



“Building a Sustainable Future with IoT Solutions for Urban Growth, Rural Empowerment, and Disaster Management”

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“Harnessing Innovation is the Key to India's Long-Term Economic Resilience”

Intro: We all are aware that the Internet of Things (IoT) is reshaping India’s socio-economic landscape. But what we may not be reading is the high impact it can make, particularly in agriculture, infrastructure, and smart city initiatives. Despite challenges like high costs, low awareness, and reliance on imports, IoT offers immense potential for innovation, precision, and efficiency. This week on **Socio-economic Voices** we have **Dr. R. Venkatesha Prasad**, Faculty Member, Networked Systems group at Delft University of Technology (TU Delft). Speaking to **Mahima Sharma** of **Indiastat**, he highlights and very finely breaks down the opportunities in manufacturing, skill development, and the global Tactile Internet market, emphasizing sustainable growth. Take a read at the exclusive insights which would be the game changer in the next decade.

MS: India’s Internet of Things (IoT) market is expected to reach \$15 billion by 2025. How do you see IoT adoption influencing the socio-economic landscape in India, particularly in rural areas?

Dr. Prasad: The Internet of Things has now reached a maturity level that can become part of our lives. In the EU, there was a big push on IoTs around 2010, which fuelled a large number of innovation projects, including the ones that are of TRL7 and above. With this in the background, if we look at the IoT landscape, it touches various domains. IoT doesn’t mean only “smart” systems; it can also do the same old tasks with better accuracy and efficiency. Now, knowing its growth is tremendous, I will pick a few important topics where, particularly, IoT will enhance the socio-economic outlook in India.

Regarding traffic... the real-time information/sensing will indeed be a big boost for managing the traffic in big cities. The synchronization of different traffic flows is missing, which can be brought onto our roads. IoT devices will make real-time decisions without human intervention.

Regarding agriculture, this is one sector India has identified with for a long time. As far as I know, the current government has a vision to feed the whole world. That means the agriculture sector is taking a big leap forward by using IoT devices for precision agriculture. I have been advising for some time on this topic; my observation is that together with the innovation potential Indians have, IoT technology and the traditional wisdom of our farmers will make this vision possible. We think the rural populace cannot handle this boom in technology, but I differ. A case in point is the digitalization of payment systems and the reach of mobiles. IoTs can provide much more real-time data and also bring the big picture regarding future trends and problems.

In the Infrastructure sector also, the IoTs are everywhere, and their reach in monitoring water resources (dams), rivers, power grids, and transportation will enable smooth logistics and efficient resource utilization. Though the infrastructure is very much connected with the urban areas, we know that the difference between rural and urban areas is diminishing slowly. The digital divide has disappeared; similarly, the infrastructure-divide will also disappear.

The above is just the tip of the iceberg of what IoT can do, and India can achieve much more balanced socio-economic growth across the country since we have the advantage of not learning from making mistakes like the West. Rather, we can plan well ahead.

MS: A 2023 report states that only 26% of Indian businesses have adopted IoT solutions. What challenges are preventing mass adoption? What fresh government policies can encourage this growth?

Dr. Prasad: As per my experience and expertise, I will list out the key reasons:

a) Semiconductors

We are not producing what we want to deploy. The import of many of the components regarding IoT devices is, at present, costly, though deployment in large numbers should help us reduce the prices. This steep upfront cost is holding back investments. IoTs can provide much more returns over the long term, like solar panels; however, the efficiency and ease of use will be immediate.

b) Humans vs. IoTs

In this arena, the thinking is that in India, we can get the same thing done with human labour. The benefits are implicit, and thus, we may tend to neglect the outcomes and avoid initial investments. Since labourers are relatively affordable, many businesses, especially smaller ones, may not see the financial benefits of switching to IoT solutions.

c) Awareness about IoT

The ideas and the creative ways in which IoTs can be utilized are lacking. IoTs are not for switching lights ON/OFF or closing/opening the doors. IoTs can do a lot more, and bringing IoTs to everyone's doorsteps is what is needed. The awareness happens when people use them, but it requires a good amount of investment. This is a chicken-egg problem.

