INSTITUTE OF AERONAUTICAL ENGINEERING

High Impact Practices for Student's Success

Side Projects

Information Packet
2024-2025

We appreciate your interest in the HIPS- Side Projects Program at Institute of Aeronautical Engineering.

The Side Projects (SP) initiative offers students an opportunity to engage in independent, self-directed technical or creative work beyond the scope of regular academic coursework. These projects provide a platform for exploring personal interests, experimenting with innovative ideas, and gaining hands-on experience across diverse domains. Whether working with emerging technologies, developing practical tools, or building interactive systems, students are encouraged to pursue meaningful projects that foster creativity, interdisciplinary learning, and personal growth.

Side Projects are:

1. **Independent** – initiated and managed by the student(s);
2. **Flexible** – carried out at the student's own pace;
3. **Cross-disciplinary** – open to students from all disciplines;
4. **Mentored** – optional mentorship available depending on scope and interest.

The initiative is designed to encourage innovation and self-motivated learning, support real-world problem solving, promote technical exploration, and strengthen student portfolios through original, hands-on work.

Areas of Focus

Projects may cover, but are not limited to, the following domains:

1. Cloud and Infrastructure
2. Security and Blockchain
3. AI and Automation
4. Creative and Interactive Technologies
5. Mobile and Edge Computing
6. Data, Services, and Integration
7. Hardware and Systems

Sustainable Development Goals (SDGs) Alignment

The United Nations Sustainable Development Goals (SDGs) provide a global blueprint for peace, prosperity, and sustainability. The Side Projects initiative aligns with several of these goals by encouraging innovative, socially responsible, and impactful solutions. Each track supports one or more SDGs through its technical focus and potential applications.

1. **Cloud and Infrastructure**
   SDGs:
   (a) **SDG 9 – Industry, Innovation and Infrastructure:** Supports scalable and innovative systems.
   (b) **SDG 11 – Sustainable Cities and Communities:** Enables smart city solutions and digital services.
   (c) **SDG 13 – Climate Action:** Promotes efficient resource use through cloud-based infrastructure.

2. **Security and Blockchain**
   SDGs:
   (a) **SDG 16 – Peace, Justice and Strong Institutions:** Encourages secure, transparent systems.
   (b) **SDG 9 – Industry, Innovation and Infrastructure:** Advances trust and innovation via decentralized tech.
3. **AI and Automation**
   SDGs:
   (a) **SDG 8 – Decent Work and Economic Growth:** Enhances productivity and creates future job opportunities.
   (b) **SDG 9 – Industry, Innovation and Infrastructure:** Drives technological advancement.
   (c) **SDG 3 – Good Health and Well-being:** Improves healthcare through intelligent systems.
4. **Creative and Interactive Technologies**
   SDGs:
   (a) **SDG 4 – Quality Education:** Enriches learning with interactive platforms.
   (b) **SDG 11 – Sustainable Cities and Communities:** Enhances public engagement and cultural experiences.
5. **Mobile and Edge Computing**
   SDGs:
   (a) **SDG 9 – Industry, Innovation and Infrastructure:** Delivers edge solutions to underserved areas.
   (b) **SDG 10 – Reduced Inequalities:** Expands digital access and inclusion.
   (c) **SDG 3 – Good Health and Well-being:** Supports telehealth and real-time monitoring systems.
6. **Data, Services, and Integration**
   SDGs:
   (a) **SDG 9 – Industry, Innovation and Infrastructure:** Enables smart data systems and service integration.
   (b) **SDG 11 – Sustainable Cities and Communities:** Helps in urban management and planning.
   (c) **SDG 17 – Partnerships for the Goals:** Promotes system interoperability and collaboration.
7. **Hardware and Systems**
   SDGs:
   (a) **SDG 9 – Industry, Innovation and Infrastructure:** Focuses on resilient hardware development.
   (b) **SDG 7 – Affordable and Clean Energy:** Involves energy-efficient and monitoring devices.
   (c) **SDG 3 – Good Health and Well-being:** Encourages development of biomedical hardware.

Eligibility and Participation

- Open to all undergraduate and postgraduate students with a passion for independent learning.
- Students may work individually or in small teams (maximum of 3 members).
- Prior experience is not required; curiosity and commitment are essential.

Interested students should:

- Submit a brief proposal outlining the project idea, objectives, and tools/technologies;
- Specify if mentorship is required and suggest possible faculty/technical mentors;
- Share periodic progress updates as scheduled.

