

Dr. Rohan Paul

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Address (India): C-II-19, AIIMS Campus, Ansari Nagar, New Delhi - 110029

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rohan.cosmos@gmail.com

Date of Birth: 1st Feb 1985

Current Position

Massachusetts Institute of Technology

Postdoctoral Associate

Robust Robotics Group

Computer Science and Artificial Intelligence Laboratory (CSAIL)

April 2015 - Present

EDUCATION

University of Oxford

Doctor of Philosophy (D.Phil.)

Mobile Robotics Group, Department of Engineering Science

Thesis: Long Term Appearance-based Mapping with Vision and Laser Supervisor:

Prof. Paul Newman

2008 - 2012

Indian Institute of Technology (IIT) Delhi

Dual Degree, Bachelors of Technology (B. Tech.) & Masters of Technology (M. Tech.)

Department of Computer Science and Engineering

2003 - 2008

WORK EXPERIENCE

Assistive Technologies Laboratory, IIT Delhi

Co-Founder and Postdoctoral Fellow/Sr. Project Scientist

2012 - March 2015

Center for Excellence in Tactile Graphics, IIT Delhi

Co-Founder and Principal Investigator

Dec 2013 - March 2015

Mobile Robotics Group, University of Oxford

Collaborator - Dept. of Engineering Science: Prof. Ingmar Posner

2012 - Present

Computer Science and Artificial Intelligence Laboratory, MIT

Visiting Researcher - Distributed Robotics Lab: Prof. Daniela Rus

Feb - Mar 2012

Skoll Center for Social Entrepreneurship, University of Oxford

Associate Fellow - Said Business School: Dr. Pamela Hartigan

2011 - 2012

Max Planck Institute of Biological Cybernetics

Undergraduate Research Scientist - Dept. of Empirical Inference: Prof. Scholkopf

May - July 2007

National Association for the Blind Delhi

Research Engineer - Technology Solutions Division

May - July 2006

RESEARCH INTERESTS

- Robotics, Artificial Intelligence, Autonomous Navigation, Machine Learning, Human-Robot Interaction.
- Assistive Technologies, Embedded Systems. Social Innovations.

MAJOR PROJECTS

- **Robotics Collaborative Technology Alliance (RCTA) or the US Army Research Labs (ARL), USA**
Human-Robot Interaction and Intelligence for Human-Robot Teams in army scenarios.
Lead Postdoc representing MIT as an alliance member with several other academic and research institutions across the US.
- **Toyota Research Institute (TRI), USA**
Project titled Reading the Mind with Language and Vision. Application domain autonomous cars and home service robots.
Lead Postdoc representing Robust Robotics Group. Collaborative project with the Center for Brains Minds and Machines at CSAIL, MIT.
- **National Science Foundation (NSF), USA**
Project under National Robotics Initiative contributing towards service robots in small and medium manufacturing units.
Lead Postdoc representing Robust Robotics Group. Collaborative project with the University of Rochester and Cornell.

HONORS AND AWARDS

MIT Technology Review's Global List of 35 Innovators under the age of 35, 2015

Government of India National Award for Best Applied Research aimed at Improving the Life of Persons with Disabilities, 2015

Best Conference Paper, International Conference on Robotics Science and Systems (RSS), 2017

Named among- *7 IITians Who Are Changing the Country for the Better*, Indiatimes Media House, 2014

Best Conference Paper, IEEE/RSJ International Conference on Intelligent Robots and Systems, 2013

Best Conference Paper, Intl. Conference on Transport and Mobility for the Elderly and Disabled Persons, 2012

Graduate Research Prize, Royal Institute of Navigation (RIN), 2012

Light Senior Graduate Scholarship Award, St. Catherines College, Oxford, 2011

Bracken Bequest Graduate Student Research Prize, Dept. of Engineering Science, Oxford, 2010