Naturally, the government can solve the above problem by allowing subsidies for deploying IoT devices. Largely, the government can do multitudes of things:

- a. The policies that govern the use of spectrum can be eased out, for example, 6G, NB-IoT, LoRa, etc.
- b. Targeted subsidies for SMEs to build, deploy, own, and provide service.
- c. Funding for the innovation. Innovation in IoTs requires good financial backing.
- d. The government should also think of the long-term applicability of the technology and the tradeoff between resource use and the number of people affected by new technology.
- e. Lastly, the IoTs should be subsidized for the rural populace on priority so as to take the cities to villages rather than creating cities by merging many villages. With IoTs and the smartness that they bring, rural life could be far better than what it is now – for example, water supply, air quality, the environment, etc.

MS: Globally, IoT is expected to contribute \$1.6 trillion to the global economy by 2030. How can developing countries like India position themselves to benefit from this surge?

Dr. Prasad: As I have already mentioned, India can learn from the successes and failures of the West. This avoids unnecessary spending and reinventing the wheel. For example, IoTs can be utilized for emergency response, predicting possible disasters, traffic control [this saves fuel and makes the environment clean], education, digital infrastructure, agriculture and healthcare, etc. These are some places where the government can spend immediately so that the benefits are higher.

Skill development is another important aspect. We have the largest young population, and IoT-related domains can be taught to these people. As IoT technology makes inroads, the demand for skilled workers who can manage, maintain, and develop IoT systems will increase. The government should invest in training programs to build a workforce that can meet this demand.

The capacity to scale up the manufacturing is much higher for India, and unlike other countries, the labour force is generally treated well, and we have enough. Thus, India can be a manufacturing hub under "Make in India". Once started, more investment will also come in. The important aspect is that we have the opportunity to make the best use of the iron when it is heated. The situation now with respect to manufacturing in the aftermath of the Corona lockdown is advantageous to India. **India can become a key player in the global supply chain. IoT is the domain where key innovation can be seen and touches multitudes of domains.**

MS: The Indian government has allocated ₹7,000 crores for smart city initiatives in 2024. What role do you think IoT and LoRa (long range) networks will play in advancing smart cities and improving urban infrastructure?

Dr. Prasad: LoRa is a recent communication protocol that doesn't need any service provider, and generally, unlicensed bands are used. LoRa networks, designed for long-range communication with low power consumption, are perfect for smart city applications. **LoRa, being long-range and low power, allows it to efficiently connect many IoT devices over wide areas, making it possible to monitor street lights, air quality, water management, smart meters for grids and water supply, and waste collection systems.**

Since LoRa supports large deployment of IoT networks, smart city initiatives can get a boost with LoRa deployment. IoT infrastructure in India will also get a boost. I have worked a lot on LoRa from its inception; some finer adjustments must be made for reliable connectivity for LoRa-based IoT devices.

MS: India ranked third in the number of IoT devices deployed globally in 2023. What economic opportunities does this bring, and how can the country leverage it for sustainable development?

Dr. Prasad: India's position as the third-largest deployer of IoT devices globally in 2023 is because of the sheer number of people and technology-savvy population we have, of course, also because of the smart city initiative. **However, what is lacking is a long-term vision of what these smart cities will be like in the next 25 years. What are the long-term benefits? What are the roles of municipalities and also users/people?** India can grow its economy by boosting "Make in India IoT" local production, reducing its dependence on imports, creating jobs, and increasing exports. This aligns well with initiatives like "Make in India," which promotes homegrown industries. India has the strength and potential to become an IoT manufacturing and innovation hub. This is a new domain to invest for newer jobs and efficient resource usage.

However, all the above can be achieved by refocusing the objectives of the smart cities initiative. **I believe we need to move away from just building smart cities to "sustainable cities". There is a difference between just being smart and being sustainable. Indeed, sustainable cities have to be smart!!**

IoT can help India develop a skilled workforce of engineers, data analysts, and educational institutions, leading to the next generation of professionals for a tech-driven economy. This is an upward spiral that makes overall development possible.

