VIDEO - CARTOGRAPHIC SYSTEM

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I. Introduction

Cartographic systems are designed for solving problems connected with data accumulation, storage and updating. The systems should be flexible, so as to provide for the introduction of new techniques. Various data processing devices, calculators, computers and numerically controlled plotters are most frequently used in the branch. These installations create different configurations. The lack of fast means for the visual communication which is indispensable in the process of map compilation has so far been creating serious difficulties. Therefore, research has been initiated on the interactive systems - in which a dialogue between a computer and an operator takes place. The dialogue is facilitated by the visual data display. Systems to be applied for automatic mapping should, therefore, provide for quick accomodation of vast amount of archival data as well as data resulting from recent research and field measurements. For several years, in the Institute of Geodesy and Cartography in Warsaw, studies and experiments are conducted on the systems, which are most useful in Polish conditions for the automatic map production. Some of the works have been presented during the Nairobi Seminar on Computer Assisted Cartography in 1978 /1/. In this report we would like to describe last experiments and consequences resulting from them.

2. Model foundation of 'marked fields' system

Acknowledging superficial density as the most important parameter of the composition of map content, which in the quantitative meaning corresponds with the density of graphic signs, we can bring the image of a map down to the matrix shape, in which each of elements will be assigned to the nature phenomenon, antropogenetic phenomenon and some individual features. During the map creation process these visual phenomenae may take the shape of thematic overlays.
In the geometric interpretation, units of such a matrix of the picture of a map may be assigned an appropriate ordering feature; cartographic grid is particularly suitable for the purpose.
If we mark by a_{ij} an element of a matrix which corresponds to the grid system coordinates /i,j/, where $i \leq N_1$ and $j \leq N_2$ then a_{ij} matrix unit is defined by the following expression:

$$a_{ij} = /a^1_{ij},\ a^2_{ij},\ a^3_{ij},\ a^4_{ij}/$$

where

- a^1_{ij} - nature phenomenae
- a^2_{ij} - antropogenetic phenomenae
- a^3_{ij} - individual features
- a^4_{ij} - user's priorities
- N_1, N_2 - belong to the set of natural numbers

This kind of spatial record in the form of marked fields associated with the geographical grid facilitates a new approach to the information coding problem. From the technological point of view, so defined elements of the matrix of map image may be recorded separately; in digital systems on video-discs and in analog systems on microfilms, each forming the cartographic data bank.
Compilation of a map on desired subject is thus reduced to the operation of adding elementary images of the map content matrix accumulated in the data bank and extended by the source information not yet incorporated into the data bank.

3. Digital image processing systems

The following four categories of operations are characteristic for digital data processing systems:

- preprocessing
- effective information coding
- pattern recognition
- computer graphics

Essential limitations which occur in digital image processing systems are connected with the capacity of the memory, transmission and data storage. To prevent this, more excellent electronic systems are produced, especially for the needs of recording TV signals, which allow for fast recording of an image in the memory with the possibility of projecting it on a monitor.

Especially promising are systems provided with videodiscs /Thomson and Philips systems/ which allow the storage of about 50 thousand color images on 12 inch PVC folio or metallized disc.

Fig.1, presents largely magnified video-disc surface with points of recorded information with the use of properly concentrated laser beam shown on Fig.2. The scheme of optical system for disc information reading in shown on Fig.3.

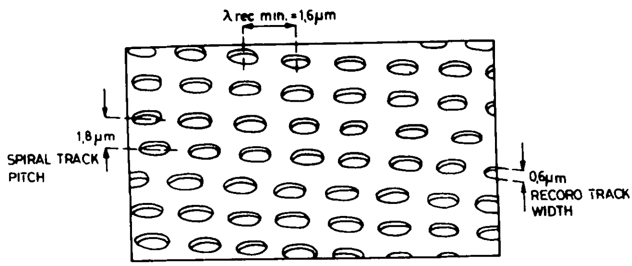


Fig.1 Largely magnified video-disc surface

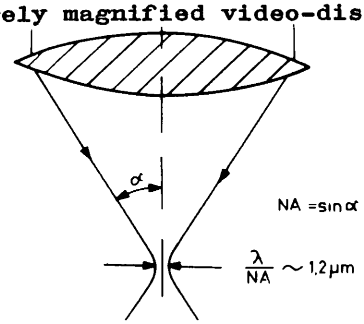


Fig.2 Concentrated laser beam characteristics

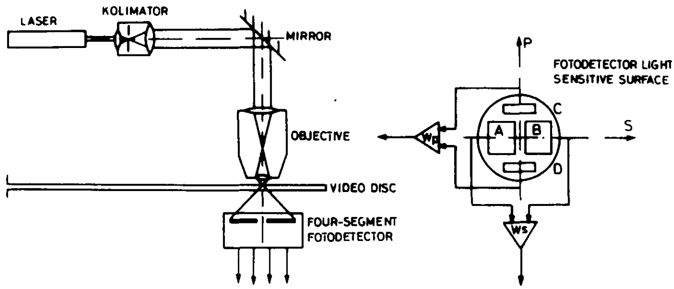


Fig.3 Scheme of optical system for disc information reading

The access to one out of 50 thousand stored images in the form of visual display on a monitor screen may be acquired in about 2 seconds.
Block diagram, shown on Fig.4, presents a configuration of the system which could be realized on the basis of an extended configuration of the existing Hamamatsu system, under the name of Computer Compatible Video Camera.

