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Biometric Technologies from the Anthropocentric and Nonanthropocentric Perspective

Technologie biometryczne w perspektywie antropocentrycznej i nieantropocentrycznej

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Abstract: Biometric technologies or biometrics are becoming widespread, and, in many ways, they help to make human life easier. As this new technology has a significant impact on not just humans but also nonhuman nature, the authors perceive that there is a need of utmost importance to deal with the evaluation of the impact from the point of view of ethics, especially environmental ethics. The article is based mainly on an interdisciplinary approach, namely, a theoretical analysis of biometric technologies from the point of view of the two most significant approaches to argumentation in environmental ethics: anthropocentric and nonanthropocentric. The study will analyze the results of empirical research conducted among consumers in Slovakia in the years (2023-2024). The authors also base the analysis on relevant empirical data, presenting their own research on consumers' subjective perceptions of the risks and benefits of biometrics. The authors conclude that it is essential to consider subjective and objective anthropocentric arguments and nonanthropocentric arguments for and against biometrics to understand the broader consequences of this technology.

Keywords: biometric technologies, biometrics, new technologies, anthropocentrism, nonanthropocentrism, ethics of technology

Streszczenie: Technologie biometryczne stają się coraz powszechniejsze i, odpowiednio wykorzystane, mogą pod wieloma względami ułatwić nasze codzienne życie. Ponieważ te nowe technologie mają znaczący wpływ nie tylko na człowieka, ale także na przyrodę pozaludzką, autorzy niniejszego opracowania dostrzegają konieczność oceny ich zastosowań z punktu widzenia etyki, a zwłaszcza etyki środowiskowej. Artykuł opiera się głównie na podejściu interdyscyplinarnym, jakim jest teoretyczna analiza technologii biometrycznych z punktu widzenia dwóch najważniejszych perspektyw przyjmowanych w etyce środowiskowej, tj. z perspektywy antropocentrycznej i nieantropocentrycznej. W artykule przedstawiono analizę wyników badań empirycznych przeprowadzonych wśród konsumentów na Słowacji w latach 2023-2024. Przeprowadzona analiza została ponadto oparta o istotne dane empiryczne, tj. własne badania autorów dotyczące subiektywnego postrzegania przez konsumentów zagrożeń i korzyści związanych z biometrią. Autorzy doszli do wniosku, że aby zrozumieć w pełni konsekwencje wykorzystania tej technologii, konieczne jest rozważenie zarówno subiektywnych, jak i obiektywnych argumentów antropocentrycznych oraz nieantropocentrycznych za i przeciw biometrii.

Słowa kluczowe: technologie biometryczne, biometria, nowe technologie, antropocentryzm, nieantropocentryzm, etyka technologii

Introduction

The aim of this article is to analyze the issue of new biometric technologies from the perspective of anthropocentric and non-anthropocentric ethics. Biometric technologies are increasingly being used in a variety of fields including education, tourism and transportation, healthcare, financial services, security, retail, sports and recreation, migration, and others.

Despite the increasing use of biometric technologies, the scientific literature has tended to examine them in the context of descriptive ethics, and there are only few scholarly papers on their impact from the perspective of environmental ethics. This lack of attention to environmental aspects is significant from our point of view, as technologies profoundly impact nature and our future.

We have chosen to focus on this topic precisely because of its timeliness and importance. Biometric technologies can change the way we interact with the world around us, and their implementation brings various ethical implications going beyond humans. We will focus on the ways in which biometric technologies affect the environment as well as on the arising ethical issues.

This article contributes to expanding the discourse on the ethics of biometric technologies through a new interdisciplinary approach incorporating an environmental perspective. We believe that such an approach is essential for a comprehensive understanding of the impact of biometric technologies on our planet and future generations.

1. Biometric Technology – What Is It?

Many people use biometric technologies even without knowing the name of biometrics - they unlock the phone with their face or laptop with their fingerprints and scan their hands to open the door when entering the office building. These are all instances of biometrics linked to new technology. It is interesting, however, that the concept of biometrics allows us to see its roots in ancient history when “fingerprints were representing a person’s signature,” for instance, in order to make transactions (Utzhanova 2016).

