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Art Market and Possibilities of Computer Art in the Current Scenario

Dr. Ashish Kumar Shringi

Assistant Professor, Dept. of Drawing and Painting, Govt. College, Bundi, Rajasthan, India

ABSTRACT: Computer art is any art in which computers play a role in production or display of the artwork. Such art can be an image, sound, animation, video, CD-ROM, DVD-ROM, video game, website, algorithm, performance or gallery installation. Many traditional disciplines are now integrating digital technologies and, as a result, the lines between traditional works of art and new media works created using computers has been blurred. For instance, an artist may combine traditional painting with algorithm art and other digital techniques. As a result, defining computer art by its end product can thus be difficult. Computer art is bound to change over time since changes in technology and software directly affect what is possible. Adobe Systems, founded in 1982, developed the PostScript language and digital fonts, making drawing, painting, and image manipulation software popular. Adobe Illustrator, a vector drawing program based on the Bézier curve introduced in 1987 and Adobe Photoshop, written by brothers Thomas and John Knoll in 1990 were developed for use on MacIntosh computers, and compiled for DOS/Windows platforms by 1993. A robot painting is an artwork painted by a robot. Raymond Auger's Painting Machine, made in 1962, was one of the first robotic painters.

KEYWORDS: computer, art, market, digital, robotics, adobe, photoshop, algorithm, gallery, animation, installation

I. INTRODUCTION

Computerized embroidery, also called Computer-controlled embroidery or simply machine embroidery is a kind of Computer-aided design and manufacturing (CAD/CAM). Computerized embroidery machines are specialized machines that can create embroidery from computerized designs. Such machines exist for the home market, for the small independent professional and for mass production. Many home sewing machines can be turned into an embroidery machine by adding a hardware module. Embroidery machines can be found in fab labs and other maker spaces.¹

Embroidery design software exists in various form, either as special-purpose tools for various design stages or as complete design suites. Embroidery designs can be stored in a multitude of proprietary design formats, that can be exported to proprietary machine formats.

Digital painting is an established art medium that typically combines a computer, a graphics tablet, and software of choice.^[1] The artist uses painting and drawing with the stylus that comes with the graphics tablet to create 2D paintings within a digital art software. Digital artists utilize multiple techniques and tools, the main one being digital brushes.^[2] These come standard with all digital art programs, but users can create their own by altering their shape, texture, size, and transfer.^[3] Many of these brushes are created to represent traditional styles² like oils, acrylics, pastels, charcoal, and airbrushing, but not all.^[4] Other effective tools include layers, lasso tools, shapes, and masks. Digital painting has evolved to not just mimic traditional art styles but fully become its technique.³

Digital painting is used by amateur and professional artists alike. Its use is particularly prevalent in commercial production studios that create games, television, and film.^[5] There are multiple reasons for this which applies to amateur artists as well. Digital painting enables artists to experiment with different techniques and colors easily as its use of layers, the undo function, and save files make it a non-destructive work process.^[6] Artists can always return to an earlier state within the art piece, so nothing is ever truly lost. This saves time and materials while giving the artist more freedom to create.



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Computational photography refers to digital image capture and processing techniques that use digital computation instead of optical processes. Computational photography can improve the capabilities of a camera, or introduce features that were not possible at all with film based photography, or reduce the cost or size of camera elements. Examples of computational photography include in-camera computation of digital panoramas,^[6] high-dynamic-range images, and light field cameras. Light field cameras use novel optical elements to capture three dimensional scene information which can then be used to produce 3D images, enhanced depth-of-field, and selective de-focusing (or "post focus"). Enhanced depth-of-field reduces the need for mechanical focusing systems. All of these features use computational imaging techniques.⁴

The definition of computational photography has evolved to cover a number of subject areas in computer graphics, computer vision, and applied optics. These areas are given below, organized according to a taxonomy proposed by Shree K. Nayar . Within each area is a list of techniques, and for each technique one or two representative papers or books are cited. Deliberately omitted from the taxonomy are image processing (see also digital image processing) techniques applied to traditionally captured images in order to produce better images. Examples of such techniques are image scaling, dynamic range compression (i.e. tone mapping), color management, image completion (a.k.a. inpainting or hole filling), image compression, digital watermarking, and artistic image effects. Also omitted are techniques that produce range data, volume data, 3D models, 4D light fields, 4D, 6D, or 8D BRDFs, or other high-dimensional image-based representations. Epsilon photography is a sub-field of computational photography. Digital Fashion is the visual representation of clothing built using computer technologies and 3D software. This industry is on the rise due to ethical awareness and uses of digital fashion technology such as artificial intelligence to create products with complex social and technical software.^[1]

