किर IITH

the crowning glory

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భారతీయ సాంకేతిక విజ్ఞాన సంస్థ హైదరాబాద్
भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology Hyderabad

Heritage Science and Technology @ IITH

CONTENTS

Volume 7 | Issue 3

CONTENTS

Volume 7 | Issue 3

Articles' Directory

Research Diary | 06 - 36

EDITORIAL EPISTLE

Volume 7 | Issue 3

Dear Esteemed Readers,
Greetings!!

With great pleasure, we present to you the latest edition of किरIITH, dedicated to the theme "Heritage, Science & Technology"—a celebration of India's timeless legacy of knowledge and innovation, and how IIT Hyderabad is carrying that spirit forward through contemporary research and technology.

From ancient discoveries in mathematics, astronomy, and metallurgy to the pioneering advancements of modern science, India's journey has always been defined by curiosity, creativity, and a quest for understanding. At IIT Hyderabad, we take pride in being a part of this continuum, where age-old wisdom inspires futuristic research. Recognizing the importance of this synergy, IITH has exclusively established a Department of Heritage Science and Technology (HST)

This edition highlights IITH's multidisciplinary efforts in Heritage Science—from digital preservation and AI-based archaeological analysis to materials research inspired by traditional practices and sustainable innovations rooted in indigenous knowledge systems. Together, these initiatives exemplify how IITH is redefining innovation by embracing the wisdom of the past to shape the future.

Through the efforts of our faculty, students, and collaborators, IITH stands at the crossroads of culture and cutting-edge science, where every discovery is both a tribute to our heritage and a step toward global innovation.

We extend our sincere gratitude for your continued support, engagement, and encouragement that make किरIITH a vibrant platform to share IITH's evolving story. We invite you to explore this edition and witness how IITH is weaving together the threads of history and technology to shape a sustainable, knowledge-driven future.

Access all previous issues of किरIITH at: https://pr.iith.ac.in/newsletter/about.html

Read, reflect, and stay inspired!

Warm regards,
The Editorial Team
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Dear Friends,

Warm greetings to all! I hope this edition finds you in good health, high spirits, and ever-growing enthusiasm to continue our shared pursuit of excellence and innovation.

It gives me immense pleasure to present to you the 24th issue of KirIITH, capturing the recent achievements, collaborative endeavors, and milestones that continue to shape the identity of IIT Hyderabad as a globally recognized hub for education, research, and innovation.

This year has been particularly rewarding for IITH. The National Institutional Ranking Framework (NIRF) 2025 placed the Institute at an impressive 7th position in Engineering, marking a climb from the 8th rank last year and surpassing one of the first-generation IITs for the first time. IITH also secured 6th position in NIRF–Innovation, while maintaining 12th position Overall and 15th in Research, reaffirming our position among India's top institutes, driving academic and research excellence.

In essence, the past quarter has witnessed IITH achieving remarkable progress across multiple dimensions — research excellence, academic innovation, sustainability, global outreach, and community engagement — all reflecting the institute's unwavering commitment to nation-building through science and technology.

On the academic front, IITH launched a bold new pedagogical experiment aimed at creating "Fearless Engineers for the Future." Through this initiative, 660 first-year undergraduate students have been paired with 90 young faculty mentors, working in small groups to pursue hands-on engineering projects supported by seed funding—encouraging innovation, creativity, and real-world problem-solving.

The 14th Convocation of IIT Hyderabad was celebrated with great pride, during which 1273 degrees were conferred. The event was graced by Shri Ashwini Vaishnaw, Hon'ble Minister for Railways, Information & Broadcasting, and Electronics & Information Technology, Government of India, as the Chief Guest, who inspired the graduating class with his visionary address on building a Viksit Bharat by 2047.

In our continued effort to align with national priorities and global challenges, IITH has taken meaningful steps through impactful academic and research initiatives. The establishment of the "Dr. Krishna Prasad Chigurupati Chair Professorship" in Process Automation, instituted through a partnership with Granules India Limited, marks a significant stride toward advancing innovation in sustainable industrial automation. Likewise, the Centre for Continuing Education (CCE), in collaboration with TCS iON, launched an industry-aligned online certification program on VLSI Chip Design — a key initiative to bridge the skill gap in India's rapidly evolving semiconductor ecosystem.

Reflecting our strong culture of collaboration, IITH signed several strategic partnerships. The Memorandum of Understanding with the Army Training Command (ARTRAC) led to the establishment of "VIGRAHA" – a Centre of Excellence in AR/VR & High-tech Applications for the Indian Army, focusing on AR, VR, AI, robotics, and unmanned systems. Another significant association was formed with Bisleri International Pvt. Ltd., under its flagship initiative 'Bottles for Change', reinforcing IITH's commitment to sustainability and environmental stewardship.

The Institute also continues to strengthen its global and industry outreach. The 8th Japan Career Day and 1st Japan Co-Research Day, organized in collaboration with JETRO, witnessed participation from 15 Japanese companies and 4 co-research partners — reflecting IITH's growing role in fostering Indo-Japan academic and industrial linkages. Similarly, the Grand Finale of the FinShield Hackathon 2025, jointly organized by the Bank of India, DFS (Ministry of Finance), and IBA, showcased IITH's commitment to innovation-led entrepreneurship in the fintech space.

Further enriching its research ecosystem, Maithri Aquatech R&D entered into an MoU with IITH to develop nature-based sustainable solutions for Atmospheric Water Harvesting (AWH). IITH was also recognized as one of the Centres of Excellence under the National Critical Mineral Mission (NCMM) by the Ministry of Mines, Government of India, a milestone that underlines our leadership in strategic materials research.

Strengthening international engagement, IITH had the honor of hosting a distinguished delegation from the U.S. Government under the U.S.–India TRUST initiative (Transforming the Relationship Utilizing Strategic Technology), reaffirming the growing global recognition of IITH as a hub for strategic science and technology collaborations.

As we move forward, this edition of KirIITH is dedicated to the theme "Heritage Science and Technology," celebrating the confluence of traditional wisdom and modern research. At IITH, we continue to explore this intersection — preserving India's cultural and scientific heritage through modern technological lenses, and translating it into innovations that serve both people and the planet.

Let us continue this journey with renewed purpose and passion — blending our heritage with cutting-edge science to build a sustainable and inclusive future.
Keep reading & stay inspired!

Prof B S Murty
Director, IIT Hyderabad

A Note from the Head - Department of Heritage Science & Technology

KID: 20250301 | Dr Kousik Sarathy Sridharan

The Department of Heritage Science and Technology (HST) at IIT Hyderabad is a groundbreaking academic initiative that merges scientific and technological disciplines with the study and preservation of India's cultural heritage. It addresses both tangible heritage—such as monuments, architecture, and artifacts—and intangible heritage, including traditional knowledge systems, classical languages, music, and wellness practices like Yoga and Ayurveda. The department started its operations in June 2022 and has moved from strength to strength. The department boasts of fifteen allied faculty from various departments of IITH, ten adjunct faculty, and several research partners from premier academic institutions in the country.

India's Indigenous Knowledge Systems and Heritage (IKS&H) industry spans diverse sectors such as culinary tourism, textiles, Ayurveda, yoga, handicrafts, publishing, and architecture, all unified by a shared cultural ethos and strong domestic demand. Despite their variety, these sectors are driven by common factors—Indic identity, consumer enthusiasm, and heritage appeal—which justify viewing them as a collective industry. While current market estimates focus solely on domestic potential, projections suggest that with rising Compound Annual Growth Rates (CAGRs), the IKS&H industry could surpass $1 trillion (₹92 lakh crore) within the next decade. This underscores the need for strategic investment, policy support, and global positioning to fully realize its transformative economic and cultural impact.

HST department's core mission is to build a multidisciplinary ecosystem that fosters research, education, and innovation in heritage domains. It aims to empower professionals and entrepreneurs by offering academic programs and technological tools that support the conservation, digitization, and commercialization of heritage assets. The department currently offers the Master of Technology and Doctor of Philosophy programs with four key specializations: Yoga Technology, Indic Language Processing, Conservation & Reconstruction and Archaeometry. These programs are designed to cultivate interdisciplinary expertise across engineering, science, design, linguistics, neuroscience and digital media and their corresponding ancient knowledge resources.

A major institutional milestone was the establishment of the Takshashila Center for Multidisciplinary Heritage Science and Technology, funded by DST-SHRI, which served as a nucleus for advanced research and collaborative projects. HST has taken a lead in organizing workshops, lecture series, and conclaves that convene experts from diverse fields to explore heritage-related innovations bringing together civilizational knowledge and modern science and technology. Some important events are noted below:

Yoga-tech conclave

The Dept of HST, IIT Hyderabad, hosted the "Yoga Tech Conclave", in collaboration with the Indian Yoga Association (IYA), along with our associate partners - Sri Visweswara Yoga Research Institute (SVYRI), Kathmandu University & Yogavijnana, curating this conclave as a confluence of Yoga and Technology. Panelists from eminent Yoga Schools across India were invited to share their insights in the brainstorming sessions on topics of essential importance to the Indian Yoga Schools, such as "Online Yoga Pedagogy - pros and cons", "Addressing challenges of small-scale Yoga centres in adopting technology", "Can Yoga philosophy and running it as a business co-exist?", "Alternate revenue models in Yoga", "Social Media Strategies for globalisation", "Tech-enabled global expansion strategy for Indian Yoga teachers and schools".

Indic architecture conclave

With the theme "Reviving Practice of Indic Architecture from Libraries to Laboratories", the Indic Architecture Conclave by the Dept of HST was an endeavor of framing a design curriculum to bring the grandeur of Indic knowledge from libraries to laboratories, and eventually to practice. The department and the event were supported by the DST-SHRI (Science Heritage Research Initiative) and the Ministry of Education, Govt of India.

Maritime Heritage Revival

A lecture hosted by the HST dept. by Shri Sanjeev Sanyal, Member of the Economic Advisory Council to the Prime Minister, focused on reviving India's maritime legacy. The event included discussions on recreating ancient stitched ships, highlighting traditional naval craftsmanship.

Indian music workshop

The Indian Music Workshop was a two-day event focused on AI applications in Indian music. It featured expert talks, hands-on tutorials, and a hackathon. Topics included Carnatic and Hindustani music analysis, AI in music generation, rhythm and percussion modeling, and source separation challenges. Speakers included leading researchers and technologists from IITs, UPF Barcelona, MIT Media Lab, and industry. The workshop was meant to foster collaboration between musicians, technologists, and researchers to develop innovative tools for music understanding and performance.

Indic Heritage Champions workshop

The "Indic Heritage Champions" initiative was a national workshop designed to engage students passionate about preserving India's cultural heritage. Participants presented local heritage projects, explore cutting-edge technologies like AI/ML in heritage applications, and received mentorship from IIT faculty to become regional "techno-ambassadors."

The program included expert talks, lab visits, and hands-on demos, with financial support provided for travel and basic expenses.

Book Launch: Elements of Indic Knowledge Systems & Heritage

On International Yoga Day 2023, HST founding head Dr Mohan Raghavan and his collaborators, Dr. Harsha Simha and Dr. C.R. Ramaswamy, launched a book titled Elements of Indic Knowledge Systems & Heritage. The book offers a structured framework of ancient Indian wisdom to guide modern life toward peace and purpose.

Collaboration with the Ministry of Tourism

The department was invited to the UNESCO World Heritage Site at Ramappa Temple, Warangal, by the Ministry of Tourism. The visit explored technology-driven strategies to improve local livelihoods and heritage site management, with support from the Mulugu District administration.

Sanskrit Day Celebration

IIT Hyderabad celebrated International Sanskrit Day (Samskrita Dinotsava) on Shravan Poornima in collaboration with Samskrita Bharati, the MOE-IKS Cell, and NFSE. The event featured a Sanskrit quiz, promoting engagement with classical language and heritage.

The department has initiated several new research initiatives in areas of archaeometry, Indic language processing, and Yoga technology. Some of these initiatives include the study of ancient Indian alloys (panchadhatu/asthadhatu) for modern applications, AI-driven analysis of Indian music, and digital reconstruction of heritage architecture.

The department collaborates actively with industry, government bodies, and cultural institutions to ensure that its research translates into real-world impact. It also supports startups and small enterprises in the heritage sector by providing access to technology and skilled professionals to strengthen the microeconomies and human resource involved in heritage assets.

HST's approach is rooted in Indian civilizational knowledge while embracing cutting-edge technologies such as artificial intelligence, neurotechnology, and gamification with the intent to position India as a global leader in heritage innovation. Overall, HST at IIT Hyderabad represents a strategic effort to blend tradition with technology, opening new avenues for cultural preservation, economic development, and global engagement. In the future, we intend to expand collaborations in more areas where science and technology interventions are crucial to build and scale microeconomies around heritage assets.

Dr Kousik Sarathy Sridharan
Head (Dept of HST) & Associate Professor
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Yoga-tech conclave

AI for Heritage Conservation: Automating Structural Health Inspection and Reporting of Monuments

KID: 20250302 | Mr Krishn Katyal, Dr Surendra Nadh Somala

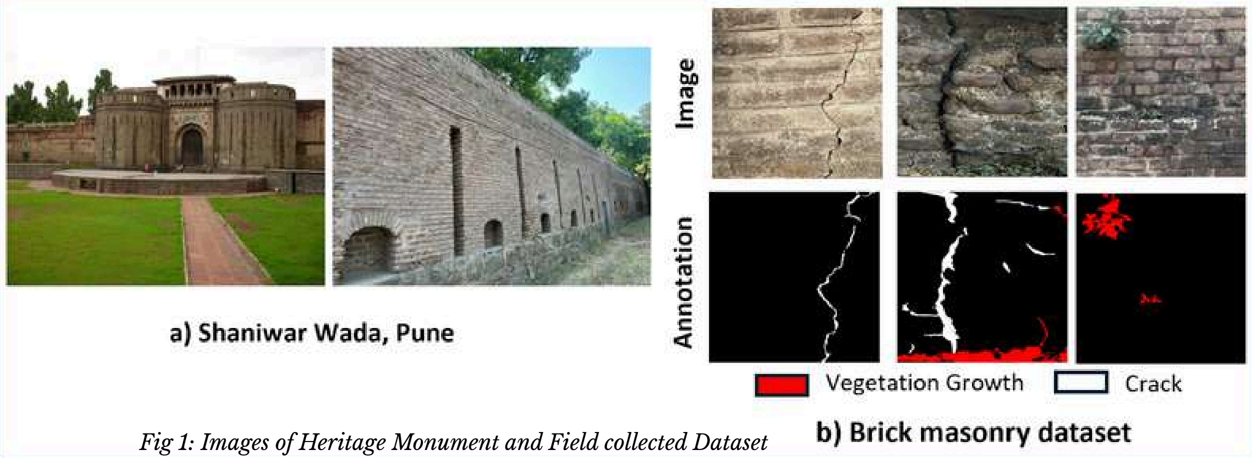
[1]

[2]

India's monuments are living records of our history. From rock shelters, stupas, temples, forts, palaces, and bridges to excavated sites, they are repositories of knowledge from our past for future generations. Preserving them is both our cultural duty and a scientific challenge.

The Archaeological Survey of India (ASI), set up in 1861 under the Ministry of Culture, manages thousands of protected monuments, including several UNESCO World Heritage Sites. As these structures face weather, pollution, urban activity, and natural disasters, we need methods that are adaptable, consistent, and timely to assess their structural health and to ensure their prompt restoration and proper upkeep.

Research in our lab addresses these challenges by developing AI-enabled visual inspection and reporting pipelines tailored to heritage contexts. We train deep learning models, including Convolutional Neural Networks and Vision Transformers, to detect, segment, and localise damage in high-resolution images. A core thrust of our work is building robust, domain-specific datasets. We collect field imagery using handheld RGB cameras and UAVs of brick and stone masonry from ASI or state-protected monument sites and annotate damage categories at the pixel level. Fig. 1 shows images from Shaniwar Wada, Pune, an ASI Grade-A protected monument, along with our manually annotated dataset of damaged brick masonry.



a) Shaniwar Wada, Pune

b) Brick masonry dataset

Fig 1: Images of Heritage Monument and Field collected Dataset

Today, manual inspection remains the norm. Teams rely on visual walkthroughs, scaffolding, and limited-access surveys to identify defects such as cracks, vegetation growth, stains, surface loss, material delamination, and biological growth on heritage building materials. This process is labour-intensive, subjective, risky on tall or complex monuments, and slow to turn observations into actionable conservation plans and reports. For large complexes or inaccessible façades, coverage gaps are common, and repeat assessments are difficult to standardise when carried out by various teams across time.

This dataset is then augmented with curated Indian and global datasets to improve generalisation across materials, textures, lighting, and weathering patterns.

On the algorithm side, we use advanced training strategies—specialised loss functions for class imbalance, augmentation for viewpoint and illumination changes, and modern computer vision architectures—for precise pixel-wise segmentation of defects on heritage monuments.

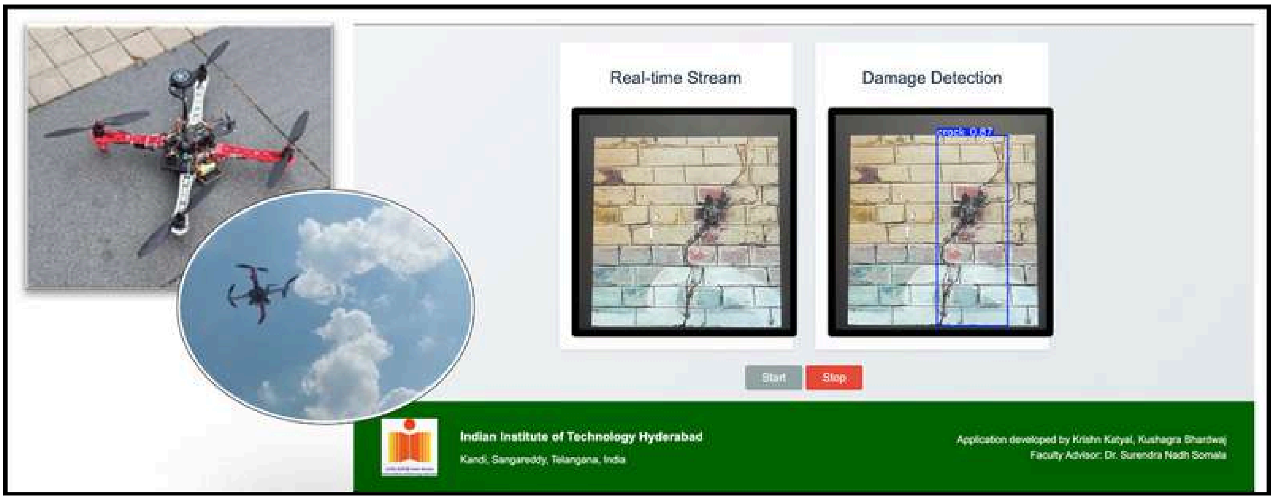
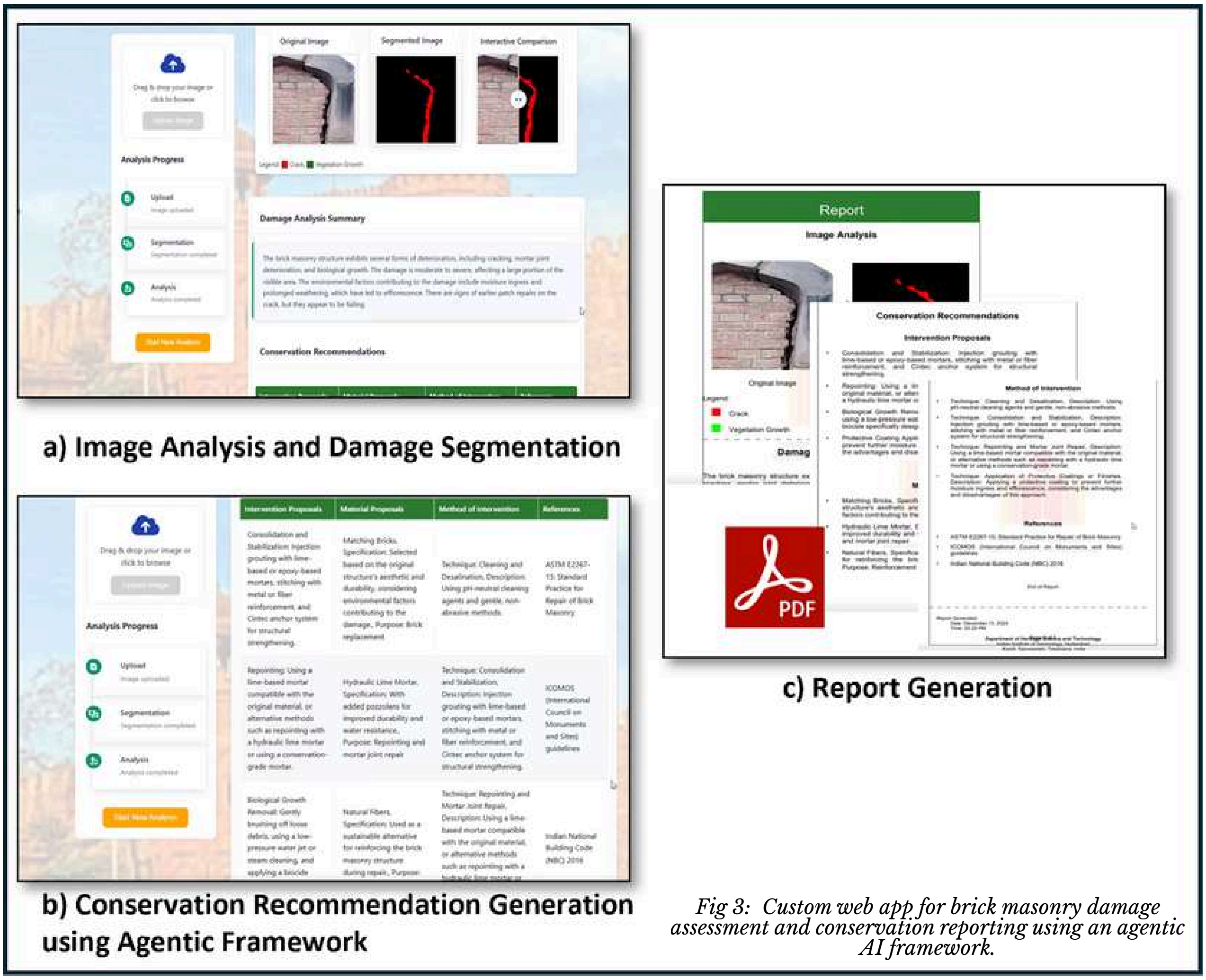


Fig 2. : UAV platform for structural health inspection and the custom web app for real-time data acquisition and inspection.



