

# “Beyond Plain Visualization: 3D Modeling of Historic Buildings in Karakol”

## Project Report

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3D modeling of cultural heritage objects is one of the effective tools for its documentation and preservation. In 2015 there was a project devoted to virtual modeling of Koshoi-Korgon fortress in At-Bashy (Naryn) led by Sh. Batyrbaeva (Batyrbaeva, 2017). The research team of faculty and students of the Kyrgyz National University have reconstructed the fortress on the basis of archaeological data with help of the special software such as ArchiCAD, Photoshop CS3, Unity3D, Autodesk 3D Max, 3DWorldStudio.

Our project of 3D modeling of historical buildings in Karakol town (Issyk-Kul region) aimed to visualize the existing historical buildings, not the reconstruction of them. Due to lack of time and situation with news about COVID19 we did not get access to Dungan Mosque. We have focused on buildings of the women's Gymnasium and Holy Trinity Orthodox Cathedral.

Project work schedule represented as follows: preparation of equipment, training, fieldwork, and some lab work in Karakol. To process all raw data, we need access to the computer at the AUCA. Therefore, the last stage of work was postponed until Fall 2020.

### **Equipment**

In the project we have used the following equipment: quadcopter Mavic Pro 2 with two more batteries, 3 memory mini cards, 2 recording tapes with 50 meters length, tripod, photo camera Canon EOS600D, laptop with installed Agisoft Photoscan program. Camera, tripod, and recording tapes were taken to make the shooting of some parts of the objects manually.

### **Training (6-12 March 2020)**

Before starting fieldwork, we organized training (theory and practice) for project members and tested the methodology of taking photographs for large objects like buildings.

In general, the methodology of making 3D models of buildings on the base of photographs can be divided into two stages:

- 1) The process of photographing (getting raw data)
- 2) Photographs processing by using special software (Agisoft Photoscan in our case).

Photography is a more complicated process and methodology varies depending on objects. To take correct photos we have to follow the specific rules: a) to get pictures from the top with an angle of 90 degrees, b) to get pictures around the object at least 2 times with the angle of the camera of 70 and 45 degrees keeping constant height, c) to make at least 1 circular flight around an object, d) overlapping all pictures up 70-80%.

We have decided to use some free special flight planning apps to help to get more accurate (to keep fixed height and angle of camera, front and side overlap of photographs to about 70-80% automatically) photographs. After testing some of them (Drone Deploy, Pix4Dcapture) we have chosen an app Pix4Dcapture. In this app, we have used two modes for 3D modeling (double grid and circular) and one mode for 2D modeling (polygon). The last one was chosen to get pictures with an angle of 90 degrees to take pictures from the top.

### *Test flights*

First, we made a series of flight photographs of the AUCA building using Pix4Dcapture in double grid mode for 3D models. We made 2 flights with the angle of the camera as 70 and 45 degrees. As a result, we have received the model of the building with fuzzy details. The model itself was slightly distorted.

Pic. 1. First model (AUCA building) in low resolution.



Then we decided to add circular flight photos, but it was not helpful.

To check what is wrong with our methodology we have chosen a small object of the AUCA Bell, and did one manual flight to take pictures from the top and one more circular flight by using the Intelligent Flight Mode Point of Interest of the DJI GO app.

Pic. 2. The second model (AUCA building)



Pic.3. The third model (AUCA Bell)



The results were good. In general, our understanding of taking photography to make 3D models was correct. But in practice, we have to learn the specifics of taking photographs of large objects like buildings.

### **In the field (13-15 March 2020)**

The field was conducted in Karakol town within 3 days. The access to the Dungan Mosque was limited because of COVID19. The Orthodox Cathedral has a complex shape to be the first model. So, we have started from the building of a former women's gymnasium.

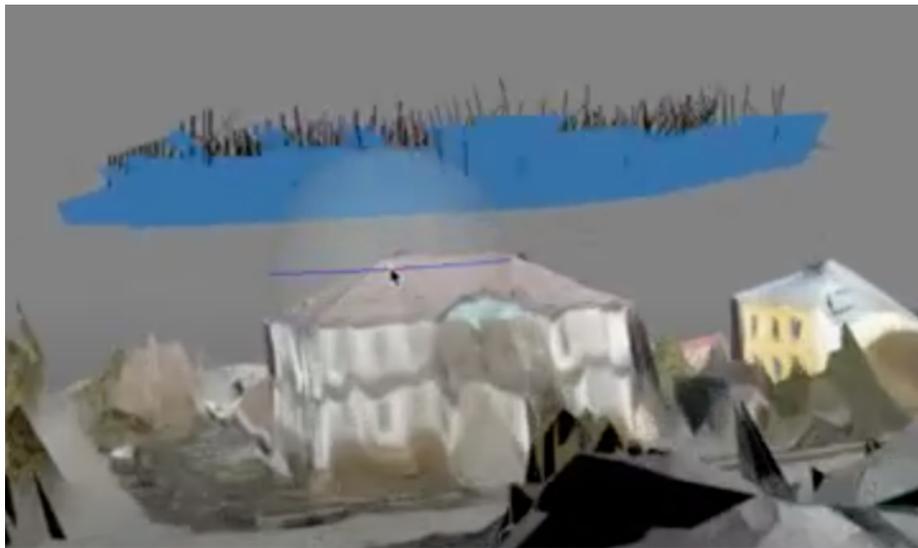
*The former women's Gymnasium building*

After arrival to Karakol, we did three flights around the Gymnasium building using the Pix4Dcapture app: 1 grid and 2 circular flights on the safe height of 25 and 22 meters.

