

## A CRITICAL REVIEW: DIGITAL MEDIA EVOLUTION, OPPORTUNITIES AND CHALLENGES

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### Abstrak

Media digital telah dikenal pasti sebagai salah satu media yang paling penting di abad ke-21. Media baru ini dianggap cara yang paling berkesan untuk mengurus kadar penghasilan data digital yang meningkat setiap hari terutama di dunia siber. Artikel ini menjejaki evolusi pembangunan teknologi media digital, peluang dan cabaran terhadap pengamal industri. Kajian literatur berkaitan dan analisis kandungan media digital berdasarkan bentuk dan keupayaannya (Penerokaan, Eksperimen, Komunikasi, Komposit, dan Pintar) dan mengetengahkan perbincangan isu-isu berkaitan peluang dan cabaran dalam industri. Pembangunan media digital mencipta beberapa peluang baru untuk penghasilan kandungan digital dari segi kreativiti, kebebasan dan fleksibel untuk berinteraksi dengan media digital. Walau bagaimanapun, terdapat beberapa cabaran yang perlu diatasi seperti pemilikan maklumat, hak cipta dan harta intelek bagi memastikan masyarakat digital memperoleh manfaat sebenar pembangunan media digital. Hasil kajian boleh membantu penyedia kandungan digital, pengamal media baru dan juga ahli teknologi komunikasi maklumat untuk memanfaatkan teknologi media digital yang ada bagi mengoptimumkan teknologi media digital sebagai alat untuk keperluan mereka dan bersedia untuk menghadapi cabaran masa depan.

**Kata Kunci:** Teknologi Media Digital, Data Digital, Industri.

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## Abstract

*Digital media has been identified as one of the most important media in the 21st century. This kind of new media is considered the most effective way to manage the high volume amount of digital data created every day especially in cyber world. This article traces the evolution of digital media in its technological development, opportunities and practitioners-challenges in the industry. The critical review on related literature leads to five categories of digital media based on their forms, abilities (Investigational, Experimental, Communicative, Composite, and Intelligent) and highlights opportunities and challenging issues in the industry. The development of digital media creates several opportunities to the content creator in terms of their creativity, freedom and flexibility to interact with digital media. However, there are few serious challenges need to be overcome such as information ownership, copyright and intellectual property in order to ensure that digital society gain the real benefit of digital media development. The findings could assist the digital content providers, new media practitioner as well as information communication technologist to discover their directions toward optimizing the digital media technology as a tool for their needs and be prepared for some possible challenges.*

**Keywords:** Digital Media Technology, Digital Data, Industry.

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## 1.0 Introduction

The critical review concentrates on the evolution of digital media as a mechanism of digital content platform for various industry in today's information age. At the beginning of the article, common definition of digital media had been discussed with some examples of its application and important of digital media in today's creative industry environment. Through a clear understanding about digital media, this article also traces the evolution of digital media from the time of its birth until now. The critical review also looks into some opportunities that we could gain from the development of digital media technology and other related challenges. The detail review findings and discovery will be discussed further in the following sections.

### 1.1 What is Digital Media?

Digital media are any media that are encoded in a machine-readable format (Technology Brief, 2006). Digital Media's rapid popularity, usually aided with the Internet and personal computing brought a new frontier to publishing, journalism, entertainment, education, commerce and politics. Its unique challenges are related to issues of copyright and intellectual property laws, fostering an open content movement in which content creators voluntarily relinquish the rights of their work. The ubiquity of digital media and its effects on society indicates that a new era of industrial history, known as the Information Age has begun. Academics and other critical opinions point culture may lead to a paperless society (Dewar and James A., 1998). The advancement of emerging technology drives the development of digital content in the world. Today the digital media could change the way how we work, play and manage our daily activities.

### 1.2 The Evolution of Digital Media Technology

The birth of Digital Media came after the first computer readable machine invented based on Machine-readable codes and information conceptualized by Charles Babbage in early 1800s. Babbage imagined that these codes would provide instructions for his Difference Engine and Analytical Engine, machines he designed to solve the problem of error in calculations (O'Carroll, Eoin, 2012). Between 1822 and 1823, Ada Lovelace, a mathematician, wrote the first instructions for calculating numbers on Babbage's engines (O'Carroll, Eoin, 2012). Lovelace's instructions are now believed to be the first computer program (O'Carroll, Eoin, 2012). This is the beginning of digital media platform when human can store data and write program into electronic medium. From the beginning of digital media birth until now, it has evolved very fast driven by rapid development of technology. The critical review lead to the findings of five generation of digital media evolution. Table 1 shows related literature and their brief description about digital media technology history as basis for this review.



