

Universidades Lusíada

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Innovative ideas an architecture, digital technologies & energy

<http://hdl.handle.net/11067/7594>

<https://doi.org/10.34628/A2PB-C025>

Metadados

Data de Publicação

2024

Resumo

Technologies developed with Industry 4.0 have started to affect people's daily lives for the first time outside the industry. In particular, two technologies, the Internet of Things (IoT) and the concept of artificial intelligence, have paved the way for the smart home life model with many devices and applications used in our daily lives. And this is the beginning of a new era of high-speed internet with its expanding application possibilities. While rapidly increas ing technological forms incre...

Palavras Chave

Arquitectura - Inovações tecnológicas, Inteligência artificial, Internet das coisas, Hidrogénio com combustível

Tipo

article

Revisão de Pares

Não

Coleções

[ILID-CITAD] Contribuições em livros

Esta página foi gerada automaticamente em 2026-10-30T02:05:40Z com informação proveniente do Repositório



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INNOVATIVE IDEAS ON ARCHITECTURE, DIGITAL TECNOLOGIES AND ENERGY

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Abstract: Technologies developed with Industry 4.0 have started to affect people's daily lives for the first time outside the industry. In particular, two technologies, the Internet of Things (IoT) and the concept of artificial intelligence, have paved the way for the smart home life model with many devices and applications used in our daily lives. And this is the beginning of a new era of high-speed internet with its expanding application possibilities. While rapidly increasing technological forms increased virtual living opportunities, they also created a need for new volumes in buildings. This development of technology has made the sustainability concerns and new life models more debatable. The green hydrogen concept added to renewable energy sources in today's climate problems has also increased the chance of providing a more valuable life. Buildings now required to be in environmentally friendly and sustainable forms, in which new excitements are embraced. In addition to the new technological materials added to the traditional perspectives in architecture, it is now a necessity to use new technology and energy-oriented opportunities.

Keywords: Industry 4.0; Internet of things; Artificial Intelligence; Green hydrogen; Architecture.

1. Introduction

In the 21st century, with the continuous development and renewal of digital technologies, their becoming more visible in daily life and their widespread use, a unique culture created by the whole world through technology has emerged. Although it brings different cultures together in common values, it also contains a spirit that reveals the power of free thought. Especially with the emergence of the internet, digitalization has started in every field, and with mobile technologies, the digital culture of humanity has become an inseparable part of life. Digital culture is defined as a new way of life and approach that emerges and develops with digital technologies. Now our life began to develop in two directions. Our real life and our digital life. Both are important to us now, and the issue of the limits of digital life is now moving towards a more debatable level. Digital life offers us different life opportunities. The sine qua non of both lives is the commitment and need for energy. All kind of life is dependent on energy. The sustainable placement of energy in our lives is an important fact. The new normal that has emerged with the pandemic period requires more digital life and the ability to solve problems together.

2. Energy of Life

Energy resources usage areas have increased their diversity in parallel with the development of technology and science. The concept of energy and the development of industry are two interdependent variables, and they have provided the development of societies in the field of industry and increased the amount of energy use. With the Industrial Revolution, there has been a rapid progress towards becoming an information society. The concept of industry has evolved. Humanity has used the acquired knowledge and technological developments in the field of industry in order to facilitate daily life and increase their welfare level. As Figure 1 shows, an estimated 8 out of every 10 people living on Earth will live in Asia or Africa by 2100 (Roser, 2019).

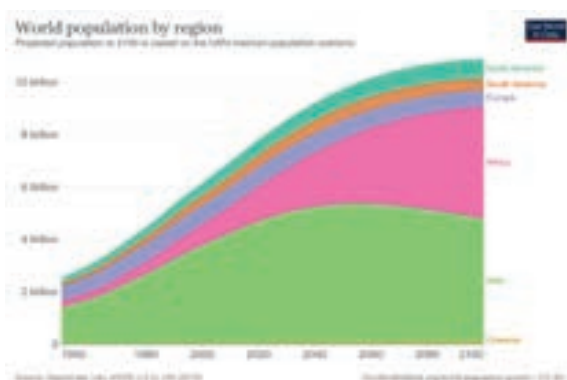


Figure 1. Population growth by world region (Roser, 2019).

Although the energy consumption of industrially developed countries with a high per capita income remains stable with a certain percentage of their population, the situation in the poor and developing countries of the world is in the direction of an increase in consumption. And this increase, as seen in Figure 2, is generally used with old fossil sources and high pollutant dose (Ritchie and Roser, 2020).