MS: The global Tactile Internet market is projected to grow at a CAGR of 17.5% by 2030. How can India tap into this growing market? And what policy changes would facilitate this expansion?

Dr. Prasad: The Tactile Internet enables real-time human-to-machine and machine-to-machine interactions and will transform industries like healthcare, education, and manufacturing.

- It can bring advancements like remote surgeries in healthcare and immersive learning in education, particularly benefiting rural areas with limited access to resources.
- India can tap into the growing Tactile Internet market through its 5G/6G telecommunications technologies.
- Tactile Internet helps to get a skilled workforce to manage the rural infrastructure.
- The disaster response becomes less risky.

My point of view is that India can not afford to put too many resources into R&D, but we need innovation in technology. How to do this?

This is where we can be creative. **Target new state-of-the-art applications and technology game changers for rural, governmental, and urban situations.** Tactile Internet applications are aplenty, and by pushing these applications, **we will be able to encourage innovation and investments.** The idea is to identify future technologies and encourage them by bringing them under CSR when an educational institution is part of it. We see that Indian industries will invest in 5G/6G and future network technologies to capitalize on this since the Tactile Internet relies on ultra-low latency and high-speed connectivity.

- **Tax benefits** for future technology development and R&D should also be implemented.
- **Strong data security and privacy regulations are crucial**, as the Tactile Internet handles sensitive information.
- **Clear legal frameworks will build trust** among businesses and consumers, positioning India as a leader in this emerging market.

MS: According to the World Bank, over 40% of the world's labor force could be impacted by automation by 2035. How should India handle IoT and the Tactile Internet to shape a safer future of work in developing economies like India?

Dr. Prasad: This is always a trade-off; one must be careful with respect to adopting IoT, LoRa, and the Tactile Internet type of domains/applications since, even now, the workforce in India is predominantly unskilled.

While automation can potentially increase efficiency and productivity significantly, it also poses a risk to traditional jobs, particularly in sectors like manufacturing and agriculture, where a large portion of the workforce is employed. **Thus, the jobs must be protected or slowly transferred to the workforce for future job profiles.**

An additional risk is that the skill sets required for the jobs lost typically do not match with the skill sets required for the jobs created. **Constant upskilling is one of the ways.** This means providing training programs to equip workers with the skills needed to manage, maintain, and work alongside automated systems and IoT devices.

The government can collaborate with the private sector to create accessible, affordable training programs targeting urban and rural workers. This situation is not new in the world. There is always enough space for everyone. **India, being the most populous, has an advantage** – that is, India needs a workforce at all levels of skills. Thus, providing employment to those who are left behind is not that difficult.

Labor policies should focus on ensuring a smooth transition, offering support to workers who may be displaced by automation, and helping them adapt to new industries, thus safeguarding both economic growth and social stability. To this end, we need technocrats, businesses, social scientists, economists, psychiatrists, and the government to work together.

MS: LoRa (Long Range) networks have been deployed across over 160 countries, including India. How can such networks improve connectivity in underdeveloped regions, and what socio-economic benefits could they bring?

Dr. Prasad: LoRa networks offer a cost-effective and scalable solution to improve connectivity for IoTs; please note LoRa is not for replacing mobile networks or connectivity for high-speed communications.

LoRa can support collecting data from remote places and thus help build digital sensing infrastructure through better governance or response to natural calamities or advisory can be rolled out.

One of the key advantages of LoRa is the low power consumption, allowing devices to operate on small batteries or even through energy harvesting, drastically reducing maintenance costs. **This makes LoRa networks ideal for rural areas with limited or unreliable power infrastructure.**

By improving resource management, reducing operational costs, and enabling real-time monitoring, LoRa networks can contribute to sustainable socio-economic development in underdeveloped regions, bridging the digital divide and empowering communities.

MS: A McKinsey report from 2022 suggests IoT could reduce global energy consumption by up to 10%. How can India utilize IoT to meet its climate goals and lower energy consumption?

