Enhancing Ambulance Accessibility in Deprived Regions: A Drone-Based Spatial Data Solution for Ashaiman, Greater Accra

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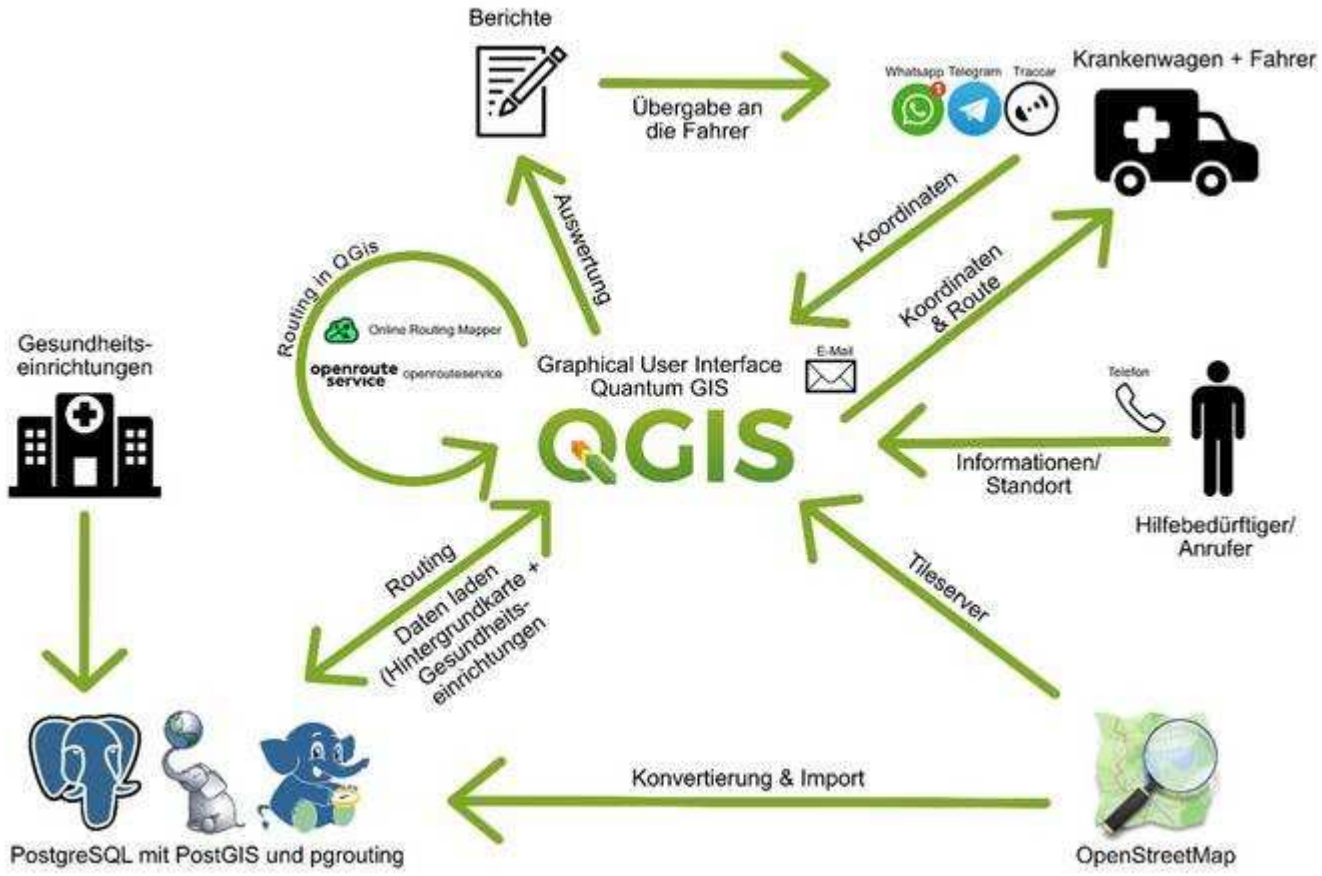
Introduction

