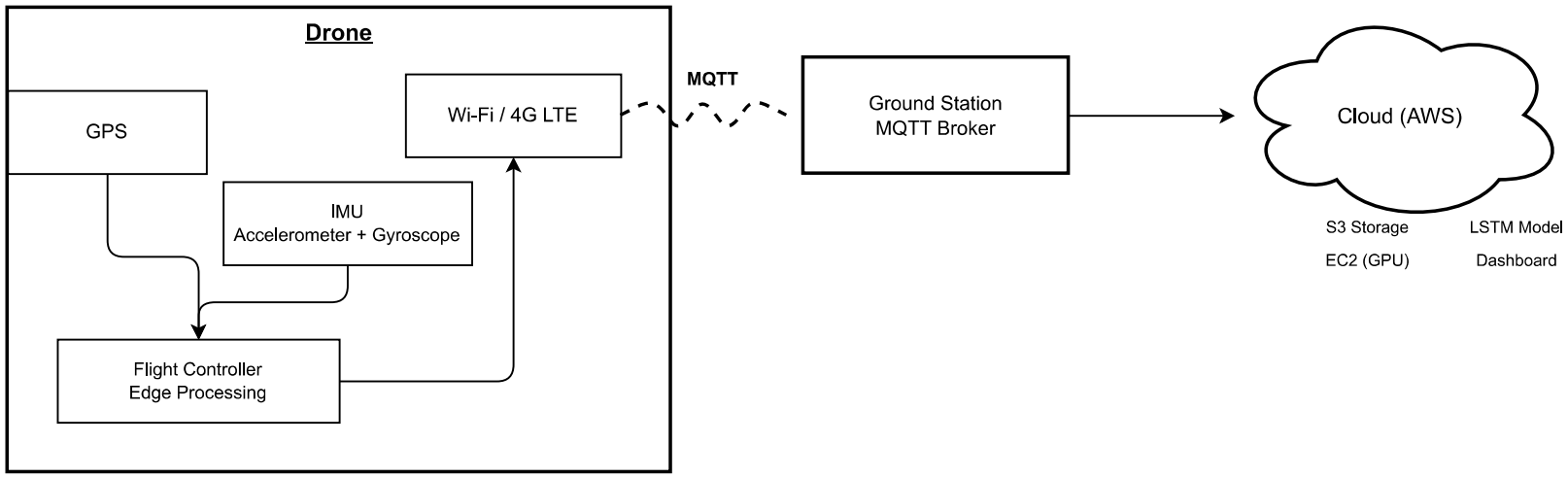
Drone Anomaly Detection IoT System



Sensors

Onboard drone sensors:
- 3-axis accelerometer (+/-50 mg)
- 3-axis gyroscope (2000 deg/s)
- 3-axis magnetometer (6 deg)
- Pressure sensor (+/-10 Pa)
- Ultrasound sensor for altitude
- Front camera: 1280x720, 30 fps, 92 deg diagonal FOV
- Vertical QVGA camera: 60 fps for ground speed measurement

Ref: Salhaoui et al., Sensors 2019

Edge / Fog Processing

IoT Gateway as fog computing layer between drone and cloud:
- Node-RED for wiring hardware, APIs, and cloud services
- Node.js ArDrone library for autonomous flight control

Tested platforms:
- Siemens IOT2040 (Intel Quark x1020, 400 MHz)
- Raspberry Pi 3 Model B (1.2 GHz Quad-Core ARMv7, 1 GB)
- Toshiba PC (Intel Core i3, 2.3 GHz, 8 GB)

Ref: Salhaoui et al., Sensors 2019

Networking

Connectivity:
- Wi-Fi (IEEE 802.11) for short range drone to ground station link
- Cellular (4G LTE) for remote or long range flights

Data Messaging: MQTT
- Publish/subscribe model
- Lightweight for constrained devices
- Supports QoS levels 0, 1, and 2
- Used in paper for drone commands and navigation data via broker

Ref: Ch. 2, Analytics for the IoT
Ref: Salhaoui et al., Sensors 2019

Data Storage and Processing

Cloud image classification:
- Paper used IBM Watson Visual Recognition to classify drone photos
- Custom model trained on images from conveyor belts
- Returned confidence scores (0.0 to 1.0) per class
- 87.28% detection accuracy

Cloud database:
- IBM Cloudant used for storing drone photos for later retrieval

Results sent back to the control system via IoT gateway.

Ref: Salhaoui et al., Sensors 2019