

Choosing the Right Machine: A Comparative Analysis of Desktops and Laptops

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Abstract

This study provides a comparative analysis of desktop and laptop computers, focusing on factors such as performance, portability, cost, and user requirements. Desktops are highlighted as the preferred option for resource-intensive tasks like gaming, video editing, and handling large-scale data because of their powerful processors, efficient cooling mechanisms, and expandability. These systems are well suited for users who prioritize high performance and the ability to upgrade components over time. On the other hand, laptops are designed with compactness and mobility in mind, featuring lightweight builds and integrated batteries. This makes them especially appealing to students, professionals on the move, and casual users who need convenience and portability rather than maximum computing power. The study carefully outlines the strengths and limitations of each category, offering readers a practical guide to choosing the right device depending on individual needs and priorities. In addition, it explores emerging technology trends that are reshaping the boundaries between desktops and laptops. Innovations such as ultra-thin, high-performance laptops and sleek all-in-one desktop systems are narrowing the gap, giving users more versatile choices. Ultimately, the discussion emphasizes that the best option depends on balancing performance requirements, mobility, and budget considerations in a rapidly evolving technological landscape.

Keywords: Portable hardware, ultrabooks, power users, operating systems

INTRODUCTION

In today's fast-paced digital environment, choosing a personal or business computer can be difficult. With several devices accessible, desktop and laptop computers are popular. Each has pros and cons depending on the user's performance, portability, and affordability. Desktops are popular for gaming, software development, and graphic design because to their power and upgradeability. Laptops, with their compact designs and built-in power sources, are the preferred choice for mobile users.

This study compares desktop and laptop computers based on hardware, performance, cost, and portability. Users can better choose a device that meets their computing needs by studying the pros and cons of each type. This research will also show how ultrabooks and all-in-one desktops are blurring the distinctions between desktops and laptops, giving casual and power users new options.

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LITERATURE REVIEW

Academic and commercial research has examined the pros and cons of desktop and laptop computers. Several studies have examined the performance, mobility, cost-effectiveness, and user preferences of both device types.

Power Desktops are used for high-performance computing. Due to their larger form factor and ability to accommodate more powerful hardware, desktop computers have higher processing power,

better graphics, and greater storage space than laptops, according to Kuo *et al.* [1]. Desktops thrive at video rendering and 3D modeling due to their ability to integrate dedicated graphics cards, enormous memory capacities, and high-performance processors [2]. Laptops have improved in performance, notably with ultrabooks and gaming laptops, but they still lag behind desktops in raw processing power and heat management [3].

Laptops are designed for portability. Over 70% of professionals and students preferred laptops since they could work remotely, according to Anderson *et al.* [4]. Since remote work and education have increased mobility, laptops are preferred by people who need to balance work and flexibility. Portability typically has drawbacks. Laptops are compact and lightweight, but performance and upgradeability may suffer [5]. Portability requires sacrificing ports, battery life, and cooling capacity [6].

Desktops are cheaper for high-performance computing. Desktop computers offer greater value, especially for those who demand high-spec hardware at a reasonable price, according to the Consumer Electronics Association (2020). Users can choose components to fit their budget and customize desktops. Due to their tiny form factor and excellent component integration, laptops are convenient but expensive. Desktops are cheaper to buy, but laptops may cost more for peripherals like docking stations or external storage [2].

Personal demands and usage patterns influence desktop and laptop user preferences. Hwang *et al.* discovered that gamers, graphic designers, and software developers choose desktops for intensive jobs [7]. In contrast, casual users and mobile workers prefer laptops. Laptops are more important in current culture due to hybrid work patterns and mobile learning. With the rise of powerful laptops and all-in-one desktops, the lines between the two are blurring.

New technologies continue to blur the distinctions between desktops and laptops. External GPU (eGPU) systems, ultra-thin laptops, and cloud computing are closing the desktop-laptop performance gap, according to Zhao *et al.* [8]. Laptops are now more competitive than desktops due to improvements in battery technology, CPUs, and cooling. Virtual and augmented reality (VR/AR) applications have also influenced laptop and desktop development, with each device optimized for distinct immersive technologies.

Finally, the literature shows how the desktop versus laptop issue is evolving. Laptops are catching up to desktops for high-end computing jobs due to improvements in performance, mobility, and connectivity. As technology advances, these two groups may blur, giving users more options based on their requirements and tastes.

