ESTABLISHMENT OF A LAND INFORMATION SYSTEM - PROJECT NEUSTADT

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ABSTRACT

The establishment of a land information system is shown by the project Neustadt. Data from existing maps and aerial photos are combined interactive graphically.
The task, hardware and software components and organization are described.

1. Introduction

Is there a need for an establishment of a land information system?
With growing number of data collection sets in the communities it becomes more and more important to unite the separate sets. In addition it has been shown as necessary to have complete and updated information available. A direct access from different users is economic and is only possible in the case of computerized data base systems.

The combination of existing data sets as cadastre, utility networks and planning information must be done in relation to a geometric unobjectionable system, in our case - photogrammetric measurements.
The stablishment of a land information system is tested in the small town Neustadt near Hannover.

2. Project Neustadt - Task and Existing Information

Neustadt has, besides various types of housing areas also light industry and a small commercial zone in the centre of the town. The main railroad, the Federal Highway from Hanover to Bremen and the river Leine is passing the town.
All this is located in an area of 4 km² corresponding to one sheet of the German topographic map 1:5 000 (DGK 5), the ideal size of a test area.
The federal cadastral office provedes all information concerning land registers, cadastral maps and survey points. Also the local authority and the public utility companies were willing to give the information about their network data.
The input for the future Land Information System (LIS) in Neustadt are those cadastral data, which are layed down in maps, legal titles will not be implemented into the system. The maps are in a scale of 1:1 000.

Other components of the LIS are:

1. traffic: railways, main roads, streets, pedestrian area, sidewalks, bike roads;
2. builtup areas: housing, commercial, light industrial and town-planning data;
3. topography: agricultural land, trees, parks, river banks etc.;
4. utility: water, gaz, electricity, sewerage, telephone.

The data of utilities are layed down usually in maps, but in different scales and with various reference to the survey points and the cadastral maps. Information about traffic and topography, in the way we need it for a LIS, is today not to be found on any map.

The task of the project is to combine all data without contradictions into one system.

Thus we use different methods of data collection:

1. Aerial photographs, scale 1:3 300, colour-diapositive film, with signalized control points.
2. Digitizing of existing maps.
3. Terrestrial surveys.

The photos are used - for aerial triangulation as geometric basis of an updated cadastral system as reference for all other data;
- for connection and updating of cadastral and utility data;
- for information about traffic and topographic situation.

The adequate method of data collection depends on the facts: effectiveness and accuracy. All collected data are revised by an inter-active graphical system.

3. Utilized hard- and software components

The basic modul for all calculating programs and for the communication between all utilized instruments for the input-output is a microcomputer PDP 11/23 of the Digital Equipment Corporation (DEC) (see fig.1.5). It is operating with the RT-11 runtime system and a 256 kbyte memory is available. Programs and data are stored on a 20 Mbyte winchester disk; a floppy disk unit is used for the transfer of external data.
For the establishment of a LIS of the project Neustadt, the following data are available: diapositiv aerial photographs in the scale 1:3 300, already existing maps in the scale 1:1 000 up to 1:500 and several terrestrial surveyings.
The measurements made in the aerial photographs will be the geometrical fundamentals for further informations. The ground coordinate system is the local one of the Federal Republic of germany, based on a transversal Mercator projection.
To get more control points and to figure out the coordinates of the excentric located signals the electronic theodolite Kern E2 with the electrooptical distance meter DM 502 and the memory unit R48 is applied (see fig.1.3). The registered data are adjusted with the program GEO 100.
The photogrammetric measurements were carried out on the Kern DSR-1 (see fig.1.1). This analytical plotter has a consequently structured module architecture of hard- and software (see Klaver, Stampa-Weßel). Those programs, all working with the menu-technique, may be combined by the user as it is necessary for the project.

