

THE USE OF GIS IN AVIATION

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Abstract

This work brings into our attention the use of Geographic Informational Systems (GIS) in the aviation field. The paper is based on topographic measurements of Sibiu airport and reveals in small steps the simplicity of realizing a 3D model helped by software like AutoCAD and ArcGIS. The process whose finality consists of the 3D model of the airport, runways and the surrounding buildings is a clear contrast to its numerous everyday applications. From the obstacle limiting surfaces to the creation of an airport 3D map and model implementation at Google Earth, the GIS applications have definitely proved its power into this field, too.

Key words: *Geographic Informational Systems, aviation, Sibiu airport, 3D model.*

INTRODUCTION

For a long time ago, scientists and researchers have been using interdisciplinary methods in order to visualize spatial data. Building a 3D model involves a set of data processing and display techniques that aid in providing reasonable interpretation and analysis of the complex relationships in large spatial data sets rapidly. GIS Data visualization refers to the presentation of data by digital images, vector data, digital elevation models, tabular information, and virtual reality, in either two or three dimensional presentations, static or animated. The main objective of building GIS visual models is to assist in data exploration and real world conceptualization.

Due to the fact that the improvement of aerial operation within and around airports remains a matter of prime importance to the international aviation community and considering the vast areas airports occupy, GIS has various tools for this entire industry. In order to improve data management and facilitate decision making, the GIS applications allow the information to be analyzed and the results are:

- Effective management of planes;
- Stacking of planes in storage or docs;
- A track of scheduled time of the planes and to keep a track of their delay;
- Avoid ground plane collisions;

- Reduce or maintain traffic on ground;
- Efficient navigation of path when the vision is not clear, e.g. in bad weather conditions;
- Analyse the map which predicts the path of the path of a plane.

As outlined above, in aviation and airport industry GIS purposes and solves many complex problems. On the one hand, it is widely used on airports to facilitate management and also storage aircraft or planes. On the other hand, it is helpful in the navigation of the planes and also in movement path of the aircrafts which must be extracted. Last but not least, GIS is helpful in proper and efficient utilization of land available on an airport.

Known in German as *Hermannstadt*, Sibiu has always been the centre of Romania's German minority since medieval times. Today Sibiu is one of Romania's cultural and tourism capitals, attracting tourists due to its wonderful medieval charm. Given the expected increase in passenger volumes it was required to expand the airport, so a new terminal building and a new runway were built. The region of Sibiu is becoming more important for international companies (Figure 1), which are looking toward to invest in manufacturing facilities.

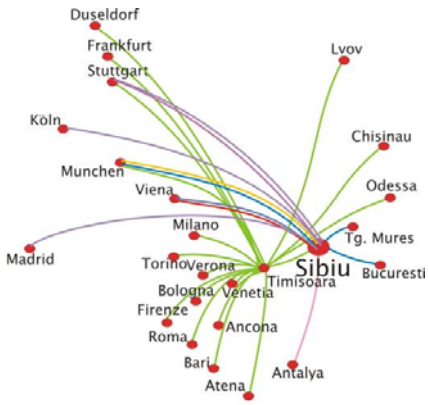


Figure 1. International flights from Sibiu Airport

Therefore a land use plan for the area surrounding the airport was really important. Site surveys, master plans and feasibility studies as well as tender management services were realized.

The object of this paper is to present how a three-dimensional model for Sibiu airport in Romania was developed in order to cope with all the issues an airport implies.

This model (Figure 2) serves as a pilot which can be extended to other local and regional airfields.



Figure 2. 3D view of Sibiu airport in 2007[1]

MATERIALS AND METHODS

To obtain a 3D model of the airport, there were many stages to be executed. In order to achieve the proposed aim we used both CAD and GIS software.

The first step in the development of the GIS model involves an accurate definition of the physical characteristics of Sibiu airport. For this purpose, topographic measurements (X, Y and Z coordinates) were used to define the runways, taxiways, aprons and intersections in AutoCAD. The buildings and the structural facilities were also outlined and provide different points of views. After completing this

step, we obtained a 2D model in AutoCAD, as shown in Figure 3.

