RECONSTRUCTION OF HISTORICAL PATHS WITH USING OF SMALL-FORMAT AERIAL PHOTOGRAPHY

Jakub MIŘIJOVSKÝ[1], Jan MARTÍNEK[2], Jan BRUS[1]

1Palacky University in Olomouc, Faculty of Science, Department of Geoinformatics
tr. Svobody 26, Olomouc, Czech Republic

jakub.mirijovsky@upol.cz, jan.brus@klikni.cz

[2]Transport Research Centre
Krapkova 3, Olomouc, Czech Republic, jan.martinek@cdv.cz

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Abstract:

First works devoted to the study of historical paths originated in the first half of the 19th century. The work was done mainly in the field of historical geography as a collection of archival materials. This situation remained almost unchanged up to the second half of the last century, when other research disciplines, especially archaeology, began to be active, beside dominant historical geography. Another milestone in the research of historical path dates to the 90s´, when first extensive field researches of relics of old paths were performed. As a result of these researches, new theories about positions of old paths started to emerge. Research gradually becomes an interdisciplinary field associating departments of history, archaeology, historical geography, as geology and geoinformatics. A new discipline emerged which put together all the operations in the process of research of old paths as well as issues of introducing a uniform terminology and methodology for identification and protection of relics of old paths, together with ways of presenting this type of cultural heritage and other problems. On the other hand, various types of remote sensors are currently available to help explore landscape and other natural components. The main part of this field is based on a small format aerial photographs (SFAP) taken by a small aircraft. Self-made aerial photographs offer researchers a maximum operability. The technical parameters of the capturing device and platform help to the photographer in determining not only place and time, but also the point of view, image coverage, and exposure settings. The Drone PIXY is a slow moving model of motorized paraglider primarily used for close-up remote sensing, allowing classical or digital aerial images and video recording at ultra-low height (50 - 500 m). This paper deals with searching of historical paths forced by a small-format aerial photography in Moravia, a region in the Czech Republic.

1. INTRODUCTION

First works devoted to the study of historical paths originated in the first half of the 19th century. The work was done mainly in the field of historical geography as a collection of archival materials. This situation remained almost unchanged up to the second half of the last century, when other research disciplines, especially archaeology, began to be active, beside dominant historical geography. Another milestone in the research of historical path dates to the 90s´, when first extensive field researches of relics of old paths were performed. New theories could go out of this research [2, 3, 4]. Research gradually becomes an interdisciplinary field associating departments of history, archaeology, historical geography, geology and geoinformatics. Similar activities can also be traced outside of the Czech Republic: in the Bavarian part of Šumava Mts. (P.Praxl, 1995), in Oberpfalz (D.J.Manske, 2003), in the German part of Krušné hory Mts. (R. Wissuwa, 1998), in Slovakia (M. Slivka, 1998; M. Hanuliak, 1998) and in Poland (J. Sadowska-Topór, 1999).

Works on a four-year project named „Research of historic routes in the north of Moravia and eastern Bohemia“ were begun in 2011. This project is a part of the programme of applied research named „Program of applied research and development of national and cultural identity (NAKI)“ supported by Ministry of Culture of the Czech Republic. The project is follow-up to the research made in the north-western part of Moravian region – delimited by historical boundary (Olomoucko, Litovelsko, Konicko, Jevíčsko, Svitavsko, Moravskotřebovsko, Mohelnicko) [2, 4].

Project will use classic methods of research (terrain survey) as well as modern ones, e.g. ground geophysical radar, aerial photography, laser scanning, and small format aerial photography from remote-controlled model. Experience from the process of acquiring images and interpretation will be described below. It is necessary to find out localities of possible occurrence of historical paths which is possible thanks to historical and other sources.

2. IDENTIFICATION OF HISTORICAL PATHS BY STUDYING MAPS AND ORTHOPHOTOS FROM NORTHERN MORAVIA AND EASTERN BOHEMIA REGION

2.1 Areas of the regional and historical long distance roads

Traces of historical paths can be seen on maps from IInd Military Survey (years 1836-1852). These paths often took place outside of the structure of municipal estate or they are leading close to the border of each municipality. Older roads, which were not very long, lost their importance. At the time of mapping they were be plotted as a dashed line.