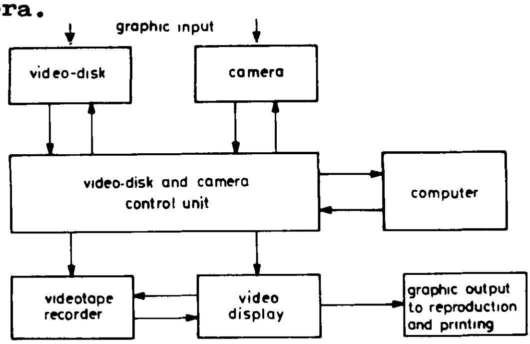


Fig.4 Configuration of the proposed system

According to the system, shown on Fig.4, individual images stored on video-disc and on video-display are added to each other. Photographic systems can than be applied in editing and printing process.
The graphic information which earlier didn't appear on video-disc can be introduced through the camera and can also be recorded on video-display. The use of video-taperecorder enables simultaneous recording of subsequent stages of map compilation process.
Research group associated with the electronic equip-

ment company in Warsaw is currently working on such a system /2/.

3.1. Examples illustrating the use of marked fields in digital systems

I would like to present you /Fig.5/ an example of computer map of soil protected from urbanization in the scale of 1:100 000 made by the Central Office of Science and Water Projects "Bipromel" in Warsaw supervised by the Ministry of Agriculture, basing on the conception of marked fields /3/.

Fig.5 Computer derived soil map at 1:100 000 scale

For elaborations in the scale of 1:100 000 the marked field 1000m x 1000m has been accepted.
The recording of source information is based on a conception of the unit of marked field. According to this conception Poland is divided into areas described by the geographic coordinates which are delimiting the marked fields. The size of the marked field of the shape close to a square, depends on the scale of elaboration. For the scale 1:25 000 the size of marked field has been accepted within the range of 25 hecta-

res, which equals to the square of 2cm x 2cm on the map. For the purpose of recording information characterized by extensive superficial variation the marked field is divided into four quarters, which at the given scale equal to the squares 1cm x 1cm and the surface of 6.25 hectares.
The elaborations in the scale of 1:100 000 are based on marked fields with the surface of about 100 hectares and map dimensions of 1cm x 1cm; each quarter of such a field is the equivalent of the marked field in the scale 1:25 000. The introduction of marked fields system allowed for the automatization of surface phenomenae generalization process.
The content of resulting thematical maps is determined by the amount and scope of imput data. While analysing information concerning each of the marked fields the computer prints a symbol of the given feature or value. By physically connecting the equivalent symbols appearing in tabulations we receive outlines of spatial arrangement of a mapped element, which after being transformed into a suitable scale are transferred onto the topographic map.
Fig.6 shows examples of different stages of compilation of a map with the use of digital system. Output information in the form of 3 following thematical overlays shown on slides were, with the help of analog- to-digital converter Optronics P 1700, converted to digital form and stored on a magnetic tape.

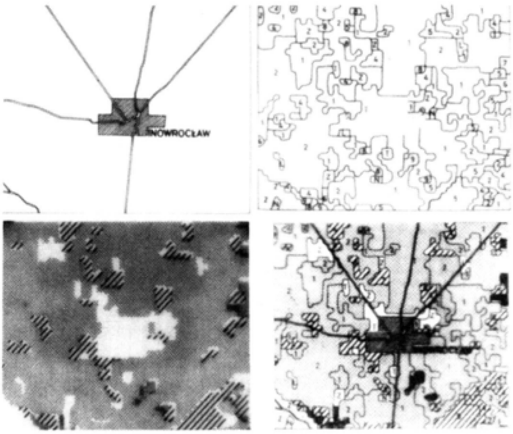


Fig.6 Examples of different stages of map compilation process

Additive process was then performed on black and white film. The examples were taken from the map of soil protected from urbanization.
On Fig.7 we can see a map of air pollution and dust fallout in scale of 1:10 000.

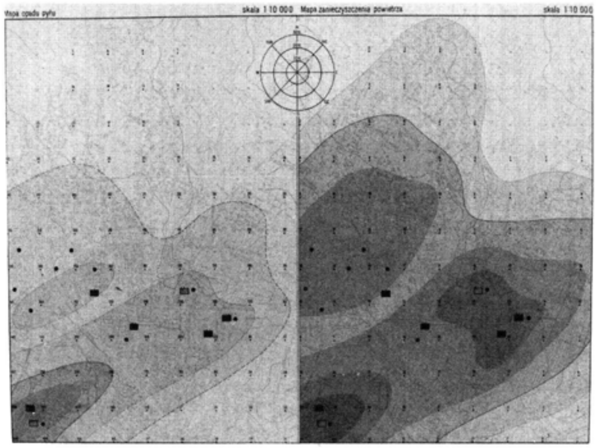


Fig.7 Map of air pollution and dust fallout /1:10 000/

The map has been elaborated with the use of traditional methods, but the application of marked field system enables the computerization of the process. The map, dealing mostly with urban areas, has been elaborated for the Ministry of Health and Welfare.

