Al-battar: Jurnal Pamungkas Hukum
DOI: https://doi.org/10.63142/al-battar.v2i3.444
Volume 2 Nomor 3, Desember 2025
e-ISSN 3063-8895 | p-ISSN - | Hal. 259-269

Reconceptualizing Legal Protection of the Human Mind and Nervous System in the Era of Brain Computer Interface Technology

***Joko Hadi Santoso, Ahmad Syahri, Adzkia Hitanaki, Lailasari Ekaningsih**
Universitas Darul Ulum Islamic Centre Sudirman Guppi
*Email: pengawal85@gmail.com, syahria085@gmail.com, hitanaki2@gmail.com, lailasarien@gmail.com

Received:	Revised:	Accepted:	Available Online:	Published:
10/10/2025	24/12/2025	25/12/2025	25/12/2025	25/12/2025

Abstract

The rapid development of Brain Computer Interface (BCI) technology enables direct interaction between the human brain and computational systems, offering substantial benefits in healthcare, education, and human capability enhancement. However, this technology also poses serious risks to the integrity of the human mind and nervous system, particularly through potential manipulation, unauthorized access to neural data, and violations of cognitive freedom. This study aims to reconceptualize the legal protection of the human mind and nervous system within the Indonesian legal framework in response to the emerging risks of BCI misuse. Employing normative legal research with a statutory and conceptual approach, this study analyzes Indonesian legal instruments, including human rights, personal data protection, electronic information, and health regulations, in conjunction with the evolving concept of neurorights. The findings reveal a significant normative gap, as existing regulations provide only fragmented and indirect protection and do not explicitly recognize neurodata or cognitive rights as distinct legal interests. Consequently, legal certainty and effective protection against BCI misuse remain inadequate. This study concludes that Indonesia urgently needs progressive legal reform by recognizing neurodata as a special category of sensitive data, explicitly incorporating neurorights into its legal system, and establishing a binding ethical and legal framework for neurotechnology. Such reconceptualization is essential to ensure that technological advancement aligns with the protection of human dignity, mental autonomy, and freedom of thought in the neurodigital era.

Keywords: *Brain Computer Interfaces, Legal Protection, Neurodata, Neurorights, Human Rights, Technology.*

Abstrak

Perkembangan pesat teknologi Brain Computer Interface (BCI) memungkinkan interaksi langsung antara otak manusia dan sistem komputasi, menawarkan manfaat substansial dalam perawatan kesehatan, pendidikan, dan peningkatan kemampuan manusia. Namun, teknologi ini juga menimbulkan risiko serius terhadap integritas pikiran dan sistem saraf manusia, terutama melalui potensi manipulasi, akses tidak sah ke data saraf, dan pelanggaran kebebasan kognitif. Penelitian ini bertujuan untuk mengkonseptualisasikan kembali perlindungan hukum pikiran dan sistem saraf manusia dalam kerangka hukum Indonesia sebagai respons terhadap munculnya risiko penyalahgunaan BCI. Menggunakan penelitian hukum normatif dengan pendekatan hukum dan konseptual, penelitian ini menganalisis instrumen hukum Indonesia, termasuk hak asasi manusia, perlindungan data pribadi, informasi elektronik, dan peraturan kesehatan, sehubungan dengan konsep hak saraf yang berkembang. Temuan ini mengungkapkan kesenjangan normatif yang signifikan, karena peraturan yang ada hanya memberikan perlindungan yang terfragmentasi

dan tidak langsung dan tidak secara eksplisit mengakui neurodata atau hak kognitif sebagai kepentingan hukum yang berbeda. Akibatnya, kepastian hukum dan perlindungan yang efektif terhadap penyalahgunaan BCI tetap tidak memadai. Studi ini menyimpulkan bahwa Indonesia sangat membutuhkan reformasi hukum yang progresif dengan mengakui neurodata sebagai kategori khusus data sensitif, secara eksplisit memasukkan hak saraf ke dalam sistem hukumnya, dan menetapkan kerangka etika dan hukum yang mengikat untuk neuroteknologi. Rekonseptualisasi semacam itu sangat penting untuk memastikan bahwa kemajuan teknologi selaras dengan perlindungan martabat manusia, otonomi mental, dan kebebasan berpikir di era neurodigital.