Damage Analysis Summary

The brick masonry structure exhibits several forms of deterioration, including cracking, mortar joint deterioration, and biological growth. The damage is moderate to severe, affecting a large portion of the visible area. The environmental factors contributing to the damage include moisture ingress and prolonged weathering, which have led to efflorescence. There are signs of earlier patch repairs on the crack, but they appear to be failing.

Conservation Recommendations

a) Image Analysis and Damage Segmentation

Intervention Proposals	Material Proposals	Method of Intervention	References
Consolidation and Stabilization: Injection grouting with lime-based or epoxy-based mortars, stitching with metal or fiber reinforcement, and Cintec anchor system for structural strengthening.	Matching Bricks, Specification: Selected based on the original structure's aesthetic and durability, considering environmental factors contributing to the damage, Purpose: Brick replacement	Technique: Cleaning and Desalination, Description: Using pH-neutral cleaning agents and gentle, non-abrasive methods.	ASTM E2267-15: Standard Practice for Repair of Brick Masonry
Repointing: Using a lime-based mortar compatible with the original material, or alternative methods such as repointing with a hydraulic lime mortar or using a conservation-grade mortar.	Hydraulic Lime Mortar, Specification: With added pozzolans for improved durability and water resistance, Purpose: Repointing and mortar joint repair	Technique: Consolidation and Stabilization, Description: Injection grouting with lime-based or epoxy-based mortars, stitching with metal or fiber reinforcement, and Cintec anchor system for structural strengthening.	ICOMOS (International Council on Monuments and Sites) guidelines
Biological Growth Removal: Gently brushing off loose debris, using a low-pressure water jet or steam cleaning, and applying a biocide	Natural Fibers, Specification: Used as a sustainable alternative for reinforcing the brick masonry structure during repair., Purpose:	Technique: Repointing and Mortar Joint Repair, Description: Using a lime-based mortar compatible with the original material, or alternative methods such as repointing with a hydraulic lime mortar or	Indian National Building Code (NBC) 2016

b) Conservation Recommendation Generation using Agentic Framework

c) Report Generation

Fig 3: Custom web app for brick masonry damage assessment and conservation reporting using an agentic AI framework.

To support on-site data collection and decision-making, we have also built a custom web application that streams live video from UAVs for real-time assessment. Lightweight object detection models provide immediate damage localisation on the live feed, creating a base for adding more specialised, fine-tuned models. Our hardware stack includes a custom, low-cost quadcopter for live inspections and a commercial drone for wider data capture—together offering flexible, field-ready coverage for real-time inspection and monitoring, with significantly reduced risk to personnel. Fig. 2 shows the UAV platform for structural health inspection and the custom web app for real-time data acquisition and inspection.

Beyond detection, we translate analysis into AI-assisted conservation reporting. A vision–language module interprets images and their segmentation masks to assign damage severity levels. An agentic AI layer orchestrates multiple large language models to generate conservation recommendations by proposing restoration interventions, identifying compatible repair materials, and outlining the methodology to be adopted for restoration, by retrieving this information from vetted sources such as ICOMOS charters, CPWD guidelines, ASI manuals on Indian heritage materials, and peer-reviewed literature. The system then compiles structured reports to support condition documentation and the preparation of tender technical specifications for the rehabilitation and restoration of our monuments.

Figure 3 shows the custom web app for brick masonry damage assessment and conservation reporting using an agentic AI framework.

In essence, AI can drive a step change in heritage monument conservation by making inspections faster, safer, and more consistent, while speeding up documentation and reporting for timely action. This, in turn, helps architects and public stakeholders expedite contracting and start restoration sooner. Crucially, our approach keeps human experts at the centre—AI augments rather than replaces conservation judgement. As these tools mature, stakeholders can prioritise resources, track changes over time with both qualitative and quantitative metrics, and plan interventions that are timely, minimally invasive, and materially compatible. The end goal of our research is to establish a reliable system—built on highly optimised computer vision models and an agentic AI framework—that is thoroughly tested and validated for heritage contexts. The fusion of AI with heritage science will not only safeguard monuments for future generations but also strengthen institutional capacity to preserve India's tangible heritage.

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A Multimodal Evaluation of Trataka Practice: A Window into Calmness, Sleep, and Inner Balance

KID: 20250303 | Ms Divya Dogga

Introduction

In the quiet glow of a flame lies an ancient secret to stillness. Trataka, one of the shatkarma (six cleansing techniques) of Hatha Yoga, is a meditative practice of steady gazing described in texts such as the Hatha Yoga Pradipika and Gheranda Samhita. Traditionally believed to purify the eyes and strengthen concentration, modern science now suggests that its effects reach far deeper—potentially harmonizing the body's autonomic functions and emotional state.

Recent explorations in mind–body science highlight the importance of cardio-respiratory coupling (CRC)—the rhythmic synchronization of heartbeats with breath. Strong CRC, especially in the high-frequency (HF) range, reflects parasympathetic (rest-and-digest) activation. This physiological signature of relaxation formed the basis of our investigation into Trataka. This pilot study examined both immediate and short-term effects of Trataka on anxiety, sleep, mindfulness, and autonomic regulation, using a multimodal approach combining psychological scales and physiological data.

Methods

Two small experiments were conducted:

Experiment 1:

Participants performed a single session of Trataka using one of four light sources—candle, diya with sesame oil, diya with ghee, and LED light. Anxiety was measured before and after practice using the GAD-7 scale and a custom experiential questionnaire. During the session, cardio-respiratory coupling (CRC) was recorded.

Experiment 2:

In a seven-day home-based study, participants practiced Trataka for 15 minutes daily. The Pittsburgh Sleep Quality Index (PSQI) and the State Mindfulness Scale for Physical Activity (SMS-PA) were administered before and after the intervention.

Results

Experiment 1: The Immediate Calm

Even a single session of Trataka led to a marked drop in anxiety. GAD-7 scores fell from 4.93 to 2.97, showing measurable relaxation.Participants' feedback echoed this shift: they felt calmer, more comfortable, and emotionally lighter. Reports of eye strain and dryness also reduced, suggesting the practice was not only mentally soothing but physically gentle.

Physiological measures confirmed these subjective impressions. CRC coherence in the HF band increased during all light-source conditions, signifying enhanced heart–breathing harmony. Notably, the diya with ghee produced the most pronounced and sustained effect, even during the post-rest phase—hinting at Trataka's lingering influence on the nervous system.

Experiment 2: Seven Days to Better Sleep

A week of consistent practice transformed sleep quality. PSQI scores dropped from 6.14 to 3.42, moving participants from the "poor sleeper" to "good sleeper" range. Mindfulness scores revealed subtle yet meaningful changes: while mental awareness slightly dipped, bodily awareness rose, suggesting that Trataka grounds the practitioner in sensory presence—feeling rather than overthinking.

Discussion

Far from being a mere focus exercise, Trataka appears to function as a natural neuro-biofeedback mechanism. By gazing steadily at a simple flame, practitioners subtly guide their physiological rhythms toward balance. The enhanced synchronization between heart and breath mirrors a deeper psychological calm—what yogic literature calls chitta-prasādana, the clarity of mind.

The sustained coherence observed even after the practice suggests that Trataka helps the body "remember" relaxation—a quality invaluable in today's overstimulated world. Its simplicity, accessibility, and non-pharmacological nature make it a promising adjunct for managing anxiety, sleep disturbances, and stress-related dysregulation.

Conclusion

In just 15 minutes a day, Trataka offers a doorway to equilibrium—soothing the mind, synchronizing the body, and kindling an inner stillness that lingers beyond the flame.

This pilot study provides early scientific validation for what yogis have long known: that through the steady gaze, one may find not only focus but also profound peace.

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Ms Divya Dogga
Research Scholar, Dept. of HST

Ancient Indian Urbanism: Cities of Water and Purity

[1]

[2]

KID: 20250304 | Mr Sudarshan Saravanan, Dr Shiva Ji

Most Indian citizens today have never experienced high-quality urban design and planning in their lifetime. Our cities are largely broken, filled with solid waste, sewage, and wastewater, broken footpaths, dusty air, heavy pollution, and segregated spaces that exclude the larger civil society from high-quality private areas. Many of us might believe that this was always the case. However, our ancestors would have looked upon us with pity. They would be filled with disgrace to see what has become of our magnificent cities after centuries of foreign rule. In this article, we will give a small glimpse into the legacy of ancient Indian urban design/planning, while focusing on the aspect of urban water management. Water in our cities today is something which we largely avoid, it is usually the source of mosquito plagues, intolerable stench, and dead flora/fauna. However, what if I tell you that scholars from ancient India have described water in cities as having tasted like pure, pristine sugarcane juice, that water was worshiped as a spiritual being, and that the built environment followed the regime of hydrologic systems.

1. Hydrology-based site planning
2. Diverse water infrastructure
3. Sacred Urban Landscape

The Mahabharata describes a scene where Bhisma advises Yudhithar to establish sufficient water resources for all animals and the biosphere, before the construction of the city of Indraprastha. The Vastu Shastra advises urban planners not to build on soil which were on a wetland.

Furthermore, if trees are to be cut during the construction process, they are to be compensated in other locations. The Manasara recommends building on soil only if the soil has a low water hydraulic conductivity.

Fig 2. Ancient India Stepwell (Generated with Google Gemini AI)

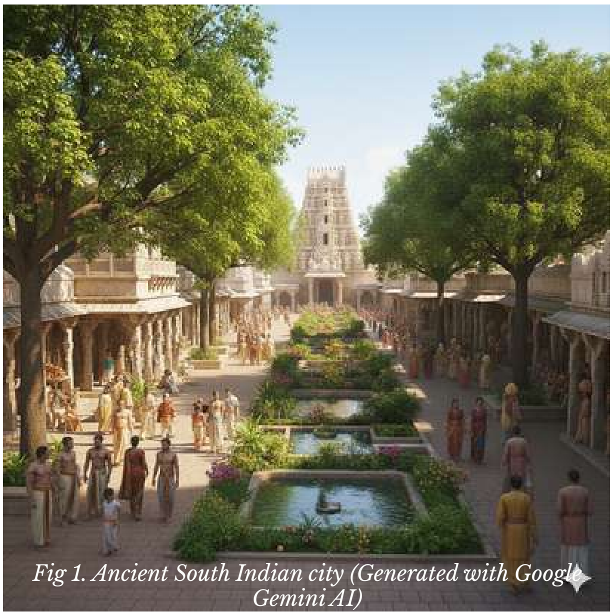

Fig 1. Ancient South Indian city (Generated with Google Gemini AI)

This is to avoid the urban systems sinking or getting damaged by the water percolating force. After a site is chosen, all urban surface infrastructure should be integrated with a natural slope for drainage and be built with limestone. Drainage engineering was a specific expertise, and the Manasara prescribed water gates or drains, called "Jaladvara' in Sanskrit for water outflow.

The text goes on outlining four types of water bodies: a "Kupa", a vertical well, a "Vapi", a stepped well with architectural access, a "Tadaga", a large artificial tank, and a "Kunda", a large artificial constructed pond. Varāhamihira's Bṛhat Saṃhitā states that ponds should be located in a specific direction to be auspicious and avoid being connected with strong wind flows. It also recommends planting thick vegetation on river embankments for flood protection, which can be interpreted as modern-day nature-based solutions or sustainable development. Telugu scriptures such as Kaṭhinīya Kāraṇa Citralu and Manasollāsa talk about the maintenance of water bodies, who is responsible, and when maintenance should be undertaken. Tamil scriptures devise different types of water bodies for different water usages and water purification, such as Kuṭṭam, Āppu, Eris, Kulam, and Āppāṇai. In all of this, the most unique aspect of Indian hydrologic urban practices is the spirituality linked to water bodies. Water has the power to elevate the consciousness of humans, and this is stressed in the Rigveda, Bhagavata Purana, and Upanishad. This is what differentiates Indian knowledge systems from modern urban science.

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Ancient Metallurgy and Early Sustainable Practices- Recycling and Resource Management


[1]


[2]

KID: 20250305 | Ms Nayanathara S, Prof Suhash Ranjan Dey

Ancient metallurgy generally deals with the understanding of the utilization and production of metals by humans of the past. It involves the entire chaine operatoire sequence, which begins from the procurement of raw materials to finished products and waste materials, since the Bronze Age. But metallurgy can be examined not only as a product of technological advancement but also as a catalyst that strengthened the cultural, economic, and environmental systems of the past. This study is trying to revolves around a major question that is faced by contemporary society, which is the idea of 'sustainability' in connection with metallurgical practices and how the past society might have dealt with it. As this problem still resonates in the present society, critical examination is long overdue.

The three-age system is the most important chronological marker that we are still following, which was introduced by CJ Thomsen in the 19th century while he was curating the Copenhagen Museum. He followed a system where the artefacts are studied with the technological stages to which these belong and categorized as the Stone Age, Bronze Age and Iron Age. Introduction of metals and metallurgy into society brought out a tremendous transformation in human history, where people began to manipulate the environment, particularly Earth's raw materials, according to their needs. From making single metals to the technique of alloying of different raw materials like copper and tin to create bronze, gives us insights about their technological advancements as well as their understanding of natural resources. The bronze artefacts found from Harappan settlements, which were one of the trademarks of its urbanization, the iron tools found from Gangetic valleys, which were the primary reason for the establishment of Janpadas and Mahajanpadas, and large-scale zinc production in Zawar, Rajasthan, all attest to the fact that metals transformed human life. From all these regional-specific metallurgical practices, it is evident that they mostly relied upon locally available ores, fuel, and techniques, and also were resource-sensitive and were against over-utilization and exploitation.

Reuse and recycling have been a significant feature of ancient metallurgy, where archaeological sites give evidence of the melting and rejoining of tools and jewelry for varied purposes. This, in turn, reduces the need for fresh mining and points to the idea of a circular economy where the resources are utilized repeatedly, and by doing that, the life of these resources gets extended, and the wastes are also minimized.

In the ancient economy, the idea of fuel was also connected with nature and was utilizing charcoal-based smelting and forging. At the same time, they practiced controlled felling, woodland management and copping in order to give the environment time to regenerate and flourish.

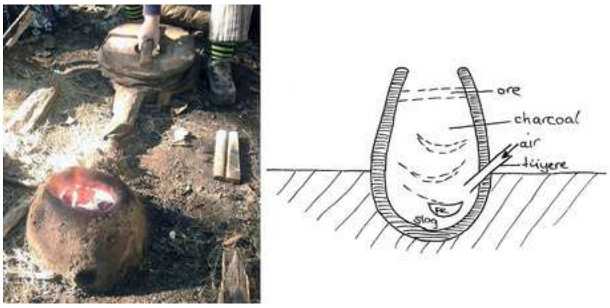

Fig 1. Iron-making experimental bowl furnace utilizing charcoal

As these communities depends their livelihood on smelting and production of metals, overexploitation of natural resources and ecological stress caused by it were taken very seriously.

In short, ancient metallurgy was not simply exploitative in nature, but also it was adaptive. Instead of exploitation and overmining, recycling was practiced, and this, in turn, helped in safeguarding the energy demands of the past society. They were keen on applying the principles of resource reuse and ecological awareness in their livelihood, which should be taken as an example in the present society.

Based on this understanding, the Department of Heritage Science and Technology and Materials Science and Metallurgical Engineering together are working on the project titled "Exploring ancient Indian panchadhatu and asthadhatu-making (high entropy alloys) with new compositions and combinations for modern age applications". Here, we are looking at the traditional Indian knowledge system of alloy making through archaeometallurgy and are trying to reimagine and reinterpret it as a prototype of the present-day high entropy alloys. Through experimenting with different compositions and combinations, this study aims to integrate past understanding of the technique of alloying with the contemporary advanced technologies, thereby creating a sustainable and futuristic methodology for the production and utilization of metals.

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ASR Datasets in Indian Languages: A Survey of Resources, Challenges, and Opportunities

KID: 20250306 | Ms Smitha HS

Abstract

Automatic Speech Recognition (ASR) has advanced rapidly in recent years, driven by deep learning models trained on large, high-quality datasets. While English ASR benefits from decades of investment and standardized corpora, Indian languages—with their linguistic diversity, dialectal variations, and code-switching practices—pose unique challenges. This article surveys publicly available and proprietary ASR datasets for Indian languages, examining their scale, diversity, quality, and applications. It highlights major initiatives such as AI4Bharat's IndicVoices, Kathbath, Shrutilipi, Dhwani, and Svarah, Mozilla Common Voice, OpenSLR (LDC-IL), Krutrim IndicST, and Bhasha Daan, alongside proprietary datasets from companies like Google, Microsoft, and Amazon. I contrast Indian ASR datasets with English resources, analyze the evolving ecosystem, and discuss implications for research, innovation, and inclusivity.

Introduction

Automatic Speech Recognition (ASR) relies on datasets that pair speech audio with text transcriptions. These datasets are critical for training models to convert spoken language into written form, enabling applications like virtual assistants, transcription services, and speech-to-speech translation. For India—a nation with 22 constitutionally recognized languages and hundreds of dialects—ASR datasets are essential for bridging digital divides and ensuring equitable access to speech technologies.

Despite India's linguistic richness, the development of ASR datasets faces challenges: scarcity of resources, noisy environments, dialect diversity, and widespread code-switching (e.g., Hinglish, Tanglish). This article surveys the landscape of Indian ASR datasets as of March 2025, highlighting both public and proprietary initiatives.

Anatomy of an ASR Dataset

An ASR dataset typically consists of:

- **Audio recordings** (formats like WAV/MP3, 8–48 kHz sample rates, mono/stereo).
- **Transcriptions** (manual, automatic, or phonetic).
- Annotations (speaker metadata, noise conditions, alignments).
- **Diversity attributes** (accents, domains, gender, age).
- **Licensing** (ranging from open-source CC0 to restricted proprietary).

High-quality datasets support model training, benchmarking, and deployment across diverse conditions.

Building ASR Datasets for Indian Languages

Constructing ASR datasets involves:

- **Data Collection** – Professional recordings, conversational speech, crowdsourcing, or mining online content.
- **Transcription** – Manual annotation, AI-assisted correction, or phonetic labeling.
- **Preprocessing** – Noise reduction, segmentation, normalization (e.g., “10 kg” → “ten kilograms”).
- **Validation** – Word Error Rate (WER), human review, benchmarking.

Challenges for India include dialectal diversity, background noise, and multilingual mixing. Initiatives like IndicVoices, Shrutilipi, and Project Vaani aim to address these complexities.

Publicly Available Indian ASR Datasets:

AI4Bharat Initiatives

- **IndicVoices**: 12,000 hours (3,200 transcribed), 22 languages, highly diverse, CC-BY-4.0.
- **Kathbath**: 1,684 hours, 12 languages, professionally labeled, CC-BY-4.0.
- **Shrutilipi**: 6,400+ hours from All India Radio, 12 languages, broadcast speech, CC-BY-4.0.
- **Dhwani**: 17,000 hours unlabeled, 40 languages, mined from YouTube/News On AIR, MIT License.
- **Svarah & Lahaja**: Accent-focused benchmarks for Indian English and Hindi.

OpenSLR – LDC-IL

20–100 hours per language (Hindi, Tamil, Bengali, etc.), clean recordings, high-quality transcriptions, CC-BY-4.0.

Mozilla Common Voice

1,000+ hours for Hindi, smaller sets for Tamil, Telugu, Kannada, etc., crowdsourced, CC0 license.

Krutrim IndicST

10.8k hours training, 1.1k evaluation, 9 languages, curated from 14 open datasets plus synthetic data.

Bhasha Daan (Bhashini)

Citizen-contributed, growing repository covering 22 languages, variable quality, supporting India's National Language Tech Mission.

Proprietary Datasets

Several corporations maintain proprietary Indian language ASR datasets:

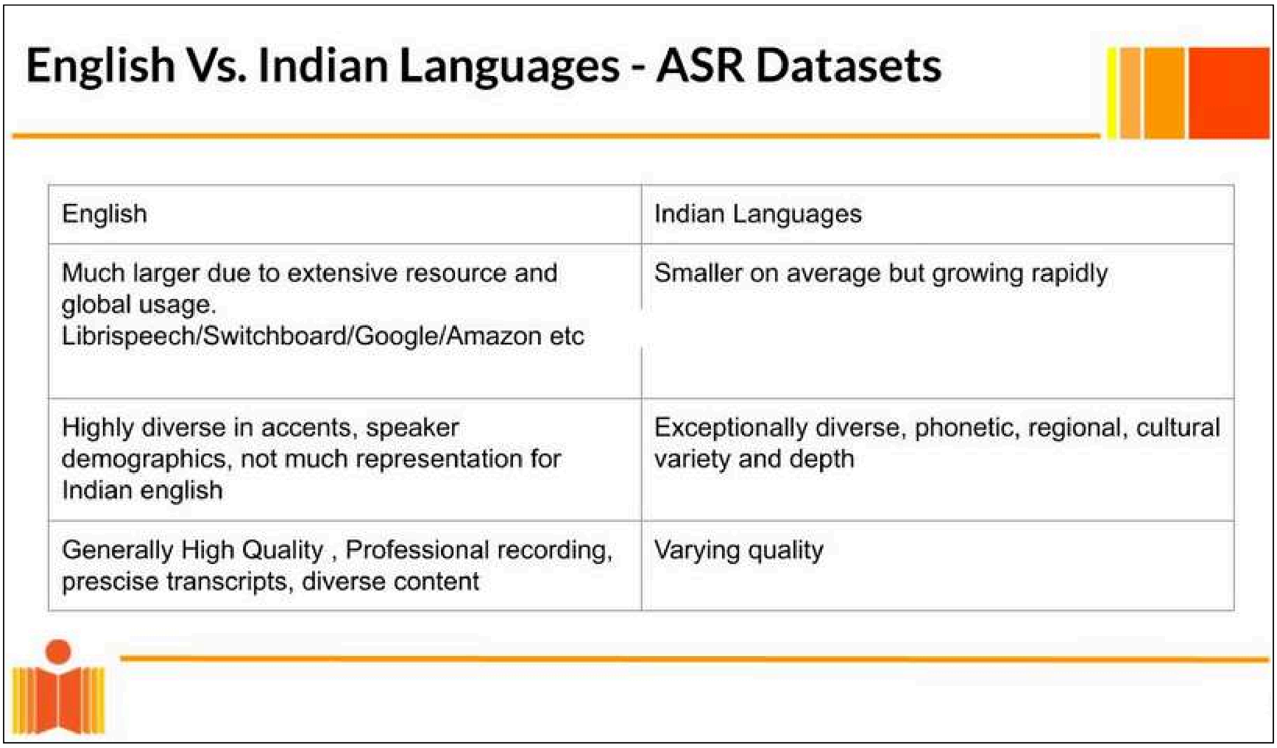
- **Microsoft Indian Language Corpus** – Telugu, Tamil, Gujarati, Hindi, Bengali (partially public, mostly proprietary).
- **Google Speech-to-Text Data** – Multilingual, large-scale, proprietary.
- **Amazon Alexa Data** – Hindi, Tamil, Telugu, Marathi, Indian English accents.
- **iFLYTEK** – Hindi, Bengali, Tamil.
- **Speech Ocean / Appen** – Commercially licensed datasets for Indian clients.

