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The Impact of Technological Progress on American Life during the 20th and 21st Century

Thesis submitted to the Department of English Language and Literature as a partial fulfilment of the requirements for the degree of *Master* in Literature and civilization.

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Declaration of Originality

I, Boulechbour Kawter, hereby declare that this Master's thesis, titled "The Impact of Technological Progress on American life During the Twentieth and Twenty-first Centuries," is my original work. All ideas, data, and research findings presented herein are my own, unless explicitly attributed to others through proper citations and references.

I confirm that I have not submitted any portion of this thesis for any other academic qualification, and I have complied with all relevant ethical and academic guidelines throughout the research process.

I understand the consequences of academic dishonesty, and I attest to the authenticity and integrity of the work presented in this thesis.

Date: 16/09/2023

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A handwritten signature in black ink, appearing to be 'B. Kawter' with a stylized flourish at the end.

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Abstract

In the span of two centuries, the United States witnessed a remarkable transformation driven by technological innovations and refinements in various fields that would forever alter the course of its history. This research work aims to provide an overview of the historical roots of technological progress in America since the late 19th century, as it also endeavors to provide an in-depth investigation of the innovations that shaped America during the last two centuries. Furthermore, to examine the rapid technological transformations that have taken place in the 21st century, including the proliferation of the internet, mobile technologies, and artificial intelligence, and their influence on the dynamics of American society. This study tends to shed light on the impacts of technological progress on American life during the 20th and 21st centuries. Henceforth, this current research work uses a multidisciplinary approach to analyze the innovations and effects of technological advancements on the United States nation. The results revealed that technology's far-reaching influences differed from one field to another including the switches of economic dynamics, changes in social interactions, and the new possibilities offered by the new emerging gadgets in all domains.

Keywords: America, Dynamics, Innovation, New possibilities, Technological progress, Transformation.

Table of Contents

Declaration of Originality	I
Dedication	II
Acknowledgments	III
Abstract	IV
Table of Contents	V
Abbreviations	VI
General introduction	01
Chapter One History and Diversity of Technology in the 19th Century America	
I.1. Introduction	04
I.2. Definition of Technology	04
I.3. The Evolution of Technology	05
I.3.1. The Early Stone Age : Ancient Innovations	05
I.3.2. Neolithic Period—8000 BCE to 3000 BCE “New Stone Age”	06
I.3.3. Ancient Mastery: Technology in the Ancient Civilizations	07
I.3.4. Innovations Across Ages: Medieval to 1750 Technological Progress	08
I.3.5. The Shift from Industrialization to Digitalization	08
I.4. The Role of Technology in Shaping Society	10
• Technological Determinism	10
• Social Constructivism	11
I.5. An Overview of the Historical Background of Technology in America	12
I.5.1. The Flourishing Industries: Textiles, Iron, Steel, and Coal Mining	12
I.5.2. Innovations Fueled by Immigration	12
I.5.3. The Governmental Support of Innovation	13
I.5.4. The Rise of the Patent System	13
I.5.5. Second Industrial Revolution (1860s–1914):	13
I.6. Key Inventions and Inventors of the 19th Century	14
I.6.1. The Telegraph 1844	14
I.6.2. The Telephone 1876	16
I.6.3. Edison Creations: The Incandescent Light Bulb, The phonograph, The current war	17
I.6.3.1. The Phonograph 1877	17
I.6.3.2. The Incandescent Light Bulb 1879	18
I.6.4. The Reliable Internal Combustion Engine	20
I.7. Conclusion	22
Chapter Two: A Century of Innovation: Technology's Role in 20th Century America	
II.1. Introduction	24
II.2. The Impact of Technological Progress on the American Economy	24
II.2.1. The Emergence of Mass Production and Automation	24
II.2.2. Technology and Employment	25
II.2.3. Technology of Agriculture	26
II.3. The Impact of Technological Progress on the American Society	28
II.3.1. Communication and Social Interaction	28
II.3.2. Applications of Technological Progress in Entertainment	29
• The Evolution of Movies Industry	29
• Technology's Influence on Music Recording	32
II.3.3. Role of Technology in Education and learning	34
II.4. Impact of Technological Progress on the American Politics	36
II.4.1. The role of technology in political Communication	36

II.4.2.The Rise of Television and Political Advertising	37
II.4.3.The Role of Mass media and technology in Political Activism and Mobilization	40
II.5.Military Innovation and Technological Progress	42
II.6.Conclusion	43
Chapter III:Beyond Gadgets: A Holistic Exploration of the Role of Technology in 21st Century America	
III.1.Introduction	45
III.2.The Impact of Technology on Trade	45
III.2.1.The Gig Economy	45
III.2.2. E-commerce	46
III.3.The Impact of Technology Healthcare	47
III.3.1. Telemedicine and Remote Patient Care	48
III.3.2. Electronic Health Records (EHRs) and Data-Driven Healthcare	50
III.3.3. Precision Medicine and Genomic Research	52
III.3.4.Artificial Intelligence Applications in Healthcare	53
III.4. Technology's Footprint on the Environment	55
III.4.1.Technology's Role in Environmental Changes	55
III.4.2. Renewable Energy Technologies and Environmental Benefits	56
III.4.3.Electric Vehicles and Efficient Energy	57
III.5. Tech-Driven Changes in Society	58
III.5.1. Education and Learning in the Digital Age	58
III.5.2. The Rise of Smartphones and Its Social Implications	59
III.5.3. Smartphone-Related Health Concerns	61
III.6.The Impact of Technology on Politics	62
III.6.1.The Role of Technology in Misinformation and Fake News	63
III.6.2.Cybersecurity and Election Integrity	64
III.7. Conclusion	65
General Conclusion	66
References	69

Abbreviation

US	United States
USDA	United States Department of Agriculture
IT	Information Technology
ICT	Information and Communications Technology
IR	Industrial Revolution

General Introduction

Since the beginning of civilization, technology has been regarded as a revolutionary force, continually reshaping our world which evolved from the earliest crafts made by prehistoric humans to the latest technologies of our modern world. The American nation is no exception, as the inventions of the late 19th century fueled its evolution from an agrarian society into a global technological superpower in today's world.

On the light of the background provided, this work will discuss the development of technology and take the United States as a case study. The following objectives are intended: Firstly, to shed light on the evolution of technology since the earliest crafts made by our ancestors till today and to examine the historical context and key inventions of the late nineteenth century in the United States. Secondly, to put under discussion the innovations and implications of the pre-existing technologies and the influence of the emergent ones on American life during the 20th century. Finally, it presents the transformative effects of 21st-century technologies, including the internet, mobile devices, and artificial intelligence, on various facets of American life. The main research questions for this work are :

1. To what extent did the Industrial Revolution in America mark a turning point in technological progress and what inventions emerged as critical drivers of change?
2. How have technological advancements impacted America and redefined its economics, society, and politics during the 20th?
3. What were the impacts of the vast adoption of 21st-century digital technologies on the dynamics of American aspects of life?

Working on the preceding research questions, the following hypotheses are provided:

1. The late 19th century was a transformative period driven by a series of inventions that fundamentally reshaped the nation's landscape and set the stage for upcoming innovations.

2. Advancements in technology have redefined America in profound ways during the twentieth century.
3. The rapid and pervasive advancement of the 21st-century technology has fundamentally transformed American life across various domains including society, economy and political landscape.

This research work will employ a multidisciplinary approach to comprehensively analyze the far-reaching impact of technological progress on American life during the 20th and 21st centuries. This multifaceted examination will draw upon diverse academic disciplines, including history, sociology, economics, political science, technology studies, cultural studies, and environmental science.

This research work comprises of three chapters to provide a detailed analysis of the diverse and wide-ranging effects of technological advancement on the American experience throughout the 20th and 21st centuries. The first chapter is divided in two sections: The initial section encompasses the progression of technology throughout history, spanning from prehistoric times to the contemporary era, and the subsequent section delves into the historical context of the Industrial Revolution and the pivotal inventions that emerged in America during that era.

The second chapter is devoted to the different implications and impacts of technological progress on the American economy, agricultural, societal and political fields during the 20th century.

Finally, the third chapter is dedicated to a comprehensive exploration of the diverse impacts brought about by the technologies of the digital age including the healthcare sector and the environmental outcomes.

Chapter I :

History and Diversity of Technology in the 19th Century

America

1.1. Introduction :

Throughout history, technology has continually evolved, revolutionizing different aspects of our lives. The progress of technology introduced us to an age of unimaginable possibilities, from the earliest instruments created by our ancestors to the intricate and linked systems of the contemporary period.

The late 19th century witnessed significant technological innovation and advancement, particularly in the industrial and manufacturing sectors, which laid the foundation for the modern world and many of the most important technological innovations of that era came to America through a combination of international trade, immigration, and domestic innovation. This chapter aims to explore the historical background of technology in America and provide valuable insight into understanding the origins and evolution of technology which is crucial for comprehending its profound impact on society and the continuous march of progress.

1.2 Definition of Technology:

Technology is derived from the Greek word “Technologos”, The ancient Greeks used the term “Techne” to refer to all that is art, skill, craft, or even craftiness.

Yet, technology has elicited different interpretations from scholars and authors, the dictionary definitions of technology include the application of science and knowledge or the study of techniques, practices, or activity (Oxford English Dictionary, n.d.), it may denote also a collection of practical skills and knowledge of a particular industry to make it function

Arthur (2009) argues that technology embodies a sequence of operations and methods that require a wide range of physical equipment or devices and execute them to supply functionality, solve problems, or enhance already existing solutions. In light of this, technology is continuously evolving from existing ones and gives birth to new ones to fulfill

the needs of that era (p, 2). Furthermore, Kelly (2011), emphasized also that technology is not merely a human invention but also emerged from the inherent creativity of life itself (p, 52).

Thus, technology can be understood as the extension of human intellect and creativity, surpassing the boundaries of our genetic makeup (Arthur, 2009. p,12). It represents the embodiment and materialization of our ideas and thoughts. In this sense, technology is not merely a collection of physical objects, but a manifestation of human thinking itself. It is a form of cognitive activity that finds expression in the tangible world.

I.3. The Evolution of Technology :

The evolution of technology is a captivating subject that has shaped the course of human civilization, it is rooted back to our earliest ancestors who harnessed natural resources for survival and progressed till the latest advancements in artificial intelligence and space exploration. The development of ideas and inventions undergo a process of refinement and selection, with the most successful and relevant ones surviving and shaping the course of progress that often mirrors the principles of nature “The evolution of science and technology parallels the evolution of nature” (Kelly, 2011,p.46).

The Prehistoric period covers the human culture from the Paleolithic to the Neolithic era.

1.3.1. The Early Stone Age : Ancient Innovations

Early humans exhibited remarkable technological ingenuity. The most important achievement is the mastery of fire which enabled them to cook food, warm their bodies and bring light into the dark caves. They crafted tools using wood, stone, and animal materials such as bones, teeth, and antlers. These tools served a multitude of purposes, ranging from digging and scraping implements to hand axes, spears, fishing hooks, choppers, and animal traps. Such tools were essential for gathering food and ensuring survival. Paleolithic humans also developed practical tools like lunar notation systems, which helped them track the cycles

of the moon. This knowledge aided in following animal migrations, enabling successful hunting ventures. In addition to practical tools, Paleolithicans utilized animal skins and transformed them into leather and cloth, using bones to make needles for sewing.

This period marked the emergence of technology, allowing humans to establish cultural practices and traditions that would eventually pave the way for settlements and the development of civilizations (Stearns,2020, pp. 08-15).

1.3.2.Neolithic Period—8000 BCE to 3000 BCE “New Stone Age”:

The Neolithic period witnessed a significant transformation in human society transforming the nomadic hunter-gatherers into sedentary societies. The Agricultural Revolution allowed Neolithic humans to settle in one place, leading to population growth and technological advancements. With the advent of agriculture, humans stopped their full dependence on hunting for survival, and food-gathering was replaced with gardening, plow farming and the technology of irrigation. Furthermore, the Neolithic inhabitants used hoes, digging sticks, axes, and adzes to clear land for cultivation. The domestication of animals was another major aspect that served multiple purposes, such as providing meat, milk, fibers, and labor. Oxen and horses were harnessed and utilized in agricultural fields.As Neolithic societies flourished, there was a rise in the construction of complex tombs and ritual structures. These architectural endeavors reflected the growing sophistication of these societies (Ibid, pp.16-20).

Metal smelting quickly emerged during the Neolithic period and turned the stone age into the bronze age(circa 4000 to 1200 BCE). The process began with the introduction of copper smelting, followed by the innovation of bronze production; an alloy of copper and tin. the advancements of smelting techniques revolutionized weaponry tools, and statuary art leading to the birth of civilizations.