Kata Kunci: Antarmuka Komputer Otak, Perlindungan Hukum, Neurodata, Hak Saraf, Hak Asasi Manusia, Teknologi**.**

INTRODUCTION

The development of Brain-Computer Interfaces (BCI) technology represents one of the most significant innovations in neurotechnology.[1] This technology enables direct interaction between the human nervous system and computers, opening up significant opportunities for medical applications, particularly in assisting patients with physical limitations or communication disorders.[2] BCIs enable paralyzed patients to communicate, operate prosthetic devices, and even enhance neurological rehabilitation.[3] This advancement demonstrates that technology can provide real solutions to previously intractable health problems.[4] However, this enormous potential also presents new challenges in terms of legal protection.

The positive benefits of BCIs are not limited to the medical field but also extend to education, industry, and even everyday communication. This technology can help humans accelerate information processing, improve interpersonal interactions, and even broaden intellectual horizons.[5] If used ethically, BCIs have the potential to significantly improve the quality of human life. However, the more widespread their use, the greater the potential for misuse, which could harm fundamental human rights.[6] This situation demands the existence of adequate legal instruments to ensure that the use of BCIs does not harm individuals or society.

The risks of misuse of BCI technology encompass a wide range of serious issues. Mind manipulation through intervention in the nervous system can rob a person of their freedom of thought. The theft of neural data, also known as neurodata, can open access to a person's deepest thoughts, including preferences, emotions, and even personal identity.[7] This type of exploitation has the potential to violate the right to mental privacy,

[1] A.C. Pramesti et al., "Analisis Bibliometrik: Artificial Intelligence dan Otak dalam Neuropsikologi," *Jurnal Ilmiah Universitas Batanghari Jambi* 25, no. 1 (2025): 383–93.

[2] A.P. Abdjul et al., "Neuralink: Dampak, Tantangan, dan Potensi di Masa Depan," *Seminar Nasional Teknologi Informasi Dan Matematika (SEMIOTIKA* 2, no. 1 (2023): 8–15.

[3] M. Fritama and A. Wibawa, "Bioinformatic & Brain-Computer Interface: AIoT & Society 5.0 di Kehidupan untuk Teknologi yang Singular," *Jurnal Inovasi Teknologi dan Edukasi Teknik* 2, no. 3 (2022): 144–54.

[4] F. Asrin et al., "Pemahaman Dampak Positif dan Negatif Perkembangan Komputer Di Bidang Kesehatan," *Jurnal Abdimas Mandiri* 8, no. 2 (2024): 159–68.

[5] W.P. Saharani, "Brain to Brain Communication Dalam Perspektif Islam dan Sains: Tinjauan Etika Sosial," *Konferensi Integrasi Interkoneksi Islam dan Sains* 6, no. 1 (2025): 113–19.

[6] S. Budiawan et al., *Dialog Digital: Memahami Komunikasi Manusia Dan Mesin Dalam Era Interkoneksi.* (Widina Media Utama, 2025).

[7] R. Yuste, "Advocating for Neurodata Privacy and Neurotechnology Regulation," *Nature Protocols* 18, no. 10 (2023): 2869–75.

which is an integral part of human dignity.[8] When the mind is no longer protected, threats to individual freedom become real. It demonstrates that legal protection of the mind and nervous system can no longer be ignored.

The absence of specific regulations in Indonesia regarding the protection of mental privacy, or neurorights, demonstrates a significant legal gap.[9] While there are laws governing personal data, health, and human rights, these regulations do not explicitly address the issue of rights to the mind and nervous system. This gap is dangerous because it allows for the misuse of BCI devices without adequate protection mechanisms.[10] Existing legal regulations tend to be general and fail to consider the unique characteristics of neurotechnology. As a result, legal protection for the mind and nervous system remains very weak.

Human rights are the primary foundation in formulating legal protection for BCI technology.[11] The 1945 Constitution's Article 28E, paragraph (1), declares that everyone is entitled to the freedom to believe, think, and act in accordance with their conscience.[12] Article 28G paragraph (1) protects everyone against threats to their personal well-being, including psychological aspects.[13] This constitutional provision affirms that freedom of thought and psychological integrity are fundamental rights that must be safeguarded, even in the face of modern technological developments. Therefore, the formulation of regulations regarding BCI must not conflict with these constitutional principles.

