

## **A ROADMAP FOR ROBOTICS AND AUTOMATION IN INDIA**

**Full-day Invitational Workshop (June 27, 2017) @ IIT New Delhi**

**ORGANIZERS: RAJ MADHAVAN & SUBIR KUMAR SAHA**

Robotics and Automation (R&A) has proven to be a transformative technology capable of changing a nation's trajectory in terms of benefits at the GDP level thereby increasing the quality of lives of its inhabitants to its standing in the international arena with far reaching implications that extend beyond technology gains. Adoption of emerging technologies tends to be slow in developing economies and India is no exception. While there are internal governmental reports and forecasts available (not all of them in the open literature however), there has not been a concerted effort in bringing together various entities to facilitate public-private partnerships and work collectively towards realizing and harnessing the potential of R&A technologies within the Indian subcontinent.

This roadmapping activity focused on India is being carried out under the IEEE Standards Association (IEEE-SA) Industry Connections (IC) program (<http://standards.ieee.org/develop/indconn/>). The objectives are to better understand and identify

- what existing R&A solutions exist across public and private sectors,
- requirements of stakeholders, and
- how existing roadblocks and impeding processes can be minimized to facilitate the adoption and growth of these technologies with particular attention to socio-economic, cultural, environmental, and sustainability factors.

The following domains are the intended beneficiaries: consumer & service robotics, industrial (automotive, manufacturing), and military & defense. The impact of this activity would be to provide a comprehensive and objective view of the state-of-the-art of R&A technologies, steps needed to bridge existing gaps (both technological and bureaucratic) in consultation with relevant stakeholders. These activities are anticipated to raise awareness of existing and emerging R&A technologies, bring together researchers, developers, and practitioners from government, industry, and academia. It is anticipated that the wide-reaching benefits of such an effort would lead to

- industries adopting best practices and benefitting from technologies developed in more advanced parts of the globe,
- providing the academia the required steps to prepare the next generation workforce and researchers, and
- informing the government of existing gaps and how these can be bridged.

The primary deliverables from this activity will include:

- A roadmap report describing identified needs to accelerate developments in the field of robotics with a focus on the Indian market; prioritization recommendations to address the identified needs; standards development activities that will be an enabler for the robotics and automation industry in India.
- Interactive workshops with key stakeholders to build consensus on the roadmap and standards recommendations. It is envisioned that 1-2 workshops will be held in India, the first to outline priority topics for a whitepaper, with the option for a second workshop towards drafting a consensus report.

We are inviting selected representatives from entities across industry, government, academia, and end-users to attend a *by-invitation-only* full-day workshop that is being held in conjunction with the Advances in Robotics (AIR) Conference at IIT Delhi. However, the summary will be shared in a session at the end of the day which will be open to the participants of the SERB School on Robotics during June 23-28, 2017 (<http://robotics.iitd.ac.in/ARL/?q=serb-school-robotics>), and the AIR 2017 during June 28-July 02 (<http://www.advancesinrobotics.com>).

### **BIOGRAPHY OF ORGANIZERS**

**RAJ MADHAVAN** is an internationally recognized expert in humanitarian robotics and automation technologies. His current research interests lie in the application and tailoring of technologies that are cost effective, reliable, efficient, and geared towards improving the quality of lives of people in underserved and underdeveloped communities around the globe with emphasis on ethical, legal, and societal considerations of emerging technologies. He is particularly invested in the development of sustainable technologies and systems in a variety of domains that enable the realization of the UN's 2030 agenda and the sustainable development goals for the benefit of humanity.

Dr. Madhavan is the Founder & CEO of Humanitarian Robotics Technologies, LLC, focusing on applied technology consulting, training, and research. Most recently he was a Distinguished Visiting Professor of Robotics at Amrita University, Kerala (Feb. 2016-Jan. 2017), and has held appointments with the Oak Ridge National Laboratory as an R&D staff member based at the National Institute of Standards and Technology (March 2002-June 2013), and as an assistant and associate research scientist, and as a member of the Maryland Robotics Center with the University of Maryland, College Park (Feb. 2010-Dec. 2015). He received a Ph.D. in Field Robotics from the University of Sydney, and an ME (Research) in Systems Engineering from the Australian National University. Over the last 20 years, he has contributed to various topics in field robotics, humanitarian technologies, and systems and control theory. He has published over 200 papers in archival journals, conferences, and magazines and has co-edited two books and four journal special issues. He has served as an invited independent judge for robotics competitions, has given numerous invited presentations in research organizations in several countries, has served on editorial boards and program and organization committees of premier robotics, automation, and control conferences, and on several national and international panels and review boards.

Within IEEE, the largest professional engineering society, he is currently active in the following roles: Co-chair, IEEE Future Directions ‘Symbiotic Autonomous Systems’ Initiative; Co-chair, Economics of Machine Automation and Humanitarian Activities, and ExCom member of the IEEE Global Initiative for Ethical Considerations in the Design of Artificial Intelligence and Autonomous Systems. Within the IEEE Robotics and Automation Society, he serves as the Founding Chair of the Special Interest Group on Humanitarian Technology (RAS-SIGHT) and as the Chair of the Robotics and Automation Research and Practice Ethics Committee. He is a senior member of IEEE, a 2008 Volunteer of the Year awardee of the IEEE Washington Section, was recognized for his services to RAS as VP of the Industrial Activities in 2014 & 2016, and is the 2016 recipient of the IEEE Robotics and Automation Society's Distinguished Service Award for his “distinguished service and contributions to RAS industrial and humanitarian activities”.

**SUBIR KUMAR SAHA**, Professor and Head of the Department of Mechanical Engineering at IIT Delhi, is a 1983 Mechanical Engineering graduate from the RE College (Now, NIT), Durgapur, India. He completed his M. Tech from IIT Kharagpur and Ph. D from McGill University, Canada. Upon completion of his Ph. D, he joined Toshiba Corporation’s R&D Center in Japan. After 4-years of work experience in Japan, he returned to India in 1995. He is actively engaged in teaching, research, and technology development. Prof. Saha recently completed the design and installation of an electrically-driven Six-DOF motion platform for SDD, Secunderabad successfully. Besides, he established the Mechatronics Laboratory at IIT Delhi in 2001, and contributed significantly to set-up an interdisciplinary Programme for Autonomous Robotics at IIT Delhi in 2010 with the financial support from BARC/BRNS, Mumbai.

As recognition of his international contributions, Prof. Saha was awarded Humboldt Fellowship in 1999 by the AvH Foundation, Germany, and the Naren Gupta Chair Professorship at IIT Delhi in 2010. He has published a textbook on “Introduction to Robotics” published by McGraw-Hill which is supported with a popular software RoboAnalyzer which he distributes free.