

Rupesh Nandi – Research Portfolio

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“Combining innovation, inquiry, and imagination to explore our world”

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2. Introduction

I am a high school student and independent researcher with a strong interest in medicine, technology, and storytelling. My work is focused on analyzing global healthcare innovations and breakthroughs in artificial intelligence. I am also building a fantasy saga that reflects complex human choices, inspired by Minecraft-style storytelling.

3. Published Research

1. **Slowing Time: The Science, Promise, and Ethics of Human Longevity (2014–2025)(version 1)**

Platform: Zenodo (Open Access)

DOI: <https://doi.org/10.5281/zenodo.15527905>

Word Count: Approx. 13,000

Abstract: This comprehensive review explores the biological, technological, and ethical dimensions of human longevity science from 2014–2025. Topics include hallmarks of aging, breakthroughs like CRISPR, senolytics, stem-cell therapies, AI-driven discovery, and global policy implications. The paper emphasizes equity, regulatory foresight, and philosophical debates around the future of aging.

Keywords: longevity, aging, CRISPR, AI in medicine, healthspan, senolytics, bioethics, lifespan equity

Version 2: preprint

Doi : <https://doi.org/10.22541/au.174957698.89327840/v1> (Platform: authorea)

2. Global Innovations in Medicine and Healthcare

Platform: Zenodo (Open Access)

DOI: <https://doi.org/10.5281/ZENODO.15359573>(version 1)

<https://doi.org/10.5281/zenodo.15535729>(version 2)

Final preprint: coming soon

Word Count: Approx. 11,000

Abstract: This paper explores 20 global medical innovations from 2015–2025, highlighting their mechanisms, applications, and social impact. It includes gene editing (CRISPR), mRNA vaccines, AI in diagnostics, telemedicine, and 3D bioprinting. The analysis evaluates both scientific and ethical dimensions.

Keywords: CRISPR, mRNA, AI in healthcare, telemedicine, biotechnology, healthcare innovation

3. Brain-Computer Interfaces: A Comprehensive Study

Date: May 11, 2025

Platform: Zenodo (DOI-linked)

DOI: <https://doi.org/10.5281/zenodo.15383755>

Abstract: A detailed exploration of neurotechnology, BCI systems, ethical concerns, and future prospects researched, written, and published independently.

Keywords: BCI, brain-machine interface, neural decoding, neuroethics

4. Breakthroughs in Artificial Intelligence (2020–2025)

Type: Analytical review

Status: Done

Platform: Zenodo (Open Access)

DOI: <https://doi.org/10.5281/zenodo.15383963>(version 1)

<https://doi.org/10.5281/zenodo.15722840>(version 2)

Focus: Major AI developments across healthcare, language models, robotics, and ethics

Estimated Word Count: 11,000

Keywords: artificial intelligence, machine learning, AI ethics, robotics, GPT, automation

Abstract: This review synthesizes the major breakthroughs in artificial intelligence between 2020 and 2025, with a focus on the rise of foundation models, multimodal systems, and general-purpose architectures that now underlie applications across science, policy, climate, and the creative economy.

We argue that this half-decade marks a phase shift: AI is no longer a discrete tool but a recursive infrastructure one that shapes the systems it is designed to serve. Foundation models such as GPT-4, AlphaFold2, and diffusion-based generators demonstrate a convergence of scale, reasoning, and accessibility, driving new forms of automation, creativity, and prediction.

We also examine emerging risks including hallucination, bias propagation, regulatory lag, and epistemic opacity, alongside global efforts to govern AI via instruments like the EU AI Act, the U.S. Blueprint for an AI Bill of Rights, and UNESCO's ethical frameworks.

This paper offers a cross-sectoral synthesis of this transformative period, arguing that AI has become not just a technological phenomenon but a civilizational substrate with recursive, accelerating impacts on science, society, and selfhood.

5. Neuro-AI Convergence: The Rise of Synthetic Consciousness and Ethical Sentience

Type: Analytical review

Status: Done

Platform: Zenodo (Open Access)

DOI: <https://doi.org/10.5281/zenodo.15538124>(version 1)

Estimated Word Count: 11,000

Abstract:

This research paper explores the convergence of neuroscience and artificial intelligence to critically assess the possibility and ethics of synthetic consciousness and artificial sentience. It evaluates leading neuroscience theories such as Global Workspace Theory (GWT) and Integrated Information Theory (IIT), alongside cutting-edge AI systems including GPT-4, neuromorphic computing, and brain-computer interfaces (BCIs). Through a skeptical, interdisciplinary lens, the paper argues that no current AI system demonstrates credible consciousness, and ethical considerations must remain grounded in human welfare. It reviews global policy gaps, proposes frameworks for neurorights, and outlines future scenarios ranging from utopian human-AI collaboration to dystopian

surveillance states. Designed for scientists, ethicists, and policy thinkers, this paper calls for precautionary governance to ensure that neuro-AI serves humanity without compromising dignity or safety

6. Post-Human Biotechnologies: Toward Recursive Intelligence and Bio-Digital Identity

Type: preprint

Status: Done

Platform: authorea

DOI: (version 1)

<https://doi.org/10.22541/au.174945271.13828281/v1>

Abstract

This paper explores the scientific, technological, and ethical dimensions of post-human biotechnologies interdisciplinary systems that integrate synthetic biology, gene editing, and artificial intelligence to enable symbiotic interaction between human DNA and machine intelligence. It investigates how AI-guided CRISPR systems, neuromorphic computing, and brain-machine interfaces may evolve into real-time bio-digital feedback loops, allowing for adaptive cognitive enhancement, emotional regulation, and programmable physiology.