The theory of legal protection developed by Satjipto Rahardjo and Philipus M. Hadjon provides a strong conceptual framework to address the challenges of BCI. Satjipto Rahardjo emphasizes that the law should protect humans as a whole, including non-physical aspects.[14] Meanwhile, Hadjon distinguishes between preventive and repressive legal protection, both of which are relevant to preventing misuse and imposing sanctions for violations.[15] In the context of BCI, preventive protection means preparing regulations governing the ethical use of technology, while repressive protection means providing legal mechanisms to prosecute violations.[16] With this theory, law can function as a protective tool for the human mind and nervous system.

---

[8] M.R. Pabubung, "Persoalan Privasi dan Degradasi Martabat Manusia dalam Pengawasan Berbasis Kecerdasan Buatan (AI): Privacy Issues and Degradation of Human Dignity in Artificial Intelligence (AI) Based Surveillance," *Jurnal Filsafat Indonesia* 7, no. 2 (2024): 198–206.

[9] N.N. Adela et al., "Hak Privasi Pengguna Dalam Era Kecerdasan Buatan: Tinjauan Normatif Hukum Terhadap Kesehatan Mental," *Interdisciplinary Explorations in Research Journal* 3, no. 1 (2025): 75–82.

[10] K. Santi et al., "Eksplorasi Pemanfaatan Teknologi Brain-Computer Interface (BCI) untuk Media Pembelajaran Anak dengan ADHD (Attention Deficit Hyperactivity Disorder," *Quantum Edukatif: Jurnal Pendidikan Multidisiplin* 2, no. 1 (2025): 25–35.

[11] A.S. Sumarahati and A. Irawan, "Analisis Yuridis Tentang Perlindungan Hak Asasi Manusia Dalam Upaya Penegakan Hukum Elektronik (E-Law Enforcement," *Indonesian Journal of Islamic Jurisprudence, Economic and Legal Theory* 2, no. 2 (2024): 812–32.

[12] A.M. Junaedi and S.N. Rohmah, "Relevansi Hak Kebebasan Mengeluarkan Pendapat Dalam Pasal 28E Ayat 3 Undang Undang Dasar 1945 Negara Republik Indonesia Terhadap Kajian Fiqih Siyasah," *Mizan: Journal of Islamic Law* 4, no. 2 (2020): 225–48.

[13] U. Mutiara and R. Maulana, "Perlindungan Data Pribadi Sebagai Bagian Dari Hak Asasi Manusia Atas Perlindungan Diri Pribadi," *Indonesian Journal of Law and Policy Studies* 1, no. 1 (2020): 42–54.

[14] S.A. Hutabarat et al., *Dasar Ilmu Hukum: Teori Komprehensif & Implementasi Hukum Di Indonesia* (PT. Green Pustaka Indonesia, 2024).

[15] J.H. Sinaulan, "Perlindungan hukum terhadap warga masyarakat," *Ideas: Jurnal Pendidikan, Sosial, Dan Budaya* 4, no. 1 (2018).

[16] M. Fikri and S. Rusdiana, "Ruang Lingkup Perlindungan Data Pribadi: Kajian Hukum Posistif Indonesia," *Ganesha Law Review* 5, no. 1 (2023): 39–57.

The ethical aspects of technology are also crucial to analyze. Innovations arising from technological developments often bring benefits, but also give rise to new responsibilities.[17] Ethics demand that technology be used for the good of humanity, not to exploit or deprive it of its basic rights.[18] BCIs, which interact directly with the nervous system, require stricter ethical standards than conventional information technology. When ethics align with law, human rights protection becomes more robust. Therefore, legal regulations must consider the ethical dimension to avoid becoming bogged down in purely technical aspects.

A clear definition of BCI is essential for a focused legal discussion. A BCI is a system that enables direct communication between the human brain and external devices through neural signals.[19] These signals are translated into commands that can control computers, machines, or even medical devices. The uniqueness of BCIs lies in their ability to access the most private information: thoughts.[20] This characteristic sets BCIs apart from other technologies, as the risk of privacy violations concerns not only external data but also the contents of a person's thoughts. This understanding suggests that BCI regulations must be stricter than those of conventional technologies.

