CAT / CAL IN PHOTOGRAMMETRY ON THE INTERNET

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ABSTRACT

CAT/CAL programs which run on any computer and operating system is the dream of many educators. The Java Virtual Machine seems to support this ambiteous goal. The reality is something else and many difficulties have to be overcome. The development of interactive CAT/CAL programs have to take care of the differences in the platforms and tools. On the other hand the Internet gives access to many other ressources and possibilities which will benefit the CAT/CAL programs. This paper discusses the problems in development and use of the interactive and Internet-based learning program "LDIPInter". The topic of "LDIPInter" is automatic measurement of images which is a central topic in digital photogrammetry. By means of rolling texts, animations and several tasks with changing data sets the learner becomes interested and active and will understand the process of automatic measurements better than with text books. Articles, manuals and dictionaries, which are accessable by the Internet, can be used in addition. The realisation of good CAT/CAL programs requires many resources, and suggestions are made how an international cooperation could improve the situation.

1. INTRODUCTION

The Internet can be used as a learning tool in combination with other aids. Especially in distance education, the Internet will play an important role. By means of the Internet many new opportunities will be created which can support the learning. For example:

- search for literature and access to
  complete texts of articles
- use of encyclopaedia, manuals and
  dictionaries, etc.
- communication between students and
  teacher as well as between students

The distribution and use of learning software packages is also possible. The learning by means of these software packages is often called "Computer-assisted learning" ("CAL") or "Computer assisted teaching" ("CAT"). If the Internet is used as the platform for a CAT/CAL program various advantages can be found (compare figure 1). Thanks to the Java Virtual Maschine (JVM) such CAT/CAL programs are automatically installed on many different platforms consisting of computer, operating system and browser. This platform independence is especially necessary for CAT/CAL programs because many different systems exist in educational environments around the world. Furthermore, the latest version of such a CAT/CAL program can be downloaded from the Internet at

any time. There exists a wealth of share- and freeware which could be integrated into new CAT/CAL programs. The development tools (Java compiler, editor, debugger and applet viewer) are also freely available which may start a common development at different locations. The use of a learning program could be monitored (counted) and even charged.

With all these advantages in mind, an existing and established CAT/CAL program, "Learning about digital photogrammetry" ("LDIP"), was transferred into an Internet version, called "LDIPInter". First experiences from the development of this Internet-based CAT/CAL program was presented in (Höhle 1997). In the meantime, new themes were added and experiences gained from its use at different platforms. It is the purpose of this paper to inform about the new achievements and about the user experiences with this type of CAT/CAL programs. In the following chapter the latest version of "LDIPInter" (1.14) will briefly be explained.

2. THE CAT/CAL PROGRAM "LDIPInter"

The Internet-based CAT/CAL program "LDIPInter" explains the theory behind automatic measurements in images step by step and provides exercises for each step. Currently, it contains two themes: "Automatic measurement" and
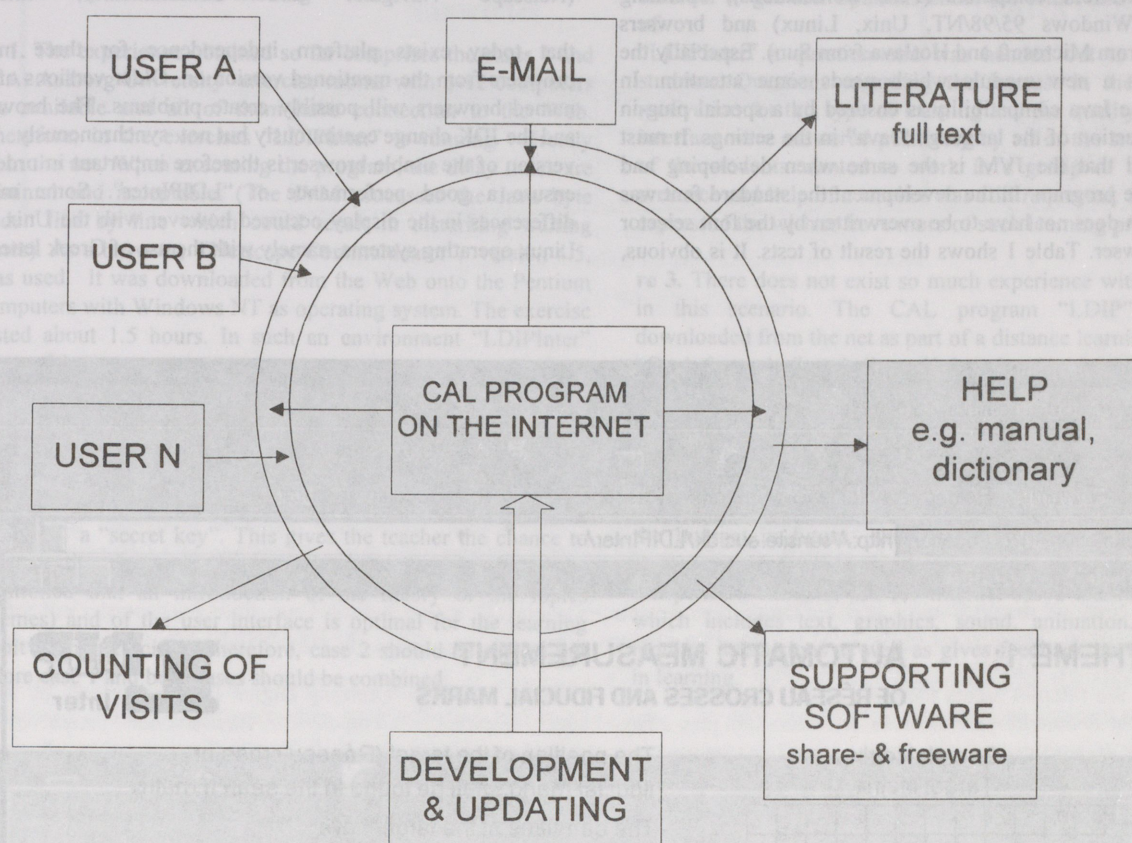
Figure 1: A CAT/CAL program on the Internet gives access to resources and allows for communication