Best Vision Paper Finalist, IEEE International Conference on Robotics and Automation (ICRA)	2010
Best Conference Paper, Intl. Conference on Transport and Mobility for the Elderly and Disabled Persons,	2010
Bracken Bequest Graduate Research Seminar First Prize, Dept. of Engineering Science, Oxford	2010
Overseas Graduate Scholarship Award, St. Catherines College, Oxford	2009
The Rhodes Scholarship	2008
National Award for Innovative Student Project, Indian National Academy of Engineering (INAE)	2008
Best Industry Relevant Thesis, Forum for Innovation and Technology Transfer (FITT), IIT Delhi	2008
Best Project with Experimental Component (BOSS Award), IIT Delhi	2008
IIT Delhi Alumni Association Award	2008
Technology Development and Initiation Award for Students, IIT Delhi	2006
National Top 1% in Indian National Physics Olympiad	2013
Young Astronomer of the Year, Nehru Planetarium Delhi	2001
National Winner, Discovery Channel Quiz, India	1999

GRANTS (CO-PI OR CORE LEAD TEAM)

Wellcome Trust, UK (Affordable Healthcare in India Initiative)	2014- present
Development of affordable Braille display based on Shape Memory Actuation	
Wellcome Trust, UK	2014- present
Development Course for National and International Dissemination of the SmartCane	
Center for Internet and Society (CIS), India Enhancement to NVDA Open-source Screen Reader	2013- present
Dept. of Electronics, Govt. of India Center for Excellence in Tactile Graphics	2014 - present
Wellcome Trust, UK (Affordable Healthcare in India Initiative)	2011- 2014
SmartCane: Development of an affordable knee-above obstacle detection and warning system for the Visually Impaired	
Dept. of Science and Technology, Govt. of India (Technology Intervention for Disabled and Elderly Scheme)	2013 - present
Bus Identification System for the Visually Impaired	
Dept. of Science and Technology, Govt. of India (Technology Intervention for Disabled and Elderly Scheme)	2013 - present
Refreshable Braille Cells based on SMA-based actuation	
Industrial R&D unit, IIT Delhi	2006 - 2008
Technology Development and Initiation Award for Students (TDP-IAS) Media Labs Asia, Dept. of ICT, Govt. of India	2006
Embedded Assistive Devices for the Visually Challenged	