1.3.3.Ancient Mastery: Technology in the Ancient Civilizations :

Sumer was established as early as 5500 BCE, Among its agricultural innovations were the dams, the sluice gates, and levees walls, and canals to guarantee a constant flow of water. The writing was a Mesopotamian innovation using cuneiform script, during the reign of Akkadian king Sargon, mining fueled military expeditions. Babylonians developed a sophisticated architecture that recorded their great massive walls and empirical buildings as wonders of the world. In Astrology, the advent of mathematics enabled the Mesopotamians to create a twelve-month calendar and predict the change of seasons (Stearns,2020, pp.43-66).

In the same way, the Indus Valley Civilization was characterized by the uniform construction of cities including the application of sanitation techniques, The Indus inhabitants developed mediums of measurements and weights, and pottery-making techniques were highly developed like the Wheel. In addition to the discovery of the Iron steeling process that replaced the earlier materials (McClellan & Dorn, 2006, pp.141-151).

Ancient Egyptians invented ramps for building pyramids and monumental architecture. They developed their own hieroglyphic writing and were considered as early pioneers in papermaking by using a medium called papyrus. Moreover, Egyptians advanced in Medicine and Surgery as well as in Mathematics and Geometry and other fields. (McClellan & Dorn, 2006, pp.42- 50).

Technology and innovation kept developing in the ancient civilizations, Romans implanted iron in agriculture and constructed extensive road networks and aqueducts. Their military innovation includes advanced siege techniques, and the use of well-organized legions(McClellan & Dorn, 2006, p 89), catapults, and ballistae, Ancient Chinese technologies include the invention of the compass for navigation, gunpowder, papermaking from materials like bamboo, the construction of suspension bridges and The Great Wall,

advancement in Silk Production, and Chinese porcelain (McClellan & Dorn, 2006, pp.118-125).

1.3.4.Innovations Across Ages: Medieval to 1750 Technological Progress

During the medieval period, the Islamic world witnessed remarkable advancements in various fields of mathematics, Islamic scholars introduced the decimal system and advanced algebra and trigonometry. Islamic physicians advanced medical knowledge upon the preserved Greek and Roman medical texts, while architects created stunning mosques with intricate geometric designs. A glance at technologies associated with the Islamic world includes Astrolabes, Arabic Numerals, water clocks, Bookbinding and Illumination techniques ...etc (McClellan & Dorn, 2006, pp.105-113).

Likewise, Medieval Europeans developed Windmills for pumping water and grinding grains, and Gothic architecture techniques allowed for taller, more spacious buildings and aesthetic churches.(Brodele,2020,pp.184-200). Advances in metallurgy and blacksmithing led to effective weapons and armor like plate armor, steel crossbows, and artillery pieces these advancements, along with improved sanitation systems, Paper mills, watermills, glassmaking, and the telescope, laid the foundation for future progress and shaped the medieval world.

Preceding the IR, technological innovations played a crucial role in the success of British explorers during the Age of Exploration and Colonization that took place from the 15th to the 17th centuries, these advancements improved navigation accuracy, enhanced ship performance, and contributed to the expansion of geographical knowledge and the establishment of British colonies in North America, the Caribbean, and parts of Africa and Asia colonies and trade networks around the world.

1.3.5.The Shift from Industrialization to Digitalization:

This period brought massive technological changes in various aspects like textile, mining, metallurgy, and transport due to the invention of the steam engine by James Watt

which provided a ubiquitous source of power that was not only used in mills and factories but in transportation followed by harnessing Electricity by multiple scientists to serve people and the invention of notable technologies like The Cotton Gin, Typewriting, Swing machines, Bessemer machine, vulcanized rubber and the automobile....etc. In addition to the development of telecommunication devices.

The IR is considered as milestone breakthrough in human history which laid the foundation for the technologies we use in the modern world.

The 20th century marked great achievements in science and technology, automobiles industry pioneered by Henry Ford allowed the car to be affordable around the globe, airplane invention by the Wright brothers in 1903 inspired the world to explore space which become reality with the launch of the first artificial satellite, Sputnik, in 1957. Electricity was at its peak, and other technologies appeared during the 20th c including computers and information technology, nuclear power, Biotechnology, and Genetic Engineering in agriculture and medicine, the latter witnessed also numerous discoveries including the advent of modern birth control, vaccination, surgeries techniques, the medical application of X-rays, antibiotics, such as penicillin, revolutionized the treatment of infectious diseases (Ibid, pp.340-399). The pre-existing devices developed in terms of size, affinity, and accessibility, and the rising concerns of the environment led to the development of solar and wind powers. The late 20th century witnessed also the invention of the Internet and the rapid development of ICT had a profound impact on communication, with the rise of mobile phones, email, instant messaging, and social media platforms.

As Technology became an essential aspect of human life, The relentless pace of technological progress continues to shape our world, fundamentally altering how we live, work, and interact and each day brings discoveries and developments that redefine our

understanding of what is possible, making it a daunting task to capture the entirety of these remarkable achievements.

I.4.The Role of Technology in Shaping Society

Understanding Technology through different categories is essential to gain a comprehensive understanding of its impact on society. Social constructivism and technological determinism are two frameworks that provide different perspectives on technology and its role in shaping society.

- **Technological Determinism**

refers to the belief that technological development and progress have an inherent power to shape and determine the direction of society and human behaviour. It suggests that technology is the driving force behind societal change and that advancements in technology determine the course of human history. Technological determinism posits that technology has its autonomy and agency, influencing and shaping social, economic, and cultural aspects of society. A key scholar who has contributed to technological determinism is Kevin Kelly. In his book "What Technology Wants," Kelly argues that technology is an autonomous force that has its agenda and desires. He writes, "Technology is not just a tool we use to do things. It is a force that wants what it wants"(p12). This quote highlights the importance of understanding technology through technological determinism to identify and harness its potential to shape society for the better.

- **Social Constructivism:**

This framework emphasizes the role of social, cultural, and political factors in shaping the development, adoption, and use of technology. According to social constructivism, technology is not an independent force that drives social change; instead, it is a product of human choices, values, and interests.

Social constructivism highlights the importance of considering the broader social context in which technology is developed and used, recognizing that different social groups may interpret and interact with technology in diverse ways. This approach encourages a more nuanced understanding of the relationship between technology and society, acknowledging the role of human agency and social factors in shaping technological outcomes Bijker et al. (2012) suggested that the sociocultural and political situation of a social group shapes their norms, values, and the meaning they give to a technological artifact (p.46).

I.5. An Overview of the Historical Background of Technology in America :

The History of Technological progress in America can be traced back to the industrial revolution which began in the late eighteenth century in Britain and Europe and spread to America in the early nineteenth century characterized by the transfer of technology and ideas, the adoption of European manufacturing methods and the spread of industrialization to America. This period marked a shift from manual labor to machine-based manufacturing, as new inventions and innovations transformed the way goods were produced. The steam engine and electrical power were two inventions that had a significant impact on the Industrial Revolution, James Watt's improvements of the Steam engine between 1765 and 1776 increased its efficiency and power, providing a reliable source of energy to factories instead of water or wind power, and enabled the machinery system to operate on a larger scale allowing for faster production processes and economic growth. Unlike other inventions that were limited to certain areas, the steam engine was widely adopted in different industries. its development in the 1780s revolutionized land and sea transportation. Steam-powered Locomotives and Steamships were widely adopted in America by the early nineteenth century (Brynjolfsson& McAfee, 2014, p. 64) and Canals like "The Erie Canal" of 1825 emerged also to connect lakes and rivers contributed to the growth of railroads, the expansion of trade networks and made long-distance travel easier and faster.

I.5.1.The Flourishing Industries: Textiles, Iron, Steel, and Coal Mining:

The textile industry thrived as advancements like the power loom, spinning jenny, and the cotton gin revolutionized the manufacturing process. In parallel, the coal mining industry underwent significant changes due to the introduction of steam-powered machinery that enabled faster and more efficient extraction of coal and other minerals. This technological leap resulted in increased production and a boost to the overall mining industry. The advent of steam-powered blast furnaces fueled the production of iron and steel. Notably, technological improvements such as the Bessemer process in the 1850s facilitated the mass production of steel allowing for the construction of more buildings, bridges, and railroads (Stearns,2013, p 63), this breakthrough revolutionized the industry, enabling large-scale and rapid production of this crucial material while reducing labor requirements.

I.5.2.Innovations Fueled by Immigration:

The growth of industries and job opportunities led to urbanization as people migrated from rural areas to cities in search of employment resulting a rapid increase in population rate, During the period between the 1870s and the 1913s, there was a significant influx of approximately 30 million European immigrants who arrived in the New World seeking new opportunities(Gordon, 2016, p.554). Many of them were skilled craftsmen scientists, engineers, physicists, and inventors who brought with them valuable knowledge and expertise in a wide range of technical fields. The shift from rural agrarian societies to urban industrial societies brought about significant social and cultural changes, including the rise of the working-class, labor movements, and the formation of diverse urban communities.

I.5.3.The Governmental Support of Innovation:

The Economic prosperity during the 19th Century led the American government to recognize the importance of scientific research and technological advancements and drove it to support, promote and forest technological progress in various ways.

The American federal government granted about 7% of the Continental United States to railroads between 1850 and 1870 as an investment in infrastructure, this action did not bind regions of California and the Pacific Northwest to the union only but facilitated the spurred technological innovation (Gordon, 2016, p.317).

The Morrill Act of 1862 established the creation of land grant colleges of agriculture (LGCA) in every state and territory, these institutions received federal and local government funds to promote higher and practical education in agriculture and mechanic art for ordinary people. The LGCA system was expanded by the Second Morrill Act of the 1890s and gave rise to African American colleges, these institutions played a significant role in transforming farming into an industry based on science and technology. (Earl, 1997, p. 1610).

I.5.4.The Rise of the Patent System:

The patent system was another major key development, The affordability of patents created a distinctive feature of American innovation, as many inventors possessed only basic or secondary education. The patent system enabled them to develop their ideas without requiring significant financial resources for obtaining a patent. Once granted, inventors, even those with limited personal income, could attract capital investment and sell licenses for their inventions. The U.S. patent system was groundbreaking in its expansion of property rights to a broad spectrum of the population. (Gordon, 2016, p.594).

I.5.6.Second Industrial Revolution (1860s–1914):

By the Second Industrial Revolution (Electrical Revolution), America was already accelerated by a convergence of factors that drove technological advancements and industrial expansion, The country's abundant natural resources, such as coal and iron ore, served as essential inputs for various industries, enabling their growth and development. Also the introduction of milestone technologies like the telegraph, telephone, and electric power brought about significant transformations in multiple sectors. In addition, an extensive

establishment of transportation networks particularly railroads facilitated the efficient movement of goods and people across the nation, opening up new markets and opportunities, resulting the beginning of a new wave of globalization, With a steadily growing population and a wave of immigrants, there was a substantial labor force available to support industrial enterprises. Visionary entrepreneurs, backed by the support of financiers and industrialists, invested in innovative technologies and infrastructure projects, bolstered by favorable government policies such as protective tariffs and land grants.

The Second Industrial Revolution brought a phase of rapid standardization, industrialization and numerous refinements of the earliest technological systems. In addition, new countless inventions were produced to facilitate American life such as the sewing machine patented by Elias Howe in 1846, typewriters by the inventor Christopher Latham Sholes in 1867, air conditioners, escalators, skyscrapers, and other notable technologies.

I.6.Key Inventions and Inventors of the 19th Century :

In the 19th century, America welcomed technological advancements with open arms and witnessed a surge in innovative gadgets that not only shaped the nation's progress but also laid the foundation for the modern world, propelling the United States into a leadership position in the global technological landscape. Milestone inventions of that time were the Telegraph, The Telephone, Electricity, the Light Bulb and the Reliable Internal Combustion Engine

I.6.1.The Telegraph 1844 :

The foundation for the telegraph was built upon the advancements in electrical science and by 1825, William Sturgeon revealed his discovery of electromagnetism that laid the groundwork for a large-scale evolution of electronic communication (Huurdeeman, 2003.p32). The invention of the Electromagnetic Telegraph was granted to the British inventors William Cooke and Charles Wheatstone in 1837, by that time in the United States Samuel F. B.

Morse's worked independently to develop his own version of the device and created along with his assistant Alfred Vail a game-changing breakthrough "The Morse Code"; a system of dots and dashes representing letters, numbers, and punctuation marks (Huurdeeman,2003,pp 55-141).

On May 24, 1844, Samuel Morse succeeded to send the first and famous message "What hath God wrought?" from the U.S. Capitol building in Washington, D.C., to a railroad depot in Baltimore, and almost immediately, telegraph networks were established involving telegraph offices, the relay stations and miles of cables were stretched. The later decades witnessed a global expansion of the Telegraph which on October 24, 1861, a successful transcontinental telegraph was completed and an undersea transatlantic telegraph cable was laid to link Britain and America in 1866. The transcontinental telegraph had great significance to the United States during the Civil War (April 12, 1861 – May 26, 1865). It emphasized the unity of the American nation and the line became a source of pride in the American heritage (Ibid.)

