actual executions of the software under test. We test the software with real or simulated inputs, both normal and abnormal, under controlled and expected conditions to check how a software system reacts to various input test data. It is essential to test the software in controlled and expected conditions as a complex, non deterministic system might react with different behaviors to a same input, depending on the system state. Dynamic testing techniques are generally divided into the two broad categories block box testing and white box testing [13][14].

BLACK BOX TESTING

Black box testing is based on the requirements specifications and there is no need to examining the code. This is purely done based on customers view point only tester knows the set of inputs and predictable outputs. Black box testing is done on the completely finished product [15] [16]. Black box testing techniques are Equivalence Class Partitioning, Boundary Value Analysis, Decision Tables, State Transition Diagrams, Orthogonal Arrays and All Pairs Technique

WHITE BOX TESTING

White box testing mainly focus on internal logic and structure of the code. White-box is done when the programmer has full knowledge of the program structure. With this technique it is possible to test every branch and decision in the program [17] [18] [9]. White box testing techniques are Static white box testing and Structural White box testing. Static white box testing further divided into Desk checking, Code walkthrough and Formal Inspections. Structural White box testing further divided into Control flow/ Coverage testing, Basic path testing, Loop testing and Data flow testing

4 TESTING LEVELS

Whichever the process adopted, we can at least distinguish in principle between unit, integration and system test [19], [20] that are distinguished by the test target without implying a specific process model. Other test levels are classified by the testing objective.

UNIT TESTING

Unit testing or component testing is used to ensure that if the unit is working as per its functional specification and/or that its design matches the intended design or not [19], [20]. Unit tests can also be applied to check interfaces, local data structure or boundary conditions[21]. These types of tests are usually written by developers as they work on code (white-box style). One function might have multiple tests, to catch corner cases or other branches in the code. Unit testing is used to ensure that units are working independently of each other or not, unit testing alone cannot verify the functionality of a piece of software. Unit testing is used to make development and QA process efficient and to increase quality of the software by eliminating errors while software is in construction before the code is promoted to QA. Depending on the organization's expectations for software development, unit testing might include static code analysis, data flow analysis metrics analysis, peer code reviews, code coverage analysis and other software verification practices[22]. The unit testing helps by three ways. First, attention is focused initially on smaller units of the program. Second, when an error is found, it is known to exist in a particular module. Finally, multiple modules can be tested simultaneously[18]. Tools for unit testing are Debug, Re- structure, Code Analyzers, Path/statement coverage tools.

INTEGRATION TEST

In Integration testing (sometimes called integration and testing, abbreviated I&T) individual software modules which have been unit tested are combined as larger aggregates and tested as a group as per the integration test plan . Integration testing delivers as its output the integrated system ready for system testing. It occurs after unit testing and before validation testing[23].

In this testing major design items are tested to ensure their functional, performance, and reliability status against requirements. Black box testing, success and error cases being simulated via appropriate parameter and data inputs are used to exercise these "design items", i.e. assemblages (or groups of units) through their interfaces. Simulated usage of shared data areas and inter-process communication is tested and individual subsystems are exercised through their input interface. The overall idea is a "building block" approach, in which verified assemblages are added to a verified base which is then used to support the integration testing of further assemblages.

Some different types of integration testing are big bang, top-down, and bottom-up. Other Integration Patterns[24] are: Collaboration Integration, Backbone Integration, Layer Integration, Client/Server Integration, Distributed Services Integration and High-frequency Integration.

SYSTEM TEST

In system testing software under test is implemented in its actual hardware environment and tested to verify that the system behaves according to the user requirements. Goals of system testing can be [25]:

- to discover system level failures which were not detected during unit or integration testing;
- to make sure that developed product correctly implements the required capabilities;
- to gather data useful for deciding the release of the product.

System testing should therefore ensure that each system function works as expected, any failures are exposed and analyzed, and additionally that interfaces for export and import routines behave as required. Generally system testing includes testing for performance, security, reliability, stress testing and recovery [19]. In particular, test and data collected applying system testing can be used for defining an operational profile necessary to support a statistical analysis of system reliability [26].

