The Human-Comput e r Interfaces Course at IST

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Abstract

This paper presents the main and most relevant aspects of the Human-Computer Interfaces course lectured for the 4th academic years (and fifth year as an optional course) of the undergraduate program in Informatics and Computer Science at Instituto Superior Técnico, Technical University of Lisbon.
The paper addresses the course contents and its pedagogical approach as well as the communication facilities used in the 1998/99 academic year to support the course operation.
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1. Introduction

The main topic of a Human-Machine Interfacing (HCI) course is the design, development and evaluation of Interactive Computing Systems.

Designing and developing human-machine interfaces has become the most expensive factor in the development of information applications. Such cost corresponds today to roughly between 30 and 50% of the whole development cost1.

However, even though the above is true, HCI has been one of the less studied and less understood disciplines2.

The Design and development of HCI projects requires competencies and know-how in many concerning yet different areas such as Systems Engineering, Programming Engineering, Graphical design, Industrial Design, Psychology, Ergonomics, Project Methodologies, Interfacing Engineering (hardware), and Organisation Engineering, among many others3.

These factors demonstrate how important it is the Universities and Polytechnics include HCI Courses in their curricula.

2. Background

In recent years, Portugal adopted the policy to foster its national software industry. Many official bodies have concurred to this with initiatives like the PEDIP Programme, The Science Programme, The Mosaico Initiative and the Nónio Programme.

Many successful showcases in the development of Portuguese products demonstrate the success of such initiatives. The Green Book on the Information Society produced by the Information Society Mission of the Science and Technology Ministry extensively reports on the results.

Software products must present the right functionality and be easy to use in order to create a stream of products and create and sustain a solid software industry.

In Portugal one can still find large competence gaps extending as far as the most successful products. This reason is more than enough to make the main Engineering Colleges in the country to include courses in HCI in their curricula. The software industry has already acknowledged the need to focus intensively on HCI too as a leverage factor to stay competitive in the international market.

The importance of HCI goes beyond developing new systems. In recent years, there has been remarkable raise in the use of integrated applications, such as SAP R3, that show a trend to dominate the market. Consultants and experts are required in order to parameterise and localise such integrated applications so that they can be efficiently used. This work includes both functional and the user interface level. The later must be adapted to the actual end users, the staff using the applications. In Portugal, there are some 60 enterprises that specialise in Interactive Computing Systems and recognise the importance of the know-how on HCI. This spans national borders and is acknowledged by both national and multinational enterprises involved in either the development or localisation of Interactive Computing Systems.

In the United States, the National Science Foundation (NSF) sponsored a study on "New Directions in Human-Computer Interaction, Research, and Practice". The report, published in 1994, stresses the importance of HCI as one of the main areas in Information Engineering. However, the report acknowledges the many difficulties that have prevented American universities from including HCI courses in their curricula.

The NSF proposes two ways to bring about the changes it recommends in its report, which are:

- Integrate lectures on the design and development of HCI in the curricula of Information Engineering programs.
- Include HCI as one of the main components of projects assigned to students in the final (senior) year of undergraduate programs.

The report further recommends the acceptance of HCI as a critical technology by universities and recognises that the development of competencies and know-how in HCI is a fundamental leverage factor in preparing students for their future professional activities in the scope of the Information Society.

The above clearly stresses the importance of HCI from an integrated social and economic point of view in those countries wishing to promote a sustained Software Industry with a future.

3. Objectives

The definition of the objectives of an HCI course must be on par with market needs on skilled professionals. Therefore, students should aim at:

1. Master the principles of information presentation and user interaction, as well as, acquire the competence to evaluate the quality and effectiveness of user interfaces.
2. Master the technologies to apply HCI principles to products and the operation those technologies's enabling tools.
3. Master the realisation of HCI projects in the scope of the most common environments (MS Windows, WWW).

The HCI course lectured at IST has a weekly load of three hours of lectures and two hours of laboratory activities. A project is assigned to the students at the final stages of the semester.