Till the introduction of the Telegraph, news and message transmission were limited to mail delivery, and messengers and it often took days, weeks or even months depending on the distance and mode of transportation. However, the invention facilitated the spread of news and communication as new monopolies were developed such as the Associated Press and the Western Union telegraph company (Gordon, 2016, pp. 139-146).

The widespread adoption of the Telegraph showcased the potential of electrical communication and encouraged further innovation in telecommunication technologies, ultimately leading to the development of telephone systems and later forms of electronic communication.

I.6.2.The Telephone 1876 :

According to the author Seth Shulman (2008), the invention of the telephone was a result of a series of incremental improvements and innovations by multiple inventors like Antonio Meucci, Elisha Gray, and Alexander Graham Bell (p.03). In 1874 Within a short span of two hours, the Scottish-born inventor Bell preceded His rival Elisha Gray and filed a patent application for the telephone that granted him by 1876 a US patent for his invention of an "improvement in telegraphy," which he called the telephone. His system involved a tin mouthpiece with a membrane and an electrified needle. When a speaker's voice caused the membrane to vibrate, the needle glided across an acidic water-filled cup. These vibrations were then transmitted through a wire to a receiver, where they were converted back into audible sound (Time Inc. Books, 2016, p. 65).

By March 10, 1876, Bell successfully conducted the first telephone call, famously saying to his assistant, Thomas Watson, "Mr. Watson, come here, I want to see you."

Almost immediately, The Bell Telephone Company (AT&T) was established in 1877 and quickly became dominant in the telephone industry, expanding its network and services across the United States and Europe. Furthermore, the later innovations accelerated the growth of the telephone networks; the switchboards developed in 1877 allowed multiple telephones to be connected to a single line (Huurdean, 2003, pp. 188-191) and progressed later by Almon Brown Strowger in 1889, from manual to automatic switchboards that use electromechanical switches to connect calls. The rotary dial or the "dialing disk" invented also by Strowger in 1891 facilitated the process and made it even faster.

The installation of one million telephones took 20 years however, By the period 1900–1950s, approximately 25 million telephones were in operation, of which 16.7 million were utilized within the United States (Huurdean, 2003, pp. 153-195).

The telephone was used for business to enable instant communication between businesses, customers, and suppliers, allowing for faster transactions, order placements, and customer service., it created new employment opportunities in telephone manufacturing, installation, and operation.

The continuous progress of telephony was marked by several important technological advancements, investment in research, and Collaboration between inventors, entrepreneurs, and governments.

I.6.3. Edison Creations: The Incandescent Light Bulb, The phonograph, the current war, harnessing Electricity:

I.6.3.1.The Phonograph 1877 :

Preceded by years of experimentation on the telephone and the telegraph Thomas Alva Edison invented “The phonograph“ on July 1877 and referred to it as the “talking machine.” the new device allowed sounds to be recorded, stored and played back. In its early stages, the phonograph employed tinfoil sheets that were wrapped around a cylinder to capture sound. However, this method faced limitations in terms of the quality of the recorded sound and the durability of the medium used. Over time, multiple inventors worked to improve the technology like Bell’s “Graphophone” and Edison’s Improved phonograph in 1888 but it was Emile Berliner who introduced a better method that used flat discs instead of cylinders, making it easier to mass-produce records. Edison had a vision that the phonographs would have various applications, such as enabling books to be read aloud for the benefit of the blind, assisting in teaching children proper speech, creating singing dolls, capturing and preserving musical performances across different time periods, and preserving the voices of past generations within a family. (Gordon, 2016, pp. 187-188).

The Phonograph transformed American life by revolutionizing the way music was experienced, allowing people to enjoy their favorite music and performances anytime at home

contributing to the birth of new music industries.(Gordon,2016, p 192). furthermore, it facilitated the dissemination of news, entertainment, and educational content, effectively reaching a wider audience and influencing public opinion. Additionally, it paved the way for the development of additional audio technologies such as radio and tape recorders.

Thomas Alva Edison's creations were not limited only to phonographs he is known as the American inventor with the most patents, holding an impressive record of 1,093 patents, and The Incandescent Light Bulb and Electricity are undoubtedly the most vital ones. (Jonnes,2003, p.366).

I.6.3.2.The Incandescent Light Bulb 1879:

Before the light bulb was invented, lighting primarily relied on gas lamps and candles as the main sources of illumination, these sources were expensive, inefficient, and posed safety risks. The demand for a safer and more reliable form of lighting drove inventors to explore electric alternatives. The early years of the nineteenth century witnessed many attempts of creating a long-lasting practical electrical light by inventors and scientists like Sir Humphry Davy with his demonstration of the first electric arc lamp in 1802 and the constant electric light using a platinum filament by James Bowman Lindsay in 1835 leading to Joseph Swan's first working incandescent lamp using a carbon filament by 1878. (Jonnes,2003, pp. 25-45).

Edison tested various materials and designs through numerous experiments until he discovered that a carbonized bamboo filament was the most effective. By 1879, in his laboratory in Menlo Park, New Jersey. Edison successfully demonstrated a working incandescent lamp that burned for fourteen and a half hours. later Edison and his team continued to innovate and expand the short lifespan of the initial carbonized bamboo filaments leading to the discovery of a longer-lasting carbonized cellulose This invention granted him a patent in 1880 (Ibid.). The businessman and inventor welcomed investments

and partnerships to finance his electric Illuminating Company and merged with other electric companies to form the General Electric Company in 1892, which became a major player in the electrical industry, his company pioneered the use of direct current (DC) as the primary method of electrical transmission. However, the (DC) generators kept failing.

The former worker of Edison's company Nikola Tesla introduced the Alternative current system (AC) which was able to change directions, vary its voltage, and travel long distances without losing power (Newsthink, 2021). Unlike Edison who believed (AC) electricity was dangerous and posed a great risk to human life, George Westinghouse saw its potential, bought Tesla's patent, and hire him to improve the system, the competing inventors went through a "War of Currents" which in Edison used his fame, reputation and sources to discredit George Westinghouse and Tesla's technology. In an attempt to showcase the dangers of the AC system, Edison developed an "Electric Chair" as a method of execution which on August 6, 1890, at Auburn Prison in New York. William Kemmler, a convicted murderer, was the first person to be executed by the electric chair (Sonneborn, 2007, pp. 82–84). Ultimately, AC prevailed as a more efficient method for long-distance power transmission and the war arrived at an end (Jonnes, 2003, p. 345).

The illumination of streets enabled cities to operate day and night, it extended the hours of social activities and outdoor activities. The invention of the Electric elevator reshaped architectural design and the use of land and through the vertical construction of buildings and skyscrapers, population density increased within urban areas like New York and Chicago. (Gordon, 2016, p.169). Its later appliances such as vacuum cleaners, and refrigerators facilitated household tasks and enhanced the quality of daily life (Ibid, p.279).

Electrical power further boosted the manufacturing sector by enabling individually powered machines and also led to innovations like air conditioning, which made previously uncomfortable workplaces more bearable (Brynjolfsson & McAfee, 2014, p. 64).

It urged a culture of technological innovation that resulted in further advancements in different domains, Electric-powered streetcars and later electric trains revolutionized transportation and made it even faster and more reliable (Gordon, 2016, p.146). Electricity-powered telecommunication devices and later Radio facilitated the exchange of information.

I.6.4.The Reliable Internal Combustion Engine:

The early stages of automotive innovation were marked by Steam-powered vehicles and electric cars, the military engineer Nicolas-Joseph Cugnot is often credited with building a steam-powered tricycle in 1769 in an attempt of creating a self-propelled vehicle. However, the challenges like maintaining steam pressure, the instability of the vehicle, and the weakness of the water boiler system limited its spread. By 1801. Richard Trevithick demonstrated a road locomotive with a carriage that reached a speed of 13 Km/h (GaryCizzle,2013).

The Electric cars underwent a collection of continuous innovation, in the 1830s, the Scottish Robert Anderson created a motorized carriage that was not practical since Batteries were not rechargeable until 1859. Around 1884, inventor Thomas Parker participated in deploying electric-powered trams and building prototype electric cars in England. William Morison applied for a patent on an electric carriage he had built around 1887 that consist of front-wheel drive, 4 horsepower, and a top speed of 20 mph (Wilson, 2023). Although Electric vehicles gained popularity for their simplicity, ease of use, and absence of noise and vibration, their limited range and the emergence of more affordable gasoline-powered vehicles restricted their adoption.

Inventors raced to create a gas-powered engine, the Swiss engineer François Isaac De Rivas designed in 1807 an internal combustion engine that used a mixture of hydrogen and Oxygen to fuel but the initial design needed a lot of innovation. (GaryCizzle,2013)

In 1876, the German engineer Nicolaus August Otto perfected Jean-Etienne Lenoir's gas engine by using a four-stroke engine to achieve higher compression, and as soon as

petroleum technologies developed, refining crude oils using the cracking method doubled the yield of gasoline and it made Mechanics and engineers see the potential of using gasoline as a new way to fuel the engine (Mokyr, 1998, p8.). Karl Benz was granted a patent for his engine in 1879 and by 1885 he succeeded to build a four-stroke gasoline-burning engine, his “Motor Wagon” was the first commercially available automobile. His wife Bertha drove it over 100km to prove the roadworthiness of her husband’s vehicle. In America, Taylor Street in Metro Center Springfield witnessed the first public run of the Duryea Motor Wagon on 21 September 1893(Wikipedia contributors, 2023).

According to Gordon (2016) from 1890 through 1910, significant advancements were made in the motorcar industry including Steering Mechanisms, Engine Placement, inventions like spark plugs, carburetors, transmissions, and self-starters that enhanced the performance of the automobile. Many mundane problems solutions were already established through the bicycle mass production in the 1890s (p. 150).

Although the automobile was European advancement and particularly in German, The development of the automobile as a cost-effective mode of transportation for the masses was largely led by American innovators, prominently including Henry Ford and other pioneers. In addition to the American entrepreneurs’ efforts to replicate and build upon the technical achievements of esteemed German automakers to shift this industry to America between 1900-1910 (Ibid.)

In 1903, Henry Ford founded “The Ford Motor Company” and by 1908 he revealed his “Ford Model T”. Ford's development of the assembly line in 1913 revolutionized automobile production, making cars more affordable and accessible.

In 1900, the number of automobiles sold reached 4,000. By 1911, this number had surged to 600,000. The popularity of automobiles continued to rise, and by 1915, the sales

figure had climbed to 895,000. The most significant leap occurred in 1927, with a staggering 3.7 million cars sold in the United States.(McClellan & Dorn, 2006, p.335).

I.7.Conclusion:

This chapter explored the concept of technology and the history of technological evolution. More precisely, it focused on how technology was adopted by America and progressed to shape the course of American life during the nineteenth century.

It highlights the pioneering inventions and innovations that emerged from America during this period. The subsequent chapter will further explore the far-reaching implementations and impacts of technology across various domains of American life mainly in the twentieth century.

Chapter II

A Century of Innovation: Technology's Role in 20th Century America

II.1.Introduction :

The relentless march of technological progress has played a pivotal role in shaping the trajectory of America leaving an indelible mark on the nation's history. From the transformative innovations and inventions of the Second Industrial Revolution in the late 19th century to the dynamic changes witnessed throughout the twentieth century, the United States has experienced a sweeping wave of technological advancements that have altered the very fabric of its existence. This chapter aims to explore the profound shift of Americans from the revolutionary innovations of the Second Industrial Revolution to the dynamic landscape of the twentieth century and the far-reaching implications these advancements have had on the realms of politics, economy, and society.

II.2.The Impact of Technological Progress on the American Economy :

II.2.1.The Emergence of Mass Production and Automation

The advent of mass production techniques, Electrification and the Assembly line accelerated the U.S. economic growth in the early years of the twentieth C. Ford's groundbreaking innovation had far-reaching effects beyond just the automotive industry, Its most significant impact on the economy was the widespread adoption of the assembly line concept by manufacturers in various industries. Successive improvements of this machine allowed parts and components of the complex products to be standardized and mass-produced, this interchangeability of parts not only streamlined production but also simplified repairs and maintenance, further reducing costs for consumers.

Firstly, as America became a mobile society, the need for efficient transportation infrastructure became apparent and the construction of highways became a national priority which led to the establishment of many acts such as the Federal Aid Road Act of 1956 (Frey, 2019, pp. 150-170)

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As a result, the technology of road building underwent continuous refinement between 1900 and 1930, leading to smoother and more durable surfaces that could withstand the increased traffic brought about by the automobile age. As technology kept progressing, ancillary sectors, such as rubber and steel in addition to asphalt and concrete experienced unprecedented growth. The number of gasoline stations increased and roadside commerce started to flourish as well, creating a whole set of new jobs.

