



**XTIC**  
EXPERIENTIAL TECHNOLOGY INNOVATION CENTRE

# XTIC Chronicle

Volume 01 | March 2024

Newsletter of Experiential Technology Innovation Centre  
of IIT Madras, Chennai



Inside

About XTIC & CAVE, Team, First XR Training & Feedback, XR Industry Trends, Partners, Announcement, Upcoming Events, Joining XTIC & Contact



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# About XTIC - Experiential Technology Innovation Centre

XTIC is an Indian Institute of Technology-Madras Community for Experiential Technology. It is India's 1st Research & Product Innovation Centre for Virtual Reality, Augmented Reality, Mixed Reality and Haptics.

## CAVE - Consortium for Augmented and Virtual reality (VR/AR/MR) Engineering:

Under umbrella of XTIC, CAVE is the first consortium in India for XR Innovations (VR/AR/MR) in Engineering Mission in India (CAVE), is an India Specific group of academia, industries, startups, government bodies, at the IIT Madras.

CAVE is a part of a bigger vision of the XTIC in which we aim to make India as the XR Corridor for the world. Similar to the phrase "India is the IT corridor of the world", XTIC and CAVE aim to realize "India as the XR Corridor of the world" by 2040.

The CAVE's Engineering Mission is to promote engineering of XR technology development, not just using XR, and adoption of virtual, augmented, and mixed reality globally, particularly in India, with best practices, dialogue with all stakeholders, government policy makers, and research institutions. The CAVE is a resource for industry, academia, consumers, and policymakers interested in virtual, augmented, and mixed reality. CAVE shall have industry and domain specific group like AutoCAVE for Automotive, AeroCAVE for Aerospace, ArchCAVE for Architecture, IoTCAVE for Internet of Things and so on to focus work for adoption in that sector.

The main objective of this consortium is to enable members to create new advanced technologies and applications in XR together. Our research collaboration is with industrial sponsors and participants from industry, academic Institutes, government, Startups, Individuals, Medium Scale Enterprises and members.

## What we do?

We are an innovation corridor that exists to support innovation in AR, VR & MR for IIT Madras projects and selected students in their pursuit to explore and

guide to the journey of entrepreneurship. We are the catalyst who will accelerate growth, expedite the process, and envision a project or product to completion.

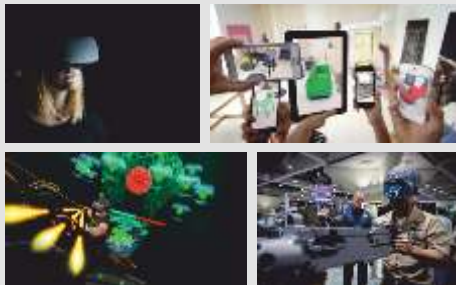
## What we offer?

We give a wide array of services to become the innovative power of individuals through a network of highly-curated tutors and advisors, peer-to-peer interaction, and inclusive resource and programming support.

## What we believe?

We firmly believe that wisdom paves the way for innovation, collaboration, and fitting together is vital as well. We also trust that by connecting like-minded people with shared goals and similar values, remarkable things happen. We believe in providing all the essential supports for innovation, including physical safety, transparency, empathy, compassion, connection, and the prospect for an inventive collision. We believe in revealing inherent value that can have a deep influence on marketplaces, on the world, and on the individuals, who come across these doors. We also instill our belief, we can be our creators.

**Our Technology:**  
Virtual Reality,  
Augmented Reality,  
Mixed Reality,  
Haptics Technology



**Our Labs:**  
Media Labs, AR/VR Studio,  
Haptic Lab, Maker Lab and  
Manufacturing Lab

For more details, please visit and join at <https://xtic.org/>

## XTIC Publication Committee

Chairman



**Rabindra Sah**  
Chief Engineer - Strategic Project  
Tata Technologies, Bengaluru

Co-Chairman



**Raghavendra Achari**  
Principal Project Officer  
IIT Madras, Chennai



# Team XTIC

## Advisory Board

### Mr. Prakash Damodhar, IAS (Retd.)

Former IT Secretary of Tamil Nadu  
Advisor for Centre of Excellence  
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### Mr. Hansraj Verma, IAS

Additional Chief Secretary,  
Government of Tamil Nadu

### Dr. Neeraj Mittal, IAS

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Department of Telecommunication,  
Government of India

## IIT-Madras Faculty

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Principle Investigator, Haptics Lab,  
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### Dr. Amit R.K.