**Table 1 Digital Media Technology Key Historical Milestones**

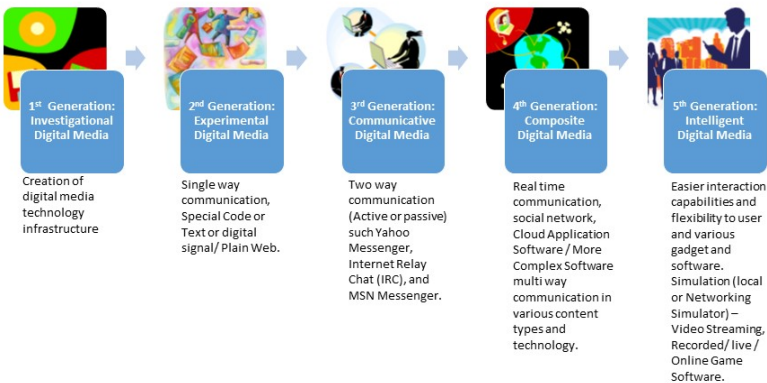
<b>Digital Media Technology Brief Description</b>	<b>User / Key Players</b>	<b>Era</b>	<b>References</b>
<i>Integrated Circuit or the Microchip which forms the basis for modern computer Technology.</i>	<i>Jack Kilby and Robert Noyce, working for Texas Instruments</i>	1958 – 1962	<a href="http://www.nobelprize.org">http://www.nobelprize.org</a> (The Nobel Prize in Physics 2000)
<i>The first ever computer game was developed</i>	<i>Steve Russell and MIT</i>	1962 – 1969	<a href="http://www.mo-bygames.com">http://www.mo-bygames.com</a> (Game Trivia for Space War)
<i>American defense project, allowed computers to talk to each other over a national defense computer network</i>	<i>ARPANET – Advance Research Projects Agency Network</i>	1969 – 1976	<a href="http://www.ietf.org/rfc/rfc2235.txt">http://www.ietf.org/rfc/rfc2235.txt</a> (RFC - Request for Comment, 1997)
<i>The Apple I, II &amp; TRS-80 &amp; Commodore Pet computers are amongst the first consumer computers</i>	<i>Apple Computer</i>	1976 - 1981	<a href="http://en.wikipedia.org/wiki/TRS-80">http://en.wikipedia.org/wiki/TRS-80</a> Welch, David and Theresa (2007).
<i>IBM PC - Home Computer which marks then beginning of then home computer revolution It had 16K of RAM and retailed for up to \$3000.</i>	<i>IBM</i>	1981 - 1984	<a href="http://en.wikipedia.org/wiki/History_of_personal_computers">http://en.wikipedia.org/wiki/History_of_personal_computers</a>
<i>Apple Macintosh developed an affordable home computer with a GUI. Apple also introduced DTP software – Macpaint, Macdraw, Pagemaker and Quark Express</i>  <i>Despite the introduction of the Motorola 68000-based Apple Macintosh in 1984 the Apple II series still reportedly accounted for 85% of the company's sales in the first quarter of fiscal 1985</i>	<i>Apple Macintosh</i>	1984 - 1985	Libes, Sol (June 1985). "Apple Bytes and Pits". <i>BYTE</i> . pp. 468–469. Retrieved October 27, 2013.



**Table 1 Digital Media Technology Key Historical Milestones (Continued)**

Digital Media Technology Brief Description	User / Key Players	Era	References
Microsoft Windows is developed and released for the PC market Microsoft Windows originated in 1985 as an operating environment running on top of MS-DOS, which was the standard operating system shipped on most Intel architecture personal computers at the time.	Microsoft	1985 - 1995	"INFO: Windows 95 Multimedia Wave Device Drivers Must be 16 bit". Support.microsoft.com. Retrieved 2012-08-07.
Introduction of the internet to the public	Internet Community, Technology and Application Service Providers	1995 - present	"7.76 Terms like 'web' and 'Internet'", Chicago Manual of Style, University of Chicago, 16th edition

The critical review on the digital media historical evolution and development leads to the categorization of 5 (five) generation digital media. Figure 1, briefly describes an overview of Digital Media Generations.