A further test level, called **Acceptance Test,** is often added to the above subdivision. It is mainly focuses on the usability requirements.

REGRESSION TEST

Properly speaking, regression test is not a separate level of testing, but may refer to the retesting of a unit, a combination of components or a whole system (see Fig. 1 below) after modification, in order to ascertain that the change has not introduced new faults [19].

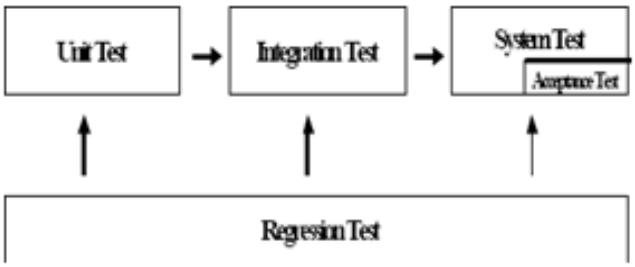

Figure 1. Logical Schema of Software Testing Levels

Selective regression test techniques [27] help in selecting a (minimized) subset of the existing test cases by examining the modifications (for instance at code level, using control flow and data flow analysis).

5 TESTING TYPES

Following are the types of testing:

INSTALLATION TESTING

An installation test assures that the system is installed correctly and working at actual customer's hardware.

COMPATIBILITY TESTING

Compatibility testing is one of the test types performed by testing team. Compatibility testing checks if the software can be run on different hardware, operating system, bandwidth, databases, web servers, application servers, hardware peripherals, emulators, different configuration, processor, different browsers and different versions of the browsers etc.,

SMOKE AND SANITY TESTING

Initial effort to determine if a new software version is performing well enough to accept it for a major testing effort.

REGRESSION TESTING

As discussed in section 4.4.

ACCEPTANCE TESTING

Acceptance testing can mean one of two things:

I. A smoke test is used as an acceptance test prior to introducing a new build to the main testing process, i.e. before integration or regression.

II. Acceptance testing performed by the customer, often in their lab environment on their own hardware, is known as user acceptance testing (UAT). Acceptance testing may be performed as part of the hand-off process between any two phases of development.

ALPHA TESTING

Alpha testing is simulated or actual operational testing by potential users/customers or an independent test team at the developers' site. [28]

BETA TESTING

Beta testing comes after alpha testing and can be considered a form of external user acceptance testing.

FUNCTIONAL VS NON-FUNCTIONAL TESTING

Functional testing refers to activities that verify a specific action or function of the code. Functional tests tend to answer the question of "can the user do this" or "does this particular feature work."

Non-functional testing refers to aspects of the software that may not be related to a specific function or user action, such as scalability or other performance, behavior under certain constraints, or security.

DESTRUCTIVE TESTING

Destructive testing attempts to cause the software or a sub-system to fail. It verifies that the software functions properly even when it receives invalid or unexpected inputs, thereby establishing the robustness of input validation and error-management routines.

SOFTWARE PERFORMANCE TESTING

Performance testing is generally executed to determine how a system or sub-system performs in terms of responsiveness and stability under a particular workload. It can also serve to investigate, measure, validate or verify other quality attributes of the system, such as scalability, reliability and resource usage.

There is little agreement on what the specific goals of performance testing are. The terms load testing, performance testing, scalability testing, and volume testing, are often used interchangeably.

USABILITY TESTING

Usability testing is needed to check if the user interface is easy to use and understand. It is concerned mainly with the use of the application.

ACCESSIBILITY TESTING

Accessibility testing may include compliance with standards such as: Americans with Disabilities Act of 1990, Section 508 Amendment to the Rehabilitation Act of 1973 and Web Accessibility Initiative (WAI) of the World Wide Web Consortium (W3C)

SECURITY TESTING

Security testing is essential for software that processes confidential data to prevent system intrusion by hackers.