SELECTED PUBLICATIONS

Robotics

- Rohan Paul, Jacob Arkin, Derya Aksaray, Nicholas Roy and Thomas Howard, Efficient Grounding Abstract Spatial Concepts for Natural Language Interaction with Robot Platforms, in *International Journal of Robotics Research (IJRR)* [Under Review]
- Rohan Paul, Jacob Arkin, Nicholas Roy and Thomas Howard, Grounding Abstract Spatial Concepts for Language Interaction with Robots, in *International Joint Conference on Artificial Intelligence – Sister Conference Best Paper Track* 2017.
- Mycal Tucker, Derya Aksaray, Rohan Paul, Gregory Stein and Nicholas Roy, Learning Unknown Groundings for Natural Language Interaction with Mobile Robots, in *International Symposium on Robotics Research (ISRR)* 2017 [Under Review].
- Rohan Paul, Andrei Barbu, Sue Felshin, Boris Katz and Nicholas Roy, Temporal Grounding Graphs for Language Understanding with Accrued Visual-Linguistic Context, in *International Joint Conference on Artificial Intelligence (IJCAI)* 2017.
- Rohan Paul, Jacob Arkin, Nicholas Roy and Thomas Howard, Efficient Grounding Abstract Spatial Concepts for Natural Language Interaction with Robot Manipulators, in *International Conference on Robotics Science and Systems (RSS)* 2016 [**Best Conference Paper Award**].
- Hugo Grimmett, Rudolf Triebel, Rohan Paul, and Ingmar Posner. “Introspective Classification for Lifelong Semantic Mapping,” in *International Journal of Robotics Research*. 2015.
- Hugo Grimmett, Rohan Paul, Rudolf Triebel and Ingmar Posner. “Visual Precise Generation using Coresets,” in *IEEE International Conference on Robotics and Automation (ICRA)*, Hong Kong. 2014.
- Rohan Paul and Paul Newman. “Seeking Out Perplexing Images for Ever Improving Navigation,” in *International Journal of Robotics Research*. 2013.
- Peter Corke, Rohan Paul, Winston Churchill and Paul Newman. “Dealing with Shadows: Capturing Intrinsic Scene Appearance for Image-based Outdoor Localisation,” in *International Conference on Intelligent Robots and Systems (IROS)*. 2013. [**Best Conference Paper**]
- Hugo Grimmett, Rohan Paul, Rudolf Triebel and Ingmar Posner. “Knowing When We Dont Know: Introspective Classification for Mission-Critical Decision Making,” in *IEEE International Conference on Robotics and Automation (ICRA)*, Karlsruhe, Germany. 2013.
- Rohan Paul, Daniela Rus and Paul Newman. “How was your day? Online Visual Workspace Summaries using Incremental Clustering in Topic Space,” in *IEEE International Conference on Robotics and Automation (ICRA)*, Minnesota, USA. 2012.
- Rudolf Triebel, Rohan Paul, Daniela Rus and Paul Newman. “Parsing Outdoor Scenes from Streamed 3D Laser Data Using Online Clustering and Incremental Belief Updates,” in *American Association of Artificial Intelligence (AAAI) Conference*, Toronto, Canada. 2012.
- Rohan Paul, Rudolf Triebel, Daniela Rus and Paul Newman. “Semantic Categorization of Outdoor Scenes with Uncertainty Estimates using Multi-Class Gaussian Process Classification,” in *International Conference on Intelligent Robots and Systems (IROS)*, Valgrave, Spain. 2012.
- Rohan Paul and Paul Newman. “FABMAP3D: Topological Mapping with Visual and Spatial Appearance,” in *IEEE International Conference on Robotics and Automation (ICRA)*, Anchorage, USA. 2010. [**Best Vision Paper Finalist**]
- Rohan Paul and Paul Newman. “Self-Help: Seeking Out Perplexing Images for Ever Improving Navigation,” in *IEEE International Conference on Robotics and Automation (ICRA)*, Shanghai, China. 2011.
- Mike Smith, Ian Baldwin, Winston Churchill, Rohan Paul and Paul Newman. “The New College Data Set 2.2 km of Vision and Laser Data,” in *International Journal of Robotics Research*, May. 2009.