4. Concept of map image recording on video-matrix made on photochromic glass

Experiments on cartographic image recording on photochromic glass which change the transmittance and colouring under the influence of radiation performed in our Institute confirm the possibility of devising a system which would realize assumptions given in point 2, concerning adding images in the systems of marked fields /4/.
For practical effects of recording we can use ruby laser /IIharmonic/ or dye laser. The dye laser, because of its good tunability to different wavelengths would allow for registration of an image and its subsequent liquidation by another wavelength /infrared radiation/

on the same material, without any chemical processing. On Fig.8 to 11 we can see examples of the reproduction of an image from linear and tonal negative and also tonal diapositive and letraset.

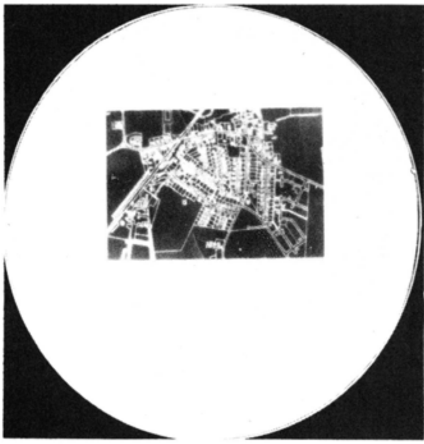


Fig.8 -linear negative

Fig.9 -tonal negative

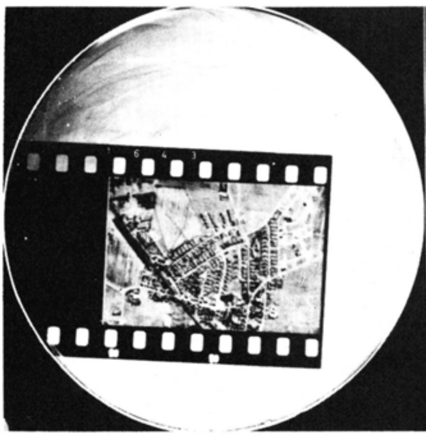
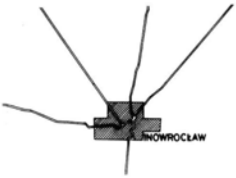


Fig.10 -tonal diapositive

Fig.11-letraset diapositive

Fig.8 to 11 Stages of the map reproduction process

On Fig.12 to 14 we can see a fragment of earlier presented map of soil protected from urbanization - made by adding components of two images with the use of photochromic glass.



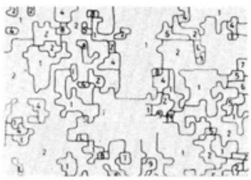


Fig.12 Topographic base   Fig.13 Thematic content

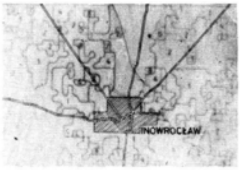


Fig.14 Compilation result /12 + 13/

Realization of automatical system can be rendered possible for example with the use of Monotype 3000 system with lasercomp produced in Great Britain /Fig.15/.

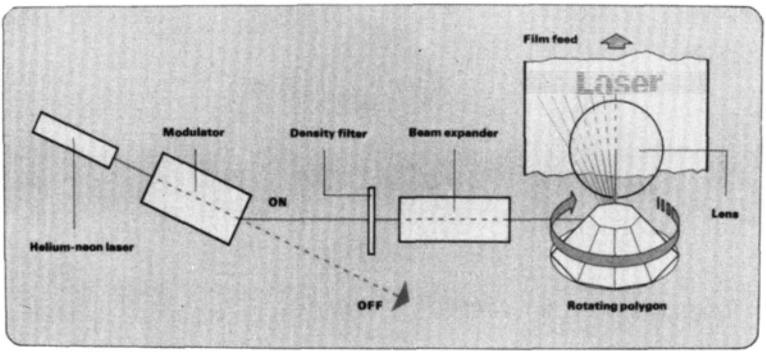


Fig.15 Monotype 3000 system

5. Conclusions

On the basis of conducted studies and experiments it seems advisable to undertake work on developing technologies which use video-systems. This conclusion refers to both digital and analog forms of cartographic image processing.
The system of marked fields allows for simultaneous processing of the entire map image as well as its fragments.

Bibliography

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/4/ Nina Grynfelder et.al. - Study on potential applications of photochromic glass for cartography. Unpublished work of the Institute of Geodesy and Cartography, Warsaw, 1979.