HUVIRIR
Delivering Intelligence

Process flow of conducting land survey with drones

PROCESS

PRE-SITE VISIT ACTIVITY

FLIGHT PLANNING

IMAGE PROCESSING

POST PROCESSING

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TOPICS

Background

Land surveying is a technique of determining the terrestrial or three-dimensional position of points and the distances and angles between them.

To measure these, high order GPS, Robotic Total Stations and terrestrial scanners have been traditionally used to map an area and make further computations.

Further, surveyors then use software, such as CAD and GIS software to draft plans and map the onsite measurements. Surveyors work on a diverse variety of projects from land subdivision and mining exploration, to tunnel building and major construction projects. The outputs provide information to guide the work of engineers, architects and developers.

Over the past few years, drones have started to emerge as a prominent tool used in surveying. We have observed that using a drone can vastly reduce the time spent collecting accurate data. By acquiring raster data from the sky – in the form of geo-referenced digital aerial images, with resolutions as sharp as 1.5 cm (0.6 in) per pixel – you can gather millions of data points in one short flight.

Large jobs that once took weeks can now be completed in just a few days, and a week's worth of traditional data collection is now achieved in just one day.

We once conducted a survey of a 1000 acres estate in 5 days - 2 days on the field and 3 days of image processing and post processing to generate all the outputs. This typically takes 3-4 weeks to get done by the traditional surveying methods.Land surveying is a technique of determining the terrestrial or three-dimensional position of points and the distances and angles between them.

Objective

In this paper, we have detailed out the steps involved in using drones as a tool for surveying, with an example of a project that we executed in December, 2016.

Aerial Survey of a Real Estate Property

A real estate developer (name concealed to protect identity) required a survey to be done on a property to get the following outputs:

- Boundary drawing
- Contours
- Feature marking

All the above outputs needed to have a maximum root mean square error of 5 centimeter both in terms of relative accuracy and global accuracy.

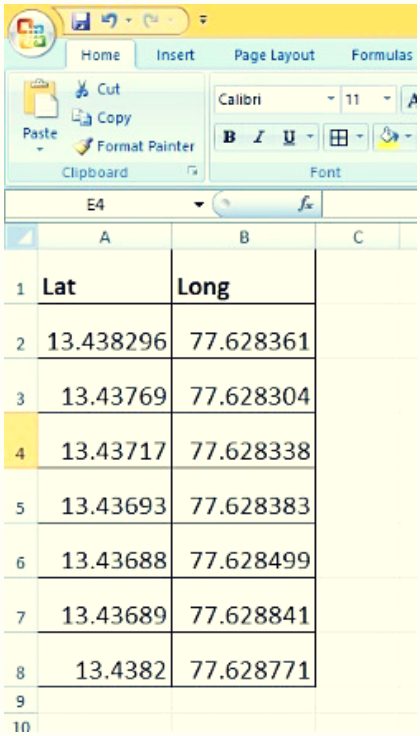
The property owner was also keen on being able to visualize the property features to be able to make decisions on designing the project. Their first go to tool was Google Earth. However, the satellite image was not of sufficient resolution for them to visualize the features accurately. Also, the satellite image was over 6 months old and seemed to indicate some differences in features as compared to the present status.

This is when they contacted Huviair Technologies to explore the possibility of using drones to take a video of the site. After understanding the requirement, we suggested to that while an aerial video was one possible output from a drone, we can use drones with ground control points as a tool for survey, which can deliver all the survey outputs they needed, plus provide them visualization that they had not thought possible before - high 2D orthomosaic with the boundaries marked, 3D textured model of the site and a digital surface model.
The real estate developer was happy to try this technology out.