- **Startups (e.g., Reverie, Gnani.ai)** – Domain-specific proprietary collections.

These datasets are often larger and higher quality but restricted to internal use, raising concerns around transparency and inclusivity.

Comparison with English ASR Datasets

- **Size:** English datasets (e.g., LibriSpeech 1,000 hours, Switchboard 2,600 hours) are smaller than proprietary Indian corpora but generally cleaner and more mature. Indian datasets are growing (IndicVoices: 12k hours, Dhwani: 17k hours).
- **Diversity:** Indian datasets surpass English in linguistic and phonetic diversity due to 22+ languages and regional variations.
- **Quality:** English datasets have standardized, high-quality transcriptions; Indian datasets vary from clean (Kathbath) to raw (Dhwani).



English Vs. Indian Languages - ASR Datasets

English	Indian Languages
Much larger due to extensive resource and global usage. Librispeech/Switchboard/Google/Amazon etc	Smaller on average but growing rapidly
Highly diverse in accents, speaker demographics, not much representation for Indian english	Exceptionally diverse, phonetic, regional, cultural variety and depth
Generally High Quality , Professional recording, prescise transcripts, diverse content	Varying quality

The Emerging Ecosystem

The Indian ASR dataset ecosystem is complementary:

- **AI4Bharat** – Large-scale, diverse, open resources.
- **Common Voice & Bhasha Daan** – Crowdsourced, inclusive, democratizing.
- **OpenSLR (LDC-IL)** – Smaller but stable baselines.
- **Krutrim** – Hybrid datasets tailored for Speech LLMs.
- **Proprietary datasets** – Large-scale, high-quality, but inaccessible.

Together, they form a multi-pronged foundation for research and deployment.

Conclusion

ASR datasets in Indian languages have grown significantly in scale, diversity, and accessibility, bridging historical gaps with English corpora. Open initiatives like AI4Bharat and Bhasha Daan have democratized access, while proprietary datasets drive commercial deployment.

The path forward requires balancing inclusivity, quality, and sustainability—ensuring that India's linguistic complexity is represented fairly in digital systems.

Future efforts must focus on:

- Expanding underrepresented languages.
- Addressing code-switching and dialectal variance.
- Creating standardized benchmarks.
- Building public–private collaborations.

With these steps, Indian ASR datasets can empower not just research, but also inclusive human–machine interaction for one of the world's most linguistically diverse populations.

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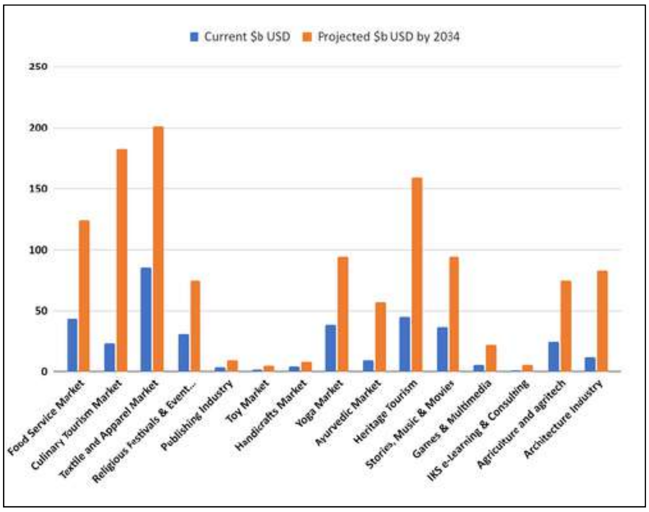
A Trillion-Dollar Legacy: The Economic Potential of India’s Heritage Industry

KID: 20250307 | Dr Mohan Raghavan

For centuries, India's cultural heritage has been a source of national pride, but a new perspective is emerging: it is also a dynamic engine for economic growth. This is the vision of a trillion-dollar heritage industry, a powerful ecosystem poised to drive prosperity by deliberately cultivating authentic knowledge rooted in ancient Indian systems. This narrative is not idealistic; it’s grounded in a compelling report [1] that projects the potential of this ecosystem to exceed a staggering $1 trillion by 2034. This ambitious target is attainable by reframing heritage from a historical artifact to a vibrant economic force, with authentic education and cutting edge research in Indic Knowledge System & Heritage Sciences at its core.

The principle of knowledge-driven value creation is evident across multiple sectors. Heritage tourism, for instance, can be elevated by moving beyond superficial sightseeing to profound, knowledge-based experiences. By training guides and professionals to draw from primary texts like the Puranas and Itihasas, a visit to a monument like the Sun Temple in Konark becomes a deep lesson in solar cosmology, rather than just a photo stop. This infusion of knowledge transforms a simple trip into a high-value journey, attracting discerning travelers and creating new revenue streams.

This same principle applies to India’s vibrant textile and handloom industry. Instead of competing on price, this sector can succeed on authenticity. Authentic education for artisans means understanding that a pattern or a weave is a narrative with deep cultural significance. A Kanchipuram silk sari can become a wearable piece of art that tells a story from the epics, allowing it to command a premium in the global market. This approach not only adds economic value but also ensures the preservation of traditional skills for future generations.



Similarly, the global popularity of Yoga and Ayurveda has faced challenges with dilution and misinformation. Authentic education provides the necessary foundation to counter this trend. By grounding these practices in foundational texts like the Yoga Sutras, Sushruta and Charaka Samhita while also validating them with rigorous scientific research, India can build a foundation of credibility that transcends cultural boundaries. This marriage of ancient wisdom with Artificial Intelligence technology allows these practices to be integrated into mainstream healthcare and wellness tourism, with the Indian Ayurveda market alone projected to reach $57 billion in the coming years.

The culinary tourism sector also benefits from this approach. Authentic education for chefs and food bloggers transforms a meal into a cultural immersion by providing historical and regional context. By studying ancient texts and folklore, the narrative behind a dish can be unearthed, adding immense value and elevating a meal from a simple transaction to an educational journey.

In essence, the vision of a trillion-dollar heritage industry is about making culture and commerce symbiotic. By strategically investing in authentic education, India can create a workforce that is both skilled and knowledgeable.

Reviving the culture of research and innovation around our Heritage disciplines allows us to stay at the forefront. Businesses can use the knowledge spillovers to offer products and services imbued with integrity and depth, attracting global investment, and, most importantly, honoring the rich legacy from which they originate. This approach is poised to make India's heritage its greatest asset, building a prosperous and sustainable future.

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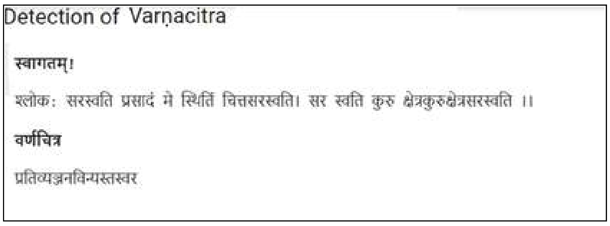
Computational Detection and Evaluation of Citrakāvya

KID: 20250308 | Mr Dilip H R

The Indian literary tradition is a veritable treasure-house of various gems. One among them is citrakāvya. The term ‘citrakāvya’ comprises two words ‘citra’ and ‘kāvya’. ‘Citra’ connotes figure or wonder and ‘kāvya’ means poetry. So citrakāvya is a special kind of poetry that inspires awe with unusual usage of letters and representation of forms or patterns through poetry. Citrakāvya is usually employed in devatāstuti (devotional verse), khaṇḍakāvya (short narrative poem) and raṇavarṇana (description of war). Citrakāvya is a demonstration of the scholarship and prowess of a poet.

Scholarly poets like Dandi, Bharavi, Bhatti, Kumaradasa, Magha, Ratnakara, Shivaswami, Harichandra, Jinasenacharya, Kaviraja, and Sriharsha have composed Citrakāvya in Sanskrit. Sanskrit poeticians including Dandi, Bhamaha, Vamana, Rudrata and Bhoja have discussed citrakāvya in their works. Citrakāvya is of various types like varṇacitra, śleṣacitra, gūḍhacitra, prahelikā, gaticitra, and bandhacitra. In addition to Sansrit, Citrakāvya is found in several other Indian languages including Kannada, Telugu and Tamil.

Computational approach for identification and classification of citrakāvya is an emerging field. We develop a computational tool based on the Python programming language to identify one of the types of citrakāvya called varṇacitra in a Sanskrit or Kannada padya. In varṇacitra, there are various kinds of limitations on the usage of letters of the alphabet bringing about an aural charm in poetry. Depending on whether the constrained letters are vowels or consonants, varṇacitra is classified as svaracitra and vyañjanacitra respectively.



Detection of Varṇacitra

स्वागतम्!

श्लोक: सरस्वति प्रसादं मे स्थिति चित्तसरस्वति। सर स्वति कुरु क्षेत्रकुरुक्षेत्रसरस्वति ।।

वर्णचित्र

प्रतिव्यञ्जनविन्यस्तस्वर

Fig 1: Screenshot of our tool detecting varṇacitra

One more kind based on the place of articulation of the constrained letter is called sthānacitra. Totally, there are about thirty-four kinds of varṇacitra-s described in Sanskrit poetics. Our tool is not only capable of identifying varṇacitra-s, but also evaluating the conformity / non-conformity of an input padya to all the available varṇacitra-s and showing the result using visual techniques.

Our work is one of the first attempts to automatically detect the presence of citrakāvya in a Sanskrit or Kannada padya and also classify them. In the upcoming stages, we plan to extend our work to cover other types of citrakāvya like gaticitra and bandhacitra. We expect our tool to be useful in composition of poetry, analysis of poetry, evaluation of poetry and in avadhānaṃ.

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Svaracitra evaluation

Input: क्षितिविजितिक्षितिविहिति व्रतरतयः परगतयः | उरु रुरुधुर्गुरु दुधुवुः स्वमरिकुलं युधि कुरवः ||

Hrasvaikasvara
क्षितिविजितिक्षितिविहिति व्रतरतयः परगतयः | उरु रुरुधुर्गुरु दुधुवुः स्वमरिकुलं युधि कुरवः ||

Dīrghaikasvara
क्षितिविजितिक्षितिविहिति व्रतरतयः परगतयः | उरु रुरुधुर्गुरु दुधुवुः स्वमरिकुलं युधि कुरवः ||

Hrasvadvisvara
क्षितिविजितिक्षितिविहिति व्रतरतयः परगतयः | उरु रुरुधुर्गुरु दुधुवुः स्वमरिकुलं युधि कुरवः ||

Dīrghadvisvara
क्षितिविजितिक्षितिविहिति व्रतरतयः परगतयः | उरु रुरुधुर्गुरु दुधुवुः स्वमरिकुलं युधि कुरवः ||

Hrasvatrisvara
क्षितिविजितिक्षितिविहिति व्रतरतयः परगतयः | उरु रुरुधुर्गुरु दुधुवुः स्वमरिकुलं युधि कुरवः ||

Catuḥsvara-dīrghasvara
क्षितिविजितिक्षितिविहिति व्रतरतयः परगतयः | उरु रुरुधुर्गुरु दुधुवुः स्वमरिकुलं युधि कुरवः ||

Prativyañjanavinyastasvara
क्षितिविजितिक्षितिविहिति व्रतरतयः परगतयः | उरु रुरुधुर्गुरु दुधुवुः स्वमरिकुलं युधि कुरवः ||
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Fig 2: Screenshot of our tool evaluating svaracitra

Edge AI for Heritage: Exploring Temple Architecture in the Digital Age

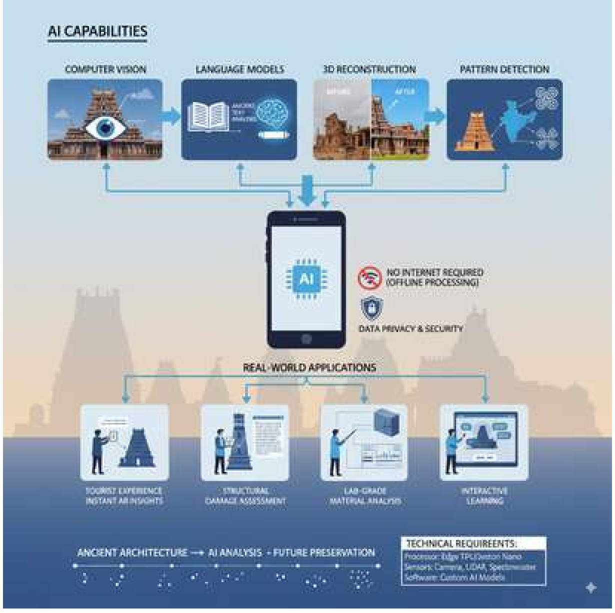

[1]


[2]

KID: 20250309 | Ms Lakshmi Mohan, Dr Surendra Nadh Somala

Indian temple architecture showcases extraordinary structures that blend regional history, philosophy, and craftsmanship into timeless masterpieces. These monuments hold secrets that have puzzled historians and archaeologists for generations. The intricate carvings at Rani ki Vav and Khajuraho display precision rivaling modern machinery, while temples follow sophisticated fractal principles where small architectural elements repeat and scale up to create entire structures—a design system creating harmony from the smallest motif to the grandest spire. These architectural patterns recur across vast geographical regions, demonstrating extensive cultural exchange between ancient civilizations.

Artificial intelligence is revolutionizing how we understand temple architecture. Computer vision models analyze photographs and video streams to identify architectural styles—distinguishing between towering Dravidian gopurams and curved Nagara shikhars—while estimating construction periods by recognizing dynastic design patterns. Large Language Models process vast amounts of traditional texts like Manasara, Vastushastra, archaeological reports, and architectural documentation to reveal construction techniques, symbolic meanings, and cultural significance.



Most remarkably, 3D generative models digitally reconstruct damaged temple sections using surviving elements, architectural principles, and historical records. This technology helps visualize temples in their original glory—complete with vibrant paint schemes, missing decorative elements, and structural wholeness based on traditional design systems. AI excels at detecting hidden connections invisible to human observers, tracing how architectural ideas, religious concepts, and artistic techniques traveled across India.

The fundamental challenge: Most heritage sites are located in remote areas with limited or no internet connectivity. The caves of Ajanta, stepwells hidden in Gujarat villages, and mountain temples in Himachal Pradesh often lack reliable network access. Cloud-based AI systems become ineffective where immediate analysis is most crucial. Edge AI solves this critical limitation by running sophisticated algorithms directly on portable devices—smartphones, tablets, or specialized hardware like Jetson devices for intensive processing requirements.

Edge AI transforms heritage preservation by bringing advanced architectural analysis directly to smartphones and tablets. This schematic illustrates the complete workflow from AI capabilities to real-world applications, enabling offline cultural insights at remote temple sites across India (Illustration : AI generated).

Edge AI ensures immediate analysis without internet dependency, maintains privacy by keeping cultural data local rather than transmitting to distant servers, and provides cost-effective deployment across India's thousands of heritage sites. This approach eliminates bandwidth limitations and enables real-time decision-making for conservation efforts.

From tourists to conservators, Edge AI unlocks temple secrets on-site — analyzing, preserving, and sharing heritage without relying on the cloud (Illustration : AI generated).

Building on these advantages, multiple user groups directly benefit from this technology. Tourists use smartphone apps to point cameras at temples and instantly learn their history—visitors at Konark Sun Temple can discover the astronomical significance of wheel carvings through AR overlays. Conservators carry tablets that detect structural damage, generate detailed reports, and recommend restoration approaches on-site without connectivity delays. Researchers deploy portable computing devices for pattern recognition and, when connected to spectrometers, analyze building materials and construction.

Edge AI makes architectural expertise accessible to everyone with a smartphone. This portable technology ensures India's temple secrets are decoded, preserved and understood for future generations, enabling smart monitoring of monuments, instant damage alerts, and restoration guidance that maintains historical accuracy while ensuring safety.

> *"Indian temple architecture showcases extraordinary structures that blend regional history, philosophy, and craftsmanship into timeless masterpieces. These monuments hold secrets that have puzzled historians and archaeologists for generations"*

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Exploring Neurophysiology of Yogic Breathing with Open BCI

KID: 20250308 | Mr Sivakumaar Palaniappan

Breath is the rhythm of life, yet its deeper role in shaping brain activity and body physiology is only beginning to be understood by science. For centuries, yogic breathing practices (prāṇāyāma) have been described as ways to calm the mind, improve focus, and support health. But how does each inhale and exhale truly affect the brain and the heart? My research attempts to make this hidden synchrony visible using low-cost, open-source tools.

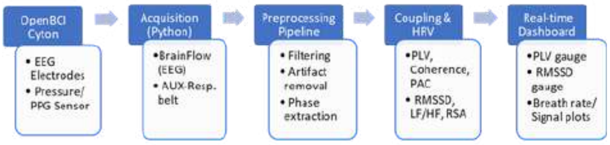
Research in neuroscience shows that breathing does more than move air—it modulates neural oscillations, particularly in the alpha (8–13 Hz) and theta (4–7 Hz) brainwave bands. This phenomenon—known as respiration–EEG coupling—may underlie the sense of calm and awareness often reported in yogic practice. At the same time, slow and mindful nasal breathing enhances heart rate variability (HRV), a key indicator of parasympathetic nervous system activity and stress resilience. Together, these insights point to breath as a "bridge" connecting mind and body.

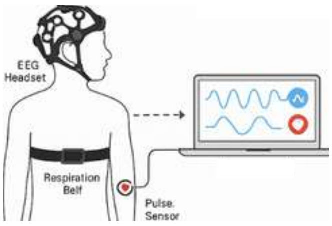
To explore this, I built a system that combines multiple signals into a single synchronized stream. Brain activity is captured through an OpenBCI Cyton board, chest movement is monitored using a custom respiration belt with a pressure sensor, and heartbeats are recorded through a lightweight pulse sensor. By aligning these streams in real time, I am able to extract the phase of each breath, track how alpha and theta rhythms fluctuate, measure heart rate variability indices such as RMSSD and respiratory sinus arrhythmia, and finally compute coupling metrics like Phase Locking Value that reveal how strongly breathing is locking onto brain activity. Instead of leaving these as raw numbers in a spreadsheet, I designed a live dashboard—a "synchrony meter"—which shows, in real time, how breath, brain, and heart are working together. The system streams shows how strongly the breath is aligning brainwaves and heart rhythms at any moment.

The important aspect of this system is its affordability and portability. Unlike expensive laboratory instruments, it can be carried into yoga studios, clinics, or even used in a home environment. This opens the door to multiple applications. In yoga research, it can provide concrete scientific evidence for long-held traditional practices. In the field of mental health, it can become a biofeedback tool for managing anxiety, stress, or sleep-related issues. In education and training, yoga teachers and therapists could use such technology to give their students objective feedback on practice quality. In healthcare, the same platform could evolve into rehabilitation devices designed to strengthen mind–body synchrony.

Looking beyond these immediate applications, the vision is even more exciting. By combining this hardware system with a mobile app, it can transform into a personalized therapeutic guide. The app could analyze the user's state of mind in real time and recommend suitable pranayama or kriya techniques based on their physiological signals. A feedback loop would allow the system to compare expected outcomes with actual results, correcting technique and guiding practice more effectively. In other words, the ancient wisdom of yoga could be delivered as a personalized, adaptive, and science-informed wellbeing tool—available in your pocket.

This project is about bringing ancient wisdom and modern neuroscience together; this work seeks to illuminate how conscious breathing reshapes our inner rhythms. The long-term vision is empowering individuals to observe, train, and strengthen the synchrony of their own breath, brain, and heart—a step towards accessible, science-informed wellbeing.





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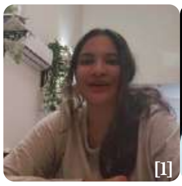
From Heritage to Holograms: AI & LiDAR Powered 3D Reconstructions of India’s Heritage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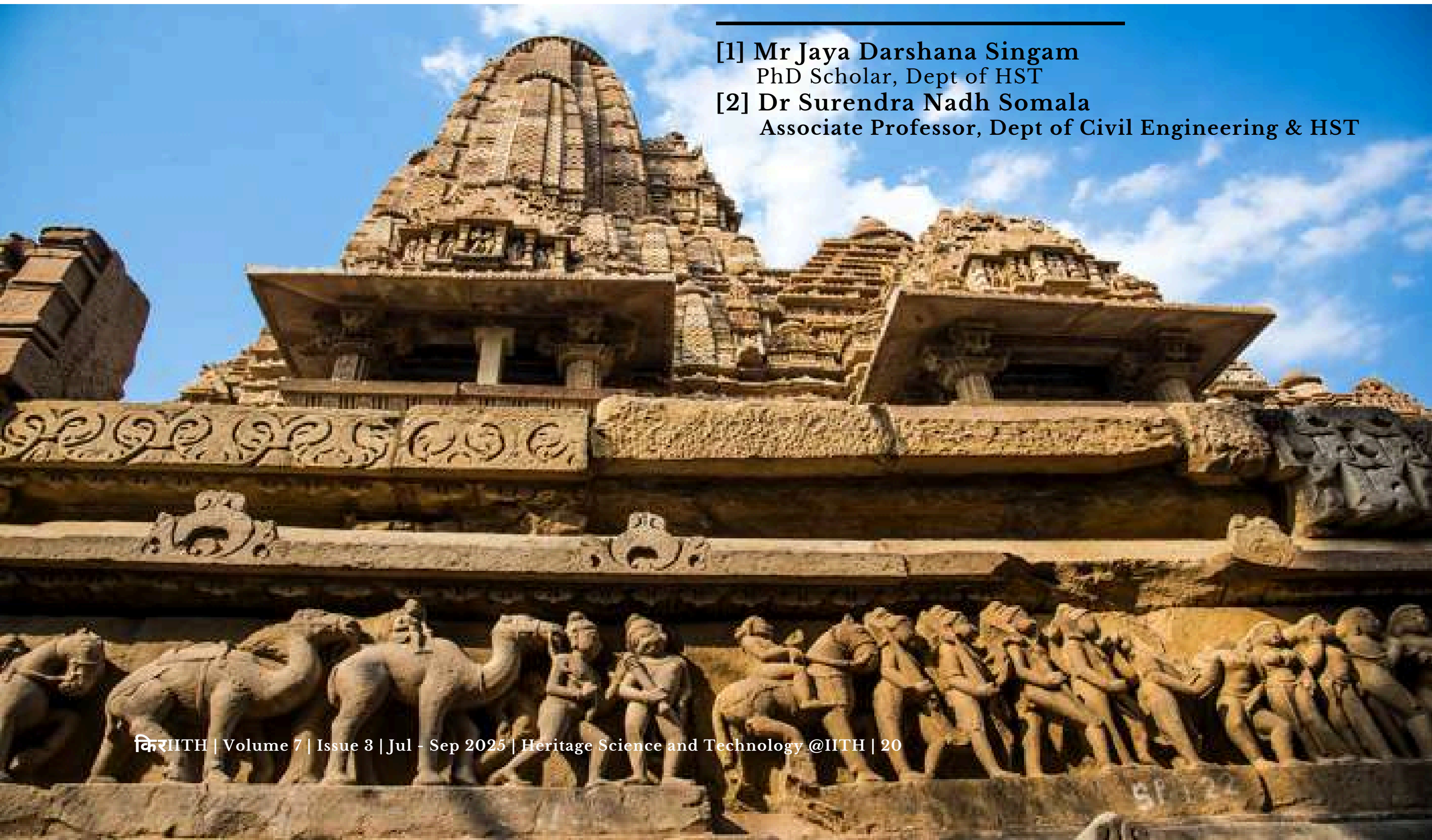
KID: 20250311 | Mr Jaya Darshana, Dr Surendra Nadh Somala

India’s architectural heritage carries a gigantic and ravelled mosaic which are not just traces of antiquity but they reflect the eternity of art, religious and cultural expression also.From the embellished carvings of Khajuraho to the majestic walls of Hampi, each structure carries a memory, knowledge, identity and artistry.