6. STRATEGIES FOR TEST CASE SELECTION

Strategies are used to increase effectiveness of testing in terms of thoroughness on one side and reducing times and costs on the other. It is very important that how the test cases are selected, as there are limited test resources.

SELECTION CRITERIA BASED ON CODE

During the late 70's and the 80's the trend was dominated by Code-based testing, also called "structural testing", or "white box" testing in software testing research. For designing test cases for white-box testing an internal view of the system, as well as programming skills are used. The tester selects inputs to exercise paths through the code and find out the appropriate outputs.

White-box testing is generally done at the unit level, it can be applied at the unit, integration and system levels of the software testing process. It can check paths within a unit, paths between units during integration, and between subsystems during a system–level test. This method of test design uncover many errors or problems, but unimplemented parts of the specification or missing requirements might left undetected. Techniques used in white-box testing include: API testing, Code coverage, Fault injection, Mutation testing methods and Static testing methods.

SELECTION CRITERIA BASED ON SPECIFICATIONS

In specification-based testing, documentation relative to program specifications is generally used to derive reference model RM[29].

In Specification-based testing functionality of software is checked according to the applicable requirements.[30] In this testing detailed test cases should be provided to the tester, who then can simply apply the test cases to check that for a given input, whether the output value (or behavior), "is" or "is not" the same as the expected value specified in the test case. Test cases are designed based on specifications and requirements, i.e., what the application is supposed to do. To derive test cases it uses external descriptions of the software, including specifications, requirements, and designs. These tests can be functional or non-functional, though usually functional.

Using Specification-based testing correct functionality may be assured, but it is not sufficient to watch against complex or high-risk situations.[31]

This method of test can be useful in all levels of software testing: unit, integration, system and acceptance. It typically uses in most of the testing at higher levels, but can also dominate unit testing as well.

OTHER CRITERIA

Some other important strategies for test selection are briefly over viewed as follows :

BASED ON TESTER'S INTUITION AND EXPERIENCE

The testing technique based on tester's intuition and experience is ad-hoc testing techniques it is most widely practiced technique [32] in which tests are developed based on the tester's skill, intuition, and experience with similar programs. The special tests not easily captured by formalized techniques might be identified by Ad hoc testing. The testing technique in which test cases are developed during testing not before, is called Exploratory testing. A subset of exploratory testing is so-called guerilla testing. In this testing experienced tester tests limited section of program exhaustively for short period of time[33].

MUTATION BASED TEST CASE GENERATION

In testing for reliability evaluation, Mutation adequacy is the main fault-based test adequacy criterion. The competent programmer hypothesis and the coupling effect are two assumptions upon which the

idea of a mutation adequate test suite is based [34]. The competent programmer hypothesis assumption states that competent programmers develop code that compile and very nearly correct as per their specification. The coupling effect assumes that tests that detect simple faults are likely to also detect complex faults [34].

BASED ON OPERATIONAL USAGE

In testing for reliability evaluation, the test environment must reproduce the operational environment of the software as closely as possible (operational profile). It is done for assessing future reliability of the software when in actual use from the observed test results. To do this, inputs are assigned a probability distribution, or profile, as per their occurrence in actual operation.[35]

7. TEST DESIGN

Test design is a important phase of software testing, in which test suites for the objectives and the features to be tested are defined. Testing levels are planned and kind of approach for each level and for each feature to be tested is decided . Stopping criteria for testing also decided in test design. It is also decided that which part of the software should be tested more keeping in view time or budget constraints. [35].

8. TEST EXECUTION

There are various types of difficulties in executing the Test cases specified in test design. The various tasks involved in launching the test and deciding the outcome of the test are discussed below. Tools for testing activities automation also given below.

LAUNCHING THE TESTS

Test cases can be executed manually or automatically.

TEST ORACLES

The “test oracle” is a concept describing a method that is used to recognize correct and incorrect test output during software testing. When a test case is inputted to the system under test output comes, tester compares this output with the output specified in test oracle to ensure that the output is expected output or not. The term was first used and defined in William Howden's Introduction to the Theory of Testing. Additional work on different kinds of oracles was explored by Elaine Weyuker. [36].