DESKTOP COMPUTER HISTORY

Since the early 1970s, desktop computers have improved in design, performance, and capability. In the 1970s and 1980s, Apple, HP, and IBM manufactured many desktop computers. Desktop computers with simple hardware and software met consumers' needs. Some of these computers were huge and expensive. A few years later, desktop computer technology advanced, and smaller desktop designs gave consumers more possibilities. In early phases, the system unit was a large box with power controls and fans outside. Although users needed a larger desk, the system unit box was still large enough to house many hardware components, making it hefty. Modern desktop computer system units are small and do not take up much room. Besides desktop computer size, system unit hardware design and placement have changed throughout time. The computer case's external component has to hold many desktop computer expansion cards. Additionally, they would need larger monitors to display computer images. Hardest hard drives and floppy disks were as big as home VCR tape recorders and placed below or behind the computer monitor. Desktop hardware components of modern computers are smarter and easier to use. This alteration is shown by the motherboard connection, which allows front-side access to all processor and RAM components. Many households and businesses adopted desktop computers in

the 1990s. Microsoft Windows OSs simplify desktop computer use with their graphical user interfaces. One of the greatest computer markets is personal computers, which are expanding. Atkinson states that desktop computers can be connected to the internet quickly and cheaply [9].

THE HISTORY OF LAPTOPS

Office work and design have changed dramatically since the 1980s personal computer revolution. In the 1980s, personal computers were deskbound, chained to neighboring electrical sockets, and limited to screen and keyboard side by side by cable length. Electronic pets required placing the computer on the floor or a workbench for convenience of use. Early workplace computers were obtrusive beyond weight. These big, industrial machines made a lot of noise, but their blinking lights showed sophistication and worth [9]. Modern technology has shrunk, hushed, and miniaturized computers. Despite this compacting process, office computers are still immediately recognizable and invasive, but it is predicted that they will disappear from the workplace within a decade. Laptops and their derivatives will replace desktops and reorganize the office. Laptops arrived in the late 1980s, but it took years for them or palmtops to disrupt the office computer market. The ambitiousness or early development of several products led to their commercial failure.

The development of small-scale general-purpose computing equipment from 19th- and 20th-century analytical engines and punched card schemes to mainframes, minis, and micros is well documented. Few historians cover the evolution of office-specific devices. A brief historical review and how the office technology issue was resolved are covered in this analysis. After assuming tiny screen and portable computer production, technical issues are handled, the research considers office computer futures. Mechanical, electro-mechanical, and electrical calculators, add-and-subtract machines, and tabulating machines were made by hundreds of companies that made mechanical office machines during the interwar period.

DESIGN, PORTABILITY

Laptop design is more prominent than desktop design. Companies only focused on making desktop monitor screens thinner shows that desktop design is being prioritized [10]. No question, laptops are more portable than PCs. Simply because desktops were not made for that. Laptops' major advantage over their cousins is that they are not "one system fits all".

In desktops, the system unit design is not changing, but accessories and ports are. The typical desktop system unit is rectangular and larger than laptop casings. In recent years, system unit cases have appeared in cube, case cooler-like box, case box with front-mounted ports, and others. New ports were added to the latest case box. Memory card slots, USB type C ports, and others have appeared. Aux, USB, SD card, and ethernet ports are color-coded. This simplifies differentiation. All of the above describe a typical desktop. Making Desktop PC monitor screens smaller has been a major design effort. Some firms focus primarily on this. Structural integrity decreases with screen thickness. Problems are assured without a stand; therefore, this is trivial. Display bezels are another alteration from the former style. Screens with little or no vessel have a larger viewing area. However, some customers dislike this desktop screen adaptation. Some disagree because the edge protects the monitor's screen from a little hit. The zero-bezel screen prioritizes aesthetics over functionality. Laptop screens also use these designs.

OPERATING SYSTEMS

A computer's operating system separates hardware from user interaction. The operating system controls computer hardware, including reading and writing data to permanent storage and internet connectivity. The operating system also has a huge application ecosystem. These programs are either built into the OS or third-party apps designed for it. The OS manages the computer's user interface, such as the Desktop Manager or Shell/Terminal. Nowadays, computers run Windows, macOS, and different Linux distributions. Different offerings make those three operating systems more or less

appealing to different users. Windows is good for most consumers, but macOS is for experts. This divergence is most obvious in the hardware ecosystem where hardware and software work seamlessly together. How the operating system separates users from computer components is maybe its most essential feature. This abstraction layer makes the computer more user-friendly and powerful, but it reduces efficiency. Other operating system elements, such as program compatibility, affect how users utilize their computers [11].