Yet, the current scenario of our India’s tangible heritage treasures are under accelerating threat from various conditions including climate stress, pollution and unregulated visitation. Safeguarding them is not only our cultural role but also a technological constraint.

This is where the concept of AI-driven 2D-to-3D reconstruction becomes meaningful. At its core, the system takes an input of a flat 2D image and by using deep-learning and computer vision methods it transforms into an interactive 3D model involving steps including depth estimation, point cloud generation, adds texture and color and finally reconstruct the mesh that can be viewed in any axis and angles to for in-depth study or even export the data.

While 2D-3D image conversion offers accessibility, the inclusion of LiDAR(Light Detection And Ranging) makes the preservation more stronger as LiDar uses lasers to capture the point cloud geometry with higher precision, complementing the image-based models which provide texture and color. The stitching of camera and LiDAR create detailed and accurate digital twins of any heritage sites/monuments. Globally, LiDAR scans support the restoration not only theoretically but also practically like the restoration of Notre-Dame(billions of laser scans) after the 2019 fire.



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Information Retrieval on Indian Knowledge Systems - Data Curation, Semantic Search & Retrieval-Augmented-Generation

KID: 20250312 | Mr Avinash H N

Introduction

India's intangible heritage most notably comprises its traditions of knowledge - oral and textual, formal and informal. The intangible heritage includes codified and informal knowledge, together referred to as Indian Knowledge Systems (IKS). It includes a large gamut of formal texts, traditional best practices, and oral wisdom of various communities. It includes fields as diverse as philosophy, architecture, grammar, mathematics, astronomy, metrics, sociology, economy, politics, ethics, geography, logic, military science, weaponry, agriculture, mining, trade, commerce, metallurgy, shipbuilding, medicine, poetics, biology, and veterinary science. Indic knowledge systems also include pervasive aspects of life and society, such as dress, language, and cuisine.

Textual Data of IKS is scattered across physical books, manuscripts, digital PDFs, text documents in private archives, and popular websites. Popular Search, Retrieval, and Generation engines rely largely on content from sources like blogs from the World Wide Web. IKS lacks specialised search engines like Google Scholar to separate this clutter and allow retrieval based exclusively on scholarly sources. Our work under Project Dhārā aims to rectify this shortcoming by providing tools for information retrieval grounded in authentic scholarly sources. Dhārā consists of a family of interlinked databases along with specialised retrieval algorithms for fuzzy search, semantic searches and retrieval-augmented-generation (RAG).

Understanding IKS Data Sources

Building Information Retrieval (IR) Systems for IKS presents several peculiar challenges beyond the commonly known issues of multilinguality and sparse data. The structure of scholarly literature in IKS is different from the peer-reviewed journal format. IKS scholarly literature has a multilayered annotation format of primary sources (Mantras, Ślokas, Sūtras) and their elaborations and commentaries (Bhāṣya, Ṭīkā, Vārttika). Primary literature has constraints of spontaneity and prosody (e.g. Vedic Mantras) or of extreme brevity (sūtras), which often decide the choice of words. Hence, the elaborations and commentaries become essential tools in understanding and interpreting. Newer books are published from time to time to consolidate the broad understanding of a field so far, to communicate the state of the art or as an expression of creative genius. These books follow a structure similar to the contemporary practice of literature survey, followed by results and discussion. The books which get accepted by peers are commented upon extensively. All of these, including primary sources and their commentaries, are broadly accepted as primary literature for our purpose. They are mostly in verse form or dense prose. A common characteristic of this primary literature is that it needs further morphological analyses before modern NLP can reliably interpret it.

A second class of literature are books authored in modern times, in the form of translations, analyses or scholarly articles published in journals. These are mostly in free-running prose that is easily understood by current NLP algorithms. For our purpose, they will be designated as secondary literature. A third category of academic literature is the Indexed data or glossaries comprising Compendia (e.g. Dhātupāṭha [1]), Encyclopaedias (e.g. Śabdakalpadruma [2], Vācaspatyam [3]) and Dictionaries (Nighaṇṭus, e.g. Amarakośa [4]). While glossaries are compiled even in modern NLP, in IKS discourse, they have a special formal role. It is a common practice in IKS to start the analysis of a concept or a problem statement by first clarifying the various terms of relevance. Discourse is gradually built by layering the meanings of the akṣaras, padas, and vākyas together in a coherent whole. They are also used as primers and for disambiguation. Dictionaries give several senses and connotations of a word with illustrative references for each of the connotations. Within the Dhārā system, the three types of data are stored in separate databases with distinct retrieval modes and algorithms. The three databases and their contents will henceforth be referred to respectively as Verse (V), Book (B) and Dictionary (D).

Information Structure of IKS Databases

Design of Information storage and retrieval systems for IKS must be cognisant of the difference between the properties of V, B and D databases and their contents. V needs significant morphological processing before it can be tokenised and processed further. B is better processed with NLP techniques than V. D is usually well structured, often with syntax that can be easily parsed with regular expressions. In spite of different properties, the contents of D, V and B are mappable to each other. If B is a translation of the same textual variant as V, then the mapping is one-to-one. If B is a summarised translation or an expanded translation, the mapping of textual chunks can be one-to-many or many-to-one. Within V itself, textual variants can be mapped to each other. Elements of V are to be stored and read along with their annotations in the form of commentaries. Verses in V are understood by pooling together annotations, mapped elements within V (textual variants) and translations (in B) and word meanings (in D). A reading of B frequently requires support from the primary reference from V.

The richness and flexibility of Indic languages generate several pseudonyms and aliases for persons and objects, leading to problems in text understanding of V. However, B and D usually do not have these issues. D can be used to disambiguate V.

Citations and references are today commonly denoted in the (Author, Year) format. However, within IKS, references are made by quoting a partial verse (typically the opening phrase).

Such references to verses in V are extensively found within B and D. Within B, the references often follow multiple styles - either the partial verse style or Text-Chapter-VerseNumber (e.g. Ṛg Veda 3.1.1). Due to the presence of several textual variants, uniquely mapping references to verses is a challenge.

Due to these properties, the typical operations performed on these databases vary. Fuzzy search for partially corrupted phrases is frequently performed on V for dereferencing. D is referenced directly as a lookup and indirectly to provide additional context. In most cases, it is retrieved using the primary key. B is more amenable to Question-answer systems. But are often considered insufficient within the IKS domain unless the mapped entities from V and D are also furnished as references.

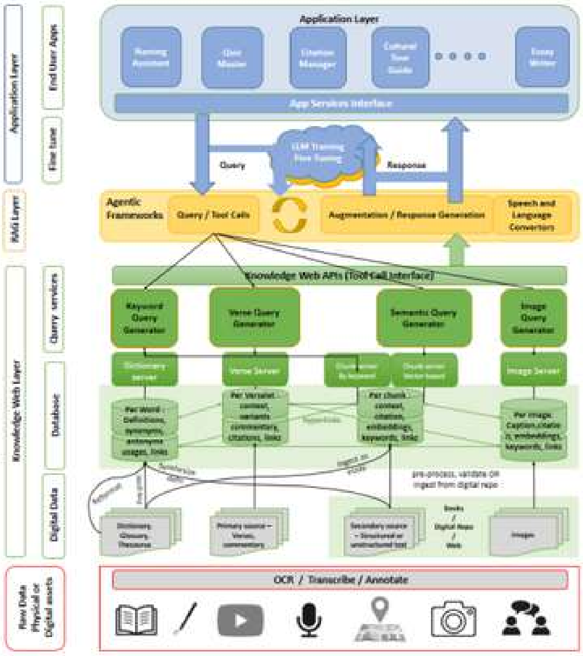

Fig 1. Architecture diagram of Project Dhārā

Structure of Database and retrieval APIs

To exploit the inherent structure of the IKS databases and address the needs of the IKS domains, we create a set of databases D, V and B with mappings between elements. The set of access methods on each of them is different. The primary access method for the V database is a fuzzy search that outputs the full original verse that contains an input partial verse (possibly corrupted). The semantic searches are the primary operation on B. Primary operation on Dictionary D is a fuzzy lookup with the key. V and B databases also support traversal to next and previous elements like a list, or a hierarchical traversal across Category->Book->Chapter->Page/Verse. Automated glossaries are also created on the contents of B to improve factual question-answer accuracy [5].

Currently, our database contain about 10+ lakh word definitions curated from dictionaries and compendia and 7+ lakh place names in D, 8+ lakh verses curated from primary texts in V and 95+ lakh paragraphs of text curated from books in B. Project Dhārā is an ongoing effort and the numbers are growing rapidly each passing day. The mappings between the databases are being developed in a phased manner.

Using the mapped databases B, D and V, we provide a variety of services as APIs, which include semantic search and RAGs. Open LLMs running locally on our servers perform the generation based on the retrieved contents. A comprehensive set of benchmarks is being developed for various tasks within the purview of IKS.

Conclusion

Project Dhārā is a massive effort to create an information storage and retrieval system for the Indic Knowledge System that takes cognisance of its unique properties and mappings. Using this system, the project also provides information retrieval as a service in multiple modes, viz, Semantic Search and Retrieval Augmented Generation. We also develop example applications and benchmarks to demonstrate the utility and power of the system. In the future, we envisage these systems becoming gold standards for a variety of applications and tasks in IKS. This system can also be distilled to build foundational models.

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> *“Project Dhārā is a massive effort to create an information storage and retrieval system for the Indic Knowledge System that takes cognisance of its unique properties and mappings. Using this system, the project also provides information retrieval as a service in multiple modes, viz, Semantic Search and Retrieval Augmented Generation”*

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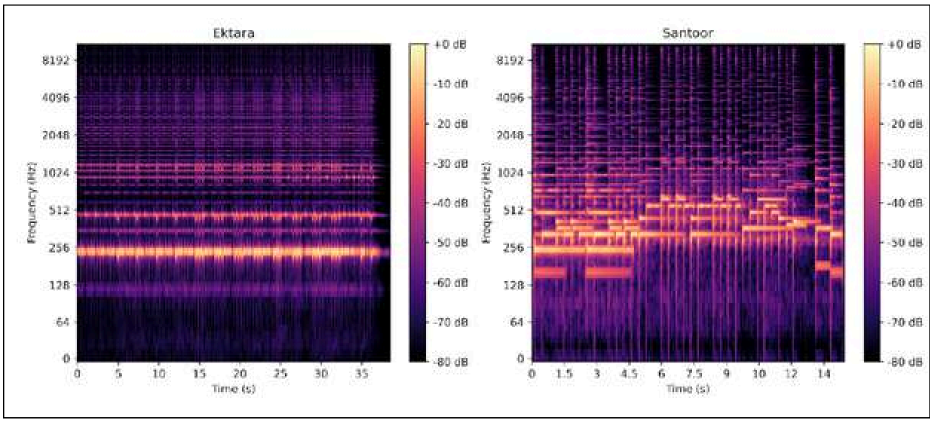
Mechanics of Indian Musical Instruments: A Research Perspective

KID: 20250313 | Dr Suhail Mohd Rizvi

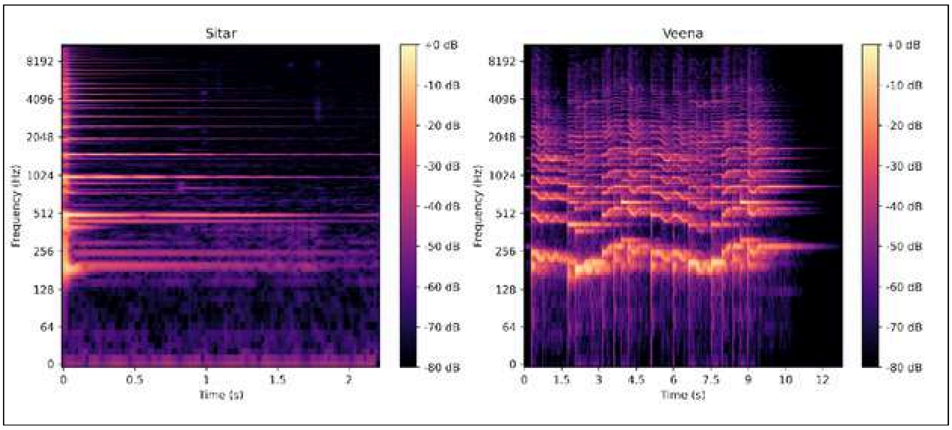
Indian music is one of the world's oldest and most enduring cultural traditions, and its instruments embody centuries of artistry, craftsmanship, and acoustic knowledge. Indian instruments are largely handmade by artisans, resulting in variability, higher costs, and challenges in accessibility.

While this artisan-based tradition imparts uniqueness, it also highlights the need for the systematic characterization of the instruments' structural, material and acoustic properties. Our research is an attempt in this direction by combining experiments, mathematical modeling, and computational simulations to study the mechanics of Indian stringed instruments.

Towards this, we begin with geometric characterization to capture the fine structural details of instruments and the arrangement of their intricate components, followed by the material characterization, that is captured by the elastic properties of the instrument materials used in instruments. A key component of our work is the acoustic characterization of instruments.



We measure frequency response functions, mode shapes, resonance spectra, decay times, and harmonic content of vibrating strings and resonating bodies (see figure for some representative examples). These measurements provide quantitative insight into how geometry and material properties translate into the tonal quality and timbre of the instrument.



Such acoustic fingerprints serve as benchmarks for validating our computational models and we hope to use this approach for distinguishing the performance of instruments made by different artisans or using alternative materials in future.

On the modeling side, we use dynamical systems approach to study the frequency response of the instruments analytically, and also employ finite element methods (FEM) to simulate the coupled dynamics of strings, bridges, and resonating bodies. These simulations allow us to systematically explore the effects of the design parameters, such as string tension, bridge placement, gourd geometry, coupling between string and membrane in some instruments, on the acoustic properties of the instruments. Our models are validated against experimental acoustic data, creating a powerful feedback loop between theory and observation. Some of the instruments we are currently working on are Indian bells and yazh, an ancient Tamil stringed instrument with harp-like structure is prominently described in Sangam literature dating back over 2,000 years.

The impact of this research spans cultural preservation, scientific understanding, and technological innovation. By documenting design principles and acoustic signatures, we contribute to heritage science while offering artisans and manufacturers tools for more consistent production.

Scientifically, these instruments provide rich case studies of nonlinear vibrations and coupled oscillatory systems. Ultimately, our goal is to ensure that Indian stringed instruments remain not only treasured symbols of tradition but also accessible, sustainable, and scientifically understood artifacts of enduring cultural and technical significance.

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Physiological Correlates of the Swara: Prototyping a Wearable for Long-Term Monitoring of the Nasal Cycle

KID: 20250314 | Mr Anup Cherukuri

Ancient Wisdom on Swara Yoga and Wellbeing

Ancient yogic texts, such as the Shiva Svarodaya, describe an intricate science of breath called Swara Yoga. This knowledge centers on the Swara, or the natural cycle of alternating airflow between the left and right nostrils. Tradition links the left nostril to the Ida Nadi (lunar channel), associated with cooling, calming, and parasympathetic functions, and the right nostril to the Pingala Nadi (solar channel), associated with heating, stimulating, and sympathetic functions. The texts also prescribe aligning daily activities with the dominant nostril; for instance, calm, receptive tasks were advised when Ida was active, while dynamic, physically demanding activities were suited for when Pingala was dominant. This conscious regulation of activity based on breath was considered fundamental to maintaining physical health, mental clarity, and emotional equilibrium.

The Value of Long-Term Monitoring

This ancient concept of a balanced rhythm finds a parallel in the modern understanding of ultradian rhythms(biological cycles shorter than 24 hours that regulate our physiology). The nasal cycle is one such rhythm. Continuous, long-term monitoring of this cycle could provide a unique window into the functioning of our Autonomic Nervous System (ANS). Disruptions in these fundamental rhythms are increasingly being associated with chronic stress, metabolic disorders, and poor sleep quality. Therefore, tracking the Swara cycle over days and weeks could serve as a non-invasive digital biomarker, potentially offering early warnings of physiological imbalance and enabling personalized interventions to restore balance.

> *“The ultimate objective is to develop algorithms that can infer the Swara cycle from data collected by a simple smartwatch or fitness tracker, making long-term, unobtrusive monitoring a reality for both researchers and individuals”*

What Modern Research Reveals

Modern science is beginning to empirically validate this ancient knowledge, linking the nasal cycle directly to autonomic regulation and overall health. Disruptions in this fundamental ultradian rhythm are associated with autonomic imbalance, which can be a precursor to various stress-related and psychiatric disorders [2]. Currently, measuring this cycle requires specialized equipment like acoustic rhinometers, or inconvenient setups involving masks and thermistors placed directly at the nostrils [1]. Research, notably by pioneers like David Shannahoff-Khalsa, has already established strong correlations between the nasal cycle and other key biomarkers, showing that shifts in nostril dominance are mirrored by changes in cerebral hemispheric activity, heart rate, and Heart Rate Variability (HRV) [3].

The Challenge: From Lab to Life

The central challenge, therefore, is translating these fascinating lab-based findings into practical tools for everyday life. The inconvenience of current monitoring techniques creates a barrier to large-scale, on-field research and personal wellness applications. My research aims to bridge this gap by exploring a range of physiological signals as potential proxies for the nasal cycle. We are investigating whether modalities that can be easily measured by modern wearables such as Galvanic Skin Response (GSR), photoplethysmography (PPG) which tracks blood volume changes, electrocardiography (ECG), skin temperature, and even pupil size ,correlate reliably with nostril dominance. The ultimate objective is to develop algorithms that can infer the Swara cycle from data collected by a simple smartwatch or fitness tracker, making long-term, unobtrusive monitoring a reality for both researchers and individuals.

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Quid Deinde?

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For centuries, yoga and prāṇāyāma have been celebrated as timeless practices of self-regulation, balance, and inner clarity. Ancient texts like the Yoga Sūtras and the Haṭha Yoga Pradīpikā describe not only their spiritual dimensions but also their profound effects on body and mind.

Yet, in the modern scientific landscape, these practices are often explored in fragments—measured in heart rates, brain waves, or stress markers—without fully capturing the depth of their mechanisms. As we inherit this wisdom in an age of data and computation, the question arises: how do we translate age-old practices into models that speak the language of science? It is here that Heritage Science and Technology finds its most compelling challenge—and opportunity.

Much of today's research on yoga and meditation tends to focus on practices such as prāṇāyāma—anuloma-viloma, nāḍi-śodhana, śītalī, brahmari, śāmbhavī. These studies catalog outcomes such as heart rate changes, subjective well-being, or EEG shifts. Yet the deeper question—how exactly do these practices work?—often remains unanswered. Without causal understanding, the knowledge risks staying anecdotal rather than clinically actionable.

Mechanism matters. Consider clinicians who rely on breathing techniques in post-operative care and rehabilitation. Or think of Lamaze training in childbirth—essentially yoga-based breathing and posture practices, yet rebranded because the original tradition was not documented in formats recognizable to modern science. The absence of mechanistic studies, large cohort research, and causal models makes yoga seem less rigorous, when in fact it carries centuries of refinement. The research ecosystem perceives this work as high-risk and low-reward, yet it is precisely where transformation lies.

Modeling can offer that bridge. Mechanisms in yoga are not always directly observable; they must often be inferred through multimodal computational approaches—physiology, imaging, sensor outputs, and even textual annotations. Artificial Intelligence can integrate such data to define plausible mechanisms across scales. This could provide the missing causal layer that connects breathing techniques to neural or cardiovascular changes. As the Bhagavad Gītā reminds us, "yogaḥ karmasu kauśalam"—yoga is skill in action. Mechanistic clarity would make this skill prescribable.

Science offers parallels. Alexander Fleming discovered penicillin, but only when its biochemical mechanism was later unraveled could antibiotics be systematically prescribed (Lobanovska & Pilla, 2017). Dr. Tu Youyou's work on Artemisia annua is another example: by isolating artemisinin and documenting the extraction method, a traditional remedy became a global antimalarial (Nobel Prize, 2015). Mechanistic understanding transforms tradition into therapy.

Yoga research could follow suit. Imagine prāṇāyāma prescribed not vaguely as "ten minutes daily," but calibrated by age, weight, comorbidities, and recovery needs—much like drug dosage. Ayurveda echoes this: efficacy depends not only on the active principle, but also on grounding, extraction, and method of administration. Yoga Sūtra I.2 reminds us, "yogaś citta-vṛtti-nirodhaḥ"—yoga is the stilling of mental fluctuations. To reach this reliably in clinical settings, reproducible parameters matter.

Looking ahead, the future of Heritage Science in yoga technology lies in developing causal mechanical models. These would benchmark traditional practices with the rigor of biomedical sciences, integrate AI-driven multimodal computation, and validate through clinical studies. When this happens, yoga will no longer be framed as an "alternative," but as a precise and evidence-based science of body–mind interaction.

So, quid deinde? The way forward is to ask not only what yoga does, but how yoga does what it does. Only then will heritage knowledge reclaim its rightful place in science and technology.