Ground control points are the geometrical base of the photogrammetric work. For control densification and for the improvement of the cadastral survey net a block adjustment was necessary. The required accuracy level could only be reached by bundle block adjustment. The measurement of the photo coordinates was done with a standard program from Kern on the DSR1.
During measurements and calculations, existing additional information like the camera calibration, control points and segments of cadastral coordinates can be added (see fig.1.4 and 1.6).
For getting a higher reliability and also better accuracy the block was measured with 80 % endlap.
Without loss of time for data transfer, the bundle block adjustment was made on the PDP 11/23 of the DSR1 with the Hannover program system for bundle block adjustment BLUH. The computation of the block with 59 photos took 33 minutes per iteration.
Even with the robust estimators, included in BLUH, no blunder was detected in the data set, because of the online check during measurement. The standard deviation of unit weight, sigma 0 of 4.5 microns corresponds to an object accuracy in X and Y of approximately ± 1.0 cm. Each object point was measured in the mean in 5.8 photos. Thus a good reliability was achieved. Together with the object accuracy this is sufficient even for the geometric improvement of the cadastre.

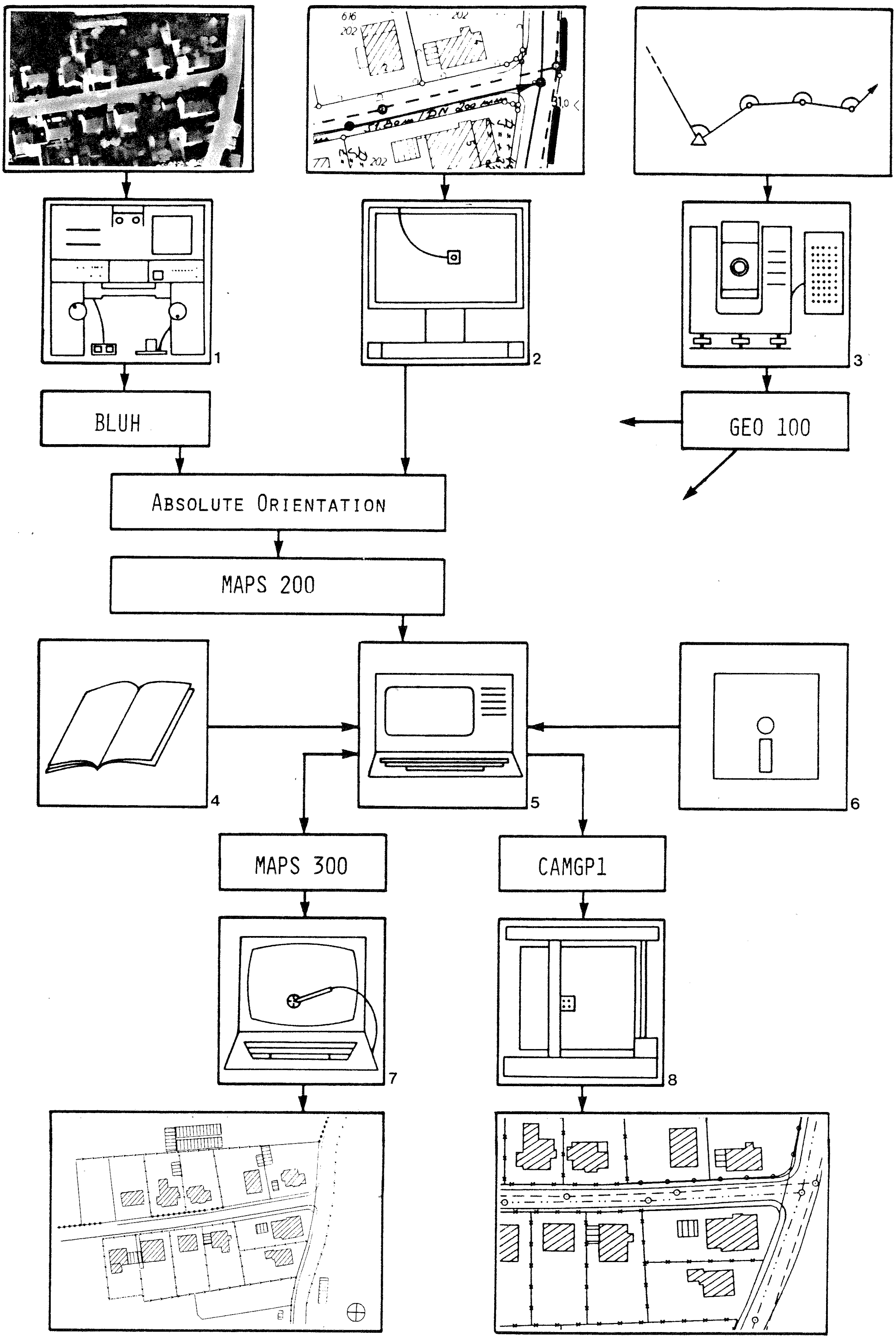
BLUH
ABSOLUTE ORIENTATION
MAPS 200
GEO 100
MAPS 300
CAMGP1
1
2
3
4
5
6
7
8

Fig.1

The orientation data are used for the orientation of single pairs of photographs. Thereafter the essential data collection for the LIS with the program MAPS200 may start.

Collecting information of already existing maps proceeds with the same program. Therefore the digitizer Kern GSD-2 (see fig. 1.2) based on two rectangular bars is applied. The absolute orientation of the digitizer is calculated with either a Helmert, an affine or a projective transformation.
The program MAPS200 combines collected data with a predefined library of linetypes and symbols, and then puts those data in predefined levels. Storing special functions like the geometrical type of lines (straight, arc ...), the squaring and hatching of buildings, parallel lines and the input of variable or fixed annotations makes this program suitable for universal application for the establishment of a LIS. The data are stored in the Kern-CAM-Format, which requires quite an amount of space, but which is selfdescriptive and easy to edit.