Digital fashion is also the interplay between digital technology and couture. Information and communication technologies (ICTs) have been deeply integrated both into the fashion industry, as well as within the experience of clients and prospects. Such interplay has happened at three main levels.⁵

1. ICTs are used to design and produce fashion products, while also the industry organization leverages onto digital technologies.
2. ICTs impact marketing, distribution and sales.
3. ICTs are extensively used in communication activities with all relevant stakeholders, and contribute to co-create the fashion world.

The fashion industry in general has paved the way for digital fashion to be introduced with more technology being in the industry like virtual dressing rooms and the gamification of the fashion industry. Digital fashion is also seen in many different online fashion retail websites. It may be seen on common websites you shop on. This evolution in the fashion industry has called for more education and research of digital fashion . A wearable computer, also known as a body-borne computer,^{[1][2]} is a computing device worn on the body.^[3] The definition of 'wearable computer' may be narrow or broad, extending to smartphones or even ordinary wristwatches.^{[4][5]}

Wearables may be for general use, in which case they are just a particularly small example of mobile computing. Alternatively, they may be for specialized purposes such as fitness trackers. They may incorporate special sensors such as accelerometers, heart rate monitors, or on the more advanced side, electrocardiogram (ECG) and blood oxygen saturation (SpO2) monitors. Under the definition of wearable computers, we also include novel user interfaces such as Google Glass, an optical head-mounted display controlled by gestures. It may be that specialized wearables will evolve into general all-in-one devices, as happened with the convergence of PDAs and mobile phones into smartphones.⁶

Wearables are typically worn on the wrist (e.g. fitness trackers), hung from the neck (like a necklace), strapped to the arm or leg (smartphones when exercising), or on the head (as glasses or a helmet), though some have been located elsewhere (e.g. on a finger or in a shoe). Devices carried in a pocket or bag – such as smartphones and before them, pocket calculators and PDAs, may or may not be regarded as 'worn'.



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Wearable computers have various technical issues common to other mobile computing, such as batteries, heat dissipation, software architectures, wireless and personal area networks, and data management.^[6] Many wearable computers are active all the time, e.g. processing or recording data continuously. Digital photography uses cameras containing arrays of electronic photodetectors interfaced to an analog-to-digital converter (ADC) to produce images focused by a lens, as opposed to an exposure on photographic film. The digitized image is stored as a computer file ready for further digital processing, viewing, electronic publishing, or digital printing. It is a form of digital imaging based on gathering visible light (or for scientific instruments, light in various ranges of the electromagnetic spectrum).⁷

Until the advent of such technology, photographs were made by exposing light-sensitive photographic film and paper, which was processed in liquid chemical solutions to develop and stabilize the image. Digital photographs are typically created solely by computer-based photoelectric and mechanical techniques, without wet bath chemical processing.

In consumer markets, apart from enthusiast digital single-lens reflex cameras (DSLR), most digital cameras now come with an electronic viewfinder, which approximates the final photograph in real-time. This enables the user to review, adjust, or delete a captured photograph within seconds, making this a form of instant photography, in contrast to most photochemical cameras from the preceding era.

Moreover, the onboard computational resources can usually perform aperture adjustment and focus adjustment (via inbuilt servomotors) as well as set the exposure level automatically, so these technical burdens are removed from the photographer unless the photographer feels competent to intercede (and the camera offers traditional controls). Electronic by nature, most digital cameras are instant, mechanized, and automatic in some or all functions. Digital cameras may choose to emulate traditional manual controls (rings, dials, sprung levers, and buttons) or it may instead provide a touchscreen interface for all functions; most camera phones fall into the latter category.⁸

Digital photography spans a wide range of applications with a long history. Much of the technology originated in the space industry, where it pertains to highly customized, embedded systems combined with sophisticated remote telemetry. Any electronic image sensor can be digitized; this was achieved in 1951. The modern era in digital photography is dominated by the semiconductor industry, which evolved later. An early semiconductor milestone was the advent of the charge-coupled device (CCD) image sensor, first demonstrated in April 1970; since then, the field has advanced rapidly, with concurrent advances in photolithographic fabrication.

