Agnel Charities

Fr. C. Rodrigues Institute of Technology, Vashi

Mechanical Engineering Students' Association

presents

URJA

2025 - 2026

DIGITAL TWIN

Shaping the Future of Engineering through Virtual Innovation

Agnel Charities

Fr. C. Rodrigues Institute of Technology, Vashi

(An Autonomous Institute & Permanently Affiliated to University of Mumbai)

Department of Mechanical Engineering

Mechanical Engineering Students' Association

Presents

ऊर्जा

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DIGITAL TWIN

INSTITUTE PROFILE

F.C.R.I.T was established in 1994 and is a part of the Agnel Technical Education Complex at Vashi, established in 1984. The institute is named after the late Rev. Fr. Conceicao Rodrigues. F.C.R.I.T persistently seeks and adopts innovative methods to consistently improve education quality. The campus has a cosmopolitan atmosphere with students from all corners of the country. Experienced and learned teachers are strongly encouraged to nurture the students. The global standards set at F.C.R.I.T in the field of teaching spurs the students in relentless pursuit of excellence.

F.C.R.I.T has, within a short period, established itself as a leading engineering college in Mumbai University. It has to its credit a verdant, well-maintained campus and extensive facilities. Its location in the vicinity of the holy places of various religious denominations underscores it secular credentials and its philosophy of "Vasudhaiva Kuttumbakam".

INSTITUTE VISION

To evolve and flourish as a progressive center for modern technical education, stimulating creativity in every student and leading to self-sustainable professionals, through holistic development, nurtured by strength and legitimate pride of Indian values and ethics.

INSTITUTE MISION

1. To provide industry-oriented quality education.
2. To provide a holistic environment for overall personal development.
3. To foster relationships with other institutes of repute, alumni, and industry.

VISION OF DEPARTMENT

To provide a vibrant academic, research, and industrial environment for creating self-sustainable professionals and responsible citizens.

MISSION OF DEPARTMENT

1. To provide state-of-the-art infrastructure and quality education.
2. To generate opportunities for students to provide Industrial Exposure.
3. To imbibe team spirit and entrepreneurial skills.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

Graduates will...

1. Be able to use effectively engineering knowledge and modern tools in the field of core Mechanical Engineering.
2. Have interdisciplinary competence in areas like Mechatronics and CAD/CAM/CAE.
3. Be able to demonstrate adequate competency and creativity to take up corporate challenges.
4. Be able to pursue higher studies and entrepreneurship.

PROGRAM SPECIFIC OUTCOMES (PSO)

Graduates will be able to...

1. Apply knowledge in the domain of Design, Thermal, and Manufacturing sciences to solve Engineering Problems.
2. Use appropriate tools and techniques to solve problems in the field of Mechanical Vibration and CAD/CAM/CAE.

PRINCIPAL'S MESSAGE

Dear Students,

The world of engineering is rapidly evolving, and the Digital Twin stands at the forefront of this technological revolution. By enabling engineers to create virtual replicas of physical systems, the digital twin empowers every phase of the engineering lifecycle—from ideation and prototyping to monitoring and predictive maintenance. This breakthrough fosters a deeper connection between data and decision-making, helping future engineers anticipate challenges and innovate with precision.

As we integrate digital twins into our curriculum and institutional research, I urge students to not only focus on mastery of tools and technology but also to develop critical thinking, adaptability, and ethical responsibility. The journey doesn’t end with technological proficiency—it calls for leadership, collaboration, and a vision for using these advancements for societal benefit. Our campus is a place where creativity thrives and where each individual's curiosity and integrity drive genuine progress. I am confident that with passion, teamwork, and diligence, our students will set new benchmarks in digital innovation and responsible engineering.

- Dr. S. M. Khot

Principal

DEAN'S MESSAGE

Dear Students,

The Digital Twin represents a paradigm shift in engineering—transforming physical assets into dynamic, interactive digital models that facilitate experimentation, learning, and optimization. Mechanical engineers now have the unprecedented ability to simulate and predict complex system behaviors before fabrication, dramatically improving efficiency, sustainability, and safety. Across sectors like aerospace, automotive, energy, and health care, digital twins are proving essential for real-time diagnostics, remote management, and product innovation.

For our department, this is an invitation to break boundaries and nurture a new generation of interdisciplinary engineers. I encourage you to participate in hands-on projects, competitions, and collaborative research—where digital twin technology is at the core of creative problem-solving. Cultivate not just technical excellence, but also qualities of resilience, empathy, and ethical judgment. Let us work together to ensure our graduates are equipped to make meaningful contributions, lead transformative change, and inspire others in this digital age.

- Dr. Nilaj N. Deshmukh

Dean Admin and Faculty

HOD’S MESSAGE

Dear Students,

Embracing the Digital Twin is essential to redefine mechanical engineering for the future. It offers students and faculty the tools to simulate real-world phenomena, validate designs with virtual experiments, detect and resolve issues proactively, and achieve new benchmarks in performance and reliability.

Our department is committed to providing state-of-the-art infrastructure and exposing students to the newest developments in digital twin technology—through clubs, workshops, industry interaction, and research. This is a call for every student to forge interdisciplinary partnerships, critically assess data, and seek innovative solutions to real-world problems, whether in manufacturing, transportation, or smart infrastructure.

As mentors and educators, our goal is to imbue team spirit, entrepreneurial thinking, and a willingness to question traditional boundaries. With digital twins, the possibilities are limitless—pushing us to imagine smarter, safer, and greener solutions to engineering challenges. Let us collaborate, innovate, and build a foundation where digital intelligence and human values work in harmony for the greater good.

I extend my heartfelt gratitude to the MESA team for their dedication to making this magazine a reality. Your hard work and commitment are truly commendable.

Wishing you all continued success in your academic pursuits and beyond.

-Dr. Aqleem Siddiqui

Head of Department

CO-ORDINATOR'S MESSAGE

MESA is a collegiate organization that stands for Mechanical Engineering Students Association. The objective of MESA is to create opportunities for students to enhance their knowledge about the latest technological developments by organizing various events. The MESA council of F.C.R.I.T., Vashi has ensured a continuous flow of ideas and knowledge by conducting annual seminars and technical events. These seminars give the students a sneak peek in the outside world. CALIBRE, SYNERGY, and MESH are the three events conducted every year under the aegis of MESA. In SYNERGY, one industry is identified during the year and is invited to the campus for interaction. The aim is to bridge the gap between industry and institute and provide an opportunity for staff and students to interact with them directly.

The emergence of Digital Twin technology marks a pivotal moment in technical education. By merging physical reality with digital models, students gain unique opportunities to visualize processes, test designs, and forecast outcomes in real-time. This fosters deeper understanding, sharpens analytical skills, and accelerates practical learning.

Our team is committed to empowering students through active engagement in seminars, special lectures, and industry-driven research. We invite students to pursue interdisciplinary projects leveraging digital twins, collaborate with experts, and apply theoretical knowledge to solve pressing societal and industrial problems.

Beyond skill development, digital twin adoption teaches students the importance of ethics, data privacy, and the responsible use of technology. We believe that nurturing creativity, adaptability, and a growth mindset will position our graduates as future leaders—ready to advance technology, inspire communities, and contribute meaningfully to a digitally connected world.

- Dr. Bharat S. Kale & Prof. Shankar Waghmode

MESA Co-ordinators

TABLE OF CONTENTS

ABOUT MESA

“MECHANICAL ENGINEERING STUDENTS’ ASSOCIATION” popularly called MESA is a collegiate organization that organizes activities under the Mechanical Engineering Department. MESA is among the most active student bodies in the institute. Experienced and proficient faculty members of the Mechanical Engineering department mentor it. Students take upon many initiatives that prepare them to face future challenges. MESA aims to create opportunities for students to enhance their knowledge about the latest developments in the ever-evolving technological world by organizing various events. Three primary events are conducted under MESA, namely SYNERGY, MESH, and CALIBRE. These events provide a broader vision to the students regarding various technologies and developments happening in the professional field outside the college classrooms.

SYNERGY is conducted in every odd semester where speakers from the industry are invited to deliver lectures for Mechanical Engineering students. Similarly, MESH is conducted so that students get to know about the latest technological research advancements through researchers from IIT, NIT and BARC in every even semester. MESA also organizes its annual technical fest called CALIBRE. CALIBRE 2K24 was organized in association with “The Institution of Engineers (India), Navi Mumbai Local Centre” which had taken the initiative to inculcate creative thinking and an innovative mindset amongst the students. The event was a huge success.

Functions of MESA-

- Promoting the interests of students in various technical areas of mechanical engineering.
- Interaction between academia and industry by organizing industrial visits, special lectures, and intellectual talks.
- Interacting with other technical societies, within and outside the institute to promote the flow of knowledge and interest.
- To allow students to learn and focus on cutting-edge technology by interestingly presenting it to the students through seminars and workshops.

SENIOR COUNCIL 2025-2026

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Ayush Banerjee
Secretary

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PRESIDENT'S NOTE 2025-26

I clearly remember every moment from my first day up to now. It feels like it was just yesterday when I began at this place. The passage of time seemed slow, creating a deep and meaningful connection to this location. Our progress was built on a foundation of mutual trust and teamwork. Under the guidance of the senior council, we reached several significant milestones. Our initial strategy involved collaborating with faculty members and aligning with the Head of Department. While developing new event concepts, we drew on insights and lessons from past experiences. Thanks to our team's dedicated efforts, we gathered the resources to bring our plans to life.

As Synergy 2024 kicked off, we received enthusiastic responses and positive feedback for all the events. Following this success, we turned our attention to Mesh 2025, where we invited speakers from IIT Bombay. We then focused on Calibre 2025, the annual festival and our flagship event for mechanical students. The anticipation for Calibre 2025 was palpable, and the event exceeded all expectations with its overwhelming response. The innovative activities and seamless execution made it a standout success, further elevating the standards set by Synergy 2024.

Reflecting on the entire year with MESA fills us with immense satisfaction. Being part of MESA has been a profoundly rewarding experience. Together, we organised and executed Synergy 2024 and saw Calibre 2025 become a remarkable event. As we prepare to move on, I want to extend my deepest gratitude to all my colleagues, senior members, faculty coordinators, and supporters of MESA for their unwavering support and trust in us.

- Milind Gupta

President MESA 2025-26

PRESIDENT’S NOTE 2024-25

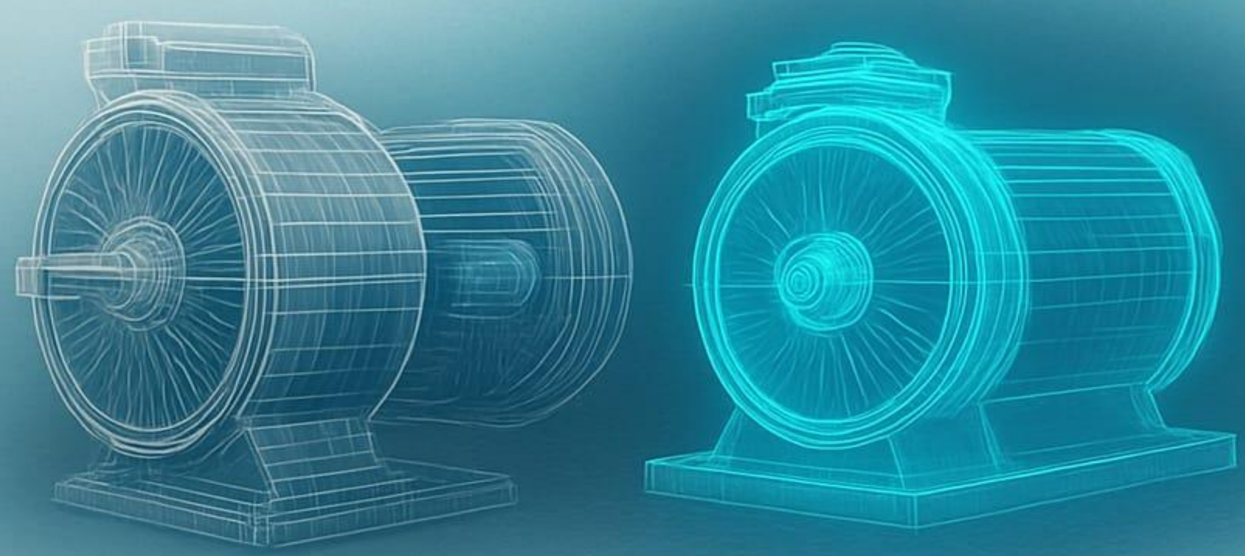
I still cherish every moment, from my very first day here to the present. It feels as if it was only yesterday when I walked in for the first time. Under the guidance of the senior council, we successfully completed Synergy 2023 and Mesh 2024. With their support and understanding, we moved ahead with confidence and determination to face upcoming challenges. We began planning with the help of our faculty members while closely coordinating with the HOD. Despite several activities running simultaneously, everything went smoothly, and when the event day finally arrived, our excitement was at its peak.

The first day of CALIBRE 2k24 marked another milestone, with every event receiving immense support and positive feedback—just as CALIBRE 2k25 did under our leadership as the senior council. Being part of MESA for two years has truly been one of the most rewarding experiences. With the arrival of new members into the MESA family, we planned and executed Synergy 2024 and CALIBRE 2k25 together. These events enhanced our coordination, strengthened mutual understanding, bridged gaps in perspectives, and refined our skills as a team. After all the dedication and hard work, it is now time to bid farewell. But parting also means moving forward and embracing new responsibilities. On behalf of everyone, I extend heartfelt thanks to all who made this journey possible and supported us throughout. I wish each of you the very best in your future endeavours. Finally, I would like to express my deep gratitude to my colleagues, senior members for their unwavering guidance, our faculty coordinators for their trust in us, and to every well-wisher of MESA.

- Kenrrick Wilson

President MESA 2024-25

Articles on Digital Twin



The Role of IoT in Digital Twin Development.

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Abstract-The combination of the IoT and digital twin has changed the landscape of industries and, moreover, it makes the communication a one that is effortless between physical systems and their digital recreations. A digital twin is a live-updated digital version of a physical thing, a process, or a system that duplicates its conduct, condition, and efficiency. However, IoT is the core of digital twins as it keeps the different models synchronized through a continuous flow of data coming from sensors, connected devices, and communication networks.

I. INTRODUCTION

Industry 4.0's coming has been the reason for the spread of the automation, connectivity, and data-driven decision-making technologies, that all fall under the broader scope of what Industry 4.0 represents. One among these is the concept of digital twins, which are gradually becoming the most promising creations, as they represent in the virtual world a physical object or process and thus grant the organization that owns it to make the same operations such as viewing, simulating, and optimizing the operation in real-time. Differing from the traditional static digital models, the digital twins keep growing and developing, being always in line with the latest conditions of the physical systems they represent and so let companies foresee the performance, lower the accidental rate and up operational efficiency.

The IoT (Internet of Things) is where the digital twin gets all the data it needs for their updates, besides what the digital twin itself can do. The IoT refers to the networks of things that are linked to each other and can manage the current data without much human work. For example, in an industrial setting, machines can have temperature, vibration, and power consumption sensors that can be used to monitor the performance. While in medicine, these wearables help monitor the essential functions of the body such as the heart rate, blood pressure, and oxygen level. This data is then sent through the communication networks such as 5G, Wi-Fi, and LPWAN, that have high speeds, so that digital twins are always up to date with the real-world systems. If there were no IoT, digital twins would be unaltered copies with no capacity to adapt to changes or highlight potential value-generating actions.

IoT-powered digital twins are reshaping the landscape of various industries. .

II. UNDERSTANDING DIGITAL TWINS

A digital twin is a dynamic and intelligent system that reflects the behavior, condition, and performance of a physical entity in real-time. Digital models are mere static representations, and digital shadows only passively show the data from the physical world. On the other hand, digital twins allow for bi-directional interaction. Therefore, changes made in the virtual model can not only modify the physical system but also vice versa.