Process followed

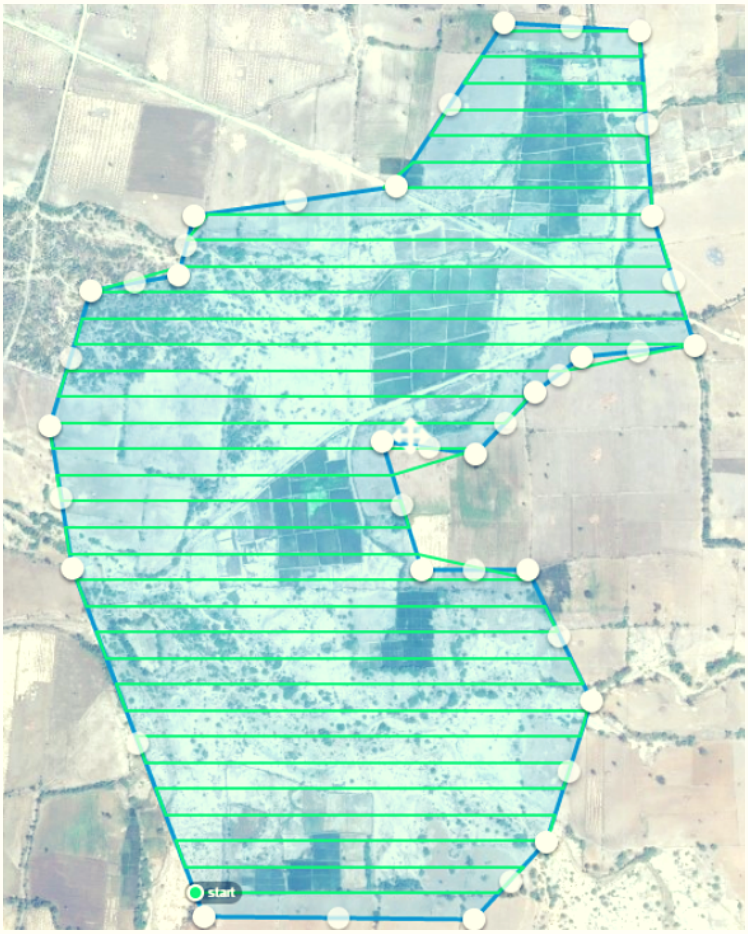
Before going to site

1. The customer sent us GPS coordinates of boundary vertices in an excel sheet.

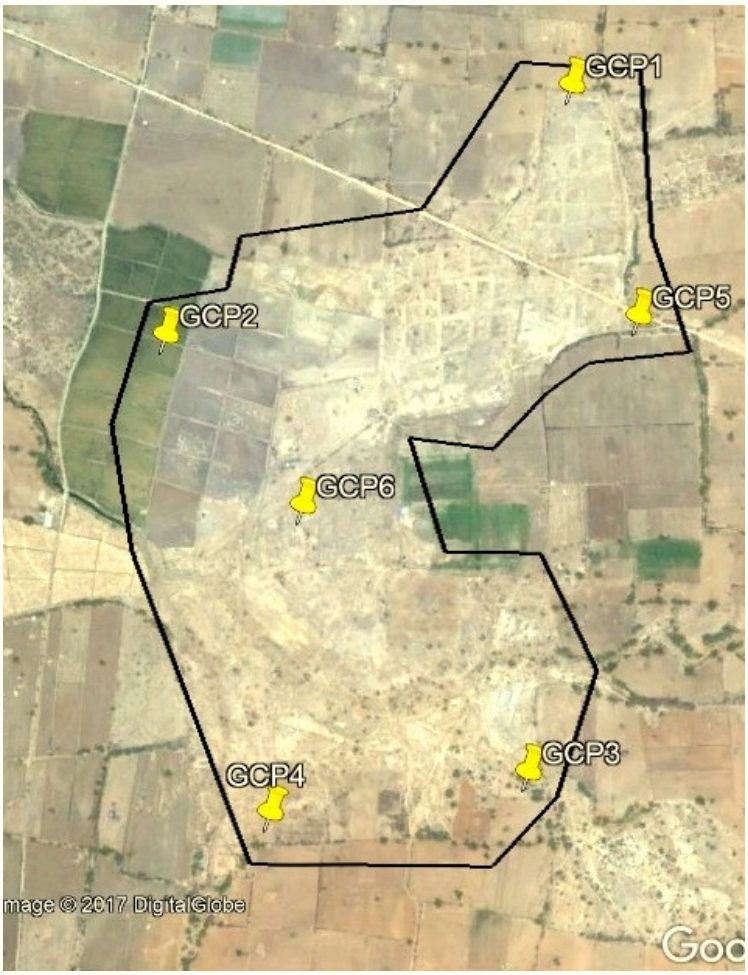


2. We converted this into a boundary polygon kml file.

3. And then into a flight plan with boundary extents further extended to ensure no part of the boundaries get missed out.



4. We then worked out the positioning strategy of the ground control points.



At Site

1. The boundary vertices were marked with visible markers. This is done to be able to use them as reference to mark the boundary points on the final outputs.

