Ethical Frameworks for Technological Advancements

Ms. Shweta Gupta[1], Dr. Rahul Singh[2], Dr. Sachin Bhardwaj[3], Dr. Smrita Jain[4]

[1]Assistant Professor, Moradabad Institute of Technology
[2]Associate Professor, Moradabad Institute of Technology
[3]Assistant Professor, Moradabad Institute of Technology
[4]Assistant Professor Moradabad Institute of Technology

Abstract—An ethical framework is a structured set of principles, values, and guidelines that help individuals, organizations, and societies make morally sound decisions. It provides a systematic way to evaluate what is right or wrong in various situations, ensuring that actions align with ethical standards and societal expectations. As technology is changing rapidly, an ethical framework is essential to be followed while development and use of technology. This paper aims at to find out the principles governing the use of technology and the various applications of technology in various fields. The objective is to find out the ethical decision-making framework. The secondary data is used for Research. The paper discusses frameworks for ethical technological advancement, including transparency, justice fairness, accountability, sustainability and environmental responsibility and inclusivity. The technological advancement is done in the field of AI and automation, the ethical principles prevent biasness in algorithm, ensuring AI decision making aligned with human values. In the field of biotechnology and genetic engineering, protecting human rights and dignity in biotechnological advancements, regulate human genetic modifications to prevent ethical dilemmas. In data privacy and cyber security, ethical framework ensures consent and control over personal data and strengthens the data protection laws. The emerging technological advancement is in the field of climate and environmental technology which encourages green innovation and eco-friendly practices for the welfare of the society. The purpose of the ethical framework is to guide in decision making in complex moral situation, ensuring consistency in ethical judgments and prevents harm by promoting good for the society. These ethical principles build trust and accountability in personal, professional and societal aspect.
Technological advancements bring both opportunities and ethical challenges. If attention not given, these innovations can lead to privacy violations, economic inequality, environmental harm, and biased AI systems.

However, with proactive governance, ethical design principles, and global cooperation, we can ensure that technology serves for the betterment of the society while minimizing risks. An ethical framework for technological advancements ensures that innovation serves humanity responsibly. By integrating ethical principles, robust regulations, and inclusive policies, we can guide technological progress towards a just, sustainable, and equitable future.

Index Terms—Cyber security, Data Privacy, Ethical framework, Sustainability, Technological advancement

I. INTRODUCTION

The subject of techno ethics, or the ethical implications of technology, has been studied by different philosophers such as Hans Jonas and Mario Bunge. Techno ethics (TE) is an interdisciplinary research area that develops various theories and methods from multiple knowledge areas (such as communications, social sciences, information studies, technology studies, applied ethics, and philosophy to analyze and evaluate the moral implications, responsibilities, and potential consequences of technology use and development. It involves identifying ethical challenges, such as data privacy, AI bias, and environmental impact, while promoting responsible innovation. This ensures that technological advancements align with societal values, fairness, and sustainability, fostering a balanced and ethical technological future. Techno ethics sees both technology and ethics as integral parts of society, influencing and shaping each other. It aims to identify ethical ways to use technology, prevent its harmful or unethical applications, and establish universal guidelines to direct future technological advancements. The goal is to ensure

that technological progress serves the best interests of society while addressing potential risks and ethical concerns. Techno ethical scholars view technology and ethics as deeply linked and integrated into everyday life and society. They believe that technology is not separate from ethical considerations but rather influences and is influenced by social values, norms, and human behavior. This perspective emphasizes the need to evaluate and guide technological advancements with ethical principles to ensure they align with societal well-being. Techno ethics is used to refer to a wide range of ethics issues that pertain to technology – from professional concern areas that affect tech professionals to societal, ethics-related, and legal issues about the role that technology plays within society and everyday life. In the contemporary era, technological advancements have transformed various aspects of human life, from communication and healthcare to finance and education. Technological advancement refers to the continuous process of improving and innovating technology to enhance efficiency, productivity, and overall human well-being. It involves the development and application of new tools, systems, processes, and knowledge to solve problems and improve various aspects of life, such as communication, healthcare, transportation, and industry. The different aspects of technological advancement include innovation, automation, digital transformation and sustainability. Advancements in fields like medicine, physics, and engineering that lead to new technological capabilities. Innovations such as artificial intelligence (AI), biotechnology, and data analytics have created unprecedented opportunities for efficiency and problem-solving. (Abou El Fadl, K. 2001). This paper aims at to find out the principles governing the use of technology and the various applications of technology in various fields. This paper analyzes different ethical theories and their application to technological progress, addressing issues such as automation, data ethics, and environmental impact. However, they also pose significant ethical dilemmas and societal challenges, necessitating a thoughtful examination of their implications. (Abdalla, A. 2020). As these technologies become increasingly integrated into daily life, the question arises: How can we ensure that these advancements align with ethical standards and values?

