ariitk.in

AERIAL ROBOTICS

IIT KANPUR

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Who we are›

We are an undergraduate team that was established with the goal of raising awareness and promoting the usefulness of UAVs. We strive to offer autonomous UAV-based open-source solutions for practical issues and represent the institute in a number of regional, national, and international competitions.

Flying high since 2017!

AERIAL ROBOTICS

Team Aerial Robotics Is A Team Made Up Of Students From Various Departments.

Our passion is building autonomous drones, and we thrive on the challenges of competitions like ICUAS, IMAV, IARC, IROS, ICRA and A2RL. Our primary focus is creating powerful and reliable drones, and we enjoy the camaraderie with fellow enthusiasts worldwide.

Working As A Team

Our team comprises four significant subsystems: hardware and firmware, visual processing and algorithms, controls, and path planning and localization. Each subsystem conducts research to improve its specific area, thereby contributing to a superior overall architecture. Extensive analysis and real-world testing ensure that our drone far exceeds expectations.

What We Can Do For You

As a student team, we constantly need industry partners and sponsors to help us with our operations. We look forward to developing strong relationships with our partners who assist us with funds, tools, and services. In exchange, we offer our partners increased brand awareness and networking opportunities with our talented student members.

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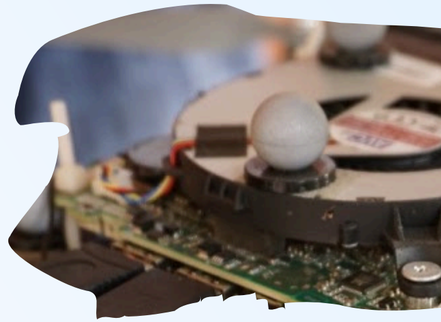
What we do›

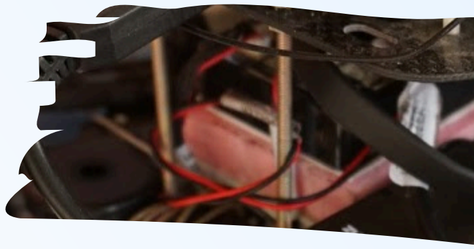
Explore

We explore the world of UAV technology and all of its related fields, like computer vision, mapping, path planning, developing hardware, etc.



Educate

We educate the community about the existing tech and try to contribute to the open-source world of UAV technology.



Compete

We participate in various national-level and international-level competitions: we travel to join competitions and make our institute proud.

SUBSYSTEMS>

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- Hardware & Firmware
- Visual Processing and Algorithm
- Control
- Path Planning & Localization

HARDWARE AND FIRMFARE

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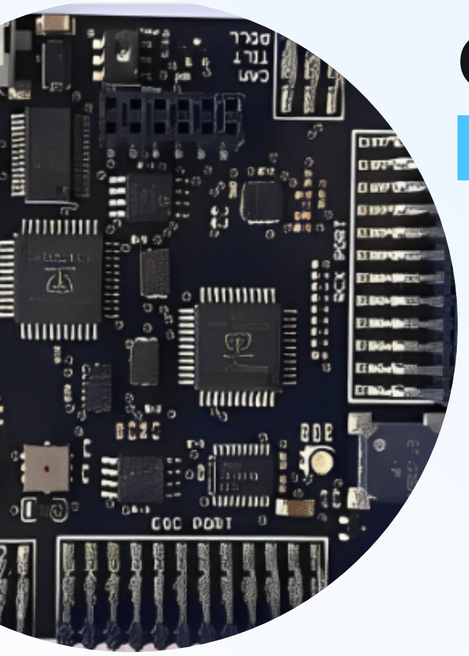
- All our UAVs are custom-built.
- Application of different materials (incl. Carbon Fiber) in constructing the drone's body.
- Hardware/Firmware testing and integration
- Testing at AirStrip and Heli Lab of IITK.

