



UNMESH MASHRUWALA
Innovation Cell
IIT BOMBAY

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ABOUT US



UNMESH MASHRUWALA
Innovation Cell
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Unmesh Mashruwala Innovation Cell (UMIC, pronounced : you-mik), is an all-student technical team at the Indian Institute of Technology Bombay, working towards the advancement of state of the art unmanned aerial and ground vehicles. The team consists of 50+ passionate and technophilic undergrads, coming from diverse fields and backgrounds but united by their love for science and technology. Common goal of the team is to develop cutting edge autonomous solutions to increase efficiency



A drone is often preferred for missions that are too 'dull, dirty, or dangerous for manned aircraft.'

Team Aerove, which falls under the sheds of UMIC is on a never-ending pursuit to develop the ultimate fleet of autonomous unmanned aerial vehicles, be it multi-rotors or fixed-winged aircrafts. The autonomous drone industry has expanded its realm of applications by starting out from military drones to now becoming increasingly popular as civilian grade and industry grade drones. The team decided to dive deeper into the ever-expanding realm of autonomous drones by presenting its solutions through various international student technical competitions. The team spans across five broad subdivisions including 'Mechatronics', 'Controls', 'Machine Learning', 'Path Planning', and 'Localisation'. Over the years the team has participated in a variety of competitions both, nationally and internationally, finishing podium level in majority of them. In recent years the primary target of the team has been the International Aerial Robotics Competition (IARC) organized by the AUVSI.

VISION

Current and Future Work



As mentioned previously, the team is actively working on the IARC Mission 9 Hardware Challenge 2022, with each of its subsystems proactively taking its respective tasks.

The Mechatronics subsystem is exploring various aerial vehicle configurations ranging from multirotors and fixed wings to the latest hybrid and VTOLs, with a vision to implement them for various real world applications by certain problem specific customizations. The Controls subsystem aims to develop a custom flight controller capable of accurately tracking a trajectory and executing agile maneuvers, specifically for a quadrotor capable of grasping and manipulating objects during flight.

The Localisation subsystem is scrutinizing various Visual-Inertial based SLAM systems for accurate localisation of the drones depending on the given environment. The Machine Learning subsystem is implementing state-of-the-art tracking and detection deep learning models. It is also closely collaborating with the Localisation subsystem to use Machine Learning methods fused with a Visual SLAM framework to precisely estimate the vehicle's current pose.

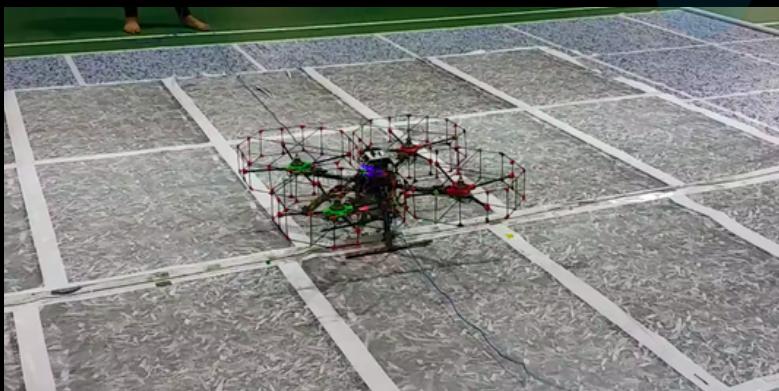
VISION

Current and Future Work



Collectively, AEROVE's ultimate vision is to develop state of the art technologies in various subdomains of autonomous UAVs by building upon existing solutions. Having conquered the IARC Mission 9 Simulation Challenge, the team now aims to achieve the same result in the upcoming hardware challenge, demonstrating their skills and positive attitude. After gaining significant expertise in both multirotors and fixed wing vehicles, the team would ultimately want to move into the domain of Hybrid VTOLs, combining the speed and range of a fixed wing UAV with the maneuverability, agility and hovering capabilities of a multirotor.