As emerging technologies continue to shape society, evaluating their ethical and social implications becomes increasingly crucial. While these advancements offer innovative applications and the potential for global transformation, they also introduce new ethical dilemmas that must be addressed. The rapid pace of technological progress challenges societal understanding, often surpassing human control.

Techno ethics aims to expand research on technology and ethics, providing a comprehensive framework for various ethical concerns related to human activities such as economics, politics, globalization, and scientific research. It also highlights the responsibilities of designers and developers in ensuring ethical technological outcomes. This is especially significant with the rise of algorithmic systems capable of autonomous decision-making, where biases in data or development can impact fairness. To address these biases, the accountability of both humans and technology must be carefully assessed, shifting the perception of technology from a purely positive tool to a neutral entity. Thus, techno ethics must consider both the human and technological aspects of emerging innovations.

As technology continues to evolve, new ethical challenges arise. For example, concerns surrounding genetically modified organisms (GMOs) and debates over the trustworthiness of artificial intelligence (AI) highlight the ethical implications of technological advancements and their impact on human values.

Techno ethics applies to multiple technological fields, including:

- Computer ethics, focusing on areas like AI, robotics, and visual technology.
- Engineering ethics, addressing professional standards and engineers' moral obligations to society.
- Internet and cyber ethics, ensuring ethical online behavior.
- Media and communication techno ethics, dealing with ethical responsibilities in mass media and digital communication.
- Professional techno ethics, covering ethical considerations in fields like journalism, medicine, and engineering.

- Educational techno ethics, examining the ethical consequences of using technology in education.
- Biotech ethics, relating to issues in cloning, genetic engineering, and stem cell research.
- Environmental techno ethics, assessing the ecological impact of technological innovations.
- Nano ethics, exploring ethical concerns in nanotechnology applications across various disciplines.
- Military techno ethics, analyzing ethical issues in military technology and warfare.

The growing influence of technology demands continuous ethical scrutiny to ensure responsible innovation and minimize potential risks.

II. TYPES OF TECHNOLOGY ETHICS

Technological ethics are principles that can be used to control technology such as the management of risks and the rights of individuals. They are basically used to deal with and resolve moral issues that are concerned with the creation and use of various forms of technology.

THERE ARE MANY TYPES OF TECHNOLOGY ETHICS:

- Access rights: access to empowering technology as a right
- Accountability: decisions made for who is responsible when considering success or harm in technological advancements
- Digital rights: protecting intellectual property rights and privacy rights
- Environment: how to produce technology that could harm the environment
- Existential risk: technologies that represent a threat to the global quality of life pertaining to extinction
- Freedom: technology that is used to control a society raising questions related to freedom and independence
- Health and safety: health and safety risks that are increased and imposed by technologies
- Human Enhancement: human genetic engineering and human-machine integration
- Human judgment: when can decisions be judged by automation and when do they acquire a reasonable human?
- Over-automation: when does automation decrease quality of life and start affecting society?
- Precaution principle: Who decides that developing this new technology is safe for the world?
- Privacy: protection of privacy rights
- Security: Is due diligence required to ensure information security?
- Self-replicating technology: should self-replicating be the norm?
- Technology transparency: clearly explaining how a technology works and what its intentions are
- Terms of service: ethics related to legal agreements

III. ETHICAL THEORIES AND THEIR APPLICATION

3.1 UTILITARIANISM

Utilitarianism, as proposed by Bentham and Mill, focuses on maximizing overall societal benefit. Bostrom and Yudkowsky (2014) discuss the utilitarian calculus of AI safety, stressing that AI should be aligned with human values to prevent catastrophic outcomes. Frey and Osborne (2017) analyze the trade-offs of automation, suggesting policies that balance efficiency gains with societal well-being. Utilitarian ethics, based on maximizing overall happiness and minimizing harm, evaluates technology by weighing benefits and risks. For example, AI-driven automation increases efficiency but may lead to job displacement, requiring balanced considerations.