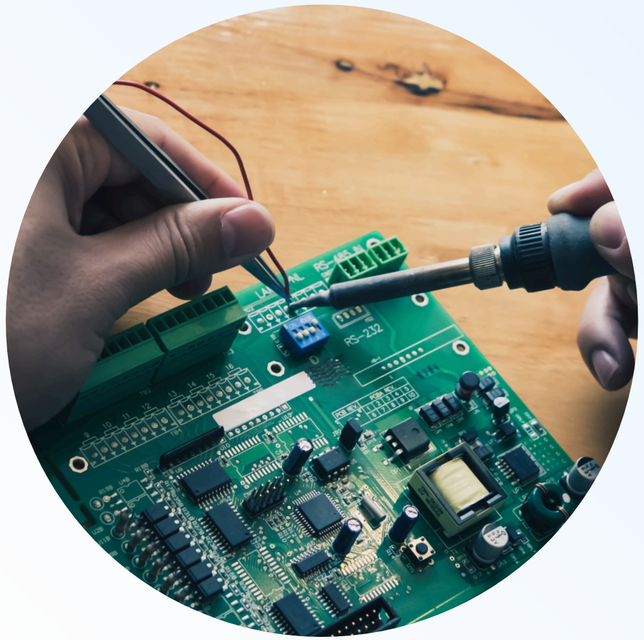
VISUAL PROCESSING AND ALGORITHM

- Implements classical object detection and segmentation methods
- Implementing single and multi-object tracking
- Implementing a VIO Pipeline, particularly fine-tuning the features' extraction/tracking



CONTROL

- Implementing different control policies to be used in different scenarios
- Further implementing optimum control policies using recent RL Methods



PATH PLANNING & LOCALIZATION

- Utilizing a combination of classical and RL-based methods for optimal trajectory planning
- Implementing a pose estimation and localization pipeline for GPS-denied scenarios
- Furthermore, refining pose estimates using methods including EKF residual modelling.

Our Past Academia Projects

Autonomous FPV Racing Under Prof. Indranil Saha

The project aims to create an autonomous FPV racing module. It primarily focuses on implementing optimized autonomous framework leveraging the policy network trained for agile autonomy, and fine-tuning the output for a given race track configuration using an actor-critic approach.

We aim to replicate the methodology presented in the paper shown and, in addition, harness transfer learning from agile autonomy techniques to create a more resilient model capable of adapting more efficiently to changes in gate positions.

Being an indoor problem statement i.e. GPS-denied, it is essential to implement local pose estimation methods. Our main objective is to enhance the reliability of the Visual-Inertial Odometry (VIO) system to reduce drift. This will be achieved through the implementation of a gate detection module, which will, in turn, determine the relative platform pose using the PnP approach. These estimates can be further fine-tuned using residual modelling.

Our Past Academia Projects

Swarm
Under Prof. Ketan Rajawat

The project aims to build a drone swarm with modules for formation flying, collision avoidance, and hierarchical coordination.
It emphasizes creating a robust communication framework using networking concepts. Waypoint generation and path planning are integral for coordinated movement.
The swarm comprises three drones, each equipped with Odroid onboard computers and connected via a router for external communication.

