Overview of Robotics Activities in India (2013)

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Third in the series of articles focusing on the state of robotics and automation (R&A) in the BRICS countries, Brazil, Russia, India, China, and South Africa, this article provides an overview of India. The objective of this series is to inform the readers of the unique challenges of these countries and the solutions they have adopted to solve their problems, and to facilitate discussions with the interested members of the community. Please send your comments and feedback to Vice President of the Industrial Activities Board Raj Madhavan at raj.madhavan@ieee.org.

Traditionally robotics and automation (R&A) technologies have not enjoyed success in the Indian milieu, partly due to the prohibitive technological costs and partly due to the in-parallel availability of an inexpensive labor force. However, it is noteworthy that this has not been due to a shortage of scientific temper to address challenging problems or the willingness to apply the most appropriate solution. As a nation, India is witnessing rapid industrialization, with a growth rate hovering between 7 and 10% over the past decade and an eye toward the global export marketplace. Within this context, the robotics industry in the country is worth approximately US$750 million (compared with a global estimate of US$17.6 billion) but is expected to grow at two to two-and-half times the average global growth rate [1].

In the past decade, R&A technologies have hastened the coming-of-age in India by helping speed up, simplify, and enhance the quality of various heavy-industry processes. Defense industrial applications remain another growing area for R&A and allied control-system technologies. Additionally, the rising affluence is also creating a consumer-focused marketplace for R&A technologies, including the health-care marketplace. Thus, from an overall perspective, the R&A picture in the Indian subcontinent mirrors the diversity and rapidly changing face of robotics worldwide (albeit on a smaller scale).

While presenting this overview of seemingly scant robotics activities within the Indian subcontinent, one needs to place this in the broader context of the technological capabilities of a nation that has successfully developed an indigenous space and nuclear program. In particular, the technological capabilities (in robotics, automation, and control systems) remain captive within the specific defense/governmental agencies and institutions and not particularly well publicized. More generally, in the pervasive one-company-for-life employment paradigm and lack of significant mobility within the labor-markets, R&A activities have traditionally remained siloed within institutional and organizational boundaries. Hence, this overview of robotics activities quite naturally coalesces around different organizations/agencies from educational institutions to research and development laboratories to actual specific industry sector deployments.

The broad categorization follows along from the source of the technological manpower with academic research organizations and educational support laboratories, and then leads into governmental and industrial research, and development laboratories, educational and hobby robotics organizations, and more recently, budding robotics-oriented professional societies. Yet, one needs to remain cognizant that this is a mere snapshot of activity at this instance in time.

As in the rest of the world, various literary and celluloid renditions of robotics play a critical role in capturing the imagination of young Indians. Additionally, interest in R&A (and embedded systems technologies at the lower end) has proven to be a natural evolution and extension of the programming paradigm and a natural target for numerous science, engineering, and technology career-oriented students each year.

Academic institutions, working in close collaboration with governmental and industrial research and development labs, are spearheading the growth of robotics in India. Much of the early efforts were led by the robotics labs within the Indian Institute of Science, Bangalore, and the Indian Institutes of Technology (IITs) in Delhi, Bombay, Madras, Kharagpur, and Kanpur. In more recent years, these have been joined by the nascent robotics labs in the next generation of IITs in addition to the National Institutes of Technology (NITs) and the Indian Institute of Information Technology (IIITs)—all institutions operating under the auspices of the Ministry of Human Resource Development. The diversity of research topics closely parallels the contemporary international research

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trends; however, inadequate access to hardware often limits scope of the work to more theoretical or simulation-oriented efforts. The rapid growth of engineering seat capacity (under the auspices of the Deemed University Act) has spurred the next generation of robotics labs in these newly formed institutions.

Additionally, there are several government-funded (civilian and military) laboratories that share a focus on R&A (and allied artificial intelligence and control systems) technologies. These include organizations like the Centre of Artificial Intelligence and Robotics (CAIR) [2], Central Mechanical Engineering Research Institute [3], National Institute of Oceanography [4], and Defense Research and Development Organization [5], focusing on bringing about self-sustenance in strategic and economic sectors. The growth in the defense robotics sector has paralleled the advances in contemporary technologies such as unmanned aerial systems, aerial defense control, and reporting systems, with public sector institutions such as Research and Development Establishment [6], PARI [7], CAIR [2], and HiTech Robotic Systems Limited [8] supporting enterprise scale deployments.