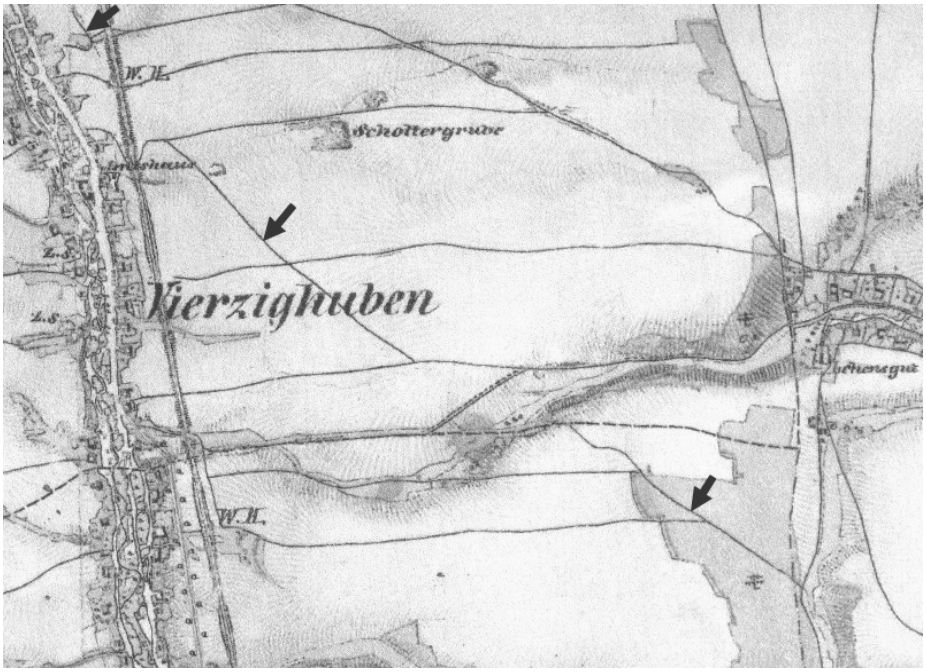

Figure 1: Map of IInd Military Survey - identification of historical paths.

2.2 Cattle tracks

Maps of IInd Military survey are very suitable for identification of cattle tracks. These objects are usually drawn as a narrow strip of pasture.

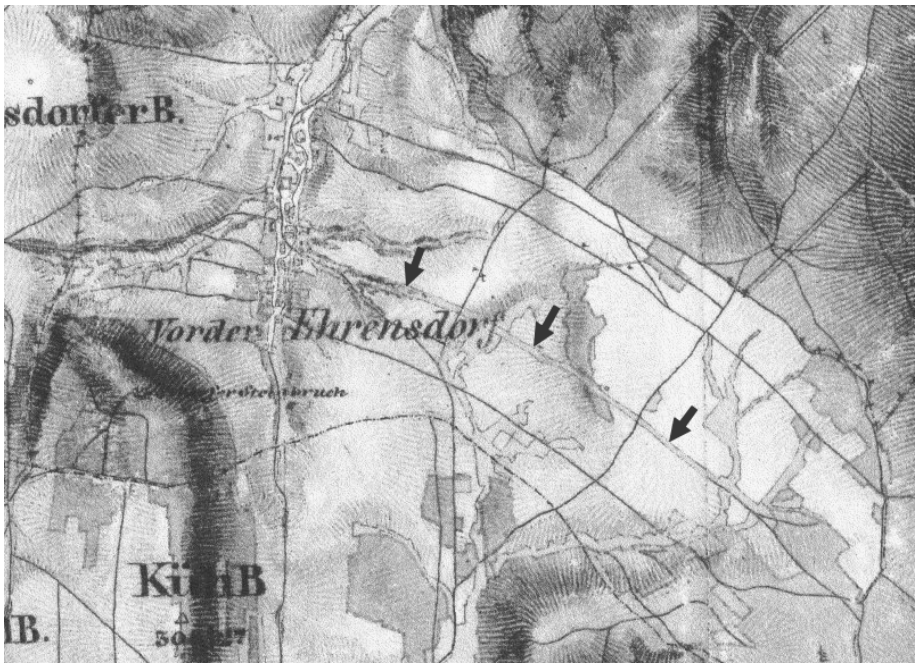

Figure 2: Map of II[nd] Military Survey - identification of cattle tracks.

2.3 Hidden relics (often buried)

Hidden relics can be easily identified from aerial photographs or images taken by remote-controlled models, with help of vegetation, soil, snow and shadow signs. The most significant signs are vegetation signs.

Other stuff which can be found in historic landscape is, for example visible relics of roads (hollow ways, hollow bonds) or ravines. Maps of Czech federation of orienteering and Base Map of the Czech Republic ZM10 are most suitable for these purposes.

3. LANDSCAPE MAPPING

Archaeologists often use non-destructive research technologies. One of them is an aerial photography (Šmejda, 2009). This technology is very expensive and suitable only for large areas. Photographing in archaeology field by models is very popular abroad [1]. These images in visible wavelengths can be used to distinguish archaeological objects and old paths in open countryside. Great results in this study field offer near infrared spectrum.

4. PARAGLIDER MODEL PIXY

The Drone PIXY is a slow moving model of motorized paraglider primarily used for close-up remote sensing, providing classic and digital aerial images and video recordings at ultra-low heights (50 - 500 m). The model allows the acquisition of traditional and digital images, including video recording. Maximum loading capacity allows having several sensors on the board at the same time. The Drone Pixy concept offers simple piloting, easy transportation, high resistance of the device and its wide use. Operating of the device does not require a special licence. Based on legislation in the Czech Republic, it is considered to be an ordinary airplane model.

Pixy Vision is equipped by Zenoah 290 engine with 2.6 HP. The payload equals 6 kilograms. It allows carrying cameras and other equipment at the professional level.

