Hybrid Operating System in Smart Phone

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Abstract—**Operating system (OS) is the backbone in any smart phone. With every passing year, newer and latest versions of OSs are being brought in the market. The application and design developers of mobile OS are trying to bring the best of it in every newer version. This paper provides a survey on the current OS used in smart phones and a comparison of most commonly used and newly designed OS in smart phones market. Our contribution is twofold. Firstly, we conduct a survey asking users about their smart phone preferences which yield some interesting results. Secondly, we propose the design of a hybrid OS for smart phone which combines the paramount features of the on hand OSs.**

Keywords--- Hybrid OS; Android; iOS; Smart phone

I. INTRODUCTION

OS is the backbone for any hardware system that provides a graphical user interface to the user, so that the user may use all available resources to get his desired output whereas OS allocates all of its on hand assets to get the input of user fulfilled by all means [1]. Smart phones have made their place in the market in a very less amount of time and now they are replacing the major part of computational work. Innovation was made from laptops to palm-tops and then the latest invention of Tabs and Note devices, all operations on just a slide of the finger. They have become the people's primary means of communication. Smart phones provide compound communication, internet and combined telecom all in just a single device, since they have combined the portability of mobile devices with the computing and networking capabilities of PC's [2]. The emerging applications are based on high security levels that cannot be forced by OS running in smart phones at present which raised a factor of security issue for smart phones [3]. It all started from java operated phone, after which the next OS introduced was Symbian OS. The major revolution was made by Apple iOS (iPhone OS) which introduced individual application platform known as the APP STORE [3] [4] , which somehow altered mobile phone into App Phone, from where user can download and install applications of his own choice instead of having factory configured phone.

Although the iOS phones have their own classification, similar to android, yet they have the compact and strongest OS to date in the market as iOS (iPhone OS) provides the maximum security and solely single handed usage. Apple's OS is proprietary, iOS is only licensed for apple hardware (iPhone or iPad) unlike Android which is an open source platform [5] . A key feature of iOS (iPhone OS) is that it provides sensor recognition (like finger print detection) that enables the phone screen lock/unlock. The security is increasing day by day with new secured features of finger / thumb and even retina / iris scanning [6], which is further improving to provide smart phones for even blind persons [7]. However, despite all the glitz android has become the market leader, outshining both iPhone and blackberry gaining 39% of the market share [8] [9].

The Samsung and HTC are two main vendors and competitors of android technology in the market now. The latest models provide a high definition display with larger screens and slim design, thus giving larger working space with a lighter body weight making it easy to hold. The latest feature provided is the Samsung Galaxy Note 3 Gear device that gives a free hand to keep on checking the phone constantly and operate phone without holding it in hand. Nevertheless Android OS was developed with a view of maintaining high user security, although new security features are being introduced, new dangers and challenges come forth for exploitation [10].

Other than Android and iOS, a third competitor is the WINDOWS based smart phones by NOKIA and Microsoft, a bit better in presentation and looks, as if they couldn't make it on PCs. The most promising feature of windows phone, which gives them a slight edge over other smart phones, is an amazing battery life. No OS can work better if it does not gets enough power supply to help it run smoothly and efficiently to carry out its operations. Nokia, being the best vendor of its times has still a long way to go before it comes close in competition with other famous android phone vendors like Samsung and HTC to overcome the lag it is facing in technology. Figure 1 shows a glimpse of the display screens of the above stated.

The current study focuses on proposing a hybrid OS for smart phones that can be used in near future and survey on the current OS's used in smart phones. A quick view of the important and key features these vendors are providing due to which they have boosted deep into the cellular market in a short span of time. Each day passing a new smart phone is taking birth in market, leaving the preceding model behind and making its own place till the next model arrives. Before going to purchase any upcoming model of cell phone, the user has

several questions in mind with reference to the design, display, key features, performance and OS version in it as: *What new features are they adding in smart phones? Does it overcome the market demands of current time? Either it is better than previous in performance and efficiency or is it dropping down its preceding model or vendor's market? How will a new model succeed in market after its launch?* And so on. Furthermore, a combine study of all vendor's products, highlighting and selecting the key feature and then propose a hybrid OS for smart phones that can revolutionize the cellular industry, having best OS in performance and compatibility with hardware and all devices attached, chip card, with slim design, fascinating looks and style, maximized speed, longer battery life and rich camera quality, to have it all in the palm of user hand with a slide of finger.