Courtesy:
Okyere et al, 2022

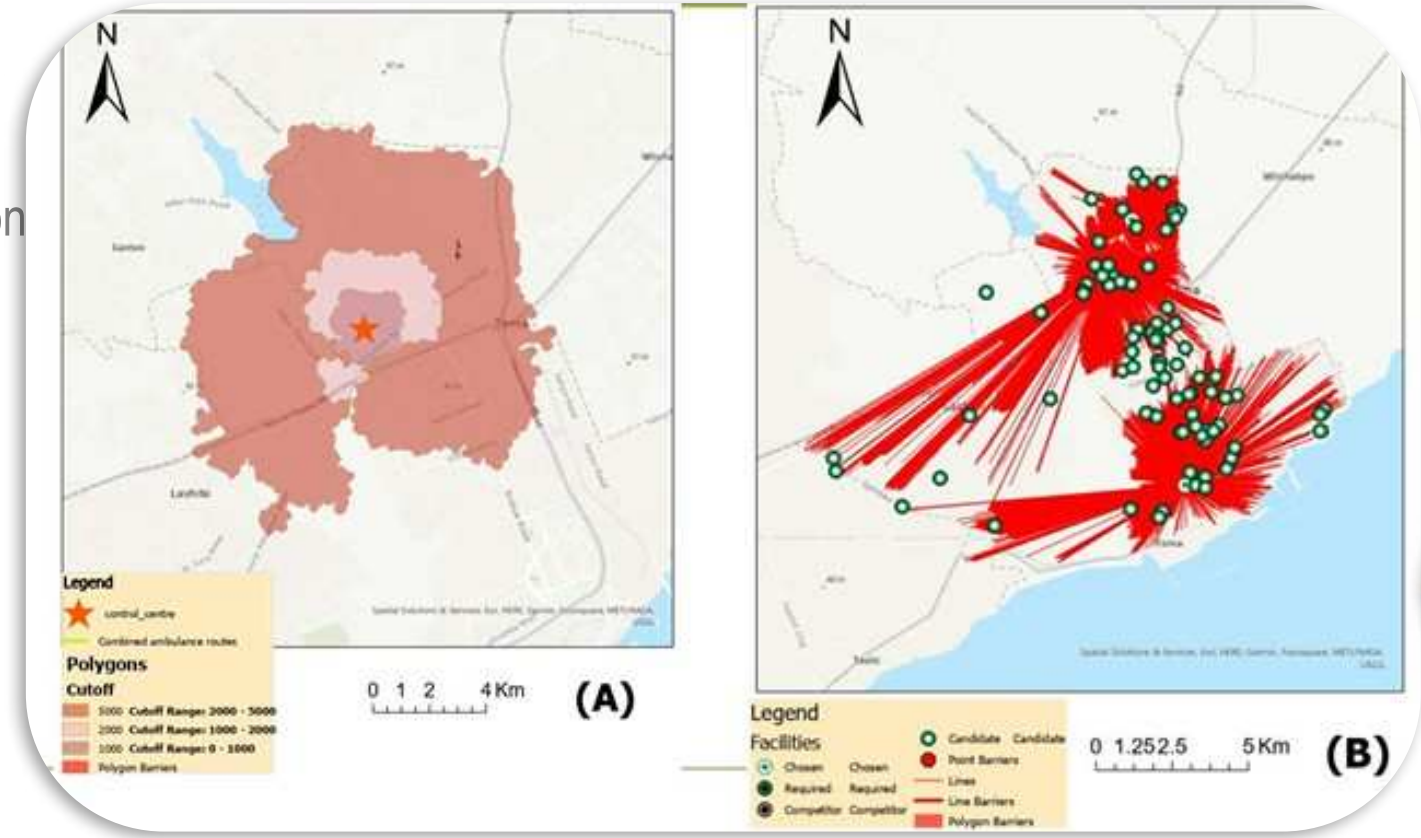


Introduction

Analysis of Implementation Data

Courtesy:

Okyere et al, 2023

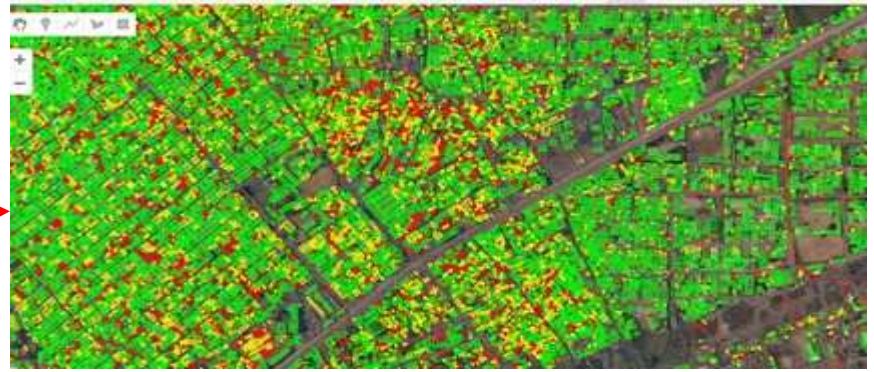


Need for Spatial Data

Ashaiman study area - High pop. Density

described as a slum by a significant number of studies (Appiah-Kubi, 2018, 2020, 2021 Osman, K., 2016 (Appiah-Kubi, 2021)).

Open global dataset →



Google Maps →

Introduction

Why UAV (drone) photogrammetry?

Security

Safety

Time and Cost

Tag	Value
Camera	
Image Data	
Image Taking Conditions	
ExposureTime	1/320 sec.
FNumber	f/5.0
ExposureProgram	Normal program
ExposureBiasValue	0.00 EV
MaxApertureValue	2.97 EV (f/2.8)
MeteringMode	Center-weighted average
LightSource	Daylight
Flash	Flash did not fire
FocalLength	10.3 mm
SceneType	Directly photographed
ExposureMode	Auto exposure
WhiteBalance	Auto white balance
DigitalZoomRatio	1
SceneCaptureType	Standard
GainControl	Normal
Contrast	Normal
Saturation	Normal
Sharpness	Hard
GPS Data	
GPSVersionID	2.3.0.0
GPSLatitudeRef	North
GPSLatitude	5° 41' 24.36"
GPSLongitudeRef	West
GPSLongitude	0° 1' 53.47"
GPSAltitudeRef	Sea level

Theory

Flying Height – maximum precision of the UAV +/- 0.5m

Overlap – Larger stereoscopic coverage.

Processing Software – Agisoft Metashape diverse setting options and the better edge representation of roofs and walls

Point Cloud -

Orthophotomosaics -

Theory

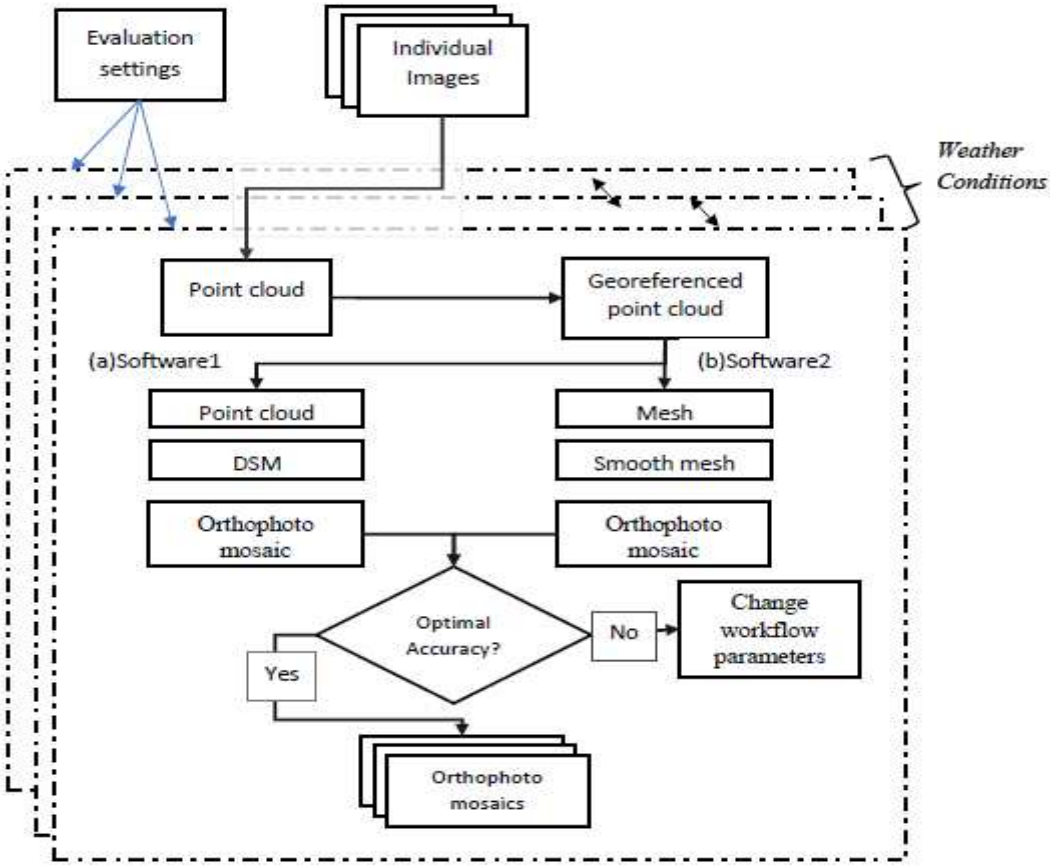
Ground resolution:

