CURRENT TRENDS IN COMPUTER DESIGN OF GARDEN AND PARK FACILITIES

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Introduction.

The field of landscape architecture is undergoing a significant shift towards the integration of modern computer technology. Computer-aided design, which was once limited to architectural drawings and interior planning, has now expanded to the design of garden and park facilities. The art of landscape design has come a long way. Historically, it was a manual process that relied on the experience and artistic vision of landscape architects. Today, computer-aided design tools have revolutionised the industry, allowing designers to create complex and accurate plans. The evolution of computer-aided design (CAD) systems in the design of gardens and parks is testament to the growing importance of this technology. The use of computer tools for designing open spaces has a rich history dating back to the late 20th century. Initially, CAD systems mainly served as drawing tools, allowing designers to create two-dimensional plans more efficiently. However, over time, CAD software has evolved into sophisticated platforms that are capable of performing 3D modelling and data-driven analysis. Computer-aided design offers numerous benefits to professionals, including increased accuracy, speed and cost-effectiveness. It allows designers to experiment with different concepts, improve their designs, and visualise the end result more effectively.

Modern CAD systems have shifted the focus from 2D drawings to 3D modelling, allowing designers to create more realistic representations of gardens and parks. These models not only improve visualisation, but also aid decision-making and communication with stakeholders. CAD software now also allows for effective analysis of environmental impact, water management and plant selection to create more environmentally friendly and sustainable outdoor spaces. At the same time, augmented reality (AR) has become a valuable tool for designers, giving them the ability to quickly overlay digital models on the physical world. This technology provides real-time visualisation and interaction with proposed projects in their real environment, facilitating better decision-making and public engagement. Modern CAD tools have greatly facilitated public participation in the design process. Virtual tours, online platforms and interactive models allow communities to participate in decision-making and provide valuable feedback.

As urbanisation and environmental concerns continue to grow, the integration of artificial intelligence (AI) into landscape design is becoming increasingly important. In recent years, the use of artificial intelligence in CAD has revolutionised the way we design and create garden and park facilities. Therefore, AI-based generative design has become a powerful tool for landscape architects. It involves the use of algorithms and machine learning to create many design options based on

specific input parameters. This method allows designers to explore a wider range of design possibilities and choose the most suitable one. An example of generative design in landscape architecture is the creation of customised urban green spaces that optimise shade, airflow and vegetation placement based on local climate data.

Predictive modelling is another key aspect of integrating artificial intelligence into garden and park design. Machine learning models can predict how different design elements and materials will interact with the environment over time. This helps to select the most durable and sustainable components for garden and park facilities. For example, artificial intelligence can predict the growth patterns of certain plant species over the years, allowing designers to create low-maintenance and self-sustaining gardens.

One of the most prominent current trends in garden design is the emphasis on increasing biodiversity. AI-driven analysis tools can assess the potential impact of design choices on local ecosystems and recommend changes that will promote biodiversity. These recommendations can include the selection of native plant species, water management strategies, and the creation of habitat for local wildlife. AI also plays a crucial role in sustainability assessment. By modelling different environmental scenarios, designers can quickly assess the environmental sustainability of their projects. This can include assessing the energy efficiency of lighting systems, water consumption, and the carbon footprint of materials used in gardening and park facilities.

While there are numerous benefits to integrating AI into garden and park design, there are challenges to overcome, such as data privacy concerns, the need for large data sets, and the potential for over-automation. The integration of artificial intelligence into the design of garden and park facilities is a significant development in the field of landscape architecture. By harnessing the power of artificial intelligence, designers are better able to create aesthetically pleasing, environmentally friendly and sustainable outdoor spaces, which ultimately contributes to a better urban living environment. The future of the field is likely to include continued advances in AI technology and a growing emphasis on interdisciplinary collaboration between landscape architects, data scientists and ecologists.

Computer-aided design has revolutionised the process of creating park facilities, offering designers a range of tools and opportunities to turn their vision into reality. Parks are the main green spaces in urban environments, providing communities with places to relax, unwind and connect with nature. The use of computer-aided design in the creation of park facilities has had a significant impact on the field of landscape architecture, resulting in more efficient, sustainable and visually appealing projects. This essay will examine the multifaceted role of computer-aided design in the creation of park facilities, highlighting its impact on visualisation, accuracy, innovation, collaboration and sustainability.

The role of computer-aided design in the creation of park facilities.

Computer-aided design software has simplified the way designers visualise and conceptualise park facilities. Through three-dimensional modelling and visualisation, designers can create virtual representations that accurately reflect their proposed designs. This virtual visualisation process allows designers and stakeholders to have a clear understanding of the final product, enabling effective decision-making. By translating their ideas into virtual formats, designers can identify shortcomings, iterate on their designs and make necessary adjustments early in the process, minimising costly changes during construction. The ability to visualise park facilities through computer-aided design has changed the way designers communicate their concepts and bring them to life.

Computer-aided design tools provide precise measurements and calculations, ensuring the accuracy and efficiency of park facilities. Designers can enter specific dimensions, functionalities and materials, resulting in objects that fit perfectly into the overall park design. With the help of computer-aided design (CAD) software, designers can manipulate and refine every detail of an object, ensuring the design is accurate and precise. Computer-aided design reduces the likelihood of human error and allows for a simplified process from design to production. In addition, advanced computer algorithms can automate tasks such as creating manufacturing drawings, optimising time and resources while achieving higher levels of accuracy. The use of computer-aided design in the creation of a park facility contributes to more efficient project execution and improves the quality of the final result.

Computer-aided design promotes flexibility and innovation in the creation of park facilities. Designers can experiment with different shapes, colours, materials and

textures, allowing them to push the boundaries of traditional design concepts. With the help of computer-aided design software, designers have access to a vast library of design elements and can explore different combinations to create unique and visually exciting park facilities. The flexibility offered by computer-aided design tools encourages designers to think outside the box and apply innovation to their creations. In addition, computer-aided design facilitates the integration of environmental practices, allowing designers to explore environmentally friendly materials, use energy-efficient features, and optimise resource use. The freedom of experimentation and innovation that computer-aided design provides greatly enhances the artistic and functional value of park facilities.

Computer-aided design facilitates effective collaboration between designers, architects, engineers and stakeholders involved in the creation of park facilities. Digital designs can be easily shared, enabling seamless communication and exchange of ideas. Designers can collaborate in real time, making adjustments and taking into account feedback from different stakeholders. Computer-aided design software allows multiple designers to work on the same project at the same time, promoting collaboration and coordination. This collaborative approach ensures that park facilities not only meet visual and functional expectations, but also meet the needs and desires of the community. Through the use of computer-aided design, the creation of park facilities becomes a participatory process that reflects the requirements of all stakeholders.

Implementing sustainable practices in park design is becoming increasingly vital. Computer-aided design tools make a significant contribution to the creation of sustainable park facilities by offering designers the means to assess and optimise environmental impact. Software applications help to model and analyse different design options, providing insight into factors such as material efficiency, energy consumption and carbon footprint. Using these tools, designers can make informed decisions and select materials and elements that improve the overall sustainability of park facilities. Computer-aided design can also facilitate the integration of renewable energy generation systems, such as solar panels, into park facilities. With sustainable design methods implemented through computer-aided design, the creation of park facilities becomes part of a larger commitment to care for the environment.