To sum it up, we may characterize biometrics as follows: “Biometrics is a scientific field focused on using distinct, measurable human characteristics to verify or identify individuals” (Sundararajan et al. 2019). Biometrics involves automated recognition of a person by their physical or behavioral characteristics, such as their face, fingerprints, voice, iris, gait, or signature (Singh et al. 2019). Biometric authentication relies on an individual's biological traits to confirm their identity and grant secure access to an electronic system. These technologies uniquely identify each person through one or more biological features (Albalawi et al. 2022).

"Biometric technology was once the purview of security, with face recognition and fingerprint scans used for identification and law enforcement. This is no longer the case; biometrics is increasingly used for commercial and civil applications" (North-Samardzic 2020). Today, biometric technologies are applied across numerous sectors, including education, tourism and transportation, healthcare, financial services, security, retail, sports and recreation, migration, and more (Hernandez-de-Menendez et al. 2021; Pai et al. 2018; Horkay et al. 2023; Wells and Usman 2024; Zhang 2020; Utegen and Rakhmetov 2023; Dijmarescu et al. 2022; Seçkin et al. 2023; Grünenberg et al. 2022).

2. Anthropocentric Approach to Biometrics

What is anthropocentrism in environmental ethics? Anthropocentrism, along with nonanthropocentrism, are the two main approaches to argumentation. Anthropocentrism is a human-centered approach to environmental ethics, focusing on direct moral obligations to humans (or even future generations of people) (Baďurová 2015). According to anthropocentric ethics, all humans and only humans have intrinsic value and direct moral status. Similarly, according to anthropocentrism, an action is judged as wrong if it harms human beings. As presented by Paul W. Taylor (1981, 197): "From this human-centered standpoint, it is to humans and only to humans that all duties are ultimately owed." A typical example of an anthropocentric approach to ethics is from notable philosophers such as Immanuel Kant (1997), who denied any direct moral duties towards nonhuman living creatures, and Aristotle (1999), who claimed that nature serves humans. Anthropocentrism is frequently cited as a root cause of the ecological crisis (Ganowicz-Bączyk 2011; Brennan 2021; Pechočiaková Svitačová 2023).

How would we judge biometric technologies from the point of view of anthropocentrism? Human benefits and risks can be perceived subjectively and objectively. Adoption of biometric technologies largely depends on the willingness of consumers to adopt these technologies. Several studies suggest that perceived usefulness influences consumer adoption of new technologies (Rukhiran et al. 2023). In other words, if consumers perceive the advantages outweigh the disadvantages, they are more willing to adopt new technologies (Al Solami 2018).

There have been several studies in which authors have investigated which benefits of using biometric technologies are considered most important by consumers. Our research, which has not yet been published, shows that consumers in Slovakia consider the top 3 most important benefits to be:

- Maximizing convenience (I don't have to remember a password);
- Faster authentication (faster login compared to entering a password, for example);
- Enabling control over access (only I can log in).

The full results and response frequencies are shown in the attached fig. below.