2. Ground control points were also marked and the geo coordinates of each point was measured accurately using a Trimble R8 base-rover GPS system in Post Process Kinematics mode.

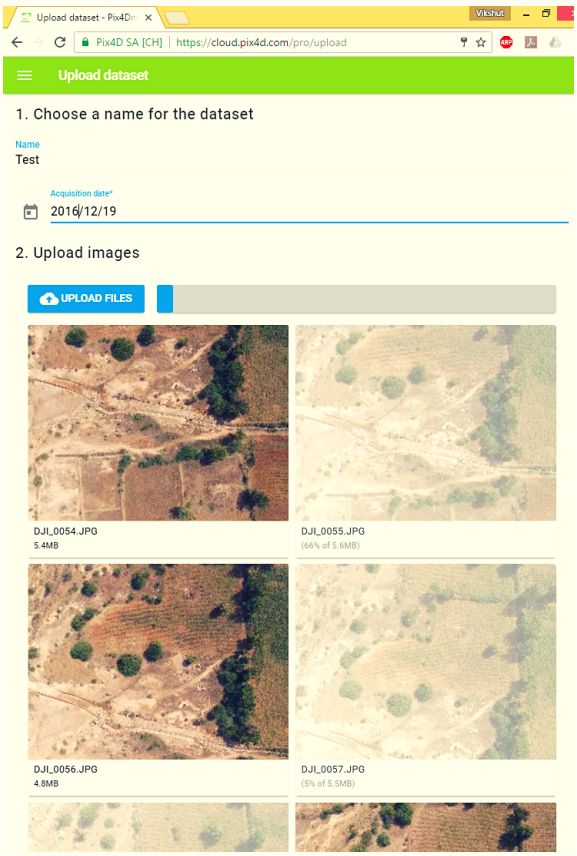
3. The flight plan was executed and over 400 nadir images were captured.

Desk Work

1. The ground control point coordinates were obtained using Trimble Business Centre Software.

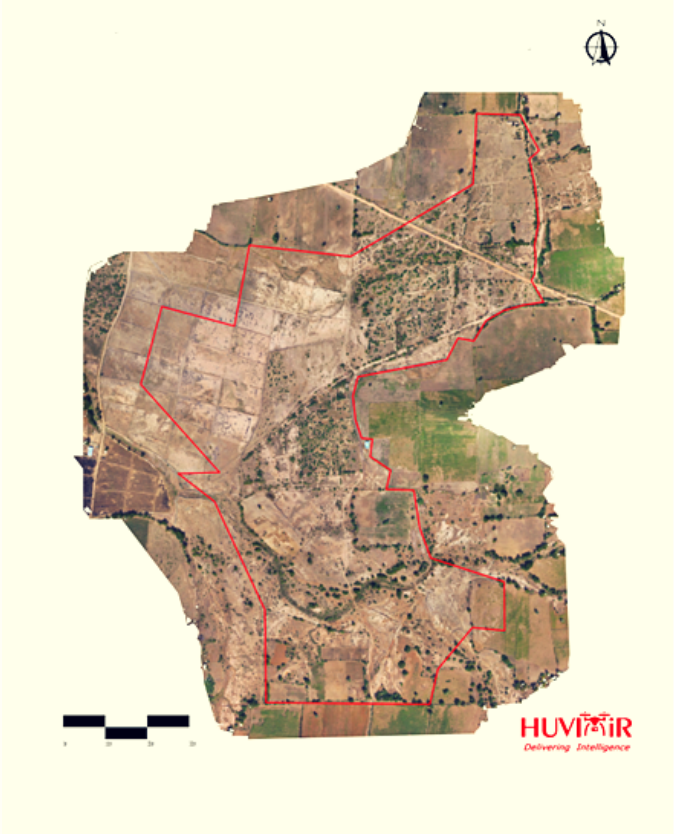
2. The images were processed on Pix4D Desktop where the GCP/MTP manager was used to incorporate the processing of the ground control points.

