

# Purnendu

Curriculum Vitae (updated: January 9, 2024)

✉ purnendu.connect@gmail.com | 🌐 www.purnendu.in | 🌐 purnendoo | Orcid: 0000-0002-1323-8873

## Research Interests

Wearable Technologies. Soft Actuators and Sensors. Haptics. Human-machine Interaction. Augmented and Virtual Reality. Computational Fabrication. Additive Manufacturing. Nanomaterials. Graphene. My research envisions creating interactive machines rooted in material science.

## Education

### University of Colorado Boulder

PH.D. (INTERDISCIPLINARY ENGINEERING/ CREATIVE TECHNOLOGIES AND DESIGN)

Boulder, Colorado, USA

Aug. 2018 - Dec. 2023

- Dissertation: *Dadhichi- Electrostatic Manipulation of Soft Matter for Rendering Reality*
- Co-Advisors: *Gregory Whiting* (Mechanical Engineering) and *Carson Bruns* (Mechanical Engineering)

### Indian Institute of Technology, Roorkee (IIT Roorkee)

INTEGRATED M.Sc. (PHYSICS)

Roorkee, India

Jul. 2013 - Jun. 2018

## Experience

### Meta Inc. (Reality Labs Research)

RESEARCH INTERN / CONTRACT RESEARCHER

Redmond, Washington, USA

Jan 2022 - Dec 2022

- Designed and built a soft wearable haptic device for the fingertip for Mixed Reality environments. Work resulted in a patent and publication.

### Max Planck Insitute for Informatics

VISITING RESEARCHER

Saarbrücken, Germany

Dec. 2017 - April 2018

- Designed and Constructed Acoustic Metamaterials for Ultrasonic sensing.

### Log 9 Materials

CO-FOUNDER AND CTO

Roorkee, India

Sept. 2015 - Oct. 2016

- Developed graphene-nanotechnology based commercial applications on a wide variety of projects.

### Bauhaus University

RESEARCH INTERN

Weimar, Germany

May 2017-Jul. 2017

- Built soft robotic TUI (Tangible User Interfaces) exploring ultrasonic sensing

### Design Studio, IIT Roorkee

CO-FOUNDER AND PRESIDENT

Roorkee, India

July 2016 - May 2017

- Design Studio, is the design club at IIT Roorkee. I co-founded the group and lead it from its inception as the founding President.

### UI/UX Designer

FREELANCE

India

Dec. 2013 - May 2015

- Managed a wide variety of cross-media projects involving branding, illustrations, animations, products, UI-UX design, and development for startups (Inst-E-Shop, AAYUU.com, to name a few) as well as industry leaders.

## Publications

[6] **Electric Field Guided Fabrication of Multi-Functional Sensors on Soft Surfaces.** Purnendu, Madhur Atreya, Teis Hart, Gregory Whiting, Carson Bruns. *[Under submission to Advanced Functional Materials (Wiley), 2023.]*

[5] **Fingertip Wearable High-resolution Electrohydraulic Interface for Multimodal Haptics.** Purnendu, Jess Hartcher-O'Brien, Vatsal Mehta, Nicholas Colonnese, Aakar Gupta, Carson Bruns, and Priyanshu Agarwal. *In Proc. of IEEE World Haptics Conference (WHC), 2023, pp. 299–305.*

[4] **Electriflow: Augmenting Books With Tangible Animation Using Soft Electrohydraulic Actuators.** Purnendu, Sasha Novack, Eric Acome, Mirela Alistar, Christoph Keplinger, Mark D. Gross, Carson Bruns, and Daniel Leithinger. *In Special Interest Group on Computer Graphics and Interactive Techniques Conference Labs (SIGGRAPH '21 Labs), August 09-13, 2021. ACM, New York, NY, USA, 5 pages. <https://doi.org/10.1145/3450616.3464523>*

[3] **Electriflow: Soft Electrohydraulic Building Blocks for Prototyping Shape-changing Interfaces.** Purnendu, Sasha Novack, Eric Acome, Christoph Keplinger, Mirela Alistar, Mark D. Gross, Carson Bruns, and Daniel Leithinger. *In Designing Interactive Systems Conference 2021 (DIS '21), June 28-July 2, 2021, Virtual Event, USA. ACM, New York, NY, USA, 10 pages. <https://doi.org/10.1145/3461778.3462093>*

[2] **Soft Electrohydraulic Actuators for Origami Inspired Shape-Changing Interfaces.** Purnendu, Eric Acome, Christoph Keplinger, Mark D. Gross, Carson Bruns, and Daniel Leithinger. *In CHI Conference on Human Factors in Computing Systems Extended Abstracts (CHI '21 Extended Abstracts), May 8–13, 2021, Yokohama, Japan. ACM, New York, NY, USA*

[1] **Graphene-Based 3D Xerogel as Adsorbent for Removal of Heavy Metal Ions from Industrial Wastewater.** [Purnendu](#), Soumitra Satapathi, 5, 2, 96-102, 2017, Journal of Renewable Materials.