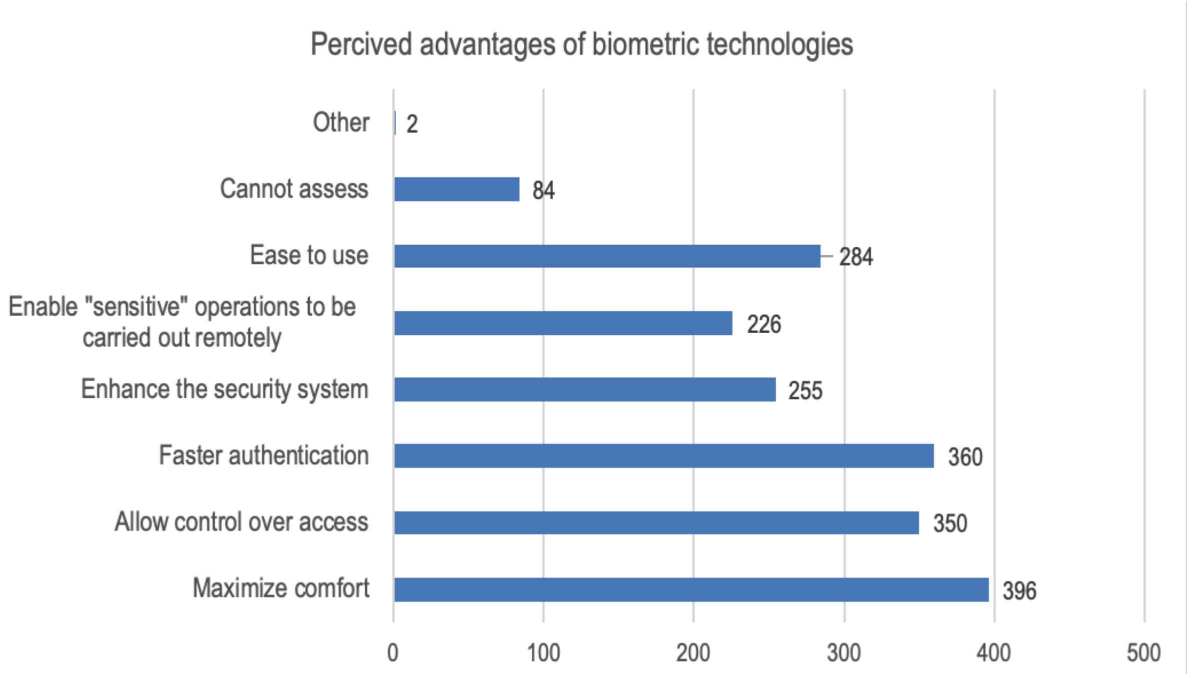

Figure 1. Advantages of biometric technology

Conversely, the three disadvantages most frequently considered by consumers in Slovakia are:

- Scanner problems (high scanning error rate);
- Theft and misuse of personal data;
- Physical changes (the system only recognizes the characters that have been entered and will not recognize the user if their physical characteristics change).

The full results and response frequencies are shown in Fig. 2 below.

