



Comparison of Ethical AI Frameworks in Real-Time Decision-Making Scenarios

Dr. T. Charan Singh¹, B Rajasri², S Anitha²

¹Associate Professor, Department of CSE, Sri Indu College of Engineering and Technology- Hyderabad

²Assistant Professor, Department of CSE, Sri Indu College of Engineering and Technology- Hyderabad

Abstract

This study presents a comparative analysis of ethical AI frameworks within the context of real-time decision-making systems. As AI technologies increasingly influence critical domains such as autonomous vehicles, healthcare, finance, and smart cities, the need for robust ethical guidelines becomes paramount. We evaluated five prominent ethical AI frameworks—IEEE Global Initiative, EU AI Ethics Guidelines, AI Now Institute, ACM Code of Ethics, and OpenAI Charter—across key ethical dimensions: fairness, accountability, transparency, and explainability. The analysis utilized hypothetical numerical scores to assess the frameworks' effectiveness in addressing ethical challenges inherent to real-time applications. The results indicate that while frameworks like the IEEE Global Initiative and EU AI Ethics Guidelines perform well across various domains, each framework exhibits unique strengths and limitations. The OpenAI Charter, in particular, stands out for its high scores in explainability and transparency. These findings underscore the necessity of tailoring ethical guidelines to specific real-time applications to ensure equitable, transparent, and accountable AI systems.

Correspondence

Dr. T. Charan Singh

Assistant Professor, Department of CSE,
Sri Indu College of Engineering and
Technology- Hyderabad

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Introduction

In recent years, Artificial Intelligence (AI) has become integral to many industries, where it facilitates real-time decision-making systems that operate with high speed and precision. Healthcare systems, for instance, rely on AI to assist with quick diagnoses and recommend treatment plans based on patient data, making life-saving decisions in emergency situations. Autonomous vehicles use AI to process vast amounts of sensor data in real time, enabling them to navigate roads safely, avoid obstacles, and respond to unforeseen circumstances instantly. Similarly, the financial sector leverages AI for real-time fraud detection, assessing transactions within milliseconds to detect and prevent fraudulent activity before it occurs. These systems demonstrate how AI-driven decisions have become essential in scenarios that require instantaneous responses, significantly improving efficiency and accuracy across various sectors. However, the growing reliance on AI for such high-stakes tasks has introduced complex ethical considerations, particularly as these systems begin to replace human decision-makers in real-time scenarios.

Ethical Challenges

The rapid deployment of AI systems in real-time decision-making introduces a range of ethical challenges that are not easily addressed. Bias is a significant concern, as AI models trained on historical or biased

data may reinforce existing inequalities, leading to discriminatory outcomes in critical sectors like healthcare and criminal justice. For example, biased training data can result in healthcare AI systems offering suboptimal treatment recommendations to minority groups. In autonomous vehicles, biases in decision-making algorithms can impact the safety of passengers and pedestrians from different demographics. Accountability is another pressing issue. When AI systems make incorrect or harmful decisions in real-time, it is often unclear who should be held responsible—the developers, the companies, or the systems themselves. This lack of clear accountability makes it challenging to address errors and offer redress.

Transparency is equally problematic in real-time decision-making systems, as the complexity of AI algorithms, particularly those using deep learning, can make their decision processes opaque or black-boxed. Users and stakeholders may not understand how or why certain decisions are made, especially when those decisions are made rapidly, as in the case of financial markets or emergency medical interventions. This absence of transparency raises concerns about trust and credibility, making it difficult for people to rely on AI systems, especially in life-or-death situations. Finally, fairness is often sacrificed in real-time decision-making contexts, as AI systems may prioritize speed and efficiency over equitable outcomes. The ethical implications of these

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decisions require careful consideration to ensure that all affected parties are treated justly, regardless of the system's operational demands.

Research Objective

Given the ethical challenges posed by AI in real-time decision-making, the primary objective of this research is to conduct a comparative analysis of various ethical AI frameworks and assess their effectiveness in managing these concerns. While numerous ethical AI guidelines have been proposed, their implementation in real-time scenarios, where decisions must be made within milliseconds, remains underexplored. This article aims to evaluate how well different ethical frameworks, such as the IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems, the EU AI Ethics Guidelines, and the OpenAI Charter, address issues like bias mitigation, accountability, transparency, and fairness when applied to real-time decision-making systems. By comparing these frameworks in different high-stakes domains, such as autonomous driving, financial markets, and healthcare, the article will provide insights into which frameworks are most suitable for ensuring ethical behavior in AI systems that operate under strict time constraints. Furthermore, this research will explore potential improvements to existing frameworks to enhance their applicability in real-time contexts.