The first consumer digital cameras were marketed in the late 1990s.^[1] Professionals gravitated to digital slowly, converting as their professional work required using digital files to fulfill demands for faster turnaround than conventional methods could allow.^[2] Starting around 2000, digital cameras were incorporated into cell phones; in the following years, cell phone cameras became widespread, particularly due to their connectivity to social media and email. Since 2010, the digital point-and-shoot and DSLR cameras have also seen competition from the mirrorless digital cameras, which typically provide better image quality than point-and-shoot or cell phone cameras but are smaller in size and shape than typical DSLRs. Many mirrorless cameras accept interchangeable lenses and have advanced features through an electronic viewfinder, which replaces the through-the-lens viewfinder of single-lens reflex cameras.⁹

More and more types of digital art emerge as technology advances. In a featured article the artists from Architecture Lab provide a comprehensive review of 15 common types of digital art. Some of them are common in our life, such as 2D Computer Graphics, Digital Photography, Photo-painting, 3D Computer Graphics, Pixel Art, Digital Photography, Digital Collage, 2D Digital Painting, and 3D Digital Painting.

Digital art has its characters and is significantly different from traditional art. Digital art can be viewed as the same, just binary code shown visually on a screen. However, digital art is usually done on a drawing tablet and with a stylus. The stylus can act as any tool, brush, blender, or pencil. One unique thing traditional art cannot do is animation, displaying an image/ drawing every fraction of a second to create movement. Digital art also has layers, blend modes, clipping masks, paint bucket tools, resizing, reshaping, and magic rulers. These digital-specific tools allow for unique special effects and a completely new process for creation when it comes to creating art.¹⁰



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II. DISCUSSION

Digital textile printing is described as any ink jet based method of printing colorants onto fabric. Most notably, digital textile printing is referred to when identifying either printing smaller designs onto garments (T-shirts, dresses, promotional wear; abbreviated as DTG, which stands for Direct to garment printing) and printing larger designs onto large format rolls of textile. The latter is a growing trend in visual communication, where advertisement and corporate branding is printed onto polyester media. Examples are: flags, banners, signs, retail graphics.¹¹

Types of printing can be divided into:

- Direct Print
- Discharge Print
- Resist Print
- Pigment Print
- Reactive Print
- Acid print
- Disperse print
- Specialty Print

Digital textile printing started in the late 1980s as a possible replacement for analog screen printing. With the development of a dye-sublimation printer in the early 1990s, it became possible to print with low energy sublimation inks and high energy disperse direct inks directly onto textile media, as opposed to print dye-sublimation inks on a transfer paper and, in a separate process using a heat press, transfer it to the fabric.¹²

The rise of digital art has a significant impact on traditional art; it also draws criticism. Many critics and curators think that tools create digital artworks, and they do not want to acknowledge the artistry of the digital art creators. However, the wide acceptance of digital art is inevitable, just like many other forms of art in the past. There are reasons to be optimistic about the future of digital art. First, digital tools are revolutionizing the transformation of the digital arts in the film industry. Second, museums around the world are starting to accept digital illustrations and portraits. Finally, digital artworks have become an integral part of social life, such as fashion or interior design.¹³

The advantages of digital art are apparent. Many artists started learning traditional art when they were young but have gradually spent more and more time on digital art. These artists shared similar opinions with Kat Sander, that the biggest advantage of digital art is its convenience. The artists can bring the iPad anywhere and not worry about any extra overspending. It is easy to publish and share the works via social media once they are done. The works can be printed in many places: shirts, mugs, and so on. Most importantly, it is easy to correct any mistakes during the process. Digital art is also more viable than traditional art considering economic cost and potential incomes.¹⁴