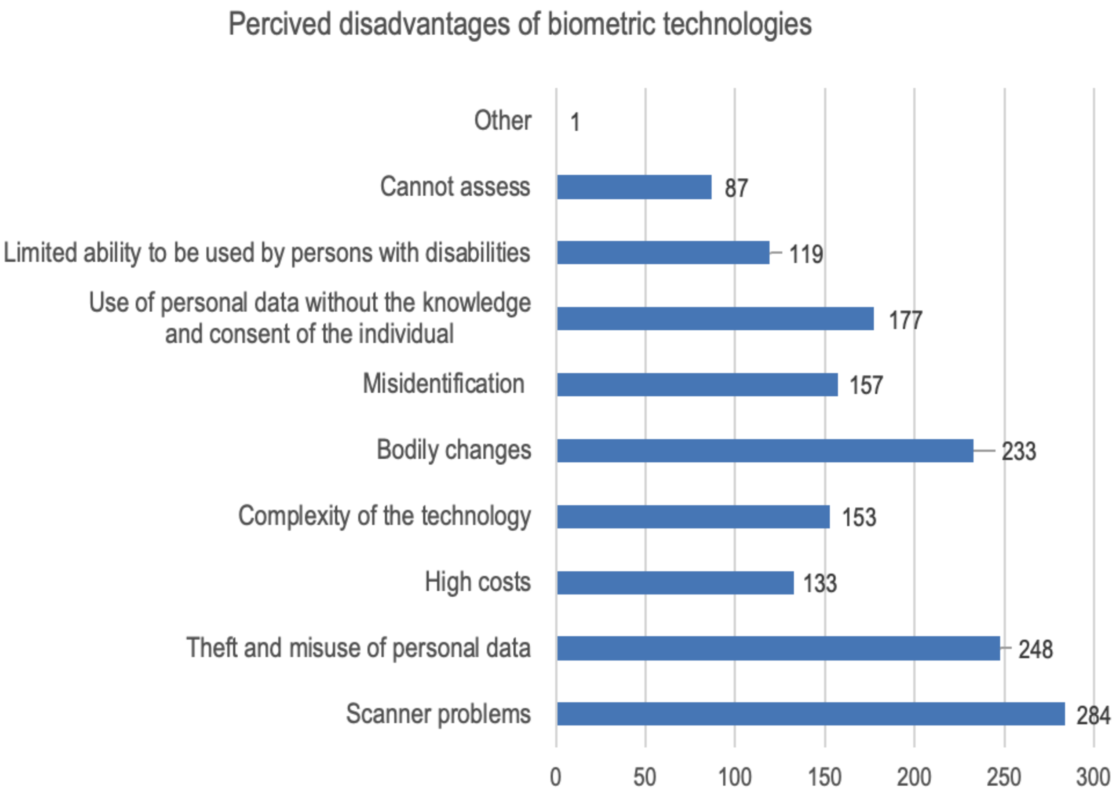

Figure 2. Disadvantages of biometric technology

The above findings represent a partial output of our research, which examined the awareness, perception, acceptance, and use of biometric technologies from the perspective of Slovak consumers. We conducted a quantitative survey and obtained responses via online questionnaires. Our sample consisted of n=615 respondents and was representative regarding gender (p=0.702) and age (p=0.537). Baby boomers, generation X, generation Y, and generation Z were included. Data collection occurred from May 16, 2023, to January 8, 2024.

As we deal with the anthropocentric evaluation of biometrics, we should consider the broader picture of its impact on human beings. There are several stakeholders involved in the use of biometric technologies; these represent different groups and organizations that have an interest in or are affected by these technologies, such as:

- Government organizations and agencies use biometric technologies to identify and authenticate citizens, control borders, and ensure public safety (Grünenberg et al. 2022; Bello and Olanrewaju 2022; Dattani 2020; Kisio and Wa Teresia 2024).
- Private companies, such as banking and retail, implement biometric solutions to improve security, authenticate users, and enhance customer service (Morake et al. 2021; Santoso and Sukendar 2019; Lowrence 2014).
- Healthcare institutions use biometric systems to identify patients and protect medical records (Wells and Usman 2024; Rakshit and Kisku 2022).

- Civil and human rights organizations monitor and evaluate the impact of biometric technologies on privacy and civil rights, and often raise concerns about potential abuse and discriminatory practices (US GAO).
- Academic institutions and researchers study the technology, its applications, and its impacts on society, including ethical and legal considerations (Council 2010; Deliversky and Deliverska 2018; Lawless 2023).
- Technology firms and developers design and develop biometric systems and solutions, considering security, privacy, and regulatory requirements (Innovatrics 2022; Pampatwar 2023).
- Public, i.e., users of biometric technologies who are directly affected by their implementation and use them for everyday tasks such as unlocking devices or authenticating payments (Zabidi et al. 2018; Chigada 2020; Olorunsola et al. 2020).

In the text and the empirical research cited above, we mainly focused on the impact of biometrics on the public, especially from the point of view of individuals as consumers. However, it may be interesting to point to the differences in various stakeholders' views on the use of biometric technologies. This is evidenced by several studies that address the issue. For example, in their study, Abomhara et al. (2021) argue that stakeholders differ in their views on using biometric technologies in border management. On the one hand, border guards argued that biometric technologies had the potential to be a very effective tool that would enhance security levels and make traveler identification and authentication procedures easy, fast, and convenient. On the other hand, travelers were more concerned about technologies threatening fundamental rights, personal privacy, and data protection.

At the same time, for instance, an influential environmental philosopher, P. W. Taylor (1986), distinguished between subjective and objective good of living beings (good of their own). For example, a child can think that eating 1kg of chocolate is good in a subjective sense, but on the other hand, eating chocolate in moderation is objectively good as it is healthier. Similarly, we can look at the views of consumers on biometrics. Subjective views on biometrics may not reflect biometric technologies' real objective risks or benefits. Therefore, we should also consider the objective impact of these new technologies. In this part, we will focus on the impact on humans, not based on the perception of individuals but on a more objective point of view. However, as we will see, some subjective benefits and risks of biometrics for humans overlap with the objective benefits and risks based on the researchers' findings.