"Correlation in the subpixel range". One more theme, "Correlation in the subpixel range - two dimensions", is in preparation. The explanation of the theories is supported by animations, sequences of text lines, and hypertexts (compare figures 2 and 3).

The exercises are mainly calculation tasks with different data sets. "LDIPInter" features a high degree of interactivity which puts the students in an active role. The program analyses the results given by the student and answers "Correct" or "Wrong". The formulae can be displayed in information windows; they contain matrices and Greek letters. The student manipulates a graph and reads values from the graph and uses them in the calculations. For the rather complicated calculations a calculator and a spreadsheet are available. Their use is explained in help windows. More detailed explanation concerning the use of the spread sheet or the theoretical background of the automatic measurement can be downloaded from the net.

"LDIPinter" is installed on a server at Aalborg University under the address:

http://sunsite.auc.dk/LDIPInter

and can be transferred and used by means of an Internet browser.

For the proper run of "LDIPInter" it is important that the Internet browser includes a Java bytecode (applet) interpreter.

3. DEVELOPMENT OF LDIPInter

The contents of the learning package "LDIP" existed in a previous version made for Macintosh computers (Höhle, 1996). The programming language was PASCAL, and the development task for "LDIPInter" consisted mainly in transferring the PASCAL code into Java code. However, some of the PASCAL toolboxes did not exist in the Java Application Programming Interface (API) so that part of the program had to be done from scratch. Furthermore, the experience gained with the behaviour of the different platforms resulted also in new ways to program. The applied tools (compiler, editor, debugger and applet viewer) are contained in Sun's Java Development Kit (JDK) which can be downloaded free of charge from the Web. The applied version was JDK-1.1.5, and the same main version (JDK-1.1) has to be used by the producers of the applet interpreter which is then part of the browser. If this condition is not fulfilled, problems may occur when running "LDIPInter". In order to fulfil the ambitious goal of "platform independence" for "LDIPInter" various tests had to be carried

out on different computers (PCs, workstations), operating systems (Windows 95/98/NT, Unix, Linux) and browsers Explorer from Microsoft and HotJava from Sun). Especially the browser is a new module which needs some attention. In general, the Java compatibility is ensured by a special plug-in or the selection of the language "Java" in the settings. It must be ensured that the JVM is the same when developing and running the program. In the development the standard font was used which does not have to be overwritten by the font selector in the browser. Table 1 shows the result of tests. It is obvious,

(Netscape Navigator and Communicator, Internet that today exists platform independence for three major browsers from the mentioned version on. Older versions of the named browsers will possibly create problems. The browsers and the JDK change continuously but not synchroneously. The version of the usable browser is therefore important in order to ensure a good performance of "LDIPInter". Some minor differences in the display occurred however with the Unix and Linux operating systems, namely with the use of Greek letters.

