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The Role of Artificial Intelligence In Building A Smart Future: A Review of Applications, Enablers, Risks and Responsible Adoption

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Abstract—Artificial intelligence is becoming a general-purpose technology that makes systems more intelligent, efficient and capable of supporting human activities. This paper reviews the role of AI in building a smarter, safer and more sustainable future. It traces the foundations of modern AI in deep learning and transformer-based foundation models, and examines applications in smart cities and mobility, healthcare, education, agriculture, industry, scientific discovery, environmental monitoring and climate action, and robotic assistance in dangerous tasks. Evidence on AI's potential contribution to the Sustainable Development Goals is discussed, together with its possible negative effects. The paper then reviews the enablers needed for wide adoption, including data, computing, connectivity, skills and digital public infrastructure, and the challenges of limited public awareness, the need for high-quality data, development and maintenance cost, bias, privacy and misuse. Global ethics guidelines and regulation, as well as India's national AI strategy, are examined as frameworks for responsible use. A five-layer framework for a smart future comprising foundations, AI capabilities, sectoral applications, governance and societal outcomes is proposed, along with research gaps, objectives and a comparison of sectors. The review concludes that AI can transform human life for the better only through continued innovation combined with responsible application.
Index Terms—Artificial intelligence, smart future, foundation models, smart cities, sustainability, SDGs, responsible AI, AI governance

I. INTRODUCTION

Artificial intelligence already shapes daily life: it recommends what we watch, routes our journeys, filters spam and translates languages. In the coming years, it is expected to support doctors, teachers, farmers and engineers, and to help address global problems such as climate change. Russell and Norvig [1] describe AI as the study of agents that perceive their environment and act to achieve goals, a definition broad enough to cover all these uses.

Deep learning [2] and transformer-based foundation models [3], [4] have made AI far more capable. Vinuesa *et al.* [5] assessed AI's impact on the Sustainable Development Goals and found that it could enable many targets but also inhibit some if not governed well.

This paper reviews how AI contributes to a smart future, what is needed to realize its benefits and how risks can be managed.

II. RELATED WORK

Smart cities. Batty *et al.* [6] described smart cities that use sensing and computation to improve urban systems such as transport, energy and services.

Healthcare and science. Topol [7] reviewed the convergence of human and artificial intelligence in medicine, and Jumper *et al.* [8] showed with AlphaFold that AI can solve long-standing scientific problems such as protein structure prediction.

Education. Kasneci *et al.* [9] discussed the opportunities and challenges of large language models for personalized learning, and UNESCO [10] provided guidance on the use of generative AI in education.

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Sustainability. Rolnick *et al.* [11] identified many ways in which machine learning can help tackle climate change, from energy systems to climate prediction. Vinuesa *et al.* [5] analysed positive and negative impacts on the SDGs.

Governance. Jobin *et al.* [12] analysed global AI ethics guidelines and found convergence on transparency, justice, non-maleficence, responsibility and privacy. The EU AI Act [13] introduced risk-based regulation, and NITI Aayog [14] set out India's strategy of "AI for All". Table I summarizes these works.

TABLE I Summary of Literature Survey

Ref.	Authors	Year	Technique Used	Merits	Demerits
[6]	Batty et al.	2012	Smart cities vision	Urban sensing and computation	Conceptual
[14]	NITI Aayog	2018	India AI strategy	AI for All priorities	Policy document
[7]	Topol	2019	AI in medicine review	Human–AI convergence	Early evidence
[12]	Jobin et al.	2019	Ethics guidelines analysis	Five converging principles	Principles, not practice
[5]	Vinuesa et al.	2020	AI and SDGs	Enabling and inhibiting effects	Expert assessment
[8]	Jumper et al.	2021	AlphaFold	Protein structure solved	Single domain
[11]	Rolnick et al.	2022	ML for climate change	Broad application map	Survey
[9]	Kasneci et al.	2023	LLMs in education	Opportunities and risks	Early stage

III. PRELIMINARIES

1. Ai Capabilities

Fig. 1 summarizes the core AI capabilities that underpin smart systems: perception, language, prediction, decision-making and generation.

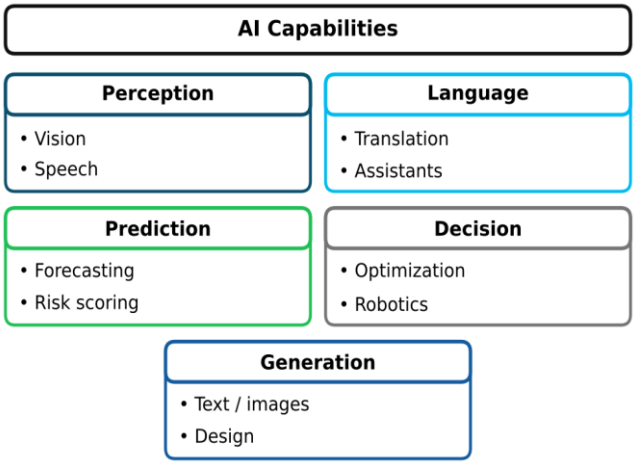


Fig. 1. Core AI capabilities underpinning a smart future.