Among the objective advantages we can include, for example, increased security, ease of use, relatively low cost of implementation, the fact that the authentication system does not require so much energy, saving of resources, elimination of paper documents, the possibility of automated authentication, wide use of biometrics (Alsaadi 2012; Babich 2012; Bhattacharyya et al. 2009; Alsaadi 2021; Matyáš and Říha 2002).

Conversely, objective disadvantages include the following: misuse of personal data, relatively high costs, invasion of privacy, dependence on technology, ethical and legal issues, lack of standardization - discrimination against physically or otherwise disadvantaged people (Matyáš and Říha 2002; Bhattacharyya et al. 2009; Alsaadi 2012; Babich 2012; Alsaadi 2021; GDPR Advisor 2023).

However, it is important to mention that biometric technologies can work with different human characteristics, so individual advantages or disadvantages may vary depending on the type of recognition characteristic used.

To sum up the anthropocentric perspective on biometrics so far, there are subjective but also objective risks and benefits for human society and individuals. The benefits and risks mentioned are measured from the point of view of human beings. The risks can be mitigated by proper design and use of the technology. It is worth mentioning that subjective views of individuals regarding the extent of risks related to biometrics can also be based on less rational grounds such as fear of new technologies, unwillingness to learn to use them, etc. On the other hand, subjective opinions regarding the perceived benefits can be too optimistic and stem from excitement to try new technologies, etc., without basis in the rational, factual analysis of benefits and risk; therefore, in order to measure the real risks and benefits ratio, we would also need to consider measurable scientific data about for example instances of personal data misuse, etc.

As we have seen above, the risks and benefits of biometrics perceived by individuals do not very much reflect the environmental impact of biometrics; they only reflect a strongly anthropocentric perspective. Likewise, intuitively, we may understand that considering the impact of the new technology only on human beings is insufficient. Therefore, the next chapter will look at the problem of biometrics from the perspective of nonanthropocentric ethics.

3. Nonanthropocentric Approach to Biometrics

What is nonanthropocentrism in environmental ethics? Since the early development of environmental ethics, the critique of anthropocentrism has often been one of the critical issues in debates, along with the justification of the intrinsic value of nonhuman natural entities. According to many authors, anthropocentrism cannot sufficiently address the problem of our obligations towards nature.

While anthropocentrism focuses only on direct moral obligations towards humans (or future generations of people), nonanthropocentrism also advocates direct moral obligations towards nonhuman natural entities (such as living beings, ecosystems, etc.). In a certain sense, nonanthropocentrism is a denial and overcoming of anthropocentrism. However, the term nonanthropocentrism sometimes leads to misunderstandings or misinterpretations. Suppose anthropocentrism grants the highest moral status to humans and proclaims direct moral obligations towards them. In that case, nonanthropocentrism should deny this and, thus, place nonhuman natural entities and living beings above humans or not assign any value to them. Even though nonanthropocentrism can be interpreted this way, it is not necessarily the only possible or appropriate interpretation (Baďurová 2015). Therefore, we will understand nonanthropocentrism as expanding moral consideration or moral status to nonhuman natural entities. Although there are several approaches to nonanthropocentrism, we will focus on them more broadly in this section.

In the following part, we will focus on the nonanthropocentric evaluation of biometric technologies. Biometrics are used nowadays to identify humans and nonhumans (Fuentes et al 2022).

Our theme of biometric technologies will focus on the impact, benefits, and risks for nonhuman natural entities.

Let us look at some environmental benefits of biometrics. An effective use of biometric technologies can optimize individual resources and help streamline processes. Biometric systems often replace traditional paper-based identification methods, reducing the need for paper forms or documents. This could lead to significant savings in paper consumption and contribute to forest conservation efforts. Biometric systems can increase the automation of processes such as access control, attendance tracking, and energy management. For example, automated lighting and heating systems triggered by biometric sensors can optimize energy consumption in buildings, thereby reducing energy waste. By improving transport and logistics efficiency through biometric authentication, individual (transport) companies can reduce fuel consumption and emissions associated with unnecessary travel, idle time, and inefficient routing. This contributes to mitigating air pollution and combating climate change. As mentioned earlier, biometric systems often replace traditional identification methods that rely on physical objects such as cards or keys in addition to paper, reducing production and disposal of plastic cards or metal keys. This contributes to the reduction of a significant environmental problem, namely, e-waste (Utzhanova 2016; Hallstedt et al., 2023; Liukkonen, Tsai 2016; Saguy et al. 2021; Xu et al. 2019; Bissessar et al. 2015; Tanwar et al. 2018).