3.2 DEONTOLOGY

Deontological ethics emphasize duty and moral rules, asserting that certain actions are inherently right or wrong. In technology, this framework applies to issues like informed consent in medical research and cybersecurity obligations. Deontological ethics, rooted in Kantian philosophy, emphasizes duty and adherence to moral principles. Moor (1985) argues that technology should be designed to respect fundamental human rights, prioritizing ethical duties over consequences. Floridi (2013) applies deontological principles to information ethics,

advocating for digital rights and responsibilities in the age of AI and big data.

3.3 VIRTUE ETHICS

This approach focuses on moral character and virtues such as honesty, justice, and responsibility. Ethical technological development encourages developers to uphold integrity and prioritize public welfare. Virtue ethics, inspired by Aristotle, emphasizes character and moral virtues in decision-making. Vallor (2016) introduces the concept of "techno-moral virtues," arguing that developers and policymakers must cultivate wisdom, humility, and justice when shaping technological advancements. This approach highlights the role of individual and institutional character in ethical technology governance.

3.4 HUMAN RIGHTS-BASED APPROACH

Human rights frameworks focus on safeguarding individual freedoms and dignity in the face of technological disruption. Zuboff (2019) critiques surveillance capitalism, emphasizing the need for data protection laws that uphold privacy rights. The United Nations (2019) promotes AI and digital technology governance rooted in human rights principles, advocating for global standards to prevent exploitation. This perspective prioritizes individual rights, emphasizing privacy, freedom of expression, and data protection. It plays a crucial role in debates surrounding digital rights, government surveillance, and corporate data usage.

3.5 JUSTICE AND FAIRNESS IN TECHNOLOGICAL ETHICS

Rawls' theory of justice provides a framework for assessing fairness in technology distribution. Noble (2018) explores algorithmic bias through a justice-oriented lens, demonstrating how machine learning systems can perpetuate social inequalities. Dignum (2019) suggests that AI governance should be based on distributive justice to ensure equitable technological benefits.

IV SOME CONTEMPORARY ETHICAL PRINCIPLES IN TECHNOLOGY

4.1 FAIRNESS AND BIAS MITIGATION

Algorithms must be designed to prevent discrimination, ensuring fairness in areas such as hiring, lending, and law enforcement.

4.2 ACCOUNTABILITY

Developers and organizations must take responsibility for the societal impacts of their technologies. Ethical AI governance frameworks promote oversight and redress mechanisms.

4.3 TRANSPARENCY

Openness in algorithmic decision-making fosters trust and allows stakeholders to understand and challenge outcomes.

4.4 PRIVACY AND SECURITY

With the rise of big data, safeguarding personal information is critical. Ethical frameworks guide policies on data collection, consent, and cyber security.

V. CURRENT DEVELOPMENTS

Despite the extensive literature regarding techno ethics beginning from the 1970s, it has only gained institutional acknowledgment quite recently as a vital research area and branch of study drawing upon various disciplines. The Epson Foundation created the Instituto de Tecnoética in 1998 under the directorship of Josep Esquirol. This organization has facilitated techno ethical research through publications, conferences, and awards. This acted to stimulate research activity to an international readership that was predominantly European.

The primary stimulus to the emergence of techno ethics resides within the publication of seminal reference volumes that are made available to the English language market and distributed internationally. The "Encyclopedia of Science, Technology, and Ethics" included an entry regarding techno ethics that helped bring it to the forefront of philosophical discussions. This further fueled interest, culminating in the publication of the first

English-language reference work dedicated to the emerging field of Techno ethics.

The two-volume *Handbook of Research on Techno ethics* explores the complex relationship between ethics and the emergence of new technologies, such as life-saving medical advancements, stem cell research, cloning, new surveillance methods, anonymity, computer networks, and the evolution of the Internet. This extensive collection provides the first in-depth examination of techno ethics and its sub-domains, featuring contributions from over 50 researchers worldwide.

The rise of techno ethics parallels the emergence of other interdisciplinary research fields in recent years, such as technoscience and techno criticism, further emphasizing its relevance in today's rapidly evolving technological landscape.

