

# Protection of Software Code of iOS (iPhone Operating System) Applications using Digital Watermarking Techniques

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**Abstract:** The primary goal of software code watermarking is to create vigorous and steady watermark for programming code. Watermarking for programming code developed as a vital solution to give copyright protection, alter detection and to keep up the integrity of information. A significant area where the programming code is remarkably evolved it must requires dependable scheme for checking programming code modification and trustworthiness. Programming designers are broadly reused their one of a unique programming code to diminish improvement time during applications advancement. Unapproved changes to code can causes genuine outcomes and might be huge misfortunes for the association.

This paper proposes a feasible reason for securing the trustworthiness of the programming code for iOS which is required to be set on open condition by utilizing computerized watermarking. Earlier strategies for watermarking programming code utilize various methods to make a watermark..

**Keywords:** iOS; Software Code; Digital Watermarking; Piracy;

## I. INTRODUCTION

In today's era the most valuable assets of IT industry is business applications or application software, as Internet and communications technology is growing. It means that in the next era everything related to the business will be done through these business applications. With the growth of such software, this will increase threats like piracy. For the protection of software code, protection of copyright is also required. Digital watermarking is the good method by which one can prove the ownership.

With the fast growth of IT, the significance of digitization has become greater than before. Now a day, most of the people is sharing their original contents using the internet facility. That means it is, now, necessary to protect such original/licensed content, for unauthorized use and also not able to make forged copies of such original contents [2].

This paper focuses on the protection of the software code for iOS application using digital watermarking. Section II focuses on the unlicensed Software Installation Rate Globally. Section III presents the related work done for the protection of copyright for software code. Section IV elaborates on the application and technique of digital watermarking, which explains the embedding and detection algorithms with the help of an example. Finally, the conclusions are presented in Section IV.

## II. UNLICENCED SOFTWARE INSTALLATION RATE GLOBALLY

Further, as per the global survey released by the Business Software Alliance [3] the rate of illegal use of software in various countries like Asia Pacific, Central and Eastern Europe( C & E Europe), Latin America, Middle East and Africa(ME & Africa), North America (N America) and Western Europe(W Europe) is shown in Table 1.1.

Country Name	Years				
	2009	2011	2013	2015	2017
Asia Pacific	59%	60%	62%	61%	57%
C & E Europe	64%	62%	61%	58%	57%
Latin America	63%	61%	59%	55%	52%
ME & Africa	59%	58%	59%	57%	56%
N America	21%	19%	19%	17%	16%
W Europe	34%	32%	29%	28%	26%

Table 1.1: Unlicensed Software Installation Rates in percentage

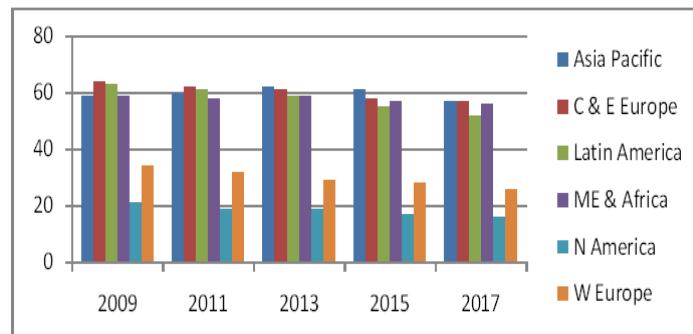


Figure (1.1): Unlicensed Software Installation Rates in percentage

It means piracy of software directly affects the revenue of software vendors. The software vendors are loosing millions of US dollars every year. Last four (alternative) year data have been shown in Table 1.2

Country Name	Years				
	2009	2011	2013	2015	2017
Asia Pacific	\$16,544	\$20,998	\$21,041	\$19,064	\$16,439
C & E Europe	\$4,673	\$6,133	\$5,318	\$3,136	\$2,910
Latin America	\$6,210	\$7,459	\$8,422	\$5,787	\$4,957
ME & Africa	\$2,887	\$4,159	\$4,309	\$3,696	\$3,077
N America	\$9,379	\$10,958	\$10,853	\$10,016	\$9,458
W Europe	\$11,750	\$13,749	\$12,766	\$10,543	\$9,461