Modern and emerging computer operating systems include cloud-based ones. These operating systems are stripped-down versions of regular operating systems that load web processors over the internet. This system model runs on nearly any hardware, can handle data-intensive applications, and provides an always-on computer experience. However, these systems consist of proprietary software owned by large corporations, easily controlled by large corporations, difficult to maintain and troubleshoot, have long-term hardware obsolescence and depend on a product's life cycle, and give the producer open access to the operational environment. Gaming and calculating work that is not meant for cloud computers will require the user to use a local operating system. Despite these drawbacks, casual users are appreciating cloud computing's versatility and ease [12].

STORAGE OPTIONS

When buying a computer for work, recreation, or school, storage options might affect performance and use. Two storage options are available for laptops and desktops. Traditional hard disk drives (HDDs) are cheaper and have bigger storage capabilities for PCs. SSDs, on the other hand, are fast, dependable, and power-efficient. Some laptops and desktops have them. Three types of desktop and laptop storage exist today. Traditional HDDs are still the most popular storage devices. Since HDDs are cheap, most econut computers will have them. Hard drives are still larger for the price, ideal for substantial, economical computer storage: 500 GB, 1 TB, 2 TB, and higher. Built-in or external HDDs are connected to the PC via USB [13].

SSDs have the latest flash memory. SSDs differ from HDDs almost entirely. SSDs read and write data faster than HDDs. Since storage generally slows computers, they usually speed them up. Many modern thin and light computers have this technology. SSDs are fast yet more expensive than HDDs. For huge SSD storage, expect a more expensive computer. Using a smaller SSD and an external HDD may work better. SSDs exist in 120, 256, and 512 GB sizes, with 500 GB models costing over \$200. This storage might be incorporated into the machine or provided externally. The latest storage technology, HDD-SSD hybrid drives, combines spinning platters and flash memory. Faster than HDDs, hybrid drives are slower than SSDs. Hybrid drives contain long-term data on flash memory and short-term data on spinning disks. Even if storage surpasses flash memory capacity, the hybrid drive can quickly retrieve frequently needed data.

CONNECTIVITY OPTIONS

Desktops and laptops' connectivity choices are crucial for networking and peripheral integration. Stability, data throughput, integration simplicity, and wireless or wired connections affect these possibilities. Built-in wired connectivity connects via cables to a network via Ethernet or peripherals via USB [14]. It is generally more stable and speedier than wireless connections. Understanding how standards affect transfer speeds is crucial, as Ethernet provides a faster and more robust networking connection. Desktop PCs, the hub of a home network, are usually connected over Ethernet for the fastest data speeds [15].

Due to several connections on a single cable, download speeds vary. Some standards, like Thunderbolt, can connect many devices from a single port and give greater transfer speeds. Laptops are getting slimmer and have fewer ports. To compensate, docking stations are employed. Wireless is more complicated, uses airborne communications, and has radiation risks like cancer. Laptops have Wi-Fi and cellular antennae in the form of a dongle or M.2 card, which helps with mobile connectivity.

Universal standards that allow peripherals to connect via Wi-Fi without a docking station are growing. Laptop sales have skyrocketed, thus most connectivity research focuses on mobility standards. In terms of connectivity, laptops have caught up to desktops, but wired connections are still better for collaborations. Recent wireless standards could lead to a data-parity ecosystem for all devices.