The concept of cognitive liberty is a key concept related to the use of BCIs. Cognitive liberty refers to an individual's right to control their own thoughts and cognitive processes without interference from others.[21] This right concerns a person's freedom to choose whether to use neurotechnology or refuse intervention into their thoughts. If cognitive liberty is not guaranteed, the use of BCIs could lead to new forms of violations of individual freedom. This principle should be the basis when countries design regulations regarding neurotechnology.

The right to the mind and nervous system can be understood as an integral part of basic human rights and cannot be diminished. Protection of mental integrity is as important as protection of physical integrity. When the nervous system is exploited without consent, humans lose their autonomy. The concepts of mental privacy, mental integrity, and psychological continuity provide a conceptual framework that states that the mind is not merely a private activity but a right that must be protected by the state (Febriarko et al., 2024). Without such protection, BCI technology has the potential to turn humans into experimental subjects stripped of their dignity. Therefore, legal protection for the mind and nervous system is an urgent need in the face of the development of neurotechnology.

RESEARCH METHODS

This research employs normative legal research, which examines law as a system of norms and prescriptive rules governing social life. The study applies a statutory approach by analyzing relevant Indonesian legal instruments, including Law Number 39 of 1999 on Human Rights, Law Number 27 of 2022 on Personal Data Protection, Law Number 11 of 2008 on Electronic Information and Transactions and its amendments, and

[17] M.K. Alieffiansyah et al., "Tantangan dan peluang MSDM terhadap perkembangan teknologi," *Jurnal Media Akademik (JMA* 2, no. 12 (2024).

[18] K. Dedes et al., "Peran Etika dalam Teknologi Informasi," *Jurnal Inovasi Teknologi Dan Edukasi Teknik* 2, no. 1 (2022): 11–19.

[19] R. Widadi et al., "Klasifikasi Sinyal EEG pada Sistem BCI Pergerakan Jari Manusia Menggunakan Convolutional Neural Network," *Techno.Com* 19, no. 4 (2020).

[20] S.A. Ramadhanty and H. Albertus, "Memori Episodik sebagai Terra Incognita yang Membatasi Neuroteknologi," *Syntax Idea* 3, no. 3 (2021): 649–70.

[21] P. Sommaggio et al., "Cognitive Liberty. A First Step towards a Human Neuro-Rights Declaration," *BioLaw Journal* 2017, no. 3 (2017): 27–45.

Law Number 17 of 2023 on Health, to assess the extent to which they provide legal protection for the human mind and nervous system against the potential misuse of Brain–Computer Interface technology. In addition, a conceptual approach is used to examine the development of neurorights, such as mental privacy, cognitive integrity, freedom of thought, and protection against neural manipulation, through legal doctrine, theoretical frameworks, and international ethical standards on neurotechnology. By integrating these approaches, this research identifies normative gaps in the current legal framework and formulates the need for legal reconceptualization to ensure adaptive and comprehensive protection in response to advances in neurotechnology.

RESULTS AND DISCUSSION

Legal Regulations in Indonesia Regarding the Protection of the Mind and Nervous System

The main constitutional pillar upon which Indonesia's human rights, particularly the right to the mind and nervous system, are based is the 1945 Constitution. Every individual has the freedom to practice their religion and worship as they see fit, as well as to choose their own education and career path, citizenship, place of residence within the nation, and the ability to return, according to Article 28E, paragraph (1). The definition of freedom of thought and expression that cannot be contested is also included in this right. Every person has the right to safeguard themselves, their family, their honor, their dignity, and the property they control, as well as the right to a sense of security and protection from the threat of fear for exercising or failing to exercise a human right, according to Article 28G, paragraph (1). Protection of psychological integrity is explicitly included in the scope of this article. The rights to life, freedom of thought and conscience, freedom of religion, freedom from torture, freedom from slavery, recognition as a person before the law, and immunity from prosecution under retroactive laws are all human rights that cannot be diminished under any circumstances, according to Article 28I, paragraph (1). These three articles establish the basis for the notion that freedom of thought, psychic integrity, and mental rights are inherent rights that cannot be diminished.