Dr. Prasad: IoT deployments can help optimize the use of energy consumption. However, we need to deploy them intelligently. India can effectively use IoT to meet its climate goals and reduce energy consumption across various sectors. **IoT-enabled smart grids can optimize electricity distribution, reduce wastage, and help monitor real-time energy usage.**

Energy leaks/losses in India can be up to 30%, including thefts. IoTs can help in reducing and bringing it to around 5%. One of the most impactful applications is energy management in factories and households. **A few years back, we did some measurements and a study where we showed that up to 33% of energy could be saved in indoor deployments of IoTs for climate control [heating, ventilation, and air conditioning (HVAC)]. Smart grids can automatically adjust supply based on demand (demand-response) to ensure energy efficiency.** This is particularly important as India continues to urbanize and the demand for energy rises.

Idle energy losses in Industries, offices, etc., are on the rise, and these inefficiencies can be brought under control; **IoT sensors can monitor equipment performance and detect inefficiencies, enabling businesses to reduce energy use and cut costs.** For example, factories can use IoT to optimize heating, cooling, and lighting systems based on their activities. The ambient climate control can be adjusted based on human presence.

In agriculture, IoT devices can help farmers monitor irrigation systems, ensuring that water and energy are just adequate. This has the effect of smooth control and also avoiding over usage of water and other nutrients. This will directly contribute to lower energy consumption and support sustainable farming practices.

Identifying the emissions and, where applicable, replacing the inefficient engines will also contribute to energy reduction and contribute to India's climate goals.

MS: A 2023 survey indicates that only 8% of Indian manufacturing firms have adopted Industry 4.0 technologies, including IoT. How can increased IoT usage improve industrial productivity and boost India's GDP?

Dr. Prasad: Industrial-IoT or Industry 4.0 are all making inroads in Western countries. The idea is to collect all sorts of information and also find that it can revolutionize the way factories operate by enabling real-time monitoring, predictive maintenance, and automation of processes. **The performance of machines needs to be monitored continuously; using Digital Twins is another great way to deploy and use IoT in industrial settings.** The best use of human resources and raw materials can be made with IIoTs. This leads to more efficient production cycles and less waste of skilled labour.

Using IoTs, Indian manufacturing can become more competitive, boosting productivity and contributing significantly to the country's GDP.

To close, I summarize my thoughts:

- a. India has the highest potential to deploy and use IoTs effectively using the experiences of the Western countries, avoiding the same mistakes.
- b. IoTs can provide jobs to people in different strata with respect to their skills.
- c. Resource efficiency is a big game changer for India, where we need to be careful.
- d. Contrary to thoughts expressed by many in the IoT field, I think it is easy to deploy, and we also get higher returns if we deploy IoT in rural areas and agriculture sectors since most of the subsidies go to rural areas.

About Dr. R. Venkatesha Prasad

Dr. R. Venkatesha Prasad is a faculty member of the Networked Systems group at Delft University of Technology (TU Delft). Dr. Prasad completed his PhD from IISc, Bangalore, India. His PhD research on a scalable VoIP conferencing platform (like Zoom/Teams) led to a start-up venture, Esqube Communication Solutions, in 2003. He was instrumental in Esqube's selection as one of the top 100 IT innovators in India in 2006 by NASSCOM and the top 100 promising companies in Asia by RedHerring in 2008. He led a student team to win the worldwide Airbus challenge – Fly Your Ideas (2019). He is a senior member of IEEE and ACM. He is a Fellow of IETE.

He has supervised PhD (20+) and MSc (75+) students. He has (co-)authored 300+ publications in peer-reviewed international transactions/journals and conferences, including patents, standards, and book chapters. He has successfully acquired and executed several European and Dutch national projects in IoT, CPS, mmWave networks, Smart-energy systems, Personal Networks, and Cognitive Radios.

About the Interviewer

Mahima Sharma is an Independent Journalist based in Delhi NCR. She has been in the field of TV, Print & Online Journalism since 2005 and previously an additional three years in allied media. In her span of work she has been associated with CNN-News18, ANI - Asian News International (A collaboration with Reuters), Voice of India,

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