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Digital Pollution: A Growing Threat To Planet Earth

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Abstract

In this document, the lurking threats and vulnerabilities to the inhabitants of this globe are focused on or emphasized, even though they are not vividly exposed or visible. Ahumble effort is also put into resolving this menace so that the generation gets rid of facing consequences from digital pollution.In today's interconnected digital world, the rise of digital pollution, encompassing environmental hazards from energy-intensive data centres, burgeoning e-waste, and the carbon footprint of internet use, poses significant global concerns. Energy consumption in data centres, fuelled by our escalating reliance on digital technologies, strains resources and intensifies environmental impact. E-waste, a byproduct of rapid technological obsolescence, contributes to soil and water contamination due to improper disposal practices. Moreover, the carbon footprint of internet use, from manufacturing to disposal of devices, adds to environmental strain. Addressing these challenges demands a multifaceted approach, including energy-efficient infrastructure, responsible e-waste management, and advocating for sustainable practices. Embracing renewable energy, designing eco-friendly devices, and enhancing digital literacy are crucial steps. As individuals, industries, and policymakers collectively engage in promoting sustainable digital practices, we can curtail the pervasive impact of digital pollution and forge a more environmentally conscious digital future.

Keywords: *Digital pollution, e-waste, carbon footprint, health hazards*

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I. Introduction:

The digital environment is an interconnected realm facilitated by the TCP/IP protocol, encompassing information and communication technologies such as the internet, software, hardware, social media, virtual reality, artificial intelligence etc (Gubbi, 2013). This domain revolves around data, which can be communicated, stored, and processed, enabling rapid exchange of information across the globe (Borgia, 2014). A paradigm shift has taken place in the way we communicate, work, and access information, shaping the current generation to be in sync with virtual reality (Floridi, 2014). However, it also raises concerns about privacy, security, and the ethical implications of a highly connected world.

Today's digitally interconnected world is moving at the speed of thought with the aids of cutting-edge digital technology (Steger, 2023). But the term "pollution" typically neurologically nurtures in our mind the images of smog-filled skies or plastic-choked oceans and hell lots of disturbing noises. Digital pollution, also known as e-pollution, refers to the environmental impact caused by the production, use, and disposal of digital technologies. It involves a wide range of harmful effects such as the generation of electronic waste (e-waste), energy consumption associated with digital activities, and the release of hazardous substances during the manufacturing and disposal of electronic products.

According to surveys, only a few reviewing articles have been obtainable in the literature. (Krumay & Brandtweiner, 2016)directed a review of the assessments of the ecological influence of digital goods. The researcher focused on indicators applied by companies to determine the ecological influences of information and communication technology (ICT) hardware. (Bieser & Hilty, 2018)directed a complete literature review on the secondary ecological effects of ICTs and the study examined the secondary environmental influence of the application of ICTs in other goods and services and the environmental influences of these deviations. (Balogun, Marks, & Sharma, 2020)inspected the present digitalization trend for cultivating environmental sustainabilitywhere they studied nine cases in many countries using emerging technologies to report climate change adaptation. They stated that digital transformations could help curtail the influences of climate variation in metropolitan centres.(Feroz, Zo, & Chiravuri, 2021)presented an outline that presented how and where such digital alterations happened in environmental sustainability. The study explained the direct consequence on the atmosphere; on the contrary, the secondary consequence had not been stated. (Bieser & Hilty, 2018)focused on the secondary influence of the application of ICTs on the atmosphere and did not report the primary influence. On the contrary, the authors focused on the influence of digitalization on environment change adaptation and sustainable development. In the meantime, the opposing effects of digitalization were not stated openly in the publication.

This poses significant environmental and health risks, as improper disposal of electronic devices can lead to soil and water contamination. Furthermore, the energy consumption of data centres and electronic devices contributes to greenhouse gas emissions. Addressing digital pollution requires implementing sustainable practices in the design, manufacturing, and disposal of electronic products, as well as promoting responsible use of digital technologies. However, in such an odd scenario, the less visible yet equally stealthy form of pollution, i.e., 'digital pollution,' is hardly recognized by our limbic system to trigger the fight-or-flight response. Our dependence on technology continues to surge, and so does the environmental impact of our digital activities(Das, 2022). Through this article, researcher is putting the humble effort to shed light on the phenomenon of digital pollution and its far-reaching consequences.

Genesis of Digital Pollution:

Digital pollution encompasses a broad range of environmental hazards linked to our digital activities. This includes the energy consumption of data centres, e-waste generated from discarded electronics, and the carbon footprint of internet use. In recent years, the exponential growth of data-driven technologies, cloud computing, and the proliferation of internet-enabled devices have significantly amplified the environmental toll of our digital footprint(Das B. , 2023).