Computer-aided design is playing a key role in the creation of park facilities, transforming the field of landscape architecture. Thanks to advanced visualisation, accuracy, flexibility, collaboration and sustainability, computer-aided design tools enable designers to bring their creative visions to life. The ability to accurately visualise park facilities, optimise accuracy and efficiency, foster innovation, promote collaboration and embrace sustainability principles ensures the creation of aesthetically pleasing, functional and environmentally friendly park facilities that enhance the overall park experience. As computer-aided design technologies continue to evolve, the possibilities for creating exciting and sustainable park facilities are only expanding, opening up exciting prospects for future generations.

History of industrial garden design in Ukraine.

Garden design in Ukraine has a rich and varied history dating back centuries. From majestic palaces and mansions to small private gardens, the country's landscape is dotted with stunning examples of garden design that demonstrate both artistry and functionality.

One of the oldest influences on garden design in Ukraine can be traced back to the time of the ancient Scythians and their burial mounds. These mounds were often surrounded by elaborate gardens with carefully planned layouts and decorative elements. Archaeological excavations have revealed traces of terraced gardens, water features and ornamental trees and shrubs.

In the medieval period, landscape gardening in Ukraine was heavily influenced by Byzantine and Western European styles. Monastery gardens played a significant role in this period, serving as places for meditation, reflection and the cultivation of medicinal herbs. The Kyiv Pechersk Monastery is an outstanding example of a medieval garden in Ukraine, with its well-preserved layout of terraces, fountains and flower beds.

In the 18th and 19th centuries, landscape art in Ukraine experienced a period of prosperity under the influence of Romanticism. Noblemen commissioned landscape architects to create large park areas around their estates with elements such as artificial lakes, grottoes, pavilions and sculptures. Sofiyivka Park in Uman is a great example of this era, combining natural beauty with architectural grandeur.

At the beginning of the 20th century, modernist influences on garden design appeared in Ukraine. Artists and architects sought to integrate gardens into the urban environment, creating public spaces that combined functionality with aesthetics. The National Botanical Garden in Kyiv is an example of this approach with its collection of rare plants in a carefully designed landscape.

However, during the Soviet era, many traditional Ukrainian gardens were abandoned as industrialisation took over. It was not until the late 20th century that a new interest in garden design emerged, driven by a growing appreciation of Ukrainian cultural heritage. The revival of traditional Ukrainian gardens, such as the Pirogovo Museum of Folk Architecture and Life in Kyiv, has helped to preserve and honour the country's rich history of horticulture.

Today, industrial garden design in Ukraine continues to evolve under the influence of global trends and a growing focus on sustainable practices. Urban gardens are becoming more common, and rooftop gardens and vertical farming are gaining popularity in cities such as Kyiv and Lviv. In addition, garden design is increasingly focusing on the use of local plants and natural materials, reflecting a desire to reconnect with the country's unique natural landscape.

The history of industrial garden design in Ukraine thus reveals a fascinating journey of influence and innovation. From ancient burial mounds to modern urban green spaces, Ukrainian gardens have evolved over time to reflect changing aesthetic preferences and societal values. As the country continues to embrace sustainable practices and honour its cultural heritage, the future of garden design in Ukraine promises to be exciting and environmentally conscious.

The combination of tradition and modernity, manifested in the use of local plants and sustainable practices, will shape the future of industrial garden design in Ukraine.

This not only contributes to the beauty and functionality of these spaces, but also serves as a reminder of the importance of preserving our natural environment.

As Ukraine's gardens continue to flourish, they will undoubtedly inspire and enchant visitors with their unique blend of history, innovation and sustainability. With ongoing efforts to promote sustainable practices and preserve cultural heritage, the Ukrainian garden design industry is poised for an exciting and environmentally conscious future. By seamlessly blending tradition and modern technology, these gardens are not only visually stunning, but also serve as a testament to the urgent need to preserve the environment. Through the use of elements such as rainwater harvesting, native plant species and organic fertilisers, they can serve as educational platforms, raising awareness of the importance of environmental conservation. In addition, these gardens can contribute to the local economy by attracting tourists and providing opportunities for ecotourism initiatives. With their commitment to preserving the past while caring for the future, Ukrainian garden designers are not only creating beautiful spaces, but also laying the foundation for a greener future. By using eco-friendly materials such as recycled wood and environmentally friendly paints in their projects, modern garden designers are setting an example for the entire industry. They are showing that it is possible to create stunning landscapes while minimising the negative impact on the environment.

Garden and park landscape design of residential areas ecological cities based on digital technologies.

In the context of urbanisation and the growing challenges posed by climate change, cities are looking for innovative solutions to effectively manage stormwater. One of these concepts is the development of green cities, which use green infrastructure to absorb and retain rainwater. In these cities, landscape design plays a crucial role in creating sustainable and resilient residential areas. With the advent of digital technology, landscape architects can now harness the power of digital tools to design and optimise garden landscapes in residential areas of such cities.

Modern digital technologies allow for the collection and analysis of data on weather conditions, rainfall and soil moisture in real time. By integrating sensors and data collection systems into the garden landscape, landscape architects can monitor and analyse these parameters. This data-driven approach provides valuable insights into the effectiveness of stormwater management systems, the strengths and weaknesses of the garden landscape design, and helps to make informed decisions for optimisation.

Digital tools allow landscape architects to create accurate modelling and visualisation of water in residential areas of sustainable cities. By modelling the behaviour of rainwater in a garden landscape, designers can identify areas prone to flooding and determine the ideal location for rain gardens, biological ponds and other green infrastructure elements. Visualisation tools help stakeholders to understand the

patterns of water flow, the effectiveness of various design measures and contribute to more informed decision-making.

Digital technology also offers huge databases of plant species with information on their adaptability, water requirements and environmental preferences. Landscape architects can use these databases to select suitable plant species for the garden landscape in residential areas of sustainable cities. In addition, digital tools can integrate weather data and soil moisture sensors to optimise irrigation systems. This ensures efficient use of water resources, reduces water loss and contributes to the health and sustainability of green spaces.

Digital technologies can increase citizen engagement by incorporating gamification elements into garden landscape design. By developing interactive apps or platforms, residents can actively participate in monitoring the condition of the garden landscape and contribute to its maintenance. This gamified approach fosters a sense of ownership and encourages greater community involvement, creating a more vibrant and sustainable residential area in ecologically balanced zones.

Digital tools provide landscape architects with the ability to create realistic and immersive visualisations of garden landscapes. Virtual reality (VR) and augmented reality (AR) technologies allow stakeholders to experience and explore future garden landscapes before they are realised. This aspect of visualisation helps residents, local authorities and decision-makers to better understand the design intent, provide feedback and make joint design decisions. It also helps to identify potential design flaws or adjustments before construction begins, saving time and resources.