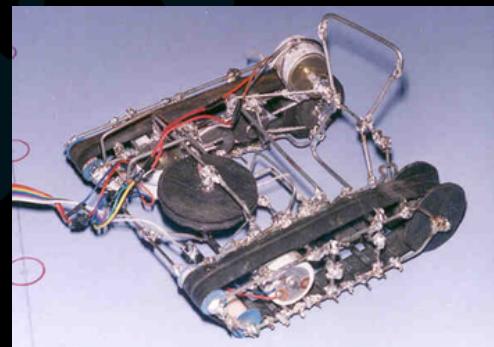
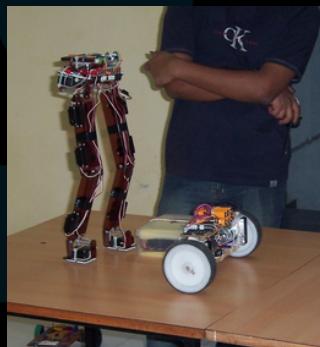
Lastly, the Motion Planning subsystem is creating a robust motion planning pipeline that can quickly adapt to various obstacles, and hence delivering optimal or sub-optimal paths in dynamic obstacle-rich environments.



LEGACY

In the Late 90's, Prof. C Amarnath at IITB had an idea, he wanted to involve students into robotics projects outside of their coursework, during extra time and vacations. Many students volunteered, together they organised a plethora of competitions, events and workshops. As a result of all this, Robotics was introduced at university level in the student community.

The initiative grew into one of the largest student technical-groups in the country, and started needing more resources and expertise in the form of mentorship. This is where Mr. Raj Mashruwala stepped in, and provided the necessary resources and support to the students. UMIC was born, and thus, in the mid 2000s, IIT Bombay gained its first student technical team. It went on to conduct workshops and events for engineering students all around, and also took part in various National and International competitions. Expanding its reach even further and catering to the general enthusiasm for technical activities in the institute, STAB (now known as Institute Technical Council) was born out of UMIC.



Looking towards greater challenges, UMIC aligned its vision with the dream of autonomous mobility and hence Sedrica was born in 2011, which took up the challenge of developing autonomous ground vehicles.

A natural and more challenging extension to ground autonomy was aerial autonomy, and hence Team Aerove was created in 2017 to develop autonomous aerial vehicles, and the rest is history!

SUBSYSTEMS

Mechatronics

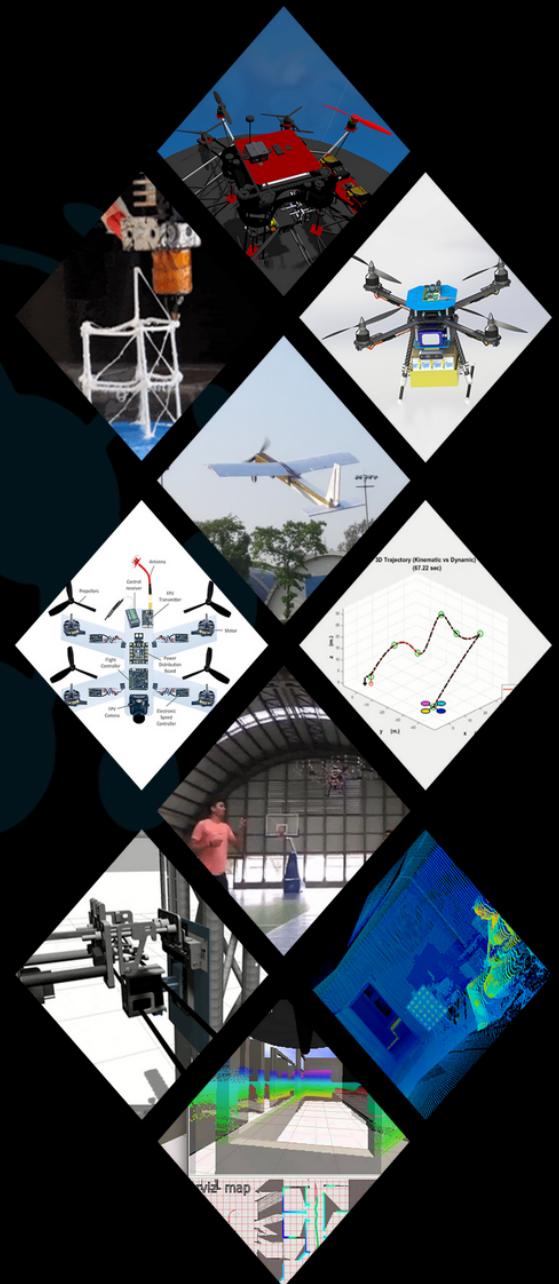
The Mechatronics subsystem deals with complete hardware requirements of the team including all the electronic components. Starting from selecting the appropriate vehicles and mechanisms, it ideates and executes the tasks pertaining to different solutions to perfect the mission delivery. Further, It involves designing and modeling the entire system in CAD software and then optimizing the design by using FEA techniques. Further, it takes charge of manufacturing, assembling, and testing of the systems.