Figure 2: Screen image for a theme in "LDIPInter"

$$ r = \frac{\text{covarians}_{TA/SA}}{\text{standard dev.}_{TA} \cdot \text{standard dev.}_{SA}} $$

$$ r = \frac{\sum (g_1 - \bar{g}_1)(g_2 - \bar{g}_2)}{\sqrt{\sum (g_1 - \bar{g}_1)^2 \sum (g_2 - \bar{g}_2)^2}} $$

$\bar{g}_1 \ldots$ arithmetic mean in the target area

$\bar{g}_2 \ldots$ arithmetic mean in the search area

4. USE OF "LDIPInter"

In order to run "LDIPInter" one has to call the applet within the browser with its URL address from above. This can be done on different client machines and browsers (see also Table1).
"LDIPInter" is downloaded from the Web within a few seconds. The loading time depends on the performance of the computer and of the network. Also the "traffic" on the Web plays a role. But under good conditions it takes a few seconds only. The loading time is considerably reduced by downloading the bytecode file onto the disk of the client machine and starting

from there. This means, however, that the advantage of automatic updating for new versions gets lost.

The application of the program can have three different scenarios or cases:

1. Exercise with a number of students in a room equipped with a
   number of personal computers
2. Demonstration of the themes and part of the exercises by the teacher in a classroom during a lecture

3. Selfstudy and distance learning

re 1. The experience obtained so far comprises the cases 1 and 2. At Aalborg University exercise rooms with 6-12 computers are available and all of them have connection to the Web. Therefore, in the exercises "LDIPInter" is running directly from the net. When executing the program, the delay times are minimal and acceptable. (The JVM processes the Java byte code line by line which could result in disturbing waiting times). As a browser, "Netscape Communicator", version 4.5, was used. It was downloaded from the Web onto the Pentium computers with Windows NT as operating system. The exercise lasted about 1.5 hours. In such an environment "LDIPInter" runs safely.

re 2. During demonstrations of themes and exercises in the class room by the teacher a multimedia projector (Epson EMP 7100) was used. The results of the rather lengthy calculation with the randomly changing data set can also be displayed by means of a "secret key". This gives the teacher the chance to shortcut the demonstrations of the exercises. It should be mentioned that an introduction of the theory of the topics (themes) and of the user interface is optimal for the learning result in the exercises. Therefore, case 2 should be carried out before case 1 and both cases should be combined.

In order to get user opinions about the effect and performance of "LDIPInter" a questionnaire was handed out to a group of students. Questions regarding the interest in the topics, the motivation for this type of learning and the quality of the user interface were answered positively by all of the students. Most of the students wanted to work in a group of two and the presence and help of a teacher was still requested. The students expressed the wish to have more of such learning programs.

