Driving the Future: IIT Indore's Enhancing Vehicle Connectivity for Safer and Smarter Transport Systems

OR

IT Indore Develops Smart Vehicle Communication Technology to Make Roads Safer and Traffic Smarter

OR

From Connected Cars to Safer Roads: IIT Indore Research Drives the Future of Smart Transportation

Researchers at the Indian Institute of Technology Indore, led by **Prof. Prabhat Kumar Upadhyay**, are working towards building smarter and safer transportation systems by using advanced vehicular communication technology known as C-V2X, or Cellular Vehicle-to-Everything communication. In simple terms, this technology allows vehicles to communicate with each other, with road infrastructure, pedestrians, and even cloud-based systems. The main objective is to create a connected road environment where vehicles can share information in real time, leading to improved safety, smoother traffic flow, and better overall road management.

With this technology, vehicles can automatically warn one another about potential dangers such as accidents ahead, slippery road conditions, or sudden braking by another vehicle, even before the driver becomes aware of the situation. This is made possible through the use of advanced wireless networks like 4G LTE and 5G, which enable fast and reliable exchange of safety-related messages. As a result, vehicles are able to take quicker and more informed decisions, helping to prevent accidents and reduce traffic congestion.

The research at IIT Indore focuses on how communication resources, such as radio frequencies used for sending and receiving messages, can be shared efficiently among different users on the road. These users include Cellular Users, such as smartphones and in-vehicle infotainment systems, and Vehicular Users, which are vehicles that exchange safety messages with one another. Since both types of users rely on the same wireless network, the challenge lies in allocating these shared resources in a way that does not affect safety or the quality of communication.

To address this, the researchers have developed intelligent algorithms that decide which vehicle should use specific communication resources and at what time. These decisions are made by considering real-time traffic conditions, signal quality, and network load. Ensuring timely communication is extremely important, as even a small delay in

transmitting safety messages can make the difference between avoiding an accident and causing one.

The research also considers the high speed and constant movement of vehicles, which can lead to rapid changes in wireless signal conditions due to motion and obstacles. To handle this, realistic models and simulations are used to test the performance of the proposed methods in dynamic traffic scenarios, ensuring that the communication system remains reliable under real-world conditions.

Highlighting the broader impact, **Prof. Suhas Joshi, Director of IIT Indore stated**, *"Research in intelligent transportation and vehicle connectivity is crucial for addressing today's road safety challenges. Technologies like C-V2X developed at IIT Indore demonstrate how advanced communication systems can save lives, reduce congestion, and support the future of autonomous and smart mobility in India."*

Explaining the vision behind the work, **Prof. Prabhat Kumar Upadhyay said**, *"This research focuses on developing intelligent vehicular communication systems that enable vehicles to share real-time information with each other and with road infrastructure. This work aims to make transportation safer, smarter, and more efficient by improving how connected and autonomous vehicles communicate on the road."*

The overall aim of this research is to improve road safety, reduce travel time, and support the future development of autonomous vehicles that can work together seamlessly. By contributing to intelligent transportation systems, where vehicles, pedestrians, and infrastructure are closely connected, this work from IIT Indore brings society closer to safer, smarter, and more efficient roads where technology plays a key role in protecting lives and improving mobility.

$g_{u,Z}^n$

V2I UE

gNB

$\tilde{g}_v^n$

$\tilde{g}_{u,v}^n$

g_v^n

V2V UE

Signal
Link

Interference
Link