Desktop and laptop computers have different pros and cons in professional settings and productivity. The hardware in desktops is highly valued. Professionals that multitask or use resource-intensive software like analytical or 3D modeling programs prefer multi-monitor systems with high-performance CPUs. Laptops' biggest benefit is their portability, allowing work to be done anywhere with the same software and interface [16]. Modern computing allows cloud services to make desktop configurations portable via applications. Many occupations required desktops before the Covid19 lockdown [17]. For instance, any self-respecting coder must learn about Visual Studio when they start desktop-based work. Some professions underestimate laptop capabilities, especially data-intensive ones, and a maximum of 16 GB RAM is not always sufficient. The presence of a charging surface is also known to decrease activity. The information safety norm for some businesses is a PC that quickly freezes any incorrect text input, however corporate policies and access vary. Another reason for desktop preference is Microsoft Office's widespread use. Documents are printed in industry-standard directions. Reference management is usually done a decade after people could utilize it. Many companies forbid working outside the office and restrict personal device use. Since the fax machine, various productivity solutions have been built for remote work. Despite its complexity, the well-marketed collaborative tools, cloud services, and digital communication are just their latest incarnation. Always use nonspecific text to hide your personal information for a more open intellectual marketplace.

ENVIRONMENTAL IMPACT

Computers are impactful from their initial production (mining, resource extraction, refining, energy consumption, and transportation) to their use (computer, monitor, and peripheral energy consumption) to their disposal. Instances of US electronics recyclers exporting dangerous devices from warehouses are investigated. Additionally, electronics manufacturers have actively opposed numerous state recycling regulations. Fruitful discourse includes researching the environment and environmentally conscious businesses' conservation efforts, internal conflicts, or sustainability policy changes due to stakeholder pressure. As environmental activist groups have long pressured industry to take greater responsibility for the harm caused to human and environmental health by high-tech waste and the high-tech waste disposal industry, the need to address the incongruity between public rhetoric and real actions in the fight against e-waste is clear. Since the public is more aware of the e-waste problem, industry is less likely to maximize the disposal of their toxic, domestic e-waste [18]. Gold, silver, and bronze levels of desktop computer certification exist [19]. Standard evasion and deflection strategies include shipping toxic, disassembled electronics from wealthy nations to the global South as second-hand electronics.

PRIVACY AND SECURITY

Everyone uses computers, smartphones, and the internet. Security is everyone's priority. Security dangers vary, but unauthorized access to critical computer systems and network attacks are the most common. Protect sensitive data from cyber-attackers and unintended recipients. Since 2010, there have been many security breaches, but the biggest losses were in 2013, 2016, and 2018, when credit card and password information was lost. In recent years, informatics has expanded to include kids and seniors. Technology and social advancement have opened numerous doors, and fresh information can be found with a computer and internet connection. I also learned about cybercrimes and the need of journaling. Anyone can gather vital or incriminating information with a few personal captures.

The size, capabilities, and original retail price of a personal computer make it usable for individuals and designed to be used by one person. Desktop computers are personal computers, unlike laptops. The computers are the most essential part of day-to-day life. It is essential to provide the protection for the computer system. Desktop computers are considered as highly protective because they are not moved

frequently from one place. On other side, laptop computer is prone to many types of thefts. Laptop protection isolates it from the environment. This may promote laptop theft. People usually transport laptops. Laptop computers are easy to carry and portable. These are frequently used in advanced technology to carry the computer anywhere. Due to carelessness of user, any sensitive information may be lost or damage to laptop. Thus, it is very necessary to give security to laptop computer.

CUSTOMIZATION AND UPGRADABILITY

One of the most distinguishable and well-recognized advantages of desktop computers is the huge form size. The resulting greater space often offers more area for better ventilation, as well as the housing of larger and more powerful components. Custom-built desktop PCs frequently contain at least one PCIe slot that can handle a variety of graphics cards and be utilized with an even larger variety of adapters. Since ATX and Micro ATX form factors are standardized, most desktop computers can use motherboards from dozens of brands and models. Not only motherboards, but also CPUs, RAM, and PSUs.

Another benefit of desktops is case variety. Desktop casings usually support additional storage drives, fans, and low-profile components that are cheaper and more plentiful than laptop components. Desktop cases are used to hold drives, unlike laptops. This is why desktops are easier to customize than laptops. This rule has exceptions. Several manufacturers have made laptops that are easy to service. Many laptops allow users to switch components by removing one screw. You may also buy pre-built desktops or cases with limited upgrade possibilities to turn them into laptops. Many All-In-One models have permanently intact desktops, although some use proprietary components or layouts. Like laptops, most compact form factors or cube desktops offer few upgrading possibilities. Since they need smaller fans to cool, smaller computers are louder. Consequently, desktop and laptop fan-less computers have been developed. These are usually more expensive and less powerful than fan-cooled ones. Users desiring a quiet, upgradeable machine can utilize a tower desktop and affordable laptop. This configuration lets the user run intensive tasks on the desktop and do daily things on the laptop.

