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Core concepts as System Structure of Android Virtual Machine

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Abstract

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The topic developed in this research is an empirical study on the Core concepts as System Structure of Android Virtual Machine.

This investigation is scientific research grounded on scientific method, which essence is all evidences should be empirical (experiment-resources). Following the same pattern, this inquiry cover it examinations as the Figure 1 illustrate on the diagram of the scientific method, sketching the subsequent points:

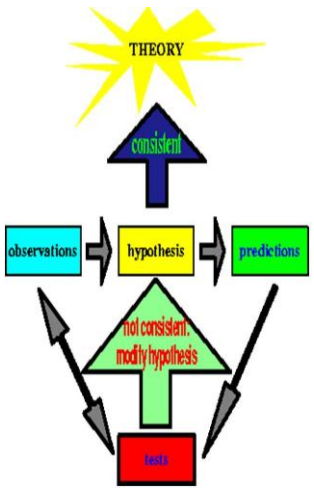

Figure 1 Flow diagram describing the scientific method.

- Observation.
- Hypothesis.
- Predictions.
- Testing the predictions or further observations/modification on the hypothesis in the light of a better result.
- Repeat the predictions and test them until there are no discrepancies between theory and experiment and/or observation (physics.ucr.edu.)

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Remarkably many smartphone operating systems such as:

Table 1 Cell phone Operating System

Apple's **iOS**	Google's Android	Windows Phone	**NOKIA**'s Symbian
RIM's BlackBerry **OS**	Maemo	MeeGo	

All have tried to be successful as Android. That has called the interest and enormous concern to explore. Perhaps this is the history that will dazzle the readers enlighten with a new perspective of Android and its virtual machine.

According to Engadget, a multilingual technology blog network with daily coverage of gadgets and consumer electronics, have categorized Android as the leading operating system of the smartphone, taking already more than 69 % of market shares worldwide. (Engadget).

Another website blog Research2Guidance has predicted Android as a galloping rising smartphone platform since 2011. It is significant to emphasize that Android platform started as a young product in October 2003. There have been bunches of speculations, but the fact is that Android numbers are mounting by thousands every day. (Research2guidance).

One of the greatest things about Android is that is an open source platform, in another words, is free to obtain, download it and install. Internet2GO An Opus Research Advisory Service has registered Android Operating System as having more free applications exceeding **Apple**. (Internet2GO).

At Android dot com has announced having more than 600.000 applications published. (Android.com).

Amazingly, Android has revolutionized the planet in less than one decade. Its projection as a product for the smartphone world is giving an obvious perceptive, it is an

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over taken side leader and it sharp enhancement.

It is not an exaggeration to suggest that Android is becoming a tremendously curious subject to read about it, and very interesting topic for a thesis research to develop.

Keywords

Android, Dalvik, Virtual Machine, Usability, Operating System, smartphone, Open Source.

Contents at a Glance

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I would like to extend my gratitude to my thesis' supervisor and mentor Professor Juha PISPA M.Sc. at Haaga-Helia University of Applied Sciences, for his assistance and supervision in order to accomplish this inquiry.

In addition I am addressing with deeply appreciation to my wife Heidi YISRAEL B.M. Bachelor of Midwifery and my mother Francisca CARDOZO D.A. Dental Assistance for their great support and encouragement.

This Bachelor Thesis has been my endeavor in order to substantiate my maturity as an undergraduate I.T. student. It is with this authoritative research my academic studies can seal the culmination of my education period at Haaga-Helia University of Applied Sciences.

My firm commitment, my motivation, my effort and my anxiety to growth as a professional, climbing higher and higher for a better yet to come; is part of the posterity, I wish to leave behind embed into my beloved children minds Rivka Malka, Ilai Shmuel, Yehiel Tzvi, Hodaya Jaffa, Rina Temima and Nicole Sheindel.

There is no better inheritance for a man to depart, than a good example to be lead. The world is a better place because of those men that never ceased to climb up till the last breath of their lives.

1 INTRODUCTION

1.1 Android's Etymology

Etymologically speaking the word Android by definition has roots from ancient Greek language. Phonetically speaking pronounced 'Antropos', which means man and the suffix phonetically, pronounced 'oid' means form or likeness. (etymonline). Since the chronological point of view, this could be a fine observation to emphasize how many ancient empires in history, such as the Hellenist and the Roman have influenced up until today.

1.2 Objectives

The main endeavor of this inquiry is to expose the technology and properties of Android narrowing the research efforts scrutinizing Dalvik's Android Virtual Machine. However the path will take the reader from the cradle of virtualization walking through its evolution until Android's virtual machine. The trail also links to the language in which Dalvik has been developed, the mother programming language Java. The Open source attributes and operations. It will reveal Android as The smartphone operating system of today. It will exhibit the peculiar way how Android runs its applications, that meaning as an enhancement technology that characterized. It will display the properties and body knowledge that associations this investigation, and all these just by means of concrete empirical evidences.

Here is a representation of core concepts as system structure sketched in this diagram Figure 2.

Figure 2 Core concepts as system structure of Android Virtual Machine

1.3 Deliverables

Essentially the peak of this research is expected to have delivered:

A useful background history of the virtualization
A reliable background history of Android
A useful definition of the computer jargon used in this research
A draft of how the virtualization works in general

A lucid comprehension of the Virtualization growth and feasibilities
An introduction of Dalvik's Android virtual machine
Emphasis and enhancement of Dalvik signifies to technology properties
How Dalvik Android virtual machine works
A sketch of Android Architecture
An brief analysis of Android and it virtual machine
Predictions of Dalvik Android's virtual machine for the yet to come
Android Open Source Licenses Issues
A view point of the Usability of Android virtual machine

1.4 Scope

The inquiry stresses it endeavors to exhibit the birth of the computer technology named virtualization. This creates a preamble and finally acquaint with Android Operating System and Dalvik, Android virtual machine. Amazingly is in Dalvik where almost all Android's applications run. This study intends to provide milestones raising a meaningful perception of Android virtual machine. It will emphasize the progress that it represents, the utilization of a virtual machine as main high technology.

1.5 Goals

This research endeavor is to display a Qualitative as well as Quantitative empirical research of Android and its Virtual Machine. Quantitatively, since the author has harvested a collection of facts in order to proof Android constrain.

Qualitatively because the whole information accumulated has been assembled and narrowed with a meticulous purpose. Dalvik Android's virtual machine has become like a ship propel leading the novelty perspective of high technology.

Fortunately, the vast recompilation of information distributed on the World Wide Web on this regards, favored this investigation to dig deeply as a fossil fuel mine.

Pragmatically Android does not require persuaders nevertheless; this enquiry is aiming to designate the study accomplished as a step stone for further empirical researches. What's more, this research might be capable as well as a modest beneficiary to contribute to the Android's community.

1.6 How to read this empirical research

To comprehend the methodology applied in this research in order to elude plagiarism; here are details of how the author proceeded.

- If the information provided is textual or is referring to a source casted for longer than one sentence of the actual section; a period, punctuation mark will be placed inside the parenthesis. (Here an illustration of the punctuation period how if located inside the parenthesis**.**)
- If the information provided is a just referrer an idea or a paragraph to the source casted longer than one sentence; a period, punctuation mark will be placed outside the parenthesis (Here an illustration of the punctuation period how is located outside the parenthesis)**.**
- All these marked references allocated in parentheses, operate and serve as anchors of the originals hyperlinks sources of information.
- Furthermore all the acronyms are also anchors that link to the abbreviations glossary to clarify their definitions.

1.7 Having an acquaintance with this research

When one is first learning boating, there seems to be an endless confusion of terms, procedures and rules to be memorized. (cs.ucla.edu). That is why carrying on the same essence of that pattern, will be indispensable to introduce or to reawaken those vital knowledge and computer jargon such as operating system, virtual machine, etc. It will definitely take a better impact for the reader as a meteorite following from out space on the surface of the earth, graving its magnitude and it existence.

Here a preface of the concepts about to discuss:

1.8 What is an Operating System?

Correctly described an Operating System is software that serves as a platform for a computer machine allowing it applications to run. This complex software, as it is an Operating System, entangles procedures that trigger actions and reactions inside the hardware of the computer machine, fabricating an expected screen output or display. (Webopedia).