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### Dr. A.N. Rajagopalan

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Engineering

### Dr. John Ebenaser

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Department of Computer Science

### Dr. Ganapathy Krishnamurthy

Medical Imaging Reconstruction Lab,  
Department of Engineering Design

### Dr. Nirav Patel

INSPIRE Lab, Department of  
Engineering Design

## International Collaborators

### Dr. Steve Lavalle

Co-Founder of Oculus, Perception  
Engineering Laboratory at the  
University of OULU-Finland

### Dr. Mel Slater

EVENT Lab: Experimental Virtual  
Environments for Neuroscience and  
Technology, University of Barcelona-  
Spain

### Dr. Mandayam Srinivasan

USA Founder of The MIT Touchlab,  
UCL, UK

### Dr. Edward J Colgate

Neuroscience and Robotics Lab,  
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### Dr. Gerrald E. Loeb

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USC Viterbi, USA

### Dr. Cagatay Bastogan

Robotics and Mechatronics Laboratory,  
KOC University-Turkey

### Dr. Marimuthu Palaniswamy

IoT, University of Melbourne-Australia

### Dr. Jung Kim

Biorobotics Lab, KAIST-South Korea

### Dr. Venkatraman Sadanand

Loma Linda Medical Center-USA

## National Collaborators

### Dr. Abhishek Gupta

Haptics Lab, Mechanical Engineering,  
IIT Bombay

### Dr. Sumit Kalra

Software Innovation Lab, Department  
of Computer Science-IIT Jodhpur

### Dr. Abhijit Biswas

Haptic Lab, CPDM -IISc Bengaluru

### Dr. Amit Bhardwaj

Haptics Lab, Electrical Engineering  
IIT Jodhpur

### Dr. Varun Dutt

VR Lab, Computing and Electrical  
Engineering - IIT Mandi

### Dr. Uttama Lahiri

VR Lab, Center for Cognitive and Brain  
Sdr.ciencies-IIT Gandhinagar

### Dr. Souptick Chanda

VR and Medical Simulations,  
IIT Guwahati

### Dr. Sivakumar Balasubramaniani

VR Lab, Bioengineering - CMC Vellore

### Dr. Sivakumar Balasubramaniam

VR and Rehabilitation-CMC Vellore

### Dr. Bhavani Rao R

AMACHI Labs, VR Skills Training-  
AMIRTA

## Project Officers & Scholars

### Dr. Madhan Kumar V

Post Doctoral Associates and Research  
Scholars

### Mr. Raghavendra Achari

Project Officers

## Industry Leaders

### Shri. Rabindra Sah

Chief Engineer - Strategic Projects  
Tata Technologies, Bengaluru- India

### Dr. Ashok Maharaj

Head XR Lab ,Tata Consultancy Services  
(TCS), India



**Dr.M. Manivannan**  
Professor - Touch Lab,  
Experiential Technology Innovation Centre,  
Department of Applied Mechanics and  
Biomedical Engineering,  
IIT Madras, Chennai

## India as a Grand Metaverse Corridor

emphasizing the fundamental science of the Metaverse to India's youngsters so as not to repeat the error of turning Indian youths into Cheap Laborers for the world, as was the case with the "IT Corridor" initiative. CAVE (Consortium for Augmented and Virtual Environment Engineering) is an Industrial consortium of XR(AR/VR/MR) led by XTIC that has more than 270 members, primarily entrepreneurs, professional consultants, and corporations from India.

India has a huge potential to lead the world in metaverse technologies towards Vasudhaiva Kutumbakam. The Indian IT sector, startup culture, and government goal of a \$5 trillion digitally driven economy will draw a large and growing youthful population to the Metaverse economy.

India will become the global "Metaverse Corridor" thanks to efforts of eXperiential Technology Innovation Centre (XTIC) of IIT Madras. To build the ecosystem for the Metaverse by 2047, XTIC is establishing the Metaverse corridor, coining a term similar to India known as the "IT corridor" of the world. XTIC emphasizes the metaverse's basic principles such as Perceptual Engineering to students in order to make this utopian future a reality. It is

The Metaverse can enhance gaming, education, e-commerce, and virtual real estate, creating new business prospects and revenue streams. India's IT specialists may discover new metaverse uses for their expertise.

