An analytical study on the modern history of digital photography

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Abstract:

Since its emergence more than thirty years ago, digital photography has undergone rapid transformations and developments. Digital technology has produced generations of personal computers, which turned all forms of technology into a digital one. Photography received a large share in this development in the making of cameras, sensitive surfaces, image storage, image transfer, and image quality and clarity. This technology also allowed the photographer to record all his visuals with a high efficiency that keeps abreast of the age's requirements and methods of communication. The final form of digital technology was not reached all of a sudden; this development – in spite of its fast pace – has been subject to many pillars, all of which have contributed to reaching the modern traditional digital shape of the camera and granted the photographer capabilities he can use to produce images that fulfill their task. Reaching this end before digital technology was quite difficult and required several procedures to process sensitive film and paper material and many chemical processes. Nowadays, this process is done by pushing a few buttons. This research sheds light on these main foundations for the stages of digital development according to their chronological order, along with presenting scientists or production companies that have their own research laboratories which develop and enhance their products.

Keywords:

Digital Photography
Image Sensor (CCD-CMOS)
Image Storage (Digital Memory)
Playback System
Bayer Color Filter
LCD display
Digital Viewfinder.

Paper received 11th February 2016, accepted 26th March 2016 , published 1st of April 2016

Introduction

Since the emergence of digital technology the technological development passed through several historical stages like the sensitive surface industry and the lenses and the storage media and methods of trading image and the image strength and quality as well as the camera industry.

The problem in this research is summed up in the main question, what are the basics which used in this development? And what is its history? And what is the impact of this on the camera industry according to the photographer requirements? What is the future vision of this development?

Objectives

The research aims at documenting digital photography's most significant stages of development, which any researcher should be well aware of in order to benefit from the potential which this development paved the way for.

The research also aims to develop a future vision is based on a scientific basis to understand what will be the innovations in digital imaging technologies that meet the needs of photographers requirements for the design of digital photo which keep pace with the developments derived from this research.

Research Methodology:

The researcher follows the historically analytical research method through illustrating the key foundations that played an effective role in developing the digital photography. To put a vision for the digital photography future.

Introduction:

Digital photography has proven to be one of the most world-changing technological breakthroughs of the late 20th century. But the quest to capture and transmit images via electrons began nearly two centuries ago. Just a few years after Frenchman Nicéphore Niépce produced the first fixed photographic image in 1826 or 1827, another invention long distance digital telecommunication arrived. And not long after Samuel F.B. Morse and Alfred Vail developed a viable electric telegraph and a binary code for conveying messages, inventors began to explore sending and recording images via dots and dashes.

This brief history of digital photography begins by looking at the first 40 years of our digital photography time-line.

1- Before digital cameras:

The history of digital photography begins in 1957. That year, the first digital image was produced on a computer. Russell Kirsch for the United States National Bureau of Standards created a rotating drum that allowed images to be scanned. Using this device, he scanned a 5 centimeter by 5 centimeter shot of his son into the computer.

This time period from 1957-1975 saw an unparalleled advancement in technology, including the beginning development of digital

cameras and digital photography.
These early years of digital technology development saw tremendous advancements in technology and marked the beginning of the relatively short history of digital photography.
In this research about the history of digital photography time line we will highlight some of these early milestones in digital photography history.
1961: Eugene F. Lally was an
American aerospace engineer. He worked in the early 1960s on U.S. interplanetary space programs. Beside his space programs he was also an inventor and developed non-space products with his own company Dynamic Development Co. which he founded in the early 1960s. He began working on a way to use a mosaic photo sensor to capture digital images. And laterally he became an active amateur photographer.
1969: Was very important in the history of digital photography because George Smith and Willard Boyle of Bell Laboratories developed the CCD (charge-coupled-device) and demonstrated it on October 17, 1969.
they share the 2009Nobel Prize in Physics for "the invention of an imaging semiconductor circuit the CCD sensor, which has become an electronic eye in almost all areas of photography. This CCD image sensor is the heart the digital camera development because it is the solid-state device that converts light into electric signals. This major breakthrough in 1969 provided the key piece of technology to begin the digital photography revolution. CCD image sensors are still widely used today. While today's CCD image sensors often have 12-14 megapixels the first one in 1969 was only 100 x 100 pixels. From 1969 to 1978 CCD technology continued to be developed and in 1978 Bell Laboratories successfully created an image sensor with 500 x 500 pixel array.

Fig (1) Bell Laboratories in Murray Hill, New Jersey.

1972: Willis Adcock patented a filmless camera however the technology was still not available to make it a viable concept.
1973: Fairchild Imaging produced the first commercial CCD imager. This 10,000 pixel sensor (100 x 100 pixels) would become the foundation for the rapidly developing world of digital imaging.