Energy Consumption and Data Centres

Energy consumption in the context of data centres refers to the amount of electrical power these facilities use to operate their computing infrastructure, networking equipment, cooling systems, and other supporting components. Data centres are critical infrastructure thatstore, process, and manage large volumes of digital data for various purposes, such as cloud computing, internet services, and enterprise applications. Due to the high-performance demands of modern computing and the necessity for reliable and uninterrupted operations, data centres can be significant consumers of electrical energy. This energy is used to power servers, storage devices, networking equipment, and the systems that maintain the appropriate environmental conditions within the facility.

Top of Form

Data centres are the unsung workhorses of the current emerging digital era, housing the servers that store, process, and communicate the vast amounts of data that Homosapiens generate on a daily basis. These centres require enormous amounts of energy to function, with some facilities consuming as much power as a small town. The energy-intensive process of cooling servers exacerbates this environmental strain. As demand for data storage and processing power continues to escalate exponentially, so does the energy consumption of these facilities.

II. E-Waste: The Dark Side of Digital Advancement

E-waste refers to unused electrical or electronic devices. These devices can range from small gadgets like pen drive, mobile phones, and laptops to larger appliances like refrigerators and washing machines. E-waste is a significant and growing global issue due to the rapid pace of technological advancement and the resulting obsolescence of older devices.

The rapid pace of technological advancement is concurrently leading to a staggering increase in electronic waste, or e-waste. Discarded devices like smartphones, laptops, tablets and different IOTs as mentioned above are attributing to the growthe of the e-waste menace. Improper disposal of these electronics not only leads to the release of hazardous materials, but also misuses valuable resources. To mitigate this issue, responsible recycling and refurbishment practices has become imperative.

Generation of E-Waste:

The varying lifestyle of people, joined with urbanization, has directed to increasing rates of consumption of electronic stuff which made electronic waste management an issue of ecological and health concern. Computer waste is made by homes, the administration, thecommunity and private segments, computer shops, and builders. The fast rate of technological alteration has directed to the fast obsolescence rate of electronic devices, producing electronic waste in the process that gets added to the waste stream. The fast development of the electronics industry and the current consumer culture of increasing rates of consumption of electronic products have led to catastrophic ecological consequences (Jaragh & Boushahri, 2009).

The e-waste that developed from such a technical revolution will have a certain and permanent effect on humans live. e-waste is not only the waste outcome from communication technology and associated apparatus, but it also covers the waste of all electrical applications, e.g., kitchen purposes, domestic uses, TVs, mobile devices, etc. Electronic apparatus is known to contain dangerous materials. If disposed of inappropriately, they pose a probable risk to human health and the atmosphere. Heavy alloys, such as Lead, Cadmium, Mercury, and other lethal amalgams, such as PVC and plastic, pose such threats. Numbers show that 40% of all lead and 70% of other heavy metals found in landfills are e-waste-related, particularly from high-tech products. The chief issue that contributed to the rise in e-waste is the fast and sustained technological development and the decrease of the computer life span from 10 years in the 1980's to about 2-3 years or less at the present time. The similar cause may hold accurate for other devices, e.g., mobile phones, games, and multimedia devices. (Jaragh & Boushahri, 2009).

The Problem with Electronics:

Several manufacturing features may rise that differentiate them from manufacturing other stuffs. They can be brief as follows:

Not Designed for Recycling: Maximum electronic stuffs are not designed with the end-of-life phase of the product in mind. Inventers emphasis on the manufacturing of the product but they usually overlook the realities of how the product will be handled when it's rejected. There are two ways that products are not designed for reusing:

- Choosing hard-to-recycle materials and
- Designing products that are hard to take apart

Hard-to-Recycle Materials

The materials used in electronics are the biggest challenge for recycling. The toxic things in these stuffs really make it impossible to recycle them back into electronic products. Here are some of the challenges these materials pose:

CRT glass: Cathode Ray Tube televisions and monitors hold four to eight pounds of lead, typically in the glass of the CRT (Nnorom, Osibanjo, & Ogwuegbu, 2011).. This glass can only either go into a lead smelter or go into "glass-to-glass" recycling—to a manufacturer who takes old CRT glass and makes new CRTs out of it. Since, the shrinking market for CRTs, this has put many glass-to-glass recycling operations out of commercial. Dealing sensibly with CRT glass is one of the recyclers' major challenges.

