Mobile GIS with in-flight-GPS-Support: 'Customizing Proposal for AA

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This contribution was submitted as an idea for a system that may become a useful aid to navigation and recording. With the author's agreement, it was circulated to three people with technical and airborne experience (and who I knew would respond!) who were asked to comment and to ask questions. These questions, and the author's replies to them, are appended to the edited contribution and may provoke further discussion on how reconnaissance is best able to benefit from current technology.

1. Introduction

In *AARGnews* **16**, Phil Markham briefly described a moving map GIS that may be used in future flying in Northamptonshire (Markham 1998, 19). This contribution develops that theme and suggests other ways and means by which this may be realised. The ideas come from this writer's professional work with utilities on the ground and have been converted to become an Aerial-Archaeological-Information-System (AAIS) in which data collected on the move is done so as an integral part of a ground-based master GIS in which they are further managed.

2. AAIS - Aerial-Archaeological Information System

Graphical data and thematic information may be recorded, processed, managed and presented in a GIS. With respect to aerial archaeology, the dataset may include oblique and vertical photographs plus high-resolution satellite imagery. These could be image processed to best show archaeological information and stored in transformed and geo-corrected form. Accompanying these images would be tabulated descriptions in a clearly structured database from which a range of queried output reports could be obtained.

3. Mobile GIS - GPS-supported

The product name of the application software is *GISMobil*© from the German company *infoGraph*. It is a mobile GIS on a notebook, that originally was developed as a 'closed' system with *Siemens Business Services GmbH* and *EWE AG* (Oldenburg). This writer uses it as a mobile information system in the utilities section to have access on a daily actual line-system database. Changes that are made in the field can be integrated a few hours later by a fully automated update procedure. A mobile Hardware variant is the *MicroPEN*© from *Microport* with the *GPS R10-CAE*© of the company *Dr. Ingeborg Bertges*, operating system Win95/98/NT©.

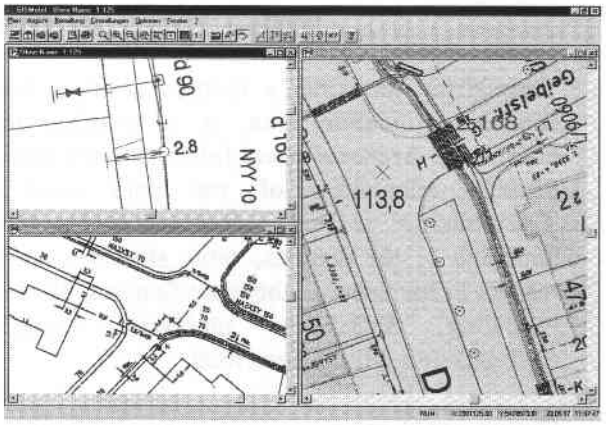

Image 1. Graphical User Interface GISMobil©

Regardless of the Hardware-constraints Image 1 gives an impression of the graphical user interface of *GISMobil*© : views of a gas-pipe documentation in different window sizes. Image 2 shows a possible overall system-configuration.

Digital base is a vectorized cadastral map where the gas supply net is referenced to (Image 1). Beyond this large-scaled data from the utilities area one can imagine also a medium-to-small-scaled topographical map. Supplied vector-formats within this environment are SICAD-SQDs and AutoCAD-DXF, TIFF and GIF-raster types.

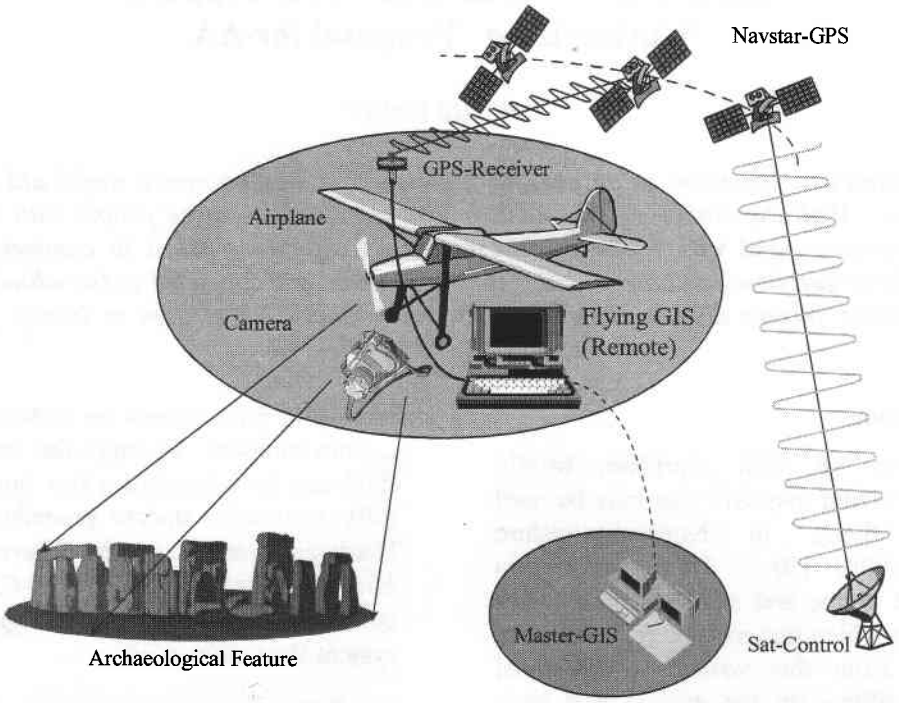

Image 2. All-over Configuration: MobileGIS (Remote / Master)

Through customizing, a tailored solution for another application area, it is possible to achieve an Archaeological Information system through adaptation of the data model. 'Customizing' in this connection means the matching of the database table structure with respect to the specific thematic features. In the following such a practical overall configuration will be described.