Table 1.2 : Amount of Loss in \$

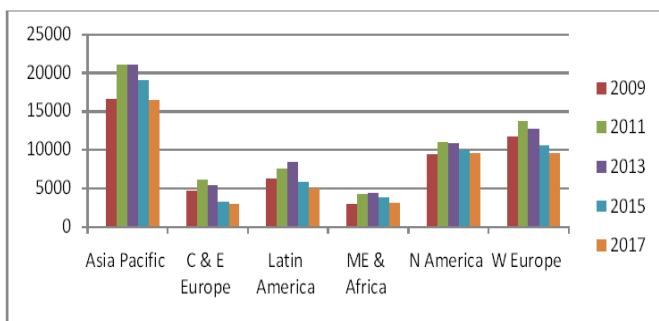


Figure (1.2): Amount of Loss in \$

It is very common to copy a part of the software or full software to be copied through internet without any knowledge of the software programmer or company or owner. IT companies are spending lots of money and efforts to provide the best business solutions to the business industries. These efforts should be protected. Cyber Laws have great importance for the protection of copyright.

Application software for business solutions is the main part of the software company; therefore, it is necessary to protect the copyright of such software. For this, it is required to have an effective method or model for the protection of copyright, so that any kind of modification in the code can be identified. Digital watermarking is a significant technology having many applications. A number of watermarking schemes have been discussed for images, audio, and video streams. In digital watermarking a key pattern will be embedded at the initial level and later on, when required, it is detected to identify the ownership. Digital watermarking is the embedding or hiding of information within a digital file without noticeably altering the file itself. Now digital image watermarking is increasing attention due to the fast developing in the internet traffic. Digital watermarking achieved is popularity due to its significance in content authentication and copyright protection for digital multimedia data. It is inserted invisible in host image so that it can be extracted at later times for the evidence of rightful ownership [4].

### III. RELATED WORK

Nisha [1] has done survey of various techniques of watermarking and, explained the comparison between different techniques based on experimental results. In this paper, she has also discussed about advantages and disadvantages of these techniques of watermarking.

Awasthi et al [5] proposed a method of digital image watermarking for the protection of digital contents. This proposed method presents a technique which is based on combination of spatial domain technique and frequency domain techniques. Discrete wavelet transform, singular value decomposition and least significant bit techniques are combined to provide robustness to the watermark image as well as to improve the quality of obtained watermarked image.

V.Kapoor[6] proposed an integrated cryptographic scheme, message digest algorithm MD5 and RSA Algorithm and an Encryption Algorithm to verify the integrity of the message.

Sharma et al [7], proposed a method, A variety of prevention techniques have been developed for copyright protection of software codes or intellectual property rights (IPR) using both hardware and software. But, unfortunately no single

technique is currently strong enough to protect the software codes. However, through a combination of techniques software developer can better protect their software codes. In this paper, they have explained mainly static and dynamic techniques of software watermarking.

Bharati Wukkada et al [8] compared between android and iPhone Operating System (iOS) mobile operating systems that available in the market which is more specific various issues and also discussed about the security of the iOS.

Advanced security features are provided by Apple for its iOS devices and yet the devices can be easily used. The security features are enabled by default. Security features like data encryption cannot be configured so the users cannot disable them. Touch ID is one of the features of iOS devices that enhances the user experience and at the same time secures the device. [9]

Apple's iOS is restrictive as compared with Android. Developers can make their applications but apple doesn't release its source code where as in Android, the source code is available for anyone. [10]

### IV. IOS OPERATING SYSTEM

iOS (formerly iPhone OS) is a mobile operating system made and created by Apple Inc. only for its hardware. It is the operating system that currently powers lots of the organization's cell devices, including the iPod Touch and iPhone; it additionally powered the iPad before the introduction of iPadOS in 2019. It is the second most well known mobile operating system internationally after Android [11].