On the other hand, among the environmental disadvantages of using biometric technologies, biometric devices, especially those containing complex sensors and processing units, require a significant number of resources to manufacture. These include, for example, metals, plastics, and other materials. Mining and processing these resources can have environmental impacts, including habitat destruction, pollution, and energy consumption. Like any electronic device, biometric technologies have a finite lifetime. When these devices end their useful life, they contribute to e-waste. Improper e-waste disposal can lead to environmental pollution and health risks due to hazardous materials such as lead, mercury, and cadmium. Another disadvantage of biometric systems is energy consumption, which often requires continuous operation, especially in access control or surveillance environments. This means that they continuously consume electricity. Although individual devices may not consume much energy, the cumulative energy consumption of large-scale deployment of biometric systems can be significant and contribute to greenhouse gas emissions if the electricity comes from non-renewable sources. Biometric systems often rely on large-scale data processing and storage, typically performed in data centers. These data centers consume large amounts of energy for cooling and operation. In addition, the necessary data center infrastructure maintenance can impact the environment, including land use and water consumption. Data privacy and security concerns may lead organizations to implement duplicate biometric systems or other security measures. These measures increase the overall environmental footprint of the security infrastructure (Beula and Sureshkumar 2021; Barroso et al. 2019; Cao et al. 2022).

Although biometric technologies bring significant environmental benefits, such as reducing paper consumption and optimizing energy use in buildings, they also have significant drawbacks. Production of biometric devices requires significant resources and energy, contributing to habitat destruction and environmental pollution. In addition, the limited lifespan of these devices leads to an increased amount of e-waste, which poses serious environmental and health risks. Continuous operation of biometric systems and the energy intensity of data centers further increase their environmental impact, especially if they are dependent on non-renewable energy sources. Thus, while biometric technologies are beneficial in some respects, they also present environmental challenges that must be carefully considered.

4. Discussion

Our article aimed to analyze biometric technologies from the anthropocentric and nonanthropocentric points of view. As there is no comparable study on the topic, the article enriches the discourse about the impact of biometrics. It is a very topical issue as these new technologies are gaining popularity and becoming widespread.

Nevertheless, our theoretical research could be expanded and modified to consider more problem dimensions. For instance, one area of the issue stems from the problem of the complexity of the key concepts - biometrics, anthropocentrism, and nonanthropocentrism.

For example, as we sketched above, there are various kinds of biometrics. Therefore, it would be possible to narrow the research to just one kind of biometrics, e.g., facial recognition and particular devices, and judge them from the perspective of environmental ethics.

Also, the concepts of environmental ethics could be more specified. For example, in the case of anthropocentrism, there are often mentioned two main subfields of anthropocentrism in environmental ethics - strong and weak:

- Strong anthropocentrism takes into account only human beings and their interests.
- Weak anthropocentrism considers nonhuman natural entities, but human beings and their interests always take precedence in conflicts of interest. It can also be interpreted as considering nonhuman natural entities but only indirectly and directly recognizing moral obligations towards humans (Baďurová 2015).

Thus, the so-called enlightened weak anthropocentrism can consider the impact of biometrics on nonhuman natural entities, as harming them can reciprocally lead to harming humans. As claimed, for instance, by Bryan Norton (1986, 131): "Weak anthropocentrism provides a basis for criticizing individual, consumptive needs and can provide the basis for adjudicating between these levels, thereby providing an adequate basis for environmental ethics without the questionable ontological commitments made by nonanthropocentrists in attributing intrinsic value to nature." However, whether it would offer sufficient arguments is a separate issue.

