Assignment 1 - System Categroization
System Description
CSE 4380

Group Thorin

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1 System Description

1.1 AeroTech Industries and the X9 Drone System

In 2005, Dr. Emily Carter and Dr. Michael Patel founded AeroTech Industries to provide aerospace and defense solutions through the design, development, and manufacturing of unmanned aerial vehicles (UAVs). The company began with the mission to revolutionize aerial solutions by providing cutting-edge UAV technology that enhances efficiency, safety, and decision-making across industries. The earliest drones produced by AeroTech were used for agricultural monitoring, and the company's focus remained primarily on the commercial market until 2020.

AeroTech's progression in drone technology is evident in its product timeline. In 2015, they released the AeroTech X5, which became an industry benchmark for reliability and performance in the commercial sector. The potential for border security, surveillance missions, and emergency services in later models attracted the interest of government agencies as well.

The AeroTech X9, introduced in 2023, is the company's most advanced drone system to date. The X9 emphasizes modularity and adaptability, allowing it to meet diverse mission requirements for government, commercial, and emergency services stakeholders on a global scale. It offers integrated advanced artificial intelligence for autonomous navigation and decision-making. The lightweight and durable materials developed through AeroTech's materials science research protect the aircraft, while state-of-the-art cybersecurity protocols safeguard operations and data integrity.

AeroTech Industries has a global presence with offices and facilities in North America, Europe, Asia-Pacific, and the Middle East, supporting the X9's worldwide operational capabilities. The company continues to invest heavily in research and development, focusing on artificial intelligence, materials science, energy solutions, and cybersecurity to maintain its position at the forefront of UAV technology.

1.2 Purpose and Capabilities

In rural areas, Aerotech drones have provided assistance to many users in the commercial sector since 2008, and the X9 will only improve upon the services previous versions provided. Farming with the X9 becomes a considerably more precise operation. The X9 can be fitted with multi-spectral and thermal sensors to monitor crop health, optimize resource use by identifying areas needing irrigation or fertilization improving yields and reducing cost. Automated drones flights can survey large fields of crops identifying pests and plant disease much earlier than traditional methods minimizing crop damage. In more urban areas, the Aerotech X9 will be used for building, bridge, powerlines, and other critical infrastructure inspections, and the remote monitoring of difficult to reach places like the tops of electrical towers to minimize expensive manual inspections. The X9 will be used for forest health and wildlife monitoring, pollution detection, rapid and efficient delivery in cities, and remote deliveries to locations within rough terrain areas. The capabilities of the X9 in commercial indistries is limited only by the imagination of the user.
(Not Finished)

1.3 System Components

1.3.1 Airframe

- Lightweight, durable materials (developed through AeroTech's materials science research)
- Modular design for adaptability and customization

1.3.2 Propulsion System

Multiply cost by number of propellors required.

- Electric Motors (Brushless DC):
  $310
  https://store.tmotor.com/goods.php?id=1149
  U8IILite Efficiency Type Multirotor UAV Motor KV100
  Specification: Stable operation, 1000 hr life, Competitive performance, 256g, 9.1kg thrust, 36 power ratio

- Propellers:
  $83
  https://store.tmotor.com/goods.php?id=964
  NS18*6 Prop-2PCS/PAIR
  Specification: Very large, 18" super lightweight and durable, 17g, lifts 5kg per propellor

- Electronic Speed Controllers (ESCs):
  $120
  https://store.tmotor.com/goods.php?id=830
  FLAME 80A 12S V2.0 Multi-Rotor UAVs ESC
  Specification: Built for tough conditions, Built in protection features, High performance processor, 109g,

1.3.3 Navigation & Control Hardware

- GPS Module:
  $(Pending response)
  Collins AeroSpace Navstrike (SPS GPS Receiver)
  https://www.baesystems.com/en/product/navstrike–gps-receiver
  Specification: Fifth-generation SAASM-based design, All-in-view tracking and navigation, No need for active antenna electronics, Field-reprogrammable software, Designed for high-g vibration and shock, High-speed serial interface, Field clock recalibration for extended storage

- Inertial Measurement Unit (IMU):
  $(Price Pending)
  Honeywell HG1930
  https://novatel.com/products/gnss-inertial-navigation-systems/imus/hg1930
  Specification: Ideal for unmanned vehicles, Easy integration with SPAN receivers, Ideal for size-constrained applications, Small size and light weight, 10-30 VDC power input, 100 Hz data rate

- Flight Controller Board:
  $(Price Pending)
  UAV Navigation VECTOR-600
  https://www.uavnavigation.com/products/autopilots/vector-600
  Specification: Automatic actions on waypoints: suitable for cargo drop or camera shots, Transponder ADS-B IN for UTM (Unmanned Traffic Management), Compact Unit., Easily Configurable, Multi-UAV Operations, Integrated ADS, Dual High-end CPU, Tactical grade ADAHRS, Flare and parachute activation for target drones