Drawing from current literature in genomics, neurotechnology, and AI ethics, the paper analyzes possible architectures for human–machine symbiosis and presents speculative models of bio-integrated consciousness. Emphasis is placed on the concept of “bio-cybernetic continuity,” where identity persists despite augmentation. Ethical challenges such as autonomy, consent, inequality, and post-human governance are critically examined

This study is intended for interdisciplinary audiences interested in future-oriented biotechnology, including researchers, philosophers, policy analysts, and emerging technologists. While speculative in nature, the work is grounded in current trends and aims to provoke dialogue about the limits of human enhancement and the responsibilities that come with designing sentient systems.

7. TIMEBRON: A Neuroadaptive Framework for Emotionally Aligned and Ethically Modulated Artificial Intelligence

Type: preprint

Status: Done

Platform: authorea

DOI: (version 1)

Abstract

Advances in affective computing and brain–computer interfaces (BCIs) have opened new possibilities for designing AI systems that interact with human users not just cognitively, but emotionally. We introduce TIMEBRON (Temporal-Integrative Emotion-Based Regulation Operator for NeuroAI), a conceptual framework for a cognitive-emotional “co-pilot” that modulates neuroadaptive AI behavior through real-time affective and ethical feedback loops. TIMEBRON integrates reinforcement learning architectures with emotion recognition systems, inspired by theories of embodied cognition, predictive processing, and the extended mind. This system is designed to dynamically align AI decision-making with user states such as cognitive load, emotional salience, and ethical acceptability, while allowing for modular applications in education, therapy, and high-stakes decision contexts. We also introduce the concept of “symbiotic explainability,” where AI transparency adapts to the user’s neuroemotional profile. TIMEBRON is not a product, but a prototype blueprint intended to guide the ethical design of future human-AI hybrids. We conclude by addressing key limitations, including signal interpretability, the risk of emotional manipulation, and socio-cultural bias. Our goal is to reframe human-AI interaction as a co-regulatory, emotionally attuned partnership, with applications that

extend from neuroethics to affective robotics and value-aligned reinforcement learning. Unlike prior emotion-aware agents, TIMEBRON proposes a dynamic ethical modulation system, affective feedback loop, and recursive explainability mechanism, making it one of the first comprehensive blueprints for emotion-aligned neuroadaptive AI

8. Comparative Meta-Analysis of Four Breakthrough Medical Innovations (2015–2025): CRISPR, mRNA Vaccines, AI Diagnostics, and Telemedicine

Type: preprint

Status: Done

Platform: research square

DOI: (version 1)

<https://doi.org/10.21203/rs.3.rs-6977013/v1>

Abstract

We performed a comprehensive meta-analysis of four major medical innovations (2015–2025) CRISPR gene editing, mRNA vaccines, AI diagnostics, and telemedicine focusing on clinical efficacy, health outcomes, and adoption. For CRISPR therapies in

hemoglobinopathies, pooled data from six trials (115 patients) show robust clinical benefits: significant fetal hemoglobin induction, transfusion independence in β -thalassemia, and reduced sickle crises【1,2】. mRNA COVID-19 vaccines exhibited extremely high efficacy; pooled vaccine effectiveness was ~96% (95% CI 93–98%) after two doses【3】, far exceeding traditional platforms. AI diagnostic tools demonstrated moderate accuracy: a meta-analysis of 83 studies found mean diagnostic accuracy ~52% statistically comparable to physicians overall (no significant difference) but lower than expert clinicians【4】. Telemedicine interventions produced modest but positive effects: in a meta-review of 33 RCTs, telemedicine outcomes were at least as good as usual care (Cohen's $d \approx 0.21$) across diverse conditions【5】. Notably, telehealth adoption surged during COVID-19 (e.g. a 683% increase in tele-visits at one center【6】). Comparative analysis indicates mRNA vaccines delivered the largest population-level impact (via prevention of disease), while CRISPR offers potentially curative benefits in niche populations. AI and telemedicine have improved diagnostic and care delivery processes with varying effect sizes. Our findings underscore each innovation's significant but distinct contribution to global health.

4. In-Progress Projects

- AI in India's Rural Healthcare: A Policy Blueprint

* Status: Drafting (Estimated Completion: June 2025)

* Focus: Leveraging AI tools to improve early diagnosis and resource distribution in underdeveloped regions of India.

- Chronoheart: Legacy of the Forgotten Age

* Type: Mythic fantasy novel

* Status: Chapter-wise drafting

* Themes: Time, identity, loss, and destiny in a collapsing ancient world.

5. Skills & Tools

- Academic Research (APA 7th Edition)
- Microsoft Word | Google Docs | Zenodo
- Citation Management (manual and digital)
- Science Communication (simplifying complex topics)
- Creative Writing & World-Building

6. Future Research Interests

- The ethics of AI in diagnosis and decision-making
- Deep-dive review on CRISPR in real-world therapies
- Wearable technology and personalized health in India

- Linking climate change to public health policies
- Youth-led innovation in global health

7. Creative Endeavors

Untitled Minecraft Fantasy Saga

- * Genre: Epic fantasy, moral ambiguity, mixed cast
- * Opening: World-shaking battle between a “hero” and a seemingly evil rival
- * Themes: Hope, corruption, betrayal, survival
- * Format: Drafting into a novel series (potential for animation/script format)

Author of the Chronoheart Series

8. Contact & Links

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Available for academic collaboration, mentorship opportunities, and youth
research forums