1.9 How operating system works?

The well-known Operating System named Windows that runs on mostly in all the computer machines in the planet, allow to run applications such as Word, Power Point, Excel and many other software programs applications on it. (Operating System Concepts, Silberschartz, Galvin & Gagne, 1)., (docs.quah.ro.)

An operating system allow the user to control, organize and flexible predict the computer behavior. To make it simple to appreciate the importance of this software a computer without it is just a box and without use. (HowStuffWorks).

1.10 Having an acquaintance with the virtual machine

Specifically a virtual machine is the software that generates a practical environment, as a physical machine emulating a computing habitat in which operating systems and applications might run parallel. (SearchServerVirtualization.com). Putting it in other words, a virtual machine is a phantom operating system or another way to put it is completely isolated guest operating system installation within a normal host operating system. (Wikipedia.)

1.11 What is Android?

Android is the most popular and the most installed software application that serves as operating system platform for smartphones devices. Operate in different languages and it has been distributed in more than 190 nations. (Developer.Android.com).

Android is beyond smart, and it's only going to get smarter. (Android). This is perhaps an observation that can turn to be a prediction framed on this empirical research.

1.12 DALVIK's Android virtual machine performance

Android virtual machine, Dalvik works like a phantom environment or habitat encapsulating a replica all the fundamental services that interrelate with the computer hardware and the operating system.

To summarize and clarify what is a service. A service is an application system process that runs independent of any program (Answers). Good examples of services are the Print Spooler, that runs the printer utilized by the user, Windows Firewall, Windows Time Service, Internet Connection Sharing, etc.

The virtual machine copy and run them inside as a very separate space; as an instance-software titled "Virtual Machine".

Why to tag it with the term instance-software? Well, literally speaking the Virtual Machine process series of events that occur inside as is would be a computer operating system itself. This provides a tremendous advantage over operating systems that runs physically at the computer. In contrast, it is just a plain in simple use of the maximum resources of the computer system without exhaust or making the computer to crash because overloading it. (Linfo.org/kernel.html).

Another advantage is that booting and restarting a virtual machine can be much faster than with a physical machine, since it may be possible to skip tasks such as hardware initialization. (vmTimes.)

Android has dazzled the planet as the operating system for smartphones. The author of this thesis wish to scrutinize into the deepest of Android's operating system, the heart, the essence of Android as it is Dalvik the virtual machine, and examine it to the maximum.

2 OBSERVATION

Based on the scientific method, this research will intend to capture Android singularities. The investigation will be noting and recording in order to build up a block of the most relevant variables to create a substantial scientific hypothesis. (brandonbeltz).

Observations:

2.1 What makes Android so Android?

Since the beginning of civilization until nowadays, "Technology", this Greek origin word has been imprinted in our minds. (oxforddictionary). This has generated, literary describe the revolutionary impact of humanity over the planet Earth. Every invention, discovery, or just the way of how to become more productive, more efficient making the world of today.

- Android runs it applications on a virtual machine, cushioning in this manner all the hardware resources (Wikipedia).
- Android has more free applications than any other operating system (Wikipedia).
- Android's sponsors are a community interested to deliver a finest product for a communal interest is not one entity (Source.android.com).

2.2 Android, iOS and Windows 8 changing people lives

In a recent post on TechRepublic, blogger Seb Janeck admonished mobile platform pundits for their incessant rivalry over which mobile **OS** platform is the best. Actually, comparing Android to **iOS** to Windows 8 (**RT** or Pro) is really missing the forest for the trees. (TechRepublic.)

2.3 The purpose of the virtualization

It will be almost hopeless to try to understand about Dalvik Android's Virtual Machine without having a glance of how the virtualization began.

On July 1, 1963 when Massachusetts Institute of Technology **MIT**, announced the **Project MAC**, which stood for Mathematics and Computation, later renamed to Multiple Access Computer with a financial plan of $2 Million provided by Defense Advanced Research Projects Agency **DARPA**, a department of defense of United States. The purpose was to research into computers, specifically in the areas of Operating Systems, Artificial Intelligence, and Computational Theory. (Everythingvm.com.)

Making straightforward, the computer capability, human using simultaneously mainframe resources in other words, time-sharing became a serious dilemma. The traditional approach for a time-sharing computer was to divide the memory and other system resources between users. This was The Wake-up call for International Business Machines **IBM**, especially when **IBM** heard of Bell Laboratories' need for a similar system. (Everythingvm.com).

2.4 IBM and the first ideas of virtualization

Time was fabricating the anxiety for a better technology. Then around 1965 researchers from **IBM** at Yorktown Research Center New York, United States, began to manufacture a new feature that revolutionized the computer commerce and use worldwide. Partitioning the mainframe computer System/360 into small pieces, providing the opportunity for diverse users to operate and take advantage of the supercomputer processor. This was the instant when the notion of the use of a Virtual Machine was born. (gmu.edu).

2.5 Growth of the Virtualization

In response to the necessity from Massachusetts Institute of Technology **MIT** and Bell Laboratories', International Business Machines **IBM** designed as well the **CP**-40 mainframe computer, which never was sold to customers, yet it was used only in laboratories. However, it is important to mention it, since this equipment later on, evolved into the **CP**-67 system, which is the first commercial mainframe computer to support Virtualization. The Operating system, which ran on the **CP**-67, it was referred to as **CP**/**CMS**, which **CP** stands for Control Program and **CMS** stands for Console Moni-

tor System. The Console Monitor System was a small a single-user operating system designed to be interactive. The Control Program was the program, which created Virtual Machines. The idea was the Control Program ran on the Mainframe, and created Virtual Machines, which in turn ran the Console Monitor System that the user would then interact with. (Everythingvm.com.)

2.6 Virtual Machine versus Time-Sharing Usability

The most significant advantages achieved by implementing the virtual machines versus a time-sharing operating system, was the efficiency gained. There was no comparison how great the Virtual Machine Usability provided over the time-sharing abilities' overall resources of the mainframe. Instead of having, the resources split equally between all users. There was better security since each users was running in a completely separate operating system. Besides, it was more reliable since no one of the user could crash the entire system, only their own operating system, meaning, and their own virtual machine. (Everythingvm.com.)

Through all these time, the Virtual Machines have played crucial roles and have improved in every occasion, narrowing specific purposes. Nevertheless, the main reason why the Usability of the Virtual Machine became a significant issue to be treat more seriously is because ever since, the opening of the computer's world. Programmers worldwide has been scratching their heads, trying to come out with a universal piece of software that might run in every single platform. Well, how wonderful is to comprehend at this instant the advantages and utilization of Dalvik's Android Virtual Machine. (gmu.edu).

2.7 A Brief background history of Android

Located in the San Francisco bay of California, raise the city of Palo Alto. The city was named after a redwood trees that growth in the area. The metropolis is the headquarters to a number of Silicon Valley high-technology companies. A List the include **HP** Hewlett-Packard, **VMware**, Tesla Motors, **Ning**, **IDEO**, Palantir Technologies. It also has served as an incubator to several other high-technology companies, such as **Apple**

Inc., Google, Facebook, Logitech, Intuit, Sun Microsystems, Pinterest and PayPal. (Wikipedia.)

It was on October 2003 at Palo Alto, when Andy Rubin, Rich Miner, Nick Sears and Chris White founded Android Inc. (Wikipedia). Android Inc. operated secretly, revealing only that it was working on a mobile phones' software. In 2005, two years after Android Inc. was founded, Rubin ran out of money. (Wikipedia.) Despite the situation, Rubin refused Steve Perlman's assistance and partnership, and as consequence of that, Android was sold. (Wikipedia).

2.8 Google acquire Android

In August 17 of 2005, Bloomberg business week website announced Google acquisition of Android on July of that year for an undisclosed sum. Bloomberg's website referred to Android as a wealth of talent coming to Google. Andy Rubin, Richard Miner and Chris White joined to Google later on, to work in the same project they all began on Android Inc. (Webcitation).

As a matter of fact, Android has won people's heart and majority now thinks to get an Android **OS** based cell-phone for personal use. (ixibo.)

2.9 Microsoft versus Android OS Progress

Curiously, the rapid claiming of Android to the market has called the interest in this research to weigh Android with the colossal operating system of the planet, as it is Microsoft Windows.

Although Android is designed primarily for smartphones and tablets, the open and customizable nature of the operating system allows it to be used on other electronics, including laptops and netbooks, smartbooks, **eBook**s readers, and smart TVs. Furthermore, the Operating System has seen niche applications on wristwatches, headphones, car **CD** and **DVD** players, smart glasses, refrigerators, vehicle satnav systems, home automation systems, games consoles, mirrors, cameras, portable media players' landlines, and treadmills. (Wikipedia.)

