AIRBY

REVOLUTIONIZING HEALTHCARE LOGISTICS WITH DRONE DELIVERY

CSDI Rewards 2025
Team No. 0021F

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WHY AIRBY?

1 CRITICAL HEALTHCARE CHALLENGES

- Delays in medical supply delivery due to **traffic congestion, remote terrain, and inadequate infrastructure** in the Northern Metropolis [1,2,3]
- Delays are critical in medical emergencies (e.g. cardiac arrests, organ transplants) where **minutes mean lives**

2 THE POWER OF SPATIAL DATA & DRONES

- Drones bypass **ground obstacles, reduce delivery duration, and minimize carbon footprint** [4,5]
- GIS and network analysis **optimise routes** for **speed, safety, and cost-efficiency**
- Allows consideration of **dynamic factors such as weather**

3 WHY NOW

- Rising potential of the **low-altitude technology**, particularly in healthcare
- Complement the **current urban development** of the Northern Metropolis and address its logistical gaps and practical needs [1,2,3]

OBJECTIVES

1 IDENTIFY OPTIMAL ROUTES

- To propose the fastest, safest paths, accounting for:
  - **Airspace restrictions** e.g. no-fly zones, altitude limits
  - **Geographic barriers (terrain, urban density)**
  - **Proximity to healthcare facilities**
- Designation of **emergency landing zones**

2 IDENTIFY POTENTIAL APPLICATIONS

- Emergency deliveries to remote areas, including:
  - **AEDs (for cardiac arrest)**[6]
  - **Organs for transplant and blood products**[7,8]
  - **Other first-aid supplies**[9]
  - **Lab samples**[10]

3 ASSESS FEASIBILITY

- Validation and compliance, such as:
  - validate route feasibility with **current spatial data**
  - validate potential applications with current drone regulations (**Civil Aviation Ordinance (Cap. 448)**)[11] and **real-world drone capabilities**[6,7,8,9,10]

DATA USAGE

CSDI

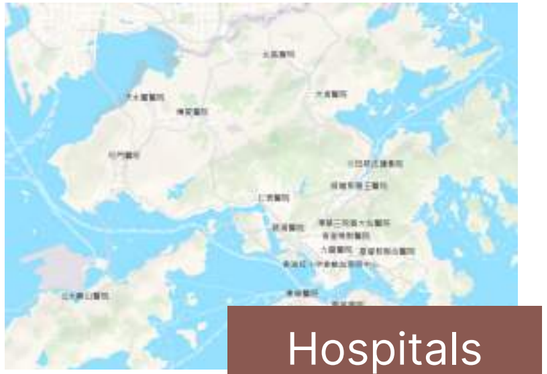
Buildings	Building
Medical Institutions	Hospital Authority Hospital/Institution List Clinic Registered under Cap.343 + HA Specialist Outpatient Clinic List
Landuse	Major land development projects under study in the Northern Metropolis Hong Kong 18 Districts (Esri)
Terrain	Digital Terrain Model (DTM)
Transport Network	Road Network + Expressways and Trunk Roads (Transport Department)
Conservation Areas	Priority Sites for Enhanced Conservation

CIVIL AVIATION DEPARTMENT

Restricted Zones	Drone Map

Buildings

Restricted Zones



Hospitals

DATA USAGE

WEATHER

Real-time Data

CSDI

- Gridded rainfall nowcast in Hong Kong
- Regional weather in Hong Kong – the latest 10-minute mean wind direction and wind speed