Controls

The control subsystem involves commanding and coordinating the precise actions required for achieving desired behavior. To put it simply, the vehicle must fly from point A to B and follow the most optimal trajectory while doing so. Also, the subsystem integrates all the subsystems into one main framework to make the vehicle fly autonomously.

Localization

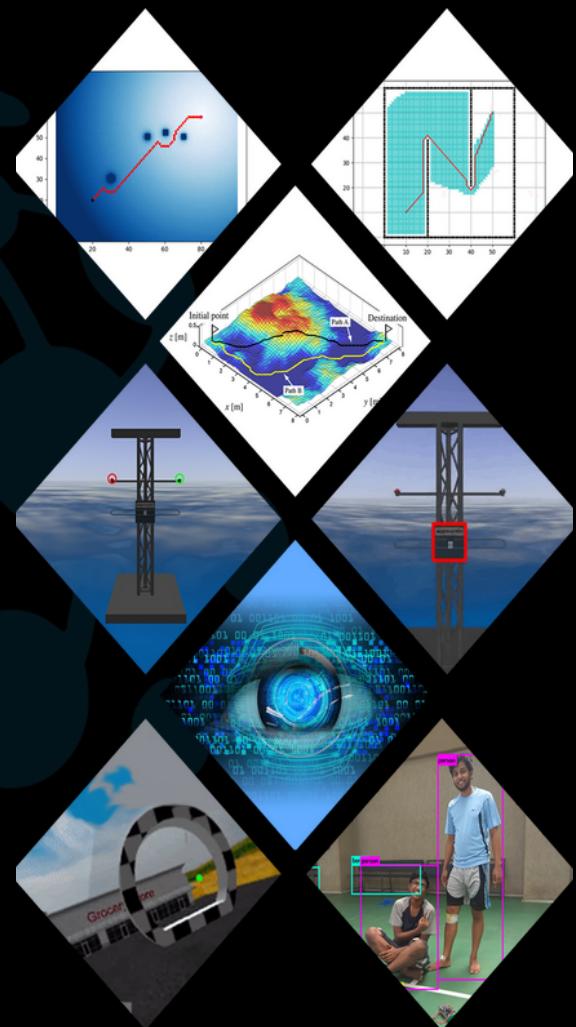
The Localization subsystem is responsible for developing an accurate positioning system according to the environment. It assists the aerial vehicle in perceiving the environment by using the input of various sensors. It is currently scrutinizing different SLAM systems, with Visual SLAM as its primary focus. Previously implemented state-of-the-art Visual SLAM algorithms for 3D mapping and obtaining pose of the vehicle in unknown environments.