Digital technologies offer enormous potential for improving the garden landscape design of residential areas in sustainable cities. By using real-time data collection and analysis, water resource modelling, optimised plant selection and irrigation strategies, gamification elements and visualisation tools, landscape architects can create sustainable, resilient and attractive garden landscapes. These digital tools allow landscape architects to make informed decisions, collaborate with stakeholders, and design garden landscapes that manage water resources efficiently. As digital technologies advance, they will play an increasingly important role in creating green, sustainable and livable urban environments.

Using artificial intelligence to optimise park areas.

Artificial intelligence (AI) has proven to be a game-changer in a variety of industries, offering unprecedented opportunities to increase efficiency, improve decision-making and streamline processes. With its potential for data analytics and pattern recognition, AI can play a transformative role in optimising parklands. Parks are not just places for recreation, they are important components of urban infrastructure that contribute to the overall well-being and quality of life of a community.

Artificial intelligence algorithms are excellent at processing large amounts of data and extracting valuable information. This ability can be of significant benefit to park authorities by optimising the allocation of resources within the park. By analysing data on pedestrian flows, visitor behaviour patterns, artificial intelligence can help determine the most appropriate placement of seating, food stalls, and other

amenities. This ensures visitor comfort, improves accessibility, and optimises the use of available space in the park.

Parks consume a significant amount of energy for lighting, irrigation, and other utilities. AI can play a crucial role in optimising energy consumption in parks. For example, AI-powered lighting systems can adjust the brightness level depending on the presence of visitors, resulting in significant energy savings. Similarly, intelligent irrigation systems can analyse weather forecasts and soil moisture to optimise water use, reducing waste and contributing to sustainable development.

Traditional waste management systems in parks often suffer from inefficiencies, such as overflowing bins and delays in waste collection. Artificial intelligence can revolutionise this aspect by implementing smart waste management systems. Using sensors, AI can track the level of garbage cans and send alerts to waste management teams when the bins reach their capacity. In addition, AI algorithms can optimise waste collection routes to ensure timely and efficient disposal. With effective waste management, parks can keep their grounds clean, minimise their environmental impact, and improve their aesthetic appearance.

Ensuring the safety of park visitors is also of paramount importance. Video analytics and AI-powered surveillance systems can significantly improve security in park areas. These systems can detect and analyse potentially dangerous situations, such as unauthorised access or suspicious behaviour. By proactively detecting and responding to such incidents, park authorities can reduce risks and create a safe environment for visitors. Facial recognition technology can also be used to detect missing people or potential threats, further enhancing security measures.

Artificial intelligence can improve the level of service in park areas. Virtual assistants or chatbots based on artificial intelligence can provide visitors with real-time information and recommendations about activities, facilities and events in the park. These intelligent systems can answer queries, offer personalised recommendations based on user preferences, and provide updates on weather conditions or park opening hours. By using artificial intelligence to deliver park services, park authorities can improve the visitor experience, engage with visitors, and foster a sense of community.

The use of artificial intelligence to optimise parklands can fundamentally change the way we plan, manage and use public spaces. By leveraging the power of AI to allocate resources, optimise energy consumption, waste management, security and intelligent services, parks can become more efficient, sustainable and visitor-friendly. However, it is very important to strike a balance between technological progress and preserving the natural nature of parks. With the development of artificial intelligence, its use in optimising park areas is expected to grow, offering endless possibilities for creating a greener and more attractive urban environment.

Trends in computer-aided design of garden and park facilities.

Computer-aided design in the context of landscape architecture encompasses a wide range of digital tools and technologies that are revolutionising the way we plan, design and maintain hardscapes. It is crucial for professionals in this field to keep abreast of technological advances, as these innovations play a key role in improving the functionality, aesthetics and sustainability of hardscapes. Digital technologies

have had a profound impact on the field of landscape architecture, especially in the field of urban landscape planning and design. These advances have revolutionised the way architects approach the creation of gardens and parks, allowing for more precise and sustainable designs.

One of the most significant advances in digital technology for urban landscape planning and design is the use of 3D modelling. This technology allows architects to create realistic simulations of environmental landscapes, giving them a better understanding of how different elements will interact within a given space.

Using 3D modelling, specialists can:

- create realistic simulations of ecological landscapes;
- visualise the end result of their developments;
- make informed decisions about design components.

This level of precision helps create more sustainable landscapes, optimising resource use and minimising environmental impact. For example, when designing a park, architects can use 3D modelling to simulate how sunlight will interact with trees at different times of the day or year. By analysing this data, they can strategically place trees to provide shade in certain areas or maximise natural light in others. This level of detail ensures that the design of the park is fit for purpose and also takes into account environmental factors.

Practical examples demonstrate the successful application of 3D modelling technology in park design projects. For example, in New York's High Line Park, 3D modelling was used to simulate various planting schemes and determine the optimal plant selection for its elevated park. The result was a vibrant green space that thrives in a complex urban environment.

Virtual reality (VR) and augmented reality (AR) technologies have also become valuable tools in urban landscape planning and design. These immersive technologies enhance the user experience in public spaces by bridging the gap between virtual design concepts and the physical environment.

Putting on a VR headset, users can:

- to be transported into a digital representation of a park or garden;
- explore space and interaction with virtual elements;
- Gain a better understanding of how the final design will look and feel.

This allows architects to gather valuable feedback from stakeholders and make the necessary adjustments before construction begins.

AR takes this immersion one step further:

- allows you to overlay virtual elements on the real world;
- allows users to view the park through their device's camera;
- see virtual objects seamlessly integrated into the physical environment.

This technology allows architects to showcase their projects to clients and the public in an engaging and interactive way. For example, Central Park in New York City has used augmented reality to create an interactive map that provides visitors with real-time information about attractions, upcoming events, and even historical facts.

This enhances the overall user experience by providing valuable information in an accessible and engaging format.

In addition, VR and augmented reality can be used for multisensory interaction in public spaces. For example, virtual reality technology can be used to create soundscapes that mimic different auditory experiences in a park. This allows designers to carefully craft the soundscape to enhance relaxation or create a special atmosphere that matches the theme of the park.

Finally, the development of digital technologies, such as 3D modelling, virtual and augmented reality, has had a significant impact on urban landscape planning and design. These tools provide architects with new ways to visualise and communicate their ideas, resulting in more accurate designs that improve the user experience in public spaces.

The impact of the "digital landscape" on urban construction.

The idea of the 'digital landscape' has transformed the way cities are built, leading to new approaches to design and construction. Here are some important points to understand this concept and its impact on urbanisation:

1. Use of big data analytics. In urban construction, the use of big data analytics has completely changed the way decisions are made and resources are used. By analysing vast amounts of information about urban spaces, designers and architects can gain valuable insights that shape their creative processes. This data-driven method allows for smarter, more efficient and environmentally friendly urban construction projects.

2. The growth of smart parks. Within the concept of the digital landscape, the emergence of "smart parks" has attracted considerable attention. These parks are designed with connectivity, sustainability and adaptability in mind. By combining these key elements, urban green spaces not only look beautiful, but also function as integrated ecosystems that meet the needs of different user groups.