Static Data

HKO

- Solar Radiation
- Radio Blackout
- Geomagnetic storm

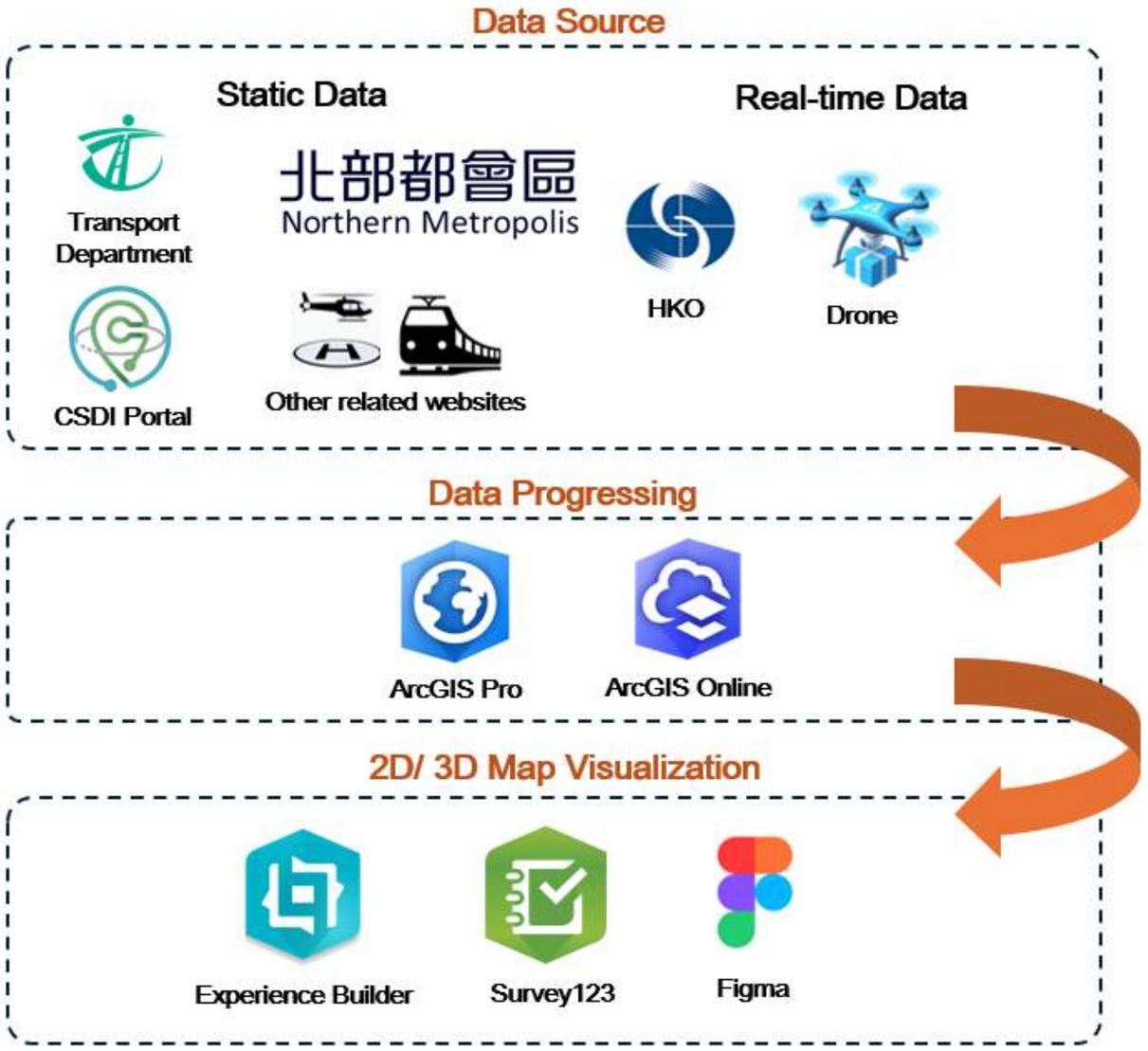
POI

MTR

- New MTR Station
- Existing MTR line and Light Railway

CSDI

- AED
- Police Station
- Fire Station



SPATIAL ANALYSIS

DATA PREPARATION

GEOREFERENCING

- import MTR map
- move to correct location with control points

CREATE & EXTRACT

- Create MTR stations of existing and new stations
- extract data with designated parameter

CLIP AND SLOPEANALYSIS

- Clip with Hong Kong layer (e.g. slope raster layer)