SUBSYSTEMS

Motion Planning

The motion planning subsystem involves helping the drone find an optimal path and avoid obstacles along the way. An efficient motion planning algorithm needs to map the environment using efficient techniques for map storage and retrieval. After mapping, it needs to use that map to determine where the obstacles and free spaces are and lastly, utilize an algorithm to calculate the most efficient or sometimes sub-optimal path to traverse the environment and reach the goal.



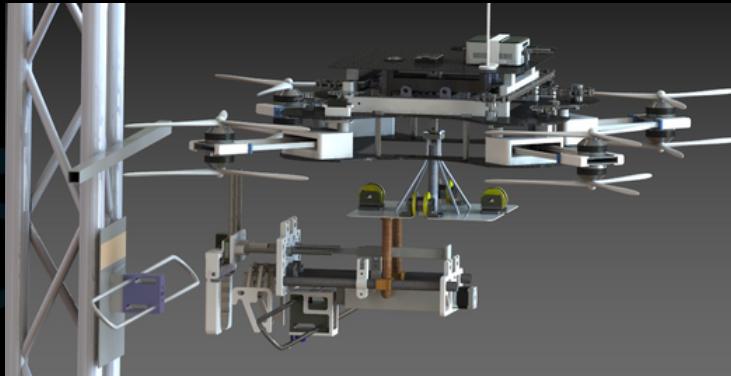
Machine Learning

The Machine Learning subsystem tackles the unique challenges faced in our missions using Computer Vision and Machine Learning algorithms. Currently, it is working on STARK (Spatio-Temporal Transformer for Visual Tracking), a deep learning based tracking model for accurately tracking an object. It is also working on one shot detection for face detection applications using ArcFace model. Previously, it implemented YOLO (You Only Look Once) for target/human detection and controlled a quadrotor with voice commands using speech classification.

ACHIEVEMENTS

World Champions: IARC Mission 9 Simulation Challenge'21

The International Aerial Robotics Competition, also the longest-running aerial robotics competition globally, allowed us to bring out the best of our capabilities and made us think in ways like never before! Owing to the team's efforts, we were crowned the World Champions for the 2020-2021 challenge



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IIT Bombay Team Wins International Robotics Competition

A team from the Unmesh Mashruwala Innovation Cell representing the Indian Institute of Technology (IIT) Bombay has won the International Aerial Robotics Competition - Simulation Challenge 2020.

Edited by Bishal Kalita | Updated: May 24, 2021 5:41 pm IST
Source: Careers360

A blurred photograph showing a person's hands holding a remote control device, likely used for operating the aerial robotics system shown in the main image.

Much like previous missions, Mission 9 demanded complex autonomous tasks such as long-distance outdoor navigation, mobile manipulation of large objects using actuators attached to our drones, interaction with moving frames of reference, and 100% onboard computations along with time constraints. Exposure to these novel domains helped the team to improve its technical expertise.

Mission 9 was held in 100% virtual mode and the problem statement was to be implemented in simulation owing to the pandemic. The team submitted a real-time simulation link to the organizers for evaluation with different environment settings for robust evaluation of the solution. Despite the ongoing pandemic, we thoroughly enjoyed working on a collective goal, the IARC Mission 9 challenge.

ACHIEVEMENTS

IARC Mission 8

Team AeRoVe chased the Mission 8 of IARC in 2018. Presented with the "Best Presentation Award" in Mission 8 of IARC in Beijing, China, the team had developed a 'swarm' of autonomous quadcopter systems specifically designed to work under GPS-denied environments



IARC Mission 8

Mission 8 focused on demonstrating technologies involved with Man-Unmanned Machine-Teaming (MUMT). In particular, a single human was to communicate navigation commands by either gesture or vocal commands to a swarm of four fully autonomous aerial robots. This competition was our team's introduction to the world of UAVs, from manufacturing the drone to developing and testing state of the art algorithms, the team gradually perfected the mission.