TEST TOOLS

Program testing and fault detection can be done using testing tools and debuggers. Testing/debug tools contains features such as: Program monitors - performs full or partial monitoring of program code including: Instruction set simulator- performs complete instruction level monitoring and trace facilities, Program animation- performs step-by-step execution and conditional breakpoint at source level or in machine code and Code coverage reports, Formatted dump or symbolic debugging, tools performs inspection of program variables on error or at chosen points. Automated functional GUI testing tools are used to repeat system-level tests through the GUI Benchmarks, allowing run-time performance comparisons to be made. Performance analysis (or profiling tools) that can help to highlight hot spots and resource usage Some of these features may be incorporated into an Integrated Development Environment (IDE)[7]. In the following of this section we present a list of typologies of most commonly used test tools:

Test harness (drivers, stubs): Test Harness contains two main parts: the test execution engine and the test script repository. Test harnesses is used to automate tests. It helps in integration testing. In integration testing test stubs are typically module of the software under development and are replaced by working module as the application is developed (top-down design), test harnesses are external to the application being tested and simulate services or functionality not available in a test environment. [37].

Test generators: It is used to generate tests.

Capture/Replay: this tool can automatically re-executes, or replays, previously run tests, on the basis recorded inputs and outputs (e.g., screens).

Oracle/file comparators/assertion checking: By using these types of tool we can decide whether a test is pass or fail;

Coverage analyzer / Instrumenter: A coverage analyzer is used to assess which and how many components of the program flow graph have been exercised. The program instrumenters insert probes into the code which helps in analysis.
Tracers: It shows the history of execution of a program;

Reliability evaluation tools: Using this tool we can analyse test results graphically. Using these test results we can assess reliability related measures according to selected models.[35]

9. TEST DOCUMENTATION

A summary of the ANSI/IEEE Standard 829-1983 describes a test plan as: "A document depicting the scope, approach, resources, and schedule of intended testing processes. It recognizes test items, the units to be tested, the testing tasks, who will do each task, and any proactive strategy for risks." This standard describes the following test plan outline: Test Plan Identifier, Introduction, Test Items, Features to be Tested, Features Not to Be Tested, Approach, Item Pass/Fail Criteria, Suspension Criteria and Resumption Requirements, Test Deliverables, Testing Tasks, Environmental Needs, Responsibilities, Staffing and Training Needs, Schedule, Risks and Contingencies and Approvals[38].

10. TEST MANAGEMENT

Test management manages the computer software testing process such as organizing test assets and artifacts such as test requirements, test plans, test cases, test scripts and test results to enable easy accessibility and reusability . Test artifact and resource organization is necessary part of test management.

11. TEST MEASUREMENTS

In the field of software engineering test measurement helps in generating description of important processes and products quantitatively, and accordingly controlling software behavior and results. Also nature and impact of proposed changes can be understood by using measurement as baseline. In addition, managers and developers use measurement to monitor effects of tasks and changes on all facets of development. In this way whether or not final product meets plans can be checked as early as possible and accordingly actions can be taken [39]. In case of testing phase, measurement can be used for evaluation of the program under test, or the selected test set, or even for monitoring the testing process itself [40].

12. CONCLUSIONS

In this paper we have presented a detailed study of software testing. The approaches over viewed include more traditional techniques, e.g., code-based criteria, as well as more modern ones, such as model checking. We have tried to contribute to the best of our knowledge by putting into all the possible details about software testing discipline, through this paper we have tried to demonstrated that testing is a very complex activity and should be given importance in software development. Through this paper, we have tried to attract interest from academy and industry. However, what we can and must pursue is to transformtesting from "trial-and-error" to a systematic, cost-effective and predictable engineering discipline.