The impact of digital technologies on shaping urban development goes beyond innovation; they are laying the foundation for a more connected, sustainable and flexible urban environment.

In the rapidly evolving field of landscape architecture, interdisciplinary collaboration plays a crucial role in driving innovation and pushing the boundaries of digital landscape research. By bringing together experts from different fields such as ecology, urban planning and computer science, new perspectives and approaches can be explored, leading to revolutionary progress in the integration of technology and landscape design.

One of the most prominent examples of interdisciplinary collaboration in digital landscape research is the emergence of geodesy, which integrates geographic information systems (GIS) with landscape design practice. GIS technologies allow designers to analyse and visualise spatial data, providing valuable insights into land use patterns, environmental factors and community dynamics. By combining these tools with design principles, geodesy allows landscape architects to make informed decisions that optimise both functionality and aesthetics.

Through geodesic design, designers can create more sustainable and resilient landscapes by taking into account factors such as water management, energy efficiency and biodiversity conservation. For example, by using GIS data on hydrology and topography, designers can identify optimal locations for stormwater management systems or green infrastructure elements such as rain gardens. This integration of technology and design expertise can improve the efficiency of decision-making processes that take into account both human needs and environmental considerations.

Collaboration with experts from different disciplines is essential to foster innovation in digital landscape research. By working with ecologists, landscape architects can gain a deeper understanding of ecological processes and incorporate ecological principles into their designs. For example, collaboration with ecologists can help identify native plant species that support local biodiversity or address issues related to the management of invasive species.

Urban planners provide valuable insights into the social and urban context of a project. Their knowledge of zoning regulations, transport networks, and public engagement strategies can be the basis for designing digital landscapes that meet the needs and aspirations of the surrounding community.

Computer scientists and data analysts are important partners in digital landscape research. Their expertise in data processing, algorithm development, and artificial intelligence can extend the capabilities of software tools for landscape architecture. For example, machine learning algorithms can analyse large amounts of data to identify patterns and trends, helping designers make data-driven decisions about land use, vegetation placement, and spatial organisation.

A prominent collaboration between landscape architects, ecologists and computer scientists is the restoration of wetlands using digital tools. Wetlands are complex ecosystems that perform important ecological functions, such as water filtration and habitat for a variety of plant and animal species. However, these habitats are often degraded or lost due to human activities.

Through interdisciplinary collaboration, landscape architects can use digital technologies to assess the ecological condition of wetlands, develop restoration strategies, and monitor the success of restoration efforts over time. For example, remote sensing techniques combined with GIS can be used to map the extent of wetlands and identify areas in need of restoration. By integrating ecological modelling software with landscape design tools, designers can simulate different restoration scenarios and evaluate their potential environmental outcomes.

This collaborative approach ensures that wetland restoration projects are not only visually appealing but also ecologically functional. It provides a holistic understanding of wetland ecosystems and promotes sustainable design that takes into account the long-term health and viability of these valuable habitats.

Finally, interdisciplinary collaboration is key to innovation in digital landscape research. By bringing together experts from fields such as ecology, urban planning, and computer science, landscape architects can leverage diverse perspectives and expertise to create more sustainable, resilient, and aesthetically pleasing landscapes. Collaborative approaches, such as geodesy, allow designers to seamlessly integrate

technology into the design process, taking into account environmental principles and social context. Thanks to such collaborations, the field of digital landscape research continues to evolve, pushing the boundaries of what is possible in garden and park design.

Explore the use of key digital tools and techniques in garden and park design.

One of the most prominent examples of the use of digital tools in landscape design is the use of GIS (geographic information systems) software to revitalise abandoned city parks. GIS technology allows landscape architects to analyse and visualise spatial data, enabling them to make informed design decisions based on accurate information. For example, consider an example where an abandoned city park was redeveloped using GIS. The landscape architects used GIS to collect data on the existing features of the park, such as topography, vegetation and infrastructure. By overlaying this data with information about the surrounding area, they were able to identify opportunities for improvement and develop a comprehensive redevelopment plan. In other words, GIS software allows landscape architects to analyse spatial data and make informed design decisions for neglected urban parks.

GIS software also played a crucial role in involving the public in the reconstruction process. Thanks to the interactive maps and visualisations created using GIS, the landscape architects were able to effectively communicate their design proposals to stakeholders and receive feedback. This collaborative approach ensured that the needs and preferences of the community were taken into account in the final design. Digital tools can help transform neglected urban spaces into vibrant, inclusive parks that meet the needs of the community.

Another interesting application of digital tools in landscape design is the integration of classical garden principles with spatial syntax analysis. This approach combines traditional design principles with advanced computational methods to create culturally significant and visually stunning landscapes. For example, Ukrainian classical gardens are known for their harmonious blend of architecture, nature, and symbolism. To preserve and adapt these principles in modern garden design, landscape architects are turning to digital technologies such as spatial syntax analysis.

Spatial syntax analysis is a method that uses computational algorithms to analyse the spatial relationships between different elements of a landscape. By applying this analysis to our classical gardens, landscape architects can gain insight into the underlying design principles and use them as a basis for creating new spaces that honour cultural heritage. For example, by analysing the spatial syntax of a traditional garden, designers can identify key design elements such as axial symmetry, hidden views and water features. They can then incorporate these principles into their digital renderings and physical installations, ensuring that the new design stays true to the essence of classic gardens. By integrating traditional design principles with spatial analysis, landscape architects can create spaces that resonate with both historical significance and contemporary aesthetics.

Finally, these case studies demonstrate the enormous potential of computer-aided design and digital tools in transforming urban spaces and preserving cultural

heritage. By applying GIS software, spatial parsing, and other advanced technologies, landscape architects can revitalise neglected parks and create landscapes that reflect a deep understanding of cultural traditions. Using these digital tools and techniques, designers can open up new possibilities in the design of gardens and parks, shaping the future of these public spaces for generations to come.

Exploring new frontiers in computer-aided design for the green environment.

The future of computer-aided design of garden and park facilities is being shaped by new trends that have great potential. With the development of technology, new horizons are opening up, opening up exciting opportunities for landscape architecture. Two key areas that are set to revolutionise the way we design and create green environments are virtual reality (VR) technology and 3D plant modelling.

Virtual reality technology has already made significant strides in improving user experience in various fields, and its application in landscape architecture holds great promise. Using VR, designers can create immersive experiences that allow stakeholders to virtually explore and interact with proposed garden and park designs. Not only does this facilitate better communication and understanding, but it also allows for real-time feedback and adjustments, resulting in more refined and impressive final designs.

Beyond virtual reality, the promising field of 3D plant modelling is poised to revolutionise landscape architecture. The ability to create detailed digital images of plants and vegetation opens up new possibilities for design research and analysis. With 3D plant modelling, designers can simulate how different species will grow and interact in a given space, making more informed decisions about layout, biodiversity and maintenance requirements.

With the advent of 3D printing technology, the lines between digital design concepts and physical green spaces continue to blur. The ability to materialise complex designs with precision and efficiency opens up a world of possibilities for creating unique elements in hardscapes. From bespoke planters to sculptural landscape elements, 3D printing offers a new way to bring digital designs to physical reality, blurring the lines between virtual visualisation and material realisation.