Assistive Technologies

- Ankit Kumar, Dhruv Gupta, Pulkit Sapra, Mayank Raj, Akash Anand, Vinit Darda, Rohan Paul, M. Balakrishnan and P.V.M. Rao. "A Compliant Mechanism Design for Refreshable Braille Display Using Shape Memory Alloy," in *ASME International Conference on Mechatronics and Embedded Systems and Applications (MESA)*. 2015.
- Mrinal Mech, Kunal Kwatra, Supriya Das, Piyush Chanana, Rohan Paul and M. Balakrishnan. "Edutactile: A Tool for Rapid Generation of Accurate Guideline-compliant Tactile Graphics for Science and Mathematics," in *International Conference on Computers Helping People with Special Needs (ICCHP)*. 2014.
- M. Balakrishnan, Rohan Paul and P. V. M. Rao. "Design of an Affordable, Multi-modal, Interactive Braille Tutor System," in *Blindness, Technology and Multi-modal Reading Conference*. 2014.
- Dhruv Jain, Rohan Paul, M. Balakrishnan. "An Indoor Path-guidance and Navigation System for the Visually Impaired," in *ASSETS: The International ACM SIGACCESS Conference on Computers and Accessibility, Bellevue, Washington, USA*. 2013. [Poster]
- Anshul Singhal, Pranay Jain, Piyush Chanana, Dhruv Jain, Rohan Paul, M. Balakrishnan and P.V.M. Rao. "Application of Shape Memory Alloy (SMA) Based Actuation for Refreshable Display of Braille," in *ASME International Design Engineering Technical Conferences & Computers and Information in Engineering Conference IDETC/CIE, Portland, Oregon USA*. 2013.
- Yogesh Taneja, Anuraag Gupta, Piyush Chanana, Saurabh Sanyal, Supriya Das, Manas Paldhe, Siddharth Easwaran, Sanjay Dhakar, Vaibhav Singh, Vasudev Sharma, Dipendra Manocha, P.V.M. Rao, Rohan Paul and M. Balakrishnan. "Study of Challenges Faced by Visually Impaired Persons in Accessing Public Buses and Design and User Testing of an Affordable Bus Identification and Homing System for the Visually Impaired," in *13th International Conference on Mobility and Transport for Elderly and Disabled Persons (TRANSED), New Delhi*. 2012.
- Dhruv Jain, Prabhav Agarwal, Kartik Maheshwari, Aman Mittal, Rohan Paul, Supriya Das, Saurabh Sanyal, Yogesh Taneja, Dipendra Manocha, M. Balakrishnan and P.V.M. Rao. "Design and User Testing of an Affordable Cellphone based Indoor Navigation System for the Visually Impaired," in *13th International Conference on Mobility and Transport for Elderly and Disabled Persons (TRANSED), New Delhi*. 2012. **[Best Paper Award]**
- Vaibhav Singh, Rohan Paul, Dheeraj Mehra, Anuraag Gupta, Vasu Dev Sharma, Saumya Jain, Chinmay Agarwal, Ankush Garg, Sandeep Singh Gujral, M. Balakrishnan, Kolin Paul, Prof. P.V.M. Rao and Dipendra Manocha. "Smart cane for the visually impaired: Design and controlled field testing of an affordable obstacle detection system," in *12th International Conference on Mobility and Transport for Elderly and Disabled Persons (TRANSED), Hong Kong*. 2010. **[Best Conference Paper]**
- Dheeraj Mehra, Vaibhav Singh, Rohan Paul, Ankush Garg, Chinmay Agarwal, Vasu Dev Sharma, Sanjay Dhakar, Pawan Arora, M. Balakrishnan, Kolin Paul, Prof. P.V.M. Rao and Dipendra Manocha "User Triggered Bus Identification and Homing System: Making Public Transport Accessible for the Visually Challenged," in *12th International Conference on Mobility and Transport for Elderly and Disabled Persons (TRANSED), Hong Kong*. 2010.
- Rohan Paul, Ankush Garg, Vaibhav Singh, Dheeraj Mehra, M. Balakrishnan, Kolin Paul, and Dipendra Manocha. "Smart cane for the visually impaired: Technological solutions for detecting knee-above obstacles and accessing public buses," in *11th International Conference on Mobility and Transport for Elderly and Disabled Persons*

WORKSHOPS AND SYMPOSIA

- Language Grounding in Robotics, American Computational Linguistics Conference, 2017
- Workshop on Reinforcement Learning and Decision Making (RLDM), 2013.
- Active Learning in Robotics: Exploration, Curiosity, and Interaction, *Robotics: Science and Systems Workshop*, 2013.
- Lifelong Learning Workshop, *International Conference on Intelligent Robots and Systems*, 2012.
- Navigation Seminar, *Royal Institute of Navigation, UK*, 2012.
- Lifelong Autonomy and Exploration, *IEEE International Conference on Robotics and Automation*, 2011.
- RGB-D Workshop on 3D Perception in Robotics, *European Robotics Forum*, 2011.
- Mapping with RGB-D Cameras, *Robotics: Science and Systems Workshop*, 2010.