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Sacred Groves to City Gardens: Ancient Indian Green Urbanism

KID: 20250316 | Mr Sudarshan Saravanan, Dr Shiva Ji

Most urban residents in India today are starved of three main ingredients for a healthy and happy life: fresh air, clean surface water, and a rich biodiversity. We are so used to seeing the best public parks locked away behind gates or only on TV, from far-flung foreign countries like Singapore. However, what if I told you that ancient Indian cities were once filled with lush, well-planned public parks and sacred forests, designed for the spiritual and philosophical enlightenment of their citizens? Ancient Indian cities embodied three core urban design principles:

- Nature-based urban design
- Ecological infrastructure
- Spiritual cultural urban design

The Skanda Purāṇa prescribes city layouts (nagara-vyavasthā), with designated parks (upavana) and sacred groves (devavana). It recommends integrating these with ponds, lakes, and temple precincts. The scripture stresses that these parks are essential to the well-being of the planet and the sacredness of the land. It describes various flowering, fruiting, and creeping species that should be planted in urban parks, such as Arjuna, Aśoka, Punnāga (Calophyllum inophyllum), Tāla (Palmyra), Hintāla (Phoenix tree), Śāla (Sal tree), Prācīnāmalaka (Flacourtia cataphracta), Lodhra (Symplocos racemosa), Bakula, Nāgakesara, coconut palms, jackfruit, mango, sandalwood, fig, and date palm. It mentions many more trees, including Priyāla, Sarala, Himalayan cedar, wood apple, champaka, karṇikāra, kovidāra, pāṭala, kadamba, margosa, nīpaka, pomegranate, mandāra, pārijāta, holy fig trees and agallochum. The Skanda rban design Purāṇa also specifically praises Orissa as a land of heaven, filled with countless beautiful flowering trees and gardens. The Mānasāra likewise prescribes the integration of upavana (parks around temples for recreation) and vanas (sacred forests) for purification of the city, ecological balance, and biodiversity retention.

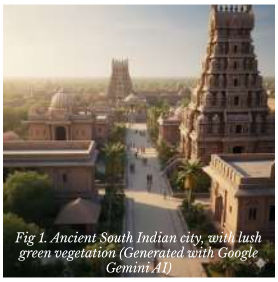

Fig 1. Ancient South Indian city, with lush green vegetation (Generated with Google Gemini AI)

Scared forests are not just merely green lawns with a few flowers scattered around, rather they are pure untouched nature, a niche for all species to thrive in cities without human intervention. No one is supposed to enter these spaces, neither are trees allowed to be cut.

These sacred forests were also essential for Ayurvedic treatments, as they served as genetic reservoirs for medicinal herbs and plants. Parks, sacred grooves, temples and urban areas are to be designed in integration. With only ⅓ third of the urban space to be built-up, the rest is for urban infrastructure and green spaces. The Manasara prescribes urban green fresh-air corridors throughout the city. The Mayamata scriptures in Sanskrit, mandates that atleaast 1/7 or ⅙ of the urban surface area should be entirely allocated for green spaces. Nagara-vatika (urban forests) are sited within residential quarters, near temples, water tanks, and along main streets. There are specific directives that parks or groves should be easily accessible from public areas, should physically as well as visually connect to important religious structures and water bodies for ritual and environmental purposes. The nagar-vartika is not just merely an ornamental park, but a multifunctional space for water management, spiritual recreation, bioengineered landscape clusters. The city of Singapore has mandated very similar principles in its 2030 Green Plan. The 12th century Lingayat reformer Basavanna, wrote about the same principles in his text Basava Purana. Southern Kerala, having been spared by invasions from invaders, has many surviving “kaavu’s” sacred forests, like the Iringole Kaavu, a temple dedicated to goddess Durga, located in the Kunnathunad Taluk.

Fig 1. Central Public Plaza, the Brahmasthana (Generated with Google Gemini AI)

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Texts to Technology: Curcumin and Kadamba in Cancer Therapeutics

KID: 20250317 | Ms Aishwarya, Prof Ganesan Prabusankar, Dr Aravind Kumar Rengan

The exploration of the medicinal importance of Haridrā (Curcuma longa) and Kadamba (Anthocephalus cadamba) is deeply rooted in classical Indian texts. In Sushruta Samhita, Haridrā is identified as a key ingredient in formulations used to treat 20 types of Prameha.[1] In particular, in Cikitsasthana 6.17, 20, it even states that there is no Prameha (modern-day disorders such as diabetes mellitus and metabolic syndrome) that is incurable by Haridrā. In Ayurveda, the therapeutic effects of C. longa are well discussed in Dashemani Lekhaniya (emaciating), Kusthagna (anti-dermatosis), and Visaghna (anti-poisonous) texts.[2] Similarly, Kadamba is mentioned in several ancient Ayurvedic texts like Charaka Samhita, Astangahridaya, Harit Samhita, Chakaradatta, etc., establishing its long history of medicinal use. In our folklore, plant parts like fruit have been used for gastric irritability, fever, as a blood purifier; whereas the stem bark is known for antibacterial activity, and used for inflammation of the eye.[3]

All together, these verses and ancient literature position Haridrā and Kadamba not just as dietary or ritual substances but as core therapeutic agents in the Ayurvedic pharmacopeia, particularly in treating inflammatory, dermal, and wound-related conditions. The primary constituents of turmeric include a group of polyphenolic compounds called curcuminoids. These curcuminoids mainly include curcumin, demethoxycurcumin, and bisdemethoxycurcumin, and essential oils like turmerone and zingiberene.[4] The medicinal properties of the Kadamba tree are attributed to a diverse range of phytochemicals, particularly indole alkaloids, such as cadambine; triterpenes, and saponins like cadambagenic acid and quinovic acid, etc.

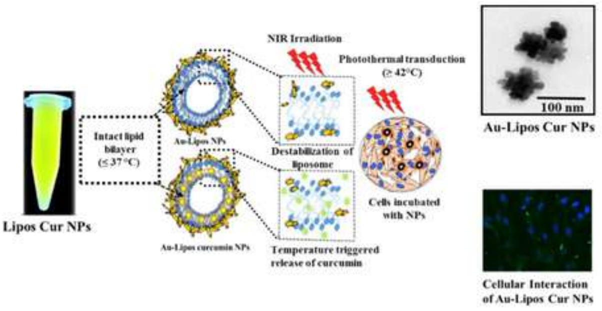

Fig 1. Schematic representation of NIR-triggered liposome–gold nanoparticle (Au-Lipos) hybrid entrapping curcumin for photothermal therapy of skin cancer. (Adapted from Singh et al., 2018)

In today's era, the challenge lies in translating these insights into clinically viable formulations. Curcumin, despite its potent activity, has poor aqueous solubility, which results in low systemic bioavailability. Numerous nanotechnology-based systems are being investigated to address these limitations. For example, Singh et al. (2018) have engineered a near-infrared-triggered liposome–gold nanoparticle hybrid entrapping curcumin. The lipid bilayer remains stable at physiological temperature, encapsulating curcumin. Upon near-infrared (NIR) irradiation, the gold nanoparticles convert light into heat (⩾42 °C), destabilizing the liposomal bilayer and triggering temperature-mediated release of curcumin. The overall system enhanced the curcumin delivery and also demonstrated synergistic tumor regression.[5]

Parallel studies have explored the potential of Kadamba (Neolamarckia cadamba) in advanced cancer therapies. Its chlorophyll-rich biomolecular fraction has been identified as a natural photosensitizer capable of harnessing light energy for photothermal and photodynamic mechanisms. Pemmaraju et al. (2018) investigated a polymeric nanosystem encapsulating Kadamba chlorophyll fractions, which, when combined with photothermal therapy, significantly enhanced cancer theranostic efficacy. This synergistic system not only improved bioavailability but also demonstrated selective tumor ablation, highlighting Kadamba as a promising plant-derived resource for nanomedicine-based cancer therapy.[6]

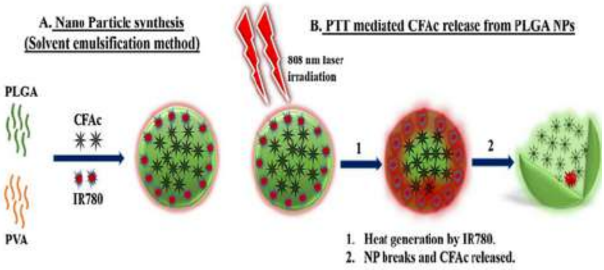

Fig 2. Schematic illustration of chlorophyll-rich biomolecular fraction (CFAc) from Anthocephalus cadamba loaded into PLGA nanoparticles for photothermal therapy (Adapted from Pemmaraju et al., 2018)

Thus, classical Ayurvedic references show Haridrā and Kadamba as potent therapeutic agents. Today, with advanced nanosystems as stated above we translate these ancient insights into clinically relevant cancer theranostics with enhanced bioavailability, selectivity, and therapeutic efficacy.

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Teaching Machines Sanskrit: Modern NLP for an Ancient Language

KID: 20250318 | Mr Sushant Dave

Sanskrit is one of the oldest living languages in the world. Its earliest known texts, the Vedas, date back over three thousand years. For centuries it served as a vehicle for philosophy, science, literature, and culture across the Indian subcontinent. Despite its systematic grammar and immense intellectual heritage, Sanskrit has remained one of the most difficult languages for computers to process.

Indic language Processing (ILP) group at HST tries to address this challenge: to bring modern Natural Language Processing (NLP) techniques to Sanskrit, bridging ancient knowledge with the latest in machine learning. This article presents the journey — the linguistic challenges, computational experiments, key breakthroughs, and why this work matters for both Sanskrit and the future of AI.

Why Sanskrit Challenges Computers

Unlike English or other European languages, Sanskrit poses unique hurdles for NLP.

Inflectional Richness

Every noun root in Sanskrit can appear in 72 different forms (3 genders × 3 numbers × 8 cases). Verbs are even more complex, with up to 900 forms across tenses, moods, persons, and numbers.

Free Word Order

The sentence "Dog bites man" can be rearranged in six different ways in Sanskrit without changing meaning, because word endings encode grammatical roles. Standard NLP methods, which rely heavily on word order, struggle with this.

Sandhi (Euphonic Combination)

Sanskrit words often merge at boundaries, changing sounds and producing new fused words. For example, guru + upadesha becomes gurupadesha. Splitting these correctly is essential but non-trivial.

Samasa (Compounds)

Beyond Sandhi, Sanskrit allows long compounds where words are joined semantically to form entirely new terms. These compounds can span multiple words and change meaning unpredictably.

Scarcity of Digital Resources

Compared to English or Hindi, Sanskrit lacks large annotated datasets. Most texts exist in traditional print editions, often without digital markup.

Together, these properties make Sanskrit a fascinating but formidable candidate for NLP research.

Why Apply NLP to Sanskrit?

The motivation is both cultural and scientific. Sanskrit texts preserve knowledge in fields ranging from astronomy to medicine. Many remain untranslated or partially studied. Computational tools could:

- Enable faster translation and annotation of manuscripts.
- Support semantic search across massive corpora.
- Assist scholars in identifying linguistic or philosophical patterns.
- Preserve and make accessible the cultural heritage of India.

At the same time, Sanskrit serves as a test case for building NLP tools for other morphologically rich and under-resourced languages worldwide.

Word Vectors for Sanskrit

Word embeddings, or word vectors, represent words as points in a numerical space, capturing semantic similarity. For example, in English embeddings,

vector(King) − vector(Man) + vector(Woman) ≈ vector(Queen)

We trained Word2Vec models on a Sanskrit corpus of over half a million unique tokens, including epics like the Mahabharata and classical works from the Digital Corpus of Sanskrit.

Findings

Verbs clustered meaningfully — many neighbors shared the same root.

Nouns were less coherent — inflectional complexity scattered related forms.

Compositional tests (e.g., gender or number changes) worked only sporadically.

The conclusion was clear: morphological preprocessing is a prerequisite before embeddings can capture Sanskrit semantics effectively.

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Language Modeling

N-gram and Neural Models

We built statistical N-gram models (unigram, bigram, trigram, 4-gram). While English models achieve perplexity scores around 100, Sanskrit models scored in the thousands — showing very poor predictive power. We then trained recurrent neural networks (RNNs) with LSTM cells on the same corpus. Training loss dropped, but validation loss stagnated — a sign of overfitting. The models memorized patterns but failed to generalize.

Inference - Without morphological analyzers to normalize word forms, higher-level tasks like language modeling are doomed to underperform.

Sandhi

Sandhi rules describe how sounds shift at word boundaries. Splitting a fused word (Vichchheda) is context-dependent and often ambiguous. We have worked on expanding the scope of earlier work done by other researchers on Sandhi. One popular approach is formulating Sandhi splitting as a sequence-to-sequence learning problem. Instead of coding all rules by hand, a neural network can be trained to predict splits directly from data. Our group has worked on improving the existing neural approaches with better training data.

Understanding Pratyaya (Suffixes)

Another focus is Pratyaya — suffixes used to derive new words. Two major types are:

- Kridanta (from verbs, e.g., participles and derivatives).
- Taddhita (from nouns/adjectives, forming secondary derivatives).

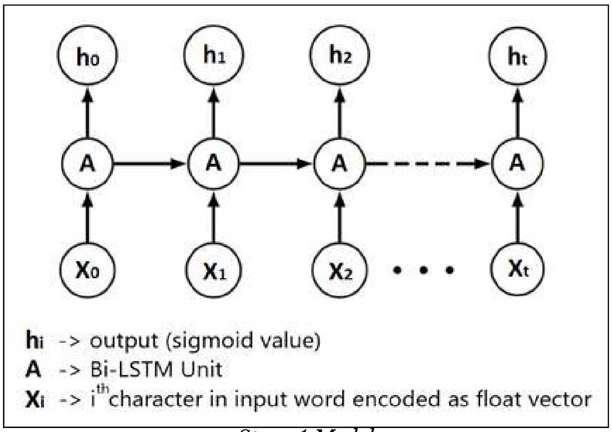
As of now, no exhaustive and reliable benchmark exists for suffix analysis in Sanskrit. ILP team is working on creating PratyayaKosh, the first benchmark corpus for suffix analysis. It includes derivative nouns annotated with their suffixes, enabling systematic evaluation of computational tools. This will be made available to the general public in the near future. Using this dataset, our team is working on Neural models and Finite State Machines that can outperform existing systems. This work can set a new baseline for Pratyaya analysis and open the door for advanced future research.

Handling Samasas

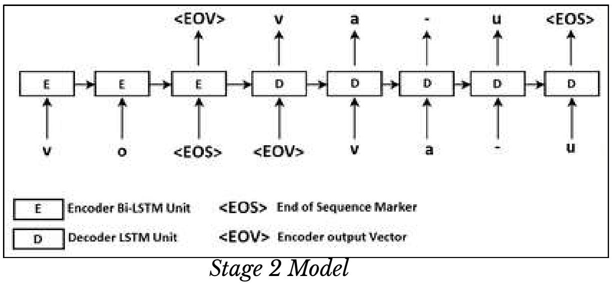
Samasas add an additional layer of complexity to the Sandhi. Samosas are compounds with mandatory Sandhi if possible as per the rules of Panini.

Approach

We took a leaf out of our Sandhi work and tried to figure out split points, before actual split. Only, this time we are looking for multiple split points and not a single one. As before, we have 2 Neural Networks doing the job.



Stage 1 Model



Stage 2 Model

Results

- The neural Samasa model holds its own against Transformer models despite having less than 1% of the trainable parameters.
- Easier to train, fewer data-points and computer resources needed to train
- Again, it required no external lexical resources.

Key Research Outcomes

1. Limits of standard NLP — word embeddings and N-gram models underperform without morphological preprocessing.
2. PratyayaKosh dataset — a standardized benchmark for suffix analysis.

1. Neural compound analysis models — outperformed existing rule-based tools.
2. Emphasis on morphology — highlighted that progress in Sanskrit NLP depends on strong morphological analyzers.

Why This Matters

- Sanskrit NLP is not just an academic exercise. By unlocking Sanskrit texts, we can:
- Make centuries of Indian knowledge in science, medicine, and philosophy accessible.
- Support digital preservation of cultural heritage.
- Build tools for education, research, and even popular use.
- Provide models for how AI can address other low-resource, structurally complex languages.

Future Scope

The journey has just begun. Future work could involve:

- Larger datasets from digitized Sanskrit manuscripts.
- Large language models For all the challenges presented, LLMS are inevitable owing to their generalization power.
- Hybrid methods combining rule-based Paninian grammar with LLMs to make training feasible.
- User-facing applications:
    1. Digital assistants that read and translate Sanskrit.
    2. Search engines for Sanskrit literature.
    3. Educational platforms for students and scholars.

The ultimate dream: AI that can not only read but also converse in Sanskrit, bridging millennia of knowledge with the present.

Sanskrit presents challenges far beyond most modern languages, but these challenges also offer opportunities. By combining ancient linguistic insights with modern AI, we can unlock texts that hold timeless wisdom. Our work at ILP on Sandhi, Pratyaya, Samasa and morphological analysis is only the first step. The road ahead is long, but the vision is clear: a future where machines understand Sanskrit as fluently as humans once did.

> *“Sanskrit presents challenges far beyond most modern languages, but these challenges also offer opportunities. By combining ancient linguistic insights with modern AI, we can unlock texts that hold timeless wisdom. Our work at ILP on Sandhi, Pratyaya, Samasa and morphological analysis is only the first step”*

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Tools for Querying Indian Knowledge Systems

KID: 20250319 | Mr Sai Kasyap

Indian Knowledge Systems (IKS) encompass a vast body of philosophical, linguistic, and scientific traditions preserved in Sanskrit and other Indic languages. However, the complexities of Sanskrit morphology, free word order, and semantic density pose significant challenges for effective retrieval and knowledge extraction from these texts. Recent advances in Natural Language Processing (NLP) have provided a foundation for developing specialized tools to query IKS, with research spanning three domains: Named Entity Recognition (NER), semantic search engines, and speech technologies.

NER for Sanskrit

NER plays a crucial role in identifying and extracting entities such as deities, places, scholars, and canonical texts from IKS corpora. Unlike high-resource languages, Sanskrit presents unique challenges due to its sandhi formations, inflectional richness, and extensive use of compounds. Recent approaches have focused on pre-annotation and expert validation for constructing high-quality NER datasets, notably Sujoy et al. (2023), whose workflow emphasizes domain-grounded entity type design and accuracy improvement (Sujoy et al. 2023).

Comparative analysis of traditional and transformer-based NER methods on Indian epics highlights the superior adaptability of deep learning architectures for entity identification and classification tasks, especially in narrative, multilingual data (Sharma and Mohania 2022). Large-scale annotation efforts such as the "Naamapadam" dataset demonstrate the evolution of multi-language NER resources, extending entity coverage across Indic scripts and improving scalable model training for Sanskrit (Mhaske et al. 2022).

Transformer-based models, including BERT and XLM-R, have shown outstanding potential for entity recognition in morphologically rich languages by leveraging self-attention mechanisms to capture context over complex sentences (Devlin et al. 2019; Pande and Bhattacharya 2021). Fine-tuning these architectures on Sanskrit corpora aims to improve precision and recall, ensuring more reliable recognition of nuanced references embedded within verses and commentaries.

Semantic Search for IKS

Keyword matching methods are insufficient for Sanskrit literature due to lexical variation and context-specific meaning (Choudhury 2010). To overcome these challenges, specialized semantic search engines for IKS texts are under development, incorporating multilingual and cross-lingual features.
The semantic engine utilizes embedding models trained on Sanskrit–English parallel data, enabling cross-lingual semantic alignment and supporting queries in both languages. Various embedding models such as XLM-Roberta, LaBSE, and Qwen embeddings have been trained on the corpus (Reimers and Gurevych 2019; Mishra 2023).

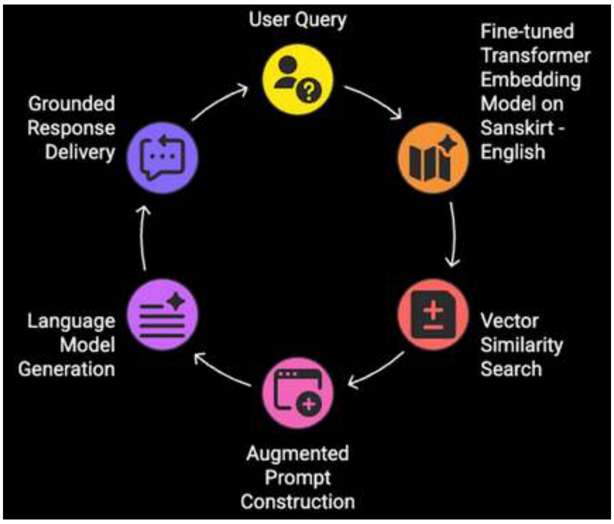

Fig 1. represents the RAG search pipeline that can be implemented after the fine tuning of the embedding model.

Speech Technologies for Sanskrit

Expanding accessibility further, speech technologies including Automatic Speech Recognition (ASR) and Text-to-Speech (TTS) are integrated into IKS tools. ASR enables users to perform voice-based searches in Sanskrit or English, reducing the barrier posed by Indic script typing challenges (Rao and Murthy 2019). Recent advances leverage transformer-based models and optimized encoder networks for Sanskrit ASR and TTS (Sproat 2017; Joshi et al. 2021). This multimodal approach ensures interaction with IKS resources not only through text but also through spoken forms—for researchers, learners, and practitioners.

Towards an Integrated Framework

By combining NER optimization, semantic search, and speech technologies, a comprehensive framework for querying Indian Knowledge Systems can be realized. This unified approach that respects the linguistic, cultural, and oral dimensions of Sanskrit. This interdisciplinary effort enables the revitalization of IKS in the digital age, supporting both academic research and broad scholarly engagement.

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Tracing Gastronomic Continuities: Patterns and Frameworks in the Evolution of Indian Cuisine

KID: 20250320 | Ms Yashaswini M R

India's culinary landscape is a vibrant tapestry of flavors, techniques, and traditions deeply rooted in its diverse cultural heritage. This extraordinary tradition—pākaśāstra—is not only central to the nation's cultural identity but also a major driver of economic growth through the food services and culinary tourism sectors. Currently valued at over $50 billion, these industries are expanding rapidly, with culinary tourism projected to grow at a 23% CAGR and food services at 11%. Together, they are expected to form a $300 billion market by 2034, significantly contributing to the economy.[1]

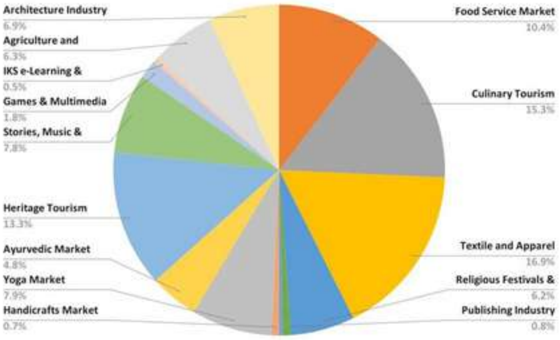

Fig 1: Indian Knowledge systems and Heritage state of the industry report [1] projects the contribution of the food service industry at 10.4% and culinary tourism at 15.3% by 2034.

Amid this rapid growth, it is vital that India's culinary heritage remains anchored in its knowledge systems. For culinary traditions to retain authenticity and serve as instruments of India's soft power, they must draw on the foundations of pākaśāstra and Ayurveda. While modern gastronomy often adopts a reductionist approach—exploring flavor molecules, ingredient interactions, or heat transformations—Indian culinary philosophy views food holistically, through the Ayurvedic systems biology framework of tridoṣa and saptadhātu. The two approaches need not stand apart; instead, they can be synergized to enrich both tradition and modernity.