How can we measure Experience with Metaverse? Metaverse is about Engineering, Technology and measuring Perception, Sensation & Manipulation. XR has 2-Pillors Immersion and Interaction. There are six foundational technologies that power the Metaverse: AR/VR Hardware, Cloud Infrastructure, Chipsets-Processors, Low Latency Networks (5G), Design Tools & SDKs, Blockchain and Currency.

Metaverse challenges include India's youth's linguistic plurality. Companies entering India must choose a language to communicate with children from 122 recognised languages and 780 dialects. The Indian market is so large that even "minority" languages are spoken by millions. Metaverse might unite Vasudhaiva Kutumbakam across languages. Without language barriers, Metaverse has enormous potential to democratize education in India given that it is geographically unrestricted and can



**Technology of Touch**  
Committed to "Make in India"

therefore make quality education readily accessible.

Although the Metaverse has immense potential in India, it also comes with its own set of challenges to overcome. First, in terms of Internet connectivity as the Metaverse requires high-speed internet, and many regions in India still struggle with poor connectivity. Second, affordability as the Metaverse requires high-end devices to run smoothly, and limited devices are presently available in India, and still expensive to most of its population in rural India. Third, regulation as the Indian government is yet to come up with specific regulations for the Metaverse, and it is paramount to ensure that the Metaverse does not promote any negative influence or have a negative impact on society. XTIC plans to take the lead in developing open source software on the Bharat OS (BharOS) platform for the metaverse built for the indigenously developed hardware with Shakthi processor being pioneered at IIT Madras.

Eventually, India will drive the Metaverse, in terms of technology, economy, social, and scientific innovation. India's understanding of human perception - and the host of new fields such as Perceptual Engineering and Perceptual Algebra will steer the Metaverse in the future, however India has to get ready with a scientific mindset. Vasudhaiva Kutumbakam is possible only by India, integrating the world, not by religion, race, borders, but by the science of Maya.

India has more to offer to Metaverse than anyone can imagine!



## Editorial Desk



**Rabindra Sah**

Chief Engineer - Strategic Project  
Tata Technologies, Bengaluru

### Immersive Digital Twins: Empowered by XR

eXtended (XR) is a term used as an umbrella term and is frequently used to group technologies such as V<sup>o</sup>, A(R) or M(R), together. XR covers the hardware, software, methods, and experience that make virtual reality, mixed reality, augmented reality, cinematic reality and others a reality.



XTIC is launching a newsletter to maximize the reach of XR's potential and promote its adoption among all stakeholders across the industry by sharing knowledge and creating a community of CAVE. The primary objective is to raise awareness of growth opportunities, technological trends, skill demands, training initiatives, Webinars, research developments, Policy documents, whitepapers and the creation of use cases to address societal issues. It aims to foster an ecosystem involving academia, Startup, industry, and government collaboration. It will meet the growing demand of XR in India and globally.

XTIC is working to create a Hub and Spoke model Pan India. It will have an umbrella of multiple CAVEs dedicated for the industry sector.

Technology-mediated experiences that combine virtual and real-world environments and realities. Whereas a Digital Twin describes the creation of a digital model that faithfully mirrors physical products, processes, or resources. Its primary purpose is to imitate real-world behaviour, enabling organizations to gain valuable insights and make informed decisions.

Application of XR in digital twin involves various stages like product design, new product introduction, process and facility planning, manufacturing, digital twin implementation, and strategic approaches for sales and marketing including product design, product validation, new product introduction, process and facility planning, manufacturing, and strategic approaches for sales and marketing which makes digital twin. XR creates

an immersive experience for the users/customers while carrying out reviews, training, maintenance & repair.

The application of XR in Digital Twin technology is versatile and relevant across various industries, including Automotive, Aerospace, Heavy Machinery, Process Industry, Healthcare, and more. This adaptability offers flexibility to cater to specific business requirements, allowing organizations to harness the benefits of XR technology tailored to their unique needs.