Recognition

While academic credit is not awarded, successful projects will be recognized through:

- Departmental showcases or exhibitions,
- Certificates of contribution,
- Recommendation letters, where applicable.

Call for Proposals

The Side Projects initiative is currently open for submissions. Students are encouraged to begin ideation, form teams if necessary, and prepare their proposals.

For further details and to submit your project idea, please contact the Side Projects Coordinator.

We look forward to your participation in this initiative and the creative, technical contributions you will bring forward.

1. Cloud and Infrastructure

The Cloud and Infrastructure track focuses on the development and management of scalable, secure, and efficient computing environments. This area emphasizes the architecture and deployment of backend systems, virtualized resources, and distributed services that form the backbone of modern digital applications.

Students in this track work with cloud platforms, containerization, infrastructure-as-code, and CI/CD pipelines to create robust and maintainable systems. Projects can include cloud-native application hosting, building API gateways, integrating microservices, and implementing monitoring and logging solutions. The emphasis is on automation, scalability, and fault tolerance in cloud-based environments.

This track offers valuable hands-on experience in managing resources in both development and production environments. Students develop skills essential to enterprise-grade software engineering, system administration, DevOps practices, and infrastructure planning—key components of today's technology ecosystem.

Goals

1. Design and deploy scalable backend systems using cloud technologies.
2. Automate infrastructure provisioning and application delivery.
3. Explore DevOps workflows and best practices for modern deployments.
4. Gain experience in managing distributed and containerized environments.

Methods and Technologies

1. Platforms: AWS, Azure, Google Cloud Platform (GCP)
2. Tools: Docker, Kubernetes, Terraform, GitHub Actions
3. Practices: CI/CD, Infrastructure as Code (IaC), Monitoring (Prometheus, Grafana)
4. Languages: Python, Bash, YAML, JavaScript (Node.js)

Majors & Areas of Interest

The Cloud and Infrastructure track welcomes students with varied technical backgrounds. The following disciplines are particularly relevant:

1. Computer Science – for backend development, cloud architecture, and distributed computing.
2. Information Technology – for network configuration, systems administration, and infrastructure management.
3. Electronics and Communication Engineering – for IoT-to-cloud integration and edge computing.
4. Artificial Intelligence and Data Science – for building and scaling data pipelines and services.
5. Cybersecurity – for securing cloud assets and implementing robust access control.

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2. Security & Blockchain

The Security & Blockchain track provides students with an opportunity to delve into the fields of cybersecurity, cryptography, and decentralized systems. With a focus on protecting digital assets, ensuring data privacy, and understanding trustless architectures, this track equips students with the knowledge to build secure and resilient applications.

Projects in this area may involve secure authentication mechanisms, network security analysis, smart contract development, or blockchain-based systems for identity, supply chain, and finance. Students will explore core principles such as encryption, secure coding practices, consensus algorithms, and auditability within distributed environments. The track also encourages ethical hacking and penetration testing practices to assess vulnerabilities.

This track fosters critical thinking and an in-depth understanding of secure system design. It draws interest from students passionate about digital trust, regulatory compliance, and emerging technologies like Web3 and decentralized finance (DeFi). The work done in this area has implications in both public and enterprise domains, where data integrity and security are paramount.

Goals

1. Understand the fundamentals of cybersecurity, cryptographic systems, and digital privacy.
2. Build and audit secure applications using blockchain and smart contracts.
3. Analyze and defend against common security threats and vulnerabilities.
4. Explore decentralized applications (DApps) and trustless protocols.

Methods and Technologies

1. Platforms: Ethereum, Hyperledger, Metamask, Ganache
2. Tools: Wireshark, Burp Suite, Truffle, Remix IDE
3. Practices: Smart contract development, penetration testing, cryptographic hashing
4. Languages: Solidity, Python, JavaScript, Bash

Majors & Areas of Interest

The Security & Blockchain track benefits from students with both software and analytical expertise. Relevant majors include:

1. Computer Science – for cryptography, blockchain development, and secure coding.
2. Information Technology – for network security, system hardening, and auditing.
3. Artificial Intelligence and Data Science – for threat detection and secure data modeling.
4. Electronics and Communication Engineering – for hardware-level security and secure embedded systems.
5. Cybersecurity – for vulnerability assessment, forensics, and regulatory compliance.

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3. AI and Automation

The AI and Automation track empowers students to delve into intelligent systems capable of decision-making, learning, and autonomous operation. This area bridges the gap between algorithmic intelligence and real-world execution, offering opportunities to develop systems that can perceive, reason, and act on their environment. Students are encouraged to explore foundational as well as advanced concepts in artificial intelligence, machine learning, and control logic as applied to automated processes.