Fig.1.Digital Twin

Fig.2.Digital twins in constructions.

III. APPLICATIONS OF IoT IN DIGITAL TWIN DEVELOPMENT

1. Manufacturing and Industry 4.0

One of the primary use cases of IoT-assisted digital twins is the implementation of digital twins in smart factories. These digital twins allow the factories to remotely monitor machinery, adjust the production line, and maintain product quality. Various sensors in the factory collect data like temperature, vibration, pressure, and energy consumption and then feed these figures into digital twins that simulate the performance of the machine in the factory. Thus, a production line twin, for example, can anticipate the wear of a machine, propose a maintenance schedule, or select the best flow rate that will lower downtime and raise productivity. As a result, companies can use the savings to better the quality of their products and increase their competitiveness in the markets. They will also grow inseparably with customers who require the increasing level of flexibility in the production process.

2. *Healthcare and Personalized Medicine*

Wearable IoT devices are sensors attached around the body such as smartwatches, implanted devices, and glucose monitors; they collect data from the patient and provide it in real-time. The patient digital twins facilitate the health situation simulation, disease progression forecasting, and the implementation of customized therapies for patients. Patient safety is the focus of this system which in turn helps to prevent hospital-acquired infections or emergencies. Digital twins for ICU are helping hospitals gate more efficiently resource allocation, patient allocation, and emergency supplies. Hence patient safety is strengthened, clinical vigilance is made possible, and the cost of care is reduced.

3. *Aerospace and Automotive Industries*

Vehicles and aircraft engines have been embedded with IoT sensors which continuously gather the operational data like engine temperature, fuel efficiency, tire pressure, and structural stress. Digital twins not only replicate the actual performance but also foresee the maintenance requirements and find the anomalies at a very early stage. As an instance, the digital twins are employed by the air carriers in managing the engine maintenance timetable thus not only avoiding expensive groundings but also enhancing flight safety. Car makers utilize the vehicle twins for self-driving technology practice and car performance optimization.

4. Energy and Utilities

IoT sensors in power plants, smart grids, and renewable energy systems provide real-time data to digital twins. These twins help monitor energy production, consumption, and distribution. They allow for better grid performance, load balancing, and predictive maintenance of turbines or transformers. Renewable energy operators can simulate the integration of solar or wind power to improve efficiency while reducing waste and outages.

5. *Smart Cities and Infrastructure Management*

Digital twins of cities or smart cities include IoT data that comes from traffic sensors, energy meters, pollution monitors, and public transport systems. With the help of such copies, urban planners oversee traffic flow, energy demand, solid waste management, and emergency response in the city. Let's look at the smart city twin as an example, which can represent the peak hour traffic scenario and, as a result, the next step of urban planning be the solution of the congestion caused by the peak or preparation of a new road extension which will make the flow increase and be more safe for the inhabitants' daily commute. This is how we can get a better infrastructure plan done which, in turn, leads to higher sustainability and (green) urban development.

IV. BENEFITS OF IOT-DRIVEN DIGITAL TWINS

1. Real-Time Monitoring

IoT sensors deliver continuous streams of live data. This lets organizations monitor equipment, processes, or environments in real time. Instant visibility helps detect deviations, failures, or inefficiencies right away.

2. Predictive Maintenance

Digital twins can foresee when a machine or system is likely to fail based on IoT data trends. This allows for proactive maintenance, which reduces unplanned downtime, extends asset life, and cuts maintenance costs. For example, a wind turbine twin can predict component wear and schedule maintenance before a breakdown occurs.

3. Process and Operational Optimization

By simulating workflows and testing different scenarios, digital twins improve production processes, energy consumption, and logistics. In manufacturing, digital twins can suggest the best production sequences or resource allocation to increase throughput.

4. *Cost Reduction*
Predictive maintenance, resource optimization, and efficiency improvements lead to significant cost savings. Organizations can cut energy consumption, reduce waste, and avoid costly emergency repairs.

V. CHALLENGES OF IOT IN DIGITAL TWIN DEVELOPMENT

1. *Data Security and Privacy*
IoT devices collect a lot of sensitive data. Protecting this information from cyberattacks is crucial. A breach could affect the accuracy of digital twins and disrupt physical operations.

2. *Scalability*
Large-scale IoT systems generate huge amounts of data. Managing, storing, and analyzing these data streams in real time needs effective cloud or edge computing solutions. These can be costly and complicated to implement.

3. *Interoperability and Standardization*
IoT devices from different vendors often use various protocols and data formats. Integrating these devices into a single digital twin platform can be difficult. It requires standardization and compatibility solutions.

4. *Latency and Connectivity Issues*
Real-time synchronization between physical systems and digital twins relies on reliable, low-latency networks. Limited connectivity, network congestion, or bandwidth problems can interrupt the flow of data, lowering the accuracy of twins.

5. *High Implementation Costs*
Setting up IoT-enabled digital twins requires investment in sensors, communication infrastructure, analytics platforms, and skilled staff. Small and medium enterprises may struggle with these expenses.

VI. CONCLUSION

Digital twins, powered by IoT, are changing how organizations monitor, simulate, and improve physical systems. IoT provides the continuous stream of real-time data needed to keep digital twins accurate, responsive, and smart. By integrating IoT, AI, and analytics, digital twins support predictive maintenance, process optimization, cost reduction, sustainability, and informed decision-making across industries.

The uses of IoT-driven digital twins cover manufacturing, healthcare, aerospace, energy, automotive, and smart city management. This shows their potential for transformation. However, challenges like cybersecurity, scalability, interoperability, and high costs must be solved for widespread use. As Industry 4.0 continues to grow, the combination of IoT and digital twins will be vital for creating smarter, more resilient, and sustainable systems that connect the physical and digital worlds

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Digital Twin in Aerospace and Automotive

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***Abstract*—Digital twin technology has become one of the major breakthroughs in industries where accuracy, safety, and efficiency are top priorities. In aerospace and automotive sectors, this technology enables the real-time duplication of physical assets such as engines, vehicles, and entire systems. As a result, continuous monitoring, predictive analytics, and optimized performance can be achieved. This article introduces the principles of digital twin technology and explores its applications in aerospace and automotive fields, while also highlighting its future potential to revolutionize transportation and air travel ecosystems.**

I. Introduction

The advent of cyber-physical networks in the aerospace and automotive realms has brought about increased complexity, higher operating costs, and stringent safety requirements. To address these challenges, organizations are adopting digital twin technology to create continuously updated digital representations of assets. By observing and engineering products through digital twins across their lifecycle, companies can monitor performance, detect anomalies, and test new initiatives virtually before applying them in reality. This approach enhances reliability, minimizes downtime, and accelerates innovation.

Fig.1. Digital twin representation showing real-time sensor data and performance analytics.

A. Understanding Digital Twin Technology

A digital twin is a virtual prototype that continuously reflects the real-time state and behaviour of its physical counterpart. It is powered by data from sensors, IoT devices, and advanced analytics. With the integration of Artificial Intelligence (AI) and Machine Learning (ML), digital twins gain advanced capabilities such as simulation, prediction, and optimization throughout the entire lifecycle of an asset.

II. Application of Digital in Aerospace and Automotiver Industry

A. Aerospace industry

The aerospace industry is characterized by the use of very complicated systems and the main feature is the safety, reliability, and efficiency of the processes. The digital twin technology has an important role in this by constructing virtual copies of aircraft components and systems, thus allowing on-the-spot observation and forecasting. In that way, engineers as well as operators are enabled to foresee breakdowns, simulate upgrades without actually doing them, and be assured of meeting the most strict regulatory requirements simultaneously reducing the risks as well as the expenses.

1. Engine Health Monitoring

Sensor data is used for real-time engine monitoring with the aim of failure prediction, fuel optimization, and increased component lifetime.

2. Structural Integrity Assessment

The modelling of the stresses that are acting on the structures of the aircraft to detect weak points and also guarantee the safety standards.

3. Pilot Training and Simulation

The development of the digital twin has now made it possible for the flight based on the digital twin technology to be as close to the real one as possible that is why the whole process of training and simulation of different situations can be done in a very safe environment.

4. Lifecycle Management

The monitoring of the airplane's performance starting from the design stage up to retirement which enables decision-making and maintenance to be carried out in an efficient manner.

Fig.2. The Analysis of jet engine parameters using digital twin technology

B. *Automotive industry*

The use of digital twins is a great support for the changes in the industry as it is virtual testing grounds, design optimization, and vehicle maintenance. By working up to thousands of real-world situations and constantly analysing the operational data, automobile manufacturers will be able to ensure safety, cut down on their costs, and speed up their development of smarter and more earth-friendly vehicles.

1.Vehicle Design Optimization

The vehicle design optimization process typically involves the simulation of the design variations to evaluate their performance, aerodynamics, and safety.

2.Autonomous Driving Development

Basically, the most activity of the virtual testing of the self-driving algorithms is conducted under a huge number of traffic scenarios.

3.Predictive Maintenance

The practice of predictive maintenance revolves around continuous monitoring of a vehicle's most critical components for the purpose of predicting failures and scheduling a maintenance routine that will be on time.

3.Connected and smart mobility

It mainly involves the use of different technologies such as the data vehicles (real-time-tricky), driver assistance systems, and V2I (vehicle-to-infrastructure) communication for fuel optimization that makes mobility intelligent.

III. Benefits and Challenges

Digital twin technology offers industries greater safety, efficiency, and innovation, but its adoption is not without hurdles. Alongside benefits like predictive maintenance and reduced costs, organizations face challenges such as high investment needs, cybersecurity risks, and integration issues.

A. *Benefits*

1.Safety Enhancement:

A fault indicator provides a new horizon for safety risks to be absolutely near zero.

2.Reduced Costs:

Reduces the need for physical testing as well as the occurrence of breakdowns that were not anticipated.

3.Faster Innovation:

The entire process from design to testing gets accelerated.

B. *Challenges*

1. High Energy Consumption:

To power sensors, platforms, and a skilled team takes a lot of energy which in turn gets converted into high expenditure.

2.Cybersecurity Concerns:

The constant data flowing in and out of systems leaves them vulnerable to hackers and other cyber threats.

3.Integration Issues:

The problem of interoperability between digital twin technologies with traditional systems still exists.

Conclusion

Digital twin technology is transforming aerospace and automotive by linking physical assets with virtual models for smarter design, maintenance, and operations. With AI, edge computing, and 5G, it enables large-scale ecosystem modeling of airports and highways. This paves the way for autonomous, safe, and sustainable mobility. As technology advances, it promises greater efficiency, innovation, and environmental impact across both industries.

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Digital Twin-Based Predictive Maintenance

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Abstract: **Digital twin technology builds a virtual replica of manufacturing systems that operates in real-time, hence allowing predictive maintenance. Through the use of sensor data and simulations, it identifies potential failures, which can lead to less downtime, better utilization of maintenance schedules, and a decrease in costs. Such an approach is the source of a greater efficiency, product quality, and longer equipment lifespan, which is the next step of intelligent and proactive manufacturing.**

Keywords: Digital Twin, Predictive Maintenance.

I. Introduction

Machines are the backbone of modern industries, and keeping them running smoothly is essential. Traditional maintenance approaches fixing machines only after they fail or servicing them on a fixed schedule often lead to high costs, wasted effort, and unexpected downtime. Predictive maintenance (PdM) improves on this by using data and analytics to forecast failures before they happen. Still, conventional PdM has its limits, as it often relies heavily on past data and struggles to adapt to complex, fast-changing conditions.

This is where digital twin (DT) technology makes a difference. A digital twin is a virtual copy of a real machine that updates continuously with live data from sensors and systems. It not only mirrors the machine's current state but can also simulate how it will behave in the future. By combining real-time monitoring, high-accuracy modeling, and intelligent decision-making, digital twins make predictive maintenance smarter and more reliable.

The use of digital twins in predictive maintenance benefits many industries, from manufacturing and energy to aerospace and construction. By seeing into the future of equipment, companies can schedule maintenance at the right time, reduce unexpected failures, extend the life of machines, and improve overall productivity. As industries move toward digital transformation, the combination of digital twins and predictive maintenance is becoming a key driver of efficiency and competitiveness.

II. History of Digital Twin and Predictive Maintenance

The idea of a digital twin first appeared in the early 2000s, with NASA using virtual models to monitor and test spacecraft from Earth. This approach allowed engineers to understand how real systems behaved without physically interacting with them. The term "digital twin" itself was introduced by Michael Grieves in 2002 when he discussed product life-cycle management. Since then, the concept has developed alongside advances in sensors, the Internet of Things (IoT), and data analytics. Today, digital twins are widely applied in industries such as aerospace, healthcare, and manufacturing, where they act as living models that mirror real-world assets and provide valuable insights for design, monitoring, and optimization.

Predictive maintenance (PdM) grew out of the need to move beyond traditional preventive approaches that relied on fixed schedules. In the 1990s, industries began using tools like vibration monitoring, oil analysis, and thermal imaging to detect early signs of equipment wear. The approach evolved rapidly with the arrival of connected sensors, artificial intelligence, and cloud computing in the 2010s. These advances allowed predictive maintenance to shift from being mostly diagnostic to becoming a proactive strategy that forecasts failures before they happen. This not only reduces unplanned downtime but also lowers costs and increases the lifespan of machines.

The combination of digital twins and predictive maintenance has become especially powerful in modern industry. Digital twins provide real-time, dynamic models of equipment, while predictive maintenance uses data-driven methods to anticipate faults. When brought together, these technologies allow organizations to simulate future scenarios, validate predictions, and plan the best response before a problem occurs. This integration moves maintenance from simply predicting breakdowns to prescribing actions that prevent them, making operations more efficient, reliable, and cost-effective in the long run.

III. IMPORTANCE OF PdM AND DT

Predictive maintenance PdM, is central to today's industries by changing the maintenance practices from the conventional reactive and preventive methods to data-based decision-making. Rather than waiting till the failure happens or changing the parts at predetermined intervals, PdM makes use of real-time sensing and sophisticated statistics to determine when the equipment will probably fail. It minimizes the unwarranted downtime, lowers the cost of operations, and increases the economic life of the machine. In high-risk sectors like energy, aviation, and manufacturing, PdM enhances reliability and safety and makes the optimum use of resources and manpower.

The digital twin is no less significant since it creates a virtual twin of a physical system to allow ongoing observation, simulation, and optimization. Through real-time integration of data, digital twins enable the organization to know how assets will behave under varying conditions, where the bottlenecks of the system lie, and test enhancements prior to implementing them on the actual systems. In addition to maintenance, DTs facilitate innovation by enhancing product design, supply chains, and customer customization. Their significance has further increased exponentially with Industry 4.0 since they act as the foundation of the intelligent factory, intelligent health systems, and infrastructure monitoring on a grand scale.

Both PdM and DT constitute a formidable duo for the improvement of industrial efficacy. PdM works on maintaining the health of the equipment on a proactive basis, and DT provides the digital domain to confirm predictions and test solutions virtually. The combining of both not just avert pricey breakdowns but also facilitates better decision-making, resilience, and sustainability in ever-more sophisticated systems.

IV. APPLICATIONS

A. Production:

Digital twins of machines and production lines track the health of equipment in real time in intelligent factories. Merging simulation models with sensor information helps manufacturers anticipate motor, conveyor, and robot breakdowns, reduce downtime, and maintain uniform product quality.

B. Aerospace and Aviation:

Aircraft engines and major components have digital twins that accompany them to track the performance as the conditions of operations vary. It allows the maintenance team to foresee the wear and tear, schedule repairs ahead of point of failure, improve safety of passengers and reduce the maintenance cost.

C. Healthcare and Medical Devices:

Hospitals have also started utilizing digital twins of medical devices like MRI scanners, ventilators, and dialysis machines to anticipate breakdowns ahead of time when they will impact patient care. DTs are also studied by virtue of human physiology simulation, allowing predictive maintenance of implantable medical devices like pacemakers.

