IIT Mandi team develops wireless powering and communication technology for IoT applications

The potential of the proposed system is vast and includes applications such as battery-free wireless cameras, wireless monitors, sensors, skin-attachable sensing platforms, contact lenses, machine-to-machine communication and human-to-machine interactions, among others.

Mandi, 12th May 2022: Researchers at the Indian Institute of Technology Mandi are working towards developing efficient remote powering and communication technology for futuristic Internet of Things applications.

The findings of this study were published in the Wireless Networks. The study was led by Dr. Siddhartha Sarma, Assistant Professor, School of Computing and Electrical Engineering, IIT Mandi, and co-authored by his student Mr. Shivam Gujral, Ph.D. Scholar, School of Computing and Electrical Engineering, IIT Mandi.

The Internet of Things (IoT) is a collection of objects ("things") that can exchange data with each other through the Internet. IoT devices range from ordinary household appliances in a "smart" home to sophisticated industrial and scientific tools. These smart things are equipped with sensors, chips, and software that must be powered and stay in communication with other devices at all times. Simplistic power sources such as batteries may be unsuitable for such applications because of the constancy of power required, and because some of these "things" may be embedded or hidden, which makes changing batteries difficult. There is thus worldwide research in combining remote communication technology with remote powering options.

Highlighting his research, Mr. Shivam Gujral, Ph.D. Scholar, School of Computing and Electrical Engineering, IIT Mandi, said, "We have developed a cooperative model, in which, backscatter communication and radiofrequency energy harvesting (RF-EH) devices act together to optimally allocate the resources such as time and antenna weights."

The team performed research on two such powering options - radio frequency energy harvesting (RF-EH) and backscatter communication. In RF-EH, energy is transmitted by a dedicated transmitter to the IoT device through radio waves, the same kind of waves that are used in mobile phones for communication. In backscatter communication, as before, power is transmitted via radio waves, but with/without the need for a dedicated transmitter. Instead, RF signals available in the vicinity, such as WiFi, cell phone signals, etc, are harnessed through reflection and backscatter to power the IoT objects.

The RF-EH and backscatter devices have their own strengths and drawbacks. For example, while the latter is associated with considerable energy savings compared to the former, it suffers from reduced data rate and a shorter transmission range. The IIT Mandi team has leveraged the complementary nature of these two technologies and judiciously combined them to achieve the desired Quality of Service (QoS) and efficiency using the power allotted to the system.

Going into the technical aspects of this work, Dr. Siddhartha Sarma, Assistant Professor, IIT Mandi, mentioned, "We used a dedicated power transmitter for the two devices, in which the backscatter device transferred information through a monostatic configuration and the RFEH device through the HTT protocol. The team used extensive numerical simulations to establish the superiority of the proposed cooperative scheme over existing schemes. In these simulations, key parameters were varied to analyze the performance of the model."

Researchers plan to implement the joint radiofrequency energy harvesting-backscatter communication system in real-time to analyze system performance. This would include working on the hardware aspects of the two complementary technologies. The potential of the proposed system is vast and includes, in addition to IoT devices, applications such as battery-free wireless cameras, wireless monitors, sensors, skin-attachable sensing platforms, contact lenses, machine-to-machine communication, and human-to-machine interactions.

About IIT Mandi

IIT Mandi has four Academic Schools and three major Research Centers. The Schools are: School of Computing and Electrical Engineering, School of Basic Sciences, School of Engineering, and School of Humanities and Social Sciences. The Centers are: Advanced Materials Research Centre (AMRC; set up with an investment of Rs. 60 crores), Centre for Design and Fabrication of Electrical Devices (C4DFED; has Rs. 50 crores worth of fabrication tools), and BioX Centre (has acquired research equipment worth Rs. 15 crores).

The unique, project-oriented B.Tech. curriculum is centred around its 4-year long Design and Innovation stream. From August 2019, IIT Mandi started 3 new and unique B. Tech. programmes in Data Science and Engineering, Engineering Physics, and Dual Degree in Bioengineering. Since the inception of the Institute, IIT Mandi faculty have been involved in over 275 Research and Development (R&D) projects worth more than Rs. 120 crore.

IIT Mandi set up the IIT Mandi iHub and HCI Foundation (iHub; a section-8 company) on its campus at Kamand with significant funding of INR 110 crores from the Department of Science and Technology (DST), Government of India. The iHub is planned to fuel research and technology development, skill development, startup and innovation, and collaborations in the HCI and allied AI/ML areas in India. IIT Mandi is the only second-generation IIT to be featured at rank no. 7 in the Atal Ranking of Institutions on Innovation Achievements of the Innovation Cell, Ministry of Education, Govt. of India.

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