Similarly, electrification shifted manufacturing from manual labor to machine-aided operations, it facilitated job processes and improved the working conditions. Prominent corporations, namely General Electric and Westinghouse, brought forth a diverse array of electrical appliances into the consumer market during this era, these included pioneering devices such as the iron (initially introduced in 1893), the vacuum cleaner (1907), the refrigerator (1916), the dishwasher in 1929, and the dryer by 1940s . Furthermore, the introduction of household mechanization enabled women to transition from unpaid domestic work to paid employment in office settings. Between 1900 and 1980, there was a significant expansion of the female workforce, with an increase of 51 percentage points. A notable study published in the Quarterly Journal of Economics, suggests that the household revolution played a substantial role in accounting for 55 percent of this growth. As the mechanization of the home advanced, more women entered the labor market, taking on paid employment that often provided greater fulfillment. Additionally, the emergence of dual-income households resulted in increased prosperity for many American families. (Ibid.)

II.2.2. Technology and Employment

The 1900s witnessed a rapid increase of demand for workers with basic mechanical skills to operate machinery and perform repetitive tasks. The continuous expansion of semi-skilled positions within American factories offered abundant opportunities, even to those who had been displaced. This allowed men to transition from the arduous work of farming to more

enjoyable and higher-paying employment in factory settings. However, As technology advanced in the later stages, the introduction of more intricate machines necessitated a higher level of skill among factory workers, whose abilities were enhanced by the integration of technology. In 1928, preceding the onset of the Great Depression, the Senate Committee on Education and Labor commissioned an investigation conducted by the Brookings Institution, the specific objective of this inquiry was to ascertain the extent to which American industry was absorbing laborers who had been displaced from their employment. This study tracked the destinies of 754 workers who had lost their jobs due to mechanization, spanning various industrial sectors. The findings revealed that, within a month, 11.5 percent of these displaced workers had secured new employment opportunities, while 5.0 percent continued their job search even after a year had elapsed. However, it is noteworthy that the overwhelming majority of these individuals remained unemployed for periods exceeding three months; nevertheless, they eventually secured gainful employment in alternative fields (Frey,2019, p. 186).

II.2.3.Technology of Agriculture

Technological progress revolutionized various sectors, and U.S. agriculture is no exception. As per the USDA's compilation of noteworthy innovations in the agricultural sector in 1940, the farm tractor and hybrid corn stood out as the foremost innovations of significant importance. The adoption of machinery like the tractors (1901), decreased the workforce required to generate a specific quantity of agricultural output and allowed farmers to cultivate larger areas of land compared to what was achievable with horses. As agricultural operations expanded in size, there arose a necessity to divide every aspect of work into specialized compartments. Apart from this, by 1960 the mechanization of tractors and other agriculture machines freed more than 81 million acres of U.S. land that were used in the 1910s only to feed horses and mules, which enabled the exploitation of these lands for other purposes.

In the year 1900, the cultivation of 100 bushels of corn necessitated an average of 147 hours of labor. However, by the 1980s, the time required for the same production had been drastically reduced to a mere 3 hours. In a similar manner, the production of one bale of cotton dropped from approximately 284 hours of labor to 5 hours by the 80s.

Innovations and advancements in dairying and livestock that evolved milking machines and automated feeding systems reduced labor demands and significantly augmented farmers' returns (Gardner, 2002, pp.12-18). Over the course of subsequent decades, a succession of motorized vehicles emerged to undertake tasks like planting, cultivating, and harvesting crops. Additionally, the dynamic between farmers and plants underwent a transformation through scientific advancements. Novel hybrid corn varieties permeated the Corn Belt during the 1930s, reshaping the approach to seed usage and intensifying reliance on scientific knowledge. The increased resilience of hybrids to drought conditions became evident during the arid periods of 1934 and 1936 and these years served as a vivid illustration of hybrids' drought tolerance, especially in contrast to traditional varieties, which suffered from withering crops. The survival of hybrid crops in comparison to the struggles of their conventional counterparts validated their efficacy, prompting a significant influx of farmers to embrace hybrid planting. In contrast to the mere 1 percent of the acreage in the Corn Belt sown with hybrids in 1933, a remarkable 90 percent of acreage was dedicated to hybrids in 1943 (Cummo, 2007, pp. 08-12)

The domain of chemistry yielded fresh insecticides and fertilizers, endowing farmers with unparalleled dominion over the natural environment and the responsibility to judiciously tailor these chemicals to the farm's requirements, eschewing indiscriminate use. Among a series of legislative actions, the Insecticide Act (1910) was enacted by Congress, mandating accurate labeling for insecticides. Concurrently, state legislatures introduced analogous laws to regulate the production and labeling of fertilizers. At that time, the United States

manufacturers of insecticides generated an approximate revenue of \$20 million (Cummo, 2007, pp. 08-12). Furthermore, The USDA data indicated that the post-World War II era witnessed a significant rise in the use of nitrogen-based fertilizers which approximately reached 12 million tons by the 1980s (Gardner, 2002, p.22).

In the 20th century, the farmer's role evolved beyond tending to plants, encompassing that of a machine operator, applied chemist, and field naturalist.

II.3.The Impact of Technological Progress on the American Society

II.3.1.Role of Technology on Social Interaction

Telecommunication innovations of the early twentieth century mainly The telephone, The radio, and The television sparked a mixture of curiosity, excitement, and apprehension in the American society as they navigated the newfound possibilities and challenges brought about by these technologies.

The advent of the telephone in American society ushered in a transformative era of communication that significantly impacted daily life. Notably, in 1986, the sheer magnitude of telephone usage was striking, with a staggering number of over 350 billion calls made by Americans. A predominant 90 percent of these calls were localized, reflecting the significance of the telephone as a means of connecting people within their immediate communities. Statistics reveal that individuals spent a substantial amount of time engaged in telephone conversations, averaging around twenty to thirty minutes per day. The telephone adoption broke societal barriers by facilitating connections among homemakers, a demographic that might otherwise have experienced feelings of isolation. By bridging social gaps, the telephone played a crucial role in fostering communication and reinforcing social bonds among different segments of the population (Cummo, 2007.p.95).

Moreover, Radio and television became central fixtures in American households. Families often gathered in their living rooms to listen to radio shows or watch TV programs

together. This shared experience created a sense of togetherness and provided common topics for discussion. Additionally, iconic shows like "I Love Lucy," "The Ed Sullivan Show," and later, "The Simpsons" became cultural touchstones, influencing humor, fashion, and societal values. The advent of these technologies not only provided American families with new entertainment channels but played a crucial role in influencing family dynamics, social norms, and public opinion.

II.3.2.Applications of Technological Progress in Entertainment

- **The Evolution of Movies Industry**

The invention of movies or motion pictures was a collaborative effort of multiple inventors and pioneers that began in the late nineteenth century. In Europe, the French scientist Étienne-Jules Marey made significant contributions to chronophotography while in 1878, the English photographer Eadweard Muybridge successfully captured the motion of a horse's movement using about twelve cameras in California. In America, Thomas Edison's work on motion pictures is rooted back to the 1880s after an encounter with Marey in Europe. Later, Edison associated with one of his team, William K. L. Dickson, led to the invention of the "kinetoscope" which by April 11, 1894, New Yorkers were granted the chance to view a selection of 10 distinct 90-second films such as "Roosters" and "Trapeze" at the launch of the Kinetoscope parlor show. Furthermore, as innovations continued to progress. The Parisian Lumière Brothers (Auguste and Louis) devised an improved portable motion picture camera and projector that allowed them to hold their Lumière premier show on December 28, 1895. Independently, Thomas Armat successfully addressed the challenge of ensuring adequate light transmission through the film to effectively illuminate a sizable screen. However, due to the inability to commercialize the improved camera, he collaborated with Thomas Edison to introduce the "Vitascope" in America's first exhibition of motion pictures on April 23, 1896, at the New York Theater. In the early years of the 20th century, penny arcades were well-

known entertainment venues that provided different forms of leisure and amusement.

However the fast growth of movies transformed it into nickelodeons which in 1900 the city of New York boasted an impressive count of over 600 nickelodeons, welcoming a staggering total of over 300,000 daily visitors (Biagi, 2017, pp. 126–129) and in 1908, Manhattan reached a number of over 200 such theaters and an impressive 8,000 scattered across the nation. Although the earliest silent movies faced a crucial technological limitation related to the projection mechanism.(Gordon,2017, p.203)

By 1907, prominent figures and producers including the Lumières and Georges Méliès were contracted with Edison to supply theaters with more movies using Edison's licensed equipment, a year later Biograph Company which had better cameras dealt with Edison to form the Motion Picture Patents Company (MPPC). Filmmakers like Edison's former projectionist Edwin S. Porter and the French Georges Méliès sought to make movies more artistic so new methods and film techniques were experimented to enhance storytelling and visual aesthetics. The silent era produced timeless classics such as *The Birth of a Nation* and Méliès's *A Trip to the Moon* in 1902 and witnessed a transition to full-length features in larger theaters. (Biagi, 2017, pp. 128–134)

Soon later, the Hollywood studio system emerged and attracted creative talents to the movie industry between the 1920s and the onset of the Great Depression giving rise to what is famously known as "The Big Five" major distributors: Warner Brothers, Fox, MGM, Paramount, and RKO. These influential studios would later come to monopolize the film industry in the subsequent decades. Moreover, the audience experienced a transition to synchronized sound movies or the "talkies" with the release of *"The Jazz Singer"* by 1927 which introduced spoken dialogue and musical sequences. (Buckmaster, 2022)

The Golden Age of Cinema and Movies in the 1930s till the 1950s was a period of sound refinement and the development of colorization technologies in addition to the

development of special effect techniques that ushered new genres like science, fantasy and documentaries that educate the audience rather than just entertain them. Moreover, Hollywood stars became iconic figures who captured the hearts of millions and left a lasting impact on popular culture and movies became an integral part of people's lives.

Ultimately, the appearance of television as a new medium of entertainment, news, and information for households worldwide brought some challenges to filmmakers and movies studios major technological changes in the wide-screen cinema format like Vista-Vision, Cinerama, CinemaScope and 3-D changed the screen's dimensions, the film's measurements and enhanced people's visual experience.

Later decades witnessed The emergence of computer technology or Information Technology, (IT) has paved a new way for the development of film and television media by reshaping the processes of shooting footage, production, editing and distribution. In this context, technologies of “visual effects” (VFX) varied from devices that create explosions and generate rain, wind or snow effects to optical effects and more recently to computer-generated imagery (CGI) that progressively developed with the spread of personal computers (PC), examples of the earlier application of VFX and CGIs in movies include *The Andromeda Strain* (1978), *Tron* (1982), George Lucas' *Star Wars* (1977) and *The Terminator* (1984) just to mention a few. Still, obstacles to accurately capturing facial expressions were addressed by James Cameron who implemented these technologies in most of his works, he devised in 1995 a compact camera placed on a helmet that could “track every facial movement, from darting eyes and twitching noses to furrowing eyebrows and the tricky interaction of jaw, lips, teeth and tongue” (Grant & Meadows, 2018, p.129-130).

Movies offered a new form of entertainment and escapism during the turbulent 20th century. In times of economic depression, war, and social upheaval, going to the movies provided a welcome distraction and a chance to forget one's troubles, if only for a few

hours. Furthermore, movies often served as a reflection of the social issues and concerns of their time. They tackled subjects such as racial discrimination, gender roles, economic inequality, and political unrest. Films like "To Kill a Mockingbird" and "Guess Who's Coming to Dinner" addressed issues of race and prejudice, while movies like "Norma Rae" focused on labor rights. As well as they played a significant role in shaping and disseminating cultural trends. Fashion, music, and language seen on the silver screen often influenced popular culture.