3. The Orthomosaic (top view single image with very high resolution), the Digital Surface Model and the 3D Model were generated as outputs.

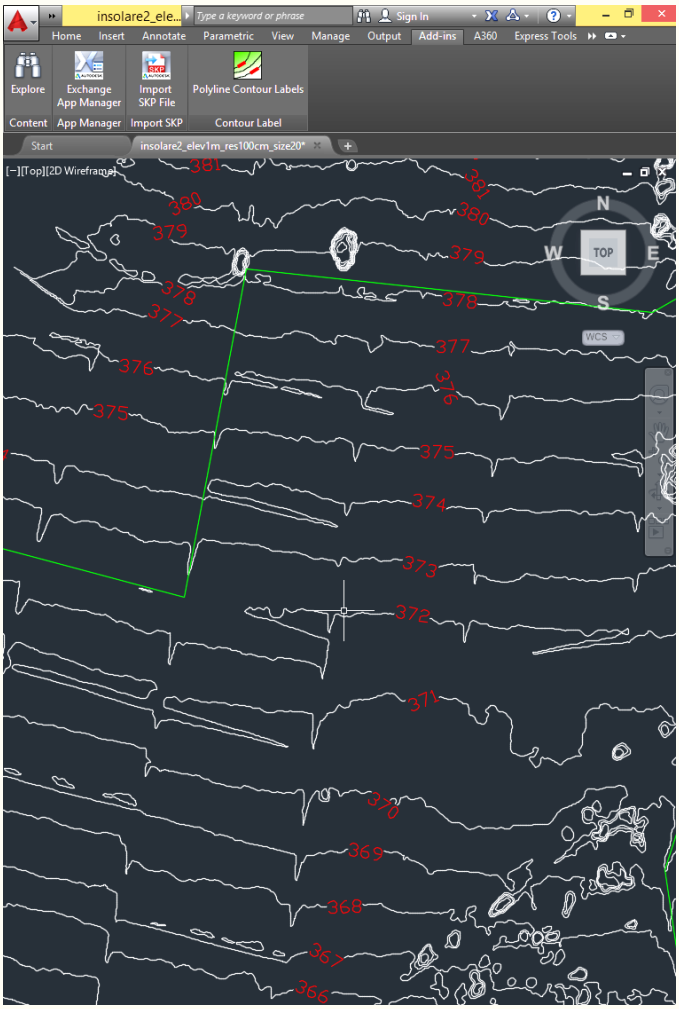


4. Post processing

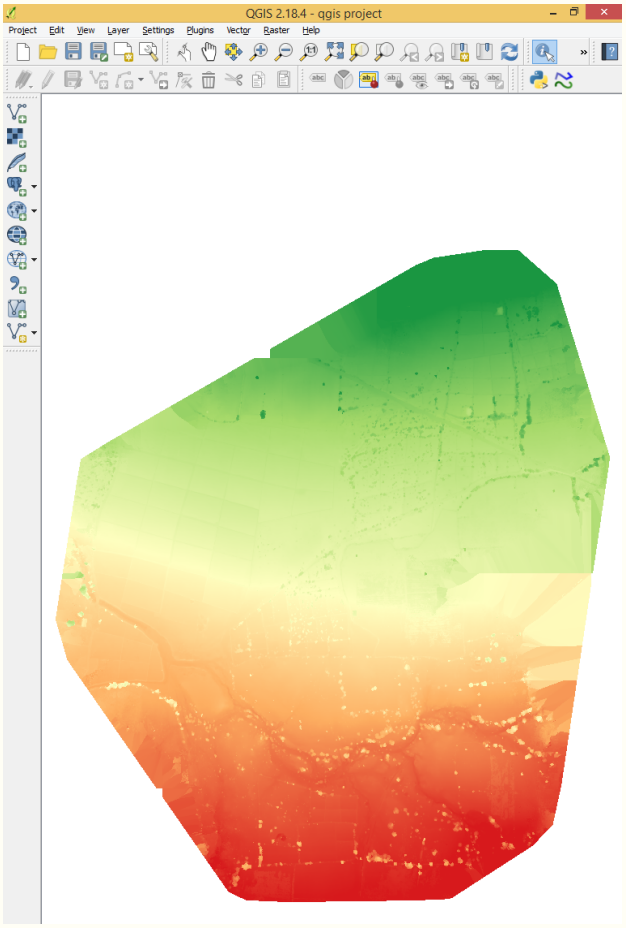