The first commercially available phone to run Android was the **HTC** Dream, released on October 22, 2008. In early 2010 Google collaborated with **HTC** to launch its flagship Android device, the Nexus One. This was followed later in 2010 with the Samsung-made Nexus S and in 2011 with the Galaxy Nexus. (Wikipedia).

In December 2011 BRG, a leading online news website announced that the Pentagon has officially approved Android for use by its personnel. (BGR).

2.10 License and Proprietary Software

Back in time in 1983, Software Licensing and Software Proprietary principals called Richard Stallman attention, the longtime member of the hacker community at the Massachusetts Institute of Technology **MIT**. Artificial Intelligence Laboratory, announced the **GNU** project. An article outlining the project and its goals was published in March 1985 labeled the **GNU** Manifesto. The manifesto included significant elucidation of the **GNU** philosophy. Richard Stallman goes into details description of why it is important that they complete this project. The reason he justify is based on **UNIX** becoming proprietary software. It then clarifies how communities can contribute to the project, besides why computer users will benefit from the project. A large part of the **GNU** Manifesto is also focused on rebutting possible objections to **GNU**'s goals. Objections described at the manuscript involve the programmer's need to make a living, the issue of advertising / distributing free software, and the perceived need for monetary incentive. Finally the Manifesto conclude describing how the free software philosophy, and why it would be a worthy choice for the technology industry to follow Free Software Definition and "copyleft" ideas. (Wikipedia.) Richard Stallman to humorous the project name, he called **GNU**, which is an ox like antelopes of the genus Connochaetes. (Dictionary.), however in this case became an acronym meaning "**GNU**'s not **UNIX**". (Wikipedia.)

The Free Software Foundation **FSF** was founded in 1985, by Richard Stallman as a non-profit corporation supporting free software development. It continued existing

GNU projects such as the sale of manuals and tapes, and employed developers of the free software system. (Wikipedia.)

2.11 Licenses Founding Investors

On regards Android Open Source Project it has been register under Apache Software License version 2.0 "Apache 2.0", likewise the majority of the Android software is licensed with Apache 2.0. While the project will strive to adhere to the preferred license, there may be exceptions which will be handled on a case-by-case basis. For instance, the Linux kernel patches are register under the General Public License version 2 acronyms **GPLv2** with system exceptions, which can be described on document of **GNU** GENERAL PUBLIC LICENSE Version 2 of June 1991. (source.android.)

One of the reasons why the license is release under **ASL**, abbreviation for Apache Software License and no under **GPLv2**, contraction for General Public License version 2, is because **ASL** which is widely used in the open-source software community and has been approved by the Open Source Initiative, is a permissive license that is conducive to commercial development and proprietary redistribution. As well it is consider user space because Android is about freedom and choice. The code that is distributed under the **ASL** and other permissive licenses can be integrated into closed-source proprietary products and redistributed under a broad variety of other terms. Unlike permissive open-source licenses, "copyleft" licenses such as the **GPL** General Public License generally impose restrictions on redistribution of code in order to ensure that modifications and derivatives are kept open and distributed under similar terms. (Arstechnica.)

The purpose of Android is promoting openness in the mobile world, nevertheless it is impossible to predict or dictate all the uses to which people will want to utilize Android as software. Consequently, Android can encourage making devices that are open and modifiable; Android does not rely on imposing anyone to do so. Using **LGPL** shortening for Lesser General Public License libraries would often strength them to do so, since The Library refers to a covered work governed by this License, other than an Application or a Combined Work. (Source.android.), (GNU.org.)

2.12 Android's Manifesto

It has been said "A picture paints a thousand words" as Frederick R. Barnard coined once. (Tranloid). That is why it will be overwhelm to visualize through sketches or diagrams, crushing lines and lines of explanations how Android's Virtual Machine manifest its operations, platform, philosophy and policy.

2.13 Android an Open Sources Technology

Beneath at this page, models of an operating system structures. How an Operating System carries out their process and sequences in comparison to Android exclusively as it was mentioned previously.

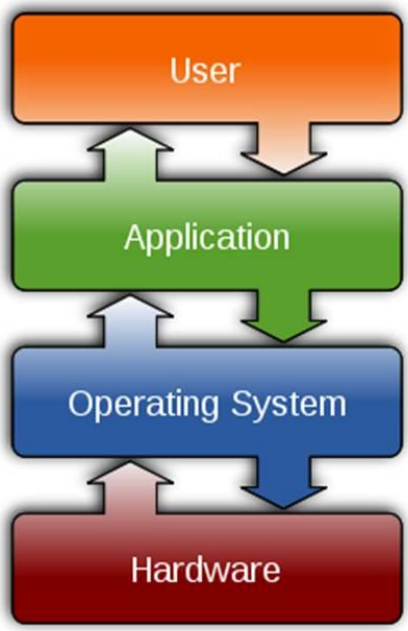

Figure 3 Operating System Placement.

From figure 3, it can be appreciated the simplicity and the scale of actions occurred from the moment the computer-user interact with the computer-machine and vice-versa. The user runs the applications on the operating system, which in turn uses the direct hardware-sources of the computer machine, which entangles procedures that trigger actions and reactions inside the computer hardware. All of these fabricate an

expected screen output or display; whereas in Android operating system runs its applications on the Dalvik, which is Android's virtual machine.

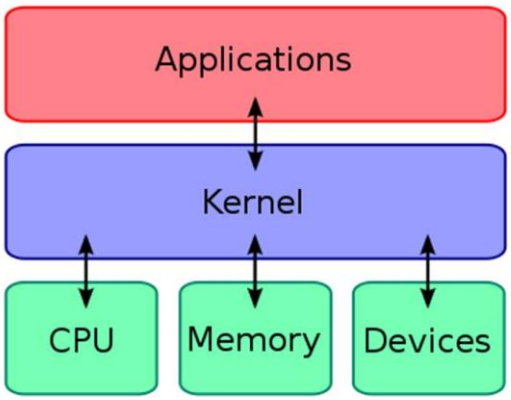

Figure 4 Kernel or Core Layout.

At this sketch Figure 4, it can be perceived how the applications go through the kernel that, in other words, the core or essence of the operating system. (Wikipedia).

2.14 Operating system functions

In contrast to all of these, Android operating system functions very differently.

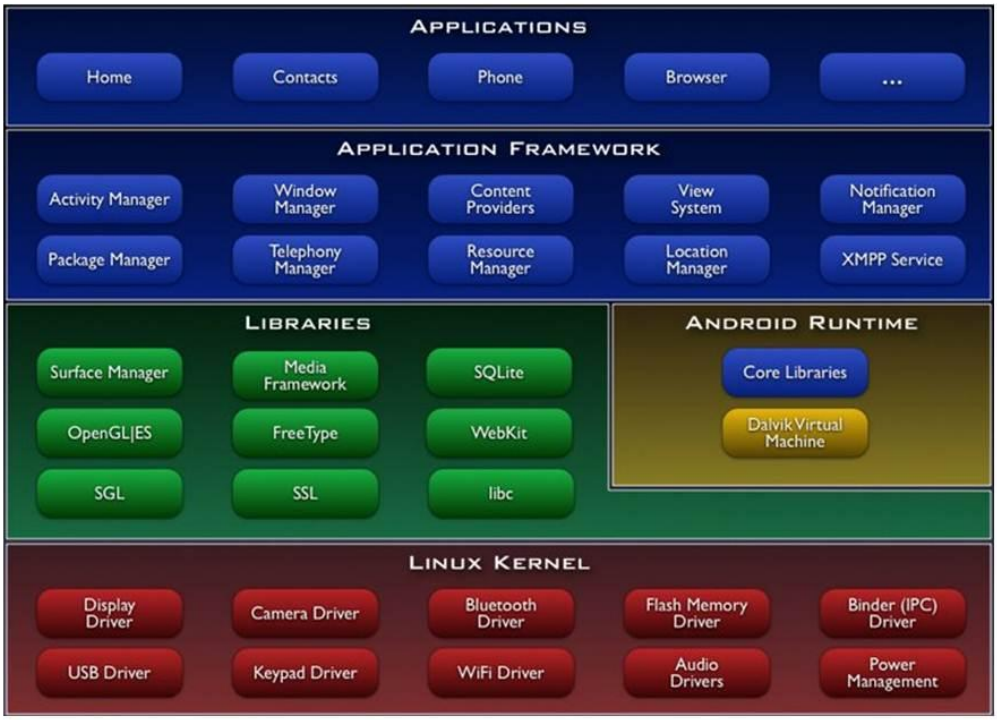

Figure 5 Android Architecture Diagram.