D. Transportation and Automotive:

Digital twins of automobiles' engines, batteries, and connected vehicles are utilized by auto manufacturers to anticipate mechanical failures. It allows service scheduling planning and enhances the reliability of the kind of fleets such as trains, truck fleets, and autonomous vehicles.

E. Oil and Gas:

Digital twins simulate offshore platforms and refineries' pipelines, pumps, and drilling systems. Predictive maintenance of the sector decreases highly hazardous environment downtime, enhances the safety of the people working, and allows continuous operations.

V. FUTURE SCOPE

Future Scope of Digital Twin and Predictive Maintenance The future digital twin and predictive maintenance will be the integration of next-generation technologies such as AI, machine learning, the Internet of Things, and 5G. These will enable more accurate simulation, faster information transfer, and real-time decisions. Predictive maintenance will move on from fault detection to autonomous, prescriptive action, and digital twins will extend into health care, smart cities and sustainable infrastructure. The intersection of DT and PdM will deliver intelligent, connected, and sustainable systems that improve efficiency, safety, and resilience across sectors.

VI. CONCLUSION

The digital twin and predictive maintenance have come to the forefront of the modern industrial revolution. Predictive maintenance enables companies to predict equipment failure ahead of time, and digital twins offer a digital copy of the assets that facilitates monitoring, analysis, and optimization. Used together, the technologies provide a holistic system that maximizes reliability, lowers expenses, and facilitates sustainable operations. With continued development of the fields of AI, IoT, and smart manufacturing, their contribution will also continue to grow and become the prime facilitators of efficient and robust systems of the future years.

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Digital Twin for Application in Electric Vehicle Optimization

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Abstract- A potent tool for optimizing electric vehicle (EV) systems is digital twin technology, which creates virtual copies of physical assets that are updated in real time. The use of digital twins in EV design, performance improvement, predictive maintenance, and vehicle-to-grid (V2G) integration is examined in this paper. Predictive diagnostics, smart energy management, powertrain optimization, and battery management are important applications. There are still issues with data integration, model fidelity, cybersecurity, sensor costs, and computational demands despite the major advantages—such as quicker development, increased efficiency, and proactive maintenance. In addition to highlighting the revolutionary potential of digital twin technology for EV innovation, the paper ends with suggestions for overcoming these obstacles.

I. INTRODUCTION

A digital twin is a digital version of a physical system that receives continuous real-time data to simulate, optimize, predict, and control its physical counterpart. This idea started with NASA's spacecraft simulations in the 1960s and has since developed into strong tools used in manufacturing, healthcare, infrastructure, and more recently, in the automotive industry. For optimizing electric vehicles, digital twins allow for virtual testing of components and systems. They offer greater insights into performance and aid in better decision-making through real-time updates to the models.

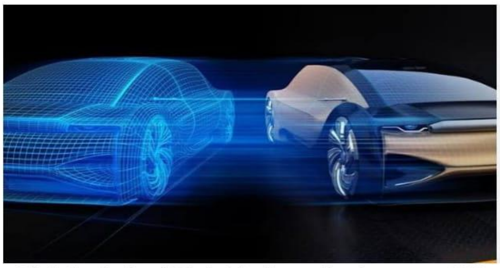

Fig1.Analysis of Digital Twin application across EV industries.

II. APPLICATIONS IN ELECTRIC VEHICLE

1. Design and Development:
   Digital twins allow for virtual prototyping of batteries, motors, and powertrains. This reduces the need for physical prototypes, speeds up design iterations, and improves performance predictions under different conditions.
2. Manufacturing and Quality Control:
   Simulating production processes with digital twins helps detect defects early and improve assembly processes, which boosts efficiency and cuts down on waste.
3. Predictive Diagnostics and Maintenance:
   Digital twins allow for real-time monitoring and predictive fault detection. This enables early identification of issues in batteries, motors, or controllers, which reduces downtime and lowers maintenance costs.
4. Performance Optimization and V2G:
   Digital twins improve energy usage and thermal performance by modeling driving patterns, charging strategies, and environmental conditions. In V2G systems, digital twin setups support real-time coordination between electric vehicles and power grids. This helps manage demand and integrate renewable energy.
5. Fleet Management and Safety:
   Fleet operators use digital twins to monitor overall performance, improve logistics, and simulate safety-critical situations. This boosts both operational efficiency and vehicle reliability.

III. CHALLENGES

1. Data Integration and Model Accuracy:
   Building accurate EV digital twins requires consistent, high-quality data from multiple sensors and platforms. Achieving this is difficult due to system complexity.

2. Computational Demands:
   Real-time analytics for vehicle and fleet digital twins need powerful computing resources, which limits scalability.
3. Cybersecurity and Privacy:

The constant data flow between physical and digital domains introduces risks of cyberattacks and data breaches. This makes security a significant challenge.

4. Sensor Costs and Fidelity:
Digital twins rely on a wide range of sensors, such as temperature, GPS, and current. Their accuracy, cost, and energy use impact model performance.

5. Scalability and Interoperability:
Scaling from component-level twins to full-vehicle or fleet models greatly increases complexity. Interoperability across platforms also remains a hurdle.

IV. BENEFITS

1. Reduced Development Cost and Time:
Digital prototyping reduces reliance on physical trials.

2. Improved Efficiency and Reliability:
Predictive diagnostics and optimization help improve energy efficiency and extend battery life.

3. Enhanced Safety:
Scenario simulations strengthen crash and system failure testing.

4. Smarter Energy and V2G Management:
Digital twins allow for optimized charging and discharging and grid interaction.

5. Fleet-Level Insights:
Aggregated data helps fleet operators make better decisions.

V. CONCLUSIONS

Digital twin technology can transform electric vehicle optimization. It supports design, predictive maintenance, V2G integration, and fleet management. There are still challenges, such as scalability, cybersecurity, cost, and workforce readiness. However, ongoing improvements in computing power, standardization, and AI integration are likely to address these issues. As these changes take place, digital twins will be crucial in shaping the future of EV technology and sustainable mobility.

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Cybersecurity Concerns in Digital Twin Systems.

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Abstract- Digital Twin (DT) systems have become essential in Industry 4.0. They allow for real-time monitoring, simulation, and improvement of physical assets using their virtual versions. These systems are used in manufacturing, healthcare, transportation, and smart cities. However, DTs face cyber threats because they depend on IoT devices, connectivity, and data sharing. This paper reviews digital twins, their uses, benefits, challenges, and security issues. It also talks about possible strategies to reduce risks.

I. INTRODUCTION

Digital Twin (DT) technology is changing industries by creating a dynamic digital version of physical systems. Through real-time data synchronization, DTs offer valuable insights into performance, predictive maintenance, and decision-making. However, combining DTs with cloud computing, IoT, and AI raises the risk of cyber threats. As a result, cybersecurity is an important issue for safely implementing DT systems

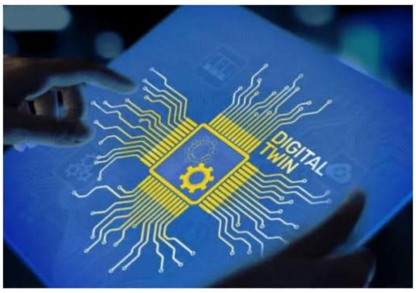

Fig.1.Digital twin Security

II. UNDERSTANDING DIGITAL TWINS

A Digital Twin is a digital copy of a physical object that changes in real-time by continually receiving and processing data from sensors, IoT devices, and other sources. It connects the physical and virtual worlds, allowing engineers and decision-makers to simulate, monitor, and predict the behavior of physical assets with high precision. This model is more dynamic than traditional simulations because it uses live operational data, making it adaptable to changing conditions.

In practice, a digital twin generally includes four key parts: the physical object, which is the real-world system; the digital model, which represents it virtually; the data communication layer, which ensures smooth synchronization; and the analytics and control tools, which use artificial intelligence and machine learning to gain insights. By bringing these parts together, digital twins create a feedback loop that improves operational efficiency, lowers risks, and encourages innovation across various fields.

III. APPLICATIONS OF CYBER SECURITY DIGITAL TWINS SYSTEM

1. *Manufacturing:*
   Weaknesses in industrial IoT devices can result in data manipulation or production sabotage. Cyberattacks on digital twins may disrupt supply chains or create unsafe conditions in automated facilities.

2. *Healthcare:*
   Patient data in digital twin models is very sensitive. Breaches can expose personal health information, violating privacy laws like HIPAA. Malicious changes to a patient's digital twin might also lead to wrong diagnoses or treatment plans.

3. *Transportation:*
   Digital twins in connected vehicles and traffic management systems face threats like GPS spoofing, data injection, and remote hijacking. These attacks can disrupt fleet operations or put passenger safety at risk.

4. *Smart Cities:*
   Digital twins of important infrastructure, such as power grids, water systems, and public transportation, are appealing targets for cybercriminals. Attacks could cause major service outages or put citizens in danger.

5. *Aerospace and Defense:*

Cyberattacks on digital twins used in aircraft systems or mission planning could threaten national security, cause system failures, or expose sensitive defense information.

Fig.2.Digital Twin Dilemmas.

IV. BENEFITS OF CYBER SECURITY DIGITAL TWINS SYSTEM

1. *Predictive Maintenance:*
   Reduces downtime and costs by predicting failures before they happen. When cybersecurity measures are in place, the accuracy and reliability of predictive models stay safe from harmful interference.

2. *Operational Efficiency:*
   Optimizes resource use and system performance. Secure digital twin systems ensure that optimization relies on real, unaltered data, preventing disruptions from data breaches or attacks.

3. *Enhanced Decision-Making:*
   Offers data-driven insights for planning. Cybersecurity ensures decision-makers can trust the information and insights, boosting both confidence and results.

4. *Innovation and Simulation:*
   Allows for virtual testing of new products and processes. When protected from cyber threats, simulations stay valid, safe, and free from outside manipulation.

V. CHALLENGE AND CYBERSECURITY CONCERNS

Despite their advantages, digital twins face several challenges:

1. *Data Integrity:*
   Compromised data from IoT devices can lead to incorrect predictions.

2. *Unauthorized Access:*
   Weak access control can make systems vulnerable to attackers.

3. *Privacy Risks:*
   Sensitive data might be intercepted or misused.

4. *Denial-of-Service Attacks:*
   Cyberattacks can disrupt real-time digital twin operations.

5. *Supply Chain Risks:*
   Weaknesses in third-party software and hardware increase risks.

VI. CONCLUSIONS

Digital Twin systems are driving innovation across industries, but they are also vulnerable to cyber threats. To make the most of their potential, organizations must incorporate cybersecurity into DT design and deployment. Secure communication, strong authentication, regular security checks, and international standards are necessary for creating resilient DT ecosystems. Future research should focus on AI-driven security frameworks, blockchain-based trust methods, and privacy-preserving computation techniques.

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Smarter Realities:A.I. Meets Digital Twin

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***Abstract*— Digital Twins are virtual replicas of make-social systems, but when merged with Artificial Situation (AI), they stop being passive look-alikes and start acting like proactive, decision-making companions.**

This article explores how AI transforms Digital Twins into predictive, interactive, And reflexive-learning models instance up opportunities in industries, healthcare, and even happening life. With joy analogies and relatable examples, this paper makes the field phenomena both informative and enjoyable.

Keywords— Digital Form, Artificial Situation, Simulation, Predictive Analytics, Showing Systems

I. INTRODUCTION

Imagine if your bike was able to say: "Boss, change my brake pads before it's too late." This is the magic of using AI with Digital Twins.

One could liken a Digital Twin to a video game character that stands for a machine, a factory, or even a human organ—and is constantly updating to show what the real thing is like. It's only a reflection. However, with AI, the reflection gets to know, anticipate, and even give feedback. This combination is the core of the 4th industrial revolution (also called as industry 4.0), where machines have gone beyond just existing; they understand the art of thinking.

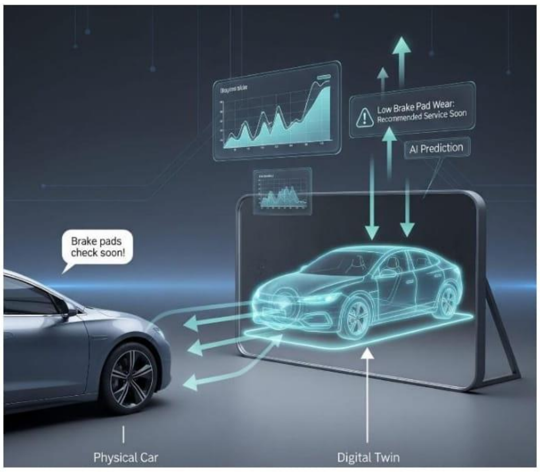

Fig.1. A futuristic Conceptual scenario

II. FROM REFLECTION TO PREDICTION

Imagine a Digital Twin of a cricket coach who simply observes your performance and comments, "Nice shot." Useful? Not at all. Incorporate AI, and the coach immediately gives you a warning saying, "Next ball is probably a yorker—guard your bat."

This is the manner in which AI-powered Digital Twins function:

Predictive Maintenance: A twin of the jet engine that not only highlights the wear but also indicates, "I will require a shutdown after 20 more flights, or I am going to fail in the middle of the air."

Smart Cities: AI-enabled Digital Twins of traffic systems foresee congestion and recommend alternative routes—time, fuel, and anger caused by honking are given back to the people.

Healthcare: Picture the help of AI with your heart's twin, which instead of a sudden heart attack, sends you a message saying, "Stop eating fries, Andy. Your cholesterol twin is yelling."

Fig.2. The advanced workflow of digital twin ft. AI

III. A CONVERSATION WITH YOUR DIGITAL TWIN

Imagine that you are the owner of a car. The following is an example of how the conversation would have been:

Car's Digital Twin: "Hey Owner, I've gone through the last 500 km and it looks like your fuel injector is giving a little trouble".

You: "What would be the next step?"

Digital Twin: "Relax. I've already scheduled a service slot with your nearest mechanic."

You: "Wow, you're like my Jarvis but for machines!"

Digital Twin: "Exactly. Just without the witty remarks about your wardrobe… or your diet."

This funny storytelling is not only for amusement, it conveys the idea of AI enabling the twin to check, predict, and make moves rather than just passively displaying as a fancy 3D model.

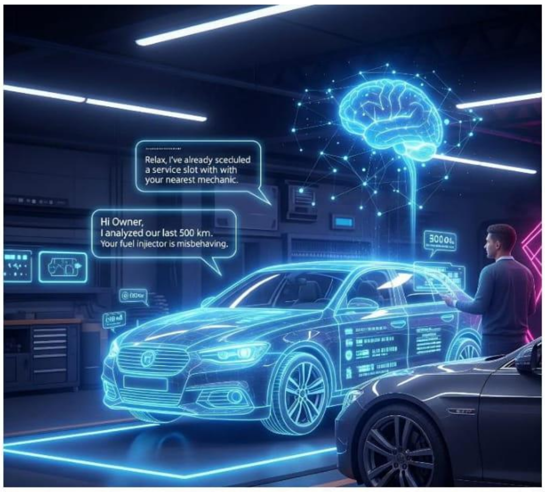

Fig.3. “Hello A.I. powered digital twin”, making life easier.

IV. CHALLENGES AND OPPORTUNITIES

A. Challenges:

Data privacy (no one wants their "digital heart twin" data to be leaked).

Trust issues (Will you really trust your fridge when it says, "No more ice cream"?).

High computational cost (AI + twins require large servers).

B. Opportunities:

Defense: AI twins of fighter jets for mission simulations.

Education: Students experimenting on AI-driven virtual labs instead of breaking expensive lab equipment.

Sustainability: Energy twins predicting wastage and optimizing usage.