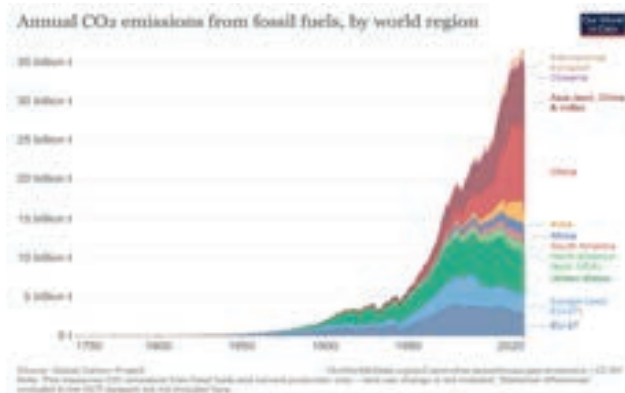


Figure 2. Carbon dioxide (CO₂) emissions, measured regionally in tons, based on annual production (Ritchie and Roser, 2020).

As a result of the continuous increase in the economic and social demand for energy, the high carbon content in coal, oil and gas has caused ecological and environmental problems. In Figure 3, the problem is more clearly understood when we look at our electricity generation resources up to date (Roser, 2020).

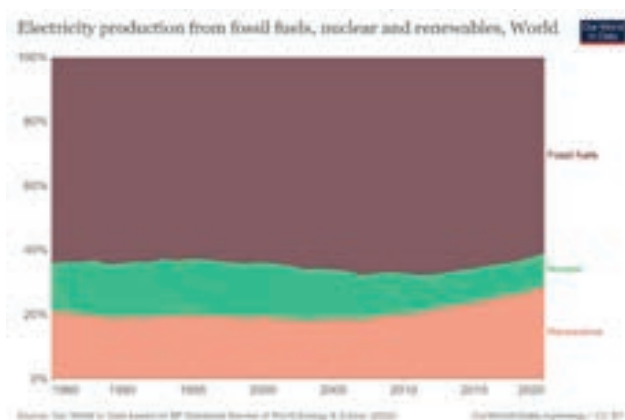


Figure 3. The rate of electricity generation in the world from 1985 to 2020 depending on which sources (Roser, 2020).

The demand for a new energy source as natural gas and clean energy sources has emerged, and the use of renewable energy sources that will not cause ecological environmental problems will take the first place in the use of energy sources in the future. The climate negotiations, which started with the Rio Summit in 1992, finally resulted in the Paris Agreement, a global agreement, at the end of 2015. The content of the Paris Agreement, which has been accepted by 196 countries today, is scientifically based, dynamic, and its long-term goals aiming to zero greenhouse gas emissions by the other half of this century are presented in Figure 4 as summarized in the table (Roser, 2020).



Figure 4. Paris climate agreement roadmap (Roser, 2020).

However, it is important to understand that renewable energy sources will play a vital role in the coming period. Trends towards reducing carbon emissions reflect the claim that power plants and motor vehicles will run on hydrogen in the near future. Most of the economies that emerge in such a situation would be referred to as the hydrogen economy. Problems that include climate change, environmental pollution, noise and population growth can end with the hydrogen solution. In the short term, although hydrogen production will rely on fossil fuels, especially natural gas due to existing pipelines and pipelines under construction, in the future there will be green hydrogen production using renewable energy sources. Here, developments are still needed for a stable, sustainable, and economical system model. Apart from renewable energy sources in buildings, hydrogen storage areas or new generation end-user distribution lines will be needed for green hydrogen systems.

In 2015, at the New York UN General Assembly, 2030 sustainable development goals were determined under 17 goals. In the 7th goal, it is aimed to provide accessible, reliable, sustainable and modern energy for everyone. By 2030, ensuring universal access to accessible, reliable and contemporary energy services, significantly increasing the share of renewable energy in the global energy

mix, doubling the rate of global improvement in energy efficiency, will include renewable energy, energy efficiency and advanced and cleaner fossil fuel technologies. Developing international cooperation and supporting investments in energy infrastructure and clean energy technologies to facilitate access to clean energy research and technologies and developing infrastructure to provide modern and sustainable energy services to all in all developing countries, particularly the least developed countries and small island developing states, and It has sub-titles such as upgrading technology. While the 11th goal of the Sustainable Development Goals, on making cities and human settlements inclusive, safe, resilient and sustainable, emphasizes the sustainability of buildings, 13 goals require urgent action to combat climate change and its effects. In addition, the UN Secretary-General António Guterres, with great will, has clearly stated the seriousness of the issue on all platforms in many of his statements and talked about the importance of energy policies to the peoples of the world's countries (*UN chief warns against 'sleepwalking to climate catastrophe'* | | *UN News*, 2022). However, in the annual survey studies of the World Economic Forum, environmental problems have emerged as the most important topics to be solved in the last few years (*Chapter 1. Global Risks 2022: Worlds Apart - Global Risks Report 2022* | *World Economic Forum*, 2022). Figure 5 shows a list of topics that may cause problems on a global scale in the next 10 years.