FUTURE INNOVATIONS AND TRENDS

From the 'Imagine the Future of Computing' series, such a study is justified by 1993 household/projection scenario numbers. These data and issues of livability, activism, and technological appropriation highlight how computing research might spur innovation in new users, uses, technology, and public media. These situations can then have more realistic settings. Future home computer technology should be more unobtrusive and/or incorporated into other home objects, more supportive of household and stranger social interactions, more transportable and/or modular, and robustly reliable. Scenario analysis suggests promising work. Several case studies demonstrate these concerns. This method can be used to investigate computers in "natural" situations like the workplace or public spaces [20].

RESULT AND DISCUSSION

Result

Performance

- Processing Power: Larger components and better cooling systems give desktop computers more processing power. Due to their tiny nature, laptops may perform poorly in high-demand applications.
- Gaming, 3D rendering, and other high-performance jobs benefit from desktops' powerful GPUs. Laptops' GPUs are improving, but they still lack desktop power.
- Laptops are portable due of their battery life. While battery life is less important for PCs, they need steady power.

Portability

Laptops are portable, allowing users to work or play anywhere. Desktops, however, are stationary and limited to one spot.

User Experience and Ergonomics

Desktops with larger screens, keyboards, and mice are more ergonomic for prolonged use. Although portable, laptops have smaller keyboards and screens, which can be uncomfortable for long usage.

Cost

Laptops cost more than desktops for the same performance due to the engineering needed to cram components into a portable form. Desktops offer cheaper, more customizable solutions. Desktops are easier and cheaper to upgrade than laptops, which cannot upgrade the screen or CPU.

Upgrade and Customize

Users can upgrade memory, storage, graphics, and CPUs on desktops to improve performance or lifespan. Laptop upgrades are rare, but some offer memory or storage upgrades. Laptop replacements and repairs are expensive due to their tight integration.

Discussion

Performance/Portability Trade-off

The main difference between desktops and laptops is performance versus portability. Desktops are ideal for gamers, video editors, and scientists who need lots of power. Laptops are for professionals and casual users who want to work on the go.

Extended Use and Ergonomics

Desktops have larger screens and more comfortable input methods, whereas laptops are better for short-term or mobile use. Laptops' small screens and keyboards might fatigue users over time. Laptops with external displays, keyboards, and mouse can solve this problem.

Cost-effectiveness

Desktops offer better value, especially for power users. Desktops might be cheaper than laptops with comparable specs and offer superior upgrade possibilities. Although more expensive per performance unit, laptops offer unrivaled convenience and portability.

User Context and Needs

User needs determine whether to utilize a desktop or laptop:

- Due of their cost-effectiveness and performance, desktops are suitable for home or office workers who rarely move.
- Laptops make working on the road easy for students, remote workers, and travelers.

Technological Trends

As laptop performance improves, especially with mobile processors like Apple's M1 and M2 chips, the power gap between desktops and laptops narrows. Desktops' customization possibilities and greater cooling will keep them dominant in gaming and high-end workstation tasks.

In conclusion, laptops and desktops serve various purposes. Laptops are more portable and convenient than desktops, which are better for power, customization, and ergonomics. Users must weigh performance, portability, and pricing while deciding between the two.

CONCLUSION

User computer needs have changed as multimedia content has evolved. Some computer areas have advanced because desktops allow users to simply update their hardware and give more computational power. In the present IT environment, laptop sales are outpacing desktops. This could be owing to portability and the reducing computing cost of equivalent gear. Stereo matching and multiview rendering, two essential multimedia applications for 3D computer vision and graphics, were used to compare desktops and laptops. This is justified by the expanding role of multimedia aspects in daily

life. The intricacy and capability of these applications exceed the real-time capacity of conventional computer equipment. To address this shortage of processing capacity, the community has conducted significant research. Four laptop and desktop typologies with differing computational capability were examined for performance, power, passive cooling, connectivity, upgradability, weight, and size. A complete desktop and laptop review was done from a 3D computer vision and graphics perspective. The prospective buyer requires such a review because it is hard to get low-level details to make a judgment. Using public datasets and setup analysis, these two types of devices were examined to empirically justify their differences.

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