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Environment For Grid Computing Using Bitdew Technology

Radhika A. Bang

A B S T R A C T

In recent years social media gaining lot of popularity and almost every user is sharing different contents in the form of images, video, text, etc. every day. This is creating a lot media repository and in near future it may require to search content from this repository and not from the typical string based data search. Major issue with media repository is that one can't search the exact content based on string query search in real time. It requires a lot of pre- processing and indexing on this media content repository. Proposed system is considering this problem and trying to provide a media search on the basis of media internal properties like color. Main component involved in research is parallel processing of huge resources using load balancer, indexing of media repository and search engine for searching content from indexed table and the media repository.

1. INTRODUCTION

BACKGROUND:

Load balancing is a computer networking method for distributing workloads across multiple computing resources, such as computers, a computer cluster, network links, central processing units or disk drives. Load balancing aims to optimize resource use, maximize throughput, minimize response time, and avoid overload of any one of the resources. For Internet services, the load balancer is usually a software program that is listening on the port where external clients connect to access services. The load balancer forwards requests to one of the "backend" servers, which usually replies to the load balancer. This allows the load balancer to reply to the client without the client ever knowing about the internal separation of functions. It also prevents clients from contacting back-end servers directly, which may have security benefits by hiding the structure of the internal network and preventing attacks on the kernel's network stack or unrelated services running on other ports.

Some load balancers provide a mechanism for doing something special in the event that all backend servers are unavailable. This might include forwarding to a backup load balancer, or displaying a message regarding the outage. Load balancing gives the IT team a chance to achieve a significantly higher fault tolerance. It can automatically provide the amount of capacity needed to respond to any increase or decrease of application traffic.

It is also important that the load balancer itself does not become a single point of failure. Usually load balancers are implemented in high-availability pairs which may also replicate session persistence data if required by the specific application.

AIM AND OBJECTIVE:

Our objective is to distribute the task among the nodes on the basis of its resource utilization such that no node computes any excessive task and user can get task's output effectively as fast as possible. So our aim is to reduce the overhead of master node by rebalancing the load in the case failure detection. Another major aim is to develop the indexing technique for media content searching.

PROPOSED WORK:

The key issue in searching large media repository increase the system's overhead. To resolve this problem load balancing technique is used where the proper utilization of computing resources get done. It can be done by partitioning a task according to load distribution strategies. Here we propose the effective load balancing technique for media repository where user can search for image from large File/Image Repository. This task get done in Processing module where master distributes, assigns the task to the slaves and task's result is stored in indexed table in Indexing module. According to indexing, fetch image set or URL of image files as final result from File/Image Repository.

2. LITERATURE SURVEY:

In paper[1] In this paper, an efficient scheme to ensure fair load distribution in such P2P systems by utilizing proximity information is explained. Nodes having higher capacity carry more loads. Proximity information is utilized to guide load balancing such that loads are assigned and transferred between physically close heavy nodes and light nodes, thereby minimizing the load transferring overhead and allowing load balancing to perform more efficiently.

MapReduce plays a key role in Cloud Computing. In this paper[2], they develop a web-based graphic user interface for ordinary users to utilize MapReduce without the real programming. MapReduce decreases the complexity of the distributed programming and is easy to be developed on large clusters of common machines. So, users do not need to install Hadoop in their computers.

This paper[3] presents *Chord*, a distributed lookup protocol that addresses location of the node that stores a desired data item. Chord provides support for a operation: given a key, it maps the key onto a node. Data location can be easily implemented on top of Chord by associating a key with each data item, and storing the key/data pair to which the key maps. Chord adapts efficiently as nodes join and leave the system, and can answer queries even if the system is continuously changing. Resulting *Chord* is scalable: Communication cost and the state maintained by each node scale logarithmically with the number of Chord nodes.

This paper[4], they presents various load balancing schemes in different cloud environment based on requirements specified in Service Level Agreement (SLA). On one hand static load balancing scheme provide easiest simulation and monitoring of environment but fail to model heterogeneous nature of cloud. On the other hand, dynamic load balancing algorithm are difficult to simulate but are best suited in heterogeneous environment of cloud computing. Distributed nature of algorithm provides better fault tolerance. Dynamic load balancing techniques in distributed environment provide better performance.