Initially disclosed in 2007 for the iPhone, iOS has been extended to help other Apple gadgets, for example, the iPod Touch (September 2007) and the iPad (January 2010). As of March 2018, Apple's App Store contains more than 2.1 million iOS applications, 1 million of which are local for iPads.[10] These versatile applications have all things considered been downloaded in excess of 130 billion times.

The iOS User Interface depends on direct control, utilizing multi touch gestures. Interface control components comprise of sliders, switches, and buttons. Association with the OS incorporates motions, for example, swipe, tap, squeeze, and converse squeeze, all of which include explicit definitions inside the setting of the iOS working framework and its multi-contact interface. Inside accelerometers are utilized by certain applications to react to shaking the gadget (one regular outcome is the fix order) or turning it in three measurements (one normal outcome is exchanging among representation and scene mode). Apple has been essentially commended for fusing intensive availability capacities into iOS, empowering clients with vision and hearing incapacities to appropriately utilize its items.

Significant variants of iOS are released yearly. On every single ongoing iOS devices, iOS consistently keeps an eye on the accessibility of an update, and in the event that one is accessible, will incite the client to allow its programmed establishment [11]. iOS is solely for the iPhone and iPod contact as the iPad variation is presently called iPadOS.

### Architecture of iOS

Design of iOS is a layered engineering. At the highest level iOS works in as a intermediary between the basic equipment and the applications you make. Applications don't communicate to the basic equipment straightforwardly. Applications talk with the equipment through an collection of well defined characterized framework interfaces. These interfaces make it easy to compose applications that work continually on devices having different equipment capacities. Lower layers gives the fundamental services which all application depends on and more elevated level layer gives refined designs and interface related administrations.

Apple gives the greater part of its framework interfaces in extraordinary packages called frameworks. A frameworks is a catalog or directory that holds a unique shared library that is a documents, related resources like as header records, pictures, and partner applications required to help that library. Each layer have a lot of Framework which the engineer use to build the applications.



Figure (1.3): Architecture of iOS

#### 1. Core OS Layer:

The Core OS layer holds the low level highlights that most different advances are based upon.

- Core Bluetooth Framework.
- Accelerate Framework.
- External Accessory Framework.
- Security Services framework.
- Local Authentication framework.

64-Bit support from IOS7 supports the 64 bit app development and enables the application to run faster.

#### 2. Core Services Layer

Some of the Important Frameworks available in the core services layers are detailed:

- **Address book framework** – Gives programmatic access to a contacts database of user.
- **Cloud Kit framework** – Gives a medium for moving data between your app and iCloud.
- **Core data Framework** – Technology for managing the data model of a Model View Controller app.
- **Core Foundation framework** – Interfaces that gives fundamental data management and service features for iOS apps.
- **Core Location framework** – Gives location and heading information to apps.

- **Core Motion Framework** – Access all motion based data available on a device. Using this core motion framework Accelerometer based information can be accessed.

- **Foundation Framework** – Objective C covering too many of the features found in the Core Foundation framework

- **Healthkit framework** – New framework for handling health-related information of user

- **Homekit framework** – New framework for talking with and controlling connected devices in a user's home.

- **Social framework** – Simple interface for accessing the user's social media accounts.

- **StoreKit framework** – Gives support for the buying of content and services from inside your iOS apps, a feature known as In-App Purchase.

3. **Media Layer:** Graphics, Audio and Video technology is enabled using the Media Layer. Graphics Framework:

- **UIKit Graphics** – It describes high level support for designing images and also used for animating the content of your views.

- **Core Graphics framework** – It is the native drawing engine for iOS apps and gives support for custom 2D vector and image based rendering.

- **Core Animation** – It is an initial technology that optimizes the animation experience of your apps.

- **Core Images** – gives advanced support for controlling video and motionless images in a nondestructive way

- **OpenGL ES and GLKit** – manages advanced 2D and 3D rendering by hardware accelerated interfaces

- **Metal** – It permits very high performance for your sophisticated graphics rendering and computation works. It offers very low overhead access to the A7 GPU.