Figure 1: Windows 8, Symbian, iOS and Android's display screen

The need for a new OS in smart phone is increasing day by day as emerging applications require new levels of security that cannot be provided by existing smart phone OS's. Consequently vendors move towards inflexible hardware extensions that increases the material cost [3]. Advancement in smart phones storage capacity, processing and communication power is immensely dependent on the development of efficient hardware since the major hurdle to this development is the portable battery life and power usage [11].

The rest of the paper is organized as follow. Section 2 reviews related work. Section 3 describes study design and data collection. Section 4 analyses our survey and discusses the results. Section 5 provides summary and findings before the paper is concluded in Section 6.

II. LITERATURE REVIEW

Smart phones are the major means of communication now-a-days. Consequently there is a mushroom growth in the smart phone industry. Every now and then a new smart phone is on the launch with sparkling new design and updated OS and hardware. The industrial and academic research communities are working to resolve a number of issues faced by consumers, ranging from low hardware power, to user friendly input and output operations, to mobile security issues. Initially, mobile

phone vendors used to design their own proprietary and highly personalized OS for their product lines but because individual software designers did not have full access to such OS's, they are no longer suitable for today's wireless market [12]. Currently the major competitors in the Smartphone market are: Nokia (Symbians OS), Apple (IOS), Microsoft (Windows OS) and Google (Android OS).

The revolutionary change in the development and working of mobile OSs is driven by the fact to create cheaper smart phones with the functionality which to date was only available on the more expensive smart phones [10]. Furthermore consumers are more critical about selecting a smart phone which supports latest and up-to-date applications and have an attractive user interface. Keeping in view the consumer needs and demands, OS vendors are moving towards a more open source solution where application developers can freely publish their applications providing the end user an opportunity to select what they desire [5] [13].

Symbians OS was born as a number of hardware manufacturers collaborated to run a single OS on their devices [14]. Resultantly Symbians became the market leader with 65% share in 2007 [15] and soon gathered a remarkable 100 million subscribers [14]. However, soon many manufacturers opted out of the company and sold their shares to the sole remnant, Nokia, the reason being the difficulty to create new application in the Symbians OS [14]. This failure to create innovative applications gave other competitors the room to take over. Additionally, the Symbians OS is subjected to a number of viruses and Symbians devices can be hacked. Thus by-passing the security of the system, giving users the chance to use unsigned codes, alter system files and gain access to the initially locked areas of the OS [16]. Symbians was antiquated and limited OS, unable to compete with android and iPhone [5].

Microsoft has been in the smart phone industry since the nineties. However the window mobile phones never acquired much grip and momentum. Microsoft has to face segmentation among its partner vendors. Since the decline of Symbians, Nokia licensed Microsoft's windows OS for its upcoming devices. Nevertheless, Microsoft's market share continued to drop [5]. Window's OS offers excellent navigations and positioning functionality, it is user friendly; moving around the homepage and applications is very simple. Kids corner is another exciting feature, this is a fenced off area of the OS, where kids can play games and access other applications without affecting the user's personal files. Even so windows phone are far behind in the line compared to android and iPhone. They lack many applications offered by other smart phone OS's. Window's 7 phones cannot be upgraded to windows 8 [17]. In 2007, Apple launched the iPhone series with its own patented proprietary OS, Mac OS. Thus firmly keeping an eye on what goes out with an apple logo has to have the Apple's OS.

iPhone has a more attractive interface and the user has access to thousands of new updated applications downloadable from the App store. However Apple strictly controls third party applications, since all applications have to be approved before

they are published on the App store. This closed platform policy allows full control making malware installation less likely than android [17] [18]. However, iOS has its own limitations; it works only with a limited number of devices. The system does not support external memory, as there are no external memory card slots [13]. Similarly flash player is not supported by the system which means a number of websites won't work [17].

In contrast, Android is a Linux based open source platform; it was taken over by Google in 2005. The system embraces a replace and reuse policy, which allows users to personalize their phone. All the applications run on the same policy owing to the open source design [8]. Thus the Android OS can run on a number of devices. This versatility of android makes it more desirable and attractive than iPhone. Android applications can be deployed on hundreds of smart phones while iPhone applications are only limited to iPhone. One of the biggest advantage android has over iPhone is the ease with which applications can be developed [19]. With this open platform , mobile manufacturers can focus more on hardware than software development [14]. Nonetheless, the open choice platform poses the user to a number of malicious software installations. Secondly individual mobile vendors can make significant changes to the software, such as installing entertainment extras and other recommended applications which make upgrading to new android versions complicated [17].