These advances signal an exciting future in which the lines between digital design concepts and physical green spaces continue to blur. As we explore these new frontiers, the potential for innovation in computer-aided green space design is becoming increasingly limitless.

Balancing technology and environmental sensitivity.

In landscape architecture, it is important to find a balance between the use of technology and care for the environment. In this way, we can create sustainable projects that are both innovative and environmentally friendly. Adopting a hybrid approach means finding a delicate balance between using cutting-edge technology and preserving ecological integrity. Sustainable design is at the heart of this approach, which aims to harmonise human-made structures with the natural environment.

One way to achieve this balance is to design with biodiversity in mind. This means using native plants in both digital renderings and on-site installations. By

incorporating native flora into our projects, we can support local ecosystems, promote biodiversity and reduce the need for intensive maintenance.

This is how we achieve balance in our landscape architecture practice:

1. Holistic sustainability: We prioritise environmental conservation and efficient use of resources in our projects. This means integrating smart technology with ecological principles to create spaces that are not only visually appealing but also environmentally responsible.
2. Integration of local plants: We aim to use native plants whenever possible. They not only contribute to the overall design aesthetic, but also provide habitat and food for local wildlife.
3. Eco-friendly materials: We carefully select materials that have a minimal impact on the environment. This may include using recycled items or local resources to reduce our carbon footprint.
4. Regenerative design: Our goal is not only to minimise negative impacts, but also to actively restore and improve ecosystems through our projects. We want to create landscapes that return to nature.

By striking a balance between technological innovation and environmental sensitivity, we can create spaces that meet the needs of communities while respecting and enriching the natural world around us.

Through sustainable design and a focus on biodiversity, the hybrid approach ensures that modern advances in computer-aided design are used responsibly in the context of landscape architecture.

The future of hardscapes is closely tied to the development of computer-aided design in landscape architecture. As technology continues to evolve, designers must welcome and adapt to these new tools and techniques to stay ahead. It is important to understand the important role that computer-aided design plays in shaping the landscapes of the future. By harnessing the power of cutting-edge technology, we can effectively shape a future in which garden and park facilities not only reflect environmental sensitivity, but also make full use of computer-aided design to create sustainable, exciting and engaging outdoor spaces.

Improving urban landscape design through information fusion.

Urban landscape design plays a crucial role in creating functional and aesthetically pleasing outdoor spaces. Traditional approaches to urban landscape design often rely on manual data integration, which can be time-consuming and inefficient. However, with the development of computer-aided design and information fusion methods, there is a growing trend towards improving urban landscape design by integrating different data sources.

Limitations of traditional approaches. The traditional model of information fusion commonly used in urban landscape design practice involves manually combining data from various sources, such as topographic surveys, environmental assessments, and user preferences. While this approach is widely used, it has a number of limitations:

1. Low efficiency: Manual data integration can be a time-consuming process involving multiple iterations of data collection and analysis. This can lead to delays in the design process and sub-optimal results.
2. Limited data integration: Traditional approaches often struggle to effectively integrate diverse data sets such as spatial, environmental and social data. Lack of effective integration limits the ability to analyse complex relationships and make informed design decisions.
3. Subjectivity: Manual data integration is subject to human bias and subjectivity. Designers may prioritise certain factors over others based on their personal preferences or experience. This can lead to a lack of objectivity in the design process.
4. Inflexibility: Traditional approaches often lack the flexibility to adapt to changing project requirements or incorporate new data sources. This can hinder the adoption of new technologies or the ability to respond to changing design needs.

To overcome the limitations of traditional approaches, a new modular framework is needed that uses computer-aided design techniques and a genetic backpropagation perspective to improve the accuracy and efficiency of data fusion in urban landscape projects.

This new approach involves breaking down the information fusion process into modular components that can be independently analysed and synthesised. Each module focuses on specific data sources and uses computational methods to integrate and analyse the data. The use of a genetic back-propagation perspective allows for iterative optimisation, increasing the accuracy and efficiency of the fusion process.

By adopting a modular framework for information fusion, urban landscape designers can reap significant benefits:

- Increased efficiency. The modular approach allows for parallel data processing, reducing the time required for data integration and analysis. This increases the overall efficiency of the design process.
- Improved data integration. The modular structure facilitates the integration of diverse data sets, allowing designers to analyse complex relationships and make data-driven design decisions. This leads to more comprehensive and holistic design solutions.
- Objective decision-making. Through the use of computational methods, new frameworks reduce subjectivity in the design process. Designers can rely on objective data analysis to make decisions, leading to more objective and scientifically sound design results.
- Flexibility and adaptability: The modular nature of the frameworks allows the flexibility to incorporate new data sources or modify existing modules to adapt to changing project requirements. This ensures that the design process remains flexible and adaptive.

Thus, improving urban landscape design through information fusion is a promising trend that offers significant advantages over traditional approaches. By adopting a new modular framework that uses computer-aided design methods and the perspective of genetic back propagation, designers can overcome the limitations of

manual data integration and create more efficient, integrated and objective urban landscape designs.

In the field of urban landscape design, information fusion plays a crucial role in integrating diverse data sources to inform decision-making. It involves the synthesis and analysis of data from various sensors, databases and expert knowledge to provide actionable insights for designing functional and aesthetically pleasing outdoor spaces. However, traditional approaches to information fusion in landscape design have limitations that hinder their effectiveness and efficiency.

The traditional model of information fusion commonly used in urban landscape design practice often suffers from low efficiency due to its rigid and linear structure. This model usually involves sequential data processing, which can be time-consuming and does not reflect the complexity and interdependencies present in real-world design projects. Furthermore, the traditional model struggles to effectively integrate heterogeneous data types such as images, sensor readings and topographic data, leading to fragmented views and sub-optimal design decisions.

To overcome these limitations, a new modular data fusion model has emerged that uses a genetic backpropagation perspective. This new approach aims to improve the accuracy and efficiency of data fusion in urban landscape projects by introducing principles inspired by genetic algorithms and neural networks.

Key features of the new modular system:

1. Flexible structure. The modular structure moves away from the linear nature of traditional models, adopting a more flexible and adaptive structure.
2. Parallel processing. Allows parallel processing of data streams, enabling simultaneous analysis of several types of data and facilitating the integration of information in real time.
3. Improved speed. The modular approach not only improves the speed of information merging, but also increases the overall consistency and quality of design solutions.

Advantages of the modular system:

- Increased efficiency: by incorporating the principles of genetic backpropagation into the information fusion process, this structure enables iterative learning and optimisation.
- Precision design solutions: uses genetic algorithms to explore a wide range of design possibilities and identify optimal solutions based on predefined goals and constraints.
- Deeper insights: Integrating neural networks enhances pattern recognition capabilities, allowing designers to gain a deeper understanding of complex data sets and make more informed decisions.
- Enhanced collaboration: The benefits of a modular structure go beyond increased efficiency and accuracy. It also facilitates collaboration and interdisciplinary exchange.