- **Technology's Influence on Music Recording**

Similarly, Music and recording underwent significant series of innovations and refinements during the last century after the introduction of the phonograph in 1877 and Emile Berliner's innovation of the Gramophone in 1888 and sooner, the 1900s became a period of maturity for the recording industry that was dominated by Edison Phonograph Company and Works founded in 1899, Columbia Phonograph Company (founded in 1891 as American Gramophone Company by a group of investors) that offered replaceable discs and established a good reputation for high-quality recordings, another major firm that just like Columbia adopted Emile Berliner's disc records technology was Victor Talking Machine Company (founded in October 3, 1901), therefore due to the patent mutuality of both companies, a corporation had emerged as stronger entity in 1901. In the following few decades, companies' concentration was more on aggressive marketing that included investments in advertising and partnerships with famous artists. In addition to signing exclusive contracts with popular musicians and figures that ensured the recording and distribution under their brand. However, the years that followed the breakdown of some essential patents allowed the U.S. Market to welcome about new 166 companies in 1919. (Tschmuck, 2006)

The expansion of the industry brought some new technologies such as electrical recording, the microphone and the widespread of radio broadcasting in the 1920s which promoted music by introducing listeners to country music or the so-called “Hillbilly” and also different styles and genres of Jazz and Blues and new generation of artists which shaped the musical taste of American society (Tschmuck, 2006)

The introduction of the musical film *The Jazz Singer* was another major contribution that drove the large film studios to integrate music and soundtracks into their coming projects. By the end of the 1930s, owned more than 65% of all music publishers represented by ASCAP. As the demand for records surged after the war, record companies eagerly explored new technological avenues to extend the playing duration of their records. Later, Director of Engineering Research and Development for CBS Peter Goldmark came up with a vinyl Long-playing record (LP) that extended the playtime to 25 minutes per side allowing albums to be stored in one record. Moreover, The German innovation of magnetic tape was crucial technology that the U.S. took advantage of under a different brand name of “Scotch” to provide the market with high-fidelity sound reproduction. Even though, the majors resisted at first the new technology, this technology shifted the recording of music from analog to digital. By the fifties, Rock ‘N’ Roll music dominated the music chart and sooner stereo recording technique was integrated for the first time into Elvis Presley’s album in 1956 (Tschmuck, 2006, pp.92-95). The development of electric guitars, keyboards, and amplifiers in the mid-20th century revolutionized music of rock 'n' roll. These instruments allowed musicians to explore new sonic possibilities, giving birth to entirely new music styles.

Later decades from the seventies till the nineteenth of century witnessed the emergence of digital devices. The advent of cassette tape technology empowered individuals to craft personalized collections of songs and audio. Cassette technology was also instrumental in the development of the hip-hop subculture. Before the first hip-hop twelve-

inch records were widely available in 1979, homemade cassette tapes were the primary way to document hip-hop music. Cassettes not only helped introduce New York City residents to hip hop but also played a crucial role in spreading this music across the country (Murdy, 2021).

By the end of the 1980s, a new format had emerged in the recording industry the compact disc (CD). The immense advantage of CDs enabled this technology to dominate the market within a few years, the clarity of sound and small size made it even more portable (Ariniello, 2010, p.12). The availability of digital sampling technology allowed artists to sample and remix existing recordings, leading to the emergence of electronic dance music, by the later years of the twentieth century iconic music videos became an essential part of an artist's identity and marketing due to the integration of music videos with television and later the internet.

II.3.3.Role of Technology in Education and Learning

The education sector, both in the United States and globally, held significant importance as inputs to productivity and economic growth. By equipping individuals with useful skills, education directly enhances productivity and, consequently, the incomes of those who receive schooling. Moreover, education plays a crucial role in stimulating invention and innovation, facilitating the rapid diffusion of technological advancements. The significance of education evolves alongside technological progress, as certain technologies necessitate advanced cognitive skills from workers, while others enable the substitution of human expertise with machinery. Particularly, formal education, including basic literacy, plays a vital role in fostering a well-functioning democracy and contributes to active citizenship and cohesive communities.

In the early 20th century, educators embraced cinema as a means to stimulate students' interest in science. Films were considered an interesting means of direct observation of nature and were selected to depict phenomena beyond students' sensory experiences, such as the

solar system, bacteria, and atomic structures. As a result, in the 1960s, short films in cartridges replaced silent films, allowing teachers to illustrate a single concept per lesson effectively. Video emerged as a contender in the 1950s but only in the 1980s did teachers transition from projectors and films to video and television sets, offering new possibilities such as recording television programs for later viewing and enabling student engagement through creating their own videos of scientific phenomena. During the 1950s, science television gained significant popularity, with Iowa State University running its television station WOI-TV. From 1952 to the mid-1970s, WOI-TV aired TV-Schooltime, a program scheduled at 10 a.m. on weekdays, delivered in thirty-minute segments. To enhance the learning experience, WOI-TV provided teachers with a corresponding guide containing suggested activities for students before and after each program. While the content may not have been adventurous, it aimed to engage students, with one program showcasing the setup of an aquarium by a teacher and her students. In 1955, WOI-TV expanded its science offerings with "Chemistry 101," designed to complement instruction in introductory high school chemistry courses. Addressing criticisms of science television being dull, Bill Nye emerged as a pioneer in captivating the MTV generation with his engaging and entertaining science program.(Cumo, 2007.pp.120-121)

As time progressed, technology continued to shape the classroom environment with the introduction of visual aids technologies including film projectors and slide Projectors into the educational sphere and training purposes, the U.S. Army air force produced over 600 filmstrips and 400 training videos that helped soldiers in their training .

The 1960s witnessed the emergence of computers in education, marked by the inception of computer-assisted instruction (CAI). This period was pioneered by the IBM 1500 CAI system and the Stanford CAI project. However, as technological advancements accelerated, the microcomputer which was a smaller and more affordable version of its

predecessor made its debut in the late 1970s, soon later the education system started its investments in this new technology for pedagogical use and by 1988 it was estimated that three million microcomputers were purchased for primary and secondary schools with an average usage of half an hour per week for student.

The CAI and microcomputers played a supporting role in developing problem-solving skills among students and programming languages like ADA, PASCOL, FORTON, and Papert's renowned coding language LOGO were specifically created to introduce children to programming and cultivate their computational thinking skills. In parallel, data management systems were developed to efficiently handle student records, attendance, and grades, thereby streamlining administrative tasks within educational institutions. These technological advances were further complemented by the provision of interactive lessons, tutorials, and educational games, enhancing the learning experience for students. Moreover, a significant application of computers in education emerged through word processing, simplifying the process for educators to generate teaching materials, craft lesson plans, and design worksheets. Together, these innovations have reshaped the educational landscape, facilitating more engaging and effective teaching methods (Saettler, 1990, pp.456-460)

II.4.Impact of Technological Progress on the American Politics

The advancement and modernization of American political communication in the mid-twentieth century were predominantly propelled by technological progress, primarily from the emerging information and communication technologies (ICTs). Over time, political figures have consistently sought to employ communication tools to circulate information, garner followers, secure funding, and rally political engagement. Therefore, what has notably evolved are the tactics and instruments employed to accomplish these objectives.

II.4.1.The role of technology in political Communication :

The rise of radio broadcasting as a new prominent medium of the political landscape can be attributed to the first KDKA station commercial radio broadcast coverage of the Harding-Cox presidential election results in Pittsburgh on 02nd November 1920, by that time the radio had already become a cherished technological marvel and a significant mode of communication as it found its way into nearly every American household's living space. (Craig, 2003, p. 08)

As highlighted by the political historian of the United States Dr. Douglas Craig in his book titled *Fireside Politics: Radio and Political Culture in the United States, 1920-1940* (2003), Prior to Franklin Delano Roosevelt's adept utilization of radio, particularly through his Fireside Chats, many politicians used the new medium as a strategy to reach more audience and to transmit their voices such as Woodrow Wilson's experiments with radio broadcasting in 1919, the President Warren G. Harding's speeches between 1922 and 1923 and his following successor President Calvin Coolidge who was considered a pioneer in integrating this new technology in political advancement. Moreover, during the presidential race of 1928, candidates Herbert Hoover and Al Smith both used radio to reach voters in their campaigns, which allowed listeners to hear the candidates' voices and emotions and have a better understanding of the personality and character of their upcoming leader. However, none of these earlier utilisations was as extensive or notable as Franklin D. Roosevelt's iconic Fireside Chats during the Great Depression and World War II (pp. 142–146).

During the presidency of Franklin D. Roosevelt between 1933 till 1945, the Great Depression and World War II presented an unprecedented confluence of challenges that pushed FRD to pioneer innovative solutions in governance and communication, leaving an indelible legacy of resilience and effective leadership in times of crisis. The “Fireside Chats” were usually aired in the evenings when families gathered around their radio which gave a sense of intimacy and personalization between the president and American citizens.

Through radio, FDR discussed the banking crisis and the solutions taken by the government, the New Deal programs, national security and the issue of WWII. Roosevelt's mastery of radio in addition to his soothing and empathetic voice alleviated the anxieties and fears of the citizens during the traumatized era. Also, the phrasing and clarity of the terms he selected in his broadcasts allowed him to create a unique bond with the common people gaining him much support. Additionally, The live chats enabled Roosevelt to explain his vision and policies to ordinary citizens without the filter of newspapers and allowed them to engage in political and economic affairs by responding to his ideas through written letters which left a historical legacy of citizens' confidence in the government leadership (Nunez, 2020, pp.117-124)

To end, the radio not only impacted American political culture but also led to a sustainable growth in the diffusion rate of over 90 percent by 1933 and a tenfold surge in the political radio audience within a mere span of six years which increased from 6.3 million listeners during an FDR address in 1932 to an astonishing 61.4 million tuning into his speech on February 23, 1942(Epstein, 2013, p. 11).

II.4.2.The Rise of Television and Political Advertising

Political advertising refers to a way of communicating political ideas and views related to candidates, political groups, or beliefs to voters and the public. It's a way to influence or participate in important political discussions. This type of advertising includes activities related to political parties, representatives, or candidates, promotions about important political topics, and information about government policies. These promotions can come from the government, political groups, advocacy organizations, and other interest groups (Oparaugo, 2021, p.19).

The earlier traditional tools of mass media including newspapers, magazines, books or posters were implemented effectively in political communication. Yet, the widespread

adoption of radio broadcasts in the 1930s and the surge of television popularity in post-World War II revolutionized the way politicians engage with the public.

Albeit, the 33rd President Harry Truman was the first to deliver a televised presidential address from the White House to the nation on October 5, 1947 and the first to use it in Campaign advertising Even though television was still in its infancy stage

Yet, the elections of 1952 were considered the origin of televised political advertising. Dwight Eisenhower's win greatly contributed to television and his campaign team employed television effectively as a multifaceted medium, drawing upon the expertise technique in the world of advertising Rosser Reeves's concept of Unique Selling Proposition (USP) that emphasized the uniqueness and superiority of Eisenhower over his opponent Adlai Stevenson through innovative programs like the "Eisenhower Answers America" series, the one-minute-long animated advertisement "I Like Ike" featured Disney animation company, catchy memorable slogans that was implemented in posters, banners and other materials complemented by direct-to-camera appeals to create a personal connection with people (Diamond & Bates, 1992).

The major event that highlighted the importance of television in political advertising and communication was the presidential elections of 1960 between the Democratic nominee John F. Kennedy a senator from Massachusetts, and The Vice President of the United States, Richard Nixon represented Republican Party. The Kennedy-Nixon speeches or the so-called the "Great Debates" were a series of four speeches between the two candidates which in they discussed domestic issues, the diplomatic relation between America and Cuba and the involvement of the U.S. in some islands near the Chinese coast.

Keneddy was aware of the television importance and took advantage of the visual media, maintained eye contact with the camera looked polished, confident and relaxed. While Nixon who was still recovering from a recent knee injury looked pale, and uncomfortable and

gave a poor performance in the first debate. After the debates, radio listeners were split on who will win and a large margin of this group thought Nixon was the winner. Whereas, those 70 million people who watched the televised debates overwhelmingly thought Kennedy was the winner. Overall, John F. Kennedy won the elections of 1960 to become the country's first television president.

With this in mind, it was reported that more than half of the voters claimed that the candidate's speeches had influenced their opinions and 6% of them gave their voices only based on the Great Debates. This turning point in American political history not only impacted the elections of the 60s but served as a precedent around the globe and soon later, debates over national offices were established in Germany, Sweden, Finland, Italy, and Japan (Soddu, 2012, p.5)

Subsequent elections saw television's further integration into political strategies, some examples of these might be: the production of offensive type of ads during the elections of 1976, the negative influence and the transmission of false information and also the incorporation of emotional appeals, dramatizations, and testimonials. Furthermore, the advent of satellites and TV cables in 1980 contributed to the rise of the 24-hour news network (CNN) introducing a new concept of non-stop, up-to-the-minute news reporting known for its continuous news broadcasting and coverage of political affairs of U.S. and global events (İnce&Koçak, 2018, p. 45).