R&A technologies have been imported en masse as part of industrial production lines (typically with foreign collaborations) as India began to reap the results of liberalization of industrial policy and direct foreign investment that began in 1992. Numerous industrial research and development labs have established an Indian operational presence such as GE India Labs, John F. Welch Technology Centre [9], ABB Robotics [10], KUKA Robotics [11], and Kawasaki Robotics [12] were set up in the past two decades. The focus has been on improving material handling, palletizing and packaging, and most importantly adaptation of the traditional manufacturing production automation solutions to the Indian milieu. More recently, using the state-of-the art R&A technologies enabled Tata Motors to produce Tata Nano (the cheapest car in world) to specifically cater to the needs of the low-cost automotive market in India. With an increasing number of global automotive players showing interest in expanding their customer base in the growing Indian economy, R&A for manufacturing are definitely expected to play a significant role [13]. In addition, an emerging trend has been to foster industrial training centers in conjunction with academic institutions, such as the Industrial Robot Training Centre developed as a collaboration between KUKA Robotics (India) and the Ajay Kumar Garg Engineering College [14], Ghaziabad.

While much of the heavy industrial robotics implementations remains directly imported, a grassroots/indigenous robotics-manufacturing industry is also forming to fill the void in the robotics ecosystem. These include organizations such as Hi-Tech Robotics [8], PARI [7], MTAB [15], and Systemantics [16], which are developing mobile robots, industry standard robotic arms like serial 6-degrees-of-freedom (DOF) robots, SCARA 4, and 6-DOF robotics arm. Finally, there is a rapidly growing demand for relatively inexpensive robot hardware to support the growing demand for robotic kits coupled with learning exercises for students to gain experimental knowledge. This has led to organizations like Robosoft Systems [17] and Nex-Robotics [18], focused on manufacturing cheap robotic products like table top humanoids to quadrotors with an aim to spread robotics education to engineering students.

Hand in glove are a slew of entrepreneurship activities (in the form of cottage industry of consulting services), typically offered by robotics students and faculty. The focus is on facilitating the dissemination of robotics knowledge in the rapidly growing ecosystem. The ability for robotics to serve embodiments of abstract programming concepts remains a universal attractor, as seen in the meteoric growth of robotics clubs involved in spreading robotics education across the country. The range of activities span from creation of barebones training kits to complete deployment solutions with workshops. Products such as RoboAnalyzer [19] software are dedicated to the teaching and learning of serial robots. Thinklabs, an IIT Bombay startup [20], was the first in the field of educational robotics, while other organizations like Thinkware [21], Robosapiens [22], Technophilia [23], etc., are focused on robotics industrial applications.

Finally, we also note the rapid growth of institutions (and potential for further increases) to support the professional development and personal growth of the robotics community in India. Most researchers retain individual professional affiliations to professional societies such as the IEEE and the International Federation for the Promotion of Mechanism and Machines Science, where efforts are focused on more traditionally academic pursuits (conferences/workshops). However, there has been a recent uptick in interest in not for profit and industry-led professional societies such as Robotics Society of India [24], Robotics and Automation Committee of Confederation of Indian Industries [25], and Roboconhelp India [26]. These institutions are now focused on developing the full set of services to support a robust robotics-ecosystem by promoting interaction between various robotics researchers in India (academic/R&D Labs/Industry) through various conferences and workshops, newsletters, training, and tutorials.

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High Tech, Low Sales—We Need a Change!

By Erwin Prassler and Bonn-Rhein-Sieg

In an earlier issue of this magazine, we discussed what might have prevented service robots from pervading our daily lives, as it has been evocated for the past 25 years. Though not complete, we created a list of the four major reasons for the rather modest triumphal procession of service robots:

1) the fact that many research results are not technologically prepared for realistic service robot applications
2) the vanishingly low scientific merit that a young robotic researcher can earn by improving this technology
3) the fact that technology development in service robotics was frequently detached from economic conditions underlying the service that was to be automated
4) the lack of low-cost technology development in robotics.

We argued that service robotics needs to either recalibrate its promise "to ease the life of humankind" or to recalibrate its roadmap for research and education.

We are clearly in favor of the second option and propose a number of extensions for a recalibrated roadmap for service robotics. The extensions are what the name says: extensions. They do not claim to be corrections or revisions and they involve both research and education.

Adjustments in Robotics Education

From our own teaching experience and from an international design contest on low-cost robotics that we organized a couple of years ago, we have gained the insight that many students do not have

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