Projects in this track may include developing intelligent agents, process automation tools, computer vision systems, or predictive analytics for smart applications. Whether it's building autonomous bots or designing decision-support systems, this track emphasizes practical application of AI concepts combined with automation strategies used in industrial and commercial solutions. The AI and Automation domain draws students from various engineering and computing disciplines, providing an environment for collaborative and interdisciplinary innovation. Participants gain experience with data handling, model training, optimization, and integration of AI capabilities into automated workflows and systems.

Goals

1. Understand and apply fundamental AI and machine learning principles in automation.
2. Design intelligent systems that perceive and act autonomously in dynamic environments.
3. Integrate decision-making logic into real-time systems and tools.
4. Promote responsible and ethical application of AI technologies.

Methods and Technologies

1. Frameworks: TensorFlow, PyTorch, OpenCV, Scikit-learn
2. Tools: Jupyter Notebook, Google Colab, MATLAB, ROS
3. Languages: Python, C++, JavaScript (for frontend integrations)
4. Techniques: Supervised/Unsupervised Learning, Reinforcement Learning, Image Processing, Control Systems

Majors & Areas of Interest

The AI and Automation track welcomes students from multiple domains who bring different strengths to intelligent system development:

1. Computer Science – for AI algorithms, model training, and software development.
2. CSE (AI & ML) – for specialized skills in machine learning models, data pipelines, and AI deployment.
3. Electronics and Communication Engineering – for signal processing, sensor data, and embedded integration.
4. Electrical and Instrumentation Engineering – for automation control, actuation, and system design.
5. Mechanical and Mechatronics Engineering – for robotics, autonomous motion, and system behavior modeling.
6. Data Science – for data analytics, preprocessing, and AI model evaluation.

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4. Creative and Interactive Technologies

The Creative and Interactive Technologies track is designed for students interested in blending technology with design, storytelling, and human interaction. This area encourages exploration in digital creativity through the development of interactive systems, immersive environments, artistic tools, and engaging user experiences. It emphasizes creativity as a driving force for technological innovation.

Projects may include interactive installations, augmented and virtual reality applications, generative art, creative coding, game development, or multimedia experiences. Students are encouraged to work at the intersection of software, hardware, and design to build systems that are intuitive, expressive, and engaging.

This track promotes an interdisciplinary approach, welcoming students with interests in computing, media, design, and communication. Participants will develop technical skills in media programming and interaction design, while cultivating creative thinking and user-centric development practices.

Goals

1. Encourage creative expression through technology and digital media.
2. Design and develop systems that respond to user interaction in meaningful ways.
3. Integrate design principles with technical development for compelling user experiences.
4. Explore novel applications of emerging technologies in art, media, and interaction.

Methods and Technologies

1. Tools: Unity, Unreal Engine, TouchDesigner, Processing
2. Frameworks: Three.js, p5.js, A-Frame, OpenFrameworks
3. Platforms: AR/VR devices (e.g., Oculus, HoloLens), Mobile, Web
4. Languages: JavaScript, Python, C#, GLSL

Majors & Areas of Interest

The Creative and Interactive Technologies track values diverse talents and welcomes students from a range of domains:

1. Computer Science and Engineering – for interactive programming and system logic.
2. CSE (AI & ML) – for generative design, intelligent interactions, and creative AI.
3. Information Technology – for web technologies, media platforms, and content integration.
4. Electronics and Communication – for sensor interfacing, gesture control, and embedded interactivity.

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5. Mobile and Edge Computing

The Mobile and Edge Computing track focuses on the development of applications and systems that run efficiently on mobile devices and edge nodes closer to data sources. This area aims to bring intelligence and functionality to devices operating at the edge of the network, enabling real-time processing, reduced latency, and offline capabilities.

Students in this track work on projects involving mobile app development, edge AI, sensor data processing, and decentralized computing. Emphasis is placed on creating responsive, resource-efficient applications that interact with the physical environment and deliver seamless user experiences on smartphones, wearables, and embedded platforms.

This area bridges software engineering with network and systems design, and encourages students to build scalable and optimized solutions suited for constrained environments, remote deployment, or real-time decision-making.

Goals

1. Design and develop mobile and edge-based applications with real-time capabilities.
2. Enable intelligent processing at the edge to minimize latency and improve responsiveness.
3. Understand the trade-offs of computation, storage, and connectivity in edge environments.
4. Build efficient and scalable solutions that leverage mobile and distributed resources.