Figure 5. Topics that could create a global crisis for the next 10 years (*Chapter 1. Global Risks 2022: Worlds Apart - Global Risks Report 2022* | *World Economic Forum*, 2022)

Despite all these experiences, our world has not reached a significant positive point with its increasing population and energy consumption values. It still uses polluting sources at a similar rate, as determined in Figure 6 ((REN21) *et al.*, 2021).

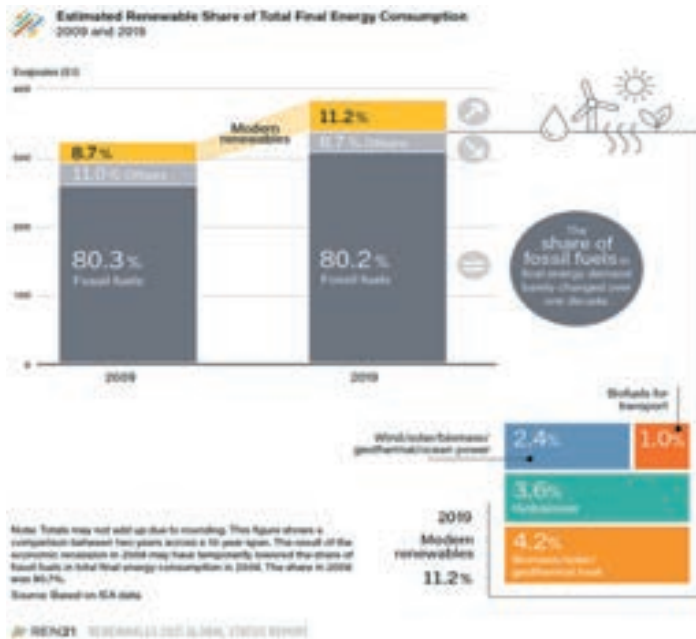


Figure 6. World energy resource usage rate and change between 2009 and 2019 ((REN21) *et al.*, 2021)

Although the share of renewable energy is still below 15%, renewable energy continued to be the fastest growing energy source for buildings, increasing by an average of 4.1% annually between 2009 and 2019. The highest growth was in electricity use, while heating with renewable energy increased more slowly. Modern bioenergy (such as the use of wood-based fuel in efficient stoves) still represented the largest renewable source in the building sector, particularly in providing heat, although its growth was roughly stagnant ((REN21) *et al.*, 2021). For this reason, it is necessary to design buildings according to the type and variety of energy sources in terms of architecture.

The way to reduce the energy problem, which is one of the biggest problems of our age, is to save energy, use energy efficiently and obtain energy from clean sources. Today, there are many studies on renewable energy sources. Hydrogen energy production systems have emerged as an alternative to some of the weaknesses among renewable energy sources. Hydrogen, as an energy carrier, creates a potential for solving these problems. For this reason, intensive research and development activities on hydrogen energy have been carried out in recent years. Hydrogen energy is created through a production process represented by different colors. It is classified as gray hydrogen produced by fossil fuels, blue hydrogen produced by natural gas, and green hydrogen produced by renewable energy. Green hydrogen is seen as an opportunity both to fulfill the commitments of the Paris Climate Agreement and to solve the energy

problem in the world. For a future where clean and renewable energy sourced hydrogen energy will meet the world's increasing energy needs, developed countries are also carrying out large-scale technological research and development programs intensively.

3. Digital Technologies in Life

The increase in the use of technology in almost every field around the world causes the rapid changes experienced not only to change the living conditions of individuals but also societies. At this point, new technologies brought to society by the industry 4.0 revolution can be fought in the fight against the climate crisis and in solving its problems. Even though our lives have changed markedly with technology, these new experiences will be faster, smaller, smarter, more efficient, greener, more connected, and more sensible. With the facilitation of communication and transportation opportunities, easier movement between locations has been provided. This reveals the lives that are competing with time and trying to fulfill many responsibilities in a limited time in order to survive in cities with more job opportunities. Smart technologies are used in the management of this process, and the concept of smart cities has emerged by developing applications for both city applications and those living in the city. Smart cities are cities where the technological systems (especially advanced information technologies) needed to overcome the problems in daily life in the city are used, and it includes the technology-oriented modeling or transformation of the city with architects and urban planners. In this way, it aims to create spaces that are sustainable, where existing resources are used effectively, have low carbon emissions or not, where negative environmental effects can be minimized, and the living standards of the urban population are improved. By analyzing real-time data collected through information-based technologies, service infrastructures will be operated effectively, and it will be possible for the urban population to obtain information and plan.