2- The first decade:

1975: Eastman Kodak engineer Steven Sasson patented a prototype digital camera using the recently invented Fairchild CCD image sensor and a lens from a Kodak movie camera.
Steven Sasson invented the first digital camera at Eastman Kodak in 1975. It weighed 8 pounds (3.6 kg) and had only 0.01megapixels. The image was recorded onto a cassette tape and this process took 23 seconds. His camera took images in black-and-white. As he set out on this project of the electronic camera, what he envisioned for the future was a camera without mechanical moving parts.

Fig (2) Prototype-Digital-Camera1.

Fig (3) Prototype Digital Camera Playback system.

1975: Bell Laboratories demonstrated the first CCD video camera with enough resolution to use for broadcast television. The CCD technology first developed by Bell Labs is found in all kinds of digital imaging devices today, including High-Definition television and video cameras. Other common technology that use CCD imagers are: web cameras, medical scopes, fax machines, copy machines, image scanners, digital cameras and bar code readers.

Fig (4) New Steve Kelly photo of Sasson with Camera1.

Fig (5) Bell Lab's Willard Boyle & George Smith with the CCD.

1975: Another milestone in the history of digital photography was when Bryce Bayer invented the Bayer Color Filter Array that enabled a single CCD or CMOS image sensor to capture color images. Without this filter capturing color images would require three separate sensors attached to a color beam splitter which would be both large and expensive.

A **Bayer filter** mosaic is a color filter array (CFA) for arranging RGB color filters on a square grid of photo sensors. Its particular arrangement of color filters is used in most single-chip digital image sensors used in digital cameras, camcorders, and scanners to create a color image. The filter pattern is 50% green, 25% red and 25% blue, hence is also called **RGBG** , **GRGB** ,or **RGGB**

Bayer Color Filter Arrays are used in almost every digital camera made today.

1977: The Konica C35 AF (nicknamed "Jasupin") is a milestone camera in that it was the world's first point and shot autofocus camera.

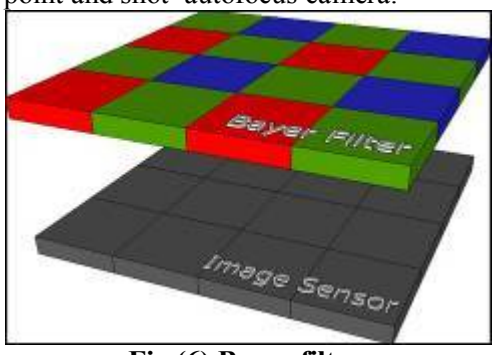

Fig (6) Bayer filter.

Fig (7) Konica C35 AF.

1978: Leica demonstrates the first SLR with fully operational autofocus at the Photo-kina photography show.

1981: The first true working digital camera was built by the University of Calgary Canada ASI Science Team. Their All Sky camera was designed to photograph auroras and used one of the 100 x 100 pixel Fairchild CCD image sensors.

1981: Sony demonstrates the Sony Mavica – the world's first digital electronic still camera. Digital photography and television images are related to the same technology, so this camera recorded images into a mini disk and then put them into a video reader. Images could be displayed to a television monitor or color printer. This early electronic camera had a resolution of 720,000 pixels (.72 megapixels) and was able to store up to 50 images on a single 2.0" video floppy disk.

Fig (8) Sony Mavica (1981), the first still video camera in history.

1981: Pentax ME-F was launched and becomes the first autofocus 35mm SLR. It uses in body focus sensor coupled with a motorized lens, brighter finder screen
different finder magnification. The focusing assistance mechanism had a selector lever with three positions, high aperture lens, small aperture lens, off. An LED in the finder and a (de-activatable) beep told the user that the subject was in focus. The lens mount had five electrical contacts. The dedicated SMC Pentax AF 35-70/2.8 zoom lens allowed full autofocus.

Fig (9) Pentax ME-F Autofocus.

3- The second decade:

1985: Fuji makes the ES-1 a SVC (still video camera) with a 640 x480 pixel CCD imager. This camera was an SLR with a 50-150mm manual zoom.

1985: Minolta releases the Minolta Maxxum 7000 the first 35mm This camera as well as all Minolota

AF SLR's to follow incorporated both the autofocus sensor and the drive motor in the camera body.

1986: Canon was the first to market a still video camera, the professional model RC-701. The RC-701 was aimed mainly at the press market. It had four dedicated interchangeable lenses and also **offered an adapter for 35mm lenses.**

Fig (10) canon RC-701 a SVC (still video camera).