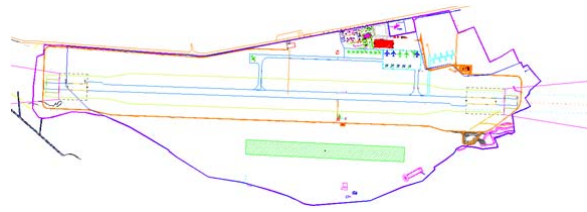


Figure 3. 2D visualization of Sibiu airport in AutoCAD

After this process was complete, the second step involved matching various data sets coordinate systems, data conversion to shapefile, since all vector layers provided were in shape 3D format (either polyline z or point z). It was crucial to convert those data sets to shapefiles as initial stage for using Arc Map. Once the X and Y coordinates were imported in Arc MAP the plan which is defined in Figure 4 was obtained.

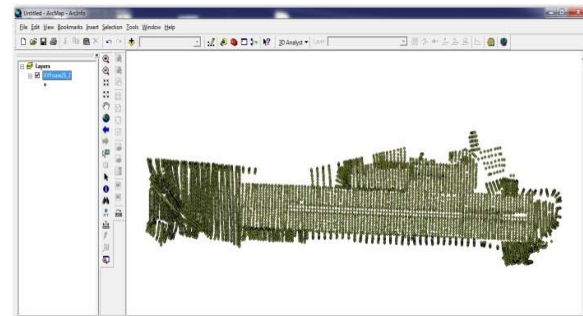


Figure 4. 2D view of the airport in Arc MAP

A TIN model is a triangulated irregular network. In few words, a TIN is a digital structure used in GIS for the representation of a surface. Due to the fact that it is a very clear and easy representation of a model, TIN was used in this case, too. Therefore the file in AutoCAD among with the X, Y and Z coordinates, provided us in Arc Map a TIN model of the airport (Figure 5).

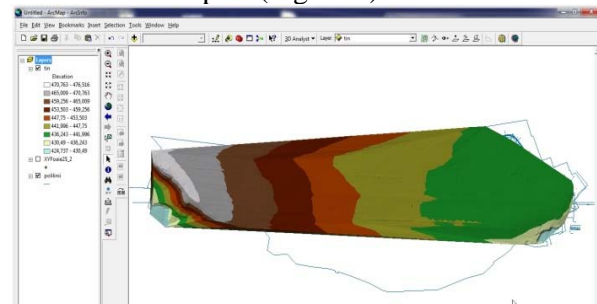


Figure 5. TIN model of the airport in Arc Map

RESULTS AND DISCUSSIONS

The GIS model has made it possible to clearly assess the geometry of the obstacle limiting surfaces for Sibiu airport (Figure 6).

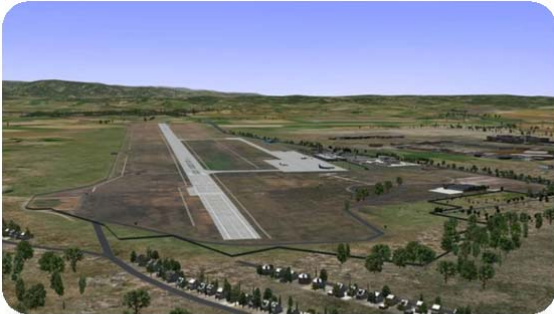


Figure 6. 3D model of the runway [1]

The 3D model allows maximum visualization of obstacle elevations (Figure 7), such as high-tension cables, aerials, built up structures, etc. These surfaces can be obtained with relative ease and accuracy as a function of their distance from the airfield and the height of the terrain from sea level.

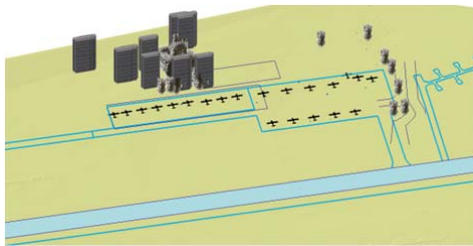


Figure 7. Obstacle elevations near the runway

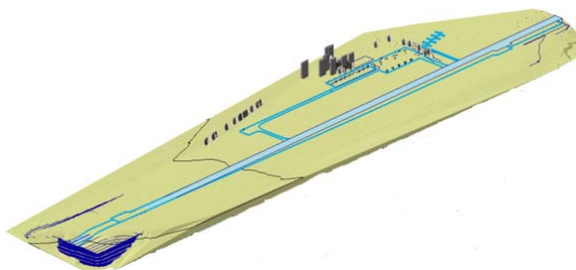


Figure 8. Areas surrounding the airport

The GIS model (Figure 8) also permitted the identification of the cadastral areas which are subject to zoning restrictions. Consequently, it

becomes adamant that the airport authority and the Civil Aviation Authority work with these municipalities to ensure that the aerial zoning criteria are properly implemented.