Our Past Academia Projects

Control & SLAM
Under Prof. Twinkle Tripathi

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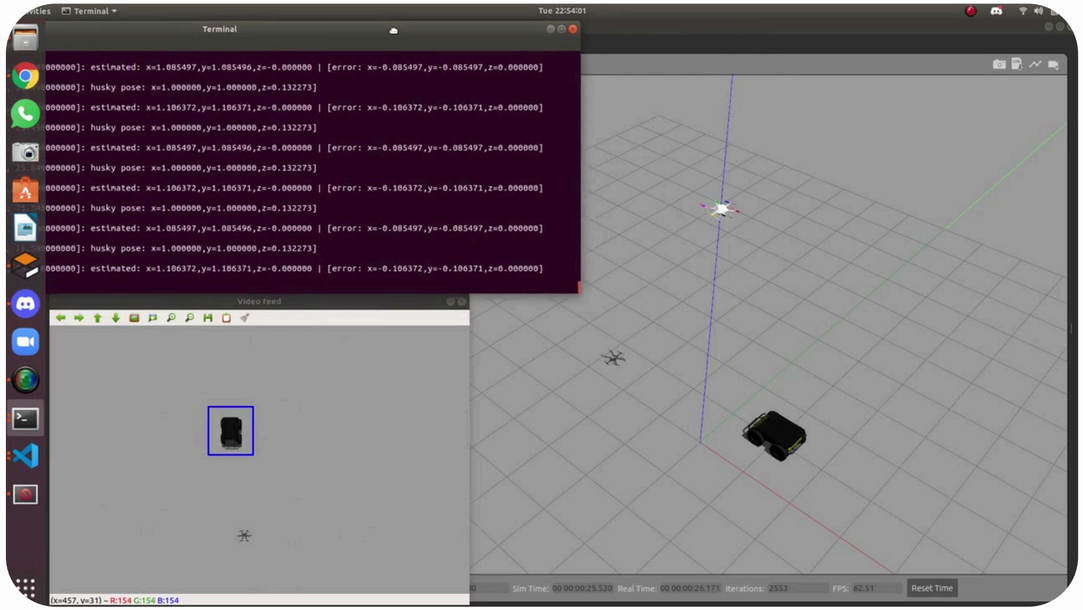
The project deals with implementing a controller that allows multiple unicycle model agents to survey an annular region whose inner boundary is under constant monitoring "WITHOUT LAPSES".
Unicycle model agents can be hierarchical or equal, and there is no intercommunication apart from localization amongst them. The basic idea behind the controller is to allow each agent to have a random trajectory that intermittently switches.
Each agent is locked onto a beacon that provides the range or radial distance of that agent, and there is an array of such beacons on the inner boundary of the annular region.
An agent switches between trajectories while being locked onto a single beacon and also switches when it is transitioning from one beacon to another, thus traversing the entire annular region. The non-trivial caveat is that each beacon must be locked onto at least one agent at all times, which means the inner boundary is always under surveillance.

Our Past Academia Projects

Video Tracker & Pick-Up Under Prof. Mangal Kothari



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The project aims to develop a comprehensive object-tracking system in simulation and hardware, focusing on image processing methods, including classical techniques and machine learning with CNNs and YOLO.

We aim to leverage Vulkan to build efficient vendor-neutral parallel implementations of tracking algorithms like KCF, MOSSE, and DCF; from scratch minimal OpenCV to build a light framework with less footprint . Further, more recent approaches based on vision transformers are to be explored and implemented.

This project also includes building custom images of Linux using the Yocto and Buildroot Framework for a custom built board, again with minimal additional utilities.

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Our UAVs›

Spedix

Ironman

Icarus

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Our UAVs>

Magnus

Ventulus

Phoenix

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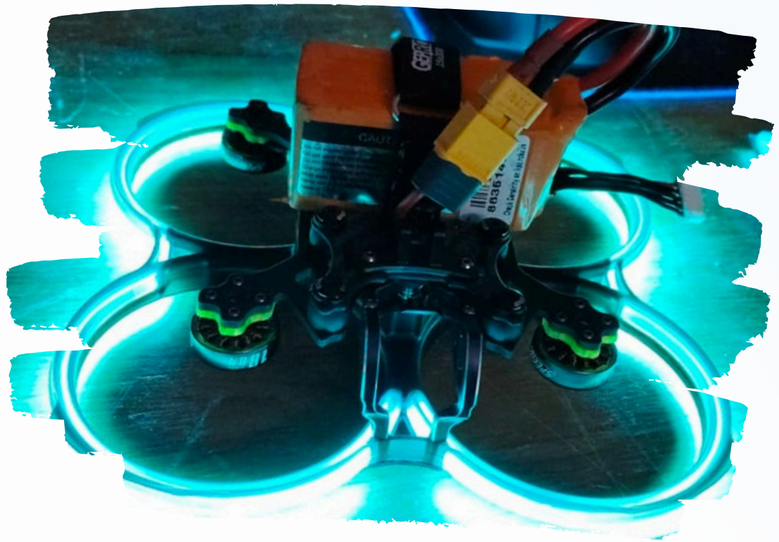
Our UAVs>