II.4.3. The Role of Mass media and technology in Political Activism and Mobilization:

The technological progress of mass media and television in the 1960s and 1970s played a critical role in multiple events in American history including The Civil right Movement, the Anti-Vietnam War protests, The Watergate scandal and the Cold War ...etc

In the case of The Civil Rights Movement in the 1960s. the ICT and specifically television had a significant role in the coverage of Little Rock Central High School segregation,

violence suppression of the Birmingham campaign in May of 1963, when the police officer Bull Connor loosed dogs and fire hoses against peaceful activists, released footage of dog lunging at youths and high-pressure water drilling on their backs spread terror among Americans. Moreover, the march on Washington and the televised speeches of Martin Luther King Jr. especially his famous speech ‘‘I Have a Dream’’ not only eased the road to pass The Civil Rights Act into law a year later in 1964 but also elevated the profile of the Civil Rights Movement on the global stage. Furthermore, television networks of ABC, CBS and NBC reported directly Selma to Montgomery March, particularly the events of ‘‘Bloody Sunday’’ on the Edmund Pettus Bridge and exposed the brutal violence and oppression of state troopers against African Americans (Bodroghkozy, 2012, pp. 117–120)

Parallely, the conflict in Vietnam received one of the longest airtime coverage along fifteen years with numerous news shows such as NBC’s Vietnam Weekly and CBS’s Vietnam Perspective, The televised coverage of that time focused on wounded and body count reports, bomber pilots clips in addition to the suffer of Vietnamese civilians and children, a few examples of these images that left an everlasting impact on Americans memory include the Photographs of the ‘Napalm Girl’ Kim Phúc, running naked and severely burned from a napalm attack, the execution of a Viet Cong prisoner, the My Lai Massacre and the self-immolation of a Buddhist monk Also the influence of television was not limited to the war itself, rather it shed light on the Anti-war movement, the televised rallies and protests played a crucial role in shaping American’s political opinion. Notable examples of these rallies include the moratorium rallies and the March on the Pentagon in 1967. (Vaughan, 2020, pp.03-07).

Television networks provided extensive coverage of anti-war protests and demonstrations encouraging more people to join in, perhaps the most famous example of television’s influence was the ‘‘Cronkite moment.’’ Walter Cronkite, a respected news anchor, visited Vietnam and, upon his return, he delivered a televised editorial in 1968 stating that the

war was unwinnable. His words carried immense weight, and it is said that President Lyndon B. Johnson remarked, "If I've lost Cronkite, I've lost Middle America."

Generally technology served as a powerful tool for the anti-Vietnam War movement, the proliferation of photocopying machines, allowed for the rapid dissemination of anti-war literature, pamphlets, and newsletters which allowed activists to produce and distribute their own materials, reaching a wider audience and mobilizing more supporters. Furthermore, the emergence of portable cassette recorders enabled activists to capture and share speeches, protests, and anti-war songs. These recordings helped to unify the movement and preserve the oral history of the protests.

II.5. Military Innovation and Technological Progress

The United States strategically employed technology to bolster its military capacities. The early years followed the first controlled, and sustained flight achieved by the Wright Brothers in 1903 saw significant advancements in military aviation and by World War I America had had 2,698 planes in service, of which 667 were manufactured in USA and by the end of the war in 1918, the United States had produced and deployed around 11,000 military aircraft. It's important to note that these numbers include various types of aircraft, including fighters, bombers, reconnaissance planes, and trainers.

Other major innovations in military weapons include development of tanks, such as the M1 Abrams. In addition to missile technologies, including intercontinental ballistic missiles (ICBMs), cruise missiles, and anti-ballistic missile systems as well as radar systems, jamming devices, and communication systems that improved situational awareness and battlefield communication. Furthermore, The U.S. in the years of 1942-1945 led the top-secret Manhattan Project to develop atomic bombs and about the same time President Harry S. Truman decided to employ the newly tested atomic bomb against Japan which in 06 August a lone American

B-29 from the Marianas dropped an atomic bomb on Hiroshima, three days later another one was dropped in Nagasaki leading Japan signing of surrender terms (Stewart, 2010, p.199)

The Cold War, the period of geopolitical tension and rivalry between the United States and the Soviet Union, lasted roughly from the end of World War II in 1945 until the dissolution of the Soviet Union in 1991. The most intense phase of the Cold War was experienced during the late 1940s to the early 1990s, during this era the US sought to prevent the further expansion of communism and Soviet influence around the world through various strategies. This period of ideological and military competition led to the development of new weapons and proliferation of nuclear weapons. Additionally, the exploration of space also known as the “Space Race” led to the development of satellites and rocket technology.

II.6.Conclusion

The twentieth century was a transformative period of American history marked by an extraordinary technological journey that reshaped America's economic, social, and cultural landscape, the following chapter will shed light on the influence of the 21st-century technology on America.

Chapter III

Beyond Gadgets: A Holistic Exploration of the Role of Technology in 21st Century America

III.1.introduction :

As the 20th century faded into the 21st, the momentum of progress showed no signs of waning. Instead, it surged forward with unprecedented vigor. The advent of the digital age brought forth an era characterized by the internet, mobile devices, artificial intelligence, and a relentless march toward automation. This chapter explores the impacts and transformations in different fields and sectors resulted from the evolution of digital age technologies

III.2.The Impact of Technology on Trade

The rapid growth of digital technologies in the past two decades has redefined the U.S. economic landscape and employment relationships, in addition to the development of automation, new forms of trade have emerged such as e-commerce, the gig economy, tech hubs and startups.

III.2.1.The Gig Economy

The gig economy or the on-demand” economy is defined as a contemporary labor market characterized by a decentralized workforce engaged in short-term, task-based employment arrangements. Although this concept is not purely new and has a long history, the digital platforms and applications facilitated the evolution and growth of the gig economy business model. individuals, commonly referred to as gig workers, partake in independent, project-specific work engagements rather than traditional full-time employment. These workers offer their skills, services, or assets on a flexible basis, responding to fluctuating demand for services across various industries. The essence of the gig economy lies in the digitized matchmaking between gig workers and consumers or clients through virtual marketplaces, fostering a more fluid and adaptable approach to work (Lobel, 2017, pp.01-03)

According to a survey carried out in 2020, over 53 million individuals in the United States, which accounts for approximately 34 percent of the total workforce, were engaged in freelance work to varying degrees.

Companies of this model have challenged the traditional and well-established employment structure offering both opportunities and challenges for workers, businesses, and policymakers. In the United States, these companies include Uber and Lyft which offer ride-hailing services, personal assistant services and handyman/handywoman errands such as TaskRabbit and Handy, food delivery platforms like Grubhub, fitness enthusiasts can offer personal training and wellness services through platforms like Thumbtack (Haris,2018, p.03)

Information technology fueled the gig economy by providing workers and employers with platforms and websites such as Fiver and Upwork to gain information about job availability, as well as it helped foster the economic market by generating employment opportunities that demand advanced technological skills, such as website development and software engineering while other freelance websites like TaskRabbit and Esty might be more suitable for individuals with expertise in handcraft and construction-related skills as they do not necessarily require high-level technical skills (Best, 2017, p.64)

III.2.2. E-commerce

E-commerce or electronic commerce involves buying and selling goods and services through electronic communications mainly over the Internet. This form of digital economy is about three decades old now and has grown rapidly in recent years. E-commerce's two fundamental categories are: business-to-consumer (B2C) which in companies directly sell products or services to individual consumers and business-to-business (B2B) e-commerce which involves transactions between companies or organizations (Tian& Stewart, 2008)

The population of e-commerce has experienced exponential growth and transformation recently which according to the 2022 report from the Retail Indicator Division of the US Department of Commerce, e-commerce sales in the United States for the year 2021 reached \$870 billion. This figure reflects a growth of 14.2% compared to the previous year

(2020) and a substantial increase of 50.5% when compared to the year 2019. In 2021, e-commerce accounted for 13.2% of the total retail sales in the United States (Goldberg, 2022).

Further, in the second quarter of 2023, the U.S. Census Bureau of the Department of Commerce reported that retail e-commerce sales reached an estimated \$277.6 billion, reflecting a 2.1% increase from the first quarter of 2023. Total retail sales for the same period were approximately \$1,798.2 billion (U.S. Census Bureau, 2023).

For decades before the emergence of e-commerce, brick-and-mortar retail also known as physical retailing held a predominant position in shaping the consumer shopping experience. These traditional establishments characterized by high operating costs, primarily driven by expenses related to physical store locations, staff salaries, and utilities not only provided customers with the opportunity to test products before making a purchase, alleviating concerns related to product quality and suitability but also provided a sense of immediate ownership as customers leave the store with their purchases in hand. However, recently E-commerce has become increasingly popular among consumers due to the convenience of online shopping, which allows consumers to shop from the comfort of their own homes and to compare prices and products across multiple retailers.

E-commerce has had a great impact on the economy as a whole, as e-commerce expanded, its influence on aggregate productivity increased. E-commerce companies utilize information technology extensively to lower transaction costs,

III.3. The Impact of Technology On Healthcare

The technological progress of medicine and the healthcare sector was very transformative across various dimensions from diagnosis and treatment to patient care and drug development.

III.3.1. Telemedicine and Remote Patient Care

Telemedicine also referred to as telehealth, encompasses the utilization of electronic information, communication technology (ICT), and telecommunications to access necessary medical care while adhering to social distancing measures. All that's required is a device with internet connectivity, such as a phone or computer. By engaging in telemedicine, individuals can seamlessly continue their medical treatment and consultations remotely through various modes of communication, including video calls, phone consultations and secure messaging (Jnr, 2020, p.04).

The concept of telemedicine extends beyond remote healthcare services; it also encompasses a broader spectrum of applications. This includes facilitating long-distance medical care, providing ongoing health education, offering training for medical professionals, and conducting administrative meetings. Additionally, telemedicine leverages existing platforms and systems, including patient portals, to facilitate the delivery of treatment to patients. While telehealth's rapid adoption in healthcare settings holds significant potential, it has given rise to new challenges that could impact established health infrastructure (Bokolo, 2020, pp.04-05)

The evolution of this approach in the USA dates back to the 1960s with the establishment of a direct two-way interactive television between the Nebraska Psychiatric Institute and Norfolk State Hospital for conducting psychiatric consultations. Though this technology initially was developed by health experts to reach remote patients in rural areas, by the time the U.S. government invested heavily in research to expand the utilization to a wider range of the population. During the Mercury space program, home monitoring advanced significantly as the National Aeronautics and Space Administration (NASA) initiated physiological monitoring over remote distances. NASA's continued efforts in this area led to a notable collaboration with the Indian Health Services, resulting in the Space

Technology Applied to Rural Papago Advanced Health Care (STARPAHC) project
(Medicine & Services, 2012, pp.11-14)

In their research on telemedicine utilization, Kane and Gillis (2018) found that The adoption of telemedicine within physician practices for patient interactions showed variation across medical specialties in 2016, with an overall utilization rate of 15.4%. Radiologists (39.5%), psychiatrists (27.8%), and cardiologists (24.1%) had the highest adoption rates. Radiologists primarily used store-and-forward technology (42.7%) for remote diagnostic interpretation, whereas psychiatrists employed videoconferencing (25.8%) for patient consultations. Cardiologists employed telemedicine (17.9%) for chronic disease management through remote patient monitoring. In interactions with healthcare professionals, 11.2% of physicians used telemedicine, with emergency medicine (38.8%), pathology (30.4%), and radiology (25.5%) leading in usage. Overall, telemedicine's diverse applications highlighted its impact on patient care and healthcare collaboration across specialties.

Telemedicine adoption was gradually growing, but its utilization was relatively limited compared to traditional in-person visits till the emergence of the pandemic. With the emergence of COVID-19, the use of telemedicine as a treatment approach became an emergency

This innovative approach allowed individuals to receive healthcare services while safeguarding both themselves and healthcare providers from the risks associated with COVID-19. Telemedicine brought forth several potential benefits as patients gain access not only to general healthcare providers but also to specialized medical experts. During the pandemic era, the U.S. Department of Health and Human Services Office permitted the use of telemedicine as a temporary procedure and encouraged it by offering physicians extra payments as long as they expanded their telemedicine services. Usually, these virtual

conferences were generally conducted via Zoom, Updox, FaceTime or VSee (Jnr, 2020, p.09).

III.3.2. Electronic Health Records (EHRs) and Data-Driven Healthcare

The Health Information Technology for Economic and Clinical Health (HITECH) Act in 2009 was a landmark piece of legislation in the United States whose primary goal was to accelerate the adoption of EHRs across healthcare providers, including hospitals and physician practices. Electronic Health Records (EHRs) are described as electronic versions of patients' medical history, treatment plans, diagnoses, test results, and other healthcare-related information that replaced traditional paper-based patient records. In the United States, there has been a swift and substantial integration of Electronic Health Records (EHRs) within the healthcare sector. Notably, statistics from the Office of the National Coordinator for Health Information Technology in 2015 revealed that by the year 2015, the prevalence of EHR utilization within hospitals had surged to surpass 80%, a marked contrast to the mere 10% adoption rate witnessed in the year 2008 (Ratwani, 2017)

In a comprehensive analysis of the utilization of Electronic Health Records conducted by Holmgren et al. (2021) as reported in the Journal of the American Medical Association (JAMA), findings of the examined sample of 371 health systems, showed that the vast majority, precisely 348 (representing 93.8% of the total), were situated within the United States (US) whereas the remaining 23 health systems (constituting 6.2% of the total) were located in various other countries.