The extent of constitutional protection is extended into a more focused normative framework by Law Number 39 of 1999 concerning Human Rights. The rights to life, freedom from torture, freedom of thought, conscience, and body, freedom of religion, freedom from slavery, recognition as a person and equality before the law, and immunity from prosecution under laws that are retroactive are all human rights that cannot be diminished under any circumstances, according to Article 4 of this law. This formulation positions freedom of thought as one of the rights that must be absolutely protected. The right to thought includes the protection of mental integrity from interference or manipulation. The connection with BCI is evident in the possibility of interventions on the nervous system, which could be considered a violation of both the right not to be tortured and the right to freedom of thought. This law is an important instrument in ensuring that mental rights cannot be subjected to technological exploitation.

The principle of protection of mental integrity in the Human Rights Law implies that the state is obliged to prevent the misuse of technology that could interfere with these rights. The right not to be tortured refers not only to physical suffering but also to mental or psychological suffering. If BCIs are used for manipulative or repressive purposes, such use potentially violates Article 4 of the Human Rights Law. It shows that Indonesian law recognizes mental protection as an inalienable right. Therefore, the use of neurotechnology that directly impacts the nervous system must comply with human rights principles to prevent new forms of oppression.

An essential basis for protecting personal data is also provided by Law Number 19 of 2016, which amends Law Number 11 of 2008 about Electronic Information and Transactions (ITE Law). According to Article 26 paragraph (1), unless the legislation specifies differently, the use of any information about a person's personal data via electronic media must be done with that person's consent. This provision affirms the principle of consent as the basis for data processing. Neurodata, which can include neural activity patterns, brainwave recordings, or interpretations of brain signals, should be included in the category of protected personal data. The ITE Law allows for linking such protection to neurodata, although it does not explicitly mention it.

The ITE Law's link to intellectual property protection lies in the mechanism for electronic data misuse. Article 26, paragraph (2) grants anyone whose personal data rights have been violated the right to file a lawsuit against the party using the data without permission. The potential for theft or manipulation of neurodata through BCI clearly falls into this category of violation. Therefore, the ITE Law can serve as a temporary legal basis for protecting intellectual property from unauthorized exploitation. However, the ITE Law remains general and requires expanded regulations to address the unique characteristics of neurodata.

Law Number 27 of 2022 concerning Personal Data Protection (PDP Law) provides a more comprehensive framework for protecting sensitive data. Article 4, paragraph (2), letter c states that specific personal data includes biometric data. Article 4, paragraph (2), letter d adds that genetic data also falls into this category. Neurodata, although not explicitly mentioned, shares characteristics with biometric data, as both derive from the unique biological characteristics of each individual. This allows neurodata to be categorized as sensitive personal data that requires special protection.

According to Article 6 of the Personal Data Protection Law, processing some personal data can only be done with the subject's express consent. This means that the use of neurodata for research, medical, or technological purposes is only lawful if the subject provides explicit consent. Furthermore, Article 15 of the Personal Data Protection Law stipulates the data controller's obligation to protect personal data from misuse or unauthorized access. When applied to neurodata, this provision means that companies or institutions operating BCIs must guarantee the protection of the neural data obtained from individuals. The Personal Data Protection Law thus serves as an important legal instrument for protecting neurodata as part of the right to mental privacy.

Law Number 17 of 2023 concerning Health also plays a crucial role in providing legal protection regarding the use of neurotechnology. Article 82 paragraph (1) states that research and development in health science and technology must be based on ethics, norms, and law. Article 82 paragraph (2) states that all health research involving humans must obtain ethical approval from a health research ethics committee. This provision clearly applies to the use of BCIs in the medical field, as they touch on aspects of the human nervous system. This regulation protects patients or research subjects from practices that violate ethics or cause psychological harm.

Patient protection is also emphasized in Article 82 paragraph (3) of the Health Law, which states that all health research and development must guarantee the safety, security, and protection of research subjects. If BCIs are used for medical purposes, users must comply with the principles of patient safety and biomedical ethics. Misuse of technology to explore or manipulate a patient's mind without consent is clearly a violation of the law. With this regulation, the Health Law not only regulates medical technical aspects but also provides an ethical framework to prevent the misuse of neurotechnology.

The incorporation of the Human Rights Law, the Electronic Information and Transactions Law, and the 1945 Constitution, the Personal Data Protection Law, and the Health Law demonstrates that, despite the absence of specific regulations on neurorights, Indonesian legal instruments provide a sufficient basis for providing initial protection. The Constitution guarantees freedom of thought and psychic integrity, the Human Rights Law affirms the absolute nature of these rights, the ITE Law and the PDP Law provide data protection, and the Health Law emphasizes the ethical and safety aspects of medical research. The synergy between these regulations points to a multi-layered legal protection approach, although new, more specific regulations are still needed to address the increasingly complex challenges of neurotechnology.