Up to 999 different levels and 999 different linetypes provide an output of individual data combinations for each task. For example this can be a plot of all informations of one utility system, or for planning and building purposes a combination of all utility systems. Every plot scale can be chosen, but should respect the information density. Because of the data base principle every update is immediately available for all users and applications. Even while plotting, changes of single linetypes and symbols in size, form and penselection, or their cancelling are possible.
The produced data can be checked and edited on the interactive graphical screen of the IMLAC-Terminal with the program MAPS300 (see fig. 1.7). In detail, the following functions can be executed:

- editing of single points
- " " segments
- " " groups
- " " line types and symbols
- " " levels
- combining of different files and levels
- producing of new files.

As well as the other programs, the MAPS 300 consists of the menu technique. The editing on the vector-screen may be performed with either light pen or the keyboard.
For the graphical output of the results of this project, the precision plotting table Kern GP1 is available (see fig. 1.8). The produced new maps are plotted with the program CAMGP1 which makes an access to the symbol- and linetype-library.

4. Presentation of a sample area

By a section of a sample area it is to be seen how the different components of the system are brought together. The original data are revised and listed together with the MAPS 300 on the IMLAC-Terminal. The output of the data in a map can vary from scale and contents. The following figures are samples of check plots of data collection, revised and combined data and at last a sample of map.

Figure 2 shows the data of the digitizing of a sewerage-utility's map. The cadastral borders are only digitized to match this data to the cadastral data and they are not used further on.
Figure 3 gives an example how a first combination of cadastral data with utility data looks like. The variation of types of border lines are layed down for this sample on one level, as you may want to leave it for special purposes, e.g. of the utility company.
Figure 4 gives the sample of a map. For more clearness we give only the sewerage system as part of the utilities, cadastral data and the information about topography, roads etc. which is collected with the DSR-1. A normal output of various data is in different colours, so that lines can be distinguished by line-elements and colour.
The figures 2-4 have a 1:1 000 scale.