Technology and ethics in the music industry with all the developments in technology, the music industry has experienced significant advancements, both positive and negative. One of the biggest concerns is piracy and illegal downloading. With the vast accessibility of content online, music, along with TV shows and movies, can be easily downloaded or uploaded for free. This poses new challenges for artists, producers, and copyright laws.

On the positive side, technology has introduced entirely new genres of music. Computers and synthesizers (electronic pianos) are now widely used to create electronic music, which is becoming increasingly popular. These advancements have allowed the industry to experiment with new sounds and explore creative possibilities.

Because the internet lacks centralized control, users can remain anonymous and find loopholes to bypass consequences associated with peer-to-peer file sharing. Peer-to-peer networks enable users to connect and freely exchange music files. Companies like Napster have capitalized on this, as enforcing intellectual property protection online is extremely difficult. Digital and downloadable music has significantly disrupted the power dynamics of the music industry, affecting major record labels, artists, and consumers. While this shift has provided more opportunities for independent music labels, it has also driven down the cost of music.

The digital music landscape is constantly evolving. "The industry is beginning to adapt to the digital environment and business challenges by leveraging online distribution and sales, using high-visibility events to boost sales, developing new artist management strategies in the digital age, and utilizing online communities to shape product development".

To support these new capabilities, strong intellectual property regulations are necessary to protect artists and their work.

Technology is the backbone of the music industry, making it essential to uphold strong ethical standards. Copyright laws and legal protections help artists safeguard their music and intellectual property. However, as music companies integrate new technologies and methodologies, protecting intellectual property become more complex, requiring continuous innovation and adaptation to industry standards.

Technology and ethics during the coronavirus pandemic

Up to April 20, 2020, more than 43 contact tracing apps had been released globally. Countries were developing their own digital methods for tracking coronavirus cases, including symptoms, confirmed infections, and potential exposures. Apple and Google collaborated to create a shared solution for contact tracing worldwide. Given the ongoing nature of the pandemic, restricting certain fundamental rights and freedoms may be ethically justifiable. In fact, failing to use these tracing solutions to slow the spread could itself be considered unethical.

The European Convention on Human Rights, the United Nations International Covenant on Civil and Political Rights, and the United Nations Siracusa Principles outline when it is appropriate to limit individual rights to control the spread of infectious diseases. These documents emphasize that any restrictions must be time-limited, necessary, proportional, and scientifically validated. It is crucial to assess whether the severity of the situation justifies the potential negative consequences, whether the technology is effective, timely, widely adopted, and capable of providing accurate data and insights. Additionally, we must ensure that the use of such technology remains temporary. These guidelines also establish ethical principles for developing and

designing such technologies to ensure both effectiveness and security.

The advancement of technology has significantly improved the ability to collect, track, and share data. Governments worldwide have leveraged technology to combat COVID-19, raising numerous ethical concerns. Various technologies, such as smartphone metadata and Bluetooth applications, have been implemented to trace contacts and provide important public health updates. However, privacy concerns arise because metadata can track an individual's every movement.

To combat the pandemic, countries worldwide have developed different digital tracing methods, including identifying outbreak sources, tracking symptoms, and monitoring confirmed cases and potential exposures. Governments have integrated technology to track individuals while attempting to minimize privacy concerns. In 2020, the Australian government introduced a Bluetooth-based app that allowed phones to communicate directly with each other rather than relying on metadata or GPS, which pose greater privacy risks. This app recorded close contacts through Bluetooth connections and automatically deleted the data after a set period. While it did not track users' locations, it could still determine whether they had been near someone who tested positive for COVID-19.

In contrast, some countries, such as South Korea, used metadata technology for more intensive surveillance. Metadata provides detailed records of an individual's movements by continuously connecting to nearby cellular towers. In South Korea, the government used individuals' metadata to distribute public health messages, releasing anonymized data about the locations of confirmed COVID-19 cases. Similarly, in Israel, emergency regulations allowed authorities to use a database that tracked the movements of individuals who tested positive for COVID-19.

The increased use of surveillance technologies by governments raises significant ethical concerns. As lockdowns and COVID-19 protocols persist, the need to protect public health can sometimes conflict with individual freedoms. While certain measures may be necessary, striking the right balance is critical.