Barcelona Smart Drone Challenge

Participating for the first time in the Barcelona Smart Drone Challenge (BSDC) in its 2020 edition, our team worked towards autonomous fixed-wing vehicles. We built over 10 prototypes in an iterative manufacturing process, and successfully tested our control architecture responsible for autonomous takeoff, landing and waypoint navigation, along with objectives like payload dropping and geolocation.

After successfully completing the two out of the three review rounds, we were preparing to complete the Flight Readiness Review, but the subsequent competition were detained because of the COVID-19 pandemic.

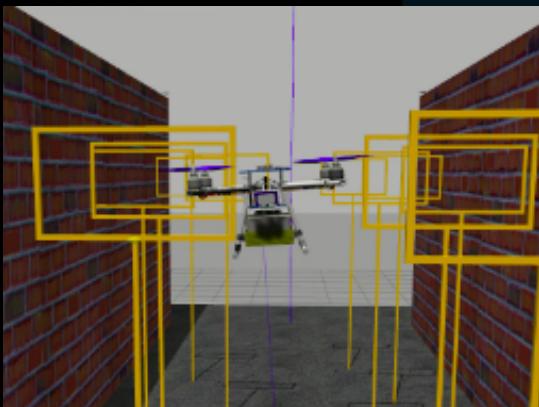


Barcelona Smart Drone Challenge

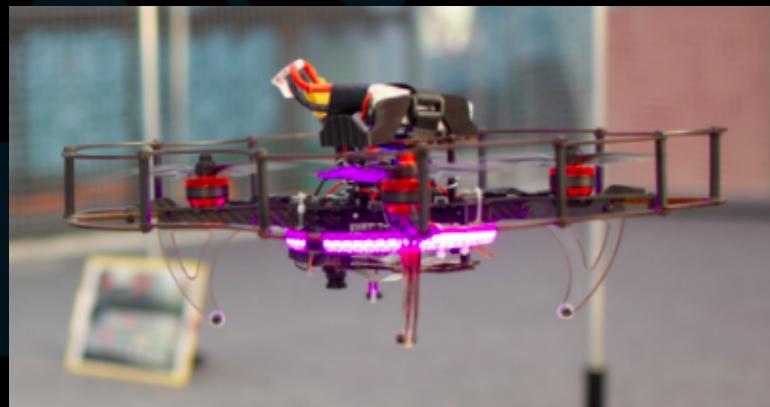
ACHIEVEMENTS

Top 3 in India: Flipkart GRiD 2.0 Challenge

Team Aerove was among the Top 3 teams of the nation in the Autonomous Indoor Drone problem statement of the competition. The team developed an Autonomous Quadrotor capable of navigating in a GPS-denied environment. The quadrotor detected obstacle frames using a Conditional Cascaded Filtering architecture, and then traversed through them without collision. The quadrotor localized itself using ORBSLAM2, a visual SLAM algorithm. The team verified their solution by successfully demonstrating the mission in a simulated environment using PX4-Gazebo Simulation.



Flipkart GRID 2.0 Challenge



BRICS Future Skills Challenge

Best of Nation title : BRICS Future Skills Challenge

COEX, a Russian Drone Manufacturing company, conducted a competition titled 'Future Skills Challenge' across the BRICS nations. Out of 10 teams that took part, our team, consisting of Pavan Kale and Yash Bhavsar, was awarded the "Best of Nation" title. In this competition, the participants had to prepare an algorithm to detect ground Aruco Markers, and then relay the information back to the base station. Then the algorithm was remotely deployed onto a drone in St. Petersburg, Russia, where it was tested and the mission was successfully executed.

TIMELINE



2017

AEROVE IS BORN

The team targeted the IARC Mission-8 Hardware Challenge, and aimed to extend UMIC's capabilities in the Autonomous domain to the skies.

IARC MISSION 8

The team competed in the IARC Mission-8 challenge held in Beijing, China. Bestowed with the Best Paper Presentation Award.