Preferring to use technology and innovation for the long-term, permanent and effective solution of vital problems such as energy use, cleaning or recycling of wastes, reducing carbon footprints in cities where the population is concentrated will affect the future assets and forms of existence of cities.

Along with the concept of sustainable development, new concepts such as environmentally friendly building, green building and smart building have emerged. Green building is used in the sense of environmentally friendly and ecological. It is defined as environmentally sensitive sustainable buildings that are designed considering social and environmental factors, that use materials that consume efficiently, consume renewable energy resources, and keep waste generation to a minimum within the climatic conditions of the location and conditions specific to that location. Therefore, green buildings have some financial advantages that standard buildings cannot provide. For example, green buildings save energy and water, lower operating and maintenance costs, and reduce waste.

For this reason, in terms of architecture, it will be the most important value to use recyclable materials that benefit from the benefits of digital technologies in their designs, take measures to conserve the energy that will be spent throughout the life cycle in the design and construction stages, and bear the responsibility of using recyclable materials that do not harm the environment and human health.

It aims to reduce the negative impact of the construction industry on the environment and to help a more sustainable development by adding BEM (Building Energy Modeling) software, which provides many tools and convenience, in addition to BIM (Building Information Modeling) programs, which are modern technology software used in building design today. The use of BEM, especially in sustainable green building projects, provides various advantages to achieve sustainability goals. In addition, the concepts that have become more important than traditional projects to achieve sustainability goals in sustainable projects such as waste reduction and design optimization. It produces successful results with its use. Before the project, it is implemented as optimizing the low risk and high value construction of an intelligent 3D virtual building model, in which the properties of all the elements that make up the building can be constructed numerically. Sustainable construction projects are projects that take into account resource efficiency and ecological concerns in order to create and manage a healthy built environment. The use of BEM contributes to sustainable green building projects by offering various solutions for waste, carbon footprint, energy and water consumption, material reuse and renewable energy use.

Advances in technology change every aspect of life, as well as the field of industry. With the 4th industrial revolution, it brings new sectors and causes some existing sectors to disappear. This is true not only for sectors, but also for people, institutions and countries. It is inevitable that the 4th Industrial Revolution will affect the production technologies, education system, economy, social and cultural structure as in the previous industrial revolutions. Anything that cannot adapt to the new industry transformation will be badly affected. This technological, digital transformation has led to the birth of new products and terms. There are many technological innovations that led to the fourth industrial revolution. Information systems and software technologies are of great importance in the development of Industry 4.0. The fourth industrial revolution is a revolution that prioritizes the interaction between analog production and the digital world. This revolution covers components such as big data, autonomous operating systems, cloud, social media, mobile and self-learning system. Examples are Cloud Computing Systems, 3D Printers, Big Data and Analysis, Cyber Physical Systems, Simulation, Internet of Things, Cyber Security, Robots, Extended Reality (Virtual, Augmented, Mixed), Artificial Intelligence Systems. At this point, a strong internet network and an independent network system are actually the infrastructure that constitutes the key point of this revolution so that all these technologies can be discussed.

The Industry 4.0 revolution process significantly changes not only what we do, but also who we are. It has many effects on us as individuals. These changes, which are experienced at an unprecedented speed, trigger both excitement and fear in human beings. Technology has primarily given us the ability to do things faster, easier and more efficiently. But our security has also created a process where it can remain vulnerable to threats. With Industry 4.0, there will be an employment problem in the unqualified workforce, and it is important to understand it in the new digital life and stay alive in new business lines that are needed. The rapid development of internet technology has led to the digitization of real life one by one.

The digitalization of socialization has accelerated especially after Web 2.0, which is known as the second-generation internet. These transformations have become dynamic in the constantly updated structure of internet technology today. This situation causes almost all internet users to be excited and curious about the next transformation.