PATENTS

- Multiple range obstacle detection and warning system, Indian Patent Office, 2007.
- User triggered duo-module destination identification system, Indian Patent Office, 2007.
- Indoor Navigation System for the visually impaired, Indian Patent Office, 2013. [Patent pending]
- A Split Grip Cane Handle Unit with Tactile Feedback for Directed Ranging, Indian Patent Office, Design registration and WIPO PCT Application 2014
- A Compliant Mechanism for Refreshable Braille Display using Shape Memory Alloy, Indian Patent Office, 2014
- A Multi-modal Infotainment Device for Interactive Braille Learning, Indian Patent Office and Design registration 2014

INVITED TALKS

TEDx Talk, New Delhi	2015
Link: https://www.youtube.com/watch?v=RpEVxMo5xcs	
Speaker, National Science Center, New Delhi	2014
Research talk, Computer Science and Artificial Intelligence Laboratory (CSAIL), MIT	2014
Speaker and Panelist, UNDP India Social Good Summit	2014
Links: http://bcove.me/xeh5ifr6 and http://bcove.me/mojuvxi7	
Invited talk, UNESCO International Conference on Role of ICTs for Persons with Disabilities	2014
Speaker, SmartCane: Release to the People Event, IIT Delhi Link: https://www.youtube.com/watch?v=ltwli5zsTSQ	2014
Invited talk, DAISY Forum of India General Body Meeting	2014
Talk, Capacity Building Session at the Christian Federation of the Blind, Bangkok, Thailand	2014
Workshop speaker, Training Session at the Hong Kong Blind Union, Hong Kong	2014
Seminar, National Innovation Showcase, Rashtrapati Bhavan (Hon'ble President of India's residential estate)	2014
Speaker, Alumni Association Event, IIT Chennai	2014
Speaker, International White Cane Day, Rotary Club of Delhi	2014
Seminar, Guru Nanak Eye Hospital, New Delhi	2014
Workshop Speaker, Jamia Milia Islamia University, New Delhi	2014
Speaker, Launch of Govt. Scheme for Subsidised Devices, Xaviers Resource Center for the Blind	2014
Speaker, Donation Event at National Association for the Blind	2014
Speaker, Introduction to Engineering Speaker Series, IIT Delhi	2014
Speaker and Panelist, International Rhodes 110th Meet, UK - Session: Fighting the World's Fight Link: http://www.rhodeshouse.ox.ac.uk/speaker-videos	2013
Speaker (Socially relevant technology development), IIT Delhi	2013
Panelist and Session Speaker, Global Scholars Symposium - University of Oxford	2013
Speaker and Panelist, Career in Science and Technology, Sardar Patel Vidyalaya	2013

Speaker, D-Rev Inc., USA	2012
Accessible Science Workshop, Little Flower School for the Deaf and Blind, Chennai	2012
Speaker, Students Forum on Scientific Research, Sardar Patel Vidyalaya	2012
Seminar speaker, e-Research Center, Oxford University	2012
Invited Talk, Social Impact Group, Rhodes Trust, UK	2011
Speaker, Knowledge Center, All India Institute of Medical Sciences, New Delhi	2010