1986: Kodak introduced a 1.4 megapixel sensor making it the first megapixel sensor small enough to fit in a handheld camera. This sensor was used in the Videk Megaplus camera designed for scientific and industrial use. These cameras sold between $10,000 and $40,000 and were essentially the first camera with enough resolution to produce a 5x7 photo quality print.

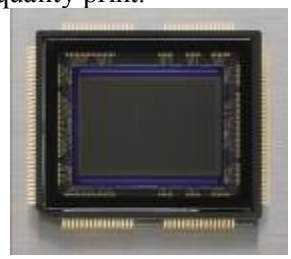

Fig (11) Kodak 1.4 megapixel sensor.

1988: At the Photokina trade fair in Germany, Fujifilm announced the FUJIX DS-1P, the world's first camera to save data to a semiconductor memory card. Taken for granted today, this method of storage was revolutionary for its time and was a Fujifilm original. With its then-impressive 2 megabytes of SRAM, the semiconductor memory card could hold 5 to 10 photographs worth of data.This camera recorded images digitally on a 16MB internal memory card and had 16mm F/5.6 lens with shutter speeds from 1/60/ to 1/200 of a second

Fig (12) Fujifilm launched the world's first fully digital consumer camera FUJIX DS-1P in 1988.

1988: Sony introduces MAVICA MVC-C1 PERSONAL CAMERA AND MVC-A10 sound MAVICA.The MVC-A10 and MVC-C1 were Sony's first Hi-band still video cameras intended for the consumer market. Both cameras were essentially the same except that the A10 could record up to 9.6 seconds of sound with each of 25 images when in Field mode. Both cameras had a 2/3-inch 280K MOS image sensor, ISO 80. Lenses were 15mm f/2.8 with shutter speeds of 1/60 to 1/500 second. Features included built-in flash, self-timer, and MAP-T1 Playback Controller for viewing photos on a television set.

Like other MAVICA models this was not a true digital camera but was a very important step in the evolution of digital cameras.

Fig (13) Sony MVC-C1.

1988: Digital Darkroom was released becoming the first image editing software for the Macintosh computer. 1988 saw another key event in the history of digital photography when the first JPEG and MPEG standards were set. These standards set in place a universal format which allowed images (JPEG) and video (MPEG) to be stored in a compressed format.

The decade of the 1990's saw much important advancement in the world of digital photography. For example it was during this time that Adobe introduced the first version Photoshop which remains the standard for image editing software still today. Other notable achievements in this decade were the invention and release of the Compact Flash memory storage card.

1989: MACINTOSH professional image program Letterset released Color Studio 1.0, the first professional image manipulation program for Macintosh computers.

1989: The MEGAVISION TESSERA The first Tessera system went into regular use in early 1989 at a commercial photo studio in Minneapolis (Photo Mechanical Services, Inc.). Shooting 4 Megapixel images in a production photo studio, believed to be the world's first professional digital camera system

1990: Kodak develops the Photo CD system and proposes the first worldwide standard for defining color in the digital environment of computers and computer peripherals.

Fig (14) The Megavision Tessera System.

1990: Adobe Systems release first version of Photoshop 1.0 making it the second digital editing program available for Macintosh computers and an important milestone in the digital photography.

1990: Logitech introduces the Dycam Model I and Fotoman digital cameras. It was a true digital camera capable of capturing 320 x 320 pixel black and white photos. The camera had 1 MB of internal memory that could store up to 32 photos. It had a 8mm fixed-focus lens with a shutter speed range of 1/30 to 1/1000 second. The camera came with a cable to download these photos to a computer and sold for $995. The camera was attached to a PC to transfer image. There was only one button on the camera, the shutter button. To turn the flash on it was necessary to connect the camera to a computer and use the program that came with the camera. To turn the flash off it was necessary to reconnect the camera to a computer.

1991: Kodak released the first professional digital camera system marketed towards journalists at a New York City press conference. The prototype camera was spruced up with a much larger image LCD

Fig (15) Dycam Model 1
The world's first consumer digital still camera.

and optional JPEG compression and serial transmission boards. It used a Nikon F-3 camera film body adapted with a 1.3 megapixel Kodak CCD image sensor.After the launch of the Kodak Professional DCS 200 IR digital camera, a magazine reviewer named this camera the "DCS 100."

Fig (16) show Nikon F-3 camera film body adapted with a 1.3 megapixel Kodak CCD image sensor.

1991: Fuji releases the DS-100 digital memory card camera. This camera had a 390,000 pixel imager and a 8-24mm F/2 power zoom lens. It recorded images to a
digital image card and sold for around $5,000. Fuji also sold a card drive that hooked up to a Macintosh computer via the SCSI port resulting in faster image downloads than the typical serial interface more commonly used. This camera included a version of Adobe Photoshop that allowed the importing of images to a Macintosh computer.