Estimated that the research have represented at Figure 5. Android's assembly diagram. Reading from the bottom up; as any other operating system Android has a Core, which mostly known as Kernel. In contrast to Microsoft operating system, Android has a Linux Kernel. Almost all Android applications run on the Virtual Machine, whereas other operating system runs their applications directly on the operating system; intensifying the probabilities of operating system overloading, using all the computer hardware resources, crashing and consequently having a machine reset loading up the entire operating system from start. To notice how important, this segment is on the operating system, when a computer collapsed, it actually means the kernel has crashed. (Linfo.org/kernel.html). The kernel orchestrates the entire operation of the computer by slicing time for each system function and each application as well as managing all the computer's resources. (PCmag.)

Continuing ascending the reading of this diagram, we meet with the section that contains all the libraries with a sub-segment of Android Run Time. It is on this specific level where Android virtual machine runs. (JAVAbeat). As it was mentioned previously

the virtual machine encapsulates all the fundamental services that interrelates with the computer hardware and the operating system, copy, manage, compile and run them, as it will be a separate operating system in a separated space as a phantom operating system.

Android's libraries are supposed to run on devices with little main memory and low powered Central Processing Unit **CPU**s, the libraries for **CPU** and Graphics Processing Unit **GPU** intensive tasks are compiled to device optimized native code. Basic libraries like the libc or libm were developed especially for low memory consumption and because of licensing issues on Android. In this layer the surface manager handles screen access for the window manager from the framework layer. Opposing to other frameworks, the media framework resides in this layer, as it includes audio and video codecs that have to be heavily optimized. (The Android Mania.)

Dalvik has a just-in-time compiler **JIT**, also known as dynamic translation, which is a method to improve the runtime performance of computer programs based on byte code, virtual machine code. (Wikipedia.)

In order to comprehend intensely byte code functionality here a brief description. To begin with a byte code is a compiled format for Java programs that runs through a virtual machine instead of the computer processor. Programs are stored in memory as byte code; however the code segment currently running is preoperatively compiled to physical machine code in order to run faster. Just-in-time compiler **JIT** represent a hybrid approach, with translation occurring continuously, as with interpreters, but with caching of translated code to minimize performance degradation. (Wikipedia.)

2.15 Dalvik Overview

In order to overview the beforehand revealed. In a byte code-compiled system, source code is translated to an intermediate representation known as byte code. Byte code is not the machine code for any particular computer, and may be portable among computer architectures. The byte code might then be interpreted by, or run on, a virtual machine. The **JIT** compiler reads the byte codes in many sections or in full, rarely and compiles them dynamically into machine language so the program can run faster. Java performs runtime checks on various sections of the code and this is the reason the

entire code is not compiled at once. This can be done per-file, per-function or even on any arbitrary code fragment; the code can be compiled when it is about to be executed hence the name "just-in-time", and then cached and reused later without needing to be recompiled. (Wikipedia.)

2.16 Dalvik Background History

Perhaps it will be indispensable to point out that Dalvik, Android virtual machine, as a virtual machine has its cradle since the beginning of the computer virtualization during the 60s.

The ambition to research for always new and better computer frontiers brought the Dalvik encounter.

Dalvik's Android virtual machine was named after a town in Iceland where Dan Bronstein, Dalvik's architect relatives came from. Dalvik means dale-bay. (Wikipedia).

Bronstein designed and wrote Dalvik together others software architects, which is often referred to as a Java Virtual Machine. Dalvik was meant to allow multiple virtual machine instances to run at once, relying on the underlying operating system for process isolation, memory management and threading support. (The Humanitarian FOSS Project).

In general, it can be said that Android uses the syntax of the Java platform, the Java's language, if you wish. That is enough to formulate that java programmers and **IDEs** Integrated Development Environments feel at home, and support the editing smoothly together with **Java SE**, which stand for Java Standard Edition. In addition is not enough to disclose that Java byte code or the Java virtual machine performing on the phone. (Iwn.)

OHA Open Handset Alliance, which is a consortium of companies including Google, **HTC** High Tech Computer Corporation-Taiwan, Intel, Motorola, Qualcomm, T-Mobile, and **NVIDIA** were determined on the creation of Android's virtual machine

having Mister Dan Bronstein as chief engineer amongst others. The primary goal of **DVM** Dalvik Virtual Machine is the creation of platform neutral dex files comparable to the Java Virtual Machine **JVM**, which processes the Java byte codes while using Java Class files or Jar files. (Toolbox.)

3 HYPOTHESIS

By definition, a hypothesis is a conjecture, based on the knowledge obtained while formulating the questions, which may explain the observed behavior of a part of our universe. (Wikipedia.) Therefore base on this regards and examinations gathered. This thesis would like to shape the Hypothesis of this research.

- Dalvik's Android Virtual Machine is an enhancement of a better technology for future operating system functionalities
- Dalvik comes to serve in a way to all programmers in the planet
- It is absolutely worth to research about Dalvik first of all, is novelty, second of all, there are not many researches about Android and its virtual machine and Finally it is tremendously interesting.

This thesis has betaken essential amount of sources of information to arrive to the summit of this assertion. Consequently, this inquiries wish to enlighten it endeavors in order to illustrate Android as Operating system. The research has provided sufficient information to substantiate Android as an enhancement for a better technology in many reasons.

- From the Usability point of view, it is vital to spotlight the great alternative of having a virtual machine on Android operating system, which managed runtime. (Source.android).
- Primarily, is on the Virtual Machine where all the application runs. (Developer. Android).
- Secondly minimize the possibility of operating system crashing. (PhoneArena).
- Thirdly since Android applications runs on its virtual machine this precise fact minimize the possibility of overloading the system (Linfo.org/kernel.html).

- Fourthly it might run an alternative operating system on another Virtual Machine
- This is way beyond what any other operating system can offer so far, managing the computer machine resources much better
- The use of the virtualization on Android comes to realize the advantages of what once started as a time-sharing solution
- Android is one of the kind operating system leading the future of the planet with it peculiarity. It is revolutionizing the smartphone and the computer world.

Therefore, summarizing the previously mentioned and finally conclude into the measly hypothesis. Yes, Android is certainly a breakthrough and has become the so expected solution for programmers finding a worldwide piece of software that could run in every single platform.

3.1 Usability of Android virtual machine

The reliability of compiling all the applications and run them as a separate space without fearing to crash the operating system, that means a great deal of enhancement to technology and effectiveness management, besides the vast intimidation to others operating systems in the market. This is perhaps the beauty of Dalvik, Android's virtual machine (Linfo.org/kernel.html).

Accurately Dalvik is the process virtual machine in Google's Android operating system. The programs are commonly written in Java and compiled to byte-code, which is the form of instructions that the Java virtual machine executes. They are then converted from Java Virtual Machine-compatible class files to Dalvik-compatible, .dex, which is the abbreviation for Dalvik Executable Files before installation on a device. The compact Dalvik Executable format is designed to be suitable for systems that are constrained in terms of memory and processor speed. (Wikipedia.) The All code found in the Application Layer are currently closed source, and are written in Java specifically for the Dalvik, Android's virtual machine. (Mibisoft Tinfotech.) It reuses duplicate information from multiple class files, effectively reducing the space requirement uncompressed by half from a traditional .jar file, which is a Java Archive File. For example,

the .dex file of the web browser application in Android is about 200K, which actually reading will be 200,000 Kilobytes, whereas the equivalent uncompressed .jar version is about 500 Kilobyte. The .dex file of the alarm clock application is about 50 Kilobyte, and roughly twice that size in its .jar version. (ITBusinessEdge.)