The benefits of XR in digital twin are multifaceted and include faster time to market, cost savings, innovation, improved quality, and staying competitive.



## XTIC Successfully delivers first training on XR - Pan India Participation

Course Title

### Foundation Course on Virtual Reality and Augmented Reality at IIT Madras, Chennai

#### HIGHLIGHTS OF COURSE COMPLETED

The course is delivered in a hybrid format spanning 8 weeks, with the first 7 weeks conducted online. The final week culminates in an in-person project & workshop held at IIT-Madras.

The Eight-week Foundation course on Virtual Reality (VR) and Augmented Reality (AR) provides working professionals with the essential Unity3D skills / tools needed to build VR AR apps by better understanding of these emerging technologies and delivered by Academia and Industry professionals.

Outline of Course Completed	
Week	Topic
Week # 01	Overview and Introduction to Immersive Technologies (AR/VR/MR)
Week # 02	Foundations of Perceptual Engineering
Week # 03	Getting Started with UNITY 3D
Week # 04	Introduction to Marker Based AR (VUFORIA) and Marker less AR (ARCORE/ARKIT)
Week # 05	Introduction 360 VR (3DOF) and OCCULUS QUEST VR (6DOF)
Week # 06	Advanced AR/VR and Industry Use cases
Week # 07	The Human Centric AR/VR -UX DESIGN -PROD PIPELINE -GUIDELINES
Week # 08	Workshop at IIT Madras including Demo, Hands-on, Seminar, Lab Visits



We at IIT Madras, thrilled to unveil our upcoming initiative tailored exclusively for corporates, working professionals, academia, and faculty members: Modular-Based AI-Enabled XR Certificate and Diploma Courses! With specialized electives focusing on XR with IoT and XR with 5G.

In addition to our certificate and diploma courses, we're thrilled to announce 3-Day XR Familiarization Workshops tailored specifically for corporates. Contact [cave@xtic.org](mailto:cave@xtic.org).

## Merkel Haptics Develops 50 Fire Safety Simulators for Indian Air Force

Merkel Haptics, a startup incubated by IITM, is thrilled to announce the successful delivery of 50 customized VR and haptic-based Fire Safety Training Simulators to the Indian Air Force in collaboration with CTPL. These simulators will facilitate fire safety training across 23 Air Force Bases in India.

The Indian Air Force often utilizes wheeled twin CO2 extinguishers alongside standard extinguishers to address potential fires during aircraft refuelling and

ignition. With Merkel's Haptic based VR Training systems, the Air Force can now undergo training without the need for real fire extinguishers, thereby making it sustainable and cost effective.





## Feedback from participants of First Batch of XR training



### An XR touch experience

**Jibitesh Mishra**  
Professor  
Odisha University of  
Technology and Research

“ It was a nice learning experience at XTIC at IIT Madras that enlightened me about XR. I was particularly impressed by the Haptic laboratory at the IIT campus. The online training followed by one week on campus stay has made much improvement in my knowledge about XR tools and techniques. The hands-on experience about Oculus headset and other haptics equipment's was wonderful. ”



### XTIC: Elevating XR Education

**MP Prathikssa**  
Architect / XR Designer  
Lucid Dream Studio Pvt Ltd, Chennai

“ The XTIC workshop emerged when there was a notable absence of trustworthy online Indian courses. Unlike expensive US alternatives focusing solely on game engines for XR, XTIC offered a comprehensive curriculum covering XR's foundational theories, evolution, and industry applicability. Participants from diverse backgrounds were encouraged to ideate tailored XR products for their respective fields. While the basics of game engines for XR were covered, the workshop broadened our perspective on XR's potential and inspired proactive engagement. ”



### Learn to craft XR with Perception Engineering

**Khagendra Sharma**  
Scientist-D  
National Institute of Electronics  
and Information Technology (NIELIT)  
under Ministry of Electronics and  
Information Technology (MeitY), Gol

“ The XR training and workshop conducted by XTIC is a professionally designed course which provides a deep understanding about how XR works with focus on designing state of art applications in various fields with human perception as the foundation. The learner is exposed to the entire lifecycle of XR development through a good mix of both conceptual and hands-on sessions. ”