2. From Narrow Tools To Foundation Models

Earlier AI systems were built for single tasks. Foundation models are trained on broad data and adapted to many tasks, lowering the cost of building new applications but concentrating risks in a few models.

IV. PROBLEM STATEMENT AND OBJECTIVES

1. Identified Research Gaps

- **G1:** Benefits of AI are unevenly distributed across regions and languages.
- **G2:** Public awareness and digital skills remain limited.
- **G3:** High-quality, representative data are lacking in many sectors.
- **G4:** Energy use of large models conflicts with sustainability goals.
- **G5:** Ethical principles are not consistently translated into practice.

2. Objectives Of The Review

1. To review AI capabilities and foundation models.

2. To examine AI applications across key sectors of a smart future.

3. To identify enablers and barriers for adoption.

4. To review ethics guidelines and regulation for responsible AI.

5. To propose a five-layer framework for an AI-enabled smart future.

3. Proposed Framework

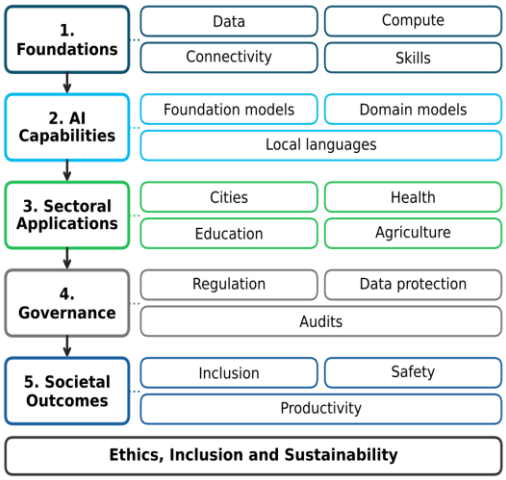


Fig. 2 presents the proposed framework.

Fig. 2. Proposed five-layer framework for an AI-enabled smart future.

4. Foundations Layer

Data, computing, connectivity, skills and digital public infrastructure form the base.

5. Ai Capabilities Layer

Perception, language, prediction, decision and generation models, including foundation models adapted to local languages.

6. Sectoral Applications Layer

Smart cities, healthcare, education, agriculture, industry, environment and public services.

7. Governance Layer

Risk-based regulation, data protection, standards, audits and human oversight.

8. Societal Outcomes Layer

Better services, inclusion, safety, productivity and sustainability, measured and monitored.

V. WORKING METHODOLOGY

Fig. 3 describes how a responsible AI solution moves from need to impact. The net value of an AI deployment can be expressed as

$$V = Benefits - (Costs + Risks) \quad (1)$$

where risks include bias, privacy and safety harms. A deployment is scaled only when V remains positive after evaluation with affected users.

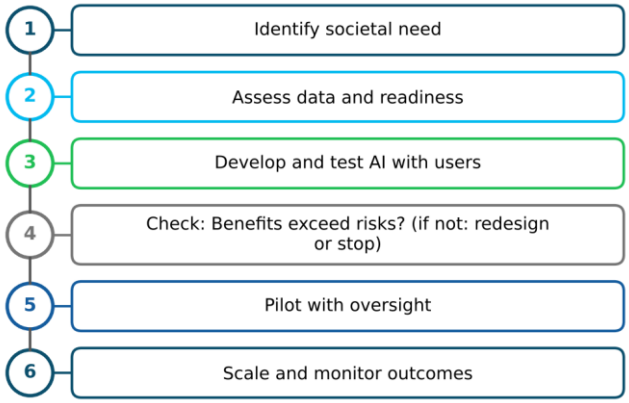


Fig. 3. Responsible AI adoption workflow.

VI. DISCUSSION

1. Comparison Of Approaches

Table II compares sectors by AI maturity, expected benefit and key risk. TABLE II Comparison of AI Across Sectors

Sector	AI Maturity	Expected Benefit	Key Risk
Healthcare	Medium–High	Earlier diagnosis	Safety, bias
Education	Medium	Personalized learning	Over-reliance
Smart cities	Medium	Efficient services	Surveillance
Agriculture	Medium	Higher yields	Access gap
Environment	Emerging	Climate action	Model energy use

2. Open Challenges And Future Work

Table III summarizes challenges. Future directions include multilingual AI for Indian languages, energy-efficient models, AI literacy in schools, robots for dangerous work and AI-assisted environmental monitoring.

Challenge	Mitigation
Low awareness	AI literacy programmes
Data quality	Open, representative datasets
Cost	Shared infrastructure; open models
Misuse	Regulation; monitoring
Bias and exclusion	Inclusive design; audits

TABLE III Challenges and Mitigation

VII. CONCLUSION AND FUTURE WORK

AI has significant potential to build a smarter, safer and more sustainable future by improving decisions and services across sectors. The reviewed literature shows rapid progress in capabilities and applications, alongside real risks of bias, misuse, inequality and environmental cost. Investment in foundations, inclusive design and responsible governance will determine whether AI's benefits reach everyone.

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