V. FUTURE OUTLOOK

The fun part? We’re moving toward personal Digital Twins. Imagine a twin that tracks your health, mood, and even study habits. One day, your AI twin might wake you up:

The transition from digital twins to human ones is gaining atraction. The new generation of twins will be able to not only monitor physical health parameters (heart rate, sleep cycles, calorie intake) but also to keep track of cognitive states, mood variations, and productivity patterns. Equipped with AI-based predictive analytics, such twins can:

1. Detect health conditions before signs such as the early cardiac risk may occur.
2. Adjust study or work schedules by taking in the data of concentration, tiredness, task completion, etc.
3. Offer on-the-spot behavioural prompts—like stopping use of the screen at night or giving a student a reminder about a robotics project—depending on the recognition of patterns and the functioning of the adaptive feedback system.

With the increase in computing power and the development of privacy-preserving frameworks, the AI-driven personalized twins may turn out to be at the centre of healthcare, education, workforce efficiency, and even emotional well-being.

“Dude, stop scrolling memes. You’ve got a project pending!”

The future is not only about smart machines, but it is also about smart relationships between humans, AI, and their virtual reflections.

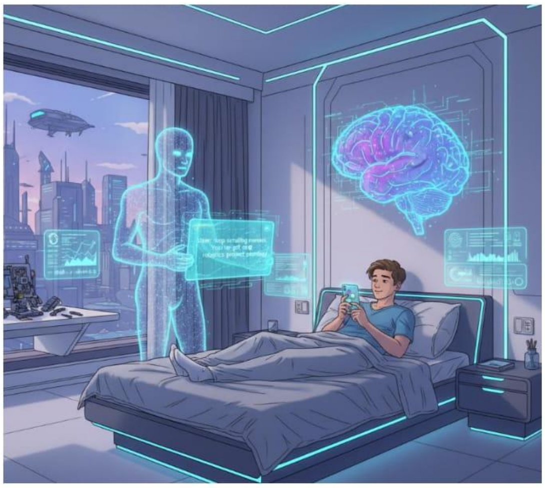

Fig.4. “Your all-time buddy”, from virtual-to-reality

CONCLUSION

The integration of AI with Digital Twins turns static replicas into living, learning companions. From factories to hospitals, from cities to personal lives, this synergy makes our reflections not just smarter, but sometimes funnier than us. The mirror is no longer passive—it’s interactive, predictive, and maybe even a little bossy.

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The Role of Digital Twin in Modern Healthcare: Innovations and Future Directions

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***Abstract*— Healthcare today needs solutions that are predictive, personalized, and efficient. Digital Twin (DT) technology, which started in aerospace, is now becoming a game-changer in healthcare. A DT is a dynamic virtual model that reflects physical systems using real-time data, allowing for simulation, monitoring, and prediction. In healthcare, DTs create patient-specific models, aid drug discovery, improve hospital operations, and enhance wearable technologies for continuous monitoring. Recent advancements, such as Human Digital Twins, blockchain-based frameworks, and integration with Healthcare IoT, have broadened their role in diagnosis, treatment, and resource management. The COVID-19 pandemic has further highlighted their importance in predictive modelling and healthcare planning. Looking ahead, DTs are expected to develop into whole-body simulations and play crucial roles in personalized medicine, organ transplantation, and regenerative healthcare. Despite challenges in privacy and interoperability, DTs have great potential as a foundation for healthcare.**

Keywords—Digital Twin (DT), Healthcare IoT (HIoT), Predictive healthcare

I. INTRODUCTION

Modern healthcare is becoming more complex, and it needs solutions that are predictive, personalized, and efficient. One technology that meets these needs is the Digital Twin (DT), a dynamic virtual model of a physical system that is continuously updated with real-time data. Initially developed for aerospace and manufacturing, DTs are now being adapted for healthcare. They offer transformative possibilities in patient care, hospital management, and medical research.

In healthcare, DTs can create patient-specific models to simulate disease progression and treatment responses. This supports the shift toward personalized medicine. They also help in drug discovery and development, optimize hospital workflows, and improve wearable technologies for continuous health monitoring. Recent advances in AI, IoT, big data, and 5G have sped up their adoption, allowing for more accurate and real-time applications.

Looking ahead, Digital Twin technology has the potential to reshape global healthcare. It can make healthcare more proactive, data-driven, and centered around patients. This may ultimately lay the groundwork for the future of healthcare.

II. HISTORY OF DIGITAL TWIN IN HEALTHCARE

The idea of the Digital Twin started well before it was adopted in healthcare. NASA first used this concept in the 1960s. They created virtual models to simulate and monitor spacecraft during the Apollo missions. Although Michael Grieves formally introduced the term "Digital Twin" in 2003, its practical use came before this. In 2012, NASA clarified the definition as an "integrated multiphysics, multi-scale, probabilistic simulation of an as-built vehicle or system" that reflects the real-life counterpart through continuous data updates.

Initially, these applications focused on aerospace and manufacturing. The healthcare sector began exploring digital twin uses much later. The COVID-19 pandemic greatly increased interest. It showed the need for real-time monitoring, predictive modelling, and resource management in healthcare systems. This period marked a turning point. The idea of "digital twinning everything as a healthcare service" was proposed, extending the industry 4.0 framework to medical contexts.

In healthcare, digital twins transformed from simple patient monitoring systems to complex five-dimensional models. These models include the physical patient, the virtual representation, data fusion, services, and two-way data connections. These improvements allowed for applications like patient-specific disease modelling, personalized treatment simulations, optimizing hospital operations, and support throughout different life stages—covering everything from preconception care to lifetime health management and afterlife considerations.

Therefore, the history of digital twins in healthcare shows a shift from an engineering innovation to a powerful healthcare tool. The ongoing blend of IoT, AI, and big data analytics has made digital twins crucial for the future of personalized and predictive medicine.

III. RECENT ADVANCES IN HEALTHCARE USING DIGITAL TWINS

Recent research shows rapid progress in applying Digital Twin (DT) technologies to healthcare, often called Healthcare 4.0. These advances use artificial intelligence, machine learning, and IoT devices to create patient-specific, real-time, and predictive models for clinical use.

One significant development is the use of medical microrobots with DT-based controllers. These can aid in drug delivery and targeted monitoring. Stochastic model predictive control with

Another advancement is the concept of a Human Digital Twin (HDT) for personalized healthcare. This is supported by federated learning, which maintains privacy while allowing continuous updates from wearable sensors and clinical data.

New machine learning frameworks, such as Factorization Machine Combined with Product-based Neural Networks (FMCPNN), have been added to DTs to improve predictive accuracy in health applications like stroke diagnosis; however, issues related to privacy and data imbalance continue. Additionally, blockchain-enabled DT frameworks have been proposed to handle patient data securely, providing benefits in transparency but facing challenges with latency.

Furthermore, DTs have been simulated at various scales of the human body, from tissues and organs to whole-body systems, to model complex conditions like viral infections. Integration with Healthcare IoT (HIoT) has improved privacy, throughput, and prediction accuracy compared to traditional systems. These advances have enabled important healthcare applications, including remote patient monitoring, drug discovery and optimization, trauma management, and personalized treatment simulations.

Overall, recent advances in DT technology show its potential to transform healthcare into a more predictive, personalized, and efficient system; however, challenges in data privacy, interoperability, and real-time deployment remain open areas of research.

IV. APPLICATIONS OF DIGITAL TWIN IN HEALTHCARE

A. Digital Patients

One of the most significant uses of Digital Twin technology in healthcare is creating digital patients, which are virtual models of individual patients that simulate anatomy, physiology, and disease progression. Large initiatives like the Blue Brain Project and the Digital Patient Roadmap have led to the development of virtual organs and whole-body twins. Commercial products such as Philips HeartModel and Siemens Healthineers' organ twins help clinicians with surgical planning, pre-operative visualization, and patient-specific therapy. These digital replicas allow doctors to test procedures virtually, reduce risks, and improve treatment accuracy.

B. Pharmaceutical Industry

In the pharmaceutical field, Digital Twins are changing how drugs are found, developed, and produced. By simulating how medications interact with human organs or cells, Digital Twins allow for the evaluation of drug safety and effectiveness before real-world testing. The SIMULIA Living Heart Project, launched with the U.S. FDA, is a prime example where drug interactions are tested on a virtual heart model. Similarly, IBM Watson's cancer simulations let researchers study uncontrolled cell division and refine targeted therapies. Pharmaceutical companies like Takeda, Atos, and Siemens are using process-oriented Digital Twins to improve drug production efficiency, shorten time-to-market, and customize therapies for patients Kalman filters has been used to improve accuracy; however, complexity remains a challenge.

C. Hospitals

Hospitals are increasingly using Digital Twins to streamline workflows, allocate resources, and manage patient flow. A notable case is Siemens Healthineers' partnership with Mater Private Hospital in Ireland, where a Digital Twin of the radiology department was created. By simulating different operational scenarios, the hospital reduced waiting times, improved equipment usage, and lowered operational costs. This shows how Digital Twins can greatly enhance healthcare delivery, especially during crises like the COVID-19 pandemic when hospital capacities and resources are often stretched.

D. Wearable Technologies

The integration of wearable devices with Digital Twins has made continuous patient monitoring and personalized healthcare services possible. Sensor-equipped wearables track vital signs like heart rate, blood pressure, respiration, and muscle activity, sending real-time data into Digital Twin models. Companies like Sooma have created wearable solutions that simulate brain activity to treat depression, while Myontec uses electromyography (EMG) sensors in smart clothing to monitor rehabilitation, improve physiotherapy, and prevent muscle injuries. These applications show how Digital Twins can bring healthcare out of clinical settings and into everyday life.

V. FUTURE SCOPE OF DIGITAL TWIN IN HEALTHCARE

The future of Digital Twin (DT) technology in healthcare is highly promising, with applications expected to expand as AI, IoT, and 5G mature. A major direction is the development of **whole-body digital twins**, integrating multiple organ models to simulate complex interactions and predict disease progression more accurately. Such twins could transform personalized medicine by enabling tailored diagnosis, treatment planning, and rehabilitation monitoring.

In the pharmaceutical industry, DTs will shorten drug development cycles by allowing virtual testing of compounds on patient-specific models, reducing costs and reliance on animal testing. Hospitals, on the other hand, will benefit from DTs for resource optimization and crisis management, simulating patient flow, predicting demand for ICU beds, and improving operational efficiency.

The integration of wearable technologies with DTs, supported by real-time data and edge computing, will enable proactive healthcare by detecting early risks in chronic diseases and improving remote patient monitoring. Furthermore, DTs show potential in organ transplantation and regenerative medicine, helping to assess donor compatibility and supporting future bioprinting of patient-specific organs.

Overall, DTs represent a cornerstone of healthcare, offering predictive, personalized, and efficient solutions that can reshape global healthcare delivery

VI. CONCLUSION

Digital Twin (DT) technology started as an engineering tool in aerospace. It has now become a powerful force in healthcare. Its ability to create real-time, data-driven virtual models enables personalized medicine, predictive healthcare, optimized hospital management, and better drug development. Recent advances like Human Digital Twins, blockchain-enabled systems, and connections with Healthcare IoT have increased its potential. However, issues related to data privacy, interoperability, and model accuracy still exist. The direction of DT research focuses on whole-body simulations, regenerative medicine, and proactive patient care. Digital Twin technology is expected to be a key element of healthcare, providing safer, smarter, and more patient-centered healthcare solutions.

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Digital Twin: Origin to Future

Chinmayi Yelve (S.E. Mech, Sem III B)
Department of Mechanical Engineering
Fr. C. Rodrigues Institute of Technology, Vashi

A. Abstract:-

Digital Twin (DT) refers to the virtual copy or model of any physical entity (physical twin), both of which are interconnected via the exchange of data in real time. Conceptually, a DT mimics the state of its physical twin in real time and vice versa. The application of DT includes real-time monitoring, designing/planning, optimization, maintenance, and remote access, among others. Its implementation is expected to grow exponentially in the coming decades. This paper intends to consolidate the different types of DT and definitions throughout the literature, for easy identification of DT from related terms.

Keywords: Digital Twin, Industry 4.0, Smart Manufacturing, Simulation

II. Introduction

In the era of Industry 4.0, Digital Twin (DT) has emerged as a cornerstone technology, driving innovation, efficiency, and competitiveness across industries. First developed in the aerospace sector, DT has expanded to manufacturing, healthcare, automotive, energy, and smart cities. By creating real-time, bidirectional links between physical and virtual entities, DT supports advanced design, predictive maintenance, optimization, decision-making, and immersive training. This capability not only reduces costs and risks but also enhances system reliability and adaptability. Valued at USD 3.1 billion in 2020, the DT market is expected to grow exponentially, accelerated by digitalisation and global disruptions such as COVID-19.

III. Digital Twin in Literature:-

A. History of Digital Twin

The idea for a digital twin was introduced in 2002 by Michael Grieves as the "Mirrored Spaces Model" for Product Lifecycle Management. Later, in 2010, NASA adopted the term "Digital Twin" in its technology roadmap. NASA described a DT as a complex simulation that mirrors a system's life. Since then, its use has rapidly grown in aerospace, defense, and manufacturing.

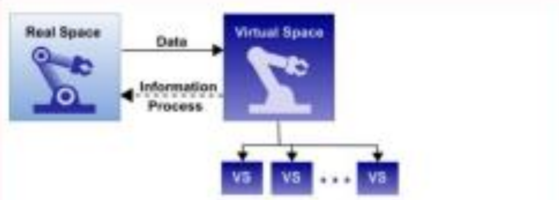


Figure 3. Mirrored Spaces Model/Information Mirroring Model as proposed by Michael W. Grieves (Adapted from [16,19].)

B. Digital Twin Discription in Literature

Since its first formal definition by NASA in 2010, Digital Twin (DT) has been described in various ways depending on the application domain. It has been called a model, counterpart, clone, representation, or simulation of a physical entity. What unites all definitions is the concept of a real-time, bidirectional exchange of data between the physical and digital entities. DT applications range from analysis, design validation, optimization, safety, and predictive maintenance.

IV. Advantages, Characteristics and Applications of Didital Twin

A. Advantages of Digital Twin:-

• Predictive Maintenance: Digital twins allow for real-time monitoring of a physical asset's health and performance. By analyzing data from sensors, they can predict when a component is likely to fail, enabling maintenance to be scheduled proactively before a breakdown occurs. This reduces downtime and maintenance costs.

• Risk-Free Simulation and Testing: A virtual replica provides a safe environment to simulate and test changes, new designs, or process improvements without risking the physical asset or causing disruptions. This accelerates innovation and product development while minimizing the need for expensive physical prototypes.

• Optimized Operations: By using the digital twin to simulate different scenarios, businesses can identify the most efficient way to operate a system. This leads to improved energy efficiency, reduced resource consumption, and streamlined workflows, ultimately boosting overall productivity.

• Enhanced Collaboration: Digital twins serve as a centralized platform for all stakeholders—from engineers and designers to maintenance staff and management—to visualize, analyze, and interact with the asset's data. This improves communication and decision-making across the entire lifecycle.

- Cost Savings: The combined benefits of predictive maintenance, optimized operations, and reduced need for physical prototypes lead to significant long-term cost savings. Organizations can save on repair costs, energy bills, and capital expenditures.

B. Applications of Digital Twin:-.

- Manufacturing: Simulates factory floor operations to optimize production lines, predict equipment failures, and improve product quality and efficiency.

- Healthcare: Creates a virtual replica of a patient to personalize treatment, plan complex surgeries, and monitor health conditions remotely.

- Smart Cities: Builds a living virtual model of urban infrastructure to manage traffic, optimize energy use, and respond to emergencies.

- Aerospace: Simulates aircraft performance and maintenance. It helps engineers test new designs and predict component failures for safer, more efficient flights.

V. CLASSIFICATION OF DIGITAL TWIN

Digital Twin (DT) technology can be classified in multiple ways, depending on factors such as creation time, level of integration, application, hierarchy, and maturity. Understanding these classifications helps organizations adopt DT more effectively, selecting the type that best fits their needs.

