Impact of Digital Computing Technology on the Environment

Question 1

Digital computing has revolutionized various aspects of human life, however this has impacts both positive and negative on the environment. Focusing on CO2 emissions, this report examines these effects.

Milestones in the history of digital computer such as the Kenbak-1 in 1971, Apple in (1976) and Microsoft in 1972 have transformed industries and daily life. However, these technological advancements, leading to the widespread use of computers on a day-to-day basis have consequences. [1]

Negative Environmental Impacts

Energy Consumption: Data servers and Centres run nonstop, consuming vast amounts energy, often derived from fossil fuels, lead to higher Co2 emissions.[2]

E-Waste: Computer systems and hardware evolve constantly and are almost unrecognisable from their distant predecessors. This obsolescence of older model contributes to electronic waste and if not managed properly the toxic substances they contain has be harmful to the environment. [3]

Nevertheless, digital computing is not all bad.

Positive Environment Impacts

Efficiency and automation: Industrial processes have become more efficient, which contributes to reducing energy waste and lowering the carbon footprint of manufacturing and logistics [4]

Environmental Monitoring: Advanced computing technologies facilitate sophisticated environmental monitoring and modelling, helping to track pollution and climate change. [5]

The global rise in CO2 emissions can be attributed to the manufacturing needs and energy demands of the digital computing infrastructure. Key countries in this innovation such as the United States and China show high emissions linked to their role in the digital industry.

The dataset shows notable increases in CO2 emissions in the early 2000 in these 2 countries. China, a major manufacturer of hardware and the United States, home to renowned tech giants e.g. Apple, Microsoft, who started up in the late 20th century. These companies saw significant growth in the early 21st century and China who would manufacture a good majority of their hardware draw links to the increase of emissions in their respective countries. (see appendix A)

Strategies to Mitigate Emissions

Improving energy efficiency: Advances in energy efficient computing technologies, for example, low-power processers and improved cooling systems, can reduce overall energy consumption. [6]

E-Waste Management: Implementing robust recycling programs and designing longer-life hardware can help to minimize the output of e-waste. [7]

Digital Computing has an overwhelming impact on the environment. At the same time, it significantly increases CO2 emissions due to the energy demands. The automation and computational power offer tools for greater efficiency and monitoring of the environment. With correct strategies put into place, the tech industry can mitigate its environmental impact and contribute to a more sustainable future.

Question 2

Datafication refers to the transformation of social actions into online quantified data, which heavily relies on internet access. Countries with widespread internet access adopt datafication more readily, impacting various sectors like healthcare, education and commerce.

Internet Access in the US vs. Afghanistan. From the analysis of the dataset, it is evident that the US has had a significantly higher number of internet users and a greater percentage of the population using the internet in comparison to Afghanistan. For example, in 1994, the US had over 12 million internet users (4.86% of the population), whereas Afghanistan had minimal internet penetration even by the early 2000s. (see appendix B)

Positive impacts of datafication

Enhanced Services: In the Us datafication has enabled advanced services such as personalised healthcare, targeted advertising and more efficient public services. [8]

Economic Growth: Improved data analytics can leas to better business decisions, driving economic growth [9]

Innovation: Datafication fuels this, leading to new products and services [10]

Negative Impacts of Datafication

Privacy concerns: Increased data collection raises significant privacy issues. [11]

Digital divide: Countries with limited Internet access will experience a widening digital divide

Job Displacement: Automation and data-driven technologies can displace jobs, particularly in sectors relying on routine tasks [11]

In Afghanistan, the limited access to internet holds back the adoption of this technology. This may be due to factors such as inadequate infrastructure, economic restraints and political instability. As a result, the country will struggle to benefit fully from advancements in data analytics, healthcare and education that would be more accessible in the United States. (B)

Internet access is evidently crucial for the adoption of emerging technologies. Datafication which I have looked at is one of many. The US, with widespread internet availability, has leveraged this technology to achieve the positives impacts of this technology, whereas Afghanistan, with limited internet access has had slower technological adoption. This

highlights the inequalities that internet access can have in the adoption of emerging technologies.

