Analysis of Crowdsourcing based data acquisition

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Abstract — The crowdsourcing based data collection is a relatively new and interesting part of the geoinformatics. In our article, we would like to present the application possibilities of a large number of images on different image and video sharing portals for an architectural survey. The article shows the possibilities of automation, the advantages and disadvantages of the technology, as well as the other potential uses of the crowdsourcing based data acquisition.

I. CROWDSOURCING

Since the end of the last decade crowdsourcing had become a fast spreading data collecting procedure due to the increasing of (mainly laic) users. We can find similar methods mainly in the field of GIS (for example community map editing), but due to the rapid spread of point cloud formation algorithms based on image matching, this field had been supplemented with an interesting application group build on large amount of pictures in various quality and resolution, originate from different photo and video sharing websites. According to the PhD dissertation of Somogyi Árpád [1] the first spatial reconstruction, based on pictures from social websites, was made of Rome with the use of approximately 150.000 pictures [2]. As a Hungarian related article, we can mention one from Dr. Gede Mátyás [3], who has made researches in connection with shared photos with geographical data. Based on the writings we can say this field counts as a newness, that is why the studying of it had become topical and reasonable. In our article we would like to present the steps and devices of the assessment, on the example of a statue in Székesfehérvár.

II. THE STUDY'S OBJECT AND TOOLS

As the concrete object of the study we chose Ohmann Béla's creation, named Fehérvári jog, in its more popular name the Országalma. One reason of our choice is symbolical. The statue, made in 1943, had been inspirited by the regalias and has become not only the city's but our faculty's emblem too. As it is the most well known monument in Székesfehérvár we expected sufficient amount of available photos therefore we did not check the number and quality of them in advance. In the interest of studying the geometry of the point cloud made by the help of crowdsourcing we needed a reference, what we get from the laser scanning measurement of the Országalma (Figure 1.).

Figure 1. Reference point cloud from the laser scanning measurement

Other than the laser scanning measurement we were taking own pictures too with simple amateur ground cameras within ideal measuring arrangement (Figure 2.). From these photos we created the dense point cloud of the statue with the help of Agisoft Photoscan software (Figure 3.). We also analyzed what was the maximal resolution and accuracy that we can reach with this measurement.

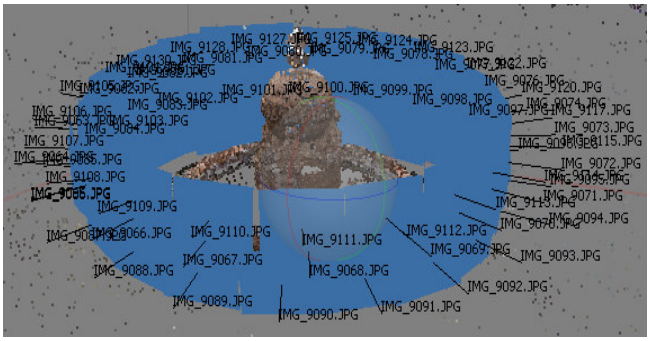

Figure *2*. Measurement layout.

Figure 3. Point cloud - made from our own photos.

During the investigation of crowdsourcing we used several sources of data. From the popular social websites of Flickr, YouTube, Vimeo, and Instagram we were exact photos and video recordings as well. Naturally crowdsourcing can be adapted the most efficiently if the filtering and downloading of pictures is automated. An example innovation with the same purpose is the API *(Application Programming Interface)* of Flickr. With calling the application's functions into our application or simply by using the web interface designed for this purpose, it is possible to filter photos by place capturing time, uploading time, attached meta data or keywords and then download them. In the course of the searching method we used the filters listed above. From our aspect it was significantly important to limit the capturing time of photos, because the statue had been resurrected and rebuilt in the past years, this way we could utilize only those photos which belong to the current position.

We obtained nearly 340 useful pictures from some of the sources. The obstacles that we have faced during the filtering, were mainly caused by the incorrect geo referencing or because the keywords were given wrong. We have done the filtration manually but further on we design to automate this process through some developments. The evaluation was also done with the above-mentioned Agisoft Photoscan commercial product. We present the result point cloud on the 4th figure. As we can see, as for the resolution, it has not as fine quality as the reference point cloud.