Practical examples of the use of modern computer technologies in landscape design.

Sensor image preprocessing plays a crucial role in obtaining an accurate representation of the terrain for designing gardens and parks. By producing high quality data, it enables the creation of accurate digital elevation models (DEMs), which are essential for landscape visualisation software.

An effective approach to preprocessing sensor images is to use the ordered number sequence method. This method provides a seamless integration with the overall design workflow, facilitating the creation of detailed and realistic images of terrain features.

The use of advanced computer technology, such as sensor image preprocessing, has revolutionised the way landscape designers approach terrain representation, offering unprecedented accuracy and detail in digital terrain models. This technological advancement has greatly increased the accuracy and visual fidelity of 3D garden landscapes, allowing designers to create immersive and realistic virtual environments that accurately reflect real landscapes.

The use of sensor image preprocessing is an example of the successful integration of artificial parallax assistance mechanisms that allow designers to achieve an enhanced sense of depth and perspective in digital images of garden landscapes. Through careful data collection and processing, this advanced technology contributes to the creation of compelling and engaging visual experiences, enhancing the overall quality of landscape design projects.

By using advanced computer technology and sensor image pre-processing to accurately map the terrain, landscape architects can overcome traditional limitations and open up new possibilities for creating exciting and realistic garden and park facilities.

Another area is the use of computational intelligence for optimal design solutions. In the field of landscape architecture, the use of computational intelligence is becoming increasingly important to facilitate informed decision-making and optimise design solutions. Two key aspects that contribute to this are neural networks and parallel data processing mechanisms. By using these technologies, landscape architects can improve their pattern recognition capabilities, interpret data more efficiently, and process large volumes of heterogeneous data during the design analysis phase.

Neural networks are computational models inspired by the neural structure of the human brain. They consist of interconnected nodes (or neurons) that process and transmit information. When applied to landscape architecture, neural networks can significantly improve pattern recognition and data interpretation capabilities, enabling landscape architects to make more informed decisions.

For example, in the context of information fusion in landscape architecture projects, neural networks can be used to solve the following tasks:

1. Analysing and interpreting complex data sets such as sensor data, climate conditions, or user preferences.

2. Identify patterns and relationships in data that may not be obvious to human designers.

3. Recognising specific features or characteristics that contribute to a successful design outcome.

Neural networks also have the ability to adapt and learn from new data. This means that as landscape architects input more information into the neural network, its performance improves over time. This adaptive nature makes neural networks a powerful tool for continuously improving design decisions based on real-time feedback and changing project requirements.

In addition to neural networks, parallel processing mechanisms play a crucial role in processing large volumes of heterogeneous data during the design analysis phase. Parallel processing refers to the simultaneous execution of multiple tasks or instructions on multiple processors or computing cores.

Landscape architecture projects involve a huge amount of data that needs to be processed efficiently. This includes geospatial data, environmental data, topographic data, etc. Parallel processing allows landscape architects to:

- Split these data sets into smaller subsets and process them simultaneously.
- Significantly reduce the time required for data analysis and increase the overall efficiency of the design process.
- Strengthen cooperation between interdisciplinary teams working on a landscape architecture project.

By distributing tasks across multiple processors or computing cores, different team members can work on different aspects of a project simultaneously. This parallelisation of tasks allows for faster decision-making, increases productivity, and ensures that all the necessary data is taken into account in the design process.

Another powerful computational tool for optimising design solutions in landscape architecture is the genetic algorithm for encoding real numbers. This algorithm uses genetic algorithms that are inspired by natural selection and evolutionary processes.

The genetic algorithm for coding real numbers optimises the configuration of modular elements in garden landscapes. It uses a combination of real numbers and genetic operators (such as mutation and crossover) to iteratively generate new solutions. By evaluating these solutions based on predefined matching criteria (e.g., functional efficiency and aesthetic consistency), the algorithm gradually approaches the optimal design solution.

This approach allows landscape architects to do just that:

1. Create responsive and flexible designs that can respond to changing user needs and site conditions.

2. Consider a wider range of design possibilities and systematically explore the design space.

3. To find innovative solutions that combine functionality, aesthetics and environmental friendliness.

Hence, the use of computational intelligence through neural networks, parallel processing mechanisms and genetic algorithms enables landscape architects to make

more informed decisions, efficiently process large amounts of data and optimise design solutions. These technologies enhance the ability to recognise patterns, interpret complex data sets, facilitate collaboration between multidisciplinary teams, and enable adaptive design. By using these computational tools responsibly and integrating them with ecological principles and human-centred design strategies, landscape architects can create truly successful garden and park spaces that enrich the lives of users and contribute to the well-being of the environment.

As we look to the future of landscape design, it is clear that the use of the latest technologies will play a key role in shaping the landscape architecture industry. The integration of computer-aided design tools, virtual reality platforms and information technology is set to fundamentally change the way we conceptualise, plan and implement landscape architecture.

Key trends for the future.

1. Integration of virtual reality. The seamless integration of virtual reality technology into the landscape design process will allow you to create multidimensional compositions of spaces, creating an immersive experience for both users and designers.

2. Real-time design modification. With the use of advanced computer-aided design tools, real-time modelling and interactive features, designers will be able to change and improve design schemes on the go, allowing for greater creativity and flexibility.

3. Sustainable design solutions. New technologies will facilitate the introduction of sustainable design practices, such as rainwater harvesting systems and environmentally friendly soil solutions, which will contribute to the environmentally conscious design of gardens and parks.

The prospects for computer-aided design in landscape architecture are endless. By using these technological advances responsibly, landscape architects can create innovative, sustainable and visually appealing outdoor spaces that blend harmoniously with their natural surroundings. As we move forward, a balanced approach that combines computational tools with ecological principles and human-centred design strategies will be crucial to creating hardscapes that enrich lives and make a positive contribution to the environment.

One of the key takeaways is the importance of staying at the forefront of technological progress. By using these tools responsibly, landscape architects can create sustainable and innovative design solutions. However, it is crucial to maintain a balanced approach that combines computational tools with ecological principles and human-centred design strategies.

Advantages of computer-aided design in gardening.

There are many advantages to using computer-aided design in landscape gardening:

1. Accurate data integration. Data fusion models improve the accuracy and efficiency of design projects.

2. High-quality data collection. Advanced computer technology enables designers to collect high-quality data and make informed decisions during the design process.

3. Optimisation of modular elements. The power of computational intelligence allows designers to optimise modular elements for optimal design solutions, ensuring both functional efficiency and aesthetic coherence in the overall composition.

Looking to the future, it is clear that new technologies will continue to shape the field of landscape architecture:

- Virtual reality technology that provides an immersive experience by integrating sight, hearing and touch into virtual landscapes.
- A computer rendering technology that allows you to create realistic visual effects and improves communication between owners and designers.

By using computer-aided design trends in garden and park facilities, landscape architects can create spaces that not only enrich the lives of users but also contribute to the well-being of the environment. Continuous study and application of these technologies will pave the way for sustainable and innovative design solutions in landscape architecture. With the development of virtual reality, landscape architects can now create immersive experiences for clients, allowing them to walk through future gardens and parks before construction even begins. This not only helps to accurately visualise the design, but also enables clients to provide feedback and make informed decisions during the design phase.