Plastics: Plastics encompass a great volume of most electronic stuffs. But maximum of them have toxic additives, either brominated flame retardants or PVC, which make them too polluted to recycle into new electronic products. A lot of the recycled plastics are used as aggregate in road construction. (Lahtela, Hamod, & Kärki, 2022)

Hard to Take Apart

Recyclers classically do some quantity of product dismantling as the primary phase in the recycling procedure, at a least to eliminate the toxic components. But numerous products are not designed to be effortlessly disassembled, using adhesive instead of fasteners, using a whole range of screw sizes in one product, making it hard to find fasteners, etc.

The LCD television can be taken as an instance for how electronics are not designed with recycling in mind because of both material assortment and physical design. Greatest numbers of LCD televisions use mercury lamps to light the screen. Mercury is very lethal, even in very small quantities. So, an accountable recycler would want to eliminate these mercury lamps before putting the rest of the device in a shredder or doing other processing that might lead to mercury exposure for recycling employees. So, one must disassemble the entire TV set first, a procedure that takes a long time and as a result, some recyclers just throw the whole screen in the shredder, undoubtedly revealing their labours to mercury. The "glass" in the LCD screen is build-up of a layer of many types of liquid crystals. The liquid crystals are one of the most exclusive materials in the television. The "recommended" method of disposal of liquid crystals is incineration.

Concerns and Management:

E-waste poses significant environmental and health risks if not managed properly. Many electronic devices contain hazardous materials such as lead, mercury, and cadmium, which can contaminate soil and water if not disposed of correctly. Recycling and proper disposal methods are crucial to mitigate these risks.Efforts are to be made globally to address e-waste through legislation, recycling programs, and the promotion of more sustainable design and manufacturing practices.

Recommendation

Electronic waste, or e-waste, is high-tech waste that contains cast-off TVs, computer monitors, keyboards, mouse, processors (CPUs), printers, scanners, fax machines, pocket computers (PDAs), walkie-talkies, baby monitors, certain kinds of watches, and cell phones—in other words, all digital that's no longer being used. Appropriate disposal of e-waste is vital since electronics comprise toxic materials such as mercury, lead, arsenic, cadmium, and beryllium that pose a threat to both humans and the atmosphere. The main approach to the treatment of e-waste is to decrease the outcome of the hazardous elements and chemicals in this equipment on the waste through sanitization, dismantling, recycling, the recovery of items of value, and then disposing of the rest.
Managements and societies should be conscious of the subsequent facts:

- e-waste is a worldwide problem.
- It is increasing at a multiplying rate.
- It has a certain negative influence on humans and the atmosphere and should not be ignored.

Some recommendation should be addressed by administrations and taken very seriously:

- Legislation must be set.
- Recycling and helping the atmosphere
- Introduce agendas for awareness.
- Encourage products that are upgradeable and recyclable.
- Encourage a take-back program (reduce trashing).
- Not to ship waste to unfit and underdeveloped places.

A clean atmosphere should be and is a human right, or else populations of this globe will have to face serious consequences.

III. Carbon Footprint of Internet Use

The carbon footprint of internet use refers to the environmental impact associated with the energy consumption and greenhouse gas emissions resulting from activities related to accessing and utilizing the internet. This includes the operation of data centres, network infrastructure, end-user devices (like computers and smartphones), and the manufacturing, transportation, and disposal of these devices.

Types of Carbon Footprint in Internet Use:

- **Data centres:** These are facilities where servers and networking equipment are housed. They require a significant amount of electricity to operate and maintain the servers, keep them cool, and provide network connectivity. Data centres can be large energy consumers due to their high computational demands.

- **End-User Devices:** Computers, laptops, tablets, smartphones, and other internet-connected devices contribute to the carbon footprint of internet use. This includes the energy required for manufacturing, charging, and operating these devices.
- **Network Infrastructure:** This involves the equipment and infrastructure that enable the transmission of data over the internet. This includes routers, switches, and other networking equipment and fixtures. The energy used in transmitting data across the internet contributes to its carbon footprint.

- **Manufacturing and Disposal:** The production of electronic devices involves energy-intensive processes. Additionally, the disposal of devices at the end of their lifecycle, if not done properly, can result in environmental harm.

Every email sent, video streamed, or website visited carries a hidden environmental cost. The energy required to transmit data across vast networks, along with the operation of end-user devices, contributes to the carbon footprint of our digital interactions. Additionally, the energy mix used by internet service providers varies widely, with some relying heavily on fossil fuels.

IV. Addressing Digital Pollution: A Collective Responsibility

Energy Efficiency and Renewable Power: Emphasizing energy efficiency in data centres and transitioning to renewable energy sources can significantly reduce the carbon footprint of our digital activities.

E-Waste Management: Implementing effective e-waste management practices, including responsible recycling and refurbishment, ensures that discarded electronics do not end up in landfills or improperly processed.