A) By Hierarchical Scope

1. Part Twin: A digital model of a single, individual component. It monitors a specific part's performance to predict failures and plan maintenance.
2. Asset Twin: A virtual replica of an entire machine or asset, integrating multiple part twins. It analyzes how components work together as a complete unit.
3. System Twin: A digital representation of a group of assets or a production line. It shows how different systems interact to optimize collaboration and efficiency.
4. Process Twin: The highest level, a model of an entire workflow. It connects multiple system twins to optimize a complete facility's operations and logistics.

B) By Lifecycle Stage

1. Digital Twin Prototype (DTP): A virtual prototype created before a physical product exists to test designs and manufacturing processes without risk.
2. Digital Twin Instance (DTI): A digital twin of a specific, individual product that is linked to its physical counterpart throughout its operational lifespan.
3. Digital Twin Aggregate (DTA): An aggregation of data from multiple DTIs to identify patterns, run analytics, and derive insights for product improvements.

VI. FUTURE AND CHALLENGES OF DIGITAL TWIN:-

A)FUTURE APPLICATIONS

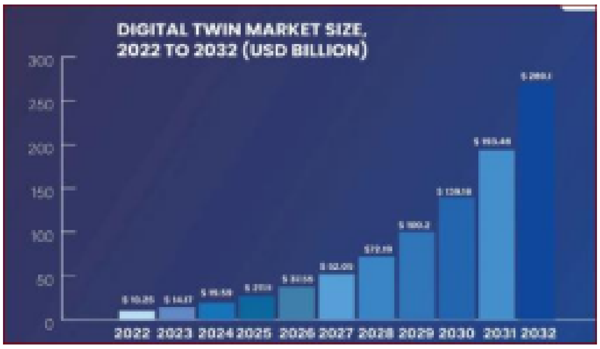
1. Human Digital Twins: Creating a virtual replica of a person to personalize healthcare, monitor health, and test new medical treatments and drugs without risk.
2. Smart Infrastructure: Building digital twins of entire cities to simulate traffic, manage resources, and plan for environmental or emergency scenarios.
3. Space Exploration: Using digital twins of spacecraft and extraterrestrial environments to simulate missions, test equipment, and train astronauts for complex operations.
4. Retail and Customer Experience: Developing digital twins of customers to create highly personalized shopping experiences, virtual try-ons, and optimize

   store layouts.

B) CHALLENGES IN IMPLMENTATION OF DIGITAL TWIN TECHNOLOGY

1. High Costs: The initial investment is significant due to the need for advanced hardware, specialized software, and expensive sensor technology. Maintaining the system adds to ongoing costs.
2. Data Integration and Quality: Digital twins rely on massive, real-time data from various sources. Ensuring data is accurate, consistent, and seamlessly integrated from legacy systems is a major hurdle.
3. Interoperability Issues: There is a lack of standardization among different digital twin platforms and vendors, making it difficult for twins to "talk" to each other and share data effectively.

4. Data Security and Privacy: Handling vast amounts of sensitive operational and personal data creates a large attack surface. Protecting this data from cyber threats is a critical security concern.
5. Lack of Skilled Professionals: Finding or training people with the necessary expertise in data science, IoT, and simulation modeling is challenging. This talent gap can slow down or stall projects.



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Smarter Manufacturing: Digital Twin in Industry

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(Dept. of Mechanical Engineering) [1]

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Abstract— The concept of Digital Twin has emerged as a key enabler in the manufacturing industry under the framework of Industry 4.0. A Digital Twin is a virtual representation of a physical asset, system, or process that continuously updates and interacts with its real-world counterpart through real-time data exchange. This paper explores the application of Digital Twin technology in manufacturing industries, focusing on its role in predictive maintenance, production optimization, supply chain management, and quality control. The challenges and future potential of Digital Twins in manufacturing are also discussed.

Keywords— Digital Twin, Industry 4.0, Smart Manufacturing, Predictive Maintenance, Cyber-Physical Systems

I. INTRODUCTION

Manufacturing industries are undergoing a rapid transformation with the integration of advanced technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), and Big Data analytics. Digital Twin technology has emerged as a powerful tool for bridging the physical and digital worlds. It provides a dynamic digital replica of machines, production lines, or entire factories, enabling continuous monitoring, simulation, and optimization. In the context of manufacturing, Digital Twins are instrumental in improving efficiency, reducing downtime, and enhancing decisionmaking capabilities.

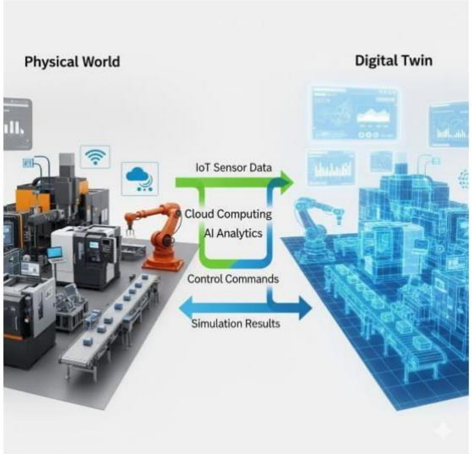

Fig.1. Conceptual framework of Digital Twin in manufacturing

II. APPLICATIONS OF DIGITAL TWIN IN MANUFACTURING

A. Predictive Maintenance

One of the most prominent uses of Digital Twin technology in manufacturing is predictive maintenance. By continuously monitoring equipment through sensor data, a Digital Twin can anticipate potential failures and recommend maintenance before breakdowns occur. This reduces unplanned downtime and extends the lifespan of machinery.

B. Production Optimization

Digital Twins enable real-time simulation of production processes. Manufacturers can test different scenarios in the virtual model before implementing them in the physical system. This allows optimization of resource utilization, cycle times, and energy consumption.

C. Quality Control

By integrating inspection data and production metrics, Digital Twins help in identifying defects early in the manufacturing cycle. Virtual models can simulate tolerance deviations and provide insights into corrective actions, thereby ensuring higher product quality.

D. Supply Chain Management

Digital Twins are not limited to shop-floor operations; they extend to supply chain networks as well. They help in forecasting demand, optimizing logistics, and ensuring resilience against disruptions.

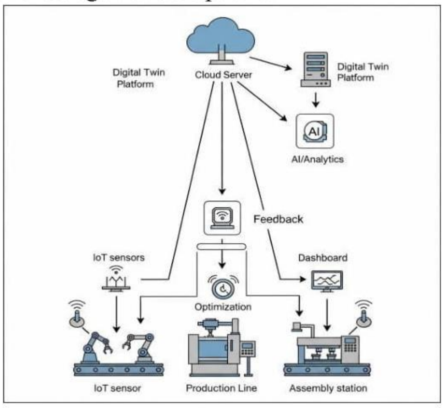

Fig.2. Workflow of a Digital Twin-enabled smart factory

III. CHALLENGES IN IMPLEMENTATION

A. Data Security and Privacy

The integration of IoT devices and cloud computing exposes manufacturing systems to cybersecurity risks. Protecting sensitive operational data remains a critical challenge.

B. High Implementation Costs

The deployment of Digital Twin solutions requires significant investment in sensors, computational infrastructure, and skilled workforce, which may be a barrier for small and medium enterprises.

C. Interoperability

Manufacturing industries often use heterogeneous systems. Ensuring interoperability among different platforms and software solutions is essential but complex.

IV. FUTURE OUTLOOK

The role of Digital Twins in manufacturing will continue to expand with advancements in AI, machine learning, and 5G connectivity. In the future, fully integrated Digital Twin ecosystems may enable autonomous factories, where production systems self-optimize with minimal human intervention. Moreover, sustainability goals can be supported through energy-efficient designs and reduced material waste enabled by virtual simulations.

Fig.3. Future vision of a fully autonomous Digital Twin-based factory

CONCLUSION

Digital Twin technology represents a paradigm shift in the manufacturing industry. By bridging the gap between the physical and digital worlds, it provides unprecedented opportunities for predictive maintenance, production optimization, quality assurance, and supply chain resilience. Although challenges such as cybersecurity, cost, and interoperability remain, the potential benefits make Digital Twin an indispensable component of the smart manufacturing revolution.

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Digital Twin Technology: A Paradigm Shift for Smart Grids and Renewable Energy Integration

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Fr. C. Rodrigues Institute of Technology, Vashi

***Abstract*— Digital Twin (DT) technology is the signature landmark of the energy sector's digital transformation beyond which the change of the entire paradigm is the real-time virtual replicas with all the physical assets equality achieved by fidelity type, created by this technology. Being the main drivers of the respective developments, decarbonization and resilience of the grid have unpacked the need for a technology that would provide the "monitor and control" functionalities in a kind of transformative manner. Embedded with the power of the Internet of Things (IoT) and Artificial Intelligence (AI), DTs are turning smart grid operations as attractive as they are with their potential for predictive maintenance and load balancing. At the same time, they provide for a smooth and stress-free integration of renewable intermittent energy sources merely by running the simulation and then setting the right parameters for achieving the best performance. To fully reap the benefits of the technology, those in key implementation positions such as data interoperability and cybersecurity must go a step further in solving these problems and by doing so gaining the trust of users to allow a gradual transition of the future way. The future map is showing a move in the direction of federated and autonomous twins describing the change from merely using the DTs as one of the instruments gluing to the active role they play in the design and architecture of the more intelligent and sustainable energy future**

I. INTRODUCTION

The global energy ecosystem is profoundly changing, driven by large-scale clean energy installations and the imperative for grid modernization. This has led to "smart grids," which integrate ICTs to enable bidirectional flows of information and energy, offering unprecedented interactivity but also new complexities in energy markets. Digital Twin (DT) technology emerges as a key solution to manage this transition. A DT is a computer model of a real-world object or process, fed with real-time sensor data via the internet. This technology has propelled performance beyond human potential across various fields, from healthcare to automotive and manufacturing. The power grid, being an interconnected and complex system, particularly benefits from DTs in simplifying its modernization process, allowing for more efficient management and optimization amidst growing complexity.

II. ENABLING TECHNOLOGIES

A modern Digital Twin (DT) integrates a multi-channel, project-based approach, powered by a confluence of several pivotal technologies.

The Internet of Things (IoT) and sensors act as the sensory layer—the "eyes and ears" of the DT. They collect and transmit vast amounts of real-time data on the operational state of physical assets like transformers and wind turbines.

Artificial Intelligence (AI) and Machine Learning (ML) serve as the "brain." These algorithms process sensor data to identify patterns, isolate anomalies, and predict future outcomes, such as equipment failure or energy production.

Finally, Cloud and Edge Computing provide the necessary infrastructure. Cloud platforms store massive datasets and offer the power for complex simulations, while edge computing processes time-sensitive data locally to reduce latency for immediate control applications.

III. TRANSFORMING POWER NETWORKS: DIGITAL TWINS IN SMART GRIDS

Power(Network Digital Twin (DT)) management is a radical change that moves the function from a reactive problem solving to a proactive one of predictive optimization. Consequently, DTs through their all-inclusive, live models extend the horizon of grid visibility for holding operations especially load balancing and demand response management. One of the foremost justificatory examples is that of predictive maintenance wherein digital duplicates of the like of transformers employing AI and the up-to-the-minute health data for the asset predict the occurrence of failures thus the repair work can be done before a valuable release happens. Besides this, DTs also allow for the presence of a safe virtual "sandbox" for the simulation of high-impact events such as cyber-attacks, so that utilities can test the defenses and strengthen the grid resilience.

IV. ACCELERATING THE ENERGY TRANSITION: DIGITAL TWINS FOR RENEWABLE ENERGY

Digital Twins (DTs) are excellent tools that can effectively address the primary issue that comes from renewable energy integration, namely, the lack of continuity. On the asset side, they basically build the virtual detailed models of the wind turbines and solar farms, taking the real-time data to adjust the blades or the orientation of the panel continuously to a maximum energy capture. Especially, grid DTs can handle fluctuations by integrating weather data with the condition of the asset to provide very accurate, short-term generation of electricity forecasts, thus giving the operators very important time to act. Besides that, DTs also help to plan and optimize Battery Energy Storage Systems (BESS), figuring out the cheapest ways of storing and releasing energy to keep the grid stable.

V. CHALLENGES AND FUTURE SCOPE

Despite the potential, various challenges are obstructing the widespread adoption of digital twins. The major ones are data-related that cover the aspects of ensuring data quality and integration from legacy systems, accomplishing interoperability between different vendors' systems, and at the same time, making sure that there is strong cybersecurity for what is now a critical data hub. Moreover, the great initial cost and the complexity of high-fidelity modeling also create obstacles. Digital twins' future is likely to be a more interconnected and intelligent ecosystem. The major trends encompass the advent of federated twin architectures where the different stakeholders' twins can communicate, and the progress towards cognitive and autonomous twins that employ advanced AI not only to forecast failures but also to initiate the corrective actions without any human assistance.

VI. CONCLUSION

Digital Twin technology is an instrumental shift that depicts the energy sector as more innovative and up-to-date. In the case of smart grids, this gives them more exemplary possibilities such as real-time control, preventive maintenance, and the ability to bounce back from failures. Renewable energy can greatly benefit from it as well since such a technology can be extremely useful in raising the level of the source's efficiency, as well as in handling the problem of intermittency. There are still major problems that lie in data management, standardization, and costs. However, the progression of AI and IoT is positively impacting the line of its development. The adoption of technology across the globe will be the main reason behind the coming of the era of resilient, adaptive, and intelligent power systems, thus creating the digital backbone of a sustainable energy future.

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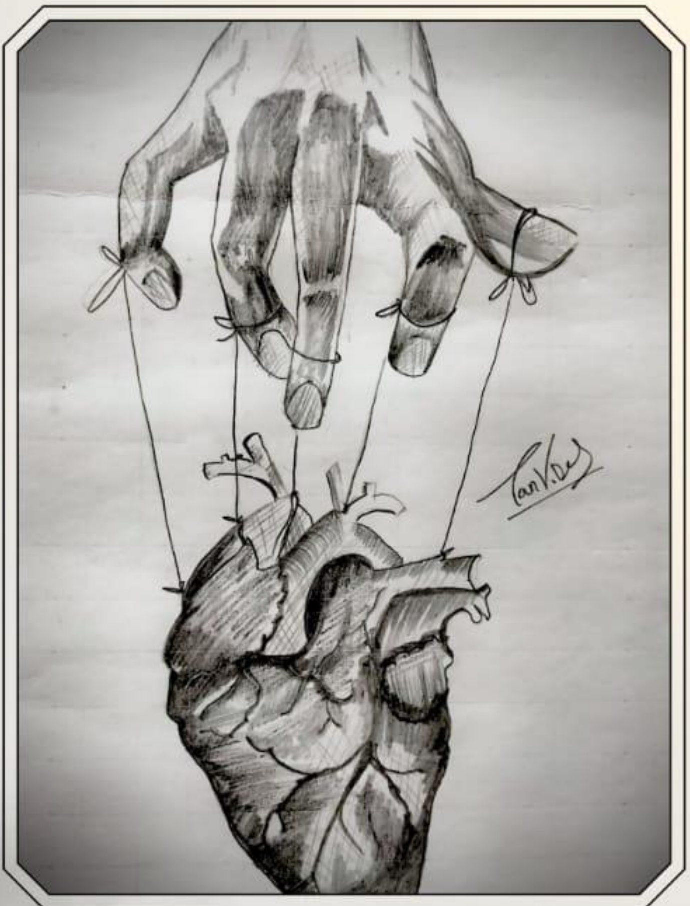
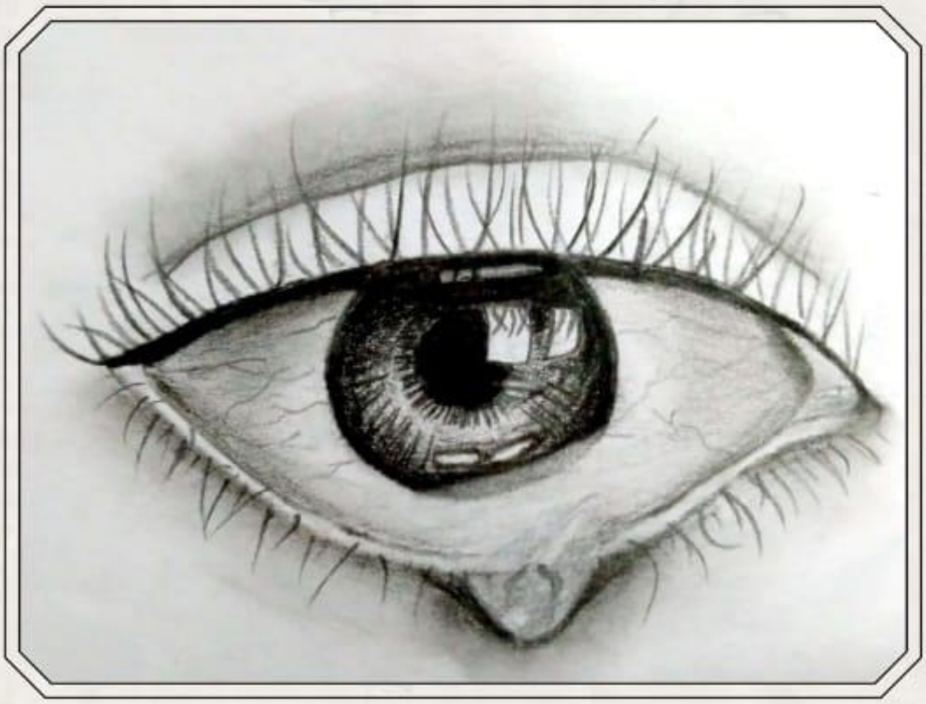
Creative Corner