Taking a look on the worldwide sales of smart phones, it is hard to believe how rapid growth they made with the user friendly features and lavishing designs. Figure 2 shows graphically the rapid increase in the sales of android phones as compared to the other market competitors as iOS, Symbian and windows phones. (Photo courtesy - Wikipedia).
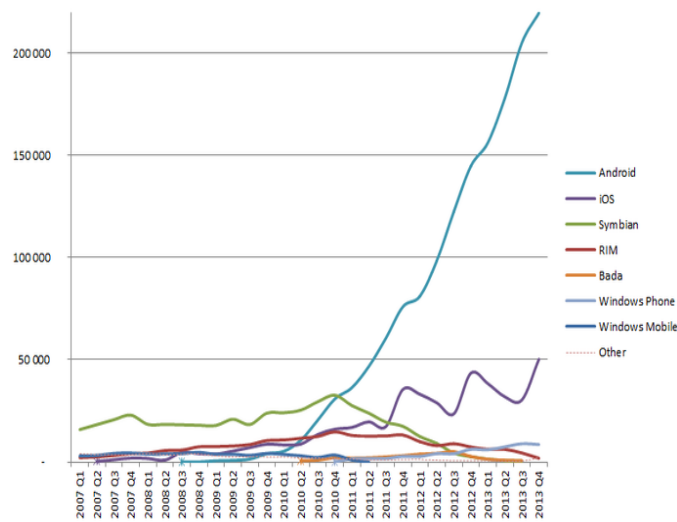

Figure 2 : World Wide Smartphone Sales (Thousands of Units)

Other than beating it competitors in sale, the strength and market hold that Android made with the upgraded OSs in feature and design is magnificent. Before android, Symbian was the leader of the cellular industry. Android had its lead due

to the Play Store, powered by Google, giving user an edge over the traditionally and factory stored apps, to have a huge variety of application, soft ware's stability, functionality and games to have in his own library and storage. Figure 3 reveals the sales percentage and market share that android contributed and gained with the above mentioned attributes. (Photo courtesy - Wikipedia)
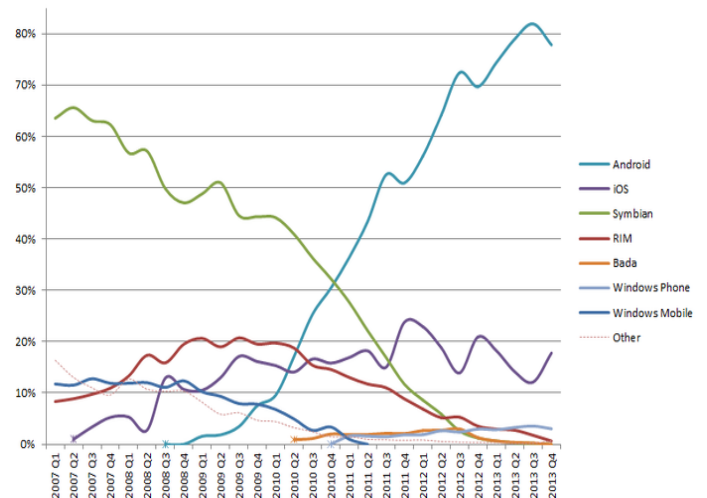

Figure 3 : World-wide Smartphone Sales (%)

Each OS has its own shortcomings; the solution can be a hybrid OS, created by merging two different OSs. One such idea was floated by the Palm OS in late 2005, when the company announced to develop a Palm-Linux OS, but no timescale was given [20][10], and the idea couldn't come to reality to-date.

Windows		Symbian	
Windows Phone		Rise of Symbian	1980
Windows Phone 7	2010	From EPOC – Symbian OS/S60 – Symbian	1980
Windows Phone 7.5 (Mango)	2011	Nokia, Ericsson, Motorola and Psion created Symbian Ltd	1998
Windows Phone -Tango	2012	Symbian launched Open source license	2009
Windows Phone 8 – Apollo	2012 (near year end)	Nokia took over Symbian	2010

Table 1: Yearly OSs launch of Windows and Symbian

Another such effort was made by Michael Robertson, founder of Lindows.inc, in 2001. The main aim of this endeavor was to create a Linux-based OS which could run windows applications. The inspiration was to make an economical OS which runs both windows and Linux code [21]. The company was sued by Microsoft in 2002 on trademark infringement, despite making clear out of the lawsuit; it was later acquired by Xandros Inc. and renamed as Linspire.