Furthermore, Holmgren et al. (2021), found that clinicians in the United States, in comparison to their non-US counterparts, dedicated significantly more time to actively using the EHR for a diverse range of clinical activities or tasks. This observation suggests that US clinicians bear a more substantial EHR burden, which may be influenced by non-technical factors. These findings underscore the importance of considering clinician wellness and

related policy interventions when addressing the challenges associated with EHR usage in healthcare systems.

Among healthcare practitioners employing Electronic Health Records (EHRs), a noteworthy majority, approximately 78 percent, attest to an overall enhancement in patient care as a direct result of EHR utilization. Furthermore, a substantial proportion, approximately 81 percent, acknowledged that EHRs facilitated remote access to a patient's medical chart, while a significant percentage, about 65 percent, noted that EHRs were instrumental in identifying potential medication errors. Moreover, EHRs were reported to effectively alert clinicians to critical laboratory values, with approximately 62 percent affirming this functionality. Moreover, between 30 and 50 percent of physicians who incorporated EHRs into their practice affirmed experiencing clinical advantages linked to the provision of recommended care, the judicious ordering of relevant diagnostic tests, and the facilitation of patient communication. Significantly, the utilization of EHRs that met the stringent criteria of Meaningful Use, coupled with an extended period of EHR integration exceeding 2 years, demonstrated an independent association with the reported clinical benefits. Notably, physicians who possessed EHRs conforming to the Meaningful Use criteria and boasted a longer history of EHR implementation were most inclined to report advantageous outcomes across the spectrum of all ten assessed measures (King, Patel, Jamoom, & Furukawa, 2014)

However, challenges and issues related to interoperability have been a persistent hurdle. Different EHR systems often struggle to communicate and share patient data seamlessly, leading to fragmentation of health information and impeding coordinated care. Additionally, concerns regarding data security and privacy, integrity of sensitive patient information in the digital realm remain a critical concern, especially in the face of cyber threats and breaches (Ratwani, 2017).

III.3.3.Precision Medicine and Genomic Research

Another innovative approach to healthcare that has garnered significant attention in the 21st century is Precision Medicine. This revolutionary approach often referred to as personalized medicine. Although the term "precision medicine" is of recent coinage, the conceptual foundation upon which it rests has been an integral facet of healthcare practice for numerous years, evident in contexts such as blood transfusions. Within the framework of precision medicine, the application of knowledge gleaned from the sequencing of both human and pathogenic genomes assumes paramount importance. This knowledge permitted the meticulous matching of patients with the most suitable therapeutic modalities, ensuring that treatment were administered with precision — encompassing the selection of appropriate pharmaceutical agents, optimal dosages, and precise timing. Furthermore, it accommodates adaptability in response to evolving conditions, such as the emergence of resistance during the course of disease progression.

The emergence of personalized medicine gained momentum with the advent of the Human Genome Project. Initiated in 2000 and completed in 2003, this monumental project involved decoding the 3.2 billion units of human DNA, ushering in a transformative era of genomic discovery. This genomic knowledge explosion was accompanied by the rapid development of cutting-edge omics technologies, including microarrays, whole-genome single nucleotide polymorphism (SNP) chips, RNA interference high-throughput screening, and next-generation sequencing, among others. Collectively, these innovations marked the onset of the genomic revolution, offering immense potential and the prospect of developing personalized medical interventions tailored to the unique genomic information of each individual (Carrasco-Ramiro, Peiró-Pastor, & Aguado, 2017).

In the current understanding of personalized medicine, it is commonly defined as a holistic approach that combines molecular profiling, employing omics methodologies, with

traditional patient-specific information such as family medical history, environmental factors, and lifestyle choices. This comprehensive approach enables the precise design of diagnostic and therapeutic strategies that are uniquely tailored to individual patients.

Technological progress in the field of genomic studies has profoundly transformed scientists understanding of diseases in recent years and reshaped the field of medicine both in the United States and over the globe.

III.3.4. Artificial Intelligence Applications in Healthcare

The innovations and technologies of the health sector and medicine in the U.S. are not limited only to telehealth and telemedicine or precision medicine. Apart from this, Digital healthcare technologies, including but not limited to artificial intelligence (AI), 3D printing, robotics, and nanotechnology, offer a wide array of possibilities for minimizing human errors, enhancing clinical results, and monitoring data consistently over extended periods.

Furthermore, artificial intelligence isn't a singular technology; it's actually a group of various technologies. While many of these technologies have direct applications in the healthcare sector, they serve diverse purposes and support different processes (Kumar et al., 2022).

One of the most significant impacts of AI is its ability to collect and later analyze a huge amount of medical data that usually includes electronic health records and medical images obtained from Computed tomography and X-ray and even magnetic resonance imaging (MRI) which is subjected to preprocessing and feature engineering to ensure data quality and relevance. Depending on the disease detection task machine learning algorithms and AI-based techniques recognize patterns within the data that are indicative of the disease and make predictions without the intervention of physicians. This approach has proven its efficiency in the diagnosis of Alzheimer's, cancer, chronic diseases, tuberculosis and heart diseases (Kumar et al., 2022b, sec. 3 Artificial intelligence in disease diagnosis).

Another area where AI has changed the healthcare and medicine industry would be AI-powered surgeon robots. AI-assisted robotic surgery systems were first authorized for use in the USA at the turn of the millennium, though crucial decisions continue to be the responsibility of human surgeons, robots were frequently employed in various medical procedures, including gynecological, prostate, and head and neck surgeries offering surgeons remarkable capabilities by enabling them to improve visualization and perform minimally invasive procedures like suturing (Davenport & Kalakota, 2019).

Yet, not all Americans feel comfortable with AI when it comes to their healthcare. To put it clearly, in a recent survey conducted by the Pew Research Center, it was found that 60% of surveyed Americans expressed discomfort with the idea of a healthcare provider utilizing artificial intelligence to perform tasks such as diagnosing their medical conditions or suggesting treatment options. Whereas only 38% felt that using AI to diagnose disease or recommend treatment would lead to better health outcomes. Similarly, 6 in 10 Americans indicated that they would prefer not to have AI-driven robots involved in conducting certain portions of their surgical procedures. It should be noted that Americans are not entirely opposed to the idea of AI in healthcare, they are open to its use in areas like skin cancer detection, with 65% believing that AI could enhance the accuracy of diagnosis in this context. These findings based on a survey of more than 11,004 people suggest that people are generally open to AI's potential benefits in improving healthcare outcomes, but they may have reservations about its involvement in more complex and critical procedures like surgery. These findings underscore the importance of understanding public attitudes and concerns as AI technologies continue to advance and integrate into the healthcare system (Tyson et al., 2023)

III.4. Technology's Footprint on the Environment

III.4.1. Technology's Role in Environmental Changes

Over the past century, the progress of industrialization and technological achievements in the United States led to unprecedented prosperity in different aspects of life but also to an increase in environmental issues. First and foremost, The Donora, Pennsylvania incident, often referred to as the “killer smog” in the fall of 1948, served as a demonstration of the profound health threat posed by air pollution. The disaster which lasted for several days because of industrial emissions, particularly from the zinc and steel plants in the region, left about 14,000 residents with serious respiratory problems and around 20 fatalities (US EPA, n.d.). In the same manner, the Cuyahoga River fires that occurred on June 22, 1969, became a symbol of the environmental degradation resulting from industrial discharges. Also the concerns of the over usage of agrochemicals and pesticides had been raised with the publication of Rachael Carson's best-selling book *Silent Spring* in 1962 which curtailed the use of DDT due to its harmful effects on non-targeted species and birds. The effects of the evolving environmental problems in the USA drove the government to take serious actions by the 1970s, these ground-breaking laws include the Clean Air Act, the Clean Water Act, the Safe Drinking Water Act, and the Resource Conservation and Recovery Act to prevent negative environmental consequences and to enhance the quality of air and water (Council of Economic Advisers, 2000, p. 241).

Today, the increased rate of economic activities in addition to the combustion of fossil fuels, including coal, oil, and natural gas in developed countries including the USA contributed significantly to global climate change and to the fast increased concentration of greenhouse gas (GHG) mainly carbon dioxide (CO₂) emissions, as well as the release of harmful pollutants such as sulfur dioxide (SO₂) and nitrogen oxides (NO_x). As a result, scientists turned their attention in harnessing technology to mitigate them and to afford eco-friendly,

sustainable alternatives. These solutions vary from renewable energy sources to cleaner transportation methods and advanced industrial processes offering a pathway toward a more sustainable and environmentally responsible future.

III.4.2. Renewable Energy Technologies and Environmental Benefits

In 2021 an estimated number of 60,000 turbines with a capacity of 134.2 GW produced about 9.2% of U.S. electricity compared to 2010 statistics that reached only 40 GW. This great surge not only accelerated but also offered some promising solutions concerning the effects of traditional electricity generation which the U.S. wind capacity played a pivotal role by preventing an estimated 319 million metric tons of CO₂ emissions. Furthermore, 2015 studies projected that if 35% of U.S. electricity generation transitioned to wind power by 2050, it could yield a remarkable 23% reduction in greenhouse gas emissions from the electric sector. However, investigations of the environmental impacts of wind energy production revealed some side effects. For instance, The absence of well-conducted studies on locating played a role in the mortality of 0.2 million migrating birds and bats as a consequence of colliding with rotating blades (Center for Sustainable Systems, n.d.).

Similarly, solar power which can be harnessed based on two key technologies of Photovoltaic (PV) solar panels and Solar thermal conversion systems generate no greenhouse gases in the atmosphere or causes any kind of pollution Although some toxic chemicals, such as cadmium sulfide and selenium are used in their manufacture. In addition to that, other renewable energy sources including biomass had comparatively lower net CO₂ emissions in contrast to fossil fuels. Upon combustion, it released CO₂ that had been previously extracted from the atmosphere. Conversely, electricity generated from hydropower was virtually free from emissions. Nevertheless, it should be noted that substantial amounts of methane and CO₂ were emitted through the decomposition of vegetation in the reservoir(Center for Sustainable Systems, n.d.).

III.4.3.Electric Vehicles and Efficient Energy

The increased concern for the environmental impact stemming from CO₂ global emissions had significantly heightened interest in the electric vehicles (EVs) market as it asserted its ability to produce zero emissions as well as its high efficiency. This industry has experienced remarkable growth since the introduction of the Tesla Roadster in 2008 and quickly increased to reach 750,000 electric cars on the road in 2015. Moreover, In the United States, the transportation sector itself was responsible for approximately 28% of the country's greenhouse gas emissions by 2017 which signified a substantial opportunity for EVs to reduce this percentage in the future (Schmid, 2017, pp.03-04).

To put it clearly, electric vehicles (EVs) rely on electricity as their power source, a secondary form of energy generated through the transformation of various primary energy sources that include fossil fuels like coal, renewable energy, nuclear power and natural gas. This initial energy source undergoes a series of conversions: first, it is transformed into electricity within power plants, then transmitted to the EV's battery. During the charging process, this electric energy would be converted into chemical energy stored in the battery. Subsequently, when the vehicle operates, the chemical energy within the battery is reversed into electricity, facilitating the vehicle's movement and operation. For renewable energy, the PV systems besides wind systems installed on both the car and garages can supply the EVs with sufficient Power (Michaelides, 2021, pp.2-4).

In terms of environmental impact, each year, fully electric cars emit 4,587 pounds of CO₂, whereas gasoline, hybrid, and plug-in hybrids collectively emit 23,885 pounds of CO₂. (Schmid, 2017, p.05).Also recent studies from the U.S. Department of Energy (2021), revealed that various vehicle types exhibit notable differences in their emissions profiles. Gasoline-powered vehicles release approximately 12.594 pounds of CO₂ equivalent emissions into the atmosphere. In contrast, fully electric vehicles demonstrate a substantially

lower emissions footprint, with only 2,815 pounds of CO₂ equivalent emissions. Plug-in hybrid vehicles, which utilize both electricity and gasoline, occupy an intermediate position in this spectrum. These vehicles are responsible for a total of 4,825 pounds of CO₂ equivalent emissions annually. It's important to note that a significant portion of these emissions, approximately 1,885 pounds, originates from electricity use, while the remaining 2,939 pounds stem from gasoline consumption. These statistics underscore the considerable environmental benefits of electric vehicles, especially fully electric models, in reducing greenhouse gas emissions and contributing to a cleaner, more sustainable transportation landscape.

III.5. Tech-Driven Changes in Society

III.5.1. Education and Learning in the Digital Age

Over the past years, technology has steadily worked its way into classrooms, reshaping the teaching methods and learning environments and creating new forms and strategies for pedagogical education. The integration of the Internet, technologies including tools and equipment of interactive whiteboards, tablets become a standard of modern educational systems, and the fast development of the World Wide Web (WWW) allowed students to attain their instruction even distantly.