TANMAY DESALE
MECH SEM 5A

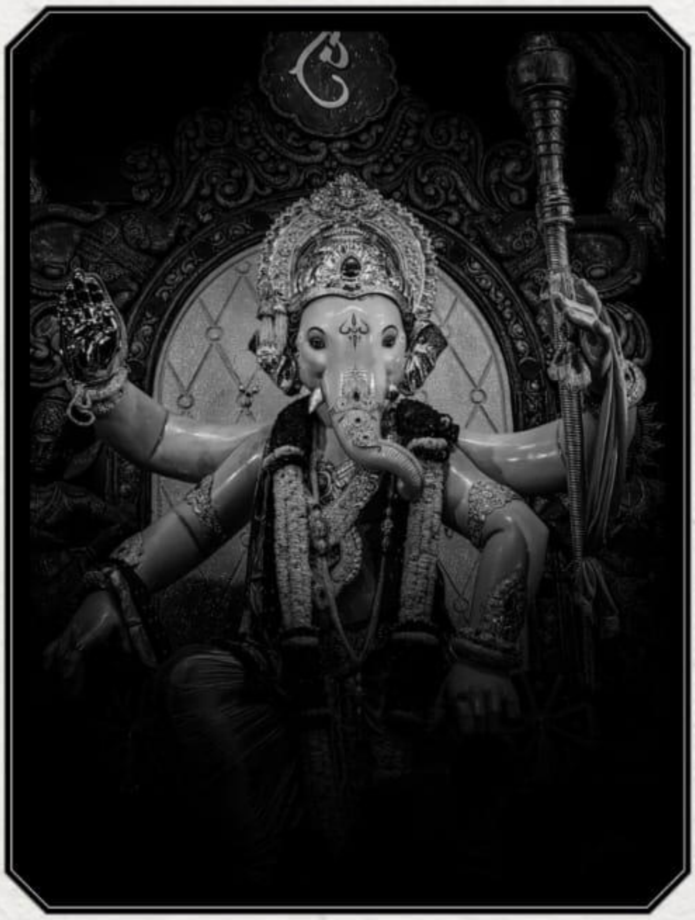
SHUBHAM KURKUTE
MECH SEM 5A



SAASHA MODAK

MECH SEM 5B

Photography



AARYA WAGHMARE MECH SEM 5B

KAUSTUBH LAMKHEDE MECH SEM 7A

SANVED PATIL
MECH SEM 5B

Poetry

life

I asked for much from life each day,
And life, in silence, loved me its way....
I wished it would never be touched by pain,
Life taught, my smile should always remain....
I wished to correct each fault, each scar,
Life taught, embrace yourself as you are....
I wished the heavens keep life in grace,
Life taught, don't stop in any phase....
I wished for joy while the moments were near,
Life taught, our bond would last year by year....
I wished we'd stay friends, never apart,
Life taught, me to hold it close in my heart....

-Tanmay Desale
Mech Sem 5-A

दोस्ती क्या है!

आज जाना कि खुदा कितनी अच्छी कहानियाँ लिखता है,
बड़े फुर्सत में था वह, जब उसने हमारी दोस्ती की कहानियाँ लिखी।

दोस्ती वही जो बदले ग़म और निराशा को ज़िंदगी के हसीन पलों में,
जो न रहकर साथ भी, उनकी यादें हमेशा रहेंगी।
दोस्त वही जो करे दुःख आधा और सुख दुगना,
बने साथी तो हो जाए हर मुश्किल आसान।

हमारे चेहरे की खामोशियाँ, बगैर कुछ कहे ही समझ जाते हो।
यह दोस्ती तो नसीब वालों को मिलती है, जिसमें खुद से पहले उनकी ही फिक्र हो।
कहते हैं दुनिया गोल है, गुजरते गुजरते इस कायना में मिलेंगे फिर कभी.

-Purvayee Keni

Mech 5A

Department Achievements

STUDENTS' ACHIEVEMENTS

2024-2025

Sr. No.	NAME	NAME OF THE EVENT/COMPETITION/WORKSHOP	ORGANISING INSTITUTE/BODY & LOCATION
1	Team Kaiser Racing	AIR 1 - Sled Pull	Baja SAE India
		AIR 5 - Endurance	Baja SAE India
		AIR 7 - Acceleration	Baja SAE India
		AIR 7 - Overall	Baja SAE India
2	AERO FCRIT	AIR 5 - Overall DDC (Team Garuda)	SAE India (Chennai)
		AIR 3 - Best CFD Analysis DDC (Team Garuda)	SAE India (Chennai)
		AIR - 1 Overall ADDC (Team Thestral)	SAE India (Chennai)
		AIR - 3 Best Safe Design ADDC (Team Thestral)	SAE India (Chennai)
3	Maitrey Naik	1st in Mumbai University Interzone Table Tennis Tournaments	Mumbai University
4	Ved	1st in United Crisis Committee	Agnel Law School
5	Manomay Pravin Jadhav	2nd in Chess Interzonal Competition	D.B.J College Chiplun
6	Athul Krishna T.B.	1st in ICEST	SVNIT SURAT
		1st in Rocket-X 3.0	FCRIT
7	Abhishekh Singh	2nd in Avishkar 2025	Saraswati College of Engineering
8	Leon Sam Benjamin	1st in Shot put competion	Nirmaan Intercollege Shotput Competition, ASL
		1st in Rocket-X 3.0	MESA, FCRIT
9	Anish Rao	1st in Rocket-X 3.0	MESA, FCRIT
10	Avishkar Mohan Khandge	1st in IDEATHON 2k25	IEI, FCRIT
		1st in Brains&Ladders	MESA & IEI, FCRIT
11	Siddhant Chikane	1st in TORQUE	SAE FCRIT
12	Chakresh Laxman Kanekar	1st in Techsparks 2025	CSI FCRIT
		1st at INNOVEX	E-CELL FCRIT
13	Maroof Husain Ansari	3rd at SAE Drone Development	SAE ISS
14	Arsalan Darvesh	1st at Autonomous Drone Development Challenge	SAEISS KCG College of Technology, Chennai
15	Atharv Gharat	1st at Poster Presentation Competition	CVS, FCRIT
16	Anuj Kabra	1st at Poster Presentation Competition	CVS, FCRIT
17	Atharva Prasad Naik	1st at Poster Presentation Competition	CVS, FCRIT

FACULTY ACHIEVEMENTS

2024-2025

Sr. No.	Name of the Faculty	Particulars
1	Dr. S M Khot	Elected as Chairman of the Board of Studies, Mechanical Engineering, University of Mumbai
		Avishkar Research Convention 2023 - 3rd prize
2	Dr. Nilaj Deshmukh	Research Consultancy on Design and Development of Hydrogen Stove with Fluidline-Exacta International Pvt. Ltd., 2025 – ₹21,24,000 (Non-Government) [Website: https://exacta.in/]
		Member of BOS
		Distinguish Fellowship from The International Inst
		Published patent
		Member of The Aeronautical Society of India
		Best Faculty of the Year - "Best Faculty of the Year" - Thought Leader award at the CSI-TechNext India 2024
		"Eminent Mechanical Engineer Award 2024" - "Eminent Mechanical Engineer Award 2024" from The Institution of Engineers (India), UP State Centre, Lucknow
		Research Consultancy – Design and Development of Hydrogen Stove (Mechanical Engineering, 2025, ₹21,24,000, Sponsored by Fluidline-Exacta International Pvt. Ltd., Link, Non-Government)
3	Dr Krishnan Sivaraman	Venus wires Award 2024 for the best technical paper in stainless steel application presented during the International Congress (IC 2024) at Bangalore
		Research Consultancy on Welding and Metallurgy consultancy with Crystal Industrial Syndicate Pvt. Ltd., 2024 – ₹2,00,000 (Non-Government)
		Research Consultancy on Welding and Metallurgy consultancy with ISGEC Heavy Engineering, 2024 – ₹6,00,000 (Non-Government)
		Research Consultancy on Welding & Metallurgy Consultancy with Zeeco India Pvt. Ltd., 2025 – ₹6,00,000 (Non-Government) [Website: https://www.zeeco.com/india]
		Research Consultancy on Welding Consultancy with Fludine Valves International Pvt. Ltd., Ahmedabad, 2025 – ₹3,60,000 (Non-Government) [Website: https://www.fluidlinevalves.com/]
		Research Consultancy on Welding and Metallurgy Consultancy with SS Stainless Equipment and Systems Pvt. Ltd., Rabale, 2025 – ₹6,00,000 (Non-Government)

		Research Consultancy – *Welding and Metallurgy Consultancy* (Mechanical Engineering, 2024, ₹2,00,000, Sponsored by Crystal Industrial Syndicate Pvt. Ltd., Non-Government)
		Research Consultancy – *Welding and Metallurgy Consultancy* (Mechanical Engineering, 2024, ₹6,00,000, Sponsored by ISGEC Heavy Engineering, Non-Government)
		Research Consultancy – Welding & Metallurgy Consultancy (Mechanical Engineering, 2025, ₹6,00,000, Sponsored by Zeeco India Pvt. Ltd., Link, Non-Government)
		Research Consultancy – Welding Consultancy (Mechanical Engineering, 2025, ₹3,60,000, Sponsored by Fludine Valves International Pvt. Ltd., Ahmedabad, Link, Non-Government)
		Research Consultancy – *Welding and Metallurgy Consultancy* (Mechanical Engineering, 2025, ₹6,00,000, Sponsored by SS Stainless Equipment and Systems Pvt. Ltd., Rabale, Non-Government)
4	Dr. Dhananjay Panchagade (Co-PI), Dr. Amrita Mandal Bera (PI), Dr. Mini Rajeev (Co-PI)	Research Project – Fabrication, Performance and Reliability Evaluation of Solar Cell made of Novel Lead-Free Perovskite (Mechanical Engineering, 2023, ₹1,75,000, Sponsored by FCRIT Vashi, Link, Non-Government)
5	Dr. Sanjay W. Rukhande (PI), Dr. Aqleem Siddiqui (Co-PI), Mr. Badal Kudachi (Co-PI)	Research Project – Enhancing High Temperature Oxidation and Corrosion Protection through Nickel based Alloy Coating (Mechanical Engineering, 2023, ₹1,00,000, Sponsored by Agnel Charities, FCRIT Vashi, Link, Non-Government)
6	Dr. Sanjay W. Rukhande, Dr. Aqleem Siddiqui, Mr. Badal Kudachi	Research Project – Enhancing High Temperature Oxidation and Corrosion Protection through Nickel based Alloy Coating (Mechanical Engg. Dept., 2023, ₹1,00,000, Sponsored by FCRIT Vashi, Link, Non-Government)
7	Dr. Prasad Bari	PhD Degree Awarded in Mechanical Engineering in April 2024 from VJTI, University of Mumbai
8	Shamim Pathan	Research Project – Faults Diagnosis of Rotating System using Machine Learning (Mechanical Engineering, 2023, ₹50,000, Sponsored by FCRIT Vashi, Link, Non-Government)
9	Deepak Devasagayam	Patent Published - Toothpaste Refiller
10	Nilesh Sonu Varkute	Appreciation as a faculty Adviser - Appreciation as a faculty Adviser to the ISHRAE student chapter

		Certification as an 'Assistant Yog Teacher' - Completed 300 hours 'Assistant Yog Teacher training Certification' with grade A, conducted by Patanjali Yog Samiti Mumbai
		Best paper Award in International Conference on Environmental Science and Technology (ICEST-2024) organized by SVNIT Surat
11	Badal Kudachi	Best paper Award in International Conference on Environmental Science and Technology (ICEST-2024) organized by SVNIT Surat
12	Mr. Afzal Ansari (PI), Ms. Rupali Deshmukh (Co-PI), Dr. Nilaj Deshmukh (Co-PI)	Research Project – Development of Closed-Loop Active Control Method for Suppression of Thermo-Acoustic Instability (Mechanical Engineering, 2023, ₹80,000, Sponsored by FCRIT Vashi, Link, Non-Government)
13	Amar Murumkar	IIW Best Students Chapter Award - IIW Best Students Chapter Award 2024
14	Dr. Bharatbhushan S. Kale	Research Project – Technology Development for Controlled Fabrication of 2D and 3D Net-Shaped Microstructures using Li (Mechanical Engineering, 2023, ₹43,43,823, Duration: 2 Years, Sponsored by Department of Science and Technology, Link, Government)
15	Sunny Sarraf	Flash Talk & Poster Award - Runner Up Poster Award
16	Amit Malgol	Patent Filed – *Integration of Stirling Engine with Scheffler Reflector for Generation of Electricity* (Filed on 20/12/2024, Application No. 214
17	Jweshvari Vidyadhar Tupe	Avishkar Research Convention 2023 - 3rd prize

PLACEMENT DATA

Highest Package – 9.5 LPA

Average Package – 5 LPA

S.N.	Name	Company Name	Package
1	Benjamin Leon Sam Suja	QuickSell	9.5
2	Khan Raziq Ur Rahman	Quality International	9.47
3	Gharat Satvik	Godrej	7.75
4	Chavan Rohan Vitthal	Godrej	7.75
5	Poojari Ansh Krishna	Godrej	7.75
6	Singh Shashank	Godrej	7.75
7	More Yash Sunil	Godrej	7.75
8	Powale Shardul Sanjay	Godrej	7.75
9	Salunkhe Atharav	Godrej	7.75
10	Shelar Siddhesh Atul	Godrej	7.75
11	Bankar Shubham Anant	Kansai Nerolac	6.5
12	Shingare Siddhik	Technip	6.5
13	Kumawat Pradeep	L & T	6
14	Hanji Veeresh Vikram	Toyo	5.6
15	Nandgaonkar Aryan	Toyo	5.6
16	Ayush Pankaj	Kansai Nerolac	5.5
17	Bagul Atharva Trusar	Kansai Nerolac	5.5
18	Dinkar Sumedh Sudhir	Johnson Control Limited	5.5
19	Kanekar Chakresh	Johnson Control Limited	5.5
20	Kumawat Deepak	Tecnimont	5.5
21	Shinde Mayuresh	Kansai Nerolac	5.5
22	Siddhivinayak Mahadani	Bajaj Mukand	5.5
23	Panchal Saurav Haresh	Bajaj Mukand	5.5
24	Rao Anish Prakash	Kansai Nerolac	5.5
25	Samant Tanvi Gajanan	Tecnimont	5.5
26	Sawant Aditya Satish	Johnsons Control	5.5
27	Sharma Khushi	Tecnimont	5.5
28	Dalvi Shardul Chandan	H & K Rolling Mill	5
29	Jadhav Aditya Ramesh	Framatome	5
30	Kadam Rohit Pradeep	Drydocks	5