In independent networks, which is the most important element of the new digital life that is formed here, it aims to benefit all of us from information in Web 3.0 standards and to benefit from the digital economy no matter what tool it is connected to. Thus, it is aimed to create a diversity and flexibility that does not get caught by the limitations of form and structure. A virtual reality-based life platform is established by buying and selling the Blockchain system, which will create the economy of this new digital life, and NFT technologies, which provide the formation of indispensable parts of the new life with it. This new digital universe of living life is also called Meta Universes. In addition to all these, there is an organic link between meta universe projects and NFTs (Non-Fungible Tokens). NFT, which is defined as a crypto asset that cannot be changed, has been a technology that helps to determine the owners and originality of the content produced or shared in the digital environment. NFT is a new type of crypto asset, a blockchain product used to generate and securely store content of artistic value in the digital environment. NFT was born out of the desire and need to create property rights on the content in the digital environment. The need to exhibit the NFTs that people buy in exchange for cryptocurrencies causes a compulsory association between the commodity universe and NFTs, thus cryptocurrencies. The most expensive sold example of NFT digital artworks reaching huge numbers is a work of the CryptoPunk series produced by Larva Labs, seen in Figure 7 (Rivas, 2022).



Figure 7. CryptoPunk #5822 was sold for 8,000 ETH for approximately \$24 million (Rivas, 2022).

While these digital works of art also led to the creation of a new art gallery design, artworks became exhibitable both in real life and in virtual universes. Physical galleries were opened Bali, in Indonesia (Horstman, 2022), in Chicago, in the United States (Steven A. Vazquez, 2021) and London, the United Kingdom as the seen Figure 8 (Gallagher, 2022).

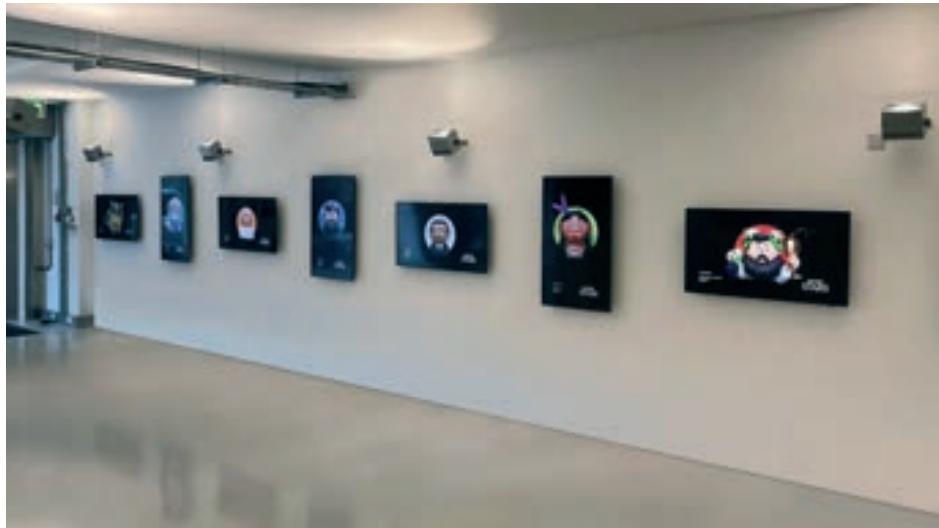


Figure 8. First physical NFT gallery in London, United Kingdom (Gallagher, 2022)

The property of exhibiting NFT assets, the fact that the meta universe is one of the most interesting channels for the display of these assets, causes both of them not to be considered separately from each other. In this way, digital artworks were created, and they were bought and sold in virtual markets with digital economies. In this new universe that has emerged, people have different experiences and buy more digital life items and want to share them with their distant friends. Zaha Hadid Architects has created a “cyber-urban” city in the metaverse, where people can buy land in cryptocurrency and enter digital buildings as an avatar. A virtual city called liberland metaverse and a private gallery displaying NFT works were also designed as shown Figure 9 (Alice Finney, 2022).



Figure 9. Liberland city designed by Zaha Hadid Architecture office (Alice Finney, 2022)

As digital technologies progress, innovative ideas will emerge and they will be more easily presented to the service of humanity. Especially for a design-oriented job such as Architecture, the creation of digital platforms that can be done freely and with pleasure will facilitate the emergence of more enjoyable works.

4. Conclusion

As a result of the continuation of the development of the meta universe, it predicts the change of lives and professions depending on it today. Especially for these new digital lives, it creates new opportunities focused on design and architecture. There are also great opportunities in virtual universes for the new generation users who have grown up in different cultures for the architectural profession, which is rooted in cultural sensitivity.

Digital technologies are preparing to add a new platform to our lives. It is advancing in new digital worlds with the support of imagination. In their digital world, construction should always be planned with clean energy solutions. Al-

though the world is going through difficult times, thanks to technology, people can come together more easily, communicate with each other faster and act together. Technology will be the key to a world dominated by ideas, not fears. In order to present it in this way, we will be the beginning generation. Technology is ready to be used for a sustainable future and a better world.

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