Analysis of Regulatory Weaknesses and the Need for Legal Reform in Legal Protection of the Mind and Nervous System from the Misuse of Brain-Computer Interface Technology

Brain-Computer Interface technology presents the potential for manipulating the human mind through brain hacking mechanisms. Illegal access to the nervous system could allow third parties to influence or even control a person's thoughts and behavior. This risk is not only related to individual harm but also to threats to freedom of thought, a fundamental right. Manipulating the nervous system has the potential to diminish individual autonomy and create new, difficult-to-detect forms of oppression. This situation highlights the potential for BCIs to become extremely dangerous instruments if not closely monitored.

Neurodata theft raises new, more complex issues than typical digital data theft. Neurodata not only depicts a person's identity but also their thought patterns, emotions, and even deeply personal preferences. If this data is used for commercial purposes, individuals can become objects of economic exploitation without ever realizing what is happening. Neurodata can also be traded illegally for criminal purposes or espionage. The potential losses arising from neurodata theft are not limited to financial aspects but also include the loss of mental privacy, a fundamental right.

Exploitation of BCIs in the military or political sphere could pose a serious threat to national stability. This technology could be used to create neural-controlled weapons or weapons systems directly connected to the human brain. In the political sphere, the possibility of manipulating public opinion through neuroscientific interventions creates a new form of propaganda that is more dangerous than conventional media. Countries without robust regulations risk becoming targets for experimentation or misuse of the technology by external parties. This potential for exploitation demonstrates that BCI is not just an individual issue, but also a national security issue.

The legal gap in Indonesia is clearly evident when the issue of BCI is confronted with existing legal instruments. Regulations concerning human rights, personal data protection, and health exist, but none explicitly regulate neurorights. This absence of specific norms creates ambiguity in the application of the law when violations related to the mind and nervous system occur. This situation provides opportunities for parties seeking to exploit BCI to operate outside the reach of the law. This legal vacuum leaves the public vulnerable to threats emanating from this technology.

The Personal Data Protection Law only regulates personal data in a general sense, without addressing the mental dimension of privacy. Protection is limited to biometric, genetic, or physically measurable identity data. However, neurodata is more complex because it concerns the invisible contents of the mind. This gap makes legal protection

for mental privacy very limited. Law enforcement could potentially be difficult if neurodata is systematically exploited by certain parties.

The Health Law emphasizes patient protection and medical research, leaving no room for regulating non-medical misuse. Yet, the risk of misuse of BCIs outside the medical realm is equally significant. Use scenarios for entertainment, industry, or even commercial applications remain unaddressed within the Health Law. It constructs a loophole that private parties can exploit to engage in harmful practices against the human nervous system. This gap highlights the need for more comprehensive, specific regulations.

Chile is a pioneer in recognizing neurorights through its 2021 constitutional amendment. The amendment explicitly recognizes that brain activity and neural data are human rights that must be protected. This step inspires the idea that protecting the mind and nervous system can be incorporated into fundamental state norms. Chile's courage demonstrates that this issue is not merely academic discourse, but a real need in the face of the neurotechnology revolution. Indonesia can learn from this step to strengthen its own legal system.

UNESCO, through its 2021 Recommendation on the Ethics of Neurotechnology, emphasized the importance of global ethics in the use of neurotechnology. The recommendation highlights the protection of freedom of thought, mental integrity, and the continuity of psychological identity. UNESCO believes that neurotechnology has a broad impact on human dignity and therefore requires universal ethical standards. This document serves as an international guideline that can be used as a reference by countries, including Indonesia, to design regulations aligned with humanitarian values. The implementation of this recommendation can provide both a moral and legal basis for the protection of neurorights.

The European Union's General Data Protection Regulation (GDPR) can serve as a reference for protecting neurodata. The GDPR strictly regulates the processing of personal data, including biometric and other sensitive data. Although it does not specifically address neurodata, the GDPR's scope is broad enough to encompass information generated from brain activity. Recognition of data subject rights, such as the right to access, rectify, or erase data, can be applied to neurodata. This regulation demonstrates that strict data protection can be a first line of defense in addressing the challenges of BCI.