3.2 Analysis of the Research

The specifics examinations of Android's virtual machine on this research are:

1. To break down in separated pieces the components parts of this study from the very beginning

    a. The research presents a fundamental explanation of the jargon utilized
    b. A background history of the virtualization and Android itself, building with this the foundation of a well illustration
    c. Sketched with figures, exemplifying how actual the operating system works and how Android differs from others software platforms

2. Separated the disambiguation among time-sharing and virtualization. To comprehend the feasibilities of the virtual machine and subsequently, Dalvik Android virtual machine
3. Eventually utilize sources of information to proof the research finding. Selecting from Quantitative amount of data-evidence narrowing carefully to a chosen Qualitative substantiation
4. Examine the complexity of elements gathered and their relations and provided statements of such analysis and much simpler

4 PREDICTIONS or FURTHER OBSERVATIONS / MODIFICATION ON THE HYPOTHESIS

This particular step of the thesis involves determining the logical consequences of the hypothesis. Obviously, any useful hypothesis will enable predictions, by reasoning including deductive reasoning. It might predict the outcome of an experiment in a labor-

atory setting or the observation of a phenomenon in nature. The prediction can also be statistical and deal only with probabilities. (Wikipedia.)

4.1 Further Observations

This research base its predictions on the probabilities consequents of the hypothesis above concealed.

Android has conquered the top state of smartphones share in stock market, and is showing off as the predominant Smartphone Operating System.

Android's concepts are suitable for the dreams of a future technology blended with science fictions.

Android's forecast grows with reduced amount of assumptions every time, since Android has proof itself to get smarter and smarter. Furthermore, a serious web block page such as "The Next Web", has announced that BlackBerry is very much considering running Dalvik's Android Virtual Machine in their next device. (Thenextweb).

For instance and substantial fact is that people will be able to watch

- Adoption of wireless charging for our phones (AndroidAuthority).
- Android controlling our home artifacts (AndroidAuthority).
- Android stays overtaking the marketplace in excess of many others Operating Systems (AndroidAuthority).

4.2 Android Virtual Machine Projections

Underpinning the smartphone market is the constantly shifting **OS** landscape," added Ramon Llamas, senior research analyst with **IDC**'s Mobile Phone Technology and Trends team. "Android will maintain leadership throughout our forecast, while others will gain more mobile operator partnerships **Apple** or that currently find themselves in the midst of a major transition: BlackBerry, Windows Phone and Windows Mobile.

What remains to be seen is how these different operating systems – as well as others – will define and shape the user experience beyond what we see today in order to attract new customers and encourage replacements. (IDC.)

Windows Phone 7/Windows Mobile will gain share despite a slow start. Windows Phone 7/Windows Mobile will be aided by **NOKIA**'s strength in key emerging markets. **IDC** expects it to be the number 2 **OS** with more than 19% share in 2016, assuming **NOKIA**'s foothold in emerging markets is maintained. (IDC.)

The fact is that all three of these **OS** platforms have their strengths and weaknesses. Depending on what the reader is already using and what the reader wants to get out of their computing experience, any one of these three choices may be the superior option. Understanding the readers own goals and each platform will deliver the most positive experience possible. Failing to understand this will lead to disappointment. Fortunately, this research is here to try and help the reader to sense of the options available. (TechRepublic.)

- **iOS** there's no doubt that **Apple** started the modern post-**PC** era. There's a lot to love about **iOS** — it's reliable, the hardware is gorgeous and cutting-edge. **iOS** is the weakest in content creation and productivity. **iOS** is aimed squarely at average consumer markets and it's hugely successful in reaching this group. The iPad is so simple that toddlers and chimps can pick it up and understand it. **iOS** is only the best choice if you want a machine primarily for consumer applications with little or no professional productivity in mind. (TechRepublic.)
- Android is the most popular smartphone **OS**, but it's also now positioned to be the dominant tablet and hybrid **OS** by the middle of 2013. It's no wonder, because Android is, in many ways, the "Windows" of mobile **OS** platforms. Android devices offer a flexibility that **iOS** cannot match. Android has become less of a consumer appliance and more of a power user's playground. At the same time, for true power users, Android falls just short of being able to deliver a completely satisfying experience. (TechRepublic.)

- Windows 8, Microsoft has positioned themselves to compete with the encroachment of mobile **OS** platforms on the traditional **PC**, but Windows 8 is a complex platform in all its myriad forms. Windows delivers much of the mobile **OS** platform nearly as well as the previously mentioned platforms, but it retains a distinct focus on corporate business productivity as its primary role. The sacrifice here is that Windows 8 reflects Microsoft's philosophy on enabling powerful business applications that reward a steep learning curve with tremendous competitive advantage. All of these Operating Systems have benefits and compromises. Perhaps the selection of the platform that appeals the most to the users. Depending on the user's needs and tastes, however, the users might end up picking a platform that isn't the best solution for him/her. Which device platform best fits the actual needs? That is the question that should rise in people's minds. (TechRepublic.)

5 THE THESIS CENTRAL OF THE TECHNOLOGY PROPERTIES OF ANDROID AND ITS VIRTUAL MACHINE

Grounded on a scientific method the thesis endeavored systematically by means of the research cycles, which procedures were:

1. Observation
2. Hypothesis
3. Predictions
4. Test of the predictions
5. Further observations /modification on the hypothesis in the light of a better result
6. Repeat the predictions and test them until there are no discrepancies between theory, experiment and /or observation (physics.ucr.edu.)

The research excluded testing of the predictions phase. However the author presents the rest of the phases with it respective analysis.

5.1 Observation:

Throughout the browsing recorded in this research it can be spotted the birth and growth of Android operating system; stressing its founding, enlightening it feasibilities.

History is powerful. The famous Spaniard-American George Santayana, philosopher, essayist, poet and novelist once said: "Those who are unaware of history are destined to repeat it"(Wikiquote.) using this paraphrase the reader might conceive, the reason why to bring up the vast background history in order to gather a better aspect of the research result.

The background overture served the reader to realize the meaning of the virtualization as a solution of the time-sharing during the sixties. Likewise how the virtualization is utilized today. (Everythingvm.com). Nevertheless virtualization stands today as part integrated of an operating system such as Android. (Mibisoft Tinfotech). Android virtual machine might clearly be the breakthrough of the expected worldwide solution for programmers to find piece of software that could run in every single platform. (gmu.edu).

The reader can perceive the reason why Android has been released under **ASL** and no under **GPLv2** license; Allowing in this way to Android the freedom of commercial development, freedom of choice considering the user space and proprietary redistribution (Arstechnica).

The website Network Computing that bases their journal on surveys has published on the 5th September 2012 an extraordinary remark. The growing prominence of tablets within the pantheon of end-user computing devices, has helped drive **BYOD** and cloud projects within the enterprise, made cell-phone networks a common remote-access option and brought relief to laptop-lugging road warriors worldwide. They have also made an even more fundamental change in the mix of devices for which corporate networking gurus are responsible, and with Android, have given Microsoft the first really credible competitor to a major new version of Windows in more than a decade (Network Computing.)

During those ten years

- Android became a serious Microsoft competitor (Network Computing).
- **NOKIA** has become with it old operating system Symbian a minor contestant (computerworld).
- Samsung sold more smartphone in the planet in 2011, and all of them with Android **OS** (connectedplanet).

Actually this approach might be the simple reason why Android is so successful. In order to substantiate the previously mentioned the better example the research can provide is the Fedex Day of Atlassian.

Atlassian is an Australian software enterprise. One Thursday afternoon at the end of one business quarter, the manager gathered their software developers and granted them with twenty-four hours totally free to produce whatever they wanted, with the team they wish. Amazingly, the results were overwhelming; corroborating that people with the autonomy can perceive a great sense of freedom, of innovation and creativity that even large money reward cannot conceive. The company has continued repeating the same event at the end of every business quarter achieving wonderful software applications. However, what more astonishing is that others enterprises around the globe have copied the same idea accomplishing the identical results. (danpink).

5.2 Hypothesis:

Based on the knowledge obtained in this research it can be synthesized:

Dalvik's Android Virtual Machine is an advance of a better future technology for operating system functionalities. The fact is that the serious web block page such as "The Next Web" have announced that the Canadian telecommunication company Research in Motion Limited, acronym **RIM**, trading as BlackBerry is very much considering running Dalvik's Android Virtual Machine in their next device. (Thenextweb)., (Wikipedia).

Dalvik have come to assist to programmers in the planet. The real fact is a better solution since a virtual machine running applications of the operating systems. Light up the thought of using multiple virtual machine running different applications on different computer source codes in the same machine. So yes, Dalvik is serving as a leap forward for programmers worldwide.

