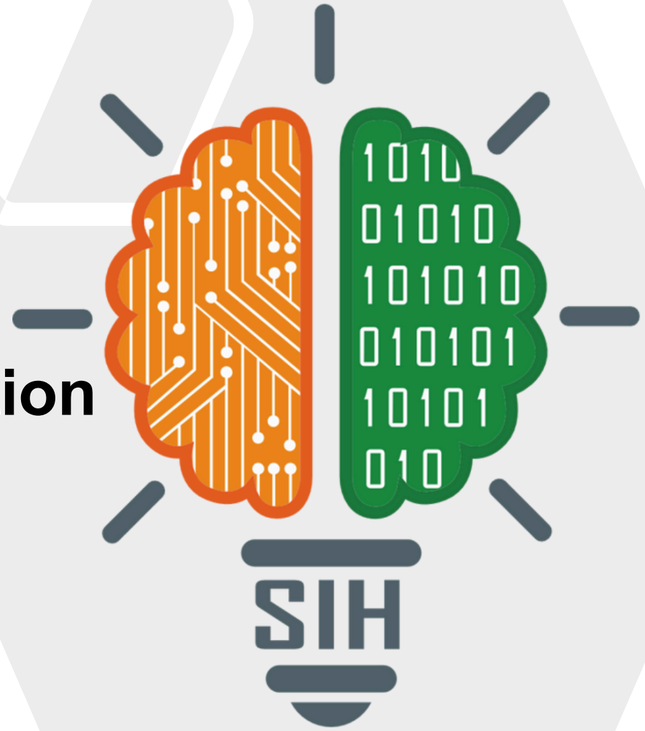
SMART INDIA HACKATHON 2025

TITLE PAGE



- **Problem Statement ID – SIH1533**
- **Problem Statement Title- Student Innovation**
- **Theme- Robotics and Drones**
- **PS Category- Hardware**
- **Team ID-**
- **Team Name - HexaBots**

HexaBots

IDEA TITLE

SMART INDIA HACKATHON 2025

Proposed Solution – SIH 2025 Theme: Multi-Purpose Drone for Defence, Surveillance & Firefighting

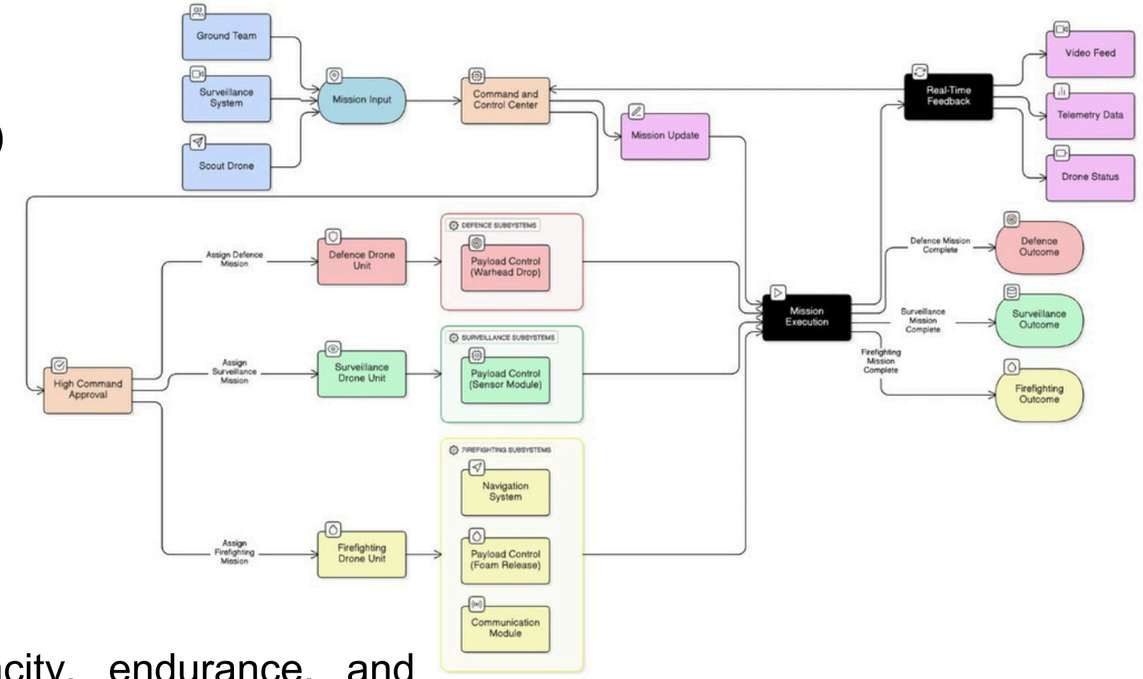
- A modular drone platform capable of switching between surveillance, firefighting, and non-lethal defence-support roles.
- Equipped with RGB + thermal cameras, GPS/IMU, and AI-powered detection for real-time decision making.
- **Onboard processing (Raspberry Pi / Jetson):-** Ensures fast response without relying on external servers.
- **Payload flexibility:** water/foam spray for firefighting, marker/release mechanism for defence-**support.**
- **Safety-first design:** secure telemetry, geofencing, return-to-home, and manual override.
- **Innovation:** Combines multi-domain utility in a single low-cost, scalable drone system.
- **Uniqueness:** Unlike existing drones built for single applications, this solution provides a multi-domain, modular, and cost-effective platform adaptable for defence, disaster management, and civilian safety operations.