Question 3

The dataset highlights various factors which influence AI capabilities across different countries. A well-documented example of a bias that these factors induce is in facial recognition technology. Studies, including those from the National Institute of Standards and Technology, have shown that these systems exhibit higher rates of error for women and people of colour compared to white males. These problems arise primarily due to the training datasets, which predominantly feature images of white males, thus leading to less accurate models for other demographics. [12]

How bias occurs

Lack of Diverse Perspectives: Teams developing AI tools may often lack representation from diverse backgrounds, leading to blind spots regarding the needs and challenges of different user demographics.

Reinforcement of Existing biases: without diverse input, AI tools may reinforce societal biases present in the training data, further marginalising already disadvantaged groups.

Strategies for avoiding bias

Broader and more diverse datasets: Training datasets must be inclusive of all demographic groups. The data shows that countries like China and the US have high scores in AI talent and development, which they could use to leverage more diverse datasets, whereas countries like the UK with lower scores, may find it more difficult to.[See appendix C] This change would be beneficial to ensuring a more robust system, supporting the point that a more robust system can result from training on larger and more diverse datasets.

Cultural sensitivity and Representation: Including people from varied cultural backgrounds can help identify and avoid insensitive outcomes. This form of sensitivity can ensure AI tools produced respect and accurately represent all consumer groups.[13]

Regular Audits and Feedback: These AI tools are not perfect and can/will make mistakes, which is why regular audits of these facial recognition systems to detect and correct biases would be beneficial to ensuring the systems evolve according to changing societal norms and values.[14]

Incorporating diversity in AI development teams and consistently reviewing and updating AI systems is crucial in addressing and mitigating biases, ensuring that AI advancements are fair, robust, and beneficial for all segments of society. The data underscores the need for countries with robust AI infrastructures to lead the way in fostering diverse, inclusive AI development practices.

References:

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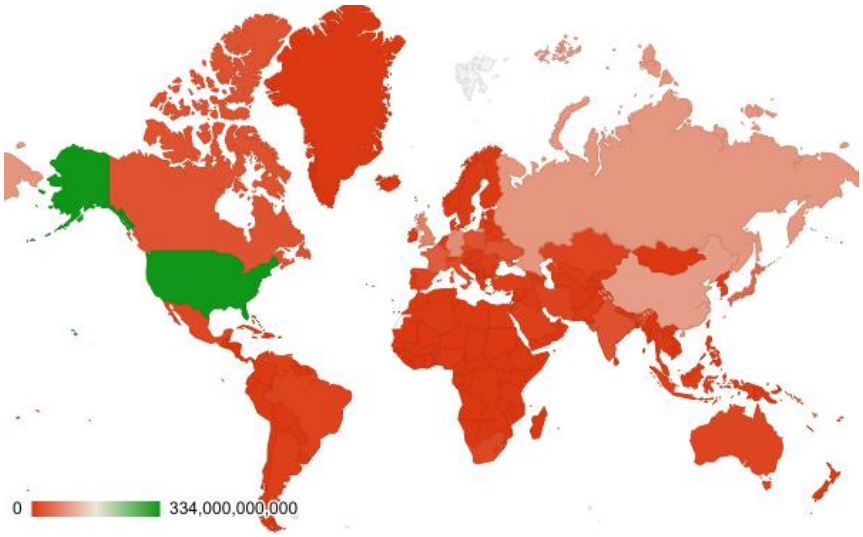
Appendices:

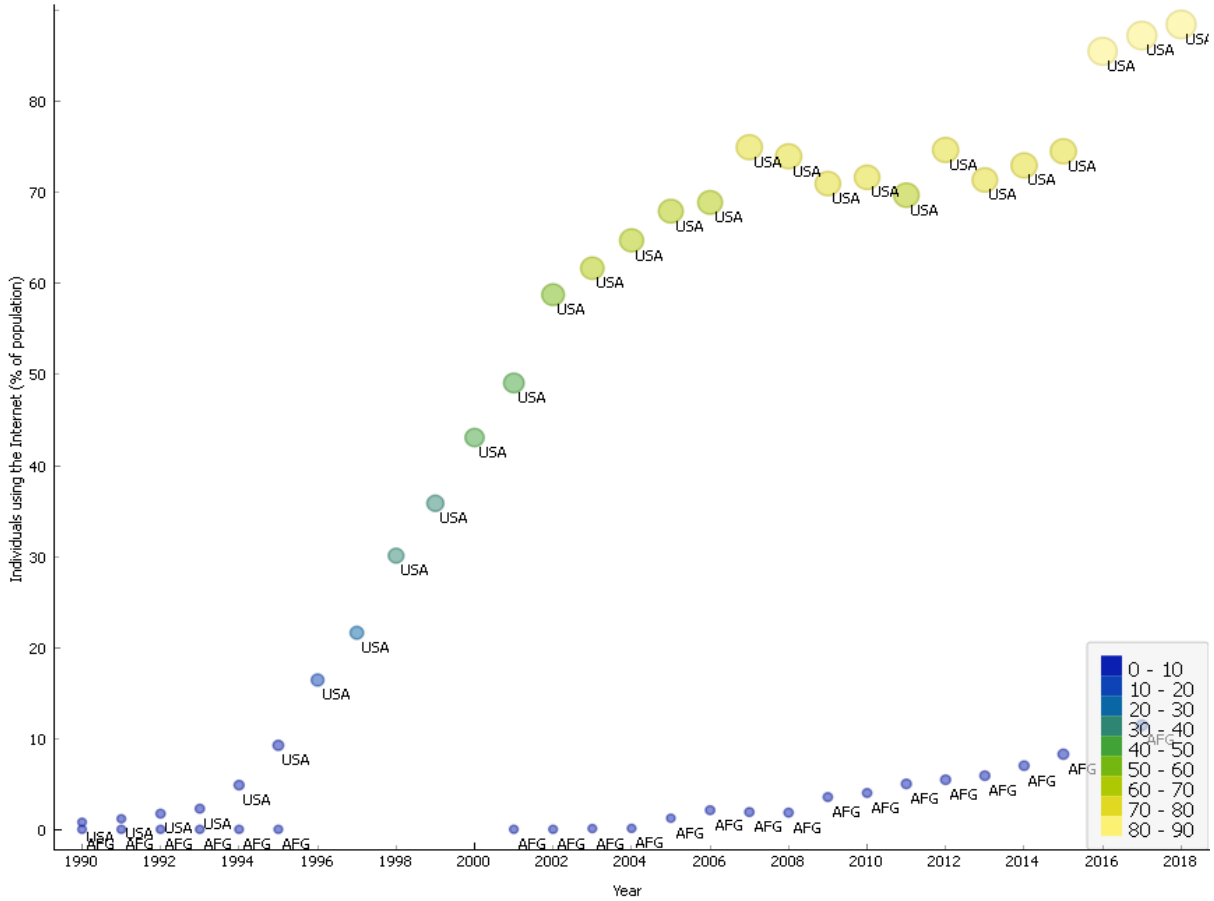
A: world emissions map 2005

Dataset link : https://www.kaggle.com/datasets/moazzimalibhatti/co2-emission-by-countries-year-wise-17502022



B:Scatter chart of the number of individuals in the US and Afghnistan using the internet between 1990 and 2018

Dataset link: https://www.kaggle.com/datasets/pavan9065/internet-usage/data



C: Heat map of countries AI infrastructure

Dataset link: https://www.kaggle.com/datasets/katerynameleshenko/ai-index/