Users interrelating with Android operating system are able to run their favorites applications that run in other operating systems. If for any the reason either application error or human error the virtual machine has to restart. Hardware initialization is omitted; in this way accelerate the startup.

There is no doubt whatsoever after been going through these pages the author dares to statement it is worth it to research about Android and It Virtual Machine.

- It is an operating system with an interesting fast growing
- It is the number one operating system using a virtual machine to run its applications. In this way minimize crashing and overloading the operating system. (Linfo.org/kernel.html).

The use of the virtualization have comes, once more, to realize the advantages that it signify.

5.3 Predictions:

Android's concepts are becoming the vision of the yet to come in technology blended with science fictions.

Furthermore Android is already overtaking the marketplace in excess many others Operating Systems (AndroidAuthority).

5.4 Further observations/modification on the hypothesis in the light of a better result.

At the end of this research perhaps many of the information gathered, have turn out to be obsolete. Given the fact that High Technology is one of the galloping science ever

existed. Nevertheless this research has served to enlight and perhaps to be utilized as a step stone for further research.

6 THEORY

6.1 Introduction

Literally speaking the term, "Theory" provides a useful way of understanding how a thesis becomes more than simply the central claim we make in a paper (iusb.edu.) Base on this clarification the author is hereby to introduce his theory subsequent of his humble study.

It will take a journey of 50 years through the window of the temporal dimension of time, as it will be travelling back with Herbert George H.G. Wells' Time Machine. The reader will appear at hippies' era, when The Beatles were around singing in every single radio station on the planet. It is on this precise time, when the Virtual Machine started together with another computer wonders, such as the **TCP/IP** protocols, the Inter-network connection and many others computer revolutions that took place during the 60s. (Wikipedia).

The globalization has spread Android worldwide as Sumatra Super-volcano eruption did 73.000 years ago with it ashes and plasma. (sciencedaily). It is without hesitation. Yet in a sparking way to estimate that this operating system will triumph the conquest of smartphone arena. A complementary significant motivation is that Android is an open source technology. This specific matter inspires developers to pour their real potential freely (source.android).

Android's philosophy is unequivocal. They have stated, "We wanted to make sure that there would always be an open platform available for carriers, original equipment manufacturers **OEMs**, and developers to use to make their innovative ideas a reality". (source.android.)

Moreover, Google Plus announced by the third quarter of 2012 that have been 500 millions devices activated with Android operating system. (plus.google).

6.2 Perspective

It is obvious Android represent nowadays the advanced perspective of high technology, since is the only operating system running its applications on a virtual machine. Android has introduced new alternatives such as multi virtualization performances. Running a range of applications furnished on varied computer languages, a dream of many software developers. Since Android use a Virtual Machine minimized the system overloading and system crashing possibilities.

6.3 Android is a Purpose Maxi-miser

Android is a Purpose Maxi-miser. Android had not planned to become a successful operating system, and yet Android has conquered that stage. Curiously Android history it just materialized so rapidly as a spatial explosion, like a supernova outshining the entire galaxy, in other words, it has become a star in just ten years 2003 – 2013. It has reached more 68.8% shares of the smartphones so far (Engadget). Android developers' life has happened coping what perhaps several software enterprises or developers ever dreamed.

Top Five Smartphone Operating Systems, Shipments, and Market Share, 2012 (Units in Millions)

Operating System	2012 Unit Shipments	2012 Market Share	2011 Unit Shipments	2011 Market Share	Year over Year Change
Android	497.1	68.8%	243.5	49.2%	104.1%
iOS	135.9	18.8%	93.1	18.8%	46.0%
BlackBerry	32.5	4.5%	51.1	10.3%	-36.4%
Symbian	23.9	3.3%	81.5	16.5%	-70.7%
Windows Phone/ Windows Mobile	17.9	2.5%	9.0	1.8%	98.9%
Others	15.1	2.1%	16.3	3.3%	-7.4%
Total	**722.4**	**100.0%**	**494.5**	**100.0%**	**46.1%**

Figure 6 World Mobile Device Sales Android 68.8% Market Share.

As an operating system has confirmed it potential of a leading and shifting for a new software platform running on all smartphones devices, table **PC** and perhaps in Personal Computer as well.

Android is the software platform, the operating system dreamed so far.

6.4 How people talk about Android

Amazingly Google Android has bitten the record of twenty-five billions downloads. Jaime Rosenberg, the Director of Digital Content published on Android official blog: "That is more than twice the distance, in miles that the Voyager 1, the spacecraft has travelled since its launch 35 years ago". "It's the amount of time, in minutes, that have passed since some of our earliest ancestors began to set foot in Europe. And now, it's a Google Play milestone". (Officialandroid).

It is astounding to add as well, that Twenty-five billions download is more than three times of the earth actual population 7,021,836,029 (Geography). Another thing to point out is that Google is hardly the first company to try using open-source software to shake up the industry. (Mobisoftinfotech.)

6.5 Android has putted a Ding on the Planet

Android has putted a Ding on the planet. A traditional computers research group name Canalys reported that more smartphones than computers were shipped on the planet in 2011. (The Verge.) However, additional surprisingly is that Android finished the first quarter as the overall leader among the mobile operating systems, accounting for more than half of all smartphone shipments. (Engadget.)

For the Record, just for the History's sake this research should mention briefly that the smartphones, the combination of computing and telephony were conceptualized as early as 1973; and were offered for sale at the beginning of 1994. The term "smartphone" did not appear until 1997, when Ericsson Company described its GS 88 "Penelope" concept as a "Smart Phone". (Wikipedia.) However Smartphone sound today like a new born term shinning the 21 century.

Figure 7 the First Smart Phone GS 88 Penelope by Ericsson.

6.6 Telling about Android

The history begin in 1981, a company named Microsoft grew together with **IBM** seeking at the time for an operating system. (Wikipedia). **DOS** that stand for Disk Operating System did not have any kind security licensing encryption for strategic market interest. This made easier for Microsoft to spread their product **DOS** round the globe into every single Personal Computer **PC**, making themselves indispensable, essential for any application software to run.

Ever since Software and Hardware enterprises aimed their production, no matter how major or minor they were, over the Operating System that globalized the software market. As it is today, 32 years subsequently Microsoft became the largest software Empire on the planet as unlikely has never existed on the history of the globe. (Wikipedia).

On regards Android, an open source technology, which interest has been to produce an alternative operating system, has over taken the smartphone market in less than a

decade. (source.android). Considering this as a great advantage over Microsoft Empire, that did not depends of any sponsors to be support or developed. This might proof the mere collective scientific interesting for a better technology, better future.

6.7 About the Licenses

Licenses law co-founded community. A software license is a legal instrument, usually by way of contract law with or without printed material governing the use or redistribution of software. In addition to granting rights and imposing restrictions on the use of software, software licenses typically contain provisions which allocate liability and responsibility between the parties entering into the license agreement. Software licenses can generally be fit into the following categories: proprietary licenses as well as free and open source **F/OSS**, **FOSS** or else free/libre/open source software **FLOSS**. (Wikipedia.)

Open source, as it is Android operating system; grant the users the entitlement of utilization, copy, study, change and improvement of its design through the availability of its source code. This approach has gained both momentum and acceptance as the potential benefits have been increasingly recognized equally by individuals as well as corporations. (Wikipedia.)

Google releases the complete Android mobile operating system stack under the open-source Apache license, freeing up carriers, **OEMs** and ambitious application development experts to build functional smart phones with the software. The mobile and wireless development is timed for T-Mobile's launch of the Android-based G1 smartphone to consumers. Developers can also contribute code to the platform thanks to a set of APIs that allows Android to host applications written by third-party developers. (eweek.)

6.8 Describing Android

Curiously Android Layers Architecture in contrast to others operates peculiar.

- Applications
- Android Runtime Libraries
- Linux Kernel

At the following figure 8 the application layer of Android operating system.

Figure 8 Application Framework Layer.

As is shown at the figure 8, the application developer has access to what Android refers to as, service processes. These services are invisible to the user of the handset. Application developers can communicate with these services via a message bus. For instance, a contact application might instigate a phone call at the behest of a user request by calling on the services of the telephony manager. All code found in this section is currently closed source, is written in Java specifically for the Dalvik, Android's virtual machine. It is not yet certain under what license these modules will be made available in the future. (Mibisoft Tinfotech.) On a regular operation system the applications runs directly on the operating system. This intensifies the probabilities of operating system overloading, crashing and consequently having a machine reset loading up the entire operating system from the start.