India's culinary legacy traces back to the Vedas, purāṇas, and sūtras. Seminal works like aṣṭāṅga hṛdaya and mānasollāsa (2nd century CE) laid down principles for health-centric cooking, emphasizing the systemic benefits of ingredients and their combinations. Later medieval texts such as bhojanakutūhala and kṣemakutūhala documented recipes that reflected trade and cultural influences, yet remained rooted in Ayurvedic frameworks. This structured approach balanced creativity with continuity, allowing the integration of new ingredients and techniques without compromising authenticity. Even a simple lemonade, for example, is valued not merely for taste but for its ability to alleviate vāta and stimulate agni, the digestive fire.

In his Pākadarpaṇa, Nala Maharaja classifies recipes into sixteen categories based on six primary flavor profiles—madhura, lavaṇa, kaṭu, tikta, āmla, kaṣāya—and forms or textures such as bhakṣya, bhojya, coṣya, lehya, and peya. This taxonomic tradition reflects the Ayurvedic view that true health lies in balance: "Samadoṣaḥ samāgniśca samadhātu malakriyāḥ Prasanna ātmendriya manaḥ svāstha ityabhidhīyate" (Suśruta-saṃhitā: Sūtra-sthāna, 15.10).

Where Ayurveda highlights systemic balance, modern food sciences explain cooking through molecular transformations, flavor pairings, and nutrient interactions. This contrast and complementarity are evident in contemporary gastronomy. Television shows and chefs bring forth innovations such as rasam khowsuey—layering flavors in exciting ways—while molecular gastronomy introduces foams, flash-frozen desserts, and deconstructed presentations. Computational gastronomy now enables systematic analysis of flavor pairing across global cuisines[3,4,5].

Trends like sourdough bread, celebrated today for its slow natural fermentation[6], resonate with India's age-old mastery of similar processes in idli and dosa. Regional cuisines also illustrate this continuity across cultural contexts. The steamed Siddu of Himachal Pradesh shares affinities with Tamil Nadu's uzhundu kozhukattai. Modaks of Maharashtra, patolis of Goa and Gujarat, and pithas of Assam and Bengal embody similar concepts adapted to regional flavors. Despite geographical and cultural divergences, these culinary practices are underpinned by shared flavor profiles and cooking methodologies that conform to the epistemic frameworks of the Indian knowledge traditions.

Thus, India's culinary wisdom offers not just a living legacy but also a fertile ground for interdisciplinary research. By bridging pākaśāstra and Ayurveda with modern scientific insights, we can rediscover the holistic foundations of Indian cooking, enrich global gastronomy, and redefine India's soft power on the world stage.

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Tridosha, Systems Biology, and the Physiome: Bridging Ayurvedic Principles with Modern Integrative Models

KID: 20250321 | Mr Rohit Marathe

Ayurveda, one of the world's oldest systems of natural healing, is a vital part of India's cultural and scientific heritage. Rooted in centuries of wisdom, it offers a holistic approach to health by balancing the body, mind, and spirit through natural remedies, diet, and lifestyle practices. Even today, Ayurveda remains highly relevant as people across the globe seek sustainable and preventive healthcare solutions, turning to its time-tested methods for wellness, immunity, and harmony in an age of fast-paced living and modern health challenges.

Ayurveda views the human system through the framework of the tridoshas—Vata, Pitta, and Kapha—symbolizing movement and regulation, metabolic transformation, and growth and support, respectively. This stands in contrast to modern medicine's reductionist, bottom-up perspective, which explains physiology by linking processes across scales from genes to organs. At the heart of Ayurveda lies the principle that health emerges from the balance of the tridoshas, while their imbalance gives rise to disease.

Previous research in this area has hypothesized that tridoshas may map to biochemical reaction pairs such as oxidation/reduction, exothermic/endothermic, and hydration/dehydration. It has also been suggested that the five sub-doshas of each dosha could correspond to major organ systems, including the epithelial, digestive, cardiovascular, and central nervous systems. Further work has conceptualized tridosha interdependencies as a network, with health representing an ideal network state and disease arising from its disruption. Despite these efforts, the precise correspondence between tridoshas, sub-doshas, and modern physiological parameters remains elusive.

With this background, we turn to Systems Biology, which is an interdisciplinary field that studies biological processes as integrated networks of genes, proteins, cells, and organs rather than isolated parts. By combining experimental data with computational modeling, it seeks to understand how complex interactions give rise to health, disease, and emergent behaviors in living systems.

Systems biology provides the foundation for understanding the Physiome, a term derived from "physio" (life) and "ome" (as a whole). The physiome refers to a quantitative and integrated description of the functional state of an individual or species, capturing the physiological dynamics of the intact organism. It is built on structural and informational layers such as the genome, proteome, and morphome. Broadly, the physiome seeks to map relationships from genome to whole organism and from functional behavior to gene regulation. Within the Physiome Project, this vision is realized through integrated models of biological components—ranging from organs and cell systems to biochemical and endocrine networks.

The perspectives of Ayurveda resonate well with these contemporary approaches in Systems Biology and the Physiome project. Just as tridosha theory emphasizes balance and interdependence, systems-level models highlight the importance of dynamic interactions and homeostasis across physiological scales, suggesting a conceptual bridge between traditional Ayurvedic frameworks and modern integrative biology.

Building on these ideas, our research seeks to model the tridoshas as an unknown triad of vectors spanning a high-dimensional space of physiological systems. Within this tridosha-based coordinate system, even subtle shifts may produce nonlinear effects across multiple physiological parameters. Health, in this view, corresponds to stable subspaces, while disease arises from deviations away from them. The precise transformation between this Ayurvedic coordinate system and the frameworks of modern physiology is not clearly defined. Our work seeks to bridge this gap by applying physiological modeling alongside methods from dynamical systems, linear algebra, and machine learning. We strongly believe that this will address the challenge of articulating Ayurvedic efficacy in contemporary biomedical language.

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Unlocking Ancient Secrets: The Manwal Temples and the Power of Photogrammetry

KID: 20250322 | Ms Aakriti Singh

A Digital Lifeline for a Vanishing Past

In the rugged landscapes of the Jammu region, amidst the remnants of the ancient Durgara State, a cluster of medieval temples stands as a testament to a rich and complex past. Long overshadowed by more prominent sites, the temples of Manwal (ancient Babbapura) are now revealing their secrets, not through traditional excavation, but through the transformative power of photogrammetry. This study delves into a detailed photogrammetric exploration of these temples, arguing that this modern, non-invasive technology is not merely a tool for documentation but a powerful instrument for unlocking architectural, historical, and cultural narratives that were previously lost to time and decay.

Insights from the Stones: An Architectural and Artistic Renaissance

The photogrammetric data has allowed for an unprecedented level of detail, revealing a sophisticated architectural tradition that flourished in this region. The analysis has uncovered several key inferences about the temples' design and craftsmanship:

Highly Sophisticated and Integrated Craftsmanship: The most remarkable finding is the evidence of a holistic design approach. Carvings were not applied as a secondary layer but were sculpted directly into the primary building blocks. The meticulous synchronization of masonry levels with external carvings to conceal joints speaks to a master builder tradition where sculpture and architecture were seamlessly integrated from the very foundation. This suggests a highly advanced level of artistry and meticulous planning. The intricate jewelry on the Nandi statue, a common feature in temple complexes, being carved into the stone itself further reinforces this exceptional dedication to detail.

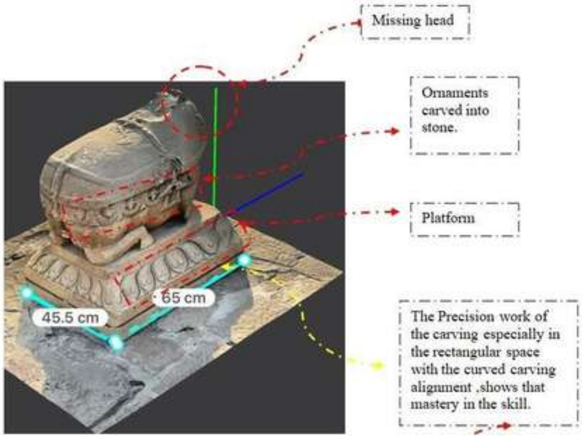


Fig 1.1. View with dimensions of Nandi ji

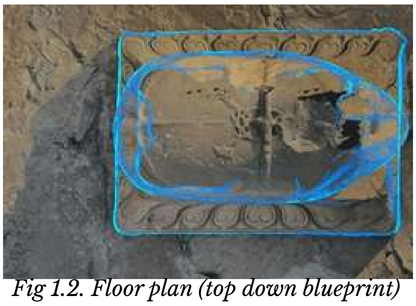


Fig 1.2. Floor plan (top down blueprint)

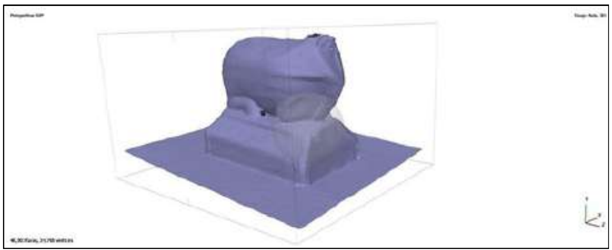


Fig 1.3. Un textured file used for 3 d printing of Nandi ji

A Unique Architectural Melting Pot:

The identification of a blend between Kashmiri decorative styles and North Indian Indo-Aryan structural elements is a critical observation. This fusion is tangible proof that Manwal was a vibrant hub for cultural and artistic exchange, likely facilitated by its location on the ancient "Uttra path." This was not a passive adoption of styles but a dynamic period of local adaptation, resulting in a unique regional architectural style or "school." The shared design features between the smaller temples and the larger "Dera Babour" hint at a consistent, flourishing tradition during the 10th to 12th centuries.

Strategic Placement for Visual Prominence:

The temples' elevated entrances and overall positioning on higher ground, in close proximity to a historic route, were not accidental. These features infer a conscious strategy for monumentality and visibility. The builders intended these temples to be imposing landmarks, projecting the cultural or religious power of the Durgara State to travelers from a distance. The use of locally available stone was not only a practical choice but part of a grand visual statement, seamlessly integrating the structures into their natural landscape

Beyond Documentation: Photogrammetry as an Interpretive Tool

The true innovation of this study lies in its use of digital preservation as an interpretive and intelligent tool. By manually annotating the digital models with textual explanations and historical references, the static 3D models have been transformed into "smart" historical records.

This process moves beyond simply documenting geometry to actively interpreting the structure, explaining its individual elements, and providing historical context. For researchers, these digital assets are invaluable: they serve as blueprints for future analysis and offer a dynamic database for understanding the temples' design and construction without physically touching the site. This methodology not only democratizes access to this vulnerable heritage but also provides a powerful new way to engage with and understand it.

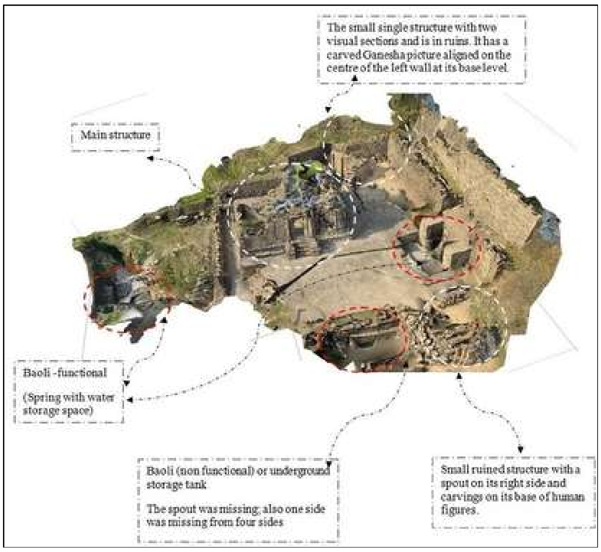
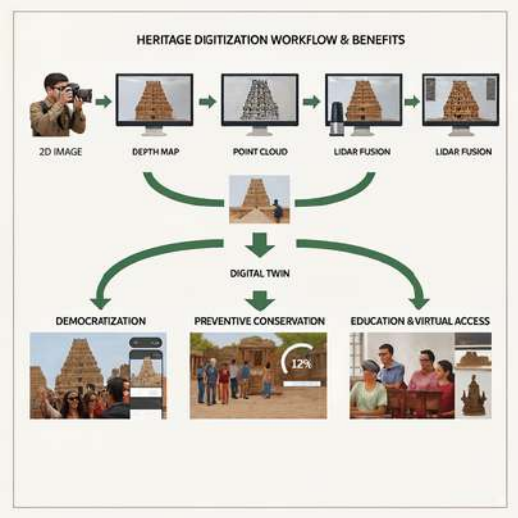


Fig 1.4 Top view of the site generated through photogrammetry

An Urgent Contribution to Heritage Conservation

This work serves as a powerful testament to the urgent and practical necessity of digital heritage conservation. The temples of Manwal, like many other historical sites, face persistent threats from decay, environmental factors, and modern development.

By proving photogrammetry's efficiency as a cost-effective and non-invasive solution, this study provides a vital roadmap for conservation. The resulting digital products are not mere visuals; they are a critical baseline for condition monitoring, a blueprint for future analysis, and essential data for any restoration or maintenance planning. Through this endeavor, these ancient temples have been handed a lifeline, securing their legacy for future generations against the relentless march of time. Robotics and drones make the practicality seem more advanced. Robots, cameras, LiDAR with environmental-sensors can pass through the fragile sanctums, while the drones can map the towering ariel viewed gopurams/forts. These machines do not replace conservators but extend them for gathering information and correct data safely and efficiently. Over-time, the time-series models can be built which can track changes with precision.



When we talk about the Indian Heritage or our cultural expression — from temples, forts, monuments and stepwells to sculptures and murals, these are irreplaceable and every lost piece of carving or collapsed element is a piece of history erased forever including the hardship of craftsmanship, ideology, memory and significance of that site. To preserve such conditions, we can say that digital immortality is no more an option but an urgency too.

Imagine Archaeologists, students, and citizens alike could explore, study, and protect heritage in various newer ways never before possible with an open archive where every monument existed from major temples to small stepwells as a living digital twin, enriched by images, LiDAR scans, and robotic surveys.By blending the practical the latest technologies we can also lessen the risks of researchers or archaeologists going inside the risky locations like unexplored caves, temples, wells ..etc where they can send curated rovers/robots suitable to that current application for their findings. This combined approach of AI, Robotics along with the latest concepts of GenAI, GANs, Agents and Quantum in future cangive memory to monuments, voice to ruins, and resilience to culture — ensuring India's heritage continues to sustain in stones, pixels and point clouds.

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Yoga in Motion: The Science and Technology Behind Postural Stability

KID: 20250323 | Mr S Uday Kumar

Based on the study “Biomechanical Analysis of Yogasana for Prevention and Rehabilitation: An Active LED-Based Marker Motion Capture System Approach”

Part 1 – The Science of Stillness: Classical Roots of Yogic Posture

“स्थिरसुखमासनम्” (Yoga Sūtra 2.46) – Āsana is a posture that is steady and comfortable. With this simple aphorism, Sage Patañjali defined what modern science now calls postural stability—the ability to hold alignment with minimal effort.

In the Bhagavad Gītā, Śrī Kṛṣṇa calls yoga “समत्वं योग उच्यते” (2.48) – equanimity. In 6.13, he instructs:
“समं कायशिरोग्रीवं धारयन्नचलंस्थिरः । संप्रेक्ष्यनासिकाग्रंस्वं दिशश्चानवलोकयन्॥”
(Samaṁ kāya-śiro-grīvaṁ dhārayann acalaṁ sthiraḥ...) — maintaining axial alignment of the spine, neck, and head while fixing the gaze at the nose tip (nāsāgra dṛṣṭi).

This ancient description mirrors what neuroscience identifies as visual anchoring – reducing unwanted eye movements to calm the nervous system.
The Gheraṇḍa Saṁhitā (1.9) states: “षट्कर्मणा शोधनं चआसनेन भवेद् दृढम्।” Through purification comes stability; through āsana, firmness. These verses reveal that early yoga texts viewed posture not as mere physical training but as a precise science of alignment, balancing gravity, breath, and consciousness. Modern biomechanics now interprets this stability through neuro-musculoskeletal coordination—a dynamic equilibrium of brain, nerves, and muscles that keeps the body upright and steady.

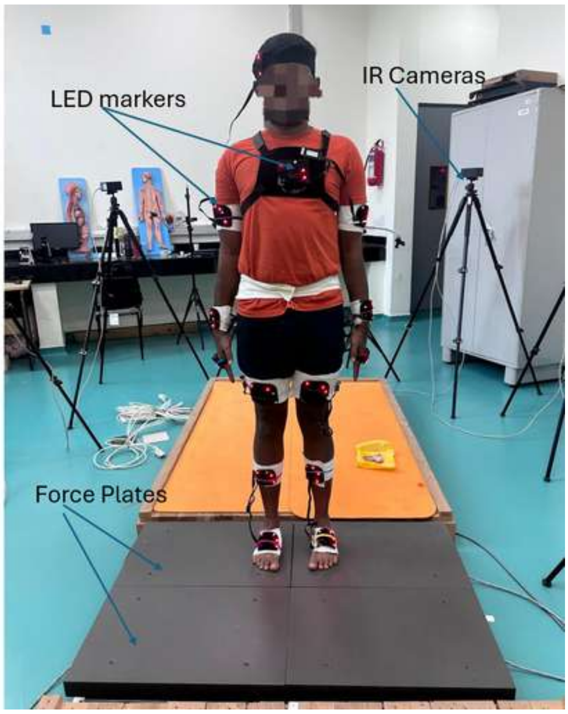


Fig 1. Capturing alignment in Tādāsana using LED-based motion tracking

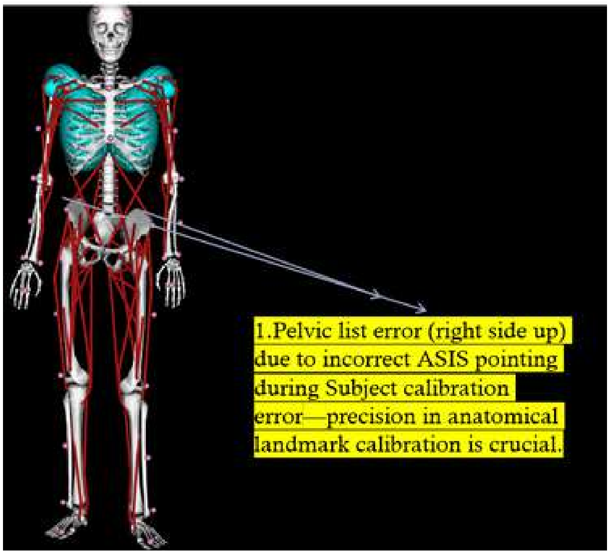
When practiced mindfully, asanas such as Tādāsana (Mountain Pose) align natural spinal curves so that the center of gravity rests directly above the base of support. Weakness or imbalance disrupts this harmony, demanding more muscular effort and leading to fatigue.

By contrast, yogic training optimizes this equilibrium —strengthening core muscles, improving proprioception, and conserving energy.

Part 2 – Modeling Motion: Biomechanics of Yogāsana through Modern Technology

To explore how āsanas create stability, researchers are applying advanced active LED-based motion capture (MoCap)systems. Each marker on the body emits infrared light, allowing cameras to record its precise 3-D position up to 1000 times per second. This high-resolution data is processed in OpenSim software using Inverse Kinematics (to calculate joint angles) and Inverse Dynamics (to estimate joint moments and reaction forces).

Synchronized EMG data further reveals muscle activation patterns—turning classical postures into quantifiable movement models.



1.Pelvic list error (right side up) due to incorrect ASIS pointing during Subject calibration error—precision in anatomical landmark calibration is crucial.

Fig 2. Inverse Kinematics in OpenSim helps visualize pelvic and spinal alignment during Tādāsana.

Common challenges such as marker displacement or calibration errors can distort data, especially if anatomical landmarks like the ASIS (anterior superior iliac spine) are imprecisely located. Soft-tissue movement may also shift markers, causing false pelvic tilt or range-of-motion (ROM) readings. Hence, precise placement and repeated calibration are crucial for reliable biomechanical modeling.

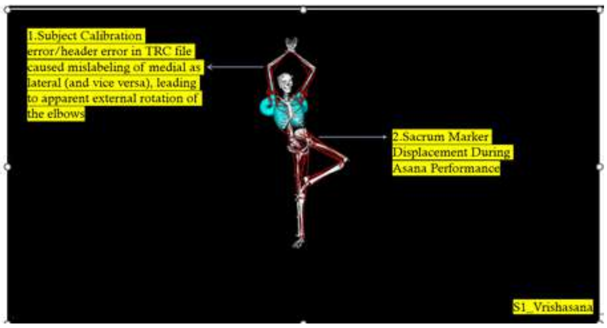
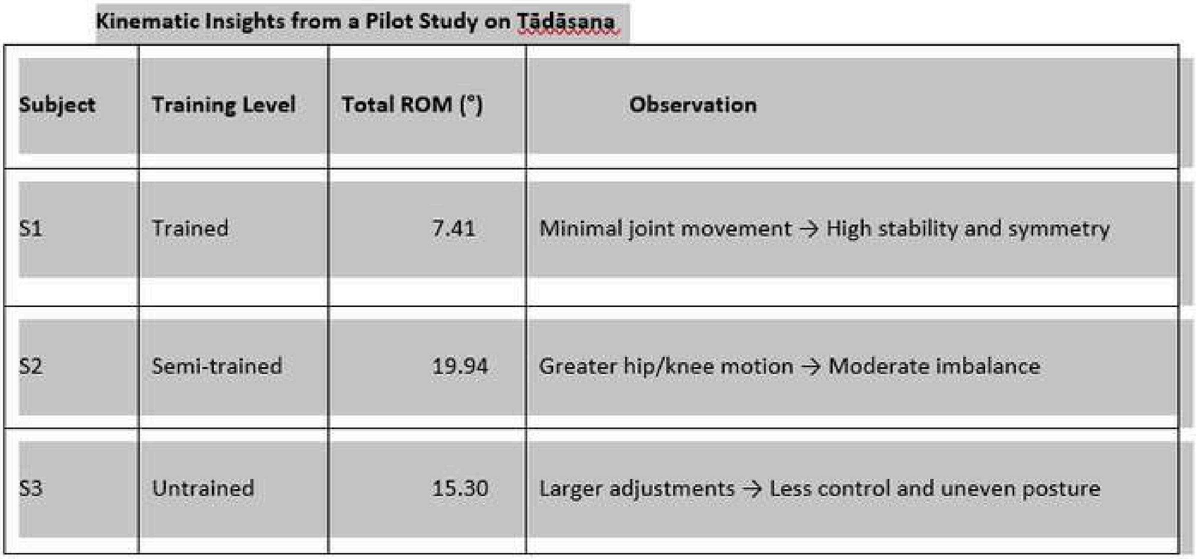


Fig 3. Marker Displacement Error: soft-tissue shifts causing apparent pelvic deviation



Kinematic Insights from a Pilot Study on Tādāsana

Subject	Training Level	Total ROM (°)	Observation
S1	Trained	7.41	Minimal joint movement → High stability and symmetry
S2	Semi-trained	19.94	Greater hip/knee motion → Moderate imbalance
S3	Untrained	15.30	Larger adjustments → Less control and uneven posture

Trained practitioners displayed the least overall movement, reflecting refined neuromuscular control and improved postural symmetry. As training level decreased, joint fluctuations increased—indicating compensatory movements and less stable alignment.