Although some governing bodies deem contact tracing ethical, these apps come at a cost. They collect sensitive personal data, including health records, raising concerns about potential violations of regulations such as HIPAA and PII if not properly managed. Even if these apps are only used temporarily, they create permanent records of individuals' health status, movements, and social interactions. Beyond privacy concerns, issues of accessibility and digital literacy must also be considered—not everyone owns a smartphone or a mobile device. Relying solely on smartphone applications could result in significant gaps in COVID-19 data.

While technology plays a crucial role in controlling the spread of COVID-19, governments must design and implement these solutions in a way that maintains public trust. There is a fine line between saving lives and potentially infringing on fundamental rights and freedoms.

VI. CASE STUDIES ON ETHICAL IMPLICATIONS OF TECHNOLOGICAL APPLICATION ARE

- AI ETHICS IN HEALTHCARE
  When discussing AI ethics in healthcare, the key challenge lies in balancing the potential efficiency gains from AI technology with the fundamental patient rights to privacy, informed consent, and autonomy, ensuring that AI systems are used ethically and do not infringe on individuals' healthcare choices. Protecting sensitive patient data used to train AI algorithms, including anonymization and de-identification techniques to safeguard privacy. Making AI decision-making processes understandable to patients and healthcare providers, allowing for scrutiny and addressing concerns about biased algorithms. Clearly, communicating the use of AI in healthcare, including potential risks and benefits, to patients before utilizing their data and allowing them to opt-out if desired. Addressing potential biases in AI systems that could lead to discriminatory treatment based on factors like race, gender, or socioeconomic status. Respecting the patient's right to make decisions about their own healthcare, ensuring AI is used as a supportive tool rather than

replacing clinical judgment. Should AI diagnostic systems be allowed to provide definitive diagnoses without a healthcare professional verifying the results, potentially leading to misdiagnosis? How to balance the potential benefits of tailored treatment with the ethical concerns of genetic profiling and privacy implications. How to ensure patient privacy and security when sensitive health data is collected and transmitted through AI-powered devices.

- BIOTECHNOLOGY AND GENETIC EDITING: THE ETHICAL BOUNDARIES OF CRISPR TECHNOLOGY:
  The ethical concerns of altering genetic traits in human embryos, potentially impacting future generations with unintended consequences. Debates surrounding the potential for parents to choose specific traits for their children using CRISPR technology. Ensuring equitable access to CRISPR-based therapies and addressing potential disparities in treatment based on socio-economic factors.

- DIGITAL SURVEILLANCE: GOVERNMENT MONITORING VS. PRIVACY RIGHTS
  The balance between using technology to improve public health and protecting individual privacy by limiting government surveillance. Establishing clear guidelines on what data can be collected, how it will be used, and providing individuals with control over their personal information. Overall, the ethical considerations surrounding AI in healthcare, biotechnology, and digital surveillance require ongoing dialogue between scientists, policymakers, and the public to ensure responsible development and deployment of these technologies that prioritize human values and rights.

- ACCORDING TO JASON SHEPHERD, CEO at Atym, A proactive approach to ensuring ethical implication of AI requires addressing the following three key areas,
  Policy- This includes developing the appropriate framework for getting standardization and establishing regulations. Government agencies in the U.S., Europe and other places have launched efforts to ensure ethical AI, and a set of standards, tools and techniques from research bodies, vendors and academic institutions are available to help organizations draft AI policy. Ethical AI policies should be capable to deal with legal issues when something goes wrong. Companies should consider following AI policies into their own code of conduct. But effectiveness depends on employees following the rules, which might not always be realistic when money or prestige is on the line.

- EDUCATION- MANAGERS, data scientist, employees and consumers must understand the policies of non-ethical AI and fake data, major considerations and potential negative results. One of the big problems is a compromise between the convenience of usage and the potential negative results of excessive co-use or disadvantaged automation in connection with data exchange and automation of artificial intelligence. Shepard said," Ultimately consumers' preparation to actively control data and pay attention to the potential threats of AI is a complex equation based on immediate satisfaction, cost, perception and risk.