High resolution image with boundaries, north symbol and scale was created using GIMP



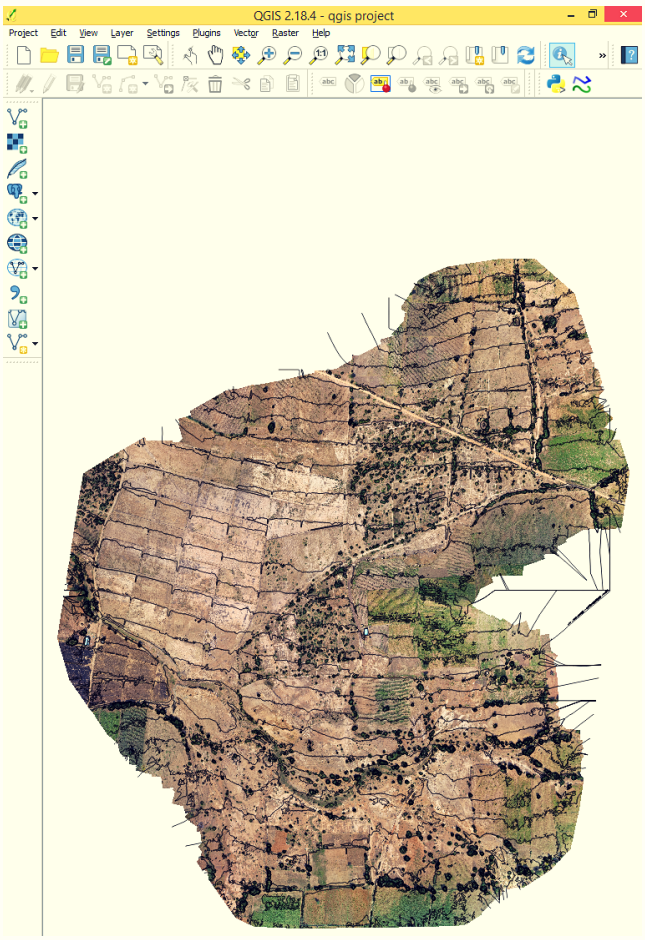
1 meter interval labeled contours and boundary drawing were processed in AutoCAD