$$GSD[cm/px] = \frac{(\text{sensor size} \times 100 \times \text{height})}{(\text{Image width} \times \text{focal length})}$$

$$H[m] = \frac{(\text{Image width} \times GSD \times \text{focal length})}{(\text{Sensor size} \times 100)}$$

Methods

The desired ground resolution is 2cm/px.
The image width of 5742 pixels,
focal length of 10.26 millimetres and
sensor size of 13.2 millimetres (Mavic 2 Pro, 2018)
The optimal flight altitude of 90 meters.



Methods

.Flight Settings

Instrument Availability (DJI) .

The image width of 5742 pixels,

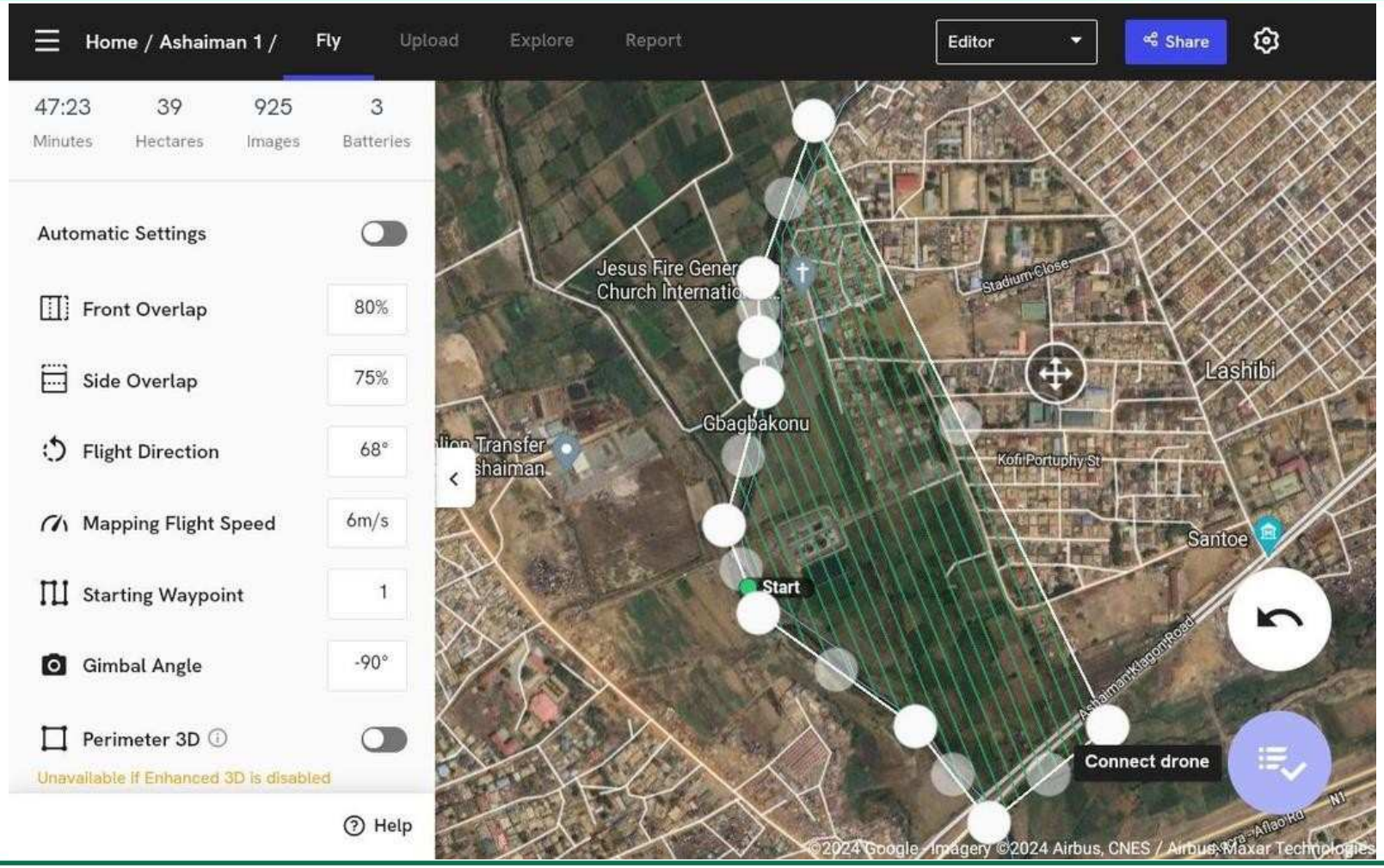
focal length of 10.26 millimetres and

sensor size of 13.2 millimetres (Mavic 2 Pro, 2018)

The **optimal flight altitude** of 90 meters.

Results

- Sample Flight Plan



Results

Digital Elevation Model

- Creating a Digital Elevation Model (DEM) is cost-effective compared to generating a point cloud and has minimal impact on total processing time

Orthomosaic

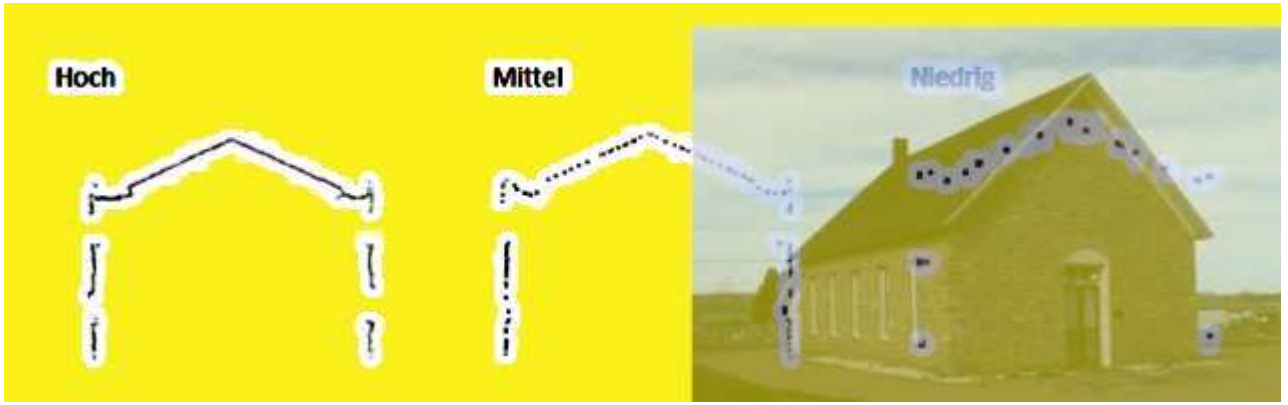
- The final step in the evaluation is creating the orthomosaic.

Results

- Point Clouds

Name	High	Medium	Low
Depth Filtering	Mild	Moderate	Aggressive
Accuracy	High	Medium	Low

Name	High	Medium	Low
Time in Depth Map	56	19	8
Time Point cloud[min]	96	23	5
Combined[Hours]	2.53	0.70	0.22
Number of Points	102475709	24943437	6082068
File Size[GB]	1.310	0.326	0.079



Conclusion

✓By planning the UAV flight for the study area and creating an evaluation workflow, the **first step** has been taken to generate **routable data** for ambulance management.

✓The results that emerge at the end of the implementation phase and evaluation are **31 Orthophotos** and point clouds.

✓ First, the orthophotos should **fit precisely and georeferenced**. An obvious approach would encompass a GIS program such as ArcGIS or QGIS to create coherent orthophotos.

✓To extract the quality of the streets - Classification that distinguishes paved roads from unpaved roads and Potholes detected.

✓ A **road network** will then be built to incorporate the classified road data into the EAMS.

✓Taking road quality into account we have **navigation solution** for our ambulance routes.

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Positioning and Measurement

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