## Patents

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[4] **Systems and Methods of Generating High-density Multimodal Haptic Responses Using an Array of Electrohydraulic-controlled Haptic Tactors, and Methods of Manufacturing Electrohydraulic-controlled Haptic Tactors for Use Therewith.** Priyanshu Agarwal, [Purnendu](#), [United States Provisional Patent, App No. 63/404,164, Filed: September 6, 2022 (pending)]

[3] **Method and apparatus for multi-material, battery-powered, Palmtop 3D-Printing.** [Purnendu](#), Carson Bruns, Mark D Gross [Provisional Patent Application No 63/283,873, Filed: 2021 (pending)]

[2] **A graphene based tobacco smoke filter and a method for synthesizing graphene composition.** Akshay V. Singhal, [Purnendu](#) [WO 2017187453 A1]

[1] **Device and method for real-time thickness controlled spin-coating.** Nipun Sawhney, [Purnendu](#), Soumitra Satapathi [E-106/43/2016/DEL/201611039173 - (pending)].

## Posters

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[1] **Graphene-Chitosan Xerogel for Heavy Metal Ion Removal.** [Purnendu](#), Soumitra Satapathi, International Conference On Nanoscience and Technology (ICONSAT), 2016, IISER PUNE]

## Selected Press

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- 2021 **TechExplore** , Origami comes to life with new shape-changing materials
- 2021 **Hackster.io** , New Shape-Changing Materials Come to Life Using Artificial Muscles
- 2021 **Science Daily** , Origami comes to life with new shape-changing materials
- 2021 **Electronics Weekly** , Electro-hydraulic actuator animates soft mini-robots
- 2021 **The Institution of Engineering and Technology** , Paper-thin origami-like artworks wriggle, flutter and bend
- 2021 **Archinect** , Electrifiow taps advancements in soft robotics to create mechanisms that operate without traditional machine parts
- 2016 **The Times of India** , IIT-R researcher develops cigarette filter that eliminates most chemicals from smoke

## Invitations and Talks

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**University of Wisconsin Madison:** Hosted by James Pikul, Sept. 2023;  
Title: Electrohydraulic Machines for Soft-matter Manipulation

**University of California Los Angeles:** Hosted by Qibing Pei, May 2023;  
Title: Inventing Soft Things to Solve Hard Problems

**John Hopkins University:** Hosted by David Gracias, May 2023;  
Title: Electrohydraulic Machines for Soft-matter Manipulation

**Boston University:** Hosted by Keith Brown, March 2023 ;  
Title: Soft Electrohydraulic Machines for Material Manipulation

**Indian Institute of Science:** Hosted by Amaresh Chakrabarti, June 2023;  
Title: Towards Mobile 3D-Printing: Reimagining Personal Fabrication

**Indian Institute of Technology, Gandhinagar:** Hosted by Vineet Vashista, June 2023;  
Title: Inventing Soft Things to Solve Hard Problems

**Indian Institute of Technology, Patna:** Hosted by Karali Patra, June 2023;  
Title: Inventing Soft Things to Solve Hard Problems

**University of Colorado, Boulder:** ATLAS Seminar, hosted by Ellen Yi-Luen Do, November 2021;  
Title: Mobile 3D-Printing: Reimagining Personal Fabrication

**University of Colorado, Boulder:** ATLAS Seminar, hosted by Ellen Yi-Luen Do, April 2020;  
Title: Manipulating Shape of Things to come: Folding and Self Assembly

**University of Colorado, Boulder:** Statistics, Optimization and Machine Learning Seminar, hosted by Stephen Becker, Oct. 2019,  
Title: The mathematical secrets of Computational Origami.

**NITTTR Chandigarh (India),** Short-term program on Make-In-India-Issues and Challenges, Nov. 2017; Future of Graphene in manufacturing.

