УДК 621.7.072

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3D-ПЕЧАТЬ В МЕДИЦИНЕ

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В данной статье исследуются последние тенденции развития технологий биопечати. Основное внимание в работе авторы акцентируют на самом процессе печати на 3D-сканере и 3D-принтере и возможностях их применения в настоящем времени и будущем.

Ключевые слова: биопечать, аддитивные технологии, биофабрикация, 3D-сканеры, полигональное моделирование, трехмерное изображение, прототипирование, имплантаты.

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3D-PRINTING IN MEDICINE

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This article explores the latest trends in the development of bioprinting technologies. The authors focus their work on the process of printing on a 3D scanner and 3D printer and the possibilities of their use in the present and future.

Key words: bioprinting, additive technologies, biofabrication, 3D scanners, polygonal modeling, three-dimensional image, prototyping, implants.

Bioprinting is an innovative field in the realm of medical advancements, emerging as a result of the rapid progress in additive technologies. This cutting-edge technique involves the intricate layer-by-layer construction of solid models using biological materials. Within the realm of medicine, bioprinting is categorized into two main groups: 3D printing with non-living materials like plastics and metals, and 3D cell bioprinting, encompassing four distinct directions with varying levels of complexity and outcomes. These include biofabrication of flat elements such as skin, vessels like veins and arteries, hollow organs like the bladder, and internal bulk organs such as the liver, kidney, and spleen.

The diversity of 3D scanners is vast, with variations in their scope of application, size, shape, and underlying technologies. These advanced devices find utility across industrial, domestic, and medical settings. Noteworthy among them is the ultrasonic 3D scanner, hailed as a valuable asset for modern medical practices. Equipped with energy, color, tissue, continuous-wave, and pulsed Doppler capabilities, this scanner boasts exceptional resolution, making it indispensable in fields like mammology, obstetrics, urology, vascular and muscular studies, echocardiography, neonatology, and pediatrics.

The aim

The aim of this study is to delve into the realm of bioprinting, an emerging trend in the field of medicine. Additionally, the research seeks to explore and demonstrate the functionality of both a 3D printer and 3D scanner in practical applications.

Material and methods

3D scanning, also known as three-dimensional scanning, involves the digitization of physical objects or products into a digital form, thus creating a comprehensive three-dimensional computer model. This technological process eliminates the need for manual labor, manual drawings, or calculations on paper. The 3D scanner employs laser illumination to gather information about the surface of the scanned object, generating a cloud of millions of points that form a polygonal model. Subsequently, these points are stitched together by the scanner's software to create a unified object. During the scanning process, various noises and irregularities may arise, which are addressed through software processing to obtain a printable three-dimensional image. When initiating the printing process, the printer reads a 3D print file containing model data and fabricates the object by layering liquid material, eventually forming a solid three-dimensional model.

Results and discussion

Various bioprinters are currently being manufactured worldwide, catering to a diverse array of medical applications. While prototyping and organ imaging have become prevalent in research and teaching, the replication of human organs with living cells, a hallmark of bioprinting, remains an evolving frontier. The applications of 3D printers in medicine are expanding rapidly, encompassing the development of musculoskeletal substitutes, dental prosthetics, and even bioengineered kidneys capable of sustaining function over a defined period. This technology has facilitated the fabrication of viable tissues for research purposes and the creation of commercial kidney tissue for pharmaceutical studies. The possibilities of bioprinting continue to evolve, offering promising avenues for medical advancements.

Bioengineers have successfully utilized 3D printing to create functional kidneys that have maintained their capabilities for a period of two weeks. Additionally, they have developed commercial kidney tissue known as exVive3D tissue, which is available for purchase by pharmacists for the exploration of potential medical compounds. The 3D Hub service provides users with the opportunity to access 3D technology for a fee, eliminating the need to invest in their own devices. An analysis conducted by the community owner based on data from 1163 3D printers within the network was recently published. The findings reveal that the most prevalent models include Ultimaker (204 units - 20.5%), Makerbots (198 units - 19.9%), and RepRap (109 units - 11%), collectively representing over half of the utilized devices.

Conclusion

In conclusion, 3D printing is a promising direction with great potential. Key advantages of this technology include its speed, versatility, and reduced labor intensity, effectively streamlining production processes. The creative freedom afforded by 3D printing allows for the fabrication of virtually any object designed in a program. Furthermore, the diversity of materials available for printing extends beyond plastics and metals to encompass living cells and even food products, revolutionizing manufacturing possibilities. Ease of use, cost-effectiveness, minimal error rates, and the application of 3D printing in fields like medicine highlight its transformative impact.

Despite its numerous benefits, 3D printing does face certain drawbacks. Challenges such as visible layer boundaries resulting in rough surfaces, size constraints, initial high costs, and ethical concerns like the potential for weapon production present hurdles to widespread adoption. However, the future of medicine holds immense promise with the integration of 3D printing technologies. Envision a world where diagnostics and prosthetics are seamlessly revolutionized by these innovations. It may not be long before individuals can effortlessly download and print models at home, much like the process of accessing digital media today. Who knows, in the near future, a 3D-printed human heart or stomach could become a reality, signaling the transformative potential of this groundbreaking technology.

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