#### 4. Cocoa Touch Layer

- **EventKit framework** – gives view controllers for showing the standard system interfaces for seeing and altering calendar related events

- **GameKit Framework** – implements support for Game Center which allows users share their game related information online

- **iAd Framework** – allows you deliver banner-based advertisements from your app.

- **MapKit Framework** – gives a scrollable map that you can include into your user interface of app.

- **PushKitFramework** – provides registration support for VoIP apps.

- **Twitter Framework** – supports a UI for generating tweets and support for creating URLs to access the Twitter service.

- **UIKit Framework** – gives vital infrastructure for applying graphical, event-driven apps in iOS. Some of the Important functions of UI Kit framework:

## V. DIGITAL WATERMARKING

The growth of digital media and the fact that unlimited numbers of perfect copies of such media can be illegally produced is a threat to the rights of content owners. A copy of digital media is an exact duplicate of the original. The authors

of a work are hesitant to make such information available on the Internet as it may be copied and retransmitted without the permission of the author. An issue facing on the Internet for digital information is how to protect the copyright and intellectual property rights of those who legally own or possess digital works. Most web based applications like e-commerce systems use cryptography to secure the electronic transaction process. Encryption provides data confidentiality, authentication, data integrity, and in some cases authentication of the parties involved. However, the unencrypted data may still be copied and distributed. In some cases, these samples may be the images used on a web site or the publication of information on the Internet. Copyright protection involves ownership authentication and can be used to identify illegal copies. One approach to copyrighting is to mark works by adding information about their relationship to the owner by a digital watermark. Digital watermarking provides a means of placing information within digital works. This information may be perceptible or imperceptible to the human senses. Early watermarking work investigated how documents can be marked so they can be traced in the photocopy process.

Digital watermarking is a technique for implanting a key information identified with an digital information (for example a image, audio, video content) inside the information itself, as shown in Fig (1.4).

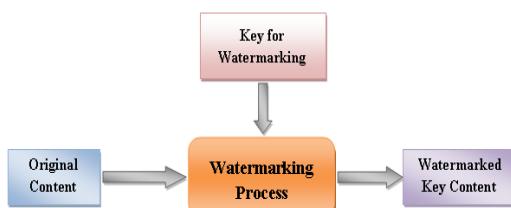


Figure (1.4): Block Diagram of Digital Watermarking

Interest in digital watermarks is growing and seems to be motivated by the need to provide copyright protection to digital works. Watermarking can be used to identify owners, license information, or other information related to the cover carrying the watermark. Watermarks may also provide some control mechanisms such as determining if the work has been tampered with or copied illegally. In the realm of video and satellite broadcasts, watermarks are used to interfere with recording devices so copies of a broadcast are somewhat corrupt. A number of hardware and software technologies are being developed to deter illegal copying [8]. By the use of digital watermarking technique in a proper way, data can be protected from unauthorized duplication of data.

It is an idea which is almost identified with steganography, in that the two of them implant a message inside Digital information. Be that as it may, what isolates them is their goal. Watermarking attempts to implant information identified with the first substance of the digital information, while in steganography the Digital information has no worth the data, and it is utilized as a spread to hide its essence. Watermarking has been utilized in a few centuries, as plain paper and accordingly in paper bills and so forth. The method of digital watermarking was created during the most recent 15 years and it is presently being utilized for a wide range of utilizations. Digital watermarking, with various applications,

is a significant innovation, for the assurance of copyright and licensed innovation right. Different watermarking plans have been examined for Text, image, audio, and video streams. A watermark is a familiar image or pattern that is impressed onto paper, which provides proof of its authenticity.

## VI. CONCLUSION

In this research paper we surveyed a number of different research papers which includes iOS based application, their security, and software watermarking. It has been seen that digital application plays a major role in all the sectors like Education, Healthcare, Automobiles, etc. So, protection of application for iOS is a major issue. This study will work as a bridge between iOS Application and Software Watermarking for the security of code. In this study we found that a security code using encrypted key can be embedded.

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