Fig (17) show Fuji DS-100.

1992: The National Center for Supercomputing Applications release Mosaic the first internet photograph browser another important event along the digital photography timeline.

Fig (18) FujixCardReader.

1992: Apple releases the Quick-Take 100 a color digital camera made by Kodak. The first digital cameras for the consumer-level market that worked with a home computer via a serial cable. this camera was able to capture a 640x480 pixel color image and came with a fixed focus 50mm lens.

Fig (19) Apple Quick-Take 100.

1993: The VC-1000 was introduced by Olympus in 1993, replacing their analog still-video VC-100 with a true digital camera. (The name **Deltis** was also used for Olympus-branded computer media.) The VC-1000 included a 2x zoom, and up to 31 images from its 380,000-pixel sensor could be stored in 2 MB of onboard, solid-state memory. It was soon followed by several costiler VC-1100 models, which included the ability to transfer data via modem—a valued feature for many professional users. the Deltis VC-1100, the world's first digital camera capable of uploading photos using a modem to another camera or computer. this camera was also one of the first cameras to store images on an external PCMCIA card.

Fig (20) Olympus Deltis VC-1100.

1994: SanDisk and Kodak released the first CompactFlash Memory Card. Kodak releases a 1 MB version of the card in early 1994 and SanDisk releases 2-24 MB versions of the card later that year. Still widely used today the development of the CompactFlash memory card was an important event in the digital photography timeline.

4- The third decade:

1995: Ricoh releases the RDC-1 the first digital camera that could also take movies with sound, The RDC-1 claims to be the world's first digital camera to offer both still and moving image and sound recording/reproduction. Its recording capacity on a 24MB PC card is 246 (768x480 pixels) still pictures in standard mode, or 492 in economy mode, or 246 still images in economy mode each with 10 seconds of sound, or 173 still images in standard mode each with 10 seconds of sound, or four video scenes of 5 seconds each with sound, or one hour and forty five minutes of sound only. All this in any combination.. Also in 1995 Casio released the QV-11 which was one of the first digital cameras with an LCD display.

1995: Canon and Kodak jointly released the EOS DCS series of digital cameras intended for professional use. Based on the CanonEOS-1N. Focal-plane shutter multi-mode AF SLR digital camera with 36-bit full color.

Fig (21) Ricoh RDC-1.

Fig (22) Casio QV-11.

(RGB each 12 bits). Imaging element size: 16.4 x 20.5 mm. 1.3 megapixel CCD (1268 horizontal x 1012 vertical pixels). ISO 200 to 1600 (color) and 400 to 6400 (B&W). Several models. Color: EOS-DCS 3c; black-and-white: EOS-DCS 3m; infrared: EOS-DCS 3ir. ISO: color: 200-1600; black-and-white: 400-6400; infrared: 400-6400. 1268 x 1012 pixel CCD. Shutter 1/30 to 1/8000 second. Canon also released the the EF 75-300mm F4-5.6 IS lens. This was the first still camera telephoto lens that had built in image stabilization technology.

Fig (23) EOS DCS series.

Fig (24) EF 75-300.the first still camera telephoto lens that had built in image stabilization technology.

1996: The Kodak CD-25 is the first camera to use a Compact Flash card for storage. Canon also started selling its "PowerShot" 600 the first in a long line of "PowerShot" cameras designed for the general user. The Canon "PowerShot" 600 also used a compact flash card to store photos and really marked the beginning of Canon's full scale start into the digital camera era and a key event on the digital photography timeline.

Fig (25) Canon PowerShot 600.

1996: Sony introduces their first "Cyber-shot" digital camera the DSC-F1. This camera used a .3 megapixel (310,000 pixel) CCD image sensor capable of a resolution of 640x480 pixels. 1/3-inch, 640 x 480 pixel CCD. Stored up to 108 640 x 480 images on 4MB of internal flash memory and could store up to 108 JPEG images. (30 images in fine mode).Video out. Infrared wireless image transmission. Fixed-focus and macro 35mm swivel lens. Built-in flash and self-timer. AE or shutter priority. Shutter 1/7.5 to 1/1000 second. Lithium Ion battery.It had 4MB of internal flash memory.

Fig (26) Sony DSC-F1.

1997: Hitachi coming out with the MP-EG1 the first digital cameras that could upload moving pictures to a personal computer in the MPEG format. Their could store up to 246 images. the MPEG format

Fig (27) Hitachi MP-EG1.

