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POSSIBILITIES AND LIMITS OF MICROCOMPUTER USING IN GEOGRAPHICAL EXAMINATIONS

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In the decade of 1980 the awaiting questions of geographical sciences need undoubtedly more and more complex exact and quick answers. Some research field e.g. interpretation and processing of satellite photos, versatile qualifying of the environment, thematical mapping haven't already done without automatic data processing and substantial advance could hoped by its use sometimes. Therefore it would be advantageous to survey those hardware and software possibilities (and limits) of automatic data processing which considering our technical and scientific background we can rely on. We would like to loosen up the presentday existing reserve of the geographers from the computer aided storage analysis and visualization of geographical data. There are many sceptical opinions about their usefulness, too. Desirable change of attitude can expected only if the geographical problem solving with automatic data processing wouldn't be the privilege of the „qualified ones" but everyday practice. The reserving could explained by the fact that most of the available computers with high capacity were available with difficulties, their use were extremely expensive and complicated and most of the problems hadn't required such a high capacity at that. At the same time first ones of microcomputers had been coming out since 1970-71 had moderate inner memory and peripheries, slow data processing that significantly limited their use.

To reduce these problems those kind of microcomputer systems were put into circulation which had much considerable inner and external memory, so large sum of data storage and data processing were made possible. These systems are associated with high resolution colour displays, printers etc. Some of the large years the developing of the hardware was so dynamical we can observe generations of microcomputers (table 1.).

The computer itself isn't enough for the effective problem solving, it needs proper software. Regrettably software developing is slow, labour-consuming process and became neither easier nor faster when new machines had appeared. The creation of a new program takes rather long time. That makes the coefficient of the hardware usefulness more and more smaller. That's why software developments were often made by the use it „obsolete" first and second generation computers.

Table 1.

EXAMPLES OF FIRST FOUR GENERATION OF MC
(after *R. Barr* 1985)

	Examples	Dominant processor
1977 First gen. 8 bit	Commodore 64 Apple II. BBC Micro	6502
1981 Second gen.	Epson Q X 10 RML 380 Z Superbrain	Z 80
1981 Third gen. 8/16 bit	IBM PC Sirius 1 ACT	8088
1983 Fourth gen. 16/32 bit	Apple Lisa Sage	68000

Hardware and software environment of the main user's fields

General inland use of computers made their use wider spreading in geographical fields too. In the course of its using the computer gradually changed the way of information handling, it became interactive transferring and processing device.

Data processing

The right ways of the data processing, and storage are very important, because that makes their later or rather repeated utilization. The way of data storage is playing important role in the speed of the processing and how many times can we examine a data sequence with difference programs without the changing of the structure of the data file. Therefore it is practical to develop different programs with standard data processing so data files could make real data banks for different users, too.

Nowadays several program packet were developed for the data file processing. These programs are generally written in BASIC are available for almost all the circulated machines. Unfortunately sometimes the programs written for same

computer have needed different kind of data storage, making their use slightly difficult. Using these packages we can compare values, analyse them make diagrams, tables, solve different kinds of problems of mathematical statistic. Their use doesn't require profound preliminary training in program-making, it supposed only the knowledge of handling the computer and its peripherial units. The common hardware configuration for these programs are the next:

— computer
— external memory unit (tape or disk)
— television screen
— printer

There are well prepared programs for the data management of geography, climatology and environment qualification

Modelling of systems

The modelling of various kind of difficulties of geographical systems had been trying from the midst of the sixties, but models which were build up on exact mathematical base had been used since the seventies. Because of the many alternative possibilities of the adequate methods for the more and more complicated, multifactorial economyprognostical, ecological problems presumed and required the use of computers. These methods made possible the recognition of the inner structure of the multifactorial connections. First ones of these models had run on high capacity computers, but nowadays already have enough capacity for the examinations. Program-making require thorough geographical and mathematical knowledge and programming experience in most cases by the collective efforts of three men. The schoosing of programming language can cause problems for the adaptations of the ready programs. In the case of the BASIC the main problem is the inner limits of the language, not the difficulties of its use. So it is not recommended. From the group of the old, well known programming languages the FORTRAN's use is advantageous. Amongst the new languages the extremely quickly spreading PASCAL's use seems to be the best.

For the processing the next configuration is necessary:

— third or fourthgenerational computer
— display
— external memory (to read in the program and to store result)
— printer.

Thematical mapping

In the middle of the seventeens microcomputers appeared in the field of the cartographical works. Amongst the first ones was the Apple II microcomputer which were used in mapping because it have high resolution graphics. It guarantied

the addressing of 280x190 spots independently from each other. Although that is rather rough for serious cartographical works but its low price made it widespreading. So the first attempts of mapmaking by computer have done by that type of machine, that resulted many cartographical software for the Apple II. But the results achieved that way are far from the ideal, so the computer aided cartography still remains an open question.

