A Technical review of Digital Camera features and High Dynamic Range Challenges

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Abstract: The inevitable use of existing Digital Cameras has enabled the layman to use them in a professional manner. The present era demands the compliance of camera users with robust methods available, and adaptation of a technology to suit their requisite.

Keywords: digital camera; HDR; camera properties; camera features; camera parameters

I. INTRODUCTION

The trends and technology of this century have revolutionalised the representation of an image – be it a photograph of small dew drops or that of a mega infrastructure. The digital cameras available today have become ubiquitous with various salient features.

The extensive use of digital camera has imposed the individual to have the technical know-how of such devices. An understanding of camera properties can surely aid a photographer to achieve better results. The current article has an insight to analyze the existing digital camera attributes and spot the potential technologies.

II. PATH TRAVERSED BY CAMERAS

Johannes Kepler invented camera and coined the term "Camera obscura". A Latin word "camera" means vaulted chamber/room, where as "obscura" means darkened chamber/room.

Figure 1. First photograph
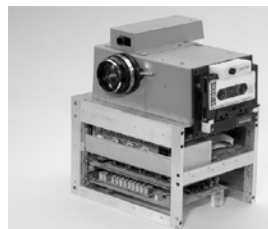

Figure 2. Roll Film camera

Figure 3. First Digicam

The world's first photograph was taken by Joseph Niepce [1] in 1826, developed using a plate and petroleum product, and named as "heliograph" (Fig. 1). The first roll film camera was invented by Peter Houston (Fig. 2) in 1881. Consequently Eastman patented it for camera and its parts [2]. As known to most users, a roll film contains a film strip, with frame numbering, being wounded forward after every exposure. This strip is 0.025 mm thick and it is made up of celluloid and gelatin. The grains contained in it are photo sensitive, especially for Red, Green and Blue colors. The cost of such camera was $1, when there was a typical salary of $2 per day.

The digital camera was commercially available in 1981 in form of Sony's MAVICA- Magnetic Video Camera (Fig. 3) to be the first one. Subsequently the companies like Kodak, Nikon, Apple and Casio launched their digital cameras.

A Digital Camera functions based on three major aspects –viz. lens, shutter and aperture, with an aim to control focusing of an object of interest, duration of light exposure and the amount of light required respectively. The image capturing also includes various calculations, image storage, format conversion, etc. which are done through the electronics (ICs) present into it. The cost of digital camera available today, ranges from $380-$10,000.

III. ROLL FILM V/S DIGITAL CAMERA

The roll-film camera is used even today since its onset, in view of the fact that it has few advantages over a digital camera [3]. The camera cost factor being a major one, a compulsory photo print is also a plus. The roll film photos can be viewed anywhere without requiring computer screens or TV sets.

However, the digital camera is now replacing the film technology, since it is considered better in many ways. The advantages of digital technology are:
   a. No need of roll purchase and tricky insertion.
   b. No roll-development charge and time involved.
   c. Lower weight compared to film camera.
   d. The availability of video recording feature.
   e. Memory storage capacity of hundreds of photos.

f. Immediate removal of unwanted photos.
g. Availability of special effects and functions.
h. Built-in battery to circumvent separate charger.

We will now discuss the potential features of digital cameras available currently.

IV. BASIC PARAMETERS

Every digital camera has a unique feature as per the application, ranging from very simple functions understood by a layman to the professional settings. The most common technical specifications are discussed below.

Mega pixels: Each portion of an image is stored in form of digital values, generally in RGB (Red, Green, Blue) format indicating the color value of that position. An image resolution is thus measured in Mega pixels (MP) as being equal to 1 million pixels [4]. The commonly available camera capacities are 2 MP, 4 MP, 6 MP, 7.2 MP, 8.1 MP and 10 MP.

It is not always true that higher the MP, better is the image quality, because the lens quality also matters [5]. The optimal value is to be decided by the user, since the higher MP value indicates more memory storage required for each image. Usually 5 MP to 8 MP camera is good enough, if only the small prints (5x7 inch) or screen displays (15") are required in the output form.