At the same time Sony released the Cyber-shot DSC-MD1 the first digital camera that recorded JPEG images onto a MiniDisc Sony's first digicam use a three-inch CD-R as the recording media, it wasn't Sony's first still image digicam to be marketed using a laser and a small plastic disc to record JPEGs. This camera had a 640x480 pixel CCD image sensor and a 37 to 111mm F/2 lens with macro functions. The same year Sony also released its MVC-FD5 the first of its Mavica cameras that allowed users to record JPEG images directly to a standard 3.5 inch floppy disk making it easy for the consumer to transfer the images directly to their computers.

Fig (28) Sony shot DSC-MD1.

1997: Olympus releases the Camedia D-500L. The D-500L had a 1024 x 768 pixel CCD imager and a 50mm to 150mm F/2.8 lens. and was the first non-SLR digital camera to use a TTL (through-the-lens) viewfinder.

Fig (29) Olympus Camedia D-500L.

1997: The Panasonic Palmcam PV-DC1080 is one of the earliest digital cameras to come with a docking station to link to the computer F/2.8 43mm fixed-focus lens. ISO 120. Shutter 1/4 to

1/2000 sec.550 and used a 640 x 480 pixel 1/3-inchCCD sensor with a 55mm fixed focus lens.

Fig (30) The Panasonic Palmcam PV-DC1080.

1998: The Sony Mavica MVC-FD91 (FD = floppy disk) came with a variety of features unmatched by other digicams at the time such as its 14X zoom and image stabilization Like other Mavicas, the FD91 stored images on standard floppy disks and used Sony's Info Lithium batteries as a power source. In addition to outlasting any other battery on the market, they provided continuous feedback to the user as to charge time remaining, and like other Lithium batteries, they did not have a memory so could be recharged at any time. The FD91 also boasted a record breaking 37:518mm 14X zoom lens which was augmented by an image stabilization system (IS) that consisted of four servo motors and a movable lens. The IS instantly corrected for small hand tremors and camera movements thereby capturing sharp images even at full 14X magnification. This system allowed owners to take photos at the maximum 518mm range of the lens without resorting to the use of a tripod. Alternatively this same lens system was capable of correctly focused macro photographs even with the subject pressed directly against the front of the lens barrel. Like the Ruvi, the FD91 could record MPEG images with sound or record audio memos with each still image. 1/3-inch 1024 x 768 pixel CCD. ISO 100. F/1.8 37mm – 518mm zoom lens. Shutter 1/60 to 1/4000 second

Fig (31) Sony's MVC-FD91.

1999: Another important point on the digital photography timeline was when Photo highwa.com started the first photography site on the internet where photos can be uploaded directly from a digital camera.

1999: Another milestone on the digital photography timeline came when Nikon released the Nikon D1.

The Nikon D1 is a digital single-lens reflex camera (DSLR) made by Nikon Corporation introduced on June 15, 1999. It featured a 2.7-megapixel image sensor, 4.5-frames-per-second continuous shooting, and accepted the full range of Nikon F-mount lenses. The camera body strongly resembled the F5 and had the same general layout of controls, allowing users of Nikon film SLR cameras to quickly become proficient in using the camera. Autofocus speed on the D1 series bodies is extremely fast, even with "screw-driven" AF lenses.

Fig (32) Nikon D1.

1999: Nikon also releases two 2 megapixel cameras capable of producing smaller photo quality prints. The Coolpix 900 came with a zoom lens while the Coolpix 700 had a fixed focal length lens.

Fig (33) Coolpix 700.

Fig (34) Coolpix 900.

2000: Canon releases the EOS D30 with a 8.2 megapixel CMOS image sensor and a RGB color filter. This camera was characterized by a small

and light body and had a fully automatic mode that made it appealing to consumers and helped expand the non-professional use of digital SLR's.

Fig (35) Canon EOS D30.

2001: Sony releases the DSC-F707 their first Cyber-shot camera with a 5 megapixel sensor. This camera also featured Sony's "Night Shot" technology that enabled users to take pictures at night without flash.

2001: Canon releases the Power Shot S40 with a 4.0 megapixel CCD Sensor.

The Power Shot S40 mark a revival by Canon of the higher end 'S' series of digital cameras. Clearly since the S10 and S20 and S30. Canon have explored the ultra-compact 'pocket' type digital camera, the S30 and S40 are a little larger but more feature rich. These two new cameras (virtually identical apart from their output resolution S30 - 3mp, S40 - 4mp) now sit between the Power Shot 'G' series (G1, G2) and the IXUS / ELPH (S100 / S110 / S300) digital cameras.

