



FIG Working Week 2024

19-24 May

Accra, Ghana

Your World, Our World:
Resilient Environment
and Sustainable
Resource Management
for All

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

Franz Okyere (Ghana), **Lena Augner**, **Fabius Limpaecher** (Germany), **Joshua Oddoye** (Ghana), **Ansgar Brunn**, **Franziska Heering** (Germany), **Tracy Arthur** and **Prosper Fometi** (Ghana)

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Introduction

Courtesy:
Okyere et al, 2022





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Introduction

Analysis of Implementation
Data

Courtesy:
Okyere et al, 2023

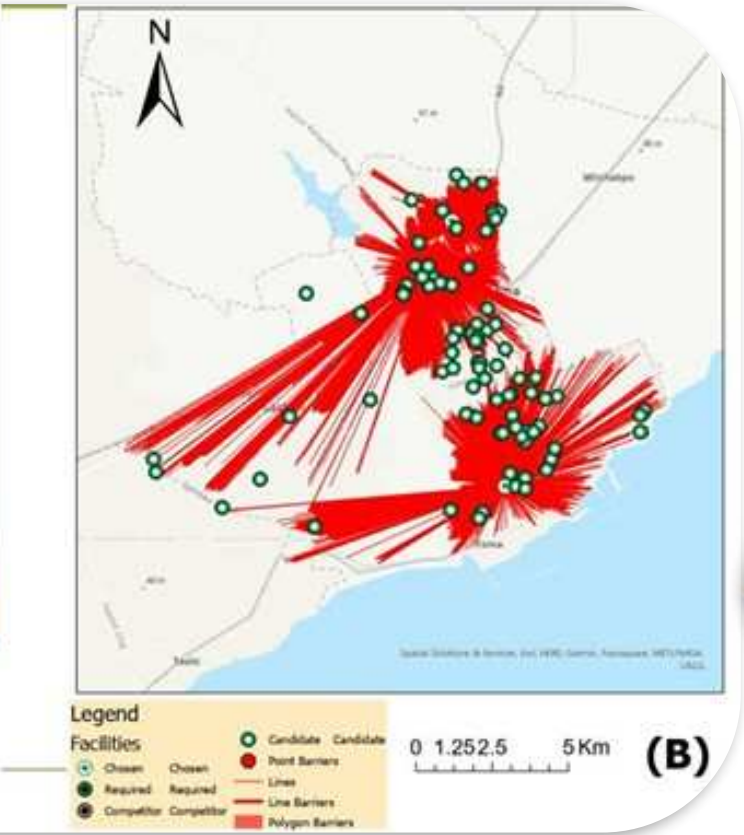
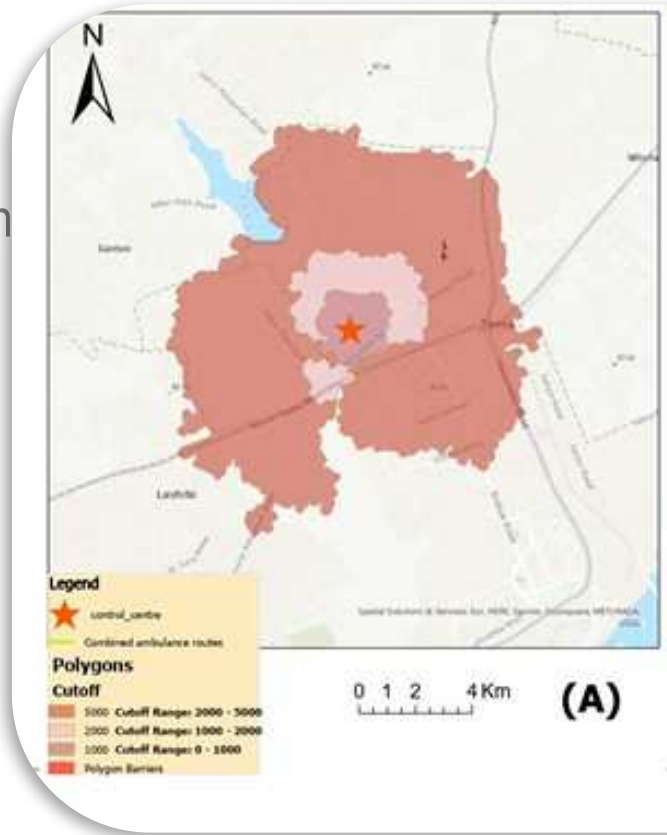