HexaBots

TECHNICAL APPROACH

SMART INDIA HACKATHON 2025

- **Technologies to be Used:-**
- **Hardware:**
- Drone frame with brushless motors & ESCs
- GPS + IMU (navigation), LiDAR/Ultrasonic (obstacle detection)
- Payload system (servo-based release, foam ball container)
- ESP32 / Raspberry Pi for edge AI & sensor integration
- Onboard camera (RGB + optional thermal)
- **Software & Frameworks:**
- Python, C++ for control logic & embedded programming
- ROS (Robot Operating System) for drone autonomy
- OpenCV & TensorFlow Lite for AI-based object/fire detection
- Mission Planner / QGroundControl for flight planning
- Secure telemetry (2.4GHz RF / LTE modules)
- **Methodology & Process for Implementation:**
- Requirement Analysis & Design – Define payload capacity, endurance, and modularity.
- Prototype Development – Assemble drone with basic navigation and payload system.
- AI Integration – Train and deploy lightweight AI models for surveillance/fire detection.
- System Testing – Conduct controlled trials (indoor → outdoor).
- Deployment & Scaling – Optimize for multi-drone coordination and real-world missions.



HexaBots

FEASIBILITY AND VIABILITY

SMART INDIA HACKATHON 2025

- **Feasibility of the Idea**
- Technically achievable with currently available drone hardware (GPS, IMU, payload-release modules, AI edge processing).
- Modular design ensures cost-effective customization for defence, surveillance, and firefighting.
- Scalable: system can start small (prototype) and expand to larger fleets.
- **Potential Challenges and Risks**
- Payload limitations affecting endurance and stability.
- Weather conditions (wind, rain, smoke) may hinder operations.
- Data security and risk of unauthorized access to command/control.
- **Strategies to Overcome Challenges**
- Optimize payload using lightweight materials and efficient propulsion systems.
- Integrate obstacle avoidance and weather-resilient design.
- Use encrypted communication channels and AI-driven fail-safe mechanisms.

HexaBots

IMPACT AND BENEFITS

SMART INDIA HACKATHON 2025

- Rapid incident detection & response: Enables early hotspot/fire detection and immediate situational awareness for first responders, reducing damage and response time.
- Safer defence-support (non-lethal / training): Provides remote ISR and marker-drop capability for training exercises and reconnaissance without exposing personnel to danger.
- Cost savings & operational efficiency: Lowers manpower/time costs by automating routine patrols, inspection and initial attack tasks; reduces need for expensive manned sorties.
- Improved data & decision support through AI: Onboard AI processes video/thermal data in real time to detect people, vehicles, and fire-signatures — creating actionable alerts and logs for post-incident analysis.
- Environmental & public-safety benefits: Early suppression reduces fire spread, pollutant emissions and infrastructure loss; remote surveillance improves crowd and disaster management.
- Scalable & multi-role platform: Modular payloads allow rapid reconfiguration (surveillance, firefighting module, sensor pods) for government, civil defence, and disaster management use-cases.

HexaBots

RESEARCH AND REFERENCES

SMART INDIA HACKATHON 2025

- National Disaster Management Authority (NDMA), “Use of Drones in Disaster Management and Firefighting”, Govt. of India, 2023.
- International Journal of Advanced Research in Computer Science, “AI-powered Drone Surveillance and Target Detection Systems”, Vol. 12, Issue 3, 2022.
- Springer Nature, “Applications of UAVs in Defence and Civil Security”, 2021.
- ResearchGate, “Firefighting Drone Technology: Early Detection and Suppression Methods”, 2020.
- IEEE Xplore, “Autonomous UAV Navigation and Payload Delivery using GPS and IMU Sensors”, 2019.
- Defence Research and Development Organisation (DRDO) Reports, “Unmanned Aerial Systems for Reconnaissance and Surveillance”, Govt. of India, 2022.