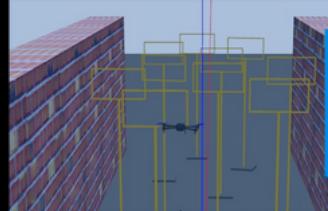
2018



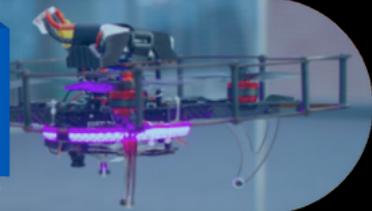
2019

BSDC 2020

Team Aerove moves on from multirotors to fixed wing UAVs, targets the Barcelona Smart Drone Challenge 2020.



2020



Spring

The team clears the Preliminary & Critical Design review stages of the BSDC 2020 competition.

Summer

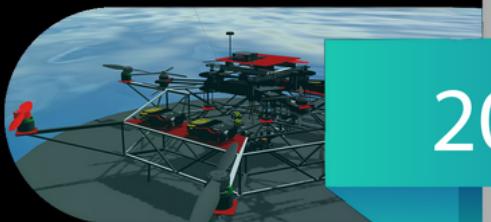
COVID strikes, lockdown, BSDC stands cancelled. But the team doesn't lose heart and decides to move forward with simulation based competitions.

Autumn

Team participates in three competitions in a span of a year- The Flipkart GRID 2.0 Challenge, the BRICS Future Skills Challenge, and the IARC Simulation Challenge.

Winter

Team Aerove declared the "Best of Nation" in BRICS Future Skills Aerial Robotics Challenge & qualifies for the National Finale of Flipkart Grid 2.0..



2021

WORLD CHAMPIONS!

After months of hardwork and nightouts, the team finally submits the entire Mission 9 Simulation. In April 2021, the team was declared as World Champions!

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"Most of the sponsorships help companies enhance their public profile, but with UMIC, it's different. We're much more than that."

Social Media Endorsement

Through us, you can widen your reach to highly qualified IIT-Bombay students pursuing majors in engineering fields. Along with our strong network and well-established campus presence, we can help expose students to your company and can cater to your specific needs.



Qualified Interns

As our sponsor, you will have access to UMIC's latest team resume booklet, featuring highly skilled and enthusiastic undergraduate students willing to work in both full-time and internship positions.



Hardware Support

Explore the possibilities of your product in the domain of Aerial Unmanned Vehicles through our hardware platforms. You can also validate the performance of beta versions of your products with us. Document and solve compatibility issues of your product.



Software Testing

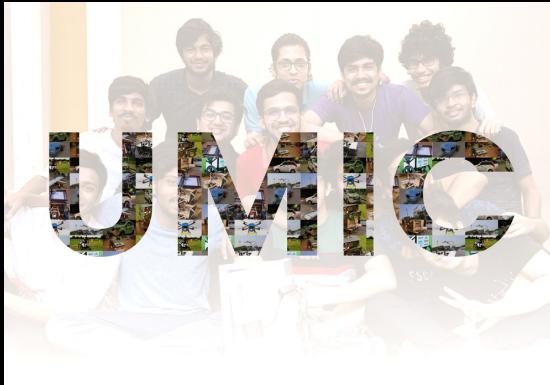
We can aid in testing and benchmarking your software through our technical capabilities. Upon leveraging your software, promoting its use as the Team's benchmark for competing at an international level.



DELIVERABLES



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We constantly strive to innovate more and more, looking out for better approaches and solutions. Every innovation comes through a lot of studies, errors, and cumulative research. Together we can devise an excellent opportunity by working on a collaborative research project.

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IIT Bombay declared global winner of prestigious International Aerial Robotics Competition

AUVSI International Aerial Robotics Competition is world's premier, longest-running collegiate aerial robotics challenge

The winning team seen above is part of Unmesh

Ministry of Education @... · May 27 ...
A team from the Unmesh Mashruwala Innovation Cell at [@IITBombay](#) has won the International Aerial Robotics Competition - Simulation Challenge 2020. This team, named AeRoVe, secured the first place globally.