A secondary analysis of bilateral asymmetry showed that experienced subjects exhibited near-equal right–left motion (difference < 1°), while semi-trained practitioners showed up to 0.5° difference, and untrained ones nearly 0.7°.

Such micro-imbalances, though small, can translate into fatigue or joint strain over time. These findings demonstrate how yoga training gradually conditions the body for mechanical efficiency, echoing ancient ideals of “effortless steadiness.

Future Scope

Integrating MoCap with electromyography (EMG) and force-plate data will deepen understanding of how muscles, joints, and gravity interact during āsanas.Refined marker placement, advanced musculoskeletal modeling in OpenSim, and larger participant cohorts will enable causal mechanical models of yogic stability. Such frameworks could help clinicians personalize post-operative or rehabilitative yoga prescriptions based on age, weight, and comorbidities—bridging traditional insight and medical application.

Heritage Science and Technology thus stands at a unique juncture: preserving ancient wisdom while defining it through data.In the end, whether seen through the lens of Sanskrit philosophy or biomechanical simulation, yoga remains a living bridge where stillness meets science.

References & Further Reading

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A world of uncertainty..

Huge opportunities!

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ABN ఆంధ్రజ్యోతి

ఐఐటీహెచ్‌లో భవిష్యత్ తరం చిప్‌ల డిజైన్

- 75కుపైగా సెమీకండక్టర్ డిజైన్ల అభివృద్ధి
- మొబైల్ నావిగేషన్, డ్రోన్లు, రక్షణ వ్యవస్థల.. సామర్థ్యాన్ని పెంచేందుకు వీలుగా రూపకల్పన
- ఎలక్ట్రికల్ ఇంజనీరింగ్ విభాగం పరిశోధకుల ఘనత

కంది, సెప్టెంబరు 25 (ఆంధ్రజ్యోతి): మొబైల్ నావిగేషన్, డ్రోన్లు, రక్షణ వ్యవస్థల సామర్థ్యాన్ని పెంచగలిగే అత్యాధునిక చిప్‌లను ఐఐటీ హైదరాబాద్ అభివృద్ధి చేసింది. అత్యంత ఆధునికమైన సుమారు 75 సెమీకండక్టర్ చిప్ డిజైన్లను ఎలక్ట్రికల్ ఇంజనీరింగ్ విభాగం అధ్యాపకులు, విద్యార్థులు కలిసి రూపొందించారు. చాలా వరకు విదేశాలకే పరిమితమైన సెమీకండక్టర్ చిప్ డిజైనింగ్‌ను ఐఐటీహెచ్‌లో విజయవంతంగా నిర్వహించడం హర్షణీయమని శాస్త్రవేత్తలు ప్రశంసిస్తున్నారు. దీనికి సంబంధించి గురువారం ఐఐటీహెచ్ అధికారులు ఒక ప్రకటన విడుదల చేశారు. ఆధునాతన ఐమెక్ సెంటర్ల నుంచి తదుపరి తరం చిప్‌ల వరకు అభివృద్ధి చేస్తూ.. సెమీకండక్టర్ పరిశోధన, శిక్షణ కేంద్రంగా ఐఐటీహెచ్ నిలుస్తోందని పేర్కొన్నారు. ఈ చిప్‌లు స్మార్ట్‌ఫోన్లు, కంప్యూటర్లు, ఎలక్ట్రిక్ కార్లు, ఆధునాతన వైద్య పరికరాల్లో వినియోగించేందుకు వీలుగా అభివృద్ధి చేశారని. కృత్రిమ మేధస్సు, కంప్యూటింగ్, కమ్యూనికేషన్ వంటి రంగాల్లో పురోగతికి మార్గం వేస్తాయని తెలిపారు. ఆధునాతన సాంకేతికతను అందిపుచ్చుకోవడంలో ఐఐటీహెచ్ ముందంజలో ఉందని ఐఐటీహెచ్ డైరెక్టర్ బీఎస్ మూర్తి తెలిపారు. వినూత్న టెక్నాలజీ ఉపయోగించి, పర్యావరణానికి ఎలాంటి హాని కలగకుండా ఉండే పరిశోధనలు జరుపుతున్నామని వివరించారు. ఐఐటీహెచ్ పరిశోధకులు ప్రపంచ స్థాయికి పరిశోధనలను విస్తరించడం గర్వకారణమని పేర్కొన్నారు.

ఐఐటీహెచ్ పరిశోధకులు అభివృద్ధి చేసిన చిప్‌లు

26/09/2025 | Sangareddy-Medak(Sangareddy Medak District) | Page : 7
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Hans India

Prof B S Murty of IITH appointed head of Indian Institute of Metals

HANS NEWS SERVICE
HYDERABAD

THE Indian Institute of Technology Hyderabad (IITH) is proud to announce the election of its Director, Prof. B. S. Murty, as the President of the Indian Institute of Metals (IIM). IIM is a prestigious professional organisation that represents Metallurgical and Materials Engineering professionals across academia, industry, and research. Prof. Murty's appointment was officially announced during the 79th Annual General Meeting (AGM) of IIM, held recently in Kolkata. He will take office on August 1, 2025.

Prof. Murty succeeds Sajjan Jindal, Chairman and Managing Director of JSW Group, who served as President until now. Prof. Murty is poised to guide IIM toward an ambitious agenda focused on enhancing its scientific and technological impact. In his address at the AGM, he shared his vision for IIM, emphasising the importance of "carrying forward the rich legacy of the organisation while actively advancing its vision and mission."

He says he is committed to enhancing engagement with young professionals and creating dynamic platforms for knowledge sharing, technological dissemination, and cross-sector collaboration. "Strengthening ties between IIM and stakeholders from industry, academia, research institutions, and professional bodies—both nationally and internationally—will be a key priority," he stated.

Prof. Murty's academic and professional journey spans over four decades. He began with a Diploma in Metallurgy in 1983, earned his Bachelor of Engineering from VRCE Nagpur, and obtained his Master's degree and PhD from IISc Bangalore. He has held significant academic positions at IIT Kharagpur and IIT Madras. Since 2019, he has served as the Director of IIT Hyderabad, currently in his second term, which runs through 2030.

Internationally recognised for his contributions to non-equilibrium materials processing and high entropy alloys, Prof. Murty has authored over 500 journal publications, guided 56 PhD students, completed 75 sponsored projects worth Rs 200 crore, and holds more than 15 patents. His accolades include the Shanti Swarup Bhatnagar Award, the National Metallurgist Award, an honorary doctorate from Deakin University, and several lifetime achievement honours.

He is a Fellow of all three Indian science academies and the World Academy of Sciences.

Founded in 1946 with just 42 members, the Indian Institute of Metals now boasts a network of over 10,000 professionals. Under Prof. Murty's leadership, IIM is expected to strengthen India's position as a leader in metallurgy, materials science, and manufacturing technologies.

31/07/2025 HYDERABAD Pg 02

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విద్యార్థుల సాంకేతిక తోడ్పాటు హర్షణీయం

ఐఐటీహెచ్‌లో హ్యాకథాన్ పోటీల్లో బహుమతులు గెలుచుకున్న విద్యార్థులు

● ఐఐటీహెచ్ డైరెక్టర్ బీఎస్ మూర్తి

కంది, సెప్టెంబరు 3 (ఆంధ్రజ్యోతి): బ్యాంకింగ్ రంగంలో విద్యార్థుల సాంకేతిక తోడ్పాటు హర్షణీయమని ఐఐటీహెచ్ డైరెక్టర్ బీఎస్ మూర్తి అన్నారు. బుధవారం ప్రభుత్వ రంగ బ్యాంకుల ఆధ్వర్యంలో బ్యాంక్ ఆఫ్ ఇండియా సహకారంతో కేంద్ర ఆర్థిక సేవల విభాగం కందిలోని ఐఐటీహెచ్‌లో ఫినషీల్డ్ హ్యాకథాన్ గ్రాండ్ ఫినాలే-2025 పోటీలను నిర్వహించారు. మొబైల్ ఇంటర్నెట్ బ్యాంకింగ్‌లో మోసాలను అరికట్టడం, సైబర్ సెక్యూరిటీ సవాళ్లను పరిష్కరించడం వంటి అంశాలపై ఈ పోటీలు జరిగాయి. దేశవ్యాప్తంగా 661 బృందాలు దరఖాస్తు చేసుకోగా, 72 టీమ్‌లను ఎంపిక చేశారు. ఐఐటీహెచ్‌లో జరిగిన పోటీల్లో ప్రతిభ కనబర్చిన 4 టీమ్‌లకు రూ.20లక్షల బహుమతులను అందజేశారు.

04/09/2025 | Sangareddy-Medak(Sangareddy Medak District) | Page : 7
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బిస్లరీతో ఐఐటీహెచ్ ఒప్పందం

● బాటిల్ ఫర్ చేంజ్‌తో ప్లాస్టిక్ రీసైక్లింగ్

కంది, జూలై 24 (ఆంధ్రజ్యోతి): పర్యావరణ పరిరక్షణకు ప్లాస్టిక్ వ్యర్థాలను అరికట్టాలని లక్ష్యంతో బిస్లరీ సంస్థతో సంగారెడ్డి జిల్లా కంది పరిధిలోని ఐఐటీ హైదరాబాద్ గురువారం ఒప్పందం కుదుర్చుకున్నది. ఈ మేరకు ఇరు సంస్థల ప్రతినిధులు ఎంఓయూలపై సంతకాలు చేశారు. ప్లాస్టిక్ వ్యర్థాల రీసైక్లింగ్, విభజన, పారవేయడంపై దృష్టి సారించడం ద్వారా స్థిరమైన వ్యర్థాల నిర్వహణ పద్ధతులను ప్రోత్సహించే దిశగా ఈ సహకారం ఒక ముఖ్యమైన అడుగుగా భావిస్తున్నారు. ప్లాస్టిక్ రీసైక్లింగ్‌ను ప్రోత్సహించేందుకు బాటిల్స్ ఫర్ చేంజ్ చొరవ కింద బిస్లరీతో కలిసి ఐఐటీ హైదరాబాద్ ప్లాస్టిక్ వ్యర్థాలను రీసైక్లింగ్ చేయనుంది. ప్లాస్టిక్ రహిత క్యాంపస్‌ను నిర్మించడమే తమ లక్ష్యమని ఐఐటీహెచ్ డైరెక్టర్ బీఎస్ మూర్తి అన్నారు.

ఒప్పంద పత్రాలను చూపుతున్న ఐఐటీహెచ్ శాస్త్రవేత్తలు బిస్లరీ సంస్థ ప్రతినిధులు

25/07/2025 | Sangareddy-Medak(Sangareddy Medak District) | Page : 6
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'Road widening to go as planned in Cantt'

Times News Network

Hyderabad: The land acquisition department of the Hyderabad Metropolitan Development Authority (HMDA), in a notice on Thursday, informed the residents of the Secunderabad Cantonment Board (SCB) that the 200-ft road widening project for the proposed elevated corridor would proceed as planned.

The notice marks the first official communication from the state govt to the residents. The notices were issued to more than 600 residents who had also approached the high court, seeking judicial intervention to halt the project.

In the notice accessed by TOI, it read: "As per the remarks of the Requisition department, a 60-metre right of way is required to accommodate a six-lane road, pedestrians, stormwater drains, and utility corridors. Thus, the request for the reduction of road width may not be considered at this juncture. Upon consideration of the submissions, the plea of petitioner seeking a reduction in the width of the road is not found tenable and not considered."

HC stays PACS staff transfers, says panel 'violated orders'

Pinto.Deepak
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Hyderabad: The Telangana high court has stayed the transfer of employees of primary agricultural cooperative societies (PACS), holding that the state-level empowered committee (SLEC) issued its circular on transfer guidelines in violation of earlier court orders.

The petitioners had challenged the circular, arguing that it introduced a uniform HR policy and transfer guidelines without inviting objections from affected employees. They contended that the circular ran contrary to constitutional provisions, the Cooperative Societies Act, and guidelines issued by the Reserve Bank of India and Nabard.

Taking note of these submissions, Justice Pulla Karthik observed that the SLEC circular is liable to be set aside. The court directed the respondents, including the Telangana State Co-operative Apex Bank, Nabard, and the district central cooperative banks of Rangareddy, Sangareddy, and Medchal Malkajgiri, to call for objections from those who have not yet joined service or who continue to have grievances regarding their service conditions, and to take a decision thereafter.

"However, in gross violation, the SLEC issued a circular duly approving and providing the guidelines to be followed by the district-level empowered committees for the implementation of the transfer policy, so as to effect transfers," Justice Karthik recorded in his order. The court also issued notices to all respondents, directing them to show cause on or before Oct 7. In the meantime, HC ordered that status quo regarding the transfer policy.

et hall claimed that 'paneer butter masala' was provided instead of 'kanda kaju cur-

ling which it will carry 9% annual interest from the date of the event until payment.

IIIT-H gives voice to tribal languages with AI

Times News Network

Hyderabad: The International Institute of Information Technology Hyderabad (IIIT-H), has given Adi Vaani, an AI-powered translator for tribal languages recently launched by the Centre, its voice. The institute developed text-to-speech (TTS) tools that allow translations to be heard in Santali, Mandari, and Bhili, with work currently underway for Gondi.

The text-to-speech systems were built with the active participation of native speakers, who visited the campus to record speech samples that trained the technology. IIITH is also preparing to expand the effort to Telangana's tribal tongues by developing similar tools for Koya, Kolami, Naikdi, Chenchu, Kaikadi (Yerukala), Lambadi, Nakkala, and Konda Kammara. Along with IIT Delhi, it is one of the lead institutions driving this national initiative.

In addition to the speech tools, researchers at IIITH have built translation systems capable of converting between English, Hindi, and Santali. These were trained using bilingual data provided by the Tribal Research Institute in Odisha and later refined through inputs from native speakers. To ensure wide access, the institute's product labs team deployed the technology on the cloud, enabling usage across devices. "This is a social initiative project that we are proud to be associated with," said Radhika Mamidi, who led IIITH's efforts in the project.

She noted that the current models are still in Beta but will continue to improve with more feedback from users. IIITH is also working to enrich online content in Telangana-origin languages through its Indic-Wiki summer internship programme.

Bridging digital divide

With over 700 tribal communities across India, experts believe initiatives like Adi Vaani could be crucial in preserving endangered languages while making education, healthcare, and govt services more accessible. By bringing together AI research and indigenous knowledge, the project aims to bridge the digital divide and ensure these voices are not lost in a technology-driven future.

'PRESERVING ENDANGERED LANGUAGES'

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- Text-to-speech systems built with active participation of native speakers
- They visited campus to record speech samples that trained the technology
- Researchers also built translation systems capable of converting between English, Hindi, and Santali
- To ensure wide access, labs team deployed technology on cloud, enabling usage across devices

ABN ఆంధ్రజ్యోతి

దేశంలోని అత్యుత్తమ ఇంజినీరింగ్ విద్యాసంస్థల జాబితాలో సంగారెడ్డి జిల్లా కంది పరిధిలోని ఐఐటీ హైదరాబాద్ నిలిచింది. కేంద్ర మంత్రిత్వ శాఖ విడుదల చేసిన ఎన్ఐఆర్ఎఫ్ (నేషనల్ ఇన్‌స్టిట్యూట్ ఆఫ్ ర్యాంకింగ్స్ ఫ్రేమ్ వర్క్)-2025 ర్యాంకింగ్స్‌లో ఏడో స్థానంలో నిలిచి సత్తా చాటింది. అంతేగాక ఓవరాల్ ర్యాంకింగ్స్‌లో 12 స్థానం దక్కించుకున్నది.

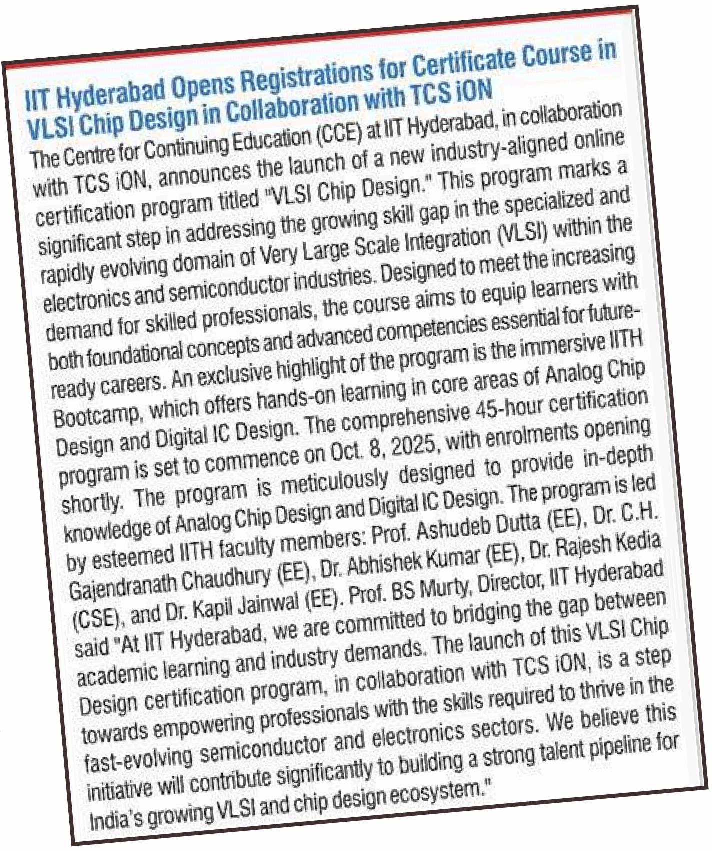
ఐఐటీ హెచ్..మరో మైలురాయి

అత్యుత్తమ విద్యాసంస్థల జాబితాలో చోటు

ఎన్ఐఆర్ఎఫ్-2025 ర్యాంకింగ్స్‌లో ఏడో స్థానం

ఓవరాల్ ర్యాంకింగ్స్‌లో 12 స్థానం కైవసం

16/09/2025 | Sangareddy-Medak(Sangareddy Medak District) | Page : 7
Source : https://epaper.andhrajyothy.com



IIT Hyderabad Opens Registrations for Certificate Course in VLSI Chip Design in Collaboration with TCS iON

The Centre for Continuing Education (CCE) at IIT Hyderabad, in collaboration with TCS iON, announces the launch of a new industry-aligned online certification program titled "VLSI Chip Design." This program marks a significant step in addressing the growing skill gap in the specialized and rapidly evolving domain of Very Large Scale Integration (VLSI) within the electronics and semiconductor industries. Designed to meet the increasing demand for skilled professionals, the course aims to equip learners with both foundational concepts and advanced competencies essential for future-ready careers. An exclusive highlight of the program is the immersive IITH Bootcamp, which offers hands-on learning in core areas of Analog Chip Design and Digital IC Design. The comprehensive 45-hour certification program is set to commence on Oct. 8, 2025, with enrolments opening shortly. The program is meticulously designed to provide in-depth knowledge of Analog Chip Design and Digital IC Design. The program is led by esteemed IITH faculty members: Prof. Ashudeb Dutta (EE), Dr. C.H. Gajendranath Chaudhury (EE), Dr. Abhishek Kumar (EE), Dr. Rajesh Kedia (CSE), and Dr. Kapil Jainwal (EE). Prof. BS Murty, Director, IIT Hyderabad said "At IIT Hyderabad, we are committed to bridging the gap between academic learning and industry demands. The launch of this VLSI Chip Design certification program, in collaboration with TCS iON, is a step towards empowering professionals with the skills required to thrive in the fast-evolving semiconductor and electronics sectors. We believe this initiative will contribute significantly to building a strong talent pipeline for India's growing VLSI and chip design ecosystem."

Prof B S Murty, Director, IIT Hyderabad, has been appointed as President of the Indian Institute of Metals (IIM)

The 14th Convocation of IITH was graced by Shri Ashwini Vaishnaw, Hon'ble Union Minister of Railways, Information & Broadcasting, and Electronics & Information Technology, Government of India

14th Convocation

1273 degrees were conferred in the 14th convocation ceremony

IIT Hyderabad successfully organized the Hindi Pakhwada Celebrations and Competitions – 2025, promoting the use and importance of Hindi in official communication

79th Independence Day Celebrations at IIT Hyderabad

A delegation from IIT Hyderabad and Ubon Ratchathani University, led by Dr. Piyanat Soikham, met Amb. Nagesh Singh to discuss cultural and academic collaborations, marked by the special presentation of a replica of the Ardhanareeswara statue

SPIC MACAY IIT Hyderabad successfully hosted the Yakshagana performance by Keremane Shivanand Hegde and his group

The stage play “Aanand” was successfully conducted at IIT Hyderabad

IIT Hyderabad Successfully conducted Plantation Drives

Plantation Drive for the month of July

Plantation Drive for the month of August

Plantation Drive for the month of September

Hon'ble Minister Shri Ashwini Vaishnaw visited TiHAN at IIT Hyderabad and witnessed a live demonstration of cutting-edge autonomous mobility innovations

A distinguished delegation of U.S. Government officials visited IIT Hyderabad

IIT Hyderabad Faculty Meet 2025

IIT Hyderabad Department of Design hosted Canvas of Time, an exhibition showcasing their paintings and artworks

CAE Lab Inauguration at IITH – supported by Collins Aerospace CSR initiative

“Review Spotlight: Opportunities in Cancer Metastasis Research”

IIT Hyderabad Biotechnology researchers identified a significant opportunity in cancer research: while calcium signalling drives tumor spread across multiple cancer types, the scientific community has underutilized zebrafish xenograft models to study these crucial mechanisms.

This work serves as both a knowledge foundation and strategic roadmap. It helps scientists identify high-impact research directions while guiding them toward unexplored opportunities in calcium biology and cancer using the merging zebrafish xenograft model.

Principal investigator

Prof Rajakumara Eerappa
Department of Biotechnology

Co-Investigator

Prof Jyotsnendu Giri
Department of Biotechnology

IIT Hyderabad successfully observed the Swachhata Pledge Ceremony as part of the Swachhata Hi Sewa Campaign under the theme 'Swachhotsav'.