The future of computer-aided design for gardens and parks.

Computer-aided design (CAD) has redefined the way architects and designers create and visualise structures. From buildings to green spaces, CAD has become an integral part of the design process. However, its potential in the field of gardens and parks remains largely untapped. As society becomes more urbanised, the need for well-designed green spaces has never been greater.

CAD software enables designers to create accurate and faithful representations of garden and park plans. It allows you to measure and manipulate space, ensuring that every detail is well thought out and optimised. Designers can experiment with different layouts, paths and elements, refining their vision before construction begins. This level of precision in spatial planning ultimately results in well-organised and efficient gardening projects.

CAD allows designers to create stunning visual representations of garden and park designs, demonstrating the potential of a space before any physical work is done. Through the use of 3D modelling and rendering techniques, CAD software brings designs to life, allowing stakeholders to visualise the end result. This visualisation aspect is invaluable in communicating the design intent to clients, community members and decision makers, gaining support and ensuring that everyone is on the same page.

Given the vast number of plant species, selecting and placing plants in a garden or park can be a daunting task. CAD software can simplify this process by providing databases of plant species with their growth characteristics, care needs

and aesthetic qualities. By simulating the growth and interaction of different plant species in a virtual environment, designers can make informed decisions about the most appropriate plants for a given space, ensuring optimal biodiversity and aesthetic appeal.

In an era of climate change and growing environmental awareness, it is essential to design sustainable and resilient gardens and parks. CAD software can incorporate climate data and simulation models to analyse the effects of solar radiation, wind patterns and water runoff. This allows designers to optimise the placement of trees, structures and water features to maximise shade, minimise water use and reduce the urban heat island effect. By integrating sustainability considerations into the design process, CAD greatly contributes to the creation of environmentally conscious green spaces.

CAD facilitates an iterative design process, allowing designers to improve garden and park designs through successive iterations. With CAD, designers can easily modify and experiment with different design elements, materials and layouts. In addition, CAD platforms support collaboration between designers, landscape architects and other stakeholders by providing a centralised platform for sharing and reviewing design iterations. This collaborative approach improves communication, speeds up decision-making and leads to more cohesive and successful garden and park projects.

The future of computer-aided garden and park design has the potential to revolutionise the way we create and use green spaces in urban environments. With precise spatial planning, visualisation capabilities, optimised plant selection and placement, climate consideration and collaborative design, CAD software enables designers to create sustainable, vibrant and functional gardens and parks. As technology advances, we can expect CAD to become an indispensable tool in the hands of landscape architects, helping to create and preserve well-designed green spaces for future generations.

Evolution of garden landscape design methods.

The design of gardens and park facilities has changed significantly over the years thanks to technology. Limitations of traditional 3D simulation methods:

- Lack of realism: Handmade models and handwritten plans often did not accurately show what the gardens would look like in real life. They could not convey details such as textures, lighting effects and spatial relationships between elements.
- Limited interaction: With traditional 3D simulation methods, designers could not easily explore different design options or make changes in real time. This made it difficult to assess how design choices would affect the overall composition and functionality of the garden spaces.

Due to these limitations, there was a need for better tools that would provide a more immersive and interactive design experience.

Virtual simulation technology has changed the rules in garden landscape design. With the use of digital technology, multimedia, virtual reality and networking, designers have been able to create more realistic and dynamic project models.

With the use of virtual simulation technology, designers can:

- Create detailed and realistic representations of garden landscapes.
- Use specialised software such as AutoCAD to accurately analyse the site and estimate flow rates.
- Present your projects with multimedia presentations and virtual reality simulations.

With the help of virtual simulation technology, designers can overcome the limitations of traditional 3D simulation methods and improve their ability to create functional and beautiful outdoor spaces.

This shift from traditional 3D simulation to virtual simulation technology has opened up new possibilities for garden landscape design. Virtual simulation technology has significantly changed the landscape architecture industry, offering innovative solutions to traditional design methods.

Innovative tools for park design.

In modern garden and park design, a variety of digital tools and technologies are changing the way we plan, visualise and create outdoor spaces. These tools help landscape architects to be more creative, efficient and collaborative in their work. The following are the key technologies that will shape the future of garden and park design:

Multimedia presentations. Multimedia presentations are an essential element in explaining design concepts to clients, stakeholders and the public. By combining different types of media, such as images, video and interactive elements, designers can create engaging presentations that effectively communicate their vision for a garden or park space.

Virtual reality simulations. Virtual reality (VR) simulations have become an inexhaustible source of realistic experience for clients and designers before any construction project. With VR technology, stakeholders can explore and interact with virtual environments, gaining a better understanding of how the space will look and feel.

Network communication technology. The ability to easily exchange information and ideas is made possible by network communication technology. This allows landscape architects to collaborate with teams from different industries, share real-time design options and receive feedback from experts from anywhere in the world. This connectivity improves collaboration and fosters innovation.

Scientific tools. By using scientific tools such as geographic information systems (GIS), environmental modelling software and climate analysis platforms, designers can make informed decisions about factors such as site suitability, environmental impact and sustainable resource management. These tools help create environmentally conscious projects.

Technological tools. Advanced software for parametric modelling, 3D rendering and digital sculpting allows you to accurately visualise complex shapes, organic structures and detailed landscape elements.

The use of tools in garden design:

- Semi-regular textures - these textures provide a structured basis for displaying the dynamics of flow in a garden space. By integrating semi-regular

textures, designers can visualise the interaction of elements such as paths, water features and plants with the natural flow of the space.

- Deformation matrices - the use of deformation matrices allows for the manipulation and transformation of visual elements in garden design. This innovative approach allows designers to experiment with different configurations and evaluate their impact on the overall flow and aesthetics of the landscape.

Advantages of flow visualization:

- Enhanced spatial understanding - Flow visualisation allows designers to gain a deeper understanding of the spatial relationships in the garden environment. By visualising how elements interact and influence each other, designers can make informed decisions that optimise both functionality and aesthetics.
- Real-time analysis - the dynamic nature of flow visualisation allows for real-time design analysis. Designers can quickly evaluate different scenarios and improve their designs based on instant feedback, leading to more efficient decision-making processes.

With the help of advanced techniques such as flow visualisation, landscape architects can improve the quality of their design process, resulting in the creation of thoughtful and engaging spatial experiences in garden and park facilities. This is defining an exciting shift towards more dynamic and responsive approaches to garden design, where technology is becoming a means of fostering creativity and innovation. By continually pushing the boundaries of what is possible with computer-aided landscape architecture, these trends will undoubtedly shape the future of gardens and public parks, providing new opportunities to create sustainable and engaging environments.

The integration of advanced drawing techniques into landscape animation has opened up new possibilities for designers. They can now create immersive animations that provide clients with a realistic preview of their future garden or park. These animations can showcase a variety of design elements, such as paths, water features, plant arrangements and lighting effects. All of these design elements can be presented in visually appealing images, thanks to advanced drawing techniques.