The manual producing of a map with high information content is the result of long and precise work. The use of the computer requires the digitalization of spatial informations and the proper capacity of inner and external memories. The information content and the detailing of the computer-made is depend on the ability of the digitalizing equipment, but unfortunately those upper limits are rather low. High sensitivity digitalizers are very rare and expensive. That's why it is very important to examine less expensive digitalizing systems with microcomputer in which situation may be inadequate or whether a quick approaching result is adequate or not. In the majority of the cases the latter often happens but the possibilities of microcomputer systems prove to sufficient for map presentation rather than analysing it in details. Other problem is the limited resolution of the displays which needs other kind of approaching in the planning of the maps and symbols which can be easier comprehendable distinguishable and appearable. The presentation of map on sheats depends on the printing device and the capacity of the backing store. So we can't utilize the possibilities given by computers in every cartographical problems.

If we'd like to solve cartographical problems by the use of microcomputers, its will be soon clear the quantities of the computer are less important than the connecting peripheries'. The usefulness of the computer is mainly depends on the connecting peripheries.

The main input device of most microcomputer is the keyboard. In the event of cartographical works the input processing is closely linked to the digitalization. The ruder ways of digitalizing (by joystik or light pen moving) are gradually superseded. The higher level of cartographical works require some kind of mechanical or electric drawing table. Their disadvantage is the limited drawing area, which can cause serious problems at the digitalization of larger sheets of maps, and also their resolution and stability can cause difficulties. The future's way is the direct data input from videocamera what is available in experimental state now. That would cease the differences between the image analysis (mainly occurring at the space photographs) and the computer aided traditional methods mainly dealing with the topological characteristics of the maps.

The computerized displaying of the spatial informatics also means great problem. The high resolution graphical representation mode of the microcomputer can seems to be advantageous. But in some cases it can limited the use of the computer because of the necessity of too large memory capacity that makes impossible the applying of the required software or the changing of the pictures. These kind of limits is becoming less in the latest computers but the commercial ones often have them. The most common output devices are the colour or monocromatic displays with conceivably increased resolution lately. Nowadays the suitable standard is the

512x216 pixel or the 800x400 ones in some machine. The resolution of the colour display is less because of their price and the background memory. The state of a monocromatic pixel can be stored in one bit of the memory but is we want that pixel have 2^{nd} colour it requires n bit.

Nowadays most map made by computer have to photograph from the display or print by pointmatrix printer. The best output of the computer aided mapping is produced by plotters.

Knowing the dimensions of the programs used at the automatic mapping and the data for managing experte consider unsuitable every microcomputers which aren't connected to at last one disk unit, as backing store. The processing of the magnetic tape units are difficult and slow. Bigger or detailed maps are made partly, step by step; data which are good for the inner memory are read out from the backing store, and the necessary operations are taking. Nowadays plenty of 350 — 600 Kbyte floppy disks are available but the data for the processing a map with the scale of 1:50.000 can be stored approximately in 10 Mbyte area so the use of hard disks with larger capacity (5—20 Mbyte) also needed.

The most critical point of the utility is the software. Most of the utilizers have no programming practice and use program packages, ready to run, standard subroutine libraries and operation systems. For these reasons the software must be stable and reliable. The program have to process every permitted data certainly and can't fail even the occurring of the total absurd parameters. The software have to be documentated detailly either in separate handbook or build up informations appearing on the screen.

The used language or code have to provide quick data transmission and running and can be transferable into other type of computers. For these purpose the BASIC isn't suitable because it makes difficulties at the computer aided carrography. Because of the compilation the running of the BASIC programs are slow aren't enough effective and doesn't support the making of wellstructured long and complex programs. The missing possibilities of the different subroutines and processes makes the modular programming unnecessarily difficult.

Geographical information system (GIS)

It is doubtless that the building up and the operating of the geographical information system require the complex applying of the above mentioned process for the computerized GIS include data system and the require methods and techniques of the data processing transferring displaying and checking too. The three main problem in connection with the use of the existing and being developed GISs:

— The most compatible connection to the different databases is very important. The efficiency is very low if the databases are set up on different systems. Geocode the unified identification system based on the geodesical coordinates seems to solve that problem.

— The access of data are very problematical from the above mentioned database. The economical legal and technical conditions have cleared up insufficiently. Unfortunately there are lot of valuable data in latent, inaccessible state.
— Nowadays the necessary software instruments and experts are still missing for data informations and the production of combined data.

Our principles for the building of the Complex Environmental Information System:

— In our opinion every mass of data have to connect with only one logical data base. Multiple copies means considerable additional work and great source of errors. Of course we don't mean every geoscientific data would be stored in one database but it would be existing only as a logical unit (Enviromental Information System). Most cases it would have consisted of different physical units. These would have been the difference sectional (soil science, environment protection etc) information system which are still having been operating.
— These databanks will be connected to a Standard Dataregistration System which is for the organization of the data input, output and processing.
— The operating of the system and the possibilities of the different inquiring will be assured by connecting to the existing and working ARC/INFO, MAP, ARIADNE information systems and the applying of their principles.
— Because of our hardware possibilities we lay the stress rather the structure of the system than the counting effectively of the computers.

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