Similarly, nonanthropocentrism can be broken down into different subfields such as biocentrism, ecocentrism, pathocentrism, etc., which would focus and give priority to slightly different values and entities, for instance, a holistic approach considering ecosystems, or more individualistic approaches focusing on living beings, animals, etc. However, the nonathropocentric approach as an expansion of anthropocentrism has to carefully calculate and balance the impact on human beings to avoid the threat of ecofascism.

The problem of ethical/political individualism versus holism is also an important parameter when judging the impact on human beings. For instance, a democratic (liberal) state should consider the subjective preferences of citizens as individuals. At the same time, it also seems that democratic states should protect the wellbeing of citizens based on actual risks and benefits stemming from scientific evidence. However, it seems self-evident that the impact on nonhuman nature is also important.

Another area of potential future research is the measurability of the risks and benefits of biometric technologies. For instance, we should consider whether we can adopt something like utilitarian calculus and in what way. We should also decide what benefits are more important, how to judge their intensity, and the risks. Thus, the presented benefits and risks must also be assessed in the context with an evaluative dimension.

In the case of biometrics, we claim that the stakeholders should take the complexity of these parameters into account and judge the impact of biometrics by considering the environmental dimensions. We think the ethical dimension is crucial to decision making and development, design, implementation, and the use of new technologies. Practical development of ethical judgment skills can be potentially trained and lead to improving critical thinking and argumentation of the involved stakeholders as well as to taking into account the broader context with nonhuman natural entities in the short and long term.

Conclusion

Biometric technologies offer several advantages, such as increased convenience and security, but they also present disadvantages in terms of misuse of personal data. There are also various ethical issues associated with the use of biometric technologies by different stakeholders. There are also important ethical aspects to mention, particularly from the environmental point of view. This article has examined biometric technologies from two perspectives, namely, from the anthropocentric and non-anthropocentric ethics, highlighting both subjective and objective perspectives on the positives and negatives of their adoption.

From the anthropocentric perspective, the primary focus is on the direct benefits and risks to humans. These include increased security, convenience, and faster authentication processes balanced against concerns such as potential misuse of personal data and privacy issues. The anthropocentric approach emphasizes that while biometric technologies offer significant benefits, they must be managed responsibly to mitigate risks to people’s wellbeing.

Conversely, the non-anthropocentric view expands the ethical discourse to include impacts on natural entities and ecosystems that are not human. This approach emphasizes the environmental benefits of reducing waste, such as eliminating plastic cards and paper documents and optimizing resource use. However, it also draws attention to the environmental costs associated with the production and disposal of biometric devices, continuous energy consumption of these systems, and the resulting electronic waste.

A comparison of the two ethical approaches shows that both have legitimate concerns and benefits. While the anthropocentric ethics prioritizes human interests and immediate benefits, the non-anthropocentric ethics emphasizes broader environmental consequences and the moral obligation to protect nonhuman entities. Balancing these perspectives is critical to a comprehensive understanding of the long-term impacts of biometric technologies.

In conclusion, implementing biometric technologies in society requires careful consideration of the arguments of individual stakeholders, as well as anthropocentric and non-anthropocentric arguments. Policymakers and stakeholders must consider the immediate benefits and risks for people and the broader environmental implications. By adopting a holistic ethical approach, we can ensure that deploying biometric technologies positively contributes to human life and the environment and promotes a sustainable future for all.

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APPENDIX

NPar Tests
Chi-Square Test
Frequencies

Q1

	Observed N	Expected N	Residual
1	296	300.7	-4.7
2	319	314.3	4.7
Total	615		

Test Statistics

Q1

Chi-Square	.146[a]
df	1
Asymp. Sig.	0.702

a. 0 cells (0,0%) have expected frequencies of less than 5.
The minimum expected cell frequency is 300.7.

NPar Tests
Chi-Square Test
Frequencies

Q2

	Observed N	Expected N	Residual
1	167	163.4	3.6
2	164	176.3	-12.3
3	173	159.9	13.1
4	111	115.4	-4.4
Total	615		

Test Statistics
Q2

Chi-Square	2,177[a]
df	3
Asymp. Sig.	0.537

a. 0 cells (0,0%) have expected frequencies of less than 5.
The minimum expected cell frequency is 115.4.