Sandy



The Middle Child

Squidward

Achievements

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ICUAS 2025

Team Aerial Robotics, IIT Kanpur secured the **1st Place** globally in the finals of the student competition at the **International Conference on Unmanned Aircraft Systems (ICUAS) 2025** held in **North Carolina, USA.**

The final round involved identifying ArUco markers on various obstacles, while maintaining communication and line-of-sight between a swarm of drones. This was implemented on Crazyflie drones. Our solution, previously implemented in simulation, where we finished third globally, was successfully adapted and executed in the real-world finals.

Achievements

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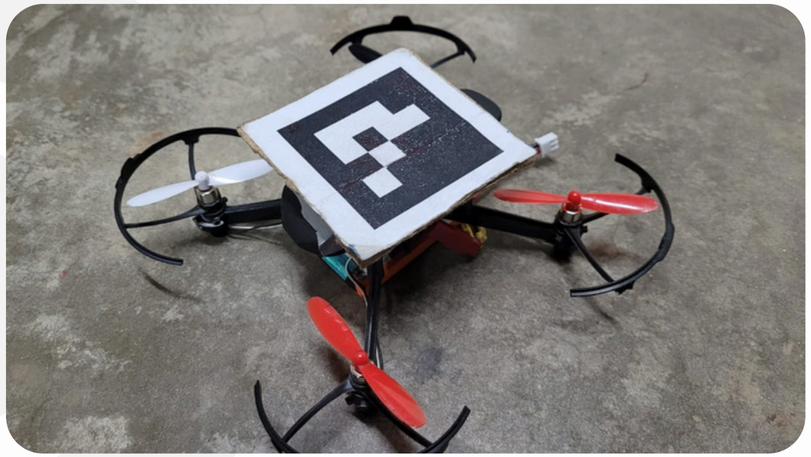
Inter-IIT Tech Meet 11.0



Bronze in Pluto swarm drone challenge ,IIT Kanpur

Inter-IIT Tech Meet 10.0

Silver in DRDO’S UAV-guided UGV Navigational Challenge, IIT Bombay

RoboFest

Secured first place in the Proof of Concept Stage, moving to the finalround, preparing for the autonomous UAV search, pick-up, and drop challenge, earning a total prize of 1.5 lakhs

Achievements

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Inter-IIT Tech Meet 9.0

Bronze in DRDO'S UAV Exploration Challenge, IIT Guhuwati

InterIIT Tech Meet 7.0

Silver in an in-person hackathon, hosted on the PlutoX platform by Drona Aviation. The challenge was to guide PlutoX to navigate parallel walls autonomously and pass a viva interview.

Inter-IIT Tech Meet 8.0

Sole Gold medal Winner with 400/400 points, and Special Mention from DRDO

Achievements

AUVSI Foundation International Robotics Competition (IARC)

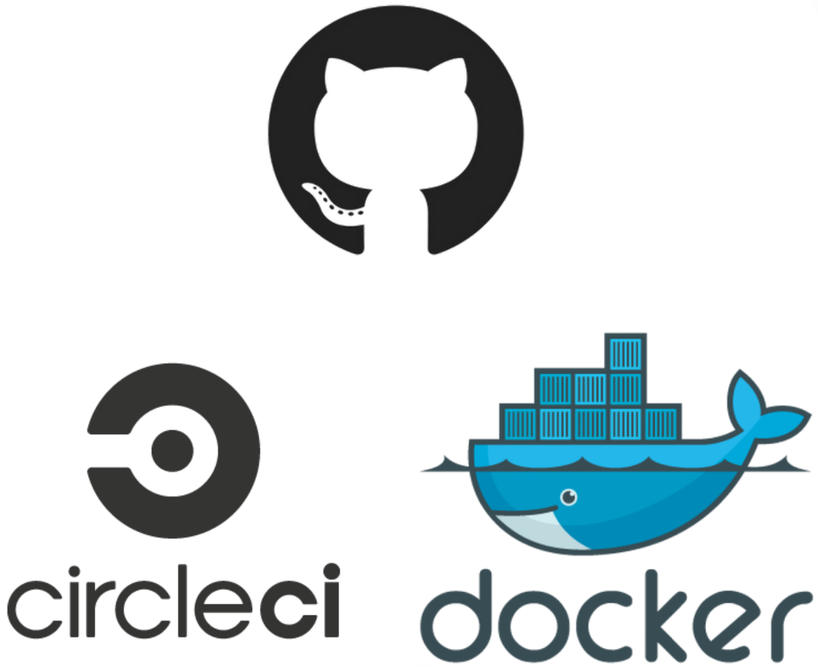
Out of 11 global teams, only us and IIT Bombay from India were chosen to participate in Mission 9 of the AUVSI Foundation International Aerial Robotics Competition.