### Virtual Reality: A new concept of professional training

**Meena Kumari**  
Chief Manager (Design)  
Hindustan Aeronautics Ltd.

“ The XR training is very valuable for us and a great learning experience. It strengthens my technical skills especially practical view of Virtual Reality and Augmented reality. The content with real life example were very interesting. Thank you very for such a great session! ”



### Entered the new happening world

**V Ganesh**  
Sr DGM  
Powergrid Corporation of India Limited, Bidar Karnataka

“ I thank IIT Madras for providing me opportunity to be part of ARVR workshop. Had an opportunity to meet the industry experts who are already working in the field of ARVR. Six days sessions were well organised with good mix of class room and hands on session. Provided life time opportunity of interact with young participants and discuss about the application of ARVR in power transmission and construction Industry. After the workshop, we had conducted AR and haptic based fire safety training in our unit at Kozhikode through Merkel Haptics, thereby we have tried to spread the ARVR applications in real life situations. ”







**Raghavendra Achari**  
Principal Project Officer  
IIIT Madras, Chennai

## Metaverse or Spatial Computing - Label Matters

prompting diverse interpretations and possibilities.

In contrast, "Spatial Computing" represents a more focused approach, emphasizing how technology enhances interactions with digital content in physical spaces. It's the next immediate evolution in computing interfaces, bridging the gap between the digital and physical realms.



Computing envision emerging immersive technologies, but their realization hinges on timing and hardware availability. Reflecting on the evolution of terms like "selfie" and the transition from "Information Superhighway" to "internet" underscores how timing and hardware advancements intersect to influence the adoption and popularization of new technologies. Just as the term "selfie" gained prominence with the advent of smartphone cameras, the widespread adoption of Metaverse and Spatial Computing relies on the accessibility and advancement of relevant hardware.

In essence, understanding the nuances of these labels is crucial in navigating the evolving landscape of digital experiences and technologies.

The terms "Metaverse" and "Spatial Computing" have become pivotal in discussions surrounding emerging technologies, often associated with Meta's marketing and Apple's initiatives, respectively. Examining these labels sheds light on how they shape our understanding and perception of future digital landscapes.

### Clarity of Vision: Long-term vision versus immediate evolution

The term "Metaverse" embodies a broad and evolving concept, evoking discussions ranging from envisioning a 3D internet to contemplating a blockchain-driven decentralized economy. It encapsulates a long-term vision of a virtual shared space,

### Generic Versus Specific:

Labelling content as Metaverse or Spatial Computing can evoke distinct perceptions. Comparatively, content tagged with Metaverse implies a diverse range of digital experiences akin to navigating a food court, where various options cater to different tastes within a shared virtual space. On the other hand, Spatial Computing-centred content resembles dining at a theme restaurant, offering specific solutions tailored to applications within the realm of spatial computing.

### Time and Hardware Matters:

The concepts of Metaverse and Spatial



**Rrahul Sethi**  
Founder  
Metaverse911

## XR's Exponential Rise and Boundless Potential

Extended reality (XR), encompassing augmented reality (AR), virtual reality (VR), and mixed reality (MR), is poised to revolutionize various sectors, transforming how we interact, learn, and work. Its growth trajectory is

undeniable, with the global XR market expected to reach a staggering \$821.5 billion by 2030, reflecting a compound annual growth rate (CAGR) of 53.7% [1].

This rapid expansion is fuelled by several key factors:

- XR empowers immersive learning experiences, enabling trainees to practice complex procedures in a safe, virtual environment. It can enhance medical education, engineering simulations, and even soft skills development.



- XR applications can optimize workflows and boost collaboration with remote teams through virtual workspaces and shared 3D models, fostering innovation and efficiency.
- XR is reshaping entertainment, offering interactive gaming experiences and virtual concerts.
- XR is pioneering new avenues in therapy, rehabilitation, and even surgery, facilitating remote consultations, patient support, and enhancing surgical precision.

While the growth is promising, challenges remain. Addressing hardware affordability, ensuring seamless user interfaces, and mitigating potential safety and privacy concerns are crucial for widespread adoption. Nevertheless, XR's potential to redefine industries and enhance human experiences is undeniable.