Digital Literacy and Conscious Consumption: Educating individuals and organizations about the environmental impact of their digital activities empowers them to make more informed choices. This includes practices like minimizing unnecessary data storage and utilizing energy-efficient devices.

Regulation and Policy: Governments and regulatory bodies must play a pivotal role in enforcing sustainable practices within the techno industry. Implementing and enforcing environmental standards can incentivize companies to adopt greener technologies and processes.

V. Effects of toxic elements on health:

In emerging countries, e-waste management is extremely informal, thus determining handling and discarding methods. Poor and marginalized groups use rudimentary means to recover valuable minerals from e-waste (Zezai, Maphosa, Mangwana, & Macherera, 2021). In developing countries, e-waste is collected with municipal waste and finds its way into landfills, intimidating the atmosphere and human health (Alam & Bahauddin, 2015). Airborne dioxins and heavy metals are released through rudimentary means such as burning and leaching, leading to environmental and epidemiological catastrophes (Sthiannopkao & Wong, 2013). Study discloses that numerous health problems, such as respiratory, gastrointestinal, dermatological, and other infectious diseases, are common at the Agbogbloshie e-waste landfill. Kids were observed burning cables and dismantling CRT displays, often using chisels and stones to break plastic casings (Böni, Schluep, & Widmer, 2014) .Metal extraction is done by dipping printed circuit boards into acid or burning them, exposing them to the breath of poisonous gases and polluting the environment (Alam & Bahauddin, 2015). Investigators determined that breastfeeding women could transfer hexabromocyclododecanes (HBCDs) and other poisons to babies via breast milk (Yohannessen, et al., 2019). Research noted that toxic chemicals like cadmium, chromium, and zinc etc. are moved to the foetus during pregnancy and found in newborn babies (Bommarito, Martin, & Fry, 2017). Open burning and burying e-waste cause illnesses such as thyroid, lung cancer, reproductive health problems, and other neurological disorders (Meem, Ahmed, Hossain, & Khan, 2021). Researchers discovered that heavy chemicals in e-waste, such as chromium, cadmium, and nickel, were related with the umbilical cord, blood, and the foetus's DNA damage, wheezing, and coughing in children (Zeng, Xu, Boezen, & Huo, 2016). Exposure to e-waste changes the biomarker accountable for immunity assessment for infectious diseases, thereby hampering immunity from vaccination (Maphosa, 2022). Labors use rudimentary methods to breathe in hazardous compounds like cadmium and other toxins (Tsydenova & Bengtsson, 2011). The World Health Organization reports that more than 18 million children are involved in informal e-waste recycling and are vulnerable to catching many diseases through cutaneious exposure (Perkins, Drisse, Nxele, & Sly, 2014). Aquifers and water bodies near e-waste dumps are polluted, affecting areas further from the dumpsite (Olafisoye, Adefioye, & Osibote, 2013). Soil samples, river sediments, and underground water are polluted by e-waste, causing skin injury, gastric ulcers, nausea, and headaches (Zezai, Maphosa, Mangwana, & Macherera, 2021).

VI. Conclusion:

It's high time to transition towards renewable energy sources. Efforts to increase energy efficiency in data centres have become a priority to reduce the environmental impact and operational costs. This includes using energy-efficient hardware, implementing advanced cooling techniques, and optimizing software and workload management.

The carbon footprint of internet use depends on the energy sources used to power data centres and other infrastructure. Data centres powered by renewable energy have a lower environmental impact compared to those powered by fossil fuels. Activities that require a lot of data transfer, such as streaming high-definition videos, online gaming, and constant downloading/uploading, can contribute significantly to the carbon footprint.

The geographical location of data centres and the energy grid they are connected to also has an impact their carbon footprint. For example, areas with a higher percentage of renewable energy in the grid will have lower associated emissions. The location and efficiency of data storage can affect the carbon footprint. Cloud services that consolidate data and optimize resource usage can be more energy efficient. Reducing the carbon footprint of internet use is a critical environmental goal. This can be achieved through various means, including using renewable energy to power data centres, designing energy-efficient devices and infrastructure, optimizing data transmission processes, and promoting responsible manufacturing and disposal practices. Additionally, individual users can contribute by adopting energy-saving behaviours and supporting companies and services that prioritize sustainability in their operations.

Digital pollution may not manifest in the same tangible form as air or water pollution, but its impact on our environment is profound and far-reaching. As we navigate the digital landscape, it is crucial to recognize the environmental consequences of our actions. By adopting sustainable practices and advocating for responsible policies, we can collectively mitigate the adverse effects of digital pollution and pave the way for a more environmentally conscious digital future.

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