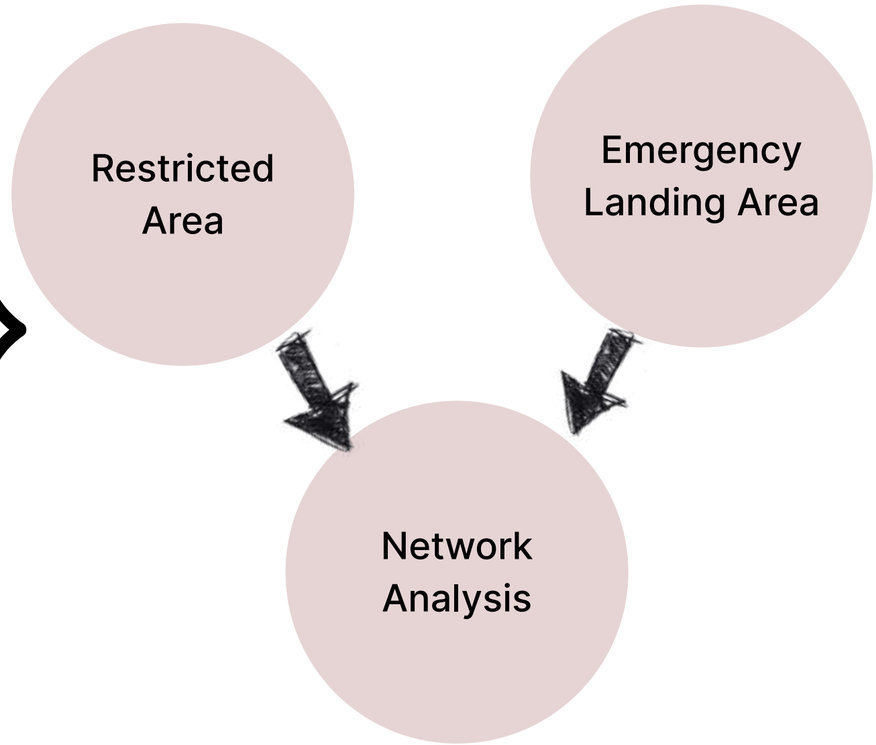
SLOPE ANALYSIS

- Use DTM to idenyify the slope inclination in Hong Kong

BUFFER & OVERLAY ANALYSIS

- Drone error buffer radius is 10m (buildings > 90m require buffer)
- restricted areas and emergency landing area “Union” with corresponding layers