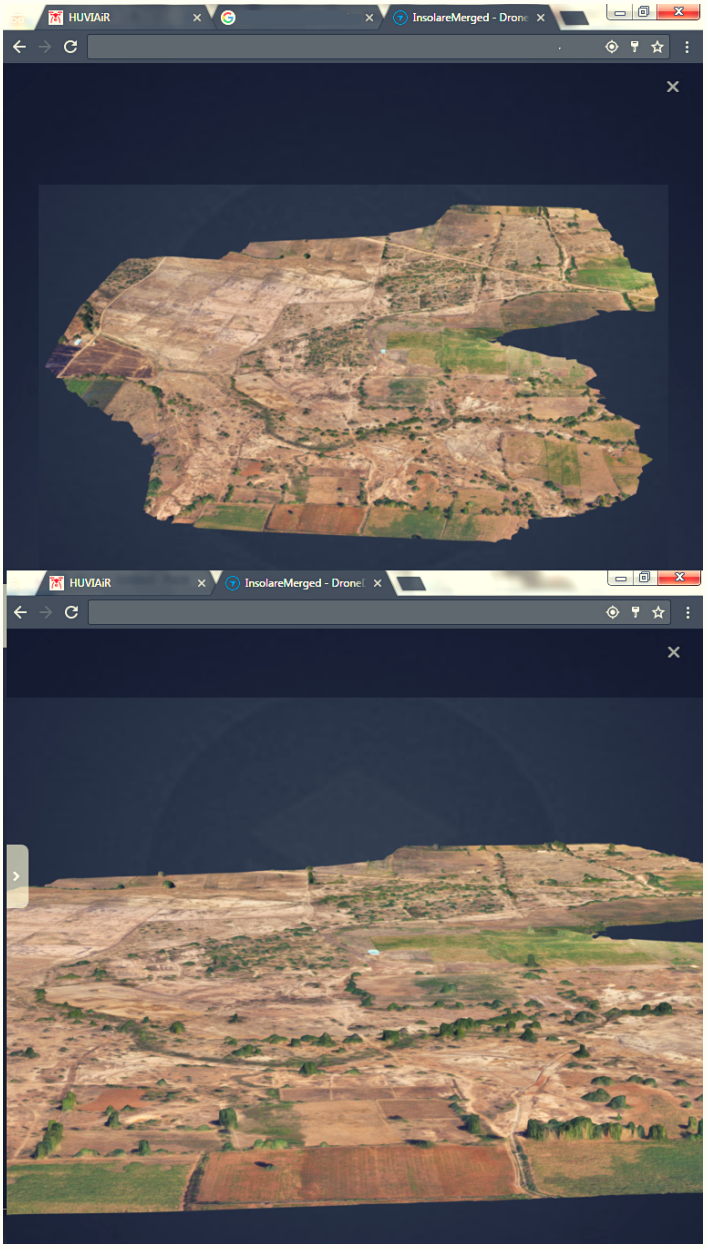
The DSM was visualized in QGIS



Contours were created and overlayed on orthomosaic in QQIS



3D Model was visualized in Sketchfab



Conclusion

The customer was satisfied with the accuracy (10 cm) and the utility of the results. The following aspects were most valuable to them:

• The contours overlayed on the high resolution orthomosaic (5cm/px) simplified the process of identifying how the contours run over the different parts of the property.

• Feature identification and marking became extremely accurate as the customer used the orthomosaic as the base layer to design the project.

• The 3D model gave the customer a clear idea of the undulations of the terrain, which helped them arrive at design decisions quicker.

• Since the boundary was created using the visible markers, the exact area of the property was verified accurately.

• And most importantly, the outputs were signed off by a Government certified surveyor as legal survey documents. This was due to the high accuracy of the outputs both in relative and absolute terms.

About us

HUVIAiR Technologies is a drone data based solutions company.

We expertise in providing solutions for the survey, construction, infrastructure, renewable energy and natural resource management sectors. We have a deep understanding of UAVs, sensors, photogrammetry, GIS mapping, surveying techniques, image processing, data analytics and software programming.

Our services include consulting, training, and drone data capture /visualization /management solutions to individuals, corporates, governments and not-for-profits working on projects in these sectors.