However shortly after its purchase Linspire OS was ceased in 2008 [22].

Efforts have been made in the past to create Hybrid OSs in order to introduce best features in a single amalgamated OS, but these endeavors were overshadowed either by copyright concerns or by the monopoly of market leaders. Nevertheless Hybrid OSs can offer better features in less cost; if such systems are developed and favored by the market shareholders they can revolutionize the OS market. Table 1 and 2 shows the current OSs launched by Android, iOS, windows and Symbian, showing the yearly & monthly upgrade their vendors and developers made.

Android		iOS	
Version	Release	Version	Release
Cupcake 1.5	April 2009	iOS 8	September 2014
Donut 1.5	September 2009	iOS 7	September 2013
Eclair 2.0	October 2009	iOS 6	September 2012
Frozen Yogurt (Froyo) 2.2	May 2010	iOS 5	October 2011
Ginger bread 2.3	December 2010	iOS 4	June 2010
Honeycomb 3.0	February 2011	iPhone OS 3	June 2009
Ice Cream Sandwich 4.0	October 2011	iPhone OS 2	July 2008
Jelly Bean		iPhone OS 1	June 2007
4.1	August 2012		
4.2	November 2012		
4.3	July 2013		
KitKat 4.4	October 2013		
Lollipop 5.0	December 2014		

Table 2: Yearly OSs launch of Android and iOS

III. STUDY DESIGN AND DATA COLLECTION

In this section, we provide details of the design of the study and data collection that we carried out for this paper. A probing study was conducted by creating a short online questionnaire.

A. Hypotheses

The primarily interest was to know the features which make most users select a smart phone. What are their priorities in choosing a smart phone device? How they rate the different smart phone vendors? Would they prefer a single OS or a mix of two different OSs? For this following hypotheses were formulated.

- *H1: Android is the preferred smart phone OS among users.*
- *H2: Most users support the development of iOS-Android hybrid OS.*
- *H3: Multimedia support, phone storage and battery timings were the chief factors controlling smart phone selection.*

For the first hypothesis the participants were asked about their current and last used smart phone device. Furthermore they were asked about their next purchasing preference based on smart phone OS. For the hybrid OS (H2) participants were asked to select from a list, combination of OS they would like to see in the upcoming smart phone device. Then the participants were solicited about the features which influence their smart phone buying decision or caused them to switch their phone and enquired about the key features which affect their phone performance

B. Data Collection and Analysis

An online survey was conducted with age groups of 16-30 and 30+. The link to the questionnaire was distributed via email and face book. The survey was named "*how well you know your Smart phone*". The survey form was designed using Google docs. After collection data was analysed using IBM SPSS version 16.

IV. RESULTS AND DISCUSSIONS

A. Demographic

A total of 100 completed questionnaires were received, after sorting out incoherent data and users that had other kinds of phones (not having smart phones), 69 valid questionnaires remained, out of these 41.4% (n=29) were android users, 18.6% (n= 13) were iOS users and 8.6% (n=6) were using windows phone and remaining were either using both iOS and android devices or using non-branded devices. Out of the 69 participants, 60.9% of the participants belonged to the age group 21-25 years (n=42), 23.2% belonged to 26-30 age group (n=16), 11.6% to 16-20 age group (n=8) and 4.3% belonged to 30+ age group (n=3). 55.1% (n= 38) were females and 44.9% (n=31) were males.

B. Evaluation of hypotheses

- Descriptive Statistics

H1: Majority of the participants were either using smart phones with android OS presently or had used it sometime in past. Additionally half of the participants opted android as their next purchasing preference among smart phones.

H2: More than half of the participants favored the development of a hybrid OS for smart phones and most of them supported the development of iOS-Android hybrid OS as shown in Figure 4 and Figure 5.

H3: Inadequate storage, battery timing and in-efficient OS were rated as the most important factors in smart phone selection as shown in Figure 6.