re 3. There does not exist so much experience with LDIPInter in this scenario. The CAL program "LDIP" could be downloaded from the net as part of a distance learning course in "Geoinformatics" at Aalborg University (Höhle, 1998). Due to the fact that the participants from Denmark and other Scandinavian countries did not have access to Macintosh computers, LDIP was not used. However, the study board of the Danish Chartered Surveyor Education supported the transfer of "LDIP" to "LDIPInter". Distance learning will extensively use the Internet in future. Therefore, it will be natural that the participants of distance learning courses, the so-called independent learners, ask for Internet-based learning software which includes text, graphics, sound, animation, etc. and requires interactions as well as gives feedback on the progress in learning.
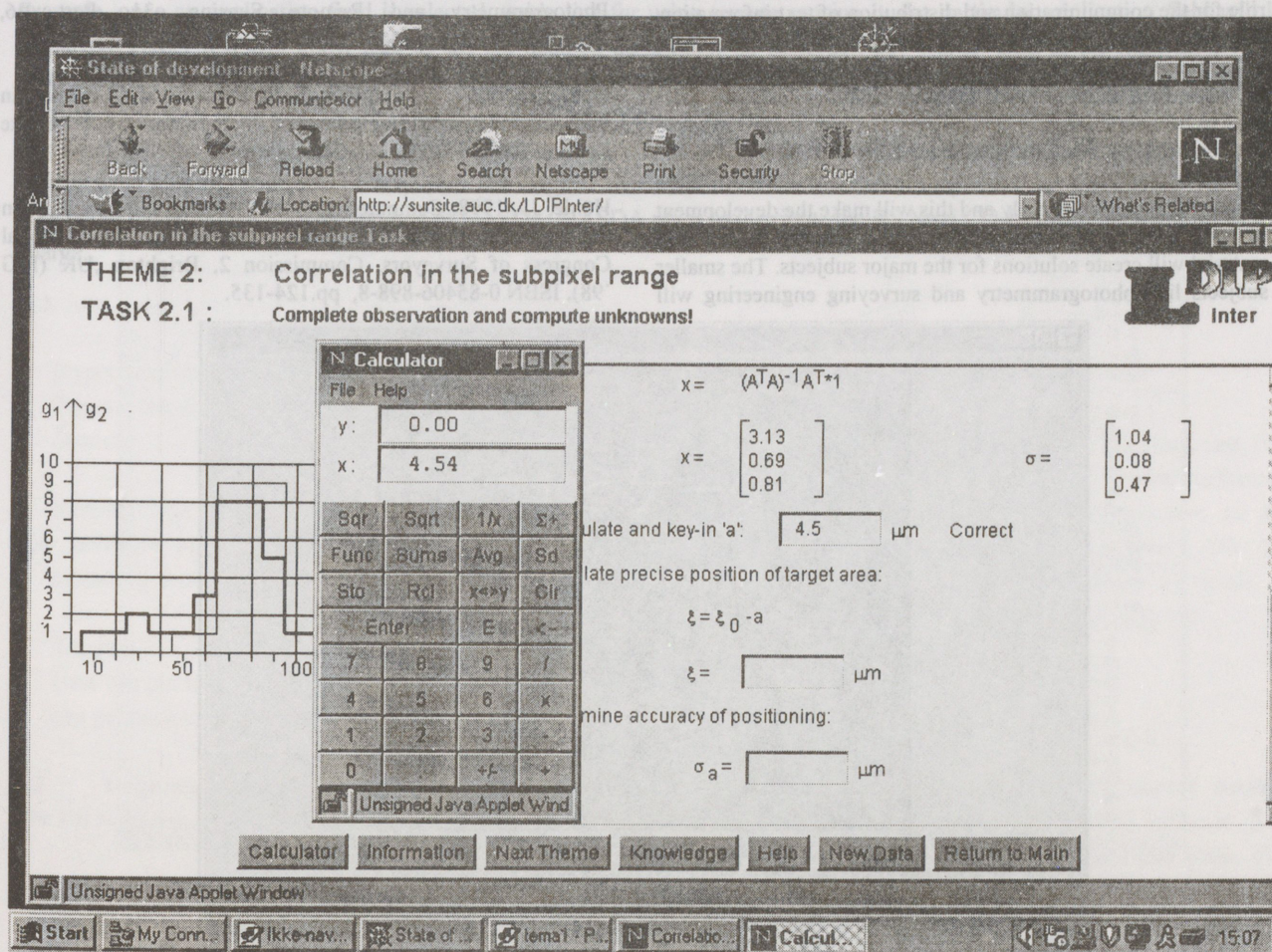

Fig. 3 Screen image for a task in "LDIPInter"

Operating system	Browser		
	Netscape Communicator 4.5	MS Internet Explorer 4.0	SUN HotJava 1.0
Windows 95/98/NT	yes	yes	yes
Solaris (Unix)	yes	yes	yes
Linux (Intel)	yes	yes	not available

Tabel 1: Use of LDIPInter on different operating systems and browsers

5. FUTURE DEVELOPMENTS

Computer, software, and the Internet change rapidly. The Internet will serve as a window to the world and as a source of information. It will be very much used in the education. In future, part of the education will be international and remote. In our competitive world there will hardly occur a standardisation or domination of one computer type or one operating system. The concept of the JVM is a possible answer to the variety of computer systems. The combination of the JVM and the Internet seems therefore to be logical and their potential for education is tremendous. Browsers will play a key-role for the communication and distribution of text information. They can also serve as starting place and as display window for interactive learning programs with multimedia features. In order to create such Internet-based learning programs efficient tools have to be available.

It is very likely that this will be possible in future due to the heavy competion between the producers of browsers. All these tools will change constantly and this will make the development of good learning programs difficult. The industry for learning material will create solutions for the major subjects. The smaller subjects like photogrammetry and surveying engineering will need a cooporation of the teachers at different places to specify, produce and document such educational material. A common platform for the development of such learning software is now also possible with the Internet-based and free development tool: Java Development Kit. It is the hope of the author that an international cooperation between motivated teachers and programmers will create extensions of LDIPInter as well as other learning software packages.

6. REFERENCES

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