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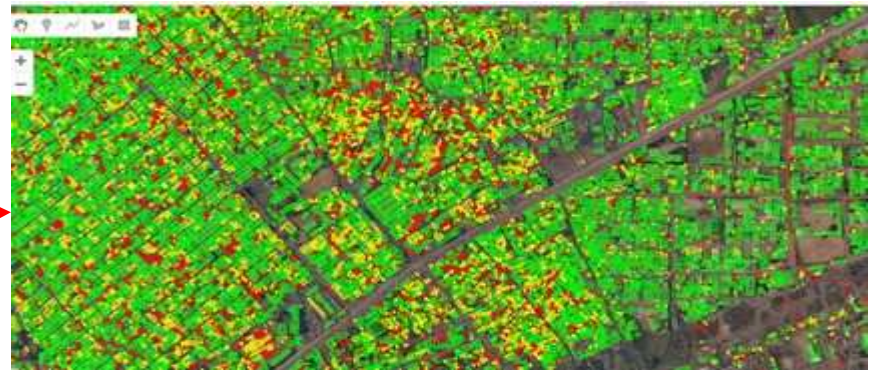
Need for Spatial Data

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





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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

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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 -

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Theory

Ground resolution:

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

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



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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.

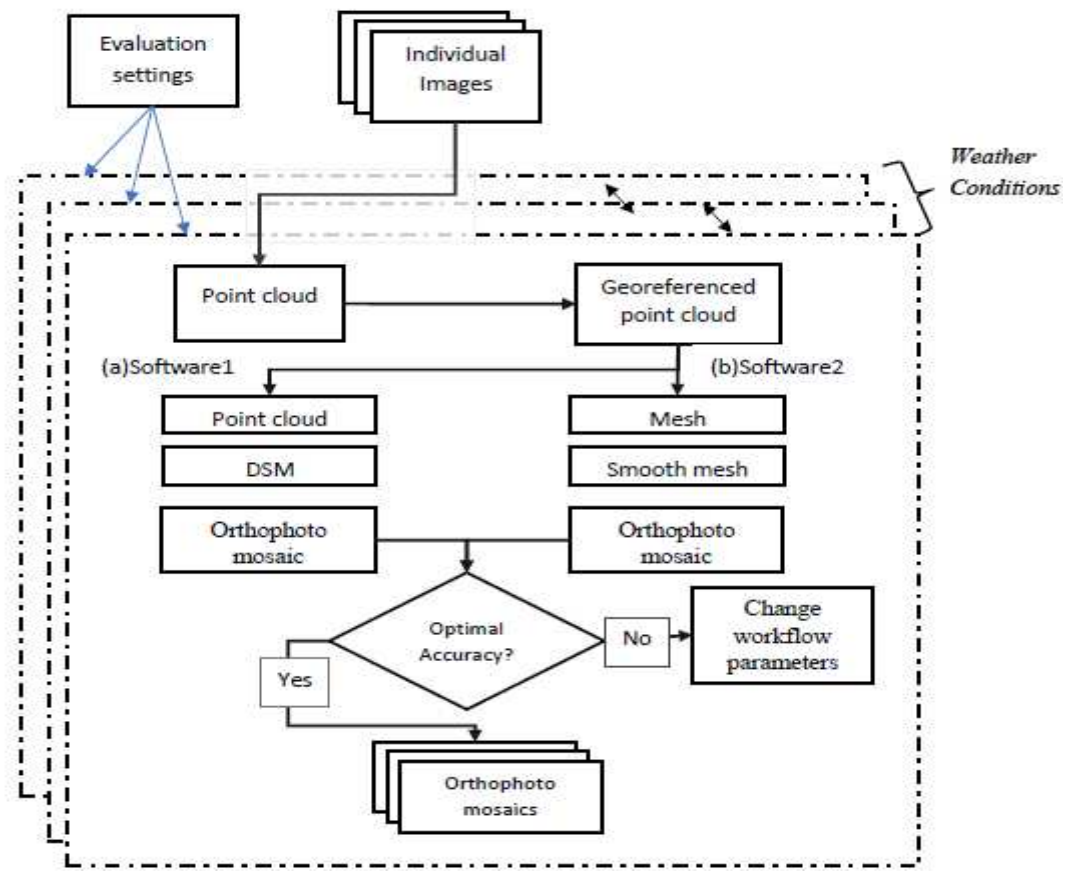




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Methods

.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.





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Results

- Sample Flight Plan

The screenshot shows the Pix4o software interface. At the top, there are navigation tabs: Home / Ashaiman 1 / Fly, Upload, Explore, Report. On the right, there are buttons for 'Editor', 'Share', and a settings icon. Below the navigation, a summary bar displays: 47:23 Minutes, 39 Hectares, 925 Images, and 3 Batteries. The left