In the paper [5], a novel load balancing protocol, Earliest Completion Load Balancing (ECLB) that monitors the distribution of system load and network latency in an attempt to dynamically create and maintain an evenly loaded system, even in the case of heterogeneous nodes or heavy load conditions. In heterogeneous environments, the completion of transactions before their deadlines depends upon both the network latency and load oneach node. In general, it outperforms other load balance strategies regardless of the environment. ECLB has shown to match the performance of basic, greedy load based protocols in situations where load is the most important factor in decision making.

In this paper[6], The Master Ant Colony algorithm has proposed. The Master ACO achieve better optimal solution for load balancing with vanishing node concept. The load balancing is solved by removing unoptimized path. The execution time reduced when all nodes in average state.

In this paper[7], they address the mis- sequencing problem by introducing a three- stage load-balancing switch architecture enhanced with an output load-balancing mechanism. It achieves high forwarding

capacity and provides transmission delay. For this nested load-balancing scheme is used. **Advantages:** Scalability, Bounded Delay, 100% Throughput, Low Average Delay. The output load-balancing mechanism is critical to the performance of the 3SLB switch, it produces finite queue lengths.

3. PROPOSED SYSTEM:

PROPOSED APPROACH:

We proposing Load balancer for media repository where user ask query for images through search engine. This search carried on multi client-server application where master get query as input hence increase in load. For resolving this problem, we use effective load balancing algorithm, accordingly master distributes and assigns task to the slaves and get result. Using output from processing module, we create and update indexed table. According to indexing, image set or URL will fetch from file/image repository as final result for user.

PROPOSED ARCHITECTURE:

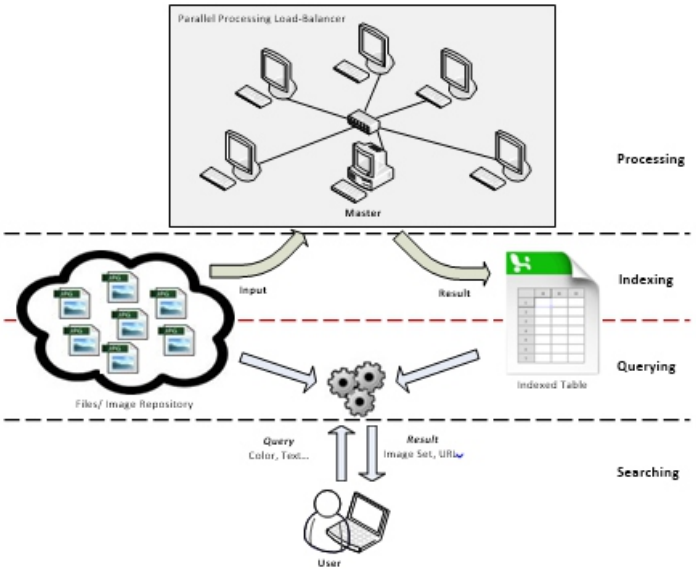

Fig.1: System Architecture

Fig.1 shows the basic block diagram of the project. Project contains following modules.

Files / Image Repository: Image repository is a large set of irrelevant images or files where we can search for required images.

Processing: Processing is based on multi-client server application building with GUI using socket programming. When task of searching is issued, File/Image Repository is required as input to the processing module and is assigned to a node, called as Master and Master distributes the task on the basis of its status (i.e. resource availability or PC hardware statistics) to other nodes, called as clients to reduce the load on the system.

Task distribution consist of :

1. File size calculation
2. File list distribution
3. Complete task progress monitoring
4. Failure detection
5. Task reassigning

Indexing/Querying: Processing provides its result to Indexing to get sequencing of images and it increases image counter so that user can directly get index of image and accordingly fetch image or URL of images from File/Image Repository.

Search Engine: User gives input as query about colour or text through system to search engine. Search of files or image set on the basis of colour level identification and text. User get output as image set or URL of image files.

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