Congratulations team! Proud of you all!

bit.ly/IITB-ARC

Narendra Modi and 9 others

IIT Bombay Team Wins International Robotics Competition

A team from the Unmesh Mashruwala Innovation Cell representing the Indian Institute of Technology (IIT) Bombay has won the International Aerial Robotics Competition - Simulation Challenge 2020.

Education | Edited by Bishal Kalita | Updated: May 24, 2021 5:41 pm IST | Source: Careers360

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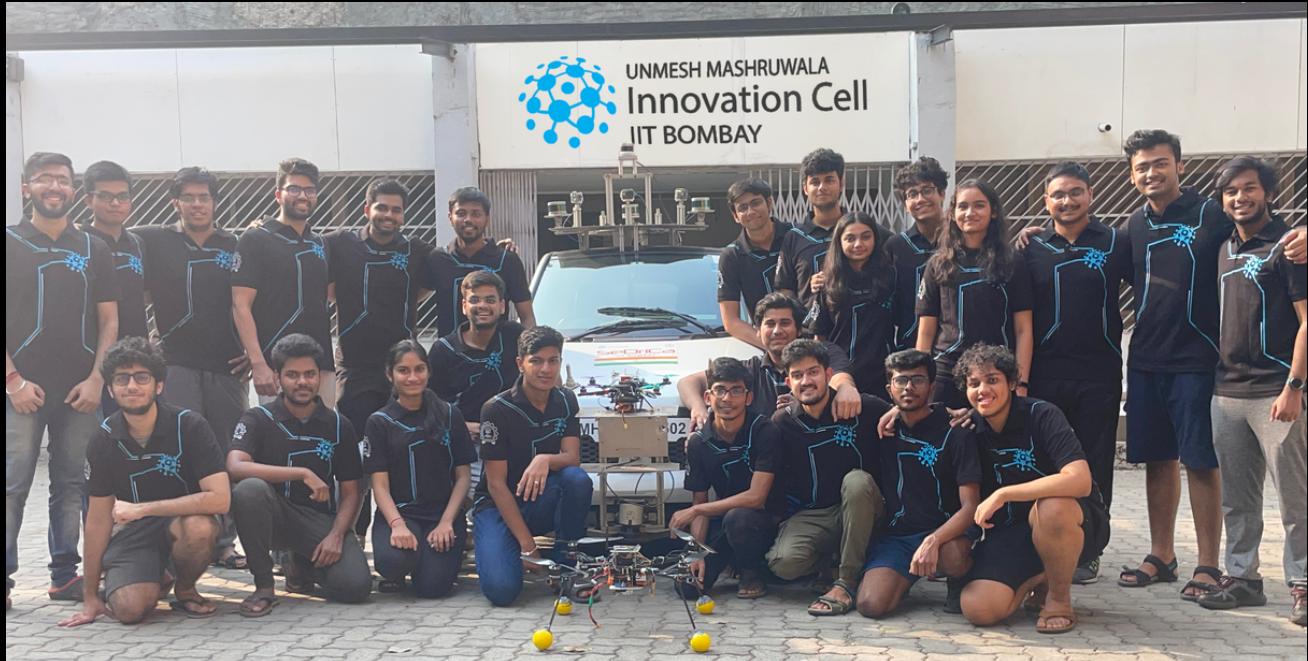


T-Shirt Logo

The unity of the team is represented through its uniform. We wear it with pride and in all of our competitions. We can emboss your logo on our apparel. The outreach of this is massive as all of our competitions are held on an international platform.



CONTACT US



Our vision would not have become a reality without our sponsors and partners' colossal commitment and active contribution. We are grateful to our esteemed Director and Deans, IIT Bombay, our faculty advisors, our sponsors, and our supporters for their overwhelming assistance and having faith in us!"



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