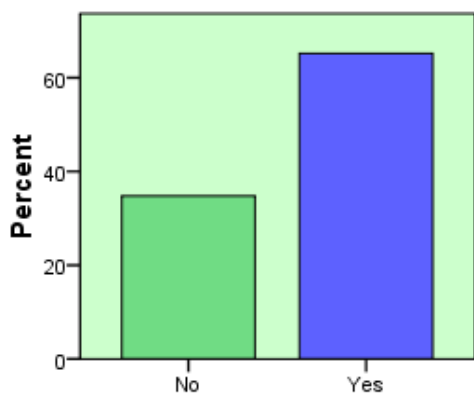Thus hypotheses one and two were proven correct but hypothesis number 3 was rejected.

Figure 4: Participants who are against and in favor for the development of a Hybrid OS for smart phones
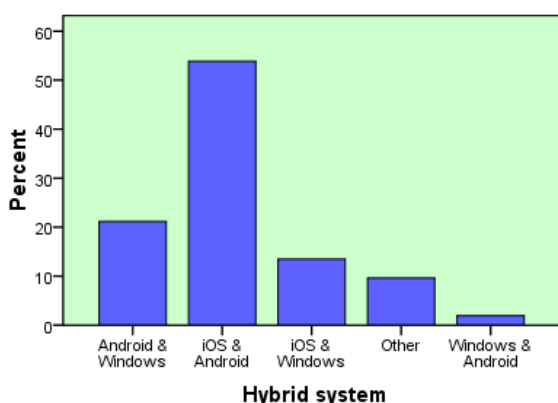

Figure 5: Preferred choices of participants for proposed Hybrid OS
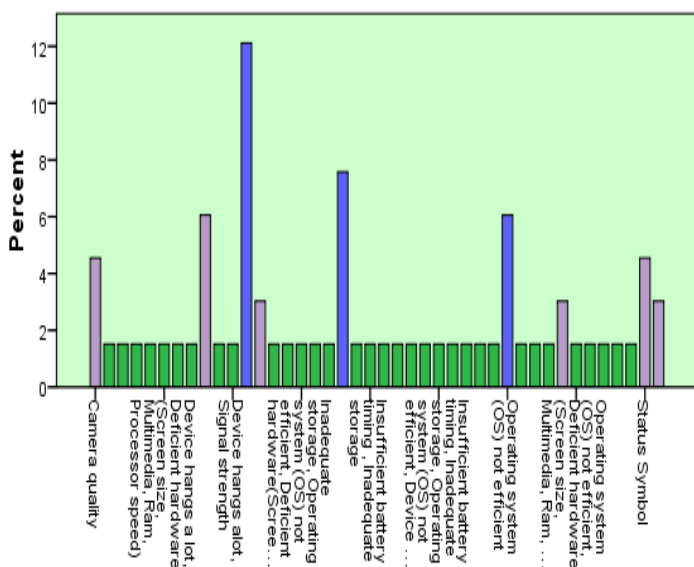

Figure 6: Features which caused participants to switch their smart phones

V. SUMMARY AND FINDINGS

With a developing country like Pakistan, people strive for the best they can do, they can be, on the basis of knowledge and resources they had. When it comes to fashion, trends or taking on technology, Pakistan is in the frontage line up to race the rest of the world. Now, people are becoming more aware of the surroundings, environment, technology, style, design and living life standards. The current survey and findings divulged some interestingly amazing facts. Now people know what they need and from where they can get it, instead of adopting the traditional market trend and what other people are getting. These facts led to the idea of proposing a new hybrid OS, that is more suitable, affordable and effectively efficient in its performance, style and workout.

VI. CONCLUSION

New Smart phones hit the market every now and then with new features and applications. Even the OS is upgraded, but there are always some drawbacks. Linux OS is gaining attention but they have their own pros and cons. We propose development of a hybrid OS for smart phones which covers and resolves all the issues faced with current OSs so that the users can get the benefit of different OSs in a single hybrid system. Efforts have been made in the past to create hybrid OSs for smart devices in order to introduce best features in a single amalgamated OS, but these endeavors were overshadowed either by copyright concerns or by the monopoly of market leaders. We will continue our research based on our surveys made earlier for this paper and some new surveys will be made in future to see the architecture, performance design, working and software stability of hybrid OS designed. Nevertheless hybrid OSs can offer better features than individual OSs; if such systems are developed and favored by the market shareholders they can revolutionize the OS market.

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