DATA ANALYSIS



SPATIAL ANALYSIS

RESTRICTED AREAS

Terrain > 90 m

10m Buffer of Buildings > 90m tall

EMERGENCY LANDING AREAS

Slope Inclination < 15 degree

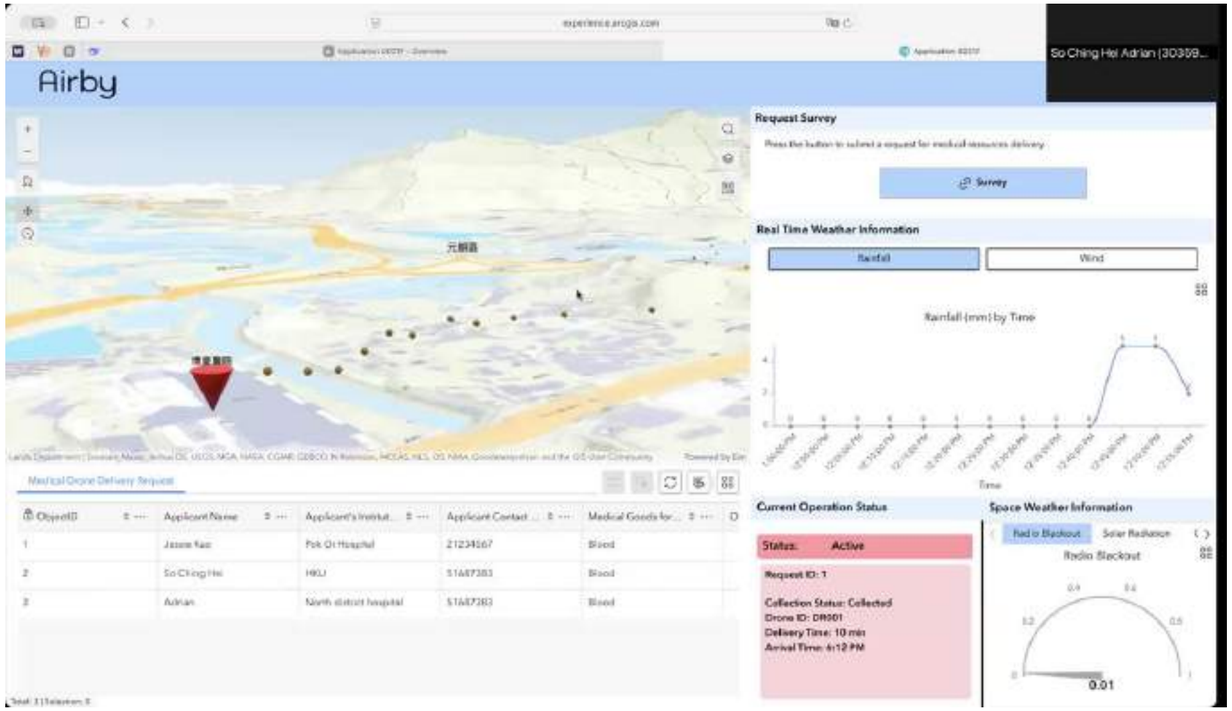
Police Station & Fire Station

SPATIAL ANALYSIS

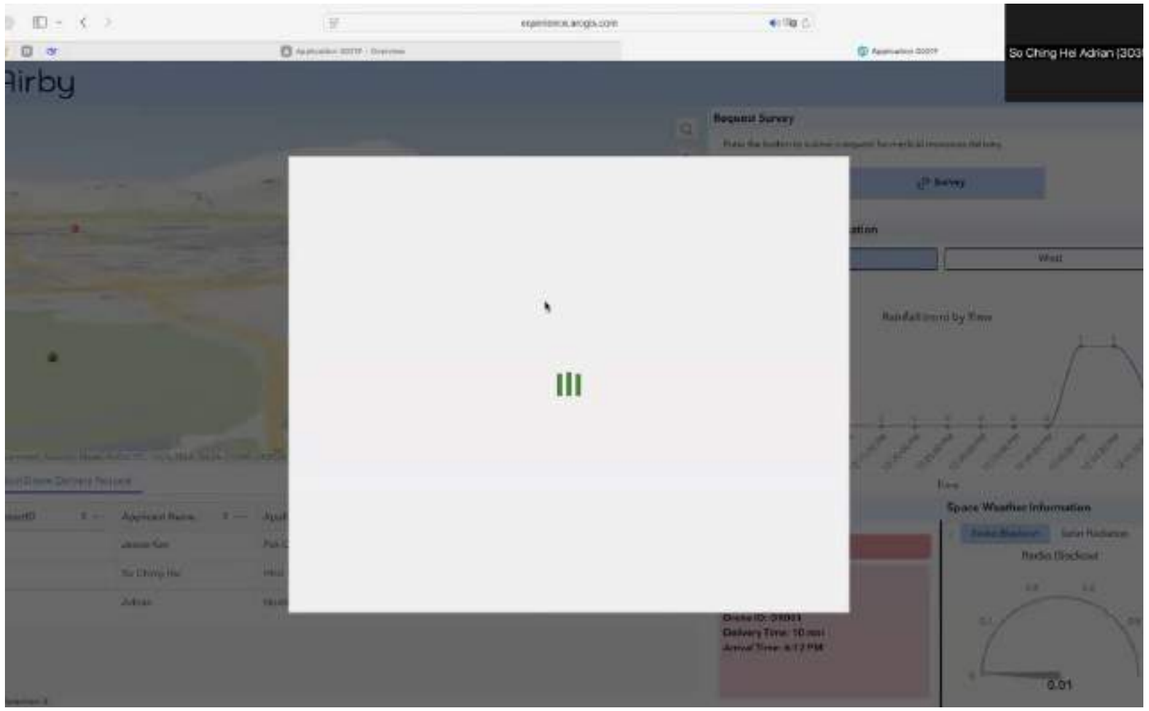
3D NETWORK ANALYSIS

1. **Convert Geospatial Data into a 3D Graph**
- **Each flight route should have an edge (flight paths with costs) which have weighted constraints(distance, energy, regulations, obstacle avoidance)**
2. **Routing algorithms: 3D A-star algorithm**
    a. **Input Data**
        i. **Obstacles: Buildings, terrain (DEM), no-fly zones.**
        ii. **Constraints: Max climb rate, battery life, wind resistance. There are a list of (x, y, z) waypoints. Which are called nodes**
    b. **Graph Construction**
        i. **Voxelize airspace into a 3D grid or use a point cloud (LiDAR).**
        ii. **Assign costs to edges:**
    c. **Pathfinding**
        i. **Priority Queue: Explores nodes with lowest f(n) first.**
        ii. **Termination: Stops when the goal node is reached.**
    d. **Output**
        i. **3D Path: A list of (x, y, z) waypoints or nodes**
        ii. **Visualization: Plot in Cesium/ArcGIS.**
3. **Including altitude in heuristic cost**
4. **Valiation in ArcGIS 3D Analyst**

APPLICATION DEMO



EXPERIENCE BUILDER



SURVEY

DRONE REQUIREMENT AND FUTURE DIRECTION

DRONE REQUIREMENT

Recommended choice of model: DJIM600 Pro[12]

- previously proven usage in kidney delivery
- payload of approximately 9.1 kg (20lbs)
- can tolerate wind speeds of up to 32.2 km/h (20 m/h)

Battery life: ≥30 mins (with 20% safety buffer)
Noise levels: < 65 dB at 10m
Usual weight/payload capacity: 9.1 kg (blood packs, vaccines, AEDs)
Maximum weight should meet Category B SUA requirements

EMERGENCY CONTINGENCY PLAN

1. Auto-divert to emergency landing zones (ELZs) if systems fail, which include hospitals, police stations and fire stations
2. Real-time crash alerts to authorities via IoT sensors.
3. Drone "black boxes" for incident investigations.

FUTURE DIRECTION

- Strategically place automated droneports near hospitals, clinics, and remote areas.
- Include battery-swapping stations for continuous operation.
- Expand sites for emergency medical services such as civil aid service and government flying service
- Increase large medical supplies centres
- Use fireproof casing and parachute recovery, backup GPS for safety
- Use shock-proof, temp-controlled containers for organs/blood.
- Technology Roadmap: AI-optimized ELZ networks; fail-safe drone swarms for payload recovery.

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