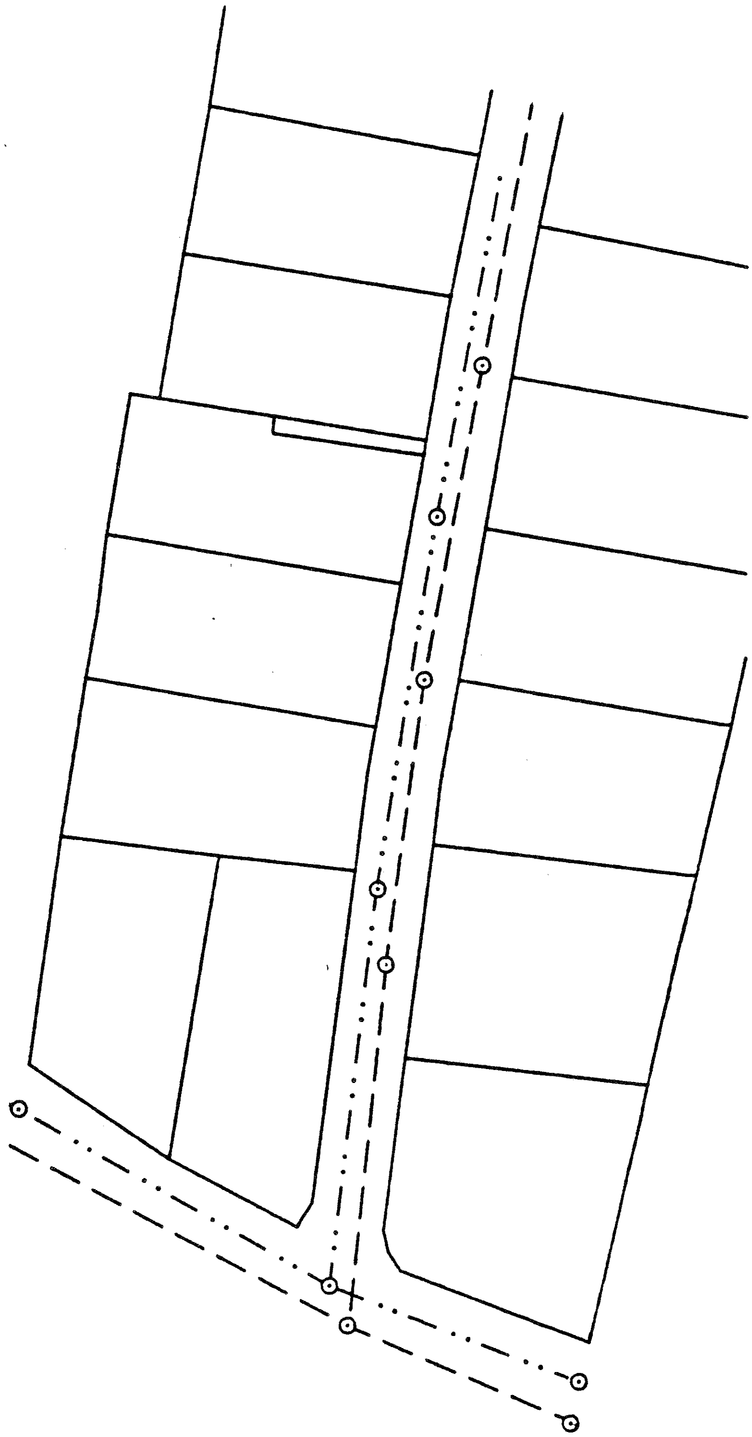

Fig.2

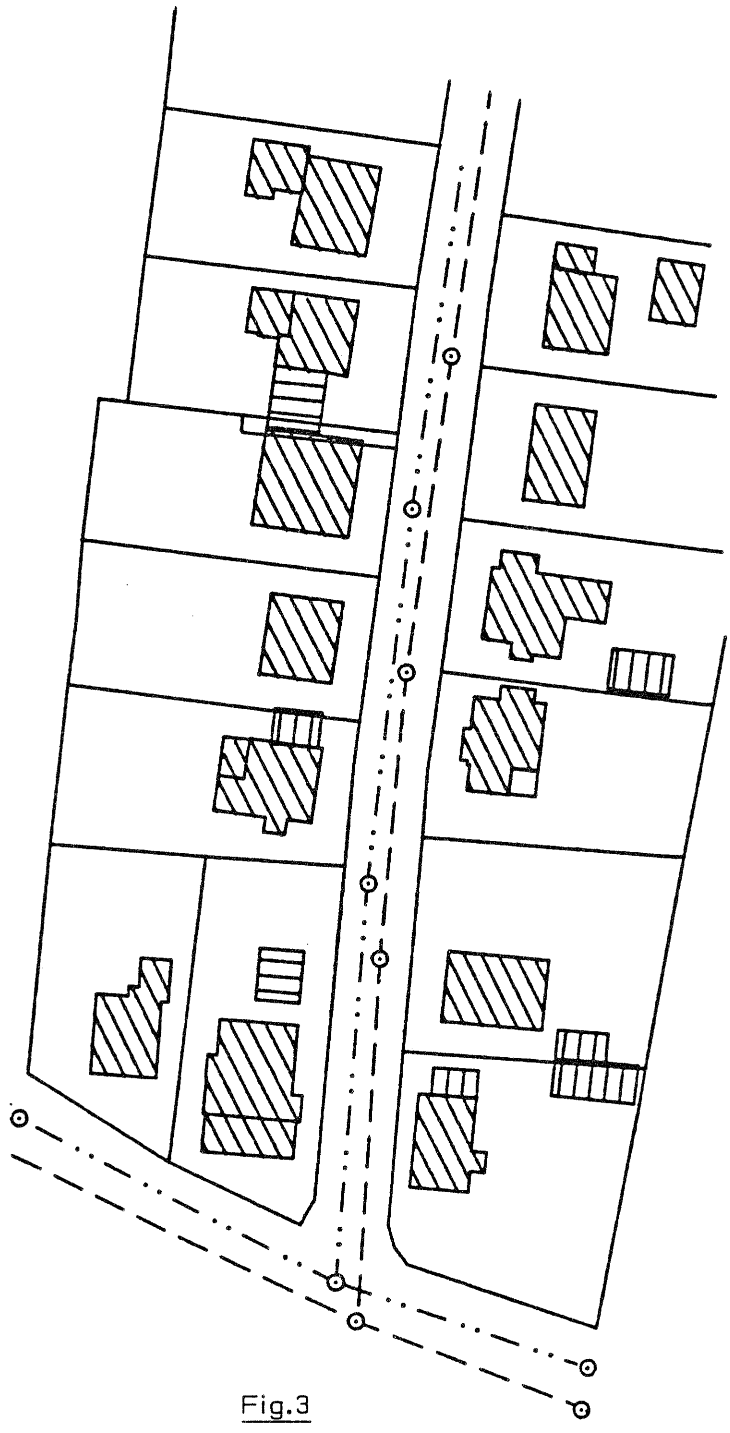

Fig.3

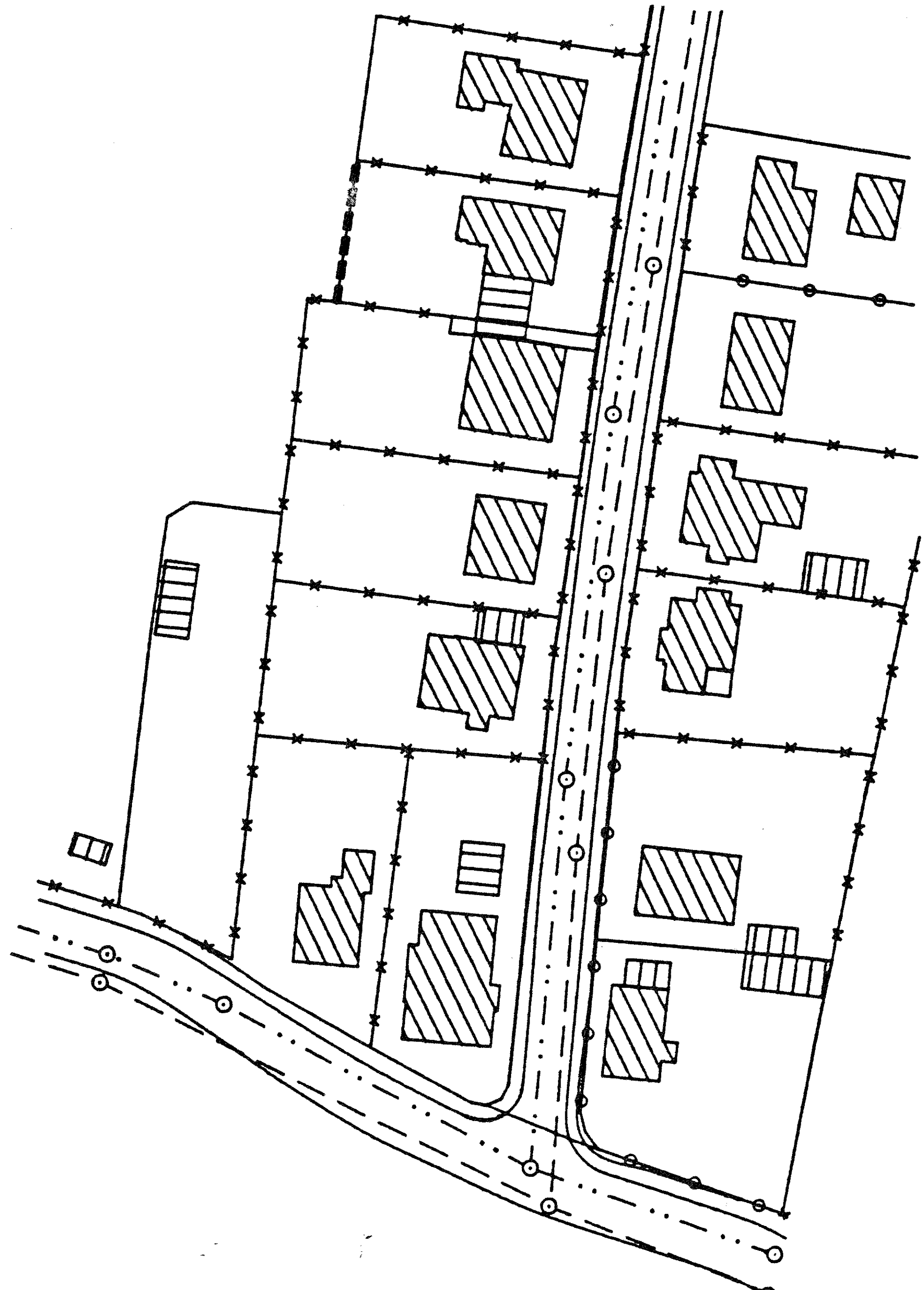

Fig.4

5. Conclusion

The complete hardware and software system with data acquisition at the DSR1, on the basis of the results of a bundle block adjustment, digitizing of cadastre and utility maps under control of the MAPS 200, the data editing with the MAPS 300 and the plotting of selected or combined graphical information with the GP1 has been shown as a flexible tool which stood the first test of the establishment of a land information system. There is no need for a hardware system with larger and expensive computers. The task can be fulfilled with the low cost mini computer PDP 11/23 without loss of time. The system is not limited to data acquisition of land information systems of course, the easier case of a usual topographic map can be solved.

References

J.Klaver: Hardware and Software for digital data collection for Land Information Systems. XV. ISPRS-Congress 1984, Rio de Janeiro

U.Stampa-Weßel: The Use of Analytical Plotters for the Establishment of Land Information Systems. XV. ISPRS-Congress 1984, Rio de Janeiro