**Figure 1: Generation of Digital Media**

### 1.2.1 1st Generation: Investigational Digital Media (1969 – 1979)

The first generation in the evolution of digital media was Investigational period. Most of digital media in this generation was only used by scientists and limited only to research works. This is the beginning of new digital media creation. Numerous of computer scientists and researchers were actively involved towards the creation of digital media technology infrastructure. Integrated Circuit or the Microchip formed the basis for modern computer Technology. The direction of the research was mostly towards the creation of the user friendly digital platform for public use.

### 1.2.2 2nd Generation: Experimental Digital Media (1979 – 1999)

When digital media became widely available in the industry, competition among technology providers was very high. The evolution continues when many digital media were created and tested. Most technology providers were actively involved in research and innovation conducting a lot of experiments in order to produce better quality of digital media. The first ever computer game was developed by a group of students from MIT, American defense project, that allowed computers to talk to each other over a national defense computer network and the Apple I, II & TRS-80 & Commodore Pet computers were amongst the first consumer computers. The introduction of Internet began after computers were able to talk within a large network. The internet creates a potential platform as a medium to disseminate information through one way communication, Special Code or Text or digital signal/ Plain Web.

### 1.2.3 3rd Generation: Communicative Digital Media (1999 – 2005)

The 3rd generation of digital media also called as Communicative or transmittable Digital Media. This kind of digital media were served as a communication platform in internet and virtual society. The early creation of the internet enhanced the capabilities of the digital media as an effective platform to communicate and transmit data among networked computers and electronic devices. However the capacity of data transmitted via internet was still limited due to unstable digital communication infrastructure. The communicative or transmittable Digital Media allowed two way communication (Active or passive) such Yahoo Messenger, Internet Relay Chat (IRC), and MSN Messenger.



#### 1.2.4 4th Generation: Composite Digital Media (2005 – 2010)

Real time communication, social network, Cloud Application Software / More Complex Software multi way communication in various content types and technology. (Blog, microblog, yahoo, Multimedia content, Web Application, Search Engine, etc.) The creation of the internet enhanced the capabilities of the digital media as an effective platform disseminating ideas and opinion across the globe.

#### 1.2.5 5th Generation: Intelligent Digital Media (2010 – present)

Simulation (local or Networking Simulator) – Video Streaming, Recorded/ live / Online Game Software. The 5th generation of digital media offers much easier interaction capabilities and flexibility to users and various gadgets and softwares. Currently the intelligent digital media are widely used among young generation and they could change the life-style of all of us soon. Some experts believe soon in the future that the nature of digital media will change and transform into transparent digital media.

Rapid development of digital media technology provides the advantages for technologist, and media practitioners to manage their work and daily activities. Every generation of digital media have their own advantages that serve each generation of technology users. The latest technology of digital media with the high complexity and intelligent digital media available today, the technology will serve as a backbone for the creation of new media platform for digital society to work, play, and study more effective towards producing the knowledgeable human in the future.

## 2.0 The Opportunities of Digital Media Technology

The Internet is a global system of interconnected computer networks that use the standard Internet protocol suite (TCP/IP) to link several billion devices worldwide. It is a network of networks that consists of millions of private, public, academic, business, and government networks, of local to global scope, that are linked by a broad array of electronic, wireless, and optical networking technologies. The Internet carries an extensive range of information resources and services, such as the inter-linked hypertext documents and applications of the World Wide Web (WWW), the infrastructure to support email, and peer-to-peer networks for file sharing and telephony. Internet is the platform for any means of digital media to be shared and communicated around the globe. The advancement of digital media technology allows for more users to interact easily. Results from our critical review highlight several opportunities gained from the advancement of digital media and the growth of internet.

Digital media has also allowed individuals to be much more active in content creation (Cohen, Cathy J.; Joseph Kahne, 2012). Anyone with access to computers and the Internet can participate in social media and contribute their own writing, art, videos, photography and commentary to the Internet, as well as conduct business online. Many media production tools that were once only available to a few are now free and easy to use. This has had a significant impact on political participation (Kelley, Peter, 13 June 2013). Digital media is seen by many scholars as having a role in Arab Spring, and crackdowns on the use of digital and social media by embattled governments are increasingly common (Rininsland, Andrew, 16 April 2012). Many governments restrict access to digital media in some way, either to prevent obscenity or in a broader form of political censorship (Crawford, Susan P., 3 December 2011).

User-generated content raises issues of privacy, credibility, civility and compensation for cultural, intellectual and artistic contributions. The spread of digital media, and the wide range of literacy and communications skills necessary to use it effectively, have deepened the digital divide between those who have access to digital media and those who don't (Jisc Digital Media, 30 March 2014).