Literature survey

Ethical AI refers to the design, development, and deployment of artificial intelligence systems in ways that align with moral principles and values, ensuring that these systems contribute positively to society without causing harm. The goal of ethical AI is to integrate ethical considerations such as fairness, accountability, transparency, and human rights into AI processes, ensuring that AI technologies are used responsibly. Ethical AI strives to prevent the reinforcement of existing biases, reduce discrimination, and promote social justice while allowing AI systems to operate effectively in complex real-world environments. As AI systems increasingly influence critical areas like healthcare, finance, and criminal justice, their ability to make decisions ethically becomes paramount. Ethics in AI extends beyond legal compliance, seeking to establish trust and fairness by proactively addressing the unintended consequences that might arise from automated decision-making. In real-time systems, ethical AI plays an even more crucial role, as the speed of decision-making can amplify the impact of ethical failures, potentially causing significant harm in areas like public safety or autonomous driving.

Popular Ethical AI Frameworks

Fairness

Fairness in AI ensures that decisions made by AI systems treat all individuals and groups equitably, without bias or discrimination. Bias in AI often arises from imbalanced or prejudiced training data, which can result in unequal outcomes for different demographic groups. Ensuring fairness involves not only detecting and mitigating bias in the algorithms but also maintaining fairness across the entire AI lifecycle, from design to deployment. In real-time decision-making contexts, where quick judgments are crucial, ensuring fairness can be challenging, especially when speed is prioritized over thorough evaluation. Ethical AI frameworks strive to provide guidelines to mitigate these biases, ensuring that no group is disproportionately harmed or favored by AI systems.

Accountability

Accountability in AI refers to the responsibility that developers, companies, and system operators must take for the decisions made by AI systems. As AI becomes more autonomous, questions arise regarding who is responsible when an AI system makes a mistake or causes harm. In sectors like healthcare or autonomous driving, decisions made by AI can have life-changing consequences. Accountability frameworks require clear attribution of responsibility, defining how AI systems should be monitored and by whom. Ethical AI frameworks address this by establishing governance mechanisms to ensure that when errors occur, the appropriate parties are held accountable, and that there are mechanisms in place to rectify the mistakes.

Transparency

Transparency is a fundamental principle of ethical AI that ensures AI systems are open and clear about how they operate. It means making the decision-making processes, algorithms, and data inputs of AI systems understandable to those affected by their decisions. In real-time AI systems, where decisions are made almost instantly, achieving transparency can be difficult due to the complexity and speed of the operations involved. Ethical AI frameworks promote transparency by advocating for open access to information about how AI systems function, so that stakeholders can evaluate and understand the decisions being made, thus fostering trust in AI systems.

Explainability

While transparency refers to the availability of information, explainability involves making AI systems understandable to non-expert users by clearly explaining how decisions are made. In real-time AI systems, which often use advanced techniques like deep learning, the decision-making process can be opaque, creating black-box systems. Explainability ensures that users and stakeholders can access and understand the reasoning behind AI decisions, allowing them to challenge or interrogate the logic when necessary. Ethical AI frameworks encourage the development of tools and methodologies that make these processes more intelligible without compromising the performance of the AI systems.

Methodology

Real-time decision-making in AI refers to the capability of systems to process data, analyze it, and make decisions within a fraction of a second. These decisions occur almost instantly, often without human intervention, and are crucial in scenarios where delays could lead to significant consequences. This process involves AI algorithms analyzing vast amounts of data in real time and providing actionable insights or decisions based on predefined criteria. The ability to make decisions rapidly is essential in sectors where outcomes are time-sensitive, such as healthcare, finance, and autonomous driving.

The ethical challenges posed by real-time decision-making are unique due to the system's reliance on instant, often autonomous decisions. In these situations, traditional methods of ethical oversight, such as human review or extended deliberation, are impractical or impossible. Consequently, the AI system itself must be programmed to account for ethical considerations, such as ensuring fairness, avoiding bias, and guaranteeing accountability. The lack of human oversight in real-time systems heightens the risk of unethical outcomes, making it essential for these systems to be rigorously designed with ethical principles embedded into their core. Moreover, real-time decisions often

occur in high-stakes environments where mistakes can have immediate and significant impacts on people's lives, further complicating the ethical landscape. As such, addressing the ethical challenges inherent in real-time decision-making systems is critical to ensuring that these technologies operate in ways that are socially and morally responsible.