Libraries, Android runtime

Figure 9 Library Layer.

Continued with the diagrams sketches at the Figure 10 the of Library layer. This consists entirely of the open source collections available under various licenses. Some of the libraries come from the **GNU** operating system projects, which it is necessary to mention its design is similar to **UNIX**, acronym for Uniplexed Information and Computer Systems. (GADGETSGURU). The licenses at this juncture vary from the Library General Public License **LGPL**, Berkeley Software Distribution **BSD**, Massachusetts Institute of Technology **MIT** and are entirely in the public domain in the case of the **SQLite** database. However, even if the licenses of some of the components found in this layer are more permissive and could allow a hardware vendor for customizations not found in other Android handsets, Google has created the Open Handset Alliance that owns the Android trademark. As part of this effort, any phone that wishes to be branded as an Android handset must meet the non-fragmentation rule. As such, any phone that would customize the libraries found in this layer, add libraries or remove them altogether would no longer be able to brand itself as an Android phone. Furthermore, under this similar pledge, its license to the proprietary Dalvik virtual machine found at the core of the Android platform would be considered null and void. (Mibisoft Tinfotech.)

The kernel Layer

Figure 10 Kernel Layer.

In the function of Kernel, in other words, the core of Android's operating system shown at figure 10. Notice that the red layer represents the services offered by the Linux kernel and associated **GNU** utility packages ported to the Acorn **RISC** Machines, **ARM** architecture. These components are licensed under the **GNU** General Public License, the **GPL**, or the **GNU** Lesser General Public License, the **LGPL**. Being subject to the **GNU** **GPL** and **LGPL** licenses, these components are licensed with all source code included. Furthermore, due to the viral nature of the **GPL** license, any modification to this layer or derived work must be distributed as source to any 3rd parties using the identical licensing terms. The **GNU**/Linux **ARM** port is mature, stable, and used in many embedded projects both in and outside of Google. (Mibisoft Tinfotech.)

6.9 USABILITY TECHNICALLY SPEAKING

Perhaps the practicable way to describe the essence of Usability is to define it as the widely answer too many of these frustrating interactions with technology. (steptwo). Likewise, the way to introduce a product to the market without the assumption that is known by the user, in other words, is the easy technique to illustrate or instruct the users in the simplest approach possible.

Usability is held by some to be a context-dependent yardstick for the effectiveness, efficiency and satisfaction with which specific users should be able to perform tasks. (Wikipedia.)

7 CONCLUSION

The author would like finally conclude this inquiry saying. Yes, there's have been mistakes, is the truth. The author has faults. However the author is glad because without mistakes the mankind could not have invented the wheel, the airplane or the light bolt. The author is not perfect and does not want to be. The author modestly is placing on the reader hands, and to whom it might concern and stipulate his effort, trying to enlighten and reveal important matters that they don't come out to daily conversation.

Through the pages this inquiry has provided a consciousness of the virtualization, Android architecture furthermore Android virtual machine.

As well has emphasized:

1. The virtualization as breakthrough and solution for the time-sharing
2. The solutions that Android presented for the overloading and crashing operating systems; since Android has a virtual machine, in which all its applications run.
3. Programmers amazingly finally will take advantage of this great deal of opportunity to run several virtual machines without really consuming the hardware resource. Certainly these represent a novel perception for a very distinctive future.

It will be a great deal of satisfaction to imagine that this thesis' vision and mission has been accomplished. Nevertheless, the impetus and humbleness of this investigation might as well, edify new knowledge.

On the achievement of this manuscript, might as well exhibit the maturity and perception of the author in order to offer an academic scientific research; based on the practical and theatrical knowledge acquired during his academic studies.

The writer has endeavored himself to be objective, seeking to contribute with crucial material concerning Android and it virtual machine. Yet, it is possibly necessary to enforce this attempt with a beautiful quoted from a distinguished man. Theodore Roose-

velt, the 26th president of United States. He once said at the Sorbonne, Paris in April 23, 1910. "Is not the critics that count, not the man who point out how the strong man stumbles or where the doer of deeds could have done them better. The credit belongs to the man who is actually in the arena (theodoreroosevelt.) Obviously Android achievements belong to a big community of supporters, sponsors, but more precisely to the developers for creating an enhanced technology. The author of this thesis just stands humble and eager to enlighten with this modest study.

GLOSSARY

A

Android is an operating system based on the Linux kernel, and designed primarily for touch-screen mobile devices such as smartphones and tablet computers.

Application (Application software) is all the computer software that causes a computer to perform useful tasks a specific instance of such software is called a software application, program, application or app.

Artificial intelligence (**AI**) is technology and a branch of computer science that studies and develops intelligent machines and software. Major AI researchers and textbooks define the field as "the study and design of intelligent agents", where an intelligent agent is a system that perceives its environment and takes actions that maximize its chances of success. John McCarthy, who coined the term in 1955, defines it as "the science and engineering of making intelligent machines"

B

BlackBerry Limited**,** formerly known as **RIM** Research In Motion Limited, is a Canadian telecommunication and wireless equipment company best known as the developer of the BlackBerry brand of smartphones and tablets.

C

Copyleft (a play on the word copyright) is the practice of using copyright law to offer the right to distribute copies and modified versions of a work and requiring that the same rights be preserved in modified versions of the work.

Crash (or system crash) in computing is an event in which a computer or a program (such as a software application or an operating system) ceases to function properly, often exiting after encountering errors.

Canalys is a team of advisors and researchers for the IT and high-technology sectors.

E

Empirical research is a way of gaining knowledge by means of direct and indirect observation or experience. Empirical evidence (the record of one's direct observations or experiences) can be analyzed quantitatively or qualitatively.

G

Google is an American multinational corporation specializing in Internet-related services and products. These include search, cloud computing, software, and online advertising technologies. Google mission statement was "to organize the world's information and make it universally accessible and useful".

Google Android is an operating system based on the Linux kernel, and designed primarily for touch-screen mobile devices such as smartphones and tablet computers. Initially was developed by Android, Inc., which Google backed financially and later bought in 2005.

H

Hacker is someone who seeks and exploits weaknesses in a computer system or computer network. Hackers may be motivated by a multitude of reasons, such as profit, protest, or challenge.

Hardware or computer hardware refers to the physical parts or components of a computer such as monitor, keyboard, computer data storage, hard drive disk, mouse, system unit (graphic cards, sound cards, memory, motherboard and chips), etc.

I

Intuit Inc. is an American software company that develops financial and tax preparation software and related services for small businesses, accountants and individuals.

iPad is a line of tablet computers designed and marketed by Apple Inc., which runs Apple's iOS

K

Kernel in computing, the kernel is a computer program that manages input/output requests from software and translates them into data processing instructions for the central processing unit and other electronic components of a computer. The kernel is a fundamental part of a modern computer's operating system.

Kilobyte or kibibyte is a multiple of the unit byte for quantities of digital information. The binary prefix kibi means 1024, therefore 1 kibibyte is 1024bytes. The byte is a unit of digital information in computing and telecommunications that most commonly consists of eight bits. Historically, the byte was the number of bits used to encode a single character of text in a computer and for this reason it is the smallest addressable unit of memory in many computer architectures.

L

LINUX is computer operating system assembled under the model of free and open source software development and distribution.

M

Mobile phone or just **mobile** (also known as a cellular phone, cell phone, and a hand phone) is a device that can make and receive telephone calls over a radio link while moving around a wide geographic area. It does so by connecting to a cellular network provided by a mobile phone operator, allowing access to the public telephone network. By contrast, a cordless telephone is used only within the short range of a single, private base station.

Manifesto is a published verbal declaration of the intentions, motives, or views of the issuer, be it an individual, group, political party or government. A manifesto usually accepts a previously published opinion or public consensus and / or promotes a new idea with prescriptive notions for carrying out changes the author believes should be made. It often is political or artistic in nature, but may present an individual's life stance. Manifestos relating to religious belief are generally referred to as creeds.

Maemo is an open source code software platform developed by Nokia and then handed over to Hildon Foundation for smartphones and Internet tablets. It is based on the Debian Linux distribution. The platform comprises the Maemo operating system and the Maemo SDK.