IMAV 2019, Spain

One of the **Top 10** student teams globally, to qualify for IMAV held at Madrid, Spain

Skills we work on

software and stimulation



testing and integration

hardware design

Current Status

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HARDWARE

- In November 2023, we bridged our **hardware** gap by building the Phoenix drone for the Y23 Pavilion. It featured a Cube Hex 2 flight controller, AirGear TMotors, and Jetson TX2 for manual manoeuvring. We also ventured into Micro Aerial Vehicles, creating one with SpeedyBee F405 FC-ESC and EMax ECO-II 2400kV motors for Robofest's autonomous tasks. Employing ELRS protocol, one drone achieves a 30km range. Our autonomous flights include SpongeBob, a custom carbon fiber frame with Odroid XU4, Cube Hex, oCam-1MGN-U Plus, GARMIN LIDAR, Arduino Mega, and Here+ GPS with RTK. Upgrades with a Realsense camera and Nvidia Jetson have been implemented. The S500, on a carbon fibre frame, integrates Readytosky motors, CUAV V5+ controller, Here+ GPS, LidarLite v3, and WiFi telemetry. Future additions involve RTK GPS, computation units. Lastly, the testing drone, F450, with SunnySky motors and Pixhawk controller, uses GPS blending and plans to integrate an External Barometer for enhanced precision during module testing.
- Constructed a **pick-and-drop** system, a common element in many problem scenarios, incorporating Arduino control with an onboard computer via a serial interface. The system also featured 3D-printed gripper components.
- Implemented Battery and Radio Failsafe with safeRTL feature.

Current Status

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SOFTWARE

- Implemented **robust object detection** pipeline on a dummy object i.e. ball, used several methods including classical methods, image segmentation, CNN and seeking to implement transformer-based models as well. Implemented module to get relative pose estimates from a depth camera, and tested module on simulation.
- Implemented On-Board Autonomous Flight Control.
- Implemented a naive approach for **FPV autonomous drone racing** using the classical path planning methods on simulation
- Implemented a **de-centralized communication network** among swarm fleet via two approaches using multimaster FKIE & by establishing communication using unique ROSMASTER:URI and on simulation, and tested on hardware.
- Executed **ROVIO pipeline on current hardware**, integrating feed form IMU from an FC and pose estimates from feature tracking

Requirements

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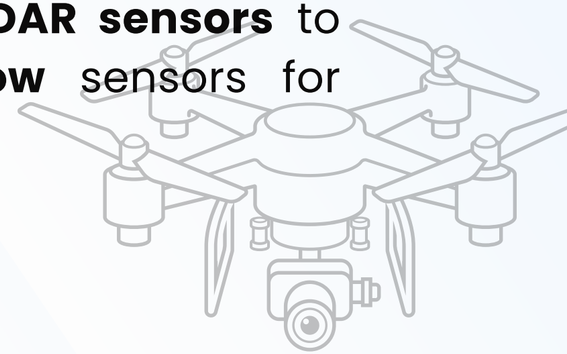
- Our autonomous aerial fleet demands high-performance **computational units**, including the CUAV V5+ Flight and the A203 **Carrier Board** for Jetson Xavier. These components serve as the backbone of our onboard computational platform, essential for managing intricate algorithms and ensuring optimal overall performance.
- We require advanced vision systems for drone navigation, like high-quality tracking and **depth-sensing cameras** for enhanced **precision and navigation**. These cameras enable simultaneous localization and mapping (SLAM) and centimetre-level accuracy in navigation.
- We use Real-Time Kinematic (RTK) Global Position Systems, which necessitates high-rate **Inertial Sensors** to ensure precision. We call for components like **high-precision GPS modules**, employing RTK technology to provide precise localization data. Additionally, we need **barometric pressure sensors** that offer critical altitude data and **LIDAR sensors** to deliver exact distance measurements. Moreover, we require **optical flow** sensors for enhanced stability in confined regions where GPS isn't helpful.