CONCLUSIONS

'The aeronautical community has recognized the acute need for accurate three-dimensional geospatial information in and around the airfield critical to flight safety, specifically for accurate runway positions, obstructions locations and heights, and topography around airfields.' (Wang, Hu and Tao, 2004).

In this paper, the powers of GIS were harnessed for purposes of aerial navigation and zoning in Sibiu. The application of GIS to Sibiu airport made it possible to visualize the 3D geometries of obstacle limiting surfaces and served in the identification of areas that are subject of obstacle height restriction around the airfield. The steps to achieve such a model are easy, as presented in Figure 9.

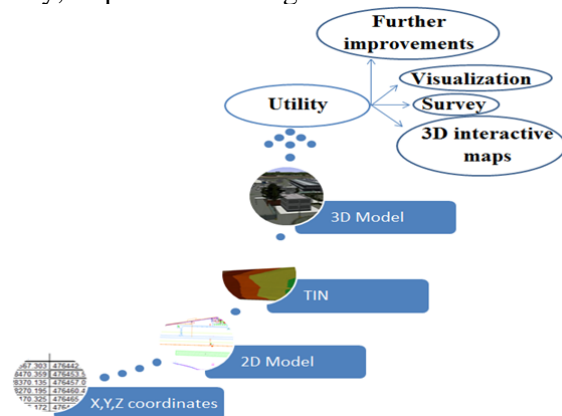


Figure 9. Workflow

What is more, the procedures discussed herein can be applied to the other aerodromes and regularly updated to meet with new requirements. Moreover, this work should be extended to other airports in order to facilitate the decision making and the updates which must regularly be done. If the airports are even bigger than the one Sibiu, a 3D model in GIS could easily provide a 3D map of all the paths to different terminals (Figure 10), therefore eliminate the possibility that people get lost and miss their flights.

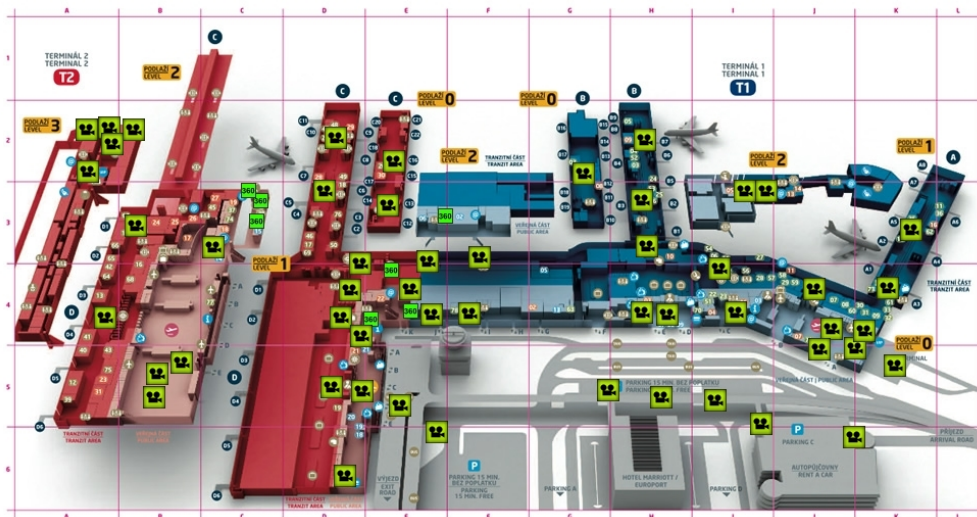


Figure 10. 3D Map of an airport [3]

Additionally, the available GIS can easily be used as a tool to manage the airport facilities, pavements and civil works. Last but not least, the realized 3D model can be proposed to Google Earth so that they can add it to their maps for a better accuracy of the zone that we studied.

In conclusion, topographic measurements among with the appropriate software provide a three dimensional view of airports which can be useful in countless problems. A 3D model can be used by specialists to cope with different problems and in the meantime it can also help the users to better understand their location and have a general view of the airport. GIS is not only the perfect tool to organize the data, but it

also allows the visualization of data in such way that is accessible to everyone.

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