The S30 and S40 are also noteworthy because they are the first Canon digital cameras with a sliding front lens cover which doubles as a power switch, this fairly common design feature on other manufacturers cameras has finally made its way to Canon digital cameras. This new cover appears to work well and help to protect the lens.

Fig (36) Sony DSC-F707.

Fig (37) Canon Power-Shot S40.

2002: The Foveon image sensor is introduced. This unique CMOS image sensor is the first one to capture color information for red, green and blue light at every pixel location during a single exposure. Sigma is currently the only camera manufacturer to use the Foveon Image Sensor.

2003: Canon launches the Digital Rebel one of the first affordable DSLR's aimed at the non professional market. These cameras allowed Canon owners with film SLR's to Transition to the digital world using their existing Canon lenses.

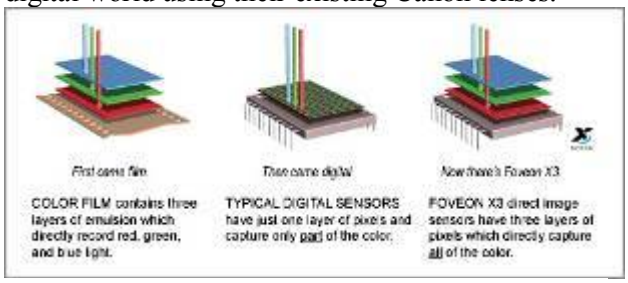

Fig (38) show the difference between Foveon image sensor and the Typical digital sensor.

2003: Olympus introduces the first DSLR with a self cleaning image sensor. Because the image sensors of DSLR's are susceptible to dust getting on them when a lens is changed this new technology was an important breakthrough and is standard equipment on most DSLR's today.

5- Fourth decade:

2006: Nikon discontinued most of its film cameras and its large format lenses to focus on digital models. As of 2010 the Nikon F6, a professional model film based SLR is the only non digital camera still being made.

Fig (39) show Nikon F-6.

2007: Nikon releases the Nikon D3 a full frame (DSLR) followed shortly by the Nikon D700 a few months later.

2008: The Nikon D90. World's first D-SLR with an HD movie mode. record exceptional 24fps movie clips with sound at up to 720p HD (1280 x 720 pixels) in Motion JPEG format, enhanced by NIKKOR interchangeable lens quality and versatility

18MP APS-C image sensor and the first one

2009: Canon releases the EOS 7D DSLR. This camera was the first DSLR with an

to use dual image processors. It had a 5184 X 3456 image sensor.

Fig (40) show Nikon D90.

Fig (41) Canon EOS-7D DSLR.

2010: Sony introduces the NEX-VG10 icon the first consumer camcorder to use an interchangeable lens and a 14 megapixel APS-C HD CMOS image sensor. This camcorder further blurs the lines as more and more DSLR's feature the ability to capture HD video and now there is a HD camcorder capable of taking DSLR quality still images. With18mm-200mm zoom lens.

2010: Canon announced the largest CMOS image sensor ever made. The new sensor measures 202mm by 205mm (8 inches by 8.1 inches). It is about 40 times the size of full-frame image sensor and is capable of capturing images using 1/100 of the light a normal professional DSLR.

Fig (42) Sony NEX-VG10.

This means that the new sensor is capable of capturing 60 fps video at the unbelievable light level of 0.3 lux.

Canon's new sensor is an important milestone in the world of digital photography.

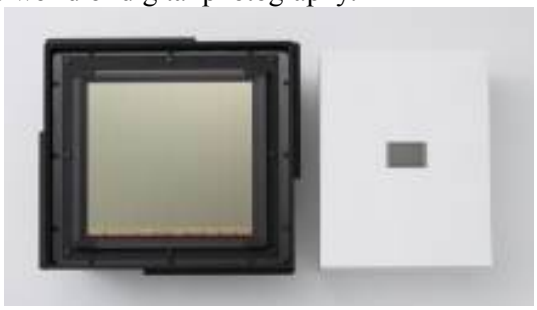

Fig (43) canon's new sensor.

2010: Sony's latest interchangeable lens cameras, the SLT Alpha A33 and A55 represent a significant technological milestone - not just for Sony but for the enthusiast camera market as a whole.

The company has rejected the traditional DSLR design and instead created a hybrid that, like a compact camera, is from the ground up built around live view, but one that is also capable of offering full-time DSLR-style phase-detection autofocus. The combination means they can offer features such as phase-detection AF during movie recording and extremely fast continuous shooting rates (10 frames per second on the A55), previously unthinkable at this price.

This is made possible by adopting an approach that has more in common with a mirrorless camera (like the Panasonic G2, for example) than an SLR by removing the bits that pretty much define such cameras: the optical viewfinder and moving mirror.