The urgency of establishing specific regulations in Indonesia cannot be delayed any longer. Protection of the mind and nervous system must be recognized as a human right, on a par with the right to life and freedom of expression. Integrating the concept of mental privacy into legislation, whether through revisions to the Human Rights Law or the Personal Data Protection Law, is a strategic step. Furthermore, oversight mechanisms and legal sanctions must be designed to deter abuse of BCIs. This specific regulation is also crucial to ensure Indonesia remains on par with other countries that have begun to explicitly recognize neurorights.

CONCLUSION

The human mind and nervous system are at the heart of individual existence and freedom, and therefore deserve legal protection equal to other human rights. The advent of Brain-Computer Interface (BCI) technology offers significant opportunities in healthcare, education, and human resource development, but it also poses serious threats if used for deviant purposes such as mind manipulation, non-consensual intervention, or behavioral control. Relevant legal instruments in Indonesia are currently limited,

containing Law Number 27 of 2022 about Personal Data Protection, Law Number 17 of 2023 about Health, Law Number 11 of 2008 about Electronic Information and Transactions and its Amendments, and Law Number 39 of 1999 about Human Rights. However, none of these regulations specifically address neurodata or neurorights, leaving legal protection against BCI misuse largely open to general interpretation and lacking adequate legal certainty.

In the face of rapid technological development, new regulatory breakthroughs are needed that specifically address the right to the integrity of the mind and nervous system, also known as neurorights. This regulation must not only place neurodata in a special category within personal data protection, but also provide ethical guidelines and legal sanctions for those who misuse BCI technology. Ideally, regulatory development should be carried out through collaboration between the government, research institutions, the medical profession, and technology stakeholders to ensure that the resulting policy is comprehensive and adaptive. Furthermore, given the cross-border nature of neurotechnology development, Indonesia needs to collaborate internationally to formulate global standards for protection against BCI misuse. This way, Indonesia will not only be able to protect its citizens from the risks of neurotechnological manipulation but also contribute to creating global governance that upholds human dignity and freedom in the neurodigital era.

ACKNOWLEDGMENTS

This section contains acknowledgments to institutions and individuals who have contributed to the implementation of the research and the preparation of this manuscript. The authors would like to express their sincere gratitude to all parties who have provided support, guidance, and assistance throughout the research process, including academic advisors, funding institutions, and other individuals or organizations whose contributions were invaluable to the completion of this study.

FUNDING INFORMATION

None.

CONFLICTING INTEREST STATEMENT

The authors state that there is no conflict of interest in the publication of this article.

BIBLIOGRAPHY

Abdjul, A.P., W.S. Ahmad, R.A. Matswaya, and F. Rahma. "Neuralink: Dampak, Tantangan, dan Potensi di Masa Depan." *Seminar Nasional Teknologi Informasi Dan Matematika (SEMIOTIKA* 2, no. 1 (2023): 8–15.

Adela, N.N., T.S. Maharani, N.S. Rahmadina, S. Kurdi, M. Wardani, and A. Hafidzi. "Hak Privasi Pengguna Dalam Era Kecerdasan Buatan: Tinjauan Normatif Hukum Terhadap Kesehatan Mental." *Interdisciplinary Explorations in Research Journal* 3, no. 1 (2025): 75–82.

Alieffiansyah, M.K., M.Z. Arifin, and I. Ismail. "Tantangan dan peluang MSDM terhadap perkembangan teknologi." *Jurnal Media Akademik (JMA* 2, no. 12 (2024).

Asrin, F., H. Anra, M.A. Irwansyah, and E.E. Pratama. "Pemahaman Dampak Positif dan Negatif Perkembangan Komputer Di Bidang Kesehatan." *Jurnal Abdimas Mandiri* 8, no. 2 (2024): 159–68.

Budiawan, S., S.T. Alvianus Dengen, R.D. Abidah, M.S. Kamrin, and R.R. Baan. *Dialog Digital: Memahami Komunikasi Manusia Dan Mesin Dalam Era Interkoneksi*. Widina Media Utama, 2025.