Requirements

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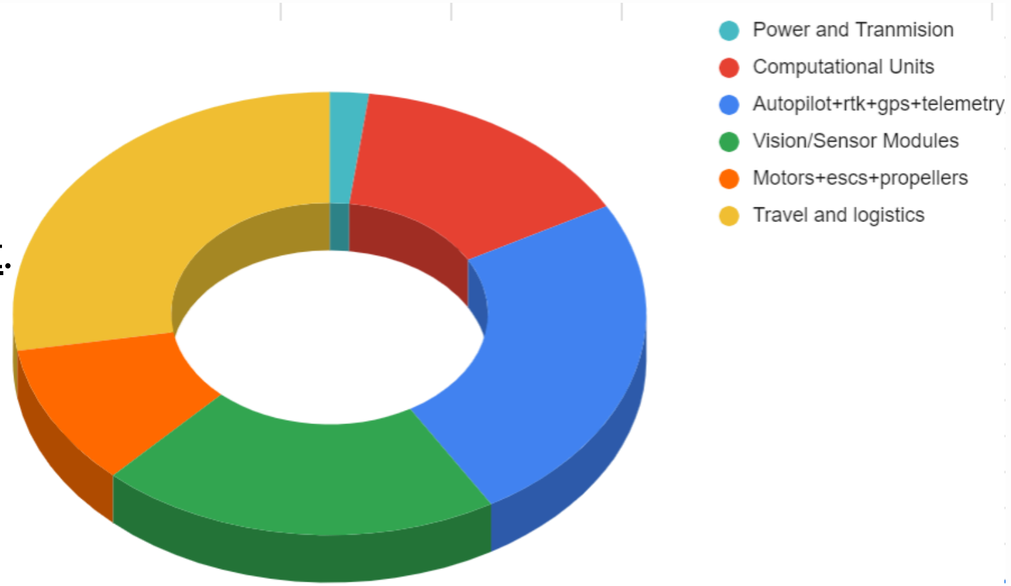
- Moreover, it is quotidian that we work on pick-up and drop statements, which require the integration of **hard and soft grippers**. Furthermore, we face shortage of **connecting wires** (In particular, JST cables, which frequently require importation, consequently come with a high cost.), and **permanent and temporary binders**, including screws and rivets.
- Moreover, we require **high-quality motors** and **carbon fibre propellers** for actuation and control, ensuring efficient and stable flight performance. Additionally we require the body **frames** which are custom designed to be 3D printed or procure carbon fiber frames for optimal weight and strength of the frame.

Here is the detailed requirement of the budget requirement.



Future Goals

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- **IROS** is the most prestigious conference in intelligent robotics, held annually in Sept-Oct, upcoming to be held in Kyoto, Japan. It features several competitions for research teams, almost always involving a PS exclusively for UAVs.
- **IMAV** is the premier UAV/MAV conference, which holds two competitions indoors & outdoors. IMAV has been the team's major target since inception, and it would be a major focus of the team to do the same.
- The **IEEE International Conference on Robotics and Automation (ICRA)** is a prestigious academic event that takes place every year and focuses on the latest developments in the field of robotics. It holds a prominent position within its discipline, sharing the stage with the International Conference on Intelligent Robots and Systems (IROS). It regularly holds student competitions involving control and navigation, often involving UAVs. We have specialized people on our team for dealing with control/navigation.
- **Robofest 5.0**, Robofest is an annual robotics competition organized by GujCOST, Gujarat.
- **IRoC 2025,** is an extra-terrestrial UAV Challenge organized by ISRO.