The designation 'SLT' stands for single lens translucent and it's the 'translucent' bit that's the key to what differentiates these new models both from conventional DSLRs and mirrorless interchangeable lens cameras. The SLTs do have mirrors, but they're mirrors that let the majority of the light pass straight through to the sensor, rather than having to swing out of the way to allow exposure. As a result they are fixed in position, always reflecting a portion of the light emerging from the back of the lens onto a phase-detection AF array housed in the top of the camera. (A newly-developed 15-point array in the case of these two cameras).

The A33 features the same 14 million APS HD CMOS sensor as the NEX-3 and NEX-5, but the sensor in the A55 is brand new, with 16.2 million effective pixels - Sony's highest-resolution APS-C format sensor yet. In another first for Sony's large-body interchangeable lens models, both cameras can shoot movie files as well, at 1080p HD resolution.

Fig (44) Sony SLT-A55.

5- Technological foundations for the futuristic vision

Through the previous analytical study to the stages of historical development and stand on the technological underpinnings.Progress in the fields of design and technology occurs simultaneously. Given that technological advancement is systemic, development in any technology is accompanied by advances in all technological fields. Therefore, it could be said that the pillars of technological advancement will be founded on nanotechnology where the nano-camera, polymers for developing lenses and physical properties, remote sensing and control, and laser technology with its holographic applications will emerge.

5-1 Nanotechnology and the nano-camera:

Recent developments in technology are now headed towards nanotechnology, which is based on the manufacture of material measured in nanometer with marvelous properties and tiny devices with incredible capacities. What is nanotechnology? What are its applications in digital photography?

Nanoscience and nanotechnology are defined as the sum total of research and technology related to developing new devices measured in nanometer, which is one millionth of one millimeter. These devices are called nanoparticles or nanodevices. American physicist Richard Feynman was the first to point to this new scientific field and called for exploring it in December 1959.

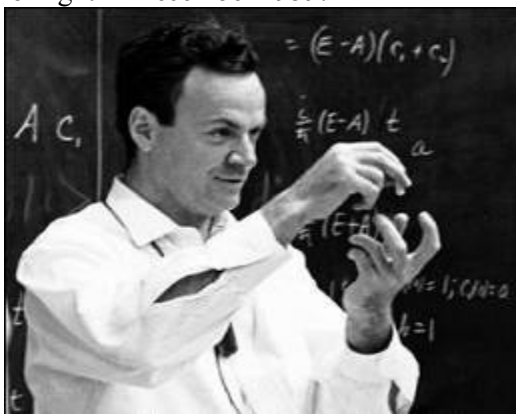

Fig (45) Richard Feynman.

Nanoscience truly took off after the 1981 discovery of the Scanning Tunneling Microscope which is used for imaging atoms and studying the composition of particles.

Three researchers in Rice University in Houston, Texas. came up in the mid-eighties with the idea to align 60 carbon atoms in an unusual form different from their natural state; a sphere with pentagons and hexagons on its surface, akin to a football. This new substance was named fullerene and was used to manufacture the first carbon nanotube in 1991. Research in this field has shown that when isolated, an atom or a small group of atoms (ten atoms of hydrogen are equal to one nanometer) do not have the same physical properties they have when they are inside a large body. If we cut a cube of carbon (graphite), its side measuring 10 cm, to four parts, we would get four cubes with sides measuring 2.5 cm each. These cubes would share the same black color and physical properties of the original cube. And if we maintain the process up to one thousandth of one millimeter (one micrometer, equal to one thousand nanometers), we would get the same result. But if we reach dimensions of about 100 nanometers, the properties change and the cubes lose their black color. As we know, gold in its natural form is yellow, but it turns transparent when gold particles are less than 20 nanometers in size. When miniaturized, they turn from green to orange and finally to red. This means tiny particles have different properties. With these dimensions, the recognized rules of physics (classical physics) become inapplicable and are replaced by quantum physics.

Interest in this field has grown especially with Soviet-born Dutch physicist Andre Geim's discovery of grapheme in 2004, for which he received the Nobel Prize in 2010. Nanoscience and nanotechnology have become one of the most prominent scientific fields prompting developed countries – on top of which are the United States, Germany, Japan, South Korea, and China – to compete in publishing scholarly articles and patenting in all scientific fields such as medicine, electronics, mechanics, biology, and artificial intelligence, as well as others.

Nanotechnology could be applied to the field of digital photography in replacing silicon oxide semiconductors with other substances that carry the properties of optical sensors and function like a camera's sensitive surface. As a result for the diminishing size of sensitive surfaces, fundamental changes will occur in camera manufacture and use. This will reflect directly on the digital image design, which will require

development in the following technologies.

