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Project Summary

Organization
Ala Abdulhadi & Khalifa Hawas
Consulting Engineering Company

Solution
Reality Modeling

Location
Al-Madinah Al-Munawwarah,
Madinah, Saudi Arabia

Project Objectives
- To develop a reality model a 55-square-kilometer section of the city.
- To conduct mobile mapping of 7,000 kilometers of roadways.

Products Used
ContextCapture, Orbit

Fast Facts

- The Kingdom of Saudi Arabia is increasing the number of pilgrims that visit Al-Madinah annually from 8 million to 30 million by 2030.
- AHCEC established a reality model using ContextCapture and Orbit for planning and designing the infrastructure needed to support the increase in visitors.
- The applications' interoperability helped easily export the models to facilitate government and stakeholder approval.

ROI

- ContextCapture and Orbit helped the team complete the objective in nine months, saving over a year in surveying time and more than SAR 42 million.
- The team captured 750,000 images, modeled 41,672 buildings, and surveyed more than 7,000 kilometers of roads.
- This project was the first of this scale in Saudi Arabia to use consumer UAVs against a short design schedule.

AHCEC Developed Reality Model of Second-holiest City in Islam

ContextCapture and Orbit Helped Model and Survey
41,672 Buildings and 7,000 Kilometers of Roads

Increasing Annual Pilgrim Capacity

Each year, a significant number of the world's 1.8 billion Muslims visit the city of Al-Madinah in Al-Munawwarah, Saudi Arabia. It is the second-holiest city for Muslims and was the first Islamic capital. Pilgrims come to visit the city's three prominent mosques and other areas of religious and historical significance.

Over the years, the number of pilgrims has increased exponentially. To accommodate the growing numbers, the Kingdom of Saudi Arabia wanted to increase the capacity of annual visitors from 8 million to 30 million by 2030. The kingdom planned a SAR 7 million project to build museums and plan routes to historical, culture, and tourist sites. With more than 55 years of experience, Ala Abdulhadi & Khalifa Hawas Consulting Engineering Company (AHCEC) was tasked with designing the plan, which included expanding transportation systems and hospitality facilities while preserving historical sites.

Developing Reality Models for Enhanced Urban Planning

AHCEC worked with the Madinah Development Authority to create strategic execution plans for the project. For example, the city wanted to implement reality modeling practices to help plan the development of the 55-square-kilometer historical area of the city, allowing the team to gather all the proper resources and streamline the project timeline. This model would be used to create a digital twin for the central part of the city.

AHCEC was also asked to help conduct mobile mapping for the 700-square-kilometer road network, which includes 7,900 kilometers of roads. The team needed to build a comprehensive application that contained 3D mobile mapping and reality mesh data to support the urban planning team. With this large area to cover and the deadline shortened from two years to one, AHCEC turned to an innovative and interoperable digital solution.

3D reality mesh of the Khalidiyah District generated with ContextCapture.

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Conducting Surveying and Mapping with UAVs and Mobile Devices

To begin, the project team captured LiDAR data to create a hybrid model that also included unmanned aerial vehicle (UAV) data. Other team members drove through the streets to capture data for the model. AHCEC divided the city into 2.25-hectare cells and used six UAVs in the field. The team established 1,038 control points around the city, which allowed them to ensure accuracy and finish data capture in 85 days with 7,033 UAV flights.

Using ContextCapture, the project team processed nearly 750,000 images, about 13.7 terapixels, to create a realistic 3D model of the city. AHCEC also used a 3D mapping solution to manage the large amounts of mobile mapping data. Orbit, Bentley's 3D mapping solution, helped effectively manage and feature extract content, as well as publish mobile mapping data. The application was able to manage and extract the large amounts of drone data and create panoramic images for the model. The interoperability of the applications also allowed the model to be exported in web-ready formats for easier approvals from the government and other stakeholders.

Documenting Significant Historical Landmarks

By using ContextCapture and Orbit, AHCEC was able to document each historical spot in the city using realistic and detailed models. These models were used to help develop new roads through the city, superimposing other models on the reality model so designers and engineers could see everything accurately and clearly laid out.

The model captured every feature of the highly congested area, including trees and the texture of the buildings. Even narrow, dark alleys were modeled in great detail with a combination of laser scanning and photogrammetry. The team also implemented data from existing point clouds.

The model provided a single location where the multidiscipline site planning and engineering teams could find information that they needed. It is now easy to share the models with other departments, as well as visualize and measure without having much experience in 2D or 3D modeling. Lastly, the team conducted a feasibility study for a 3-kilometer walkway between two important mosques, as well as conduct shading analyses to allow for maximum walking comfort between the mosques and surrounding facilities.

Creating a Solid Foundation for Future Projects

Reality modeling provided the team with a reliable survey technique that minimized modeling time and costs while streamlining decision-making and visualization. AHCEC's reality model helped the team complete the project 15 months ahead of schedule while still creating a design that facilitates pilgrim access to Al-Madinah. Using ContextCapture and Orbit, the project team completed the objective in nine months, saving over a year in surveying time and more than SAR 42 million. The team captured more than 750,000 images, modeled 41,672 buildings, and surveyed more than 7,000 kilometers of roads in high definition.

This project was the first of its scale in Saudi Arabia to use consumer UAVs in such a short timeframe. Moving forward, the team will use Bentley's iTwin® Services to create a digital twin. AHCEC plans to collect information from utilities, including environmental sensors, to add to the reality model. The team plans to implement AssetWise and ProjectWise, creating a single source for all project information that can be contained in the reality model.

3D reality mesh of 216 sqkm of the Al Jumah District generated with ContextCapture.