MEDIA

The Rhodes Scholar Magazine, <i>The Cane Do Attitude</i> In Press: May '15 issue	2015
The New Indian Express - <i>An Ultrasound Cane and Able Story</i> http://www.newindianexpress.com/cities/chennai/An-Ultrasound-Cane-and-Able-Story/2015/03/23/article2725291.ece	2015
The Hindu - <i>The Visually Impaired get a Smart Guide</i> http://www.thehindu.com/news/cities/chennai/visually-impaired-get-a-smart-guide/article7019756.ece	2015
BBC World Service Radio - <i>The Science Hour: SmartCane for People with Visual Impairment</i> http://www.bbc.co.uk/programmes/p025684s	2014
Better India - <i>Brilliant Invention from IIT Delhi May Just Change The Way Blind People Move Around</i> http://www.thebetterindia.com/11954/invention-blind-smartcane-mobility-visually-impaired-innovation/	2014
IndiaTimes - <i>8 Indian Innovations for the Common Man</i> http://www.indiatimes.com/lifestyle/technology/8-indian-innovations-for-the-common-man-228196.html	2014
The Free Press Journal - <i>Techies put their mind to social activism</i> http://www.freepressjournal.in/techies-put-their-mind-to-social-activism/	2014
IndiaTimes, <i>7 IITians Who are Changing the Country for the Better</i> http://www.indiatimes.com/news/india/7-iitians-who-are-changing-the-country-for-the-better-227865.html	2014
inSight: Retina India - <i>Celebrating Entrepreneurs - Interview with Trailblazers</i> http://www.retinaindia.org/insight-2/insight-jun-2013-2/	2013
Fortune India, <i>Innovation Sides with the Blind</i> http://assitech.iitd.ernet.in/doc/media-coverage/Fortune%20India.pdf	2014
Civil Society - <i>SmartCane Goes Places</i> http://assitech.iitd.ernet.in/article%20on%20SmartCane.pdf	2014
Mid Day - <i>IIT Delhi Creates Affordable SmartCane for the Blind</i> http://www.mid-day.com/articles/iit-delhi-creates-affordable-smart-cane-for-the-blind/15506173	2014
Indian Express (Mumbai) - <i>SmartCanes made by IIT Delhi team to help 60 Blind in the City</i> http://epaper.indianexpress.com/c/3275184	2014
International Business Times - <i>A Smart Walking Stick That Uses Sonar To Guide Blind People</i> http://www.ibtimes.co.uk/smartcane-smart-walking-stick-that-uses-sonar-guide-blind-people-1453556	2014
Daily Mail (UK) - <i>White Stick Gets a 21st Century Makeover</i> http://www.dailymail.co.uk/sciencetech/article-2663715/The-white-stick-gets-21st-century-makeover-30-smart-cane-uses-SONAR-vibrations-help-blind-people-see.html	2014
India Today - <i>Vidya Balan Launches SmartCane for the Blind</i> http://indiatoday.intoday.in/gallery/vidya-balan-launch-smartcane-blind-st-xaviers-college/1/12398.html	2014
The Telegraph - <i>Bus Guide for the Blind</i> http://www.telegraphindia.com/1080607/jsp/nation/story_9377321.jsp	2014
Wellcome Trust, UK - <i>Innovation Showcase</i>	2014

<http://www.wellcome.ac.uk/Funding/Innovations/Innovations-showcase/WTP056065.htm>

The New Indian Express - *Tech Guru: Rohan Paul*

2014

<http://www.newindianexpress.com/lifestyle/tech/2014/11/29/Tech-Guru/article2546671.ece>

PROFESSIONAL SERVICE

Program Committee Member

International Conference on Robot Learning (CORL)	2017
American Association for Artificial Intelligence (AAAI) Fall Symposium	2017
International Conference on Robotics Science and Systems (RSS)	2017
International Joint Conference on Artificial Intelligence(IJCAI)	2013

Co-Founder and Mentor

Assistive Technologies Group, IIT Delhi	2004 - Present
Center for Excellence in Tactile Graphics, IIT Delhi	2014 - Present
Rhodes Social Impact Group (RSIG), Rhodes Trust, UK	2011 - 2012

Invited Member

International Rhodes Scholarship Committee, Rhodes Trust, Oxford, UK	2011 - Present
Indian Rhodes Scholarship Selection Committee, India	2013
Committee on Assistive Technology, Min. of Social Justice and Empowerment, Govt. of India	2011

Chair

Executive Committee on Technology Solutions for Persons with Blindness, Saksham Trust, India	2013
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Adjunct Fellow

Vidhi Center for Legal Policy, New Delhi, India	2012 - Present
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Reviewer

Conferences: ICRA, IROS, RSS, IJCAI, MESA Journals: IJRR, JFR, TRO	2008 - Present
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Volunteer

International Symposium on Experimental Robotics (ISER)	2011
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EXTRACURRICULAR ACTIVITIES

Training in Indian Classical Music from Gwalior Gharana.

Coordinator of Indian Music Section of Delhi based professional music group *Artistes Unlimited*. Recorded a music collection *Dharohar* (2002) and an album titled *En Route* (2007).

Trained in Taekwon-do martial art. Attained Black Belt.

Member, Amateur Astronomers Association, Nehru Planetarium, New Delhi. Table Tennis Zonal Champion

Quizzing