Future Goals

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- **ICUAS’26** is an international conference which centers around civil and public domain applications, and on the impact of unmanned aviation to society. Technical challenges cover a wide spectrum of topics, involving swarm robotics for practical purposes such as threat detection.
  We secured Rank 1 in ICUAS’25.
- **ICRA**, aims at programming of autonomous drones using Model-Based Design and Simulink
- **IARC** is another premier competition in the domain of Aerial Robotics. Aim to represent IITK in the same. **The International Aerial Robotics Competition (IARC)** is prestigious owing to its history, challenging tasks, international participation, innovation promotion, industry recognition, and career opportunities. It fosters technical expertise and collaboration, offering a platform for global teams to push the boundaries of aerial robotics and advance the field.
- **A2RL** is an upcoming autonomous racing league in Abu Dhabi featuring autonomous fpv drone racing challenges. We are currently working in the direction of building a full-fledged software stack, building upon our previous works. The ultimate goal is to put this software to the test within the upcoming league

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Future Goals

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Deliverables

Participating in competitions often involves significant costs such as **travel**, lodging, **registration**, and **equipment**. These expenses strain our budget, particularly when pursuing excellence. **Financial support** allows us to invest in technology, research, and development, **enhancing competitiveness**.

Funds provide access to **training and mentorship**, helping us **improve skills** and stay at the forefront of our field. These allocated resources will support our involvement in prestigious robotics competitions, offering platforms to **showcase innovations**, **exchange ideas**, and **compete globally**.

The funds will cover travel, registration, equipment, and essential resources for our success in these events.

Ways To Support Us

AERIAL ROBOTICS

Financial Support: Provide financial resources to help cover equipment costs, research and development, competition fees, and travel expenses.

Mentorship and Expertise: Offer industry expertise, mentorship, or access to technical advisors who can guide the team in their projects and provide valuable insights.

Equipment Sponsorship: Donate or provide discounted access to cutting-edge aerial robotics equipment, such as drone parts, sensors, cameras, or software tools.

Sponsorship of Competitions and Events: Help fund the team's participation in aerial robotics competitions, conferences, or industry events, enabling them to showcase their skills and gain exposure.

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Thank you!

We hope that the information provided above has given you a better understanding of our team, Team Aerial Robotics at IIT Kanpur.

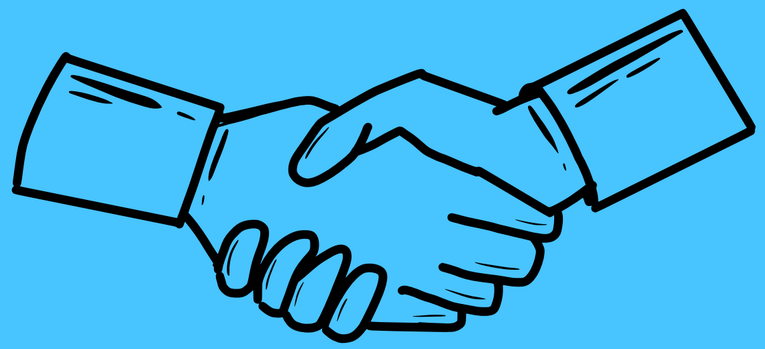
We are ecstatic and eager to build a strong and fruitful relationship with you. Your help and partnership are extremely valuable to us.
If you have any questions or suggestions, we would be delighted to hear them. Your feedback is extremely valuable to us as we strive to achieve success in our endeavours.

Thank you for taking the time to consider our team, and we look forward to the opportunity to collaborate.

Sincerely yours

Team Aerial Robotics
IIT Kanpur

THANK YOU



CONTACT US

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Aerial Robotics has 84 repositories available. Follow their code on GitHub.

GitHub