31	Karkera Harsh Naresh	IAVL	5
32	Meshram Sanchit	IAVL	5
33	Sastry Ananya Srinivas	Drydocks DP World	5
34	Singh Abhishek	Drydocks DP World	5
35	Singh Akhil Sanjay	IAVL	5
36	Chipkar Om Rajesh	Turner Consulting and Management	4.5
37	Mhatre Vinit Prakash	Turner Consulting and Management	4.5
38	Yewale Amey Prasad	Framatome	4.5
39	Mungekar Prathmesh	Turner Consulting and Management	4.5
40	Wagle Saeem Samir	Bhavi Plast Pvt. Ltd.	4.5
41	Katkar Srushti Rajesh	Nikhil Comforts	3.66
42	Mhatre Rohit Anant	Akasa Air	3.5
43	Baviskar Rohan Kantilal	TCS-Ninja	3.36
44	Magar Pranav Narendra	Surmount Energy	3.36
45	Zope Hemant Sanjay	Surmount Energy	3.36
46	Kavale Rugved Vasant	Das Offshore	3
47	Jagtap Sarthak Mahesh	Brick & Byte (by MSIPL)	3
48	Mulani Aftab Munaf	Consistent Engineering	3
49	Gupta Nikhil Vinod	Mars Petrochem	3
50	Mhatre Mihir Ashok	Mars Petrochem	3
51	Rejoy Roy George	Bharat Bijlee	3
52	Sawant Rohan Sanjay	PRESPL	3
53	Mokashi Swapnil	Bhavi Plast Pvt. Ltd.	3
54	Thali Ayush Dinesh	Akasa Air	3
55	Varhadi Om Vijay	Bharat Bijlee	3
56	Veturkar Ayush Prasad	Das Offshore	3
57	Wavhal Piyush Vinayak	Jasmino Corporation Limited	3

LIST OF TOPPERS (FH-2025)

Semester - 4

Rank	Name	CGPA
1	Ganesh Charan Sapna Jalvi	9.6
2	Eshan Rajesh Jadhav	9.57
3	Harsh Deu Khapre	9.35

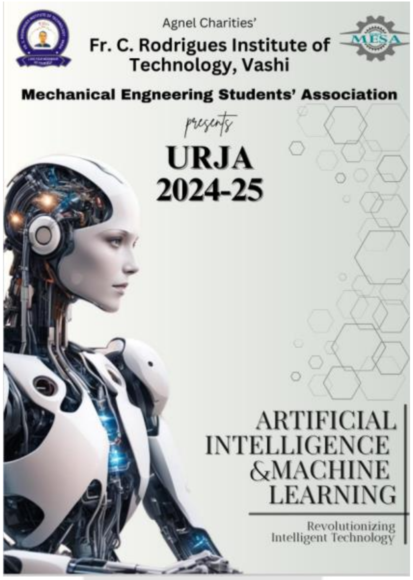
Semester - 6

Rank	Name	CGPA
1	Chaurasia Snehal Balram Rekha	9.45
2	Ambulkar Tanmay Vishnu Vimal	9.43
3	Bhoite Hrushikesh Nilesh Anamika	9.35

Semester – 8

Rank	Name	CGPA
1	Dinkar Sumedh Sudhir Sandhya	9.85
2	Shingare Siddhik Rajesh Ruchi	9.3
3	Vernekar Dhruv Sandeep Renuka	9.26

SYNERGY 2K24



SYNERGY is organized to bridge the gap between the industry and the institute and facilitate an effective interaction. This event provides an opportunity for the students as well as the faculty members to know more about the emerging technologies and methodologies adopted by the industry. Also, the industry, in turn, gets to know the institute closely, thereby providing an opportunity to identify the value addition required to create high-class professionals from the institute. Synergy 2024 was the latest edition of our vibrant and vigorous industry-academia interaction.

It was held on 21st September, 2024 at the premises of our very own college Fr. C. Rodrigues Institute of Technology, Vashi. We were fortunate to have guest speakers from Hindalco Mr. Jitendra Malhotra and Mr. Rakesh Ranjan Who spoke on the topic of Aluminium extraction and job opportunities. Mr. Girish Kumar Panchal & Mr. P. Murli Mohan who conversed on the topic of static equipment and finite element analysis. Mr. Vikas Nandapurkar & Mr. Rajeev Jambhekar conversed on the topic of Pumps & Centrifugal Forces. Mr. Vishal Gupta & Mr. Chinmay Manekar who spoke on the topic of Finite Element Analysis. The Industrial Professionals graced us with their presence and shared their valuable knowledge and experience with students. The speakers dealt with technical aspects of and opportunities in their field. It was followed by an open interaction where there was wholehearted involvement from the students

Collegiate Clubs

ISHRAE COLLEGIATE CHAPTER

The Indian Society of Heating, Refrigeration, and Air Conditioning Engineers (ISHRAE) is a leading professional society committed to advancing the HVAC industry in India. Since its inception, ISHRAE has emphasized not only professional excellence but also the grooming of young engineers through its student chapters, which act as a bridge between classroom learning and real-world industry exposure.

The ISHRAE Student Chapter at **Fr. C. Rodrigues Institute of Technology (FCRIT)** was inaugurated in 2007 with the aim of nurturing technical talent in the field of HVAC and providing students with opportunities to explore this ever-evolving domain.

Guided by experienced faculty advisors and supported by industry professionals, the chapter regularly organizes **technical events, industrial visits, paper presentations, technical quizzes, and the much-anticipated Job Junctions**. These activities have become a platform for students to not only sharpen their subject knowledge but also build professional networks and career pathways.

The academic year **2024–25** has been particularly vibrant for ISHRAE FCRIT. The chapter began with the **Installation Ceremony of the Student Council**, where new leaders took charge with a vision to drive innovation and inclusivity in upcoming activities. This was followed by an **industrial visit to Belimo Cesim, Rabale**, where students gained first-hand exposure to modern technologies like damper actuators, control valves, and smart sensors—key elements in today's energy-efficient HVAC systems.

The highlight of the year was the flagship event **Jamboree 9 (2024)**, which saw enthusiastic participation from nearly 100 students, supported by a strong team of volunteers. The event featured technical competitions, interactions with dignitaries from ISHRAE Mumbai Chapter, and opportunities for students to present their innovative ideas. Such initiatives not only enhance technical learning but also instill leadership, teamwork, and communication skills among participants.

Through consistent engagement and industry collaboration, ISHRAE continues to **inspire the next generation of HVAC engineers** at FCRIT, preparing them to take on future challenges with knowledge, confidence, and a spirit of innovation.

SAE COLLEGIATE CHAPTER

The SAE FCRIT Collegiate Club is a distinguished student organization within the Mechanical Engineering Department at Fr. C. Rodrigues Institute of Technology, Vashi dedicated to providing students with comprehensive automotive knowledge. As an affiliate of SAEINDIA, a non-profit engineering society, the club is committed to advancing the mobility industry by fostering academic discussion and technical innovation among students. With over 50 members, the club is advised by Dr. Aqleem Siddiqui, Prof. Kamlesh Sasane, and Prof. Syed M. Arif. The club organizes a variety of technical events, with two of its flagship initiatives being the annual ‘Ignition X’ lecture series and the ‘TORQUE’ RC racing competition.

Featured Events

1. TORQUE 2025: Intercollegiate RC Racing Competition.

TORQUE is the clubs signature intercollegiate electric radio-controlled car racing competition, which took place on February 14, 2025. This event brought together teams from across Mumbai to navigate a challenging dirt track, showcasing their passion and driving skills. The competition attracted a large audience of students and faculty, with five participating teams demonstrating impressive displays of their RC cars. The winning team was awarded cash prizes by Head of the department and faculty members.

Winners of TORQUE 2025

Organizing Team of TORQUE 2025

2. Ignition X: Expert Lecture Series

The SAE FCRIT Collegiate Club regularly hosts seminars and webinars as part of its annual ‘Ignition X’ series. On August 17, 2024, the club featured Mr. Prathamesh Mane, a former Baja International captain. He provided valuable insights into the engineering journey and offered a comprehensive overview of the evolving automotive industry, specifically focusing on luxury and sports cars. The seminar facilitated discussions among industry experts and enthusiasts.

Introduction to Vehicle Systems: On April 24, 2025, a seminar was conducted for third-year engineering students on “Introduction to Vehicle Systems”. The session was delivered by automobile expert Mr. Syed Arif and aimed to bridge the gap between theoretical knowledge and practical application. The presentation covered major vehicle systems like the powertrain, braking, and suspension, and also touched upon emerging technologies. such as electric vehicles and ADAS.

Expert Interacting with students

Flyer of Ignition - X

3. Trackscape: The Ultimate Design Challenge:

Trackscape was a track-designing competition organized by the Mechanical Engineering Department on February 4, 2025 (online) and February 15, 2025 (physical event). The event challenged students to design creative, maze-like tracks for Electric RC Cars that were both challenging and engaging. Participants were required to include multiple paths to the finish line in their designs, promoting problem-solving and out-of-the-box thinking. Coordinated by student Norita Sabu and the SAE Council, the event had 15 participants and was considered a success. The winning design was planned for use in the TORQUE 2025 event.

Trackscape's track in TORQUE 2025

Flyer of Trackscape

BAJA SAE INDIA

Team Kaiser Racing from Fr. C. Rodrigues Institute of Technology, Vashi, achieved a historic milestone in the Baja SAEIndia 2025 season, marking a remarkable chapter in their journey since their inception in 2017. Competing in their 5th season, the team delivered a stellar performance, securing 1st place in the Sled Pull event and finishing 7th overall (6th Runner-Up). Their exceptional showing also included notable rankings in various events: 1st in Sled Pull, 5th in Endurance, 7th in Acceleration, 9th in both IPG & Validation and Suspension & Traction, and 12th in Maneuverability. For the first time, they proudly brought home two trophies, a testament to their dedication and teamwork. This achievement was made possible through the unwavering support and guidance of faculty advisors Dr. Dhananjay Panchagade and Mr. Sandeep Arote, Head of Department Dr. Aqleem Siddiqui, Principal Dr. S. M. Khot, and Rev. Fr. Peter and Rev. Fr. Seby Rodrigues, along with all faculty members. Their encouragement has been the cornerstone of the team's success and growth.

BAJA SAE INDIA, Pithampur, India, Team photo mBAJA is a premier competition within the BAJA SAEINDIA event that emphasizes the design and performance of off-road vehicles powered by internal combustion engines (ICE). This event challenges teams of engineering students to showcase their automotive expertise by designing, fabricating, and racing durable and high-performance BAJA vehicles capable of handling tough terrains. The competition consists of various rounds, including technical evaluation, acceleration, maneuverability, suspension and traction events, as well as a static final round. The static final round features assessments like a sales presentation, cost analysis, Go Green initiative, innovation event, and CAE evaluation. mBAJA takes place at NATRAX in Pithampur, India, renowned as Asia's largest automotive proving ground, providing the perfect venue for testing and showcasing the capabilities of these innovative vehicles.

Suspension and traction event

Sled pull event

AERO FCRIT

A team of 7 members aspiring to fly high, set a spark for the foundation of Aero Club in 2019. The team registered for their first event SAE Aero Design Challenge in August 2019 and started with the journey of Aero Design i.e., the designing and fabrication of a highly stable heavy-lifting RC aircraft falling under given constraints. All the efforts put in by every member of the team paid off, as they secured an impressive 5th place in the technical presentation round and 16th for the report submitted in the year 2020 and secured third place in the technical report submission round in the year 2021. In 2023, we laid the foundation of the drone department in our AeroFCRIT and from the year 2023-24, AeroFCRIT participated in two departments i.e., the Fixed wing (planes) department and the Multirotor (drone) department. We also collaborated with DRONACHARYA i.e., a group of industry experts that provide drone solutions across multiple domains and organised a webinar to give information about the use of multi-rotors in today's industry.

In March 2022 our club organized a national-level drone racing event known as IDRL (Indian Drone Racing League) in our college. This event was organized in our college fest, ETAMAX and was the first event of IDRL to be held at Navi Mumbai. A total of around 25 pilots from all over India participated in the event. This event was a grand success of ETAMAX and got our club the recognition it deserved.

Team Thestral secured AIR 1 (Overall performance) in the SAE Autonomous Drone Design Challenge (ADDC) 2025 held in Chennai from 3-5 April 2025. Despite various failures, the team members excelled in GCS, Avionics, Design & Manufacturing resulting in this remarkable achievement in the 3rd year of the foundation itself. Team Garuda secured AIR 5 (overall), AIR 3 in Best CFD and AIR 4 in a technical presentation at SAE DDC` 2025.

COUNCIL OF VIBRATION SPECIALISTS INDIA (CVS)

Council of Vibration Specialists (CVS), a non-profit organization (the first of its kind in the country exclusively on Vibration) has been formed by a few expert professionals dedicated in Vibration Science and Engineering, both from academia and industry to scale up the reach of this inter-disciplinary specialization. The CVS Students Chapters was formed to plan and organize technical programs and activities, to provide a common platform for the student members to exchange ideas and information, to facilitate practical training/project work and to play a major role in the development of human resources required in industries/research organizations through training and certification in various domains of vibration. Celebrating our 4th Anniversary CVS-FCRIT students' chapter, we would like to start by congratulating our mentor Dr. Nilaj Deshmukh, Dean Admin & Faculty for being elected as the first chairman of CVS, Mumbai Chapter.


Since its inception last three year when a wonderful inauguration ceremony flagged off the students' chapter, the student chapter has been actively organizing and was part of many events. Led by student president Mr. Vaze Gaurish Shailesh chapter organized a Seminar on Condition Based Monitoring and Reliability of Systems" delivered by Shri Jitendra Malhotra, Central Reliability, HINDALCO. The motive of this webinar was to make mechanical engineering students aware of the opportunities across the industries as vibration specialists and encourage students to consider vibration analysis as a career option.

Seminar on Condition Based Monitoring and Reliability of Systems

Technical Project Competition on Vibration and Acoustics

This year we got an opportunity to host a Technical Project Competition on Vibration and Acoustics was successfully organized on 20th April 2024 by FCRIT in association with the CVS Student Chapter for engineering and diploma students. The event was graced by dignitaries including Dr. H. S. Gambhir (President, CVS), Dr. Tarapda Pyne (Secretary, CVS), Mrs. Soloni Gosalia, and Mr. Sunder. Dr. Pyne emphasized the importance of vibration analysis and condition-based maintenance in modern industries. The Department of Mechanical Engineering, Fr. C. Rodrigues Institute of Technology, Vashi, in association with the Council of Vibration Specialists (CVS, Mumbai Chapter), organized a One-Week Short Term Training Program on “AI-Based Predictive Maintenance Strategies in Industry 4.0” from 21st to 26th July 2025 in hybrid mode. The program highlighted advanced AI-driven approaches for predictive maintenance in modern industries.

The Student Chapter of CVS at Fr. C. Rodrigues Institute of Technology proudly received the ***Active Student Chapter Award during INVEST 2025.*** This recognition reflects the chapter’s consistent efforts and active participation in advancing knowledge and activities in the field of vibrations and predictive maintenan

INDIAN INSTITUTE OF WELDING

The Indian Institute of Welding (IIW-India) was incorporated on 22nd April 1966 at erstwhile Calcutta to foster the development of welding science, technology, and engineering in India, and since then has been serving to the cause of the welding industry. It has 13 Branches, 2 Centres, and several Student Chapters throughout India. The Institute is a not-for-profit organization registered under Section 25 of the Companies Act 1956 (presently Section 8 of the Companies Act 2013) and is also registered under Section 12A of the Income Tax Act 1961, as an Institution for charitable purposes. Through its various activities and programs, IIW-India is now recognized as the premier professional Institute related to welding in the country, with over 4500 Individual and Corporate Members. Furthermore, as a member society of the International Institute of Welding (IIW), it is helping to project the importance and achievements of the Indian Welding Industry to the global community. IIW-India is also a member of the Asian Welding Federation (AWF) since its inception.