- TECHNOLOGY-The architecture of the AI system requires technical functions to automatically detect fake data and non-ethical behavior. To do this, not only examines the company's artificial intelligence, but also requires suppliers and partners to check the malicious use of AI. For example, Deep fake's videos and text are used to damage competitors or use AI to start complex cyber-attacks. This will be a more important issue because artificial intelligence tools will be comprehensive. In order to deal with these potential effects, the organization must invest in protection measures based on open, transparent and reliable AI infrastructure. Shepherd believes this will lead to trust, which provides a systematic approach to confidential automation, ensuring data trust and detecting AI's non-ethical use.

VII. HISTORY OF ETHICAL CONSIDERATIONS IN THE TECHNOLOGICAL ADVANCEMENTS

The historical evolution of innovations and its ethical considerations is a complex and multifaceted task that reflects the rapid advancements in technology and the corresponding emergence of ethical challenges. This progression from the start to the present time displays an interactive relationship between the evolution of innovation in technology and the emerging understanding of moral principles within the AI framework. In the initial stages of AI development, ethical framework was not considered. However, as technologies began to demonstrate their potential to transform human-society-device relationships, the need to address ethical, legal, and standardization questions became increasingly urgent. Mezgár (2021) provides an overview of this transition, highlighting the shift from general ethical issues to the development of AI standards, particularly in the context of Cyber Physical Production Systems (CPPS). This shift marks a critical point in AI history, where the focus expanded from technological development to include the ethical implications of these technologies (Mezgár, 2021). The field of AI ethics has emerged as a branch of digital ethics in response to growing concerns about the ethical implications of artificial intelligence. Kazim and Koshiyama (2021) provide an in-depth exploration of AI ethics, linking it to earlier fields like engineering ethics, the philosophy of technology, and science and technology studies. They examine how AI ethics has evolved through different perspectives, including guiding principles, ethical processes, and moral awareness, while also addressing the challenges of integrating ethical considerations into engineering practices. This historical viewpoint highlights the relatively young nature of AI ethics and emphasizes its crucial role in shaping the responsible development and use of AI technologies (Kazim & Koshiyama, 2021). The ethical conversation surrounding AI gained widespread attention with the rise of Neural Networks and Machine Learning, which greatly expanded AI's capabilities and its impact on society. Hagendorff (2020) examines the ethics of AI ethics based on an analysis of new guidelines that have been published. Such guidelines encompass normative principles and recommendations that are meant to unlock the disruptive potentials of new AI technologies. Hagendorff's work provides a comprehensive overview of the field of AI ethics and examines the extent to which ethical principles and values are implemented in the research, development, and application of AI systems (Hagendorff, 2020). The historical evolution of AI ethics has seen a path that has experienced rapid technological evolution accompanied by growing concern regarding the ethics of the new technologies. The evolution has witnessed the field shift from the early days of focusing on innovation to include a comprehensive system of ethics principles and guidelines. The evolution has seen the ongoing attempt to balance the transformative nature of AI with the need to preserve ethics principles and ensure the safe evolution and use of AI technologies. The evolution of AI ethics has been an interdisciplinary path that has taken concepts from other fields to address the complex ethics challenges that AI poses to current society.

VIII. CONCLUSION

As never before, technology is rapidly advancing, and a strong ethical framework needs to be in place to guide its development and application. Ethical principles must balance innovation with human well-being to ensure that humanity benefits from it and does not exacerbate inequality, violate privacy, or pose ethical dilemmas.

It would have to be founded in such basic principles as inclusivity, accountability, fairness, and transparency. It would involve multidisciplinary collaboration among technologists, policymakers, ethicists, and the public to come up with guidelines that prioritize human rights, environmental sustainability, and equal access to technological benefits.

Moreover, ethical principles have to be adaptive, changing constantly to address new challenges such as AI bias, data privacy, and job impact from automation. A forward-looking strategy—rather than a reactive strategy to regulation—can prevent and forestall ethical wrongdoing and foster responsible innovation.

Overall, ethical consideration must be a component of technological advance. Through embedding ethical

principles in design, manufacture, and use, new technologies can be made to be in harmony with human values, to promote social welfare, and to minimize potential harm.

The ethical frameworks guiding technological advancements are diverse and interdisciplinary. Deontology, utilitarianism, virtue ethics, justice theories, and human rights-based approaches offer valuable insights for ethical decision-making in technology development. As technology continues to evolve, a multi-faceted ethical perspective is essential to ensure that advancements align with societal values and human dignity.

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