**Make-In-India Week,** Mumbai (India), Feb. 2016; Special Invitee.

## Reviewer

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**Journals:** Advanced Functional Materials, Advanced Science, Small Methods, Advanced Materials Technologies, Advanced Healthcare Materials, Macromolecular Rapid Communications, Nano Select, Chemistry Select, Chemistry Open

**Conferences:** ACM CHI 2019, 2020, 2021, 2024; ACM DIS 2021; ACM TEI 2024

## Awards and Honors

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- 2023 **Graduate School international Travel Grant** , University of Colorado Boulder
- 2023 **ATLAS Travel Grant** , University of Colorado Boulder
- 2023 **Special Recognition for Outstanding Reviews** , ACM Conference on Human Factors in Computing, 2024
- 2022 **Beverly Sears Graduate Student Grant** , University of Colorado Boulder
- 2021 **Special Recognition for Outstanding Reviews** , ACM Conference on Designing Interactive Systems, 2021
- 2018 **Dean's Scholarship** , University of Colorado Boulder
- 2013-18 **Inspire Scholarship for Higher Education (SHE)** , Ministry of Education, Govt. of India

## Mentoring

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**Teis Hart:** Undergraduate student in Mechanical Engineering, University of Colorado Boulder; Project: Designing a miniature 3D Printer

**Aniket Agarwal:** Master's Student in Creative Technology and Design, University of Colorado Boulder

**Marian Baldonado:** Master's student in Creative Technology and Design, University of Colorado Boulder

**Cassidy Jensen:** Undergraduate student in Creative Technology and Design, University of Colorado Boulder; Project: Acoustic Metamaterials

**Vishal Shenoy:** Master's student in Mechanical Engineering, University of Colorado Boulder

**Ankit Kumar:** Undergraduate student in Physics, IIT Roorkee

## Teaching Experience

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### Computational Fabrication (Graduate: CSCI 7000/ATLS 5519)

*Boulder, CO, USA*

TEACHING ASSISTANT

*Fall 2023*

- This course teaches techniques, representations, and workflows for computational fabrication i.e blending computer programming with Digital fabrication machines like 3D printers and laser-cutters. Students use techniques to design and build functional, creative objects leveraging existing computer-aided design (CAD) tools, programming languages and digital fabrication machinery.

### FORM (Undergraduate: ATLS 3100)

*Boulder, CO, USA*

TEACHING ASSISTANT

*Spring 2021*

- The course teaches the fundamentals of 3D modeling, 3D animation (using Rhinoceros 3D and Grasshopper) and 3D printing / rapid prototyping from a conceptual and sculptural perspective.

## Graduate Coursework

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**Computer Science:** Design and Analysis of Algorithms, Natural Language Processing, Applied Machine Learning, Theory of Computation, Bio-inspired Multi-Agent Systems, Quantum Information and Computing [all at CU Boulder]

**Design:** Haptic Interfaces, Metamaterial Design Principles [all at CU Boulder]

**Mathematics:** Partial Differential Equations [at CU Boulder]

**Physics:** Quantum Information and Computing, Advanced Condensed Matter Physics, Physics of Nanosystems, Physics and Technology of Thin Films, Advanced Characterization Techniques, Molecular Spectroscopy and Lasers [at IIT Roorkee]

## Skills

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**ADVANCE SKILLS in soft actuator design and development:** Including Soft Lithography, Elastomer Fabrication and Various methods of thermosetting plastics, as well as high-voltage (1kV-10 kV) circuit design and development.

**ADVANCE SKILLS in Nano-material fabrication and experimentation:** Including microfluidic control and study, soft-lithography, photolithography, thin film deposition, nanofabrication, chemical fabrication, wet-lab techniques, different types of spectroscopy (Fluorescence, UV-Visible, FTIR), X-Ray Diffraction, Atomic Force Microscopy and Electron Microscopy (SEM, TEM, STM) and instrumentation.

**ADVANCE SKILLS in macro-scale instrumentation, prototyping, and digital fabrication:** 3D printing, cutting, molding, casting; instrumentation of most digital machines to handle plastic/composite/metal/wood.

**ADVANCE SKILLS in Design thinking, Design software in both 2D and 3D:** (Adobe Creative Suite, Autodesk Softwares, Rhino with Grasshopper, Cinema-4D, Blender).

**MEDIUM SKILLS in software development and scientific computing:** Graphics, Animation, and Machine Learning in Python, MATLAB, Javascript, FORTRAN.

**MEDIUM SKILLS in electronic hardware design and assembly:** Digital and analog circuit design, signal processing, microprocessors, fast-prototyping as well as machine building.

Fluent in spoken and written English, Hindi, and Maithili (mother tongue). Vocational proficiency in Bengali and Sanskrit.

## References

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Available upon request