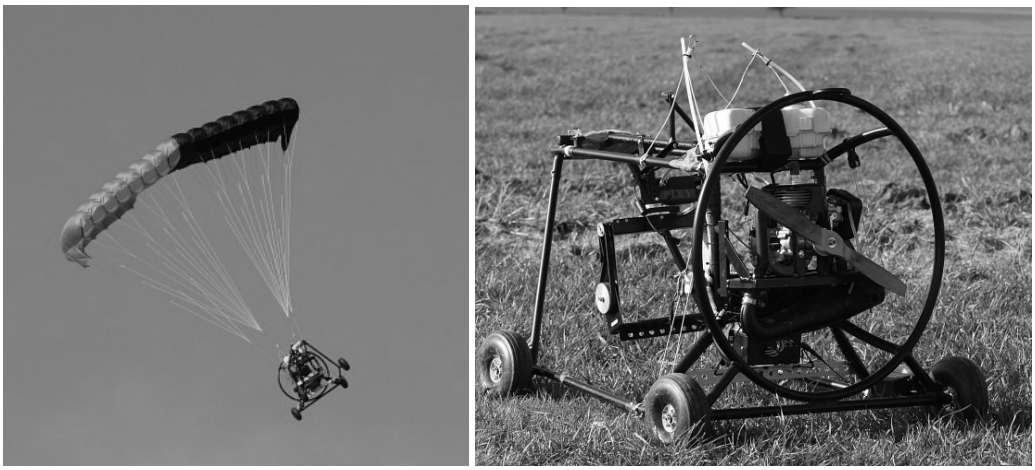

Figure 3: Drone PIXY model. Left: the model during a flight. Right: detail of the engine part.

PIXY Vision model has very good flight characteristics. Wireless range of the communication unit ends farther than 2 km. The flight possibilities are limited mostly by weather conditions. The maximum speed of wind should be from 3 to 35 km/h.

PIXY can also take-off in windless conditions, but the wind shortens the take-off. The model is little bit sensitive to side and gusty wind due to its low weight (about 10 kg) and due to a relatively large wing. The model has a 1 litre fuel tank, which is sufficient for one hour flight.

The model uses a ground station for the flight control. The station is equipped with a small LCD monitor which shows the screen from camera placed on PIXY. The function providing a Live View of camera enables us to observe the area of interest during the flight. The station is equipped with RCA output. LCD glasses can be connected- for a better control during imaging. The station can be connected with the PC. A built-in GPS module enables to track the current location and movement reports. The GPS module also enables us to navigate the model by keeping the track on monitor with underlying a map of the area. Targeting to the area of interest is then more accurate.

The Pixy Vision model is equipped with a constant flight level module. The model still keeps the same altitude after the activation. The principle of the module is based on the GPS height measuring. It is necessary to use the module to keep the same height during the flight.

5. IDENTIFICATION OF THE PATH RELICS IN THE IMAGES TAKEN BY THE MODEL

5.1 Identification of cross-section of a buried hollow way

- orientation of camera for imaging should be approximately in the direction of the axis of the hollow way
- higher obliqueness of the final image is better for identification of hollow way (the shape of the cross-section of buried hollow way is more visible)
- ideal state of vegetation: early stage - the crop is in the process called “sowing”
- spacing of crops should be perpendicular or oblique to the buried hollow way (to identify the cross-section can be also used the boundary of two parcels)

5.2 Vegetative signs

The green phase is the ideal state of vegetation. Crop is usually taller and darker over the buried hollow (it is best seen on cereals, but other suitable crops are, for example alfalfa, peas, sugar beet and oilseed rape). It is also possible to take a picture of with cereals in the ripening stage of a grain. Crops over the hollow way remain green (they are supplied with more water) contrary to the neighborhood which turns yellow. The crops are more mature and stems are bent. In direct sunlight, stems seem to be lighter in comparison with the others.

Figure 4: Historic path identification based on vegetative signs.

5.3 Soil signs

Ideal time for taking images is the period when the soil is without any vegetation (spring or fall or 1-2 days after rain). Side walls of hollow way can be distinguished if the mild depression is in the axis of the hollow way (wall oriented to the north dries more slowly and stays darker).

Figure 5: Historical paths identifiable based on soil signs.

5.4 Snowy signs

It is ideal to take images during the snow defrosting. In the stripe of buried hollow way, snow remains longer. It has two reasons. There is usually minor depression in the hollow way area and it creates a snowdrift. The snowdrift melts more slowly than the snow on in surrounding areas. The second reason is the waterlogging of hollow way area. Temperatures are usually slightly above 0 °C, which can also result in slower melting of snow (frozen soil with high water content defrost significantly slower).

Figure 6: Areas of the historical paths (A, B) identified by snow signs.

6. CONCLUSION

North Moravia and East Bohemia are areas with the highest number of the historical paths relics. These areas are absolutely unique not only in the Czech Republic, but also in Central Europe. There are more relics in these areas than the famous and the most remembered Golden Path. This is the reason why it is important to make an archaeological survey there. This survey should document the locality and propose some preserving methodologies. The situation must be solved before the relics will be destroyed by heavy forestry equipment. Paraglider model PIXY is one of the ways to promote this research. Using of PIXY to identify historic paths is a highly effective method of research and it can bring new valuable insights into the field.

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