sidebar contains 'Automatic Settings' with several options: Front Overlap (80%), Side Overlap (75%), Flight Direction (68°), Mapping Flight Speed (6m/s), Starting Waypoint (1), Gimbal Angle (-90°), and Perimeter 3D (disabled). The main area is a satellite map with a green flight path overlaid, starting from a 'Start' point and ending at a 'Connect drone' point. Various landmarks are labeled on the map, including 'Jesus Fire Gen Church Internatio', 'Stadium Close', 'Lashibi', 'Kofi Portuphy St', 'Santoe', and 'Ashaiman/Klagon Road'. A 'Help' icon is visible at the bottom left of the settings panel.



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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.





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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

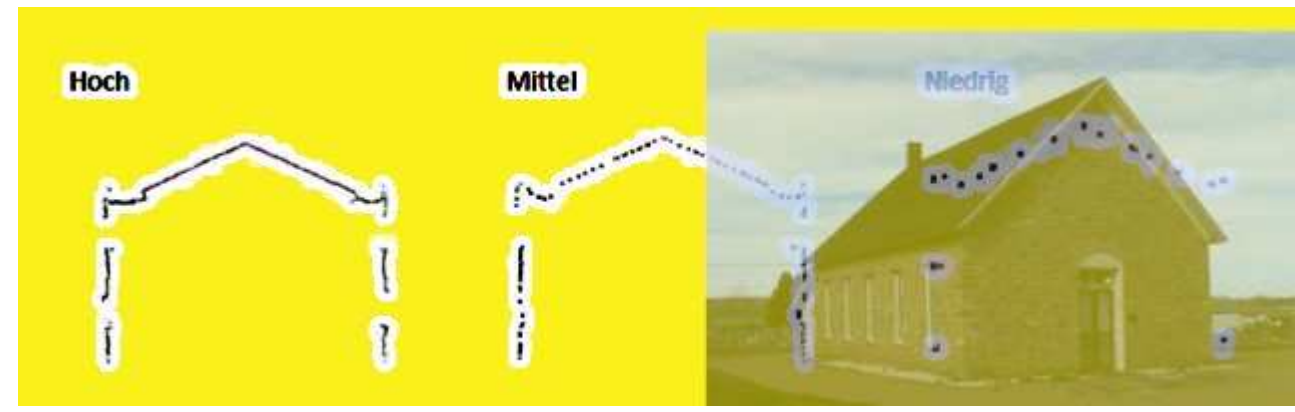




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Conclusion

- ✓ 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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SUSTAINABLE DEVELOPMENT GOALS

International Federation of Surveyors supports the Sustainable Development Goals

Commission 5

Positioning and Measurement

Advancing Surveying through Technology including Uncrewed Systems