- Transmitter/Receiver (for remote control):
  $(Price Pending)
  Crysalis™ Tactical GCS
  https://www.avinc.com/uas/crysalis/tactical-gcs
  Specification: Back-Packable, 20 km range, 10 min setup, 3.9 kg Android OS, Swappable battery, Compatible Antennas: pDDL, Standard Range Antenna, ERA

1.3.4 Power System

- High-Capacity Battery (LiPo or similar):
  $(Price Pending)

Back-up Batteries for MALE UAS
https://www.epsilor.com/product/batteries-for-unmanned-aerial-systems-uas/batteries-for-tactical-and-male-uas/
Specification: Flexible design and form factors addressing complex geometries, High energy density: 250 Wh/kg, High power density: 3,000 W/kg, Long life cycle – supporting hundreds of missions with a single battery, Cold and hot weather operability

- Power Distribution Board (PDB):
$(Price Pending)
https://vat.aero/1800w-power-distribution-unit/
Specification: 24 to 55 VDC, Umbilical input 28 to 60 VDC, six outputs(three unique) Altitude rating 10,000m, Operating temperature range -40 to +55°C, Connectors MIL-D38999 and LEMO M-Series, Communications protocols RS232 (57600 8N1), CAN (1Mb/S)

- Voltage Regulators:
#(Price Pending)
https://www.ti.com/product/LM138QML
Texas Instruments LM138QML
Specification: Manufactured and Tested per Texas Instruments Military Grade Flow, Specified 7-A Peak Output Current, Specified 5-A Output Current, Wide Temperature Range –55°C to 150°C, Adjustable Output Down to 1.2 V, Specified Thermal Regulation, Current Limit Constant With Temperature, Output is Short-Circuit Protected

1.3.5 Payload Interfaces

- Standardized mounting points:
12mm Rail Payload Mount Kit (Alta X)
https://store.freeflysystems.com/products/12mm-rail-payload-mount-alta-x
$350
Specifications: Compatible with payload mounting brackets using 12mm rails , Machined aluminum and carbon fiber for lightweight, rigid payload mounting, Weight in use: 6.6 oz / 186 g, Quick-release levers for easy adjustment, Includes fasteners and driver for installation

- Power and data connections for various sensors/payloads:
Mouser Electronics provides most connectors that might be necessary, and these will be included as needed.

- Cameras:
VEGA Ultra Long-Range Multi-Sensor PTZ Camera
https://www.infinitioptics.com/sites/default/files/2023-06/Vega%20PTZ%20Series%20Brochure%202 10%20Jun2023.p
Specifications: 6.8 kg, 15.4–2075mm HD IR-Corrected Zoom Lens (with IZE doubler), 27°–0.2° Horizontal Field of View gives a 135X Zoom Range, 550X Zoom Ratio with 110° Wide-Angle Spotter Camera, 1280×1024 or 640×480 Cooled Thermal Imager, Thermal Lens Options Available with up to 1400mm 125° to 0.39° Thermal HFOV, Depending on Lens and Sensor, Optional ZLID™ Illumination for up to 6km of High Definition, NIR Imaging in Complete Darkness, Endless 360° Rotation Pan/Tilt with Speeds up to 0.001–100°/s, Up to 0.00036° Resolution Pan/Tilt with Low Backlash, Rugged IP66/67 and -50° to +65°C with Anti-Corrosion Finish

1.3.6 Communication System

- Antenna &Telemetry Module (for real-time data transmission):
MPSL900+2400 — Omni Directional UAV Drone Antenna
https://www.mpantenna.com/product/uav-antenna-mpsl900-2400/
Specifications: Ultra Light Weight, Gooseneck Style Coax Pigtail, Connectivity for any wireless network, Stable connections, Obstruction Penetrating transmit and receive, RoHS Compliant, Custom Configurations Available

1.3.7 Software Components

Software Components:
Flight Control Software:
Stabilization algorithms
Navigation algorithms (GPS-based, autonomous)
Mission planning and execution software
Real-time control algorithms
AI and Autonomy Software:
Machine learning algorithms for decision-making
Object recognition and tracking
Path planning and obstacle avoidance
Cybersecurity Software:
Encryption protocols
Intrusion detection systems
Authentication and authorization mechanisms
Sensor Data Processing Software:
Image processing algorithms
Data fusion algorithms (combining data from multiple sensors)
Communication Software:
Telemetry data encoding/decoding
Command and control protocols
User Interface Software:
Ground control station software
Mobile app for remote control and monitoring

1.3.8 Third-Party Components/Services

1.4 Stakeholders

1.5 Operational Environment