Methods and Technologies

1. Platforms: Android, iOS, Flutter, React Native
2. Edge Devices: Raspberry Pi, NVIDIA Jetson, Coral Dev Board
3. Frameworks: TensorFlow Lite, ML Kit, Edge Impulse
4. Communication: Bluetooth, MQTT, WebRTC, REST APIs

Majors & Areas of Interest

The Mobile and Edge Computing track is ideal for students with the following interests:

1. Computer Science and Engineering – for mobile software development and system optimization.
2. CSE (AI & ML) – for edge intelligence, lightweight model deployment, and sensor data analytics.
3. Electronics and Communication Engineering – for embedded edge devices and wireless communication.
4. Information Technology – for mobile platforms, integration, and service design.
5. Data Science – for real-time analytics, visualization, and data-driven application logic.

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6. Data, Services, and Integration

The Data, Services, and Integration track focuses on building robust digital infrastructures and integrating diverse systems for scalable, real-time applications. This area enables students to develop backend services, design APIs, manage service orchestration, and handle large-scale data operations using modern cloud-native tools and architectural patterns.

Participants work on designing interoperable microservices, managing containerized workloads, and integrating third-party services. Projects may include developing RESTful APIs, setting up data pipelines, building CI/CD workflows, or deploying cloud-hosted applications. The track encourages a systems thinking approach, with attention to performance, scalability, and modularity.

The track is suitable for students with a strong interest in backend development, system design, DevOps, and data services integration. It promotes collaborative and modular project development, simulating real-world software engineering practices.

Goals

1. Design and implement scalable APIs and backend services.
2. Integrate external data and service endpoints into unified platforms.
3. Explore service-oriented and microservice architecture.
4. Develop CI/CD pipelines and infrastructure automation tools.

Methods and Technologies

1. Tools: Docker, Kubernetes, GitHub Actions, Postman
2. Platforms: AWS, Azure, Google Cloud, Firebase
3. Technologies: REST, gRPC, GraphQL, Kafka, Redis
4. Languages: Python, Node.js, Go, Java

Majors & Areas of Interest

This track benefits from a diverse range of skills. Students from the following departments are especially encouraged to participate:

1. Computer Science and Engineering – for service development, data structures, and integration logic.
2. CSE (AI & ML) – for developing data-enabled intelligent services.
3. Information Technology – for system integration, cloud deployment, and backend tools.
4. Data Science – for designing data workflows, API-based analytics services, and real-time insights.

Mentor Contact Information

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7. Hardware and Systems

The Hardware and Systems track offers students the opportunity to explore the foundations of physical computing and embedded technology. This area focuses on the design, development, and implementation of real-world systems that integrate both hardware components and software logic. From simple sensor-based applications to complex embedded architectures, students gain hands-on experience in bringing tangible solutions to life.

Participants in this track engage with microcontrollers, circuit design, sensor integration, and hardware-software communication protocols. Projects may range from home automation systems and wearable devices to robotics and industrial monitoring tools. Emphasis is placed on low-level programming, power management, and reliable real-time operation—core aspects that distinguish hardware-based projects from purely software-driven solutions.

The Hardware and Systems area encourages interdisciplinary learning and problem-solving, drawing on knowledge from electrical, electronics, and computer engineering. Students will not only enhance their technical skillset but also develop competencies in debugging, prototyping, and system integration that are vital in modern engineering applications.

Goals

1. Design and prototype embedded systems that interact with the physical world.
2. Understand the integration of hardware and software in real-time applications.
3. Build foundational skills in electronics, microcontroller programming, and circuit design.
4. Foster an appreciation for hardware-level optimization and resource management.

Methods and Technologies

1. Platforms: Arduino, Raspberry Pi, ESP32, STM32
2. Communication Protocols: I2C, SPI, UART, MQTT
3. Tools: Breadboarding, PCB Design (KiCad, Eagle), Multimeter testing
4. Languages: C/C++, MicroPython, Embedded C

Majors & Areas of Interest

The Hardware and Systems track benefits from a diverse set of skills. Students from the following backgrounds are especially encouraged to participate:

1. Electronics and Communication Engineering – for circuit design, microcontroller interfacing, and sensor systems.
2. Electrical Engineering – for hardware integration, signal processing, and instrumentation.
3. Computer Science – for embedded programming, firmware development, and device-software interfacing.
4. Mechatronics and Robotics – for system-level design involving hardware, control, and automation.
5. Instrumentation and Control – for data acquisition systems, calibration, and embedded diagnostics.

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