5-2 Polymers for developing lenses and physical properties:

Due to the changes expected to occur in camera size, the manufacturing of lenses will advance as their components will be replaced with transparent, lighter polymers. They will also be formed with optical properties identical to lenses with a short focal length. The range of these lenses could reach that of a fisheye lens, which has a 180-degree angle of view. Other features such as rotation to capture 360-degree panoramic views will be added. The camera itself may be spherical in shape, or supported on tripods, or built into the photographer's headgear or his eyeglasses, or tied to his hand or shoulder.

5-3 Remote sensing and control:

Current developments in cameras, like the GO PRO,which is wirelessly connected to mobile phones and tablets. the view finder then is completely separate from the camera which could be controlled with a joystick. Cameras on helicopter tripods, where the camera follows the photographer wherever he goes, have emerged as well. The photographer can direct the camera where he wants. This will lead to a leap in media and journalistic photography.

5-4 Laser and its holographic applications:

There are many indicators pointing to holographic technology and the employment laser in two directions. The first indicator targets media storage in nano-cameras which require a built-in storage memory. Holographic memory will be the optimal choice for camera manufacturers; this is a development we may be witnessing soon in traditional digital cameras. The second indicator would show in the materialization of the imaged produced, where the holographic image is fully materialized 25 centimeters away from display screens or holographic printing paper.

Research Results:

After studying the key foundations upon which the development of digital photography was based, manufacturers settled on the final shape of the camera in a manner that meets the photographer's needs. This final shape is the new traditional digital one.and Through these historical analytical study, the research extrapolated The basic pillars of the future development of digital photography.

After the analytical study to the history of digital technology to produce photographs and its developments. the research has found that the basic of this development are as follows:

- Using semiconductor technologies, especially silicon oxides, which changed the concept of photographic process from just recording the reflected light on silver halides surfaces to convert the reflected light into electrical pulses.
- Through the development of the semiconductor and the emergence of the sensitive surface (CCD) the new sensor surface (CMOS) appear, which is lower in its price and better in its quality and become now the most common in digital cameras.
- Using the compact electrical circuits technology to development the of mechanical processes inside the camera, and using it in each of the adjusting the focal length for camera lenses. And controlling in the mechanism of the shutter movement and speed, as well as the aperture.
- Using both of the compact electrical circuits technology and the semiconductor technology to offer a new feature to the photographer and give him the ability to change the photographic speed (ISO) to control in the sensitive speed of the surface to light, which was impossible before, unless change the film inside the camera.
- Using both of the compact electrical circuits technology and the semiconductor technology to add control to the white balance in the produced digital image, without changing the materials or using special materials day light or tungsten light. And with the continuous development the photographers have the ability to choice of color temperatur he will use measured (Kelvin).
- Using lenses production techniques, as a result of changing the sensitive surface area, which required special change in lens design and their optical properties to suit the designer's needs to control the depth of field of the image.
- Using the liquid crystals technology (LCD), which allowed the photographer the freedom to see his photos either through a specific optical vision or through a specific technology vision made of liquid crystals (LCD), it became available to him to see his taken photos immediately.
- Using the electro-magnetic techniques to produce media storage to handling with the captured images, which begun in the form of magnetic tapes, and evolved now to (Hard disk) built inside the camera.

Recommendations:

- The research recommends that photographers should be well-informed and fully aware of this history to be able to follow up with the rapid, continuous developments.
- It also recommends that educational institutions for photography teach this development, and

give him more interest.
- The photographers and educational institutions and research centers must be interested to develop the scientific studies and research for these basics in the future.

Discussion

Digital technology has produced generations of personal computers, which turned all forms of technology into a digital one. Photography received a large share in this development in the making of cameras, sensitive surfaces, image storage, image transfer, and image quality.

This technology also allowed the photographer to record all his visuals with a high efficiency that keeps abreast of the age's requirements and methods of communication.

The final form of digital technology was not reached all of a sudden; this development in spite of its fast pace has been subject to many pillars, all of which have contributed to reaching the modern traditional digital shape of the camera and granted the photographer capabilities he can use to produce images that fulfill their task. Reaching this end before digital technology was quite difficult and required several procedures to process sensitive film and paper material and many chemical processes.

Nowadays, this process is done by pushing a few buttons. This research sheds light on these main foundations for the stages of digital development according to their chronological order, along with presenting scientists or production companies that have their own research laboratories which develop and enhance their products.

In this research we focused in Studying history of digital camera one of the most important step to know the development of the camera history from its begging to present, it also evaluates of the camera sciences movement in the world, by analyzing step by step the changes addressed with the study of the most important camera manufacture pioneers in the digital history.

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