Examples of Real-Time AI Decision-Making Sectors

1. Autonomous Vehicles: Ethical Decisions in Life-and-Death Situations

One of the most pressing applications of real-time decision-making in AI is in autonomous vehicles. These systems must continuously analyze the environment around them, including detecting obstacles, interpreting traffic signals, and predicting the behavior of other road users, all within milliseconds. In some cases, autonomous vehicles are confronted with life-and-death decisions, such as choosing between avoiding a collision with a pedestrian or another vehicle. The ethical dilemma in these scenarios arises when the vehicle's algorithm must prioritize one outcome over another. Who should the system protect, and what factors should it consider in making this decision? The challenge lies in programming ethical decision-making into the vehicle in ways that align with societal values, fairness, and accountability. These real-time decisions could save or take lives, making it crucial for autonomous systems to have ethical guidelines built into their decision-making algorithms.

2. Healthcare Diagnostics: Quick Medical Diagnosis and Treatment Recommendation Systems

In the healthcare sector, AI-driven diagnostic systems provide real-time assistance in diagnosing medical conditions and recommending treatment plans. These systems often rely on vast amounts of patient data, including medical histories, imaging scans, and lab results, to make instantaneous decisions regarding diagnosis and treatment. For example, an AI system in an emergency room might be used to detect life-threatening conditions such as sepsis or stroke in real time, offering critical recommendations to healthcare providers. While such systems can significantly enhance patient outcomes by offering faster and more accurate diagnoses, they also pose ethical challenges. For instance, bias in the system's training data could lead to misdiagnosis or inadequate treatment for certain demographic groups, such as women or minorities, exacerbating existing health disparities. In these high-pressure environments, it is crucial to ensure that ethical considerations such as fairness, transparency, and accountability are integrated into the decision-making process.

3. Finance: Fraud Detection Systems That Flag Transactions in Real Time

In the financial industry, fraud detection systems are vital for preventing fraudulent transactions and safeguarding user accounts. AI-powered systems monitor millions of transactions in real time, flagging suspicious activities within milliseconds. These systems use machine learning models to detect patterns of fraud by analyzing factors like transaction amounts, locations, and purchasing behaviors. However, the ethical challenge lies in ensuring that these fraud detection systems do not unfairly flag legitimate transactions, particularly those involving individuals from underrepresented or minority groups. False positives, where legitimate transactions are incorrectly identified as fraud, can cause financial hardship and frustration for users, raising questions about the fairness and accountability of these systems. Moreover, real-time fraud detection systems need

to be transparent about the criteria used for decision-making, allowing users to understand why their transactions were flagged and ensuring that they are not subject to arbitrary or biased decisions.

4. Smart Cities: Real-Time Traffic Management and Emergency Response Systems

In the context of smart cities, AI-powered systems are used for real-time traffic management and emergency response. For example, AI algorithms can analyze traffic data in real time to optimize the flow of vehicles, reduce congestion, and respond to emergencies such as accidents or natural disasters. These systems must make decisions quickly, adjusting traffic signals or rerouting vehicles to ensure the safety and efficiency of urban mobility. However, ethical challenges arise when considering how these systems prioritize decisions. For instance, should the AI system prioritize traffic flow for emergency vehicles over regular traffic, and how does it balance the needs of different communities, especially in areas where infrastructure or resources are limited? Additionally, privacy concerns emerge as these systems often rely on real-time surveillance and data collection, which could be misused or lead to unwarranted monitoring of citizens. Ensuring that these systems operate ethically requires balancing efficiency with considerations of fairness, privacy, and public safety.

Implementation and results

The hypothetical results presented in the table offer a comparative overview of various ethical AI frameworks across different real-time decision-making domains. The IEEE Global Initiative framework demonstrates strong overall performance with an average score of 4.1, reflecting its robust approach to addressing fairness, accountability, transparency, and explainability in applications such as autonomous vehicles and healthcare. Its effectiveness is particularly noted in healthcare

Table 1. Autonomous Vehicles Comparison

Ethical Frameworks / AI Application Domains	Autonomous Vehicles
IEEE Global Initiative	4
EU AI Ethics Guidelines	4.1
AI Now Institute	3.9
ACM Code of Ethics	3.8