Digital and Optical zoom: Most of the cameras provide digital zoom, which is a bit of illusion. The digital zoom indicates the post processing part, which reveals that an image can be viewed by zooming to a given factor like 2X. An optical zoom is the "real" zoom feature, where a lens has a capacity to detect a distant scene clearly [6], [7] without going near to it.

Lens: The lens property is measured in form of its focal length, measured in millimeters. It represents the distance between the optical center of a lens and its focal plane. The lower the focal length, the wider is an angle of view. The standard camera has a typical focal length of 50mm to 55mm, while a professional lens has 80mm to 500mm focal length.

Memory cards: A removable memory card in a camera is the actual place where all photos are stored. They are generally in form of flat Smart Media, Compact Flash or memory Stick type of cards. The latest cards have Secure Digital (SD) feature, available in sizes of SD, Mini-SD and Micro-SD.

Figure 4. Capture modes

Table I. Applications of Camera modes

Sr .No.	Situation	Mode
1	A family posing outdoors during daytime.	Auto
2	A fashion enthusiast showing tattoo on his hand.	Macro
3	An interesting sign board found on the road.	Aperture
4	Popular car model moving on the road.	Shutter
5	The children blowing crackers at New year eve.	Night
6	A sunrise with different color effects.	Manual

Image capture modes: During the image acquisition, a user is able to select one of the different modes available in a camera (Fig.4.), depending on the type of scene one needs to capture.

a. Auto Mode: The automatic or default settings of a camera are used, which results into a good image quality under normal situation; irrespective of the area to be covered, light conditions, type of surface, etc.
b. Shutter Priority Mode: This feature focuses on the speed of shutter, which is useful in image acquisition of fast moving objects.
c. Aperture Priority Mode: It is useful to focus on a stationary object at a fixed depth, whereas Shutter speed is tuned accordingly.
d. Manual Mode: The multiple factors can be simultaneously adjusted by the user, through manual mode.
e. Macro Mode: The objects which are very close to the camera can be captured using macro mode (typically few inches).
f. Night Mode: A low light conditions, the image production is difficult. This mode uses lower shutter speed in order to capture maximum information and light flash to get the image details without reflection and blur effects.

The features provided by camera manufacturers are generally condition specific. In order to have a glimpse of such conditions, Table 1 represents the applications of such features.

V. ADVANCE FEATURES

The professional camera differs to the commonly available ones in form of the special features that they provide [8]. The subsequent lines will now narrate such pro features.

Red-eye removal: Due to the biological properties, the human or animal eyes appear red with the flash exposure in low light condition. This novel feature removes such defect of an eye colour [9].

Image stabilization: A moving object can be captured by using aperture mode, but the movement of camera itself will result into bad quality image. This feature allows the vibrations in a camera to some extent, tolerating camera shaking by hands or absence of camera stands.

Face detection: The colour and texture features of human face can be identified by using this feature. Hence, the

aperture can be focused to face and nearby area, resulting to better human face images.

SLR and DSLR: SLR stands for Single Lens Reflex used by professional photographers. Basically the design is such that light entering the lens is reflected by a mirror up into the viewfinder, allowing the photographer to see exactly what the final picture will look like. DSLR - Digital SLR is just a computerized version of the mechanical SLR.

VI. FUTURISTIC CAMERAS

Figure.5. Fujifilm G-Shot with 3D image capture

Figure 6. Samsung DualView with 12 MP Sensor

Figure 7. Panasonic FP8 with 27 scene modes

Figure 8. Seitz 160 MP

The frontiers in a digital camera technology suggest creative ideas every day. This results into special camera for fun, such as 3D camera compatible for 3D viewing (Fig.5),two-sided LCD preview for self photo (Fig.6.), light weight camera with multiple modes (Fig.7.) and high MP (160 MP) camera worth $36,000 with mini computer storage instead of memory card (Fig. 8).

VII. ACKNOWLEDGMENT

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