Source: [1] Worldwide Market Size of XR Industry from 2020 to 2030

(<https://www.grandviewresearch.com/press-release/global-augmented-reality-market>)





**Keyur Bhalavat**  
CEO & Founder

Plutomen Technologies Private Limited

## Adoption / Application of XR (AR-VR-MR) in industry

The future of industry isn't just about smart factories; it's about smart workers too. While digital transformation focuses on automating processes and optimizing shop floors, a crucial element often gets sidelined - the frontline workforce. Empowering your frontline workforce is crucial to maximizing productivity, reducing operational costs and staying ahead of the curve.

Plutomen

**XR In Industries:**  
Building a Future-Ready  
Workforce



This is where Extended Reality (XR) steps in. XR, an umbrella term encompassing Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality offers a revolutionary approach to empowering frontline workers.

Here's how XR empowers frontline workers across industries:

- 1. Enhanced Training:** XR offers immersive training for frontline workers, allowing them to learn complex tasks and practice maintenance in a virtual setting, reducing on-the-job accidents and enhancing knowledge retention.
- 2. Remote Collaboration:** VR and AR platforms empower teams to collaborate seamlessly, overcoming geographical barriers. This shortens time to resolution and increases first-time-fix rate.
- 3. Optimizing Maintenance and Repair:** AR streamlines maintenance procedures by providing field technicians with instant access to

crucial data. This reduces downtime, improves repair accuracy, and empowers technicians to handle complex tasks independently.

- 4. Improving Safety and Risk Management:** XR allows workers to practice risky procedures in a safe, virtual environment. This prepares them for real-world situations without the risk of injury.
- 5. Increasing Efficiency and Productivity:** Provide workers with real-time instructions and data, leading to significant productivity gains. Studies show XR can improve overall productivity by an average of 32%.

With continued advancements, XR's integration with Artificial Intelligence (AI) and the Internet of Things (IoT) offers even greater possibilities, resulting in a more effective, innovative, and collaborative future of work.



**Ranganadh Thatha**  
Associate Director

Sony India Software Centre, Bangalore

## Portable Motion Capture Devices

Motion capture technology transforms the dynamics of a real-world entity into digital form, enhancing the realism of computer-generated figures in video productions. This innovative method is gaining popularity across various industries, including films, animations, video games and metaverse.

Traditionally, motion capture has been a resource-intensive process, necessitating a studio setup with numerous cameras and actors wearing specialized suits dotted with reflective markers. Traditional mocap setup costs anywhere between \$25K to \$500K. This is out of reach for normal users.

However, advances in sensor and AI technologies allowed engineers to create low-cost alternatives in terms of portable motion capture devices. This novel approach leverages compact, unobtrusive sensors, eliminating the need for elaborate studio arrangements and cumbersome suits.

Portable motion capture devices empower normal users to capture authentic human motion in everyday attire, in any setting, and seamlessly integrate it into virtual characters.

Sony's "Mocopi" device is one such example. It was launched in Japan & USA markets and costs around \$400.



Figure 1: Motion Capture (MoCap) Studio Setup



Ref: Sony Corporation - mocopi | About mocopi



## Expanding Partnerships: XTIC's Growth Journey



**National Council of Science Museums**  
Ministry of Culture, Government of India



## XTIC Connect: Join & Stay Linked

for upcoming Events, Training, Newsletter, Update, Latest Development, Membership, Research Partnership with Startup, Industry, Academic Partner, International Academic Partner

QR Codes to Join XTIC membership and follow on LinkedIn and Visit XTIC Website



QR code for XTIC Membership



QR for LinkedIn



QR for XTIC website

## AutoCAVE – CAVE for Automotive Sector

AutoCAVE is the Consortium for Augmented and Virtual Reality (VR/AR/MR) Engineering (CAVE) for the automotive sector. It comprises industry experts who collaborate at every stage of the product lifecycle, from design to sales and marketing.

The team has identified 30 priority domains within the automotive sector. Academia and start-ups can select any of these 30 problem statements to develop products and case studies.

For more detail, please visit <https://xtic.org/autocave/>

Register to participate in AutoCAVE <https://forms.gle/9SZN4UR5ffwbLxuS6>



QR code for More on AutoCAVE



QR code to apply for AutoCAVE





## Glimpses of First Batch of XTIC Training/Workshop