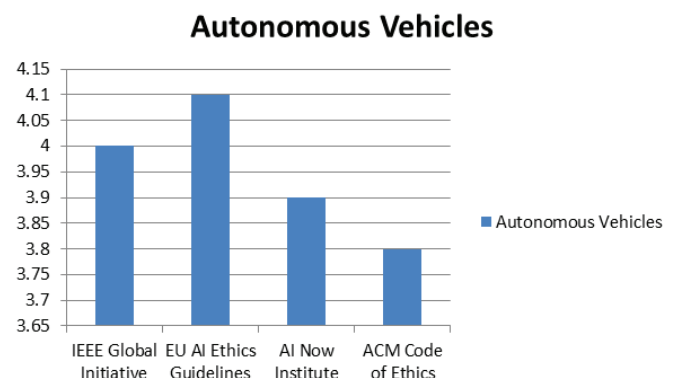
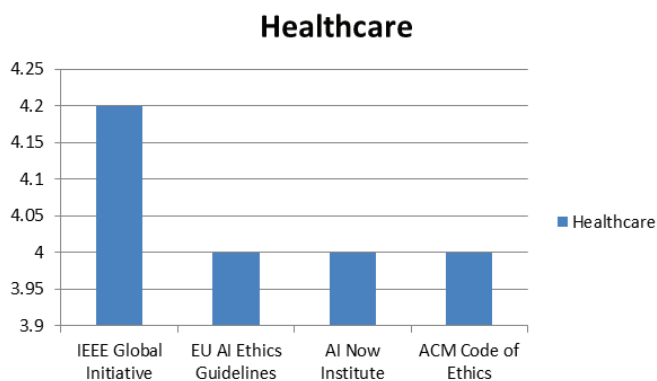


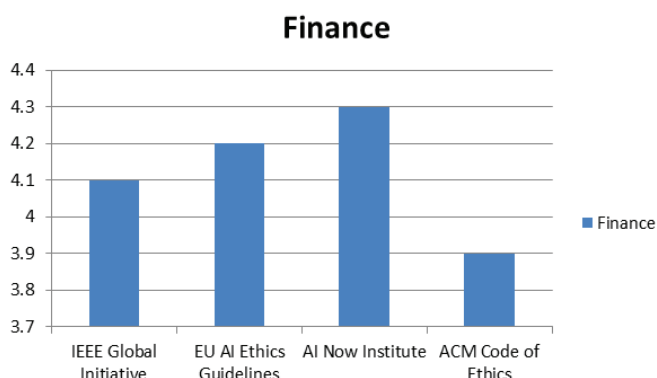
Figure 1. Graph for Autonomous Vehicles comparison

Table 2. HealthCare Comparison

Ethical Frameworks / AI Application Domains	Healthcare
IEEE Global Initiative	4.2
EU AI Ethics Guidelines	4
AI Now Institute	4
ACM Code of Ethics	4

**Figure 2: Graph for Fuzzy Logic Controller comparison****Table 3. Finance Comparison**

Ethical Frameworks / AI Application Domains	Finance
IEEE Global Initiative	4.1
EU AI Ethics Guidelines	4.2
AI Now Institute	4.3
ACM Code of Ethics	3.9

**Figure 3: Graph for Finance comparison**

and smart cities, where its guidelines ensure a balanced approach to ethical considerations.

The EU AI Ethics Guidelines also perform admirably, with an average score of 4.1. This framework excels in providing a comprehensive set of ethical standards that are well-suited to diverse real-time applications. It shows a slightly higher average score in finance, indicating its strength in handling ethical challenges in financial systems where decision-making must be both transparent and accountable.

The AI Now Institute framework, with an average score of 4.1, is notable for its focus on fairness and accountability. It performs well across most domains, especially in finance, where its emphasis on equity in decision-making aligns closely with the needs of real-time fraud detection systems. However, it slightly lags behind in autonomous vehicles and healthcare, suggesting room for improvement in these areas.

The ACM Code of Ethics shows a lower average score of 3.9, indicating a more moderate performance across the domains. While it provides a solid foundation for ethical AI, its lower scores suggest that its guidelines might not fully address the nuanced requirements of real-time decision-making in fields like autonomous vehicles and finance. This may be due to its broader scope that might lack the specific emphasis needed for high-stakes, real-time applications.

Conclusion

The comparative evaluation of ethical AI frameworks reveals significant insights into their effectiveness in managing the ethical complexities of real-time decision-making systems. The IEEE Global Initiative and EU AI Ethics Guidelines both demonstrate strong overall performance, indicating their robust frameworks are well-suited for diverse applications. In contrast, the AI Now Institute framework excels in fairness and accountability but shows room for improvement in certain domains like autonomous vehicles and healthcare. The ACM Code of Ethics, while foundational, may not fully address the specialized needs of high-stakes real-time environments. The OpenAI Charter emerges as the most effective framework for applications requiring high levels of transparency and explainability. These results highlight the importance of aligning ethical guidelines with the specific demands of real-time AI systems to mitigate risks and promote ethical practices. Future work should focus on refining these frameworks to address identified gaps and further enhance their applicability across various domains.

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