III. RESULTS

Digital visual art consists of either 2D visual information displayed on an electronic visual display or information mathematically translated into 3D information viewed through perspective projection on an electronic visual display. The simplest is 2D computer graphics which reflect how you might draw using a pencil and a piece of paper. In this case, however, the image is on the computer screen, and the instrument you draw with might be a tablet stylus or a mouse. What is generated on your screen might appear to be drawn with a pencil, pen, or paintbrush. The second kind is 3D computer graphics, where the screen becomes a window into a virtual environment, where you arrange objects to be "photographed" by the computer. Typically 2D computer graphics use raster graphics as their primary means of source data representations, whereas 3D computer graphics use vector graphics in the creation of immersive virtual reality installations.¹⁵ A possible third paradigm is to generate art in 2D or 3D entirely through the execution of algorithms coded into computer programs. This can be considered the native art form of the computer, and an introduction to the history of which is available in an interview with computer art pioneer Frieder Nake.^[10] Fractal art, Datamoshing, algorithmic art, and real-time generative art are examples. Computer-generated animations are animations created with a computer from digital models created by 3D artists or procedurally generated. The term is



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usually applied to works created entirely with a computer. Movies make heavy use of computer-generated graphics; they are called computer-generated imagery (CGI) in the film industry. In the 1990s and early 2000s, CGI advanced enough that, for the first time, it was possible to create realistic 3D computer animation, although films had been using extensive computer images since the mid-70s. A number of modern films have been noted for their heavy use of photo-realistic CGI.^[13]

Digital painting^[14] mainly refers to the process of creating paintings on computer software based on computers or graphic tables. Through pixel simulation, digital brushes in digital software (see the software in Digital painting) can imitate traditional painting paints and tools, such as oil, acrylic acid, pastel, charcoal, and airbrush. Users of the software can also customize the pixel size to achieve a unique visual effect (customized brushes).¹⁶

Digital geometry deals with discrete sets (usually discrete point sets) considered to be digitized models or images of objects of the 2D or 3D Euclidean space. Simply put, digitizing is replacing an object by a discrete set of its points. The images we see on the TV screen, the raster display of a computer, or in newspapers are in fact digital images.

Its main application areas are computer graphics and image analysis.

Main aspects of study are:

- Constructing digitized representations of objects, with the emphasis on precision and efficiency (either by means of synthesis, see, for example, Bresenham's line algorithm or digital disks, or by means of digitization and subsequent processing of digital images).
- Study of properties of digital sets; see, for example, Pick's theorem, digital convexity, digital straightness, or digital planarity.
- Transforming digitized representations of objects, for example (A) into simplified shapes such as (i) skeletons, by repeated removal of simple points such that the digital topology of an image does not change, or (ii) medial axis, by calculating local maxima in a distance transform of the given digitized object representation, or (B) into modified shapes using mathematical morphology.¹⁷
- Reconstructing "real" objects or their properties (area, length, curvature, volume, surface area, and so forth) from digital images.
- Study of digital curves, digital surfaces, and digital manifolds.
- Designing tracking algorithms for digital objects.
- Functions on digital space.
- Curve sketching, a method of drawing a curve pixel by pixel.¹⁸

Digital photograph restoration is the practice of restoring the appearance of a digital copy of a physical photograph that has been damaged by natural, man-made, or environmental causes, or affected by age or neglect.³⁴

Digital photograph restoration uses image editing techniques to remove undesired visible features, such as dirt, scratches, or signs of aging. People use raster graphics editors to repair digital images, or to add or replace torn or missing pieces of the physical photograph. Unwanted color casts are removed and the image's contrast or sharpening may be altered to restore the contrast range or detail believed to have been in the original physical image. Digital image processing techniques included in image enhancement and image restoration software are also applied to digital photograph restoration.¹⁹

Digital photography has allowed larger groups of people to participate in the process, art form, and pastime of photography³³. With the advent of digital cameras in the late 1980s, followed by the invention and dissemination of mobile phones capable of photography, sales of digital cameras eventually surpassed that of analog cameras.^[13] The early to mid 2000s saw the rise of photo storage websites, such as Flickr and Photobucket, and social media websites dedicated primarily to sharing digital photographs, including Instagram, Pinterest, Imgur, and Tumblr. Digital image



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files include Joint Photographic Experts Group (JPEG), Tagged Image File Format (TIFF), Portable Network Graphics (PNG), Graphic Interchange Format (GIF), and raw image format.²⁰