Online learning, also known as distance learning or e-learning, refers to a mode of education in which instruction and learning take place primarily through digital and internet-based technologies, rather than in a traditional physical classroom setting.

Online education in the U.S. has had a long history that preceded the vast adoption made of today's technologies. The first-ever fully online courses and programs in the U.S. were provided to students in the early 1980s and gradually online learning was implemented in K-12 schools, and undergraduate and graduate degree programs. Additionally, the expansion of Internet networks by the end of the 20th century facilitated the widespread use of

websites and chat rooms that were highly used for conferring and emailing during the education process. Till the introduction of Massively Open Online Courses (MOOC) in 2008, online education was limited to users or university students pursuing degrees and diplomas who often had the chance to have an entirely online courses or blended or hybrid courses, that integrate both face-to-face teaching and online technology-based elements. Furthermore, MOOC mode was designed to make education accessible to anyone interested in enrolling, regardless of geographic location or prior educational qualifications and thus, they were offered to a global audience, this mode was initiated by Coursera in 2012 that joint efforts of several universities including Stanford University and Princeton University, other popular initiatives include edX, eduMOOC, Udemy (Sun, 2016, pp.160-162)

Online Learning not only provides its students with the flexibility to access course materials and participate in classes at their own pace but it tends to be more cost-effective than traditional on-campus education, It also offers an opportunity to learn from professors and professionals in their fields worldwide. The anonymity nature of online education was a helpful element for people with shy personalities to engage actively in the learning process.

The pandemic of COVID-19 highlighted the effectiveness of E-education in the U.S. after the shutdown of campuses and schools in 2020, 84 percent of college students found themselves in situations where their classes were either partially or entirely conducted through online instruction (National Center for Education Statistics, 2022). The transition from traditional face-to-face classrooms to virtual classes via platforms like Zoom, Microsoft Teams and Moodle helped students continue their learning from home,

On the other hand, the sudden implementation of online learning has brought some challenges, from teacher's perspective, connectivity issues disrupted teaching flow and limited student's engagement and cause delays in commencing classes due to students' slow joining, , they reported also that a lot of students poor attendance demotivated them (Nambiar, 2020)

III.5.2. The Rise of Smartphones and Its Social Implications

In the ever-evolving landscape of technology, few innovations have had as profound an impact on our lives as the smartphone. The cell phone, originally designed for communication evolved to encompass a wide range of functionalities, from voice calls and messaging to personal information management (PIM) and wireless connectivity.

Although, the smartphone market has been around for more than a decade now, the leading Smartphone “Simon” created by IBM in 1994 was able to sell 50,000 devices just half a year after its launch, at the start of the new millennium the first camera J-SH04 mobile was introduced to the world and later versions of smartphones such as BlackBerry, Nokia 7650 and LG Prada brought other features of Camera, Bluetooth, Wi-Fi, Email, Web browsing and capacitive touchscreens. However, the launch of the first-generation iPhone in 2007 with its captivating features was a game changer as it started a new phase in this industry and paved the way for new possibilities for this trend. Within a year later Google Company unveiled a new operating system of Android (Nuhel, n.d.).

Up till today, many innovations and changes in the smartphone have enhanced its functionality and performance and So, the device itself transformed a lot of aspects of people's daily life. Recentsurveys illustrated that almost all Americans possess a cellphone with 85% of them being smartphone owners in 2021 compared to those 39% from the 2012 survey (Pew Research Center, 2021).

The impacts of smartphones cannot be limited to a specified area since they have been implemented extensively in various domains. The First and foremost impact of these digital devices is the instant connectivity facilitated by messaging apps and calls regardless of the geographical location of the users. In the U.S. society, smartphone applications and platforms such as Facebook, Instagram and Snapchat facilitate instant communication between adults and their friends. The majority of individuals aged 18 to 29 reported active usage of

Instagram, with 71% of this demographic indicating their engagement with the platform.

Similarly, Snapchat garnered significant usage in this age group, with 65% of individuals reporting that they actively use it (Atske, 2022).

Human reliance on smartphones has reached such a significant level that these devices have become virtually indispensable in our daily lives. These devices offer a wide range of services for daily tasks. Like high-quality cameras, instant access to the internet, email, and social networking sites, smartphones offer health-related assistance. For education, it served as a valuable learning tool. Additionally, through phones people can be informed about the latest news, sports, and online shopping. However, the overuse of mobile can bring some negative effects such as Attention-Deficit/Hyperactivity Disorder (ADHD) and cyberbullying (Rather & Rather, 2019) which by 2018 it was estimated that at least 59% of teenagers experienced online harassment and cyberbullying in U.S (Pew Research Center, 2018)

III.5.3.Smartphone-Related Health Concerns

While smartphones brought undeniable benefits and tremendous advantages, Researchers' studies of the reasons behind the increased number of mental health and psychological problems among youth and college students had paralleled a steep rise in the use of smartphones and social media of the same category.

Face-to-face interactions were gradually replaced by virtual chats and text-based exchanges affected negatively cognitive functions, including the capacity for critical thinking, memory retention, attention span, and emotional regulation. Moreover, excessive use and time spent on apps and social media can develop addictive habits that heighten problems of anxiety, depression and dysfunctional impulsivity. Data from a national survey conducted in the USA revealed that 46% of users rely on smartphones to an extent they can not function or imagine life without it, other actions of constant connectivity and unnecessary habitual phone checks and the fear of missing out (FOMO) (Ratan et al., 2021). In the same context, a

comprehensive examination of more than twenty research studies revealed a connection between the utilization of social media and the development of body image issues and disordered eating behaviors. Furthermore, in a randomized experiment, female participants conveyed heightened negative emotions after a mere 10 minutes of perusing their Facebook profiles, in contrast to those who browsed a website devoid of appearance-related content, individuals with a heightened inclination to compare their appearance with others reported an increased aspiration to alter their facial, hair, or skin appearance subsequent to their time on Facebook, compared to those who explored the neutral website (Abi-Jaoude, Naylor, & Pignatiello, 2020).

Additionally, results from experiments on the use of electronic screens prior to bedtime were demonstrated to disrupt sleep in several significant ways. These disruptions encompassed an extended time required to fall asleep, decreased evening sleepiness, diminished melatonin secretion, a delay in the circadian clock, a reduction in the amount and postponement of rapid eye movement sleep, and a decrease in morning alertness (Abi-Jaoude et al., 2020).

Other studies on physical problems associated to the addictive use of phones revealed that issues related to posture changes, such as cervical repositioning errors involving flexion and lateral flexion, as well as persistent neck discomfort, were found to be more likely associated with smartphone addiction (Ratan et al., 2021).

III.6.The Impact of Technology on Politics

Technology has made its way into the political scene long before the introduction of the Internet and the advancements brought by today's digital technologies. However, during the early elections of 2000, the Internet became a turning point in shaping electoral strategies and practices of communication with voters, reaching and mobilizing voters and fundraising efforts. Examples of the primary campaigns that implemented the features brought by the Internet include, John McCain's Campaign and Al Gore's email campaign launch of a website

that featured detailed policy proposals and targeted supporters' emails to collect donations and mobilize volunteers

Internet technologies have transformed campaign fundraising. In 2004, Howard Dean pioneered online fundraising by appealing to small donors through his campaign website.

Barack Obama's 2008 campaign took online fundraising to new heights, raising record-breaking sums through a vast network of small donors. Thus, this model has since become standard practice for political campaigns of all sizes and ideologies.

the advent of social media networks made it easier for citizens to participate in political discourse prominent examples are the 2008 and 2012 Obama campaigns took this to the next level, using platforms like Facebook, Twitter, and MySpace (back then) to engage with voters directly. And by 2016, Donald Trump's presidential campaign harnessed Twitter to communicate directly with the electorate, circumventing traditional media gatekeepers. His provocative tweets created a real-time feedback loop with his base and dominated news cycles.

III.6.1. The Role of Technology in Misinformation and Fake News

Fake news, often described as news that seeks to damage the reputation of an entity, individual, or organization, has found fertile ground in today's political landscape, particularly on social media platforms. This phenomenon has not only led to the spread of misinformation but has also eroded the trust in mainstream news outlets, further dividing society along ideological lines. The advent of the internet and the proliferation of social media giants like Facebook and Twitter, boasting billions of users, have created an environment where content can be generated and disseminated with ease. Furthermore, companies such as Google, Facebook, and Twitter employ algorithms that determine the content users see based on their past searches and preferences and latest interactions. This algorithmic curation, while aiming to provide personalized experiences, unwittingly creates "filter bubbles." In these bubbles,

individuals are exposed to content that aligns with their existing beliefs, reinforcing confirmation bias and deepening ideological polarization. The 2016 U.S. presidential election witnessed a surge in public engagement with fake news stories, particularly on Facebook that enable the rapid sharing of news stories without the traditional fact-checking. Thus, individuals construct their own media echo chambers, consuming content that reinforces their existing viewpoints. Another pertinent example, former President Trump's utilization of the term "fake news" in a tweet in 2017 to discredit investigations into alleged collusion with Russia. Therefore, by labeling unfavorable reports as fake news, political leaders further undermine trust in reputable journalism and sow seeds of doubt in the minds of their supporters.

At its core, democracy relies on informed citizens making rational decisions based on reliable information but dissemination of fake news disrupts this foundation causing citizens to form misguided opinions and make irrational political choices (Lee, 2019)

III.6.2.Cybersecurity and Election Integrity

The events involving Russian cyberattacks on voter registration databases leading up to the 2016 election marked a significant turning point in the discussion surrounding election security. These incidents brought to the forefront a fresh and concerning method through which foreign nations with adversarial intentions could disrupt U.S. elections.

First, a cyberattack can be defined as an effort to illicitly infiltrate a computer or its systems without permission with the intent of inflicting harm or causing damage. These cyberattacks usually target voting machines and voter registration databases creating obstacles in the voting process hence damaging the election integrity (Barabander, 2020).

The Russians' attempts to affect the results of the 2016 US elections pushed the government to look forward for solutions and actions to improve cybersecurity to safeguard the forthcoming elections. Thus, by 2020 the US experienced a very successful and well-secured presidential

election that resulted from efforts of three primary strategic avenues: firstly, a comprehensive whole-of-government initiative that encompassed activities at the federal, state, and local levels; secondly, fortified technical defenses, which were reinforced through the allocation of U.S. federal resources and the infusion of specialized expertise; and thirdly, the involvement of credible messengers, including senior-level American leaders in national security and cybersecurity who demonstrated a willingness to disseminate precise information in the public domain (Cordero, 2022)

III.7. Conclusion

In our rapidly evolving technological landscape, several emerging technologies have already materialized, aligning with the predictions of scientists who anticipated their transformative impacts on the fundamental aspects of American and global dynamics from the advent of the internet and the proliferation of personal computing in the late 20th century to the rapid developments in artificial intelligence, renewable energy, and biotechnology in the 21st century, technology has become an inseparable part of the American experience.

General Conclusion

Technological progress played a crucial role in the sophistication of American life spanning the 20th and 21st centuries. Throughout the 20th century, technology acted as a catalyst for industrialization, economic growth, and improved standards of living. It brought forth innovations that altered the very fabric of American society, from the mass production of automobiles to the democratization of information through the Internet. These advancements enabled Americans to connect, communicate, and innovate like never before.

The results of the impacts of technological progress during the twentieth and twenty-first centuries have been diverse.

Economically, technological advancements have driven unprecedented growth, industrialization and mass production changed the nature of work and the later introduction of Internet led to the creation of new industries and jobs.

In terms of communication, the early 20th century, telephones and radios allowed people to communicate over long distances and by the 21st century the internet and smartphones revolutionized communication with applications and social networks enabling them to connect with others on a global scale.

Politically, technological advances allowed politicians to innovate new strategies to reach more audience, raise significant funds and engage a broad base of supporters by harnessing mass media technologies to their own benefits.

The last two centuries, the United States has borne witness to truly remarkable strides in the realm of medical technology and healthcare. These advancements have fundamentally reshaped not only the way we diagnose ailments but also the very nature of healthcare itself.

In terms of environmental results, technology has generated both positive and negative impacts on the environment, often referred to as the "double-edged sword" of technology. The

increase of polluted emissions and the natural disasters driven by technology raised concerns leading scientists to search for sustainable and environmentally friendly energies.

The current study is the starting point of a further research projects in terms of studying the technological progress in the United states. In this regard, the following topics “The Role of Artificial Intelligence (AI) in the 21st Century”, “Evolving Cybersecurity Threats in the Digital Age: Implications for National Security”, “Virtual Reality in Education: Enhancing Learning Experiences in the Digital Classroom”, “The Role of Biotechnology in Modern Medicine: Challenges and Innovations” and “Media Literacy in the Age of Misinformation: Strategies for Critical Thinking” could be proposed as a kind of continuation to the current study for the further researchers.

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