In addition, the use of advanced rendering technologies can greatly enhance the realism of these animations. For example, realistic lighting effects can be simulated to reflect how a garden or park will look at different times of day and in different weather conditions. Textures and materials can also be applied to objects to create a more painterly representation of the final design.

Advanced drawing techniques have transformed landscape animation, allowing designers to create more dynamic and expressive images of gardens and parks. The integration of technologies such as OpenGL and contour line generation has improved the realism and visual appeal of these animations. The ability to showcase complex details, simulate lighting effects and depict changes in elevation allows landscape animations to provide clients with a compelling preview of their future outdoor space.

Virtual simulation technology has proven to be indispensable in optimising the installation and maintenance of garden lighting systems, especially in situations where medium voltage operation is required without power outages. This application of

virtual simulation demonstrates the clear benefits of integrating advanced technology into outdoor design.

Also in the field of garden landscape design, various methods of rational judgement play a significant role in guiding the decision-making process. The main methods of rational judgement in garden landscape design include:

1. Judgement method based on weighted average theory. This approach involves assigning weights to different criteria based on their relative importance, which allows for a comprehensive evaluation of design elements. By calculating a weighted average of these criteria, designers can make informed decisions that address both aesthetic and functional aspects.
2. The network projection method of judgement. Using the network projection judgement method involves analysing the complex relationships in a garden landscape design. This method takes into account the complex relationships between different elements, such as vegetation, paths and focal points, to assess the overall coherence and visual harmony of the outdoor space.
3. Deep Learning Judgement Method. Deep Learning Judgement explores advanced computational technologies to predict and evaluate the long-term impact of design choices on sustainability and ecological balance. Using deep learning models and data from analytics, designers can assess the environmental impact of their decisions, ensuring responsible and sustainable development.

The use of these rational judgement techniques not only improves the accuracy of computer-aided garden design, but also highlights the importance of the human mind in creating outdoor spaces that harmoniously combine technological innovation with practicality and sustainability.

Integration of digital tools for integrated design solutions.

The integration of Autocad with other digital tools allows landscape architects to create integrated solutions that take into account various aspects of public park design. The most famous examples of these tools include:

- 3D modelling software that allows you to visualise proposed projects and conduct virtual walks.
- Geographic information systems (GIS) for spatial mapping and analysis of environmental factors.
- Rendering software that allows you to create realistic images and videos of the proposed park design.

By combining the strengths of each tool, designers can improve the efficiency and accuracy of the design process while enriching their understanding of the potential of a place. This integrated approach also fosters collaboration between the multidisciplinary teams involved in public space renewal projects, such as architects, engineers and urban planners.

Through the use of Autocad and other advanced design technologies, landscape architects can bring public spaces to life with the help of:

- careful planning that takes into account the unique characteristics and needs of the local community;

- resource management practices aimed at preserving nature and minimising environmental impact;
- attractive outdoor environments that promote physical activity, social interaction and contact with nature.

In general, this comprehensive approach to the design of public parks is aimed at creating inclusive spaces that contribute to the well-being and quality of life of residents of all ages and social strata of society.

Future directions of expanding the boundaries of computer support for the design of gardens and parks.

The field of computer-aided design for gardens and public parks is constantly evolving, driven by advances in technology and the need for more efficient and sustainable solutions. Looking to the future, we can identify some interesting trends and innovations that are likely to shape the way we design and experience open spaces:

- AI-assisted plant selection algorithms: With the help of artificial intelligence, designers can quickly and accurately select plants that are well suited to specific environmental conditions. These algorithms can take into account factors such as soil type, sunlight exposure, and climate data to create optimal plant palettes that thrive in their environment.
- By combining technological innovation with sustainable design practices, we can create garden and park structures that are not only visually appealing, but also environmentally sound and socially relevant. These advances have the potential to revolutionise the way we design and experience outdoor spaces, providing us with more efficient, engaging and sustainable landscapes.

- As this industry continues to evolve, it is important for designers and landscape architects to keep up to date with the latest trends in computer-aided design for garden and park facilities. By introducing new technologies and experimenting with innovative approaches, we can push the boundaries of what is possible in landscape architecture and create outdoor spaces that inspire and delight.

As we move forward, it's important for designers and enthusiasts to stay up to date with the latest advances in computer-aided design for gardens and parks. By experimenting with new technologies, we can push the boundaries of creativity and create truly immersive experiences for users. However, in the midst of all the technological innovation, it is important to keep in mind the timeless aspects of nature-inspired aesthetics and community needs. While technology can enhance our design processes, it should not obscure the basic principles of sustainable design and environmental conservation. We should use technology as a powerful tool that can enhance our creativity and efficiency. By staying informed about trends in computer-aided garden and park design, we can make informed decisions about how to incorporate technology into our projects. Nature has always been the greatest source of inspiration for designers throughout history, and it continues to provide valuable lessons in aesthetics, functionality and sustainability.

The success of any landscape design project depends on its ability to coexist harmoniously with nature and the environment. Technology can be a powerful tool in achieving this harmony, but it must be used wisely and with respect for nature. It is important to preserve what makes our world unique and wonderful and work with it, not against it.

REFERENCES

1. Aijun Jia, "Intelligent Garden Planning and Design Based on Agricultural Internet of Things", Complexity, vol. 2021, Article ID 9970160, 10 pages, 2021. https://doi.org/10.1155/2021/9970160
2. Peiye Xu, Chao Wei, "Modularized Information Fusion Design of Urban Garden Landscape in Big Data Background", Mathematical Problems in Engineering, vol. 2022, Article ID 5377872, 9 pages, 2022. https://doi.org/10.1155/2022/5377872
3. Ping Gong, Jiangxiao Li, "Application of Computer 3D Modeling Technology in Modern Garden Ecological Landscape Simulation Design", Security and Communication Networks, vol. 2022, Article ID 7646452, 8 pages, 2022. https://doi.org/10.1155/2022/7646452
4. Viunenko Oleksandr. Modern trends in computer design of garden and park objects: Technologies of the XXI century: coll. theses based on the materials of the 29th International Science-Pract. conf. (November 20-22, 2023). Part 1. Sumy: SNAU, 2023. P.89-90.
5. Xuanfeng Zhang, Song Yan, Quan Qi, "Virtual Reality Design and Realization of Interactive Garden Landscape", Complexity, vol. 2021, Article ID 6083655, 10 pages, 2021. https://doi.org/10.1155/2021/6083655
6. Zhiyong Tian, "Application of Computer 3D Modeling Technology in the Simulation Design of Modern Garden Ecological Landscape", Mathematical Problems in Engineering, vol. 2022, Article ID 7033261, 9 pages, 2022. https://doi.org/10.1155/2022/7033261
7. Yuchen Bai, "[Retracted] Sustainable Development Garden Landscape Design Based on Data Mining and Virtual Reality", Journal of Electrical and Computer Engineering, vol. 2022, Article ID 3726801, 10 pages, 2022. https://doi.org/10.1155/2022/3726801