Dedes, K., A. Prasetya, E.P. Laksana, L. Ramadhani, and V. Setia. "Peran Etika dalam Teknologi Informasi." *Jurnal Inovasi Teknologi Dan Edukasi Teknik* 2, no. 1 (2022): 11–19.

Fikri, M., and S. Rusdiana. "Ruang Lingkup Perlindungan Data Pribadi: Kajian Hukum Posistif Indonesia." *Ganesha Law Review* 5, no. 1 (2023): 39–57.

Fritama, M., and A. Wibawa. "Bioinformatic & Brain-Computer Interface: AIoT & Society 5.0 di Kehidupan untuk Teknologi yang Singular." *Jurnal Inovasi Teknologi dan Edukasi Teknik* 2, no. 3 (2022): 144–54.

Hutabarat, S.A., R. Masturi, M. Amalia, et al. *Dasar Ilmu Hukum: Teori Komprehensif & Implementasi Hukum Di Indonesia*. PT. Green Pustaka Indonesia, 2024.

Junaedi, A.M., and S.N. Rohmah. "Relevansi Hak Kebebasan Mengeluarkan Pendapat Dalam Pasal 28E Ayat 3 Undang Undang Dasar 1945 Negara Republik Indonesia Terhadap Kajian Fiqih Siyasah." *Mizan: Journal of Islamic Law* 4, no. 2 (2020): 225–48.

Mutiara, U., and R. Maulana. "Perlindungan Data Pribadi Sebagai Bagian Dari Hak Asasi Manusia Atas Perlindungan Diri Pribadi." *Indonesian Journal of Law and Policy Studies* 1, no. 1 (2020): 42–54.

Pabubung, M.R. "Persoalan Privasi dan Degradasi Martabat Manusia dalam Pengawasan Berbasis Kecerdasan Buatan (AI): Privacy Issues and Degradation of Human Dignity in Artificial Intelligence (AI) Based Surveillance." *Jurnal Filsafat Indonesia* 7, no. 2 (2024): 198–206.

Pramesti, A.C., N.V. Aristawati, D.E. Wikantyasning, A.S. Salsabilla, S. Kusrohmaniah, and A. Sulastri. "Analisis Bibliometrik: Artificial Intelligence dan Otak dalam Neuropsikologi." *Jurnal Ilmiah Universitas Batanghari Jambi* 25, no. 1 (2025): 383–93.

Ramadhanty, S.A., and H. Albertus. "Memori Episodik sebagai Terra Incognita yang Membatasi Neuroteknologi." *Syntax Idea* 3, no. 3 (2021): 649–70.

Saharani, W.P. "Brain to Brain Communication Dalam Perspektif Islam dan Sains: Tinjauan Etika Sosial." *Konferensi Integrasi Interkoneksi Islam dan Sains* 6, no. 1 (2025): 113–19.

Santi, K., M. Sahroni, and F. Arsyad. "Eksplorasi Pemanfaatan Teknologi Brain-Computer Interface (BCI) untuk Media Pembelajaran Anak dengan ADHD (Attention Deficit Hyperactivity Disorder." *Quantum Edukatif: Jurnal Pendidikan Multidisiplin* 2, no. 1 (2025): 25–35.

Sinaulan, J.H. "Perlindungan hukum terhadap warga masyarakat." *Ideas: Jurnal Pendidikan, Sosial, Dan Budaya* 4, no. 1 (2018).

Sommaggio, P., M. Mazzocca, A. Gerola, and F. Ferro. "Cognitive Liberty. A First Step towards a Human Neuro-Rights Declaration." *BioLaw Journal* 2017, no. 3 (2017): 27–45.

Sumarahati, A.S., and A. Irawan. "Analisis Yuridis Tentang Perlindungan Hak Asasi Manusia Dalam Upaya Penegakan Hukum Elektronik (E-Law Enforcement."

Indonesian Journal of Islamic Jurisprudence, Economic and Legal Theory 2, no. 2 (2024): 812–32.

Widadi, R., B.A. Widodo, and D. Zulherman. "Klasifikasi Sinyal EEG pada Sistem BCI Pergerakan Jari Manusia Menggunakan Convolutional Neural Network." *Techno.Com* 19, no. 4 (2020).

Yuste, R. "Advocating for Neurodata Privacy and Neurotechnology Regulation." *Nature Protocols* 18, no. 10 (2023): 2869–75.