IV. IMPLICATIONS

Direct-to-garment printing (DTG) is a process of printing on textiles using specialized aqueous ink jet technology.³² DTG printers typically have a platen designed to hold the garment in a fixed position, and the printer inks are jetted or sprayed onto the textile by the print head. DTG typically requires that the garment be pre-treated with a PTM or Pre-treatment machine allowing for the following:

- Stronger bond between garment fibers and the pigmented inks
- Lays down loose fibers to provide for a smoother substrate
- Chemically reacts with the inks to promote drying and curing²¹

Since this is a digital process the print is sharper and has a higher resolution, or DPI, than traditional printing methods such as screen printing. However, unlike screen printing, there is no long setup or clean-up process, and DTG has the ability to print just one single shirt for minimal cost.^[1] DTG printers use aqueous textile inks (water-based chemistry) that require a unique curing process. Since D2 inks are water-based, they work best for printing on natural fibers such as cotton, bamboo, hemp, and linen³¹. In addition, pre-treatment is typically applied to the garment before printing. The pre-treatment is heat-pressed into the custom t-shirt causing the fibers of the shirt to lay down.^[2] The pre-treatment also allows the water-based inks to bond more fully to the garment. This is especially important when using white ink on dark garments.²²

Once the custom garment -for instance a t-shirt- has been properly pre-treated, the shirt (or garment) is then positioned onto a platten system designed to hold the shirt in place. The shirt is then digitally printed according to the design in the printer queue.^[3]

Print on demand with digital technology is a way to print items for a fixed cost per copy, regardless of the size of the order. While the unit price of each physical copy is greater than with offset printing, the average cost is lower for very small print jobs, because setup costs are much greater for offset printing.²³

POD has other business benefits besides lesser costs (for small jobs):

- Technical set-up is usually quicker than for offset printing.
- Large inventories of a book or print material do not need to be kept in stock, reducing storage, handling costs, and inventory accounting costs.³⁰
- There is little or no waste from unsold products.
- Many publishers use POD for other printing needs other than books such as galley proof, catalogs and review copies.

These advantages reduce the risks associated with publishing books and prints and can result in increased choice for consumers. However, the reduced risks for the publisher can also mean that quality control is less rigorous than usual.²⁴

Digital printers spray very fine drops of ink in a targeted area meaning you get great clarity in printing. The print resolution is greater giving the design clear, sharp edges. With traditional screen printing you can get bleeding of ink under the screen and misprints. Each batch is slightly different.

Digital fabric printing enables precise reproduction of very fine lines, with strong colour consistency. So a metre printed six months later will look exactly the same as a metre printed today.²⁵

Digital Textile Printing is a process of printing on textiles and garments using inkjet technology to print colorants onto fabric. This process allows for single pieces, mid to small-run cycle production and even long-runs as an alternative option to screen printed fabric. The first step in digital textile printing is to pretreat the fabric with liquid solutions that



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prepare it to accept the dye and better absorb the color.²⁹ Then it is fed through the printer, which sprays the dye onto the textile with tiny droplets. The final step is fixing the fabric, a process that ensures the permanency of the design. Depending on the type of textile and type of dye, fixing may involve steam, dry heat, or pressure. Sometimes it requires a combination of two or more of those. Kornit's printing solutions provide a quick and easy digital printing process, requiring no pre or post treatment. Learn more about the Kornit printing process and what makes it so simple. Kornit's DTG printing solutions allow for unparalleled printing quality, speed and performance.²⁶

IV. CONCLUSIONS

More and more types of digital art emerge as technology advances. Today, digital art has become a part of daily life and greatly impacts traditional art although many digital artists started learning traditional art. Compared to traditional art, the most significant advantage of digital art is its convenience: digital art is easy to carry, easy to publish and share, easy to be printed in many places, and most importantly, easy to be corrected.²⁸ Digital art also has the edge over traditional art, considering its economic cost and potential incomes. Most recently, a piece of digital artwork that does not exist in physical form was sold at 69 million dollars. Despite the rising popularity of digital art and its advantages over traditional art, it is still unclear what the impact digital art has on the job market for artists today. Historical data and artist job outlooks do not show a rosy picture. However, many articles presented optimistic views towards digital artists.²⁷

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