During aerial reconnaissance a ground feature is recognized by the observer, circled and photographed. This is part one of the data gathering. The positional fix may be achieved by overflying the discovered site and GPS-registration at the zenith, i.e. triggered through the notebook. Alternatively, the location may be considered to be the centre of the circuit. During the archaeological flight the path may be recorded continuously by a flight path line in the display of the remote notebook where it can be shown on topographic maps. When the position mark on the display moves close to the edge during the flight, it will automatically be repositioned to the centre. This information comes from the real-time GPS-position. Additional in-flight-parameters can be registered and saved in the local database: flight date, flight time among others. A second person can put in-flight descriptive data onto the remote system: object address, site description. Later on the ground additional in-field recognitions can also be entered in the 'mobile station . All can be downloaded to the master GIS by a fully automated update procedure.

Beside *GISMobil*© from the company *infoGraph* there is another Moving-Map-System : *Observer*© (*Skyforce Avionics Ltd.)*. In principle it is the same, but *Observer* is based on military requirements so is more rugged and totally integrated into the instrument board panel. However, it does not offer the GIS-flexibility of *GISMobil.* A Route-Planning-Software builds the kernel, which is up- and downloadable through a PCMCIA-slot. A flight-logging-function records all relevant mission parameters . A user-defined database is customer-adaptable. As parameters for the archaeological site (image) only a label string, position and additional descriptive text can be registered. Two digital images can be attached to each site. *Observer* can be configured using a choice of vector or raster geo-referenced maps which can be displayed at different scales.

4. General Considerations to GIS-procedures

GISMobil© or mobile GIS allows digital, in-flight and in-field, recording at the moment of data capture. Use of automated updates make it more efficient to upload this information into a master record than transfer of a hand-written flight record. Information from previous flights can be used to navigate back to specific targets on different dates by following the GPS-supported flight symbols. The mobile GIS was initially born through the demands from the urban utilities. In this example the procedure has been transferred to aerial archaeology. More application areas will arise through individual needs and a following customizing through adaptation. It is efficient to make an extract from the master, working with the datasets decentral at a remote site and updating the master with the changed objects at the end of the daily process.

5. Reference

Markham, P., 1998. Air photography and GIS; the Northants approach. *AARGnews* **16**, 17-20.

Appendix: questions and answers

What is the cost for hardware, maps, etc?

Hardware components in DM :	MicroPEN	*ca* 10000.00
	GPS	3800.00
	Accessories	*ca* 1500.00
Application Software:	GISMobil	4900.00

What are hardware dimensions, weight, power requirements?

MicroPEN	*ca* 25 x 30 x 6 cm^3 ,	*ca* 2.5 Kg
GPS	*ca* 15 x 10 x 5 cm^3 ,	*ca* 1.0 kg
storage battery	*ca* 20 x 8 x 5 cm^3,	*ca* 1.0 kg (for 4 hours)

If the system runs off aircraft power it may be necessary to meet CAA requirements. Has this potentially large problem been investigated?

Unknown.

Can one navigate with 'track up mode'?

Unknown.

How are additional maps added (for example of different countries), and who can do that? (This also raises the question of how much information can be practically stored and is rapidly accessible.)

The digitized maps i.e. in TIFF-G4-graphic-format have to be copied onto the internal hard disk. The map area (number of map 'sheets') that can be stored on the computer depends on the scale and resolution. At a scale of 1:50,000 and a resolution of 300 dpi (colour) a hard disk of about 10GB will hold ground coverage of about 250 km x 250 km. This should not only be enough for a prospection mission, also for an entire country area.

In Germany it is possible to get topographic maps on a CD (country mapping service). Where to get digital maps for other countries is unknown. Foreign data may have been surveyed using different map projections and will have to be georeferenced to the specific coordinate system [see Scollar: *AARGnews* **18**].

How is the unit operated in the aircraft?

Operating mode is via mouse or keyboard.

It is thought probable that a notebook screen may not be easily visible in bright summer light in an aircraft cockpit (where often there is no shade). Has clarity of visibility been tested?

Nothing like this has been tested. The configuration is a proposal for AA derived from the ground-based Remote-GIS used in the pipeline documentation of urban utilities.

How rapidly does the moving map move? At what speed does the display change?

The velocity of the position mark in GISMobil depends on the chosen map scale. Supposing a flight velocity of 150 km/h several configurations are calculated:

Scale 1:10,000	→	4.5 mm / sec
1:25,000	→	1.8 mm / sec
1:50,000	→	0.9 mm / sec

Running towards the display boundary, the map view will be recentered when the position mark approaches 15% of the edge.