MeeGo was a Linux-based free mobile operating system project, which lives on in a fork called Mer. Primarily targeted at mobile devices and information appliances in the consumer electronics market, MeeGo was designed to act as an operating system for hardware platforms such as netbooks, entry-level desktops, nettops, tablet computers, mobile computing and communications devices, in-vehicle infotainment devices, SmartTV / ConnectedTV, IPTV-boxes, smart phones, and other embedded systems.

N

Nexus One is an Android smartphone designed and manufactured by HTC as Google's first Google Nexus smartphone.

O

Operating System is software that serves as a platform for a computer machine; this software entangles procedures that trigger actions and reactions inside the hardware of the computer, fabricating an expected screen output or display.

Open source as a development model promotes a) universal access via free license to a product's design or blueprint, and b) universal redistribution of that design or blueprint, including subsequent improvements to it by anyone. Before the phrase open source became widely adopted, developers and producers used a variety of terms for the concept; open source gained hold with the rise of the Internet, and the attendant need for massive retooling of the computing source code.

Q

Qualitative research is a method of inquiry employed in many different academic disciplines, traditionally in the social sciences, but also in market research and further contexts. Consist on harvesting a collection of facts in order to proof the research constrain.

Qualitatively Research the whole information harvested on the research, systematic empirical is assembled and narrowed it with a meticulous static and purpose, which is to determine the research specifics.

R

Runtime is when a program is running (or being executable). That is, when you start a program running in a computer, it is runtime for that program. In some programming languages, certain reusable programs or "routines" are built and packaged as a "runtime library." These routines can be linked to and used by any program when it is running.

S

Scientific Method The scientific method is a body of techniques for investigating phenomena, acquiring new knowledge, or correcting and integrating previous knowledge. To be termed scientific, a method of inquiry must be based on empirical and measurable evidence subject to specific principles of reasoning. The Oxford English Dictionary defines the scientific method as: "a method or procedure that has characterized natural science since the 17th century, consisting in systematic observation, measurement, and experiment, and the formulation, testing, and modification of hypotheses.

Service is an application system process that runs independent of any program.

Smartphone (**smart phone**) is a mobile phone built on a mobile operating system, with more advanced computing capability and connectivity than a feature phone.

Smart TV, sometimes referred to as connected TV or hybrid TV, (not to be confused with IPTV, Internet TV, or with Web TV), describes a trend of integration of the Internet and Web 2.0 features into television sets and set-top boxes, as well as the technological convergence between computers and these television sets / set-top boxes.

Satnav or **Sav Nat** satellite navigation or sat nav (stanav) system is a system of satellites that provide autonomous geo-spatial positioning with global coverage. It allows small electronic receivers to determine their location (longitude, latitude, and altitude) to high precision (within a few meters) using time signals transmitted along a line of sight by radio from satellites.

Sun Microsystems, Inc. was a company that sold computers, computer components, computer software, and information technology services and that created the Java programming language, and the Network File System (NFS). On January 27, 2010, Sun was acquired by Oracle Corporation for US$7.4 billion, based on an agreement signed on April 20, 2009. The following month, Sun Microsystems, Inc. was merged with Oracle USA, Inc. to become Oracle America, Inc.

Symbian is an open-source (**ECL** Eclipse Public License) mobile OS operating system and computing platform designed for smartphones and currently maintained by Accenture. Symbian was originally developed by Symbian Ltd., as a descendant of Psion's **EPOC** and runs exclusively on **ARM** processors, although an unreleased x86 port existed. The current form of **Symbian** is an open-source platform developed by Symbian Foundation in 2009, as the successor of the original **Symbian OS**. Symbian was used by many major mobile phone brands, like **Samsung**, **Motorola**, **Sony Ericsson**, and above all by **Nokia**.

T

Time-sharing is the sharing of a computing resource among many users by means of multiprogramming and multi-tasking. Its introduction in the 1960s, and emergence as the prominent model of computing in the 1970s, represented a major technological shift in the history of computing.

Theoretical computer science and mathematics, the theory of computation is the branch that deals with how efficiently problems can be solved on a model of computa-

tion, using an algorithm. The field is divided into three major branches: automata theory, computability theory, and computational complexity theory.

U

Usability is the ease of use and learn-ability of a human-made object. The object of use can be a software application, website, book, tool, machine, process, or anything a human interacts.

V

Virtual machine (VM) software based, fictive computer. Virtual machines may be based on specifications of a hypothetical computer or emulate the computer architecture and functions of a real world computer.

VMware, Inc. is an American software company that provides cloud and virtualization software and services, being the first who managed to virtualize the x86 architecture.

W

Windows Phone abbreviated as WP is a series of proprietary smartphone operating systems developed by Microsoft. It is the successor to Windows Mobile, although it is incompatible with the earlier platform.

ABBREVIATIONS GLOSSARY

A	B	C
Apple Apple Inc., formerly Apple Computer, Inc.	**BYOD** Bring your own device (also called bring your own technology.	**CD** stands for Compact disc, is a digital optical disc data storage format.
ARM is a family of instruction set architectures for computer processors based on a reduced instruction set computing **RISC** architecture developed by British company **ARM** Holdings.	**BSD** acronym Berkeley Software Distribution.	**CP** stands for Control Program.
		CPU Central Processing Unit.
		CMS stands for Console Monitor System.
ASL abbreviation for Apache Software License.		
D	**E**	**F**
DARPA Defense Advanced Research Projects Agency.	**eBook** stands for electronic book, is a book-length publication in digital form.	**FSF** stands for Free Software Foundation.
DVM acronym for Dalvik Virtual Machine.	**EPOC** acronym of epoch, the beginning of an era, but was back fitted by the engineers to "Electronic Piece Of Cheese". Succeeded by Symbian in 1998.	**FLOSS** stand for free libre open source software.
		FOSS or **F/OSS** stand for free and open source.
DOS acronym for Disk Operating System.		
DVD stand for Digital Video Disc is a digital optical disc storage format.		

ABBREVIATIONS GLOSSARY

G	H	I
GNU antelopes of the 'genus Connochaetes (beard)', however in this case is the acronym for "GNU's not Unix".	**HP** stands for Hewlett-Packard.	**IBM** stands for International Business Machines.
		IDEs Integrated Development Environments.
GPU stands for Graphics Processing Unit.		**IDEO** stands for Innovation, Design Engineering Organization.
		iOS stands for "internet operating system." It's the Apple operating system that powers the iPad, iPhone, and all the iPods, but not the Mac itself.
GPL stands for General Public License.	**HTC** acronym for High-Tech Computer. Taiwanese manufacturer of smartphones & tablets headquartered in New Taipei City, Taiwan.	**IDC** International Data Corporation is the premier global provider of market intelligence, advisory services, and events for the information technology, telecommunications and consumer technology markets.
GPLv2 contraction for General Public License version 2.		

ABBREVIATIONS GLOSSARY

J	L	M
JIT acronym for Just-in-time compiler.	**LGPL** shortening for Lesser General Public License libraries.	**MIT** stands for Massachusetts Institute of Technology.
JVM acronym for Java Virtual Machine.		
Java SE stands for Java Standard Edition.		
N	**O**	**P**
Ning is an online platform for people and organizations to create custom social networks, launched in October 2005.	**OS** stands for Operating System.	**Project MAC**, which stood for Mathematics and Computation, later renamed to Multiple Access Computer.
	OEMs is an acronym for original equipment manufacturers.	
NVIDIA is an American global technology company that manufactures graphics processing units (GPUs)	**OHA** stand for Open Handset Alliance.	**PC** stands for Personal Computer.
NOKIA a Finnish communications and information technology multinational corporation named the town NOKIA in FINLAND.		

ABBREVIATIONS GLOSSARY

R	S	T
RIM acronym for Research in Motion Limited.	**SQ** was a program used in the early 1980s on both **DOS** and **CP/M** (Control Program for Microcomputers).	**TCP/IP** is an acronym for Transmission Control Protocol / Internet Protocol.
RISC Reduced instruction set computing, is a CPU design strategy.	**SQL** acronym for Structured Query Language.	
RT Windows RT is a variant of the Windows 8 operating system designed for mobile devices.	**SQLite** is ACID-compliant and implements most of the SQL standard.	
U	**V**	**W**
UNIX is a multitasking, multi-user computer operating system that exists in many variants. Developed at AT&T's Bell Labs research center.	**VMware** Virtual machine software is used to emulate computer hardware inside of a computer's operating system.	**WWW** stands for World Wide Web.
	VM stands for Virtual Machine.	

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