The rapid development of digital media technology provides opportunities for media practitioners in the industry. From the literature, we can conclude the following opportunities offered by digital media technology :

- Freedom and Flexibility for Content Creator
- Encourage Creative Content Creation
- An Effective Information Dissemination & Advertising Channel
- An Prospering the Creative Content Industry
- Enabler for Interactive Learning and Teaching

The critical review highlight some of the significant opportunities contributed by the digital media technology that give a lot of advances to digital media users and technologies. Therefore, it depends on us how we are going to use and utilize the technology for our own benefit to the nation, society and community.

### **3.0 Challenges of Implementing Digital Media**

Digital media pose many challenges to current copyright and intellectual property laws (Barnett, Emma, 18 May 2011). The ease of creating, modifying and sharing digital media makes copyright enforcement a challenge, and copyright laws are widely seen as outdated (Brunet, Maël, March 2014; Kloc, Joe, 12 November 2013). For example, under the current copyright law, common Internet memes are probably illegal to share in many countries (Trotter, Andrew, 17 October 2008). Legal rights are at least unclear for many common Internet activities, such as posting a picture that belongs to someone else to a social media account, covering a popular song on a YouTube video, or writing fanfiction.



To resolve some of these issues, content creators can voluntarily adopt open or copyleft licenses, giving up some of their legal rights, or they can release their work to the public domain. Among the most common open licenses are Creative Commons licenses and the GNU Free Documentation License, both of which are in use on Wikipedia. Open licenses are part of a broader open content movement that pushes for the reduction or removal of copyright restrictions from software, data and other digital media.

Compared with print media, the mass media, and other analog technologies, digital media are easy to copy, store, share and modify. In other words, copied content is identically twin from the original source. This quality of digital media has led to significant changes in many industries, especially journalism, publishing, education, entertainment, and the music business. The overall impact of these changes is so far-reaching that it is difficult to quantify. For example, in movie-making, the transition from analog film cameras to digital cameras is nearly complete. The transition has economic benefits to Hollywood, making distribution easier and making it possible to add high-quality digital effects to films (Carter, Beth, 26 April 2012). At the same time, it has had an impact on the analog special effects, stunt, and animation industries in Hollywood (McCracken, Erin, 5 May 2013). It has imposed painful costs on small movie theaters, some of which did not or will not survive the transition to digital (Kirchhoff, Suzanne M. , 9 September 2010). The impact of digital media on other media industries is similarly sweeping and complex (McCracken, Erin, 5 May 2013).

In journalism, digital media and citizen journalism have led to the loss of thousands of jobs in print media and the bankruptcy of many major newspapers (Zara, Christopher (2 October 2012). Conversely, the rise of digital journalism has also created thousands of new jobs and specializations (Bain, 2011). E-books and self-publishing are changing the book industry, and digital textbooks and other media-inclusive curricula are changing primary and secondary education (Toppo, Greg, 31 January 2012; Horrigan, John, May 2007). Meanwhile in academia, digital media has led to a new form of scholarship, called digital scholarship, and new fields of study, such as digital humanities and digital history. It has changed the way libraries are used and their role in society (Lauer, Claire, 2009). Every major media, communications and academic endeavor is facing a period of transition and uncertainty related to digital media.

Unfortunately, the development of digital media technology also provides several challenges to media practitioners in the industry manage. If the involving party could not manage and control the challenges effectively, it could contribute to negative impact. From the literature, we can conclude the following challenges that need serious consideration in order to gain optimum benefit from utilizing the digital media technology:

- Information Ownership, Copyright and Intellectual Property
- Information Security Issues
- Advanced Technology Changes (Hardware/Software)
- Printing - Related Industry Shrinking



- Digital Content Trustworthy
- Managing the Cyber-Related Crime and Fraud

The critical review highlights several potential challenges that need special attention by digital media users and technology practitioners. Therefore, the challenges highlighted from this review could provide sources of reference to digital media users and implementers as guidelines to manage the challenges better.

## Conclusion

Digital Media become the key element for virtual environment development. Every second, data created, transferred, shared, modified in digital media platform through information technology communication (ICT) digital highway. The integration and interaction of all these components create the cyber world that needs to be managed efficiently for future human digital civilization development. Review the evolution of digital media could provide facts and historical evidences on how media digital evolved from Investigational form to Intelligent form leading to the classification of 5 Digital Media generations. Digital media offer great opportunities to the individuals who live in digital society in order to manage their knowledge, work and ideas because of their functions and capabilities. However, several challenges need to be overcome such information ownership, copyright and intellectual property in order to ensure the digital society gain the real benefits of digital media development.

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