In the evening we gathered photographs to a simple 3D model. The model failed (Pic.4). After that, we carefully reconsidered all aspects of our methodology of taking photos including the settings of the Pix4Dcapture app.

The next day we took photos of the gymnasium using 2 grid flights in the Pix4Dcapture app with a camera of 70 and 45 degrees on 25 meters in height and 1 circular flight with the Intelligent Flight Mode Point of Interest DJI GO app. Additionally in the Pix4Dcapture app, we added in settings 'center to the object' option.

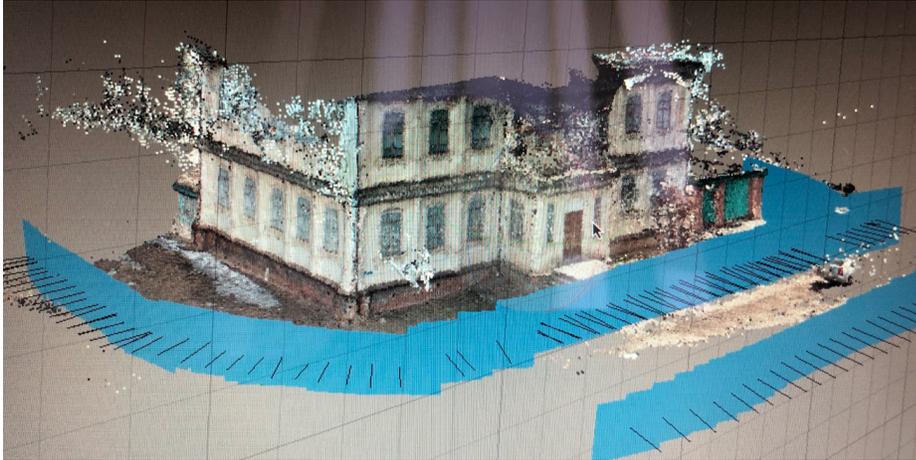
Pic.4 First failed model of the gymnasium



### *Manual photography*

To make sure that we will get high-resolution details of the building we took photos manually. Photos were taken by camera Canon EOS600D with the help of a tripod, on the same height and distance from the building (11 meters to take photos of the 1st level of the building and 20 meters to cover both levels). Thus, we collected photos of the western, southern, and eastern sides of the building. These photos were gathered separately from others to check the correctness of taking photos (Pic.5). In the evening manually taken photos were successfully combined with drone photos in the Agisoft Photoscan program into the 3D model of the building (Pic.6).

Pic.5. Model is based on manually taken photos of gymnasium (low resolution)



Pic.6. 3D model of the gymnasium on the base of drone and manually taken photos (low resolution)



### *The Holy-Trinity Orthodox Cathedral*

Afternoon we moved to the Orthodox Cathedral but could not meet with the priest to be allowed to start our shooting. The next morning, we came back, met with the priest, and got permission to take photos of the cathedral. We did 2 grid flights with an angle of the camera of 70 and 45 degrees on safe height in 33 meters and 1 circular flight with an Intelligent Flight Mode Point of Interest of the DJI GO app.

At the same time, we took photos manually from a distance of 9 meters around the building.

Due to quarantine, we were able to create only a low-resolution model of the Cathedral from drone photos (Pic. 7).

Pic.7. 3D model of the Holy-Trinity Orthodox Cathedral on the base of drone pictures (low resolution)



### **Limitations**

As a result of fieldwork following limitations were observed:

- a) Automatically planned flights with help of special apps only are not a guarantee to make good 3D models. The different parts of the object have to be taken manually by the camera and by drone;
- b) Special parts of the building such as steeples, domes, bells, towers, etc. have to be taken separately and then combined with other photos;
- c) Almost all buildings are part of landscapes and living places. They are surrounded by trees, bushes, other buildings and this makes the shooting process often challenging, sometimes impossible. All this noise has to be cleared in special programs, sometimes reconstructed.

### **Preliminary outcomes**

For now, we made 3D simple low-resolution models of two historical buildings in Karakol town: a former women's Gymnasium building and the Orthodox Cathedral. These models were uploaded to Sketchfab, which is the world's largest platform to publish, share, and discover 3D content on the web, mobile, AR, and VR.

These models are not final, we have to work on them additionally to get more accurate and high-quality images. In the future, we plan to publish them on our Omeka platform.

The results of our project were submitted to the forthcoming 5th International Congress of the Association of Anthropologists and Ethnologists of Kyrgyzstan on 2-3 July 2020 in Naryn within

*Experimental creative practices and new technologies in heritage conservation and management* theme of the event. However, the event was postponed.

The models can be found through the links given below:

<https://skfb.ly/6SA9J>

<https://skfb.ly/6SAtJ>

## **References**

Batyrbaeva S.D., Soltobaev O.A., Tursunova E.T. — Virtual Reconstruction of the Medieval Settlement of Koshoy-Korgon – a Fortress of Nomads on the Great Silk Road // Историческая информатика. – 2017. – № 1. – С. 63 - 74. DOI: 10.7256/2306-0891.2017.1.22452 URL: [https://nbpublish.com/library\\_read\\_article.php?id=22452](https://nbpublish.com/library_read_article.php?id=22452).

Link to the Google Drive folder with all data

<https://drive.google.com/drive/u/0/folders/10VMKM68j6I3euaS9F-SzPQD6Wba3xuuW>