Figure 4. Point cloud produced from crowdsourced images

Figure 5. Manually selected ground control points

We made point clouds not only from automatic evaluation, but with the manual giving of tie points as well (Figure 5.). The comparison of the point cloud achieved with crowdsourcing and the reference one was done by the analogy with a former casework [4]. All of the point clouds were transformed, with an ICP algorithm based transformation (Figure 7-8.), into a common reference system, then we examined their average distance and deviation correlate with the reference point cloud. The study had been carried out separately on recordings with different sources, the outcome is exposed in the 1st table.

It is noticeable, that naturally, the best resolution belongs to the point cloud produced from our own pictures what ensures the highest overlap. The next one is the point cloud made from the numerous pictures extracted from videos. The model, calculated by the help of ~340 crowdsourced images, contains much less points. One of the reasons of it is although the number of pictures is relatively large, the spatial distribution of them is not nearly even.

Source of the reference point cloud	Source of the adjusted point cloud	Average distance [m]	Deviation [m]	Number of points in the point cloud (pcs)
Laser scanner	336 assorted pictures, without tie points	0,043	0,063	3740
Laser scanner	336 assorted pictures, with tie points placed on buildings	0,001	0,001	2486
Laser scanner	336 assorted pictures, with tie points placed on the statue	0,028	0,033	12059
Laser scanner	Pictures extracted from videos	0,023	0,024	61011
Laser scanner	Own pictures	0,011	0,010	204683

Table 1. Average distances from the reference point cloud in the cases of recordings with different sources

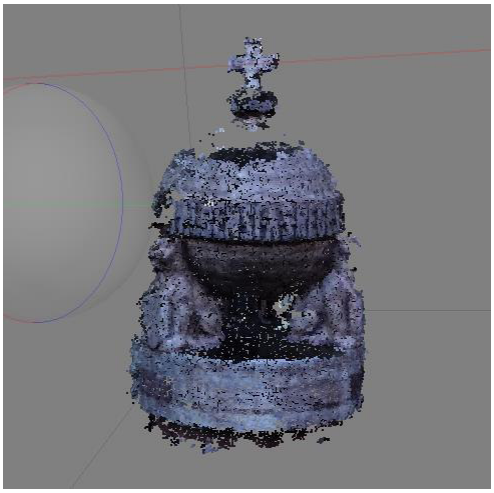

Figure 6. Point cloud from videos

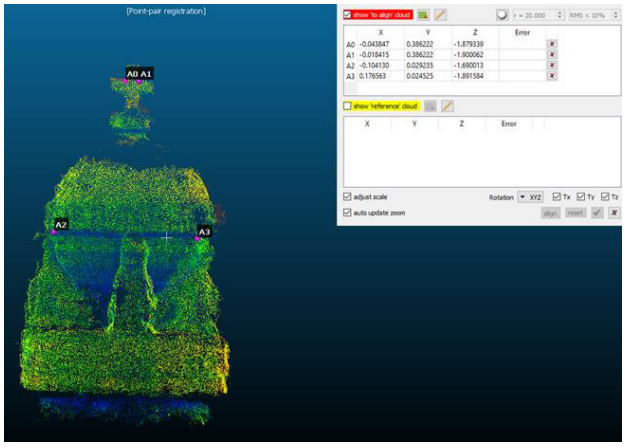

Figure 7. Point cloud (from Photos)

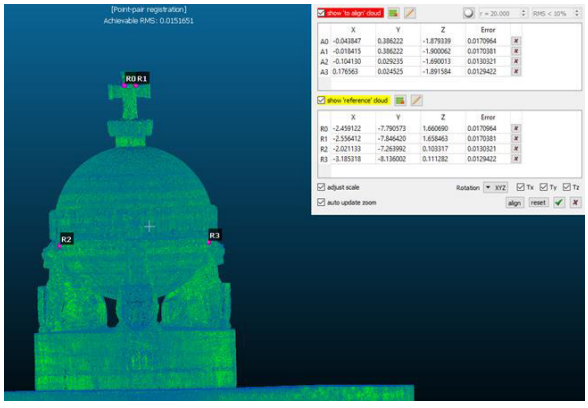

Figure 8. Point cloud (from scanner) and the result of ICP algorithm

III. CONCLUSIONS

All in all, on the score of the paper we can establish that the crowdsource based point cloud processing holds promising developmental possibilities. One of its main advantages lies in the opportunity of automation. Especially in those locations that are beloved by tourists we can expect the sufficient quantity (and quality) of imagery that lead to proper coverage and geometry. The final product can be suitable for architectural or cultural heritage conservational purposed assessment too [5, 6]. In further developments we set our sights on the automation of filtering the pictures originate from crowdsourcing.

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