IIT Hyderabad successfully conducted the 'Ek Din, Ek Ghanta, Ek Saath' cleanliness drive on 25th September 2025

IIT Hyderabad successfully conducted the 'Ek Din, Ek Ghanta, Ek Saath' cleanliness drive on 25th September 2025

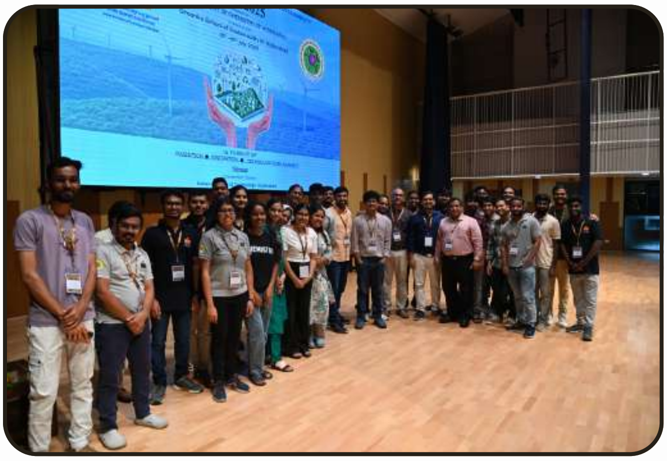
IIT Hyderabad and Hokkaido Government are exploring innovation partnerships in the areas of AI, telecom infrastructure, and embedded systems

IIT Hyderabad warmly welcomed the Mayor of Hamamatsu City to strengthen academic and cultural collaborations

Grand Finale of FinShield Hackathon 2025 Concludes Successfully at IIT Hyderabad

IIT Hyderabad hosted the Orientation Program – 2025, the welcoming a new wave of scholars ready to innovate, explore, and lead

The International Conference on Chemistry for Sustainability (ICCS 2025), organized by the Department of Chemistry, IIT Hyderabad, was successfully conducted from 13th to 16th July 2025.



Japan Co-Research Day @ IIT Hyderabad

Baithak brought the campus together for a soulful retro-themed sing-along evening, celebrating the timeless magic of Bollywood classics

NSS IIT Hyderabad organized a Blood Donation Camp with Niloufer Blood Bank on 15th August

IIT Hyderabad successfully celebrated National Space Day

Prof B S Murty, Director, IIT Hyderabad, Welcomed the New IITH Alumni Association Executive Committee 2025-27

"The Suzuki Next Bharat Research Fellowship 2025 has been successfully conducted, fostering impactful solutions for India's rural and informal sectors."

IIT Hyderabad Hosted Japan Career Day 2025

Inauguration of the Office of Career Services at IIT Hyderabad

A Delegation visit comprising the senior administrators of various Educational Institutions from Coimbatore, under the banner of the CII Coimbatore Chapter to the state-of-the-art Research facilities at IITH

IIT Hyderabad proudly hosted the Mass Pledge Against Drug Abuse under "Nasha Mukt Bharat Abhiyaan" Organised by The Ministry of Social Justice & Empowerment, Government of India

The Global Leadership Program team visited IIT Hyderabad, engaging with the institute's vibrant academic and innovation ecosystem.

Students from DAV School visited the IITH Library, gaining insightful exposure to its rich academic resources and learning environment

The second edition of the international conference Phoenix 2025 was successfully held from 9th to 11th July 2025

IITH successfully conducted the workshop 'You vs Your Device: Digital Well-being' by Mr Bala Kishore

The Department of CSE IITH successfully conducted the ROCA 2025 workshop, focusing on Research Opportunities in Computer Architecture

Session on Fundamentals of Lean Startup Approach by Dr Jayshree Patnaik, Dr Lohithaksha M Maiyar, Dr Nakul Parameswar & Dr M.P. Ganesh

The visit of Shri Sarfaraz Ahmad, IAS, HMDA Commissioner, to IITH's Center for GeoSpatial AI and Digital Twins (CGDT) was successfully conducted, marking the start of a promising collaboration for smart urban planning

Workshop on Pharma & Biopharma: How these work in industry by Mr Bedadyuti Chakraborty, Director, RxCella

The Department of Civil Engineering, IITH, hosted the National Symposium on Porous Media Research, bringing together experts and researchers for insightful discussions

Prof. B.S. Murty, Director IITH, Inaugurates Sports Injury Prevention Program

The Annual Symposium on Advances in Materials Characterization was successfully conducted at SATHI-CISCoM, IIT Hyderabad

Dr Sano Hiroshi from Mitsubishi Chemical Corporation visited IITH and delivered an open lecture on "India-Japan Collaboration toward Sustainability—Focusing on Chemicals and Plastics"

The Incubator Development Program (IDP), organized by IIC and iTIC Incubator at IITH, was successfully held

IITH's Institution's Innovation Council (IIC) successfully conducted the Quarter-IV Meeting

Global Young Scientists Conference inaugurated by Shri Dharmendra Pradhan, Hon'ble Union Minister of Education, GoI

The IEEE PELS PhD Summer School, hosted by the Department of Electrical Engineering at IIT Hyderabad, was successfully conducted from 19th to 23rd July 2025

Session on Angel Investment/ VC Funding Opportunity for Early-Stage Entrepreneurs by Mr Gaurav DahakeCo-founder and COO of Frinks AI

Fireside chat by Mr Anup Gupta, founder and CEO of MathonGo

Session on Exploring Smart Grid Research and Career Opportunities byDr Ramakrishna Kappagantu, Independent Consultant

IITH signed an MoU with the Army Training Command to establish VIGRAHA, a Centre of Excellence for AR/VR, AI, robotics, drones, and advanced defense technologies, fostering Atmanirbhar Bharat in defense innovation

IITH has partnered with Bisleri International Pvt Ltd to Implement the 'Bottles for Change' sustainability initiative on campus

IITH and Granules India Ltd. Establish "Dr Krishna Prasad Chigurupati Chair Professorship" in Process Automation

MoU Signed Between IITH and Maithri Aquatech R&D for Nature-Based Water Solutions

Prof Suryanarayana Jammalamadaka

Department of Physics

Elected as Fellow of the Royal Society of Chemistry (FRSC)

Prof C Malla Reddy

Department of Chemistry

elected as Fellow of the Indian Academy of Sciences (FASc)

Dr Mayur Vaidya

Department of Materials Science & Metallurgical Engineering

Elected as aAssociate Fellow of Indian National Science Academy (INSA - 2025)

Prof Vineet N Balasubramanian

Department of Computer Science & Engineering

honored with the Prestigious National Award to Teacher (NAT-2025) by the Department of Higher Education, Ministry of Education, Government of India

Dr Amrita Datta

Department of Liberal Arts

Selected for the Elizabeth Adiseshiah Award 2025

Dr Suryasnata Tripathy

PhD scholar, Department of Electrical Engineering

Appointed as an Assistant Professor in the Department of Biomedical Engineering at IIT Ropar

Prof Kiran Kumar Kuchi

Department of Electrical Engineering

Elected as Fellows of the Indian National Academy of Engineering (FNAE) 2025

Ms Swapna Bhattu

PhD scholar Department of Chemistry

Received The Best Oral Presentation Award - cash prizeand RSC membership at the Joint conference of 10th Asian Pacific Congress on Catalysis (APCAT-10)

Prof Kirti Chandra Sahu

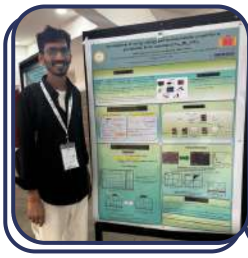
Department of Chemical Engineering

Elected as Fellows of the Indian National Academy of Engineering (FNAE) 2025

Mr B Bangarraju

PhD scholar, Department of Mechanical & Aerospace Engineering

Received The Second Prize in the Bharat Ratna Dr A P J Abdul Kalam Best Student Technical Paper Award for poster presentation at The International Conference and Exhibition on Advanced Materials and Structures (ICEAMS 2025)



Mr Sumit Kumar Mev

Post Doctoral Researcher, Department of Physics

Won The Best Poster Award at the IEEE–South Asia Ferroelectric Symposium 2025 held at IISc Bangalore

Mr Ranjan Kumar Sahu

Post Doctoral Researcher, Department of Physics

Won The Best Poster Award at the IEEE–South Asia Ferroelectric Symposium 2025 held at IISc Bangalore

Ms Swarubini P J

PhD scholar
Department of Biomedical Engineering

Selected The Prestigious TCS Fellowship Awards

Ms Madhumitha V

PhD scholar
Department of Artificial Intelligence

Selected The Prestigious TCS Fellowship Awards

Ms Lakshmi Raja

MSc in Medical Physics

Received the prestigious Maitri Scholarship Award at The Australian National University (ANU) in Canberra

Mr Aditya Patankar

MDes Student Department of Design

Received the India's Best Design Student Award 2025

Dr Santhosh Sivasubramani

IITH Alumnus Department of Electrical Engineering

Appointed as Faculty in the Centre for Sensors, Instrumentation and Cyber Physical Systems Engineering, IIT Delhi

Dr Satyabrata Mahapatra

IITH Alumnus Department of Electrical Engineering

Appointed as Assistant Professor in the School of Physical Sciences, Indian Institute of Technology Goa (IIT Goa)

Mr Sahil Dhiman

IITH-Deakin joint ID-PhD student, Department of Mechanical & Aerospace Engineering

Received the Bursary Award by Materials Australia for his presentation on Additive Manufacturing at the 4th Asia-Pacific International Conference

Mr R S Anandu

PhD scholar, Department of Physics

Received the Best Poster Prize at the 51st EPS conference in Plasma Physics held in Vilnius, Lithuania

Dr Uday Roopavath

IITH Alumnus, Department of Biomedical Engineering

Appointed as Assistant Professor at IIT Jammu

Faculty

Dr Md Haseen Akhtar

Assistant Professor
Department of Design

Dr Md Haseen Akhtar has been appointed as an Assistant Professor in the Department of Design, IIT Hyderabad. Prior to joining IITH, Dr Md Haseen Akhtar was a Postdoctoral Researcher (FARE Fellow) from November 2024 till present at the Department of Design, IIT Kanpur. Dr Md Haseen Akhtar did his BArch from NIT Trichy (Gold Medalist) and obtained his MDes and PhD in Design degrees from the Department of Design, IIT Kanpur. During his PhD, he was a Fulbright Nehru Fellow at the Jacobs Institute for Design Innovation and Department of Architecture, CED at UC Berkeley, USA. His research interests are in the fields of Healthcare Infrastructure and Services Design, (more than) Human Centred Design, Design with Emerging Technologies (XR and AI), Human Computer Interaction (HCI), and Design for Global Health.

Dr Kuchibhatla Sai Aditya Raman

Assistant Professor
Department of Mechanical and Aerospace Engineering

Dr Kuchibhatla Sai Aditya Raman has been appointed as an Assistant Professor in the Department of Mechanical and Aerospace Engineering, IIT Hyderabad. Prior to joining IITH in 2025, Dr Aditya was a Postdoctoral Fellow in the Smart Structures and Dynamical Systems Lab (SSDSL) at Georgia Institute of Technology. He did his PhD at Georgia Tech, Atlanta, USA, has an MS (Research) from IIT Madras, and a BTech (Mech) from NIT Karnataka, Surathkal. His research interests are in the fields of dynamics, acoustics, metamaterials, and smart structures.

Dr Pranav Ashok Satpute

Assistant Professor
Department of Design

Dr Pranav Ashok Satpute has been appointed as an Assistant Professor in the Department of Design, IIT Hyderabad. Prior to joining IITH, Dr Pranav was an Associate Professor at ADYP University, Pune. Earlier, he worked with Valmont Industries Inc, Pune, as Deputy Product Manager in Industrial Design and New Product Development. Dr Pranav completed his BE from Pune University and obtained his MDes and PhD degrees from IIT Guwahati. His research interests include Industrial Design, Design Innovation, New Product Development, and Design for Social Impact.

Dr Sandipan Dandapat

Associate Professor
Department of Computer Science and Engineering

Dr Sandipan Dandapat has been appointed as an Associate Professor in the Department of Computer Science and Engineering, IIT Hyderabad. Prior to joining IITH in 2025, Dr Dandapat was a Principal Applied Researcher at Microsoft India since 2016 and worked as a Research Scientist at Xerox Research Centre India from 2015 to 2016. Before moving to industry, he was an Assistant Professor in the Department of CSE at IIT Guwahati. He completed his Master’s degree at IIT Kharagpur in 2008 and obtained his PhD from Dublin City University. His research interests span a broad spectrum of Natural Language Processing and Generative AI, including their theoretical foundations and practical implementations.

Dr Krishan Kanhaiya

Assistant Professor
Department of Chemical Engineering

Dr Krishan Kanhaiya has been appointed as an Assistant Professor in the Department of Chemical Engineering, IIT Hyderabad. Before working at IIT Hyderabad, he was a postdoctoral fellow at the Institute for Theoretical Physics, Ruhr Universität Bochum, Germany. Dr Krishan did his BTech from IIT Kanpur, UP, and obtained his MS and PhD degrees from the University of Colorado, Boulder. His research interests are in the fields of atomistic simulation, multiscale modelling, solvation dynamics, and interfacial phenomena.

Dr Subhojit Kadia

Assistant Professor
Department of Civil Engineering

Dr Subhojit Kadia has been appointed as an Assistant Professor in the Department of Civil Engineering, IIT Hyderabad. Prior to joining IITH, he was a Postdoctoral Researcher at the Technical University of Munich (TUM), Germany, from 2024. He did his BE from Jadavpur University and obtained his MTech from IIT Roorkee and his PhD from NTNU, Norway. His research interests are in the fields of experimental and computational hydraulic engineering. Prior to PhD, he served as an Assistant Engineer at WBSEDCL, primarily in the hydropower section, for about 5 years.

Non-Teaching Staff

Mr Naveenprasath

Junior Technician
Department of Biotechnology

Mr Naveenprasath has pursued BSc in Zoology from PSG College of Arts and Science, Coimbatore, Tamil Nadu, a Diploma in Bioinformatics from Bharathiar University, Tamil Nadu, and MSc Zoology at Bharathidasan University, Tamil Nadu.

Mr Shri Jatin Sharma

Technical Superintendent
Department of CSE

Mr Jatin Sharma completed his MTech in Computer Science and Engineering from VNIT Nagpur, specializing in Cybersecurity and Server Management. He earned his BTech in Information Technology from Himachal Pradesh University. With over four years of experience as a Technology Analyst at Infosys, he has worked extensively on Firewalls, Servers, SIEM Solutions, Vulnerability Management, and Incident Response. He is skilled in tools such as Palo Alto, Microsoft Sentinel, and Rapid7 XDR, and has developed projects on MitM Detection, Data Leak Prevention, and ERP/CRM Solutions. A PCNSA and Certified Network Security Specialist, he has also published research on DDoS Attack Modeling. His interests include Network Security, Intrusion Detection, and Server Infrastructure Management.

Mr M Rajashekar

Executive Assistant
Stores and Purchase Section

Mr Rajashekar holds a BTech in Electronics and Communication Engineering from Rajiv Gandhi University of Knowledge Technologies, Basara. He has over 8 years of experience in the Banking Sector as a Probationary Officer (Scale I), where he gained extensive expertise in Customer Service, Operations, and Financial Administration.

Following his Banking tenure, he joined IIT Hyderabad as a Junior Assistant, where he has been contributing for over a year, supporting Administrative Tasks, Academic Coordination, and Departmental Operations with efficiency and professionalism.

Mr Chinmaya Kumar Pradhan

Accountant
SRC

Mr Chinmaya Kumar Pradhan has completed MCom in Finance Specialization & BCom (Accountancy Honours) from Utkal University and also accomplished the Intermediate Stage of Cost & Management Accountant Course (CMA Inter) from ICMAI. At the beginning of his career, he joined a CA firm as an Audit Assistant. Later, he worked in Educational, Medical Science Research, & Social Welfare Institutions in his domain. A couple of years back, he was appointed as an Accounts Officer in IITH under a project and was later selected as an Accountant in IITH. He has more than eight years of experience in the field of Maintaining & Developing Account Records, Financial Reporting, Project funding, Budgeting & Forecasting, Compilation of Financial Statements, UC-SOE & Audit Compliance, Store & Procurement. He has good experience in the Accounting Software (Tally & ZOHO) and System (PFMS), etc. His areas of interest are the use of AI & Analytics in preparing Accounting Reports, Financial Management, and Cost Analysis. He has also completed some valued Online Courses – Diploma in Business Valuation & AI and Analytics in Business Valuation from ICMAI RVO (Registered Valuers Organization) this year.

Mr Praveen Kumar Gaddam

Junior Technical Superintendent
Dept of CSE

Mr Praveen Kumar Gaddam completed his B.Tech in Computer Science and Engineering from JNTU Hyderabad (2009). He has over 13 years of experience in System Administration, IT Infrastructure Management, and Technical Support. From February 2023 to August 2025, he worked as a Junior Technician in the CSE Department at IIT Hyderabad, actively contributing to Data Center Operations, Server and Network Administration, IT Lab Management, and Infrastructure Support. During this time, he developed a strong interest in AI Technologies for automating IT resources and gained hands-on experience with DevOps Practices. He also served as a System Administrator at TiHAN Foundation, IIT Hyderabad (March 2023 – February 2024), managing IT Infrastructure and supporting Research-Driven Projects. Previously, he spent 10 years at Acharya Degree College, Zaheerabad (June 2012 – June 2022), where he held multiple roles including System Administrator, Lab In-Charge, NSS Program Officer, and Tutor for subjects such as C, C++, Java, SQL, Linux, and DevOps Tools. This experience strengthened his Technical Skills, Leadership Capabilities, and Academic Involvement. He is certified in Linux Administration and CCNA, and is known for his proactive approach and enthusiasm for continuous learning. With a solid foundation in Systems, Networks, DevOps, and Automation, he remains committed to leveraging Technology and AI Solutions to enhance efficiency, support departmental objectives, and drive long-term growth

Mr Syed Omer Ali

Junior Technician - Draughtsman Civil (CMD)

Mr Syed Omer Ali has done an ITI in Draughtsman Civil from the Government ITI Sangareddy, Apprenticeship from BDL Bhanur, and also done Auto CAD from the Government of Andhra Pradesh, Sangareddy. He worked in IITH in Project Mode in the Construction and Maintenance Division for the last 7 years. He has more than 12 years of experience preparing Architectural Drawings using AutoCAD software for all types of Construction Capital Works. He is certified in Auto CAD & the National Academy of Construction (NAC).

Mr Ragolu Kiran

Executive Assistant
Stores and Purchase Section

Mr Ragolu Kiran has done BTech in Mechanical Engineering from MVGR College of Engineering, Vizianagaram, Andhra Pradesh. He has altogether 8 years of experience in the field of Procurement of Goods and Services through GeM Portal and Tenders, Dealing with Annual Maintenance Contracts, Stores, Inventory Management and Record Keeping, Local Purchase, Local Audits Coordination, Contract Management, Administration and Accounts, Bills and Work Slips Preparation, Logs of Stores, Equipment's and Grievances Management, Reports and O & M, Quality Control Inspections as per IS Codes, Disposal of Materials etc. His areas of interest are Stores and Purchase, Administration, Engineering Departments and any other fields. He has knowledge in MS Office, GeM and Complete Mechanical Suite.

Mr G Saidulu

Executive Assistant
HR Section

Mr G Saidulu completed his Master's in Bio-Technology in 2010 and a Postgraduate Diploma in Bio-Informatics, both from Osmania University, Hyderabad. He has altogether 14 years of comprehensive experience spanning Administration, Quality Control Operations, Stores & Purchase, and Inspection of Storage Depots. His core strength lies in Food Grain Storage Management, with strong expertise in Handling, Preserving, and Monitoring the Quality of Stored Grains in compliance with Regulatory Norms, particularly within the framework of the Public Distribution System (PDS).

Mr Jiban Jyoti Palai

Junior Technician
Central Workshop

Mr Jiban Jyoti Palai has done Diploma in Mechanical Engineering from Govt. Polytechnic Kendrapada. He has more than 4.5 years of experience in Programming, Designing, Operating, and Setting up VMC, HMC, CNC and Manual Machines (Lathe). He is a former employee of Tata Sikorsky Aerospace Limited, where he operated CNC Machines. He also worked as a Trainer at the Central Tool Room & Training Centre, Bhubaneswar, where he was involved in imparting training to students in all regular and long-term courses on CNC Turning and Milling Machines. Mr. Jiban Jyoti Palai can be reached at the email id- jibanjyoti.palai@admin.iith.ac.in

Mr B D Manikanta Swami

Accountant, CCE

Mr G B D Manikanta Swami earned his qualification from the Institute of Cost Accountants of India (ICMAI) in 2021. He has over 10 years of professional experience in Auditing, Taxation, and Accounting. Throughout his career, Mr. Swami has developed strong expertise in handling complex Financial Audits, Tax Compliance, and Accounting Practices. His in-depth knowledge and practical experience enable him to provide valuable insights and effective Financial Solutions, making him a respected figure in his field.

Mr Sachin S. V.

Junior Technician
Computer Center

Mr Sachin S V has completed Diploma in Computer Engineering from the Technical Education Board, Kerala. Upon completion of his studies, he began his career as a System Administrator at Bizarre Power Solutions. He was later selected as an IT Support Engineer at the Indian Institute of Management Kozhikode (IIM Kozhikode). He has more than 8 years of experience in the field of System Administration, IT Support, Admission Process Automation, CAT Data Processing, Linux Administration, and Computer Hardware Maintenance.

Ms Kathala Sreevidya

Junior Technician
Chemical Engineering

Ms Kathala Sreevidya holds a Bachelor's Degree in Chemical Engineering from AP IIIT RGUKT RK Valley and a Master's Degree (MTech) in Chemical Engineering from Sri Venkateswara University, Tirupati. She was appointed as an Assistant Professor in the Department of Chemical Engineering at AP IIIT RGUKT RK Valley, where she served for two years. During her tenure, she actively contributed to Academic Instruction and various Departmental Activities. Her academic background and teaching experience reflect a strong foundation in Chemical Engineering and a dedicated commitment to Higher Education.

◆

Anecdote of the Cover Page

The cover artwork celebrates the richness of Indian heritage through vibrant symbolism. The background is inspired by Kashmiri Pashmina and Kani shawls—renowned for their intricate patterns, vivid colors, and royal legacy.

At the forefront, a figure writes on a circular stone tablet, echoing ancient traditions of inscribing knowledge on enduring materials. Together, the composition honors the timeless journey of craftsmanship, wisdom, and innovation—from heritage to modern science.

భారతీయ సాంకేతిక విజ్ఞాన సంస్థ హైదరాబాద్
भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology Hyderabad

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