On becoming a member of IIW-India, one joins the wide fraternity of welding professionals in India both at the National and International levels. The various seminars, conferences, workshops, and technical lectures organized by the Institute not only provide platforms for exchange of technological knowledge and information but also serve as forums for establishing contacts and information with professionals in one's chosen field. The Indian Institute of Welding Students chapter is formed under the Department of Mechanical Engineering Fr. C.

Rodrigues Institute of Technology. The Indian Institute of Welding Students chapter was inaugurated on 5th August 2023 with the admired presence of Mr R. Srinivasan, Dr. Archana Sharma, and Mr. Abby. K. Joseph, Mr. N Kanagasabai, Mr V.V. Kamath, Dr. S.M. Khot, Dr. Nilaj Deshmukh, Dr. Krishnan Sivaraman. During the Inaugural ceremony, the importance and evergreen future of research in the field of welding was presented and conveyed to fellow student members.

The Fronius India Solution and Skill Centre for Welding is in collaboration with Fronius India Pvt Ltd., a global leader in innovative welding solutions. Inaugurated on 19th May 2023 in the FCRIT campus, the event was attended by prominent industry leaders including Mr. V. V. Kamath (Managing Director - Fronius India), Mr. Prithvi Hegde (Director - Crystal Industrial Syndicate Pvt Ltd), and Mr. N. Kalyan (Director - ELCA Laboratories), along with key members of the institute, such as Fr. Almeida (Managing Director - Agnel Technical Education Complex, Vashi), Dr. S.M. Khot (Principal, FCRIT), and others. This cutting-edge facility underscores the significance of welding, offering students and researchers advanced technologies and opportunities to engage in workshops, seminars, vocational training, and research. The center is poised to enhance the learning experience and foster a deeper understanding of welding's impact across various industries.


Congratulations!
Parimal Biswas Memorial Award
For Best Student Chapter - 2024
Awarded by
THE INDIAN INSTITUTE OF WELDING
WINNER
Winner
THE INDIAN INSTITUTE OF WELDING
Parimal Biswas Memorial Award
for the Best Students' Chapter - 2024
Joint Winner
Fr. C. Rodrigues Institute of Technology, Navi Mumbai
Awarded at the National Welding Seminar (NWS-2024), Jamshedpur
December 12, 2024
President


WELCOME
TO
THANKS TO OUR SPONSORS

INSTITUTE OF ENGINEERS INDIA (FMSC)

The inception of Institution of Engineers (India) FCRIT Mechanical Student Chapter took place under the guidance of Reverend Father Peter D'souza , Managing Director, Agnel Technical Education, Dr. Nilaj Deshmukh, Dean (Admin and Faculty), Dr. Aqleem Siddiqui, the Head of the Mechanical Department, Prof. Kamlesh Sasane and Prof. Sunny Sarraf (Faculty advisor of IEI-FMSC) intending to improve and develop the overall welfare of future engineers.

In the academic year 2024-2025, IEI FMSC conducted a 5 day Short Term Training Program from January 6 to January 10, 2025, on Tools and Methods of Research and Publication. This STTP aimed at increasing awareness about research and publications as well as making students familiar with software like LaTex and Mendeley.

On March 15, 2025, IEI FMSC also conducted the first round of "IDEATHON 2K25", in association with The Institution of Engineers (India)- Navi Mumbai Local Centre where over 50+ teams from 10+ colleges participated to pitch their unique ideas or proposal for impactful societal applications. Out of 54 teams, 9 teams were selected for the second round which was conducted on March 29, 2025 at The Institution of Engineers (India)- Navi Mumbai Local Centre. The judges for this event were Mr. S. P Singh and Mr. R. K. Modi, who added a lot of value to the event with their wealth of knowledge.


On April 19, 2025, IEI FMSC and MESA FCRIT in association with IEI NMLC and FCRIT Vashi also conducted a National Level Poster Presentation Competition (NPPC) where over 35+ teams from various colleges participated to showcase their innovative projects in the form of posters on diverse engineering and societal theme. Out of 37 teams, 12 teams were selected for the final round which was conducted on the same day. This event created a remarkable impact by providing a platform to the students to present their innovative projects in a structured manner.


IEI FMSC in association with IEI NMLC and Department of Mechanical Engineering, FCRIT Vashi, also conducted a two day All India Seminar on "Role of Artificial Intelligence and Machine Learning in sustainable development of 'Viksit Bharat' by 2047" on 18^{th} and 19^{th} of July. With offered a total of 8 Invited speakers and 5 Keynote speakers to the attendees regarding the role of AIML in sustainable development of 'Viksit Bharat' by 2047

FACULTY PROFILE

Sr. No.	Name of the Professor	Designation	Qualification	Area of Specialization
1	Dr. S. M. Khot	Principal	Ph.D. (IIT Bombay) — Aerospace Engineering	Area of Research - Mechanical Vibration Dynamics and Control, Active Vibration Control.
2	Dr. Nilaj Deshmukh	Professor and Dean-Admin & Faculty	Ph.D. (IIT Bombay) – Aerospace Engineering M. Tech. (VJTI, Mumbai)	Area of Research - Virtual instrumentation Combustion, Combustion Instabilities, Measurement Techniques, Noise
3	Dr. Krishnan Sivaraman	Professor and Asst. Dean R&D	PhD (IIT Bombay) ME (PSG College of Technology, Coimbatore)	Welding/ Mechanical
4	Dr. Aqleem Siddiqui	Associate Professor and HOD	Ph.D. (Mumbai University)	Area of Research - Active Vibration Control, Automobile Design
5	Dr. Dhananjay Panchagade	Associate Professor and Assistant HOD	Ph.D. (Auburn University, USA) M.S. (Wayne State University, USA)	Area of Research - Machine Design
6	Dr. Sanjay Rukhande	Associate Professor	Ph.D. (VJTI, Mumbai) M.E. (SPCE Mumbai)	Design, Analysis, Finite Element Method, Surface and Coating

7	Dr. Vishal Salunke	Associate Professor	PhD (Shivaji University, Kolhapur), M.E.	Vibration Analysis and Condition Monitoring, Tribolo gy, Roto-dynamics
8	Mr. Nanaji Kshirsagar	Assistant Professor	Ph.D. Pursuing M. Tech. (VJTI Mumbai)	Design, MEMS, Synthesis of Mechanism
9	Dr. Prasad Bari	Assistant Professor	Ph.D. (VJTI, Mumbai) M. Tech. (VJTI, Mumbai)	Micromachining, Optimization Techniques
10	Ms. Shamim Pathan	Assistant Professor	Ph.D. Pursuing (IIT, Bombay) M.E. (Mumbai University)	Hypersonic Test Facilities and Measurement Techniques, Condition Monitoring and Fault Diagnosis
11	Mr. Bipin Mashilkar	Assistant Professor	M. E. (Mumbai University) - CAD/CAM and Robotics	Computational Fluid Dynamics
12	Ms. Pallavi Khaire	Assistant Professor	Ph.D. Pursuing (VJTI, Mumbai) M. E. (Mumbai University)	Mechanical Vibration, Machine, Design and Condition Monitoring
13	Mr. Praseed Kumar	Assistant Professor	M. E. (Mumbai University)	Active Vibration and Control, Control Systems, Smart Materials and Measurement
14	Mr. Kamlesh Sasane	Assistant Professor	M. E. (Mumbai University)	Design Analysis, Mechanical Vibrations, Automobile and Mechanical Materials

15	Mr. Deepak D.	Assistant Professor	Ph.D. Pursuing M. E (Old Dominion University, US)	Manufacturing, Production, 3D Printing
16	Mr. Nilesh Varkute	Assistant Professor	M.E (Mumbai University)	Computational Fluid Dynamics, Heat Transfer, Renewable Energy and Energy Management
17	Ms. Suvarna Rode	Assistant Professor	M. E. (Mumbai University)	*Non-Destructive Evaluation, Computer Aided Design and Development, Rapid Prototyping*
18	Mr. Badal Kudachi	Assistant Professor	M. Tech. (VTU, RC, Mysore)	Renewable, Thermal Barrier Coating, CFD and Energy Storage
19	Mr. Mohammod Afzal Alam Ansari	Assistant Professor	M. Tech. (IIT Bombay)	Propulsion, CFD, FEA, Combustion, Thermoacoustic
20	Mr. Amar Murumkar	Assistant Professor	M. E. (Mumbai University)	Quality, TQM, Six Sigma and Cost of Quality
21	Dr. Bharat S. Kale	Assistant Professor	Ph.D M.Tech	Thermal Engineering, Viscous Fingering
22	Mr. Sunny Sarraf	Assistant Professor	M. Tech. (VNIT)	FEA, CAD CAM, 3D Printing and Bio-modeling

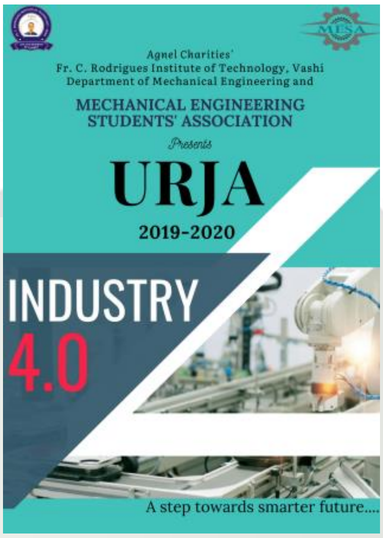
23	Mr. Syed M. Arif	Assistant Professor	M. E. (Mumbai University)	Automobile Engineering
24	Mr. Varad Deshpande	Assistant Professor	M. E.	Design Engineering
25	Mr. Juned Kazi	Assistant Professor	M.E (Dr. Babasaheb Ambedkar Technological University Lonere)	Thermal & Fluid Engineering with RAC, Cryogenics System
26	Mr. Shankar Waghmode	Assistant Professor	M. Tech. (Walchand College of Engineering, Sangli)	Manufacturing Production
27	Dr. Amit Malgol	Assistant Professor	Ph.D. (NIT, Calicut)	Rotor-dynamics and Vibration Control
28	Mr. Madan Kulkarni	Assistant Professor	M. E.	Manufacturing
29	Mr. Mohammad Adil Momin	Assistant Professor	M.Tech	Heat Power Eng
30	Ms. Jweshvari Tupe	Assistant Professor	Ph.D. Pursuing M. E. (Mumbai University)	CAD/CAM and Robotics

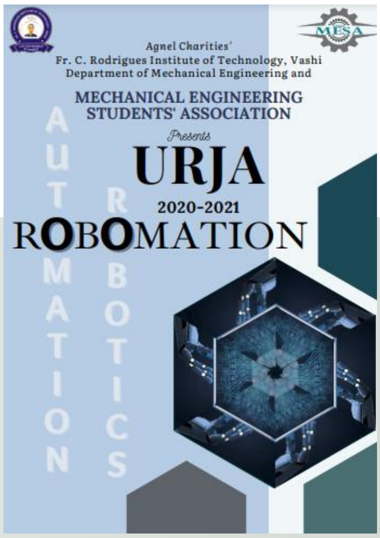
Non – Teaching Staff

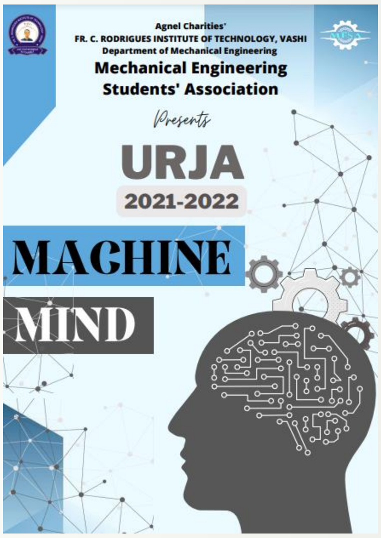
Mr. Sandeep Arote	Lab Assistant
Mr. Pravin Patil	Lab Assistant
Mr. Sanjay Junonikar	Lab Assistant
Mr. Sunil Desai	Lab Assistant
Mr. Ankush Molawade	Lab Assistant
Mr. Pramod Bhosale	Lab Assistant
Mr. Dil Bahadur	Peon

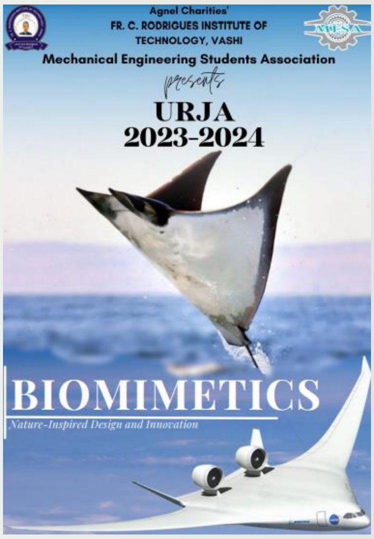
ABOUT URJA MAGAZINE

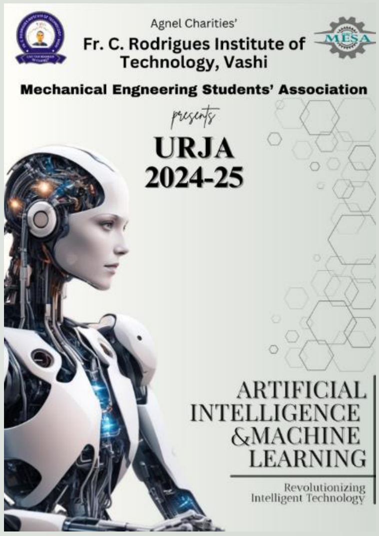
URJA is the annual magazine published by MESA which is based on various technological topics, where articles are published related to research papers and inventions that provide a glimpse into new and upcoming engineering advances. URJA also provides insight into the annual activities performed by MESA in association with the Mechanical Department. Here is a glimpse of all the Urja Magazines till 2024-25.











EDITOR’S NOTE

"We didn’t just simulate systems this year. We simulated futures."

As we stand at the crossroads of imagination and precision, URJA 2025-26 celebrates the era of Digital Twins—where engineering meets its virtual reflection. This year’s theme, Digital Twin: Bridging Realities, invites us to explore the transformative potential of creating living, breathing replicas of our physical world. A turbine that predicts its own fatigue, a city that models its energy heartbeat, a prosthetic leg that mirrors gait in real time—these are not science fiction anymore, but science in sync. If Industry 4.0 was about digitization, Digital Twins are about symbiosis: a continuous dialogue between the real and the virtual. Here lies both the promise and the paradox. Can a model ever fully capture life’s unpredictability? Can we simulate without reducing, predict without oversimplifying? This edition embraces these tensions—through student explorations in smart grids, biomedical twins, and aerospace simulations—while reminding us that the most enduring engineering is guided by responsibility as much as by algorithms. Beyond code, URJA captures the pulse of creation: the late-night debugging marathons, the glowing servers as silent companions, the joy when a digital replica forecasted exactly what the physical prototype confirmed. In an age obsessed with artificial intelligence, we celebrate augmented intelligence—where virtual twins don’t replace human creativity, but enhance it. From a bridge’s twin that foresees structural stress to a factory’s twin that balances sustainability with efficiency, these stories show us how harmony can exist between the tangible and the virtual. As you explore these pages, remember: A Digital Twin is not just a mirror of what exists, but a window into what could be. The same predictive power that helps an airplane engine self-correct today could help cities self-heal tomorrow—if we wield technology with foresight and humility. Let this anthology of student innovation remind us that the greatest twin of every model is not its accuracy, but its purpose.

Thought to take away:
"The future is not only built; it is simulated, tested, and then reimagined."

Acknowledgement:

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