The lecture time is dedicated to fulfil the first objective. The syllabus includes lecturing the basic principles that must be applied in order to achieve effective information delivery to the user. Such principles stem from mental models of information processing and are a collection of methods and techniques and good practice examples. These have been known and applied since long in areas like advertising.

HCI derived its theoretical ground from a very large set of experimental data collected over the years in the laboratory and from field experiments. In the laboratory session, students examine existing interfaces and check their conformance against the theoretical principles they learn. This activity is closely linked with evaluation, either qualitative or quantitative (usability).

The second aim of the HCI course (mastering HCI enabling technologies) targets at the analysis and proficient use of the technologies applied when implementing efficient user interfaces, the evolution of such technologies and their choice. In this, the course also aims at providing students with an overview of the available technologies, their evolution and capabilities to present information and interact with the user.

The third objective is reached by using a " learn by doing" pedagogical approach with an HCI project. The project is carried out by students in the closing weeks of the semester. The project's main target is to lead students into applying the know-how they have acquired and make it mature through actual use. A rather important point is the constant stress to be put on the pivotal role played by the end users in the development of the project. This is further enhanced by the project's requirement to conduct evaluation activities at all the project's phases using real end users for that effect.

4. Lectures

Lectures use the active discourse method pedagogical approach with the support of transparencies and examples of good (and bad) practice to demonstrate concepts.

Students are submitted to five unannounced mini-test papers in order to further ensure learning success and provide students with feedback. These test papers take place during the last 15 minutes of a lecture and address the lecture's topics.

There is no sufficiently comprehensive textbook spanning all the subjects lectured in the HCI course. This makes it necessary to recommend several textbooks to students, with the latest edition of the textbook by Shneiderman[4] as a starting basis and the textbooks by Preece[5] and Mayhew[6] covering the details in many areas. This dispersion stresses the need for a new a more comprehensive textbook in HCI.

5. Laboratory Activities

The evolution of information systems design lead to today's widely accepted client-server architecture. One of the best features of this architecture when applied to Interactive Systems is the clear separation of information processing from the user interface it provides.

On the other side, window management systems and related APIs evolved over the times. Recent years have seen the dominance of X/Motif (and its derivatives) and MS Windows. Then the World Wide Web made its first steps in 1994/95 and experienced an exponential growth in the years that followed. At the same time, the WWW increased its information presentation and user interaction

capabilities due to the emergence of new or improved standards of the HTML, Java and JavaScript languages. This, in turn, fostered the use of the enhanced capabilities by an ever-increasing number of services and users.

The classes of services available extended to services to the citizen, education, entertainment, business, home banking, etc. Business services7 became particularly important and include such categories as advertising, direct sales and employment offer. Ho8 goes even further to propose three different business categories: product and services promotion, data and information services and business transaction services.

Because of the vast world opened up by the WWW highlighted above, the WWW role in the Information Society and the WWW' programming and interactive potential, the HCI targeted its laboratory and project activities at the WWW. These activities follow two main guidelines:

- Evaluation of WWW sites with special didactic value, using case study methodologies, aiming at developing students' capacity for criticism and their proficiency in applying evaluation methods and techniques to HCI design and implementation.

- Exploration, discovery and application of the user dialogue and information displaying potential of the HTML and JavaScript languages with the aim of promoting the skills students require to carry out their project assignments.

5.1. Evaluation of WWW sites

The laboratory activities involving the evaluation of WWW sites were carried out in three steps.

In the first step, groups of students analysed and criticised several proposed sites against the following criteria:

- Use of colour
- Use of fonts and font sizes
- Page layout
- Look and feel
- Navigation
- Use of metaphors

The second step had each group of students choose one of the WWW sites and redesigning on light of the findings when applying the above criteria. The number of student groups allowed more than one group to redesign the same WWW site. This was important for the third step, as it will be shortly evident.

In the third step, each group of students presented its site redesign proposal to all the colleagues attending that laboratory session. Each presentation included the group's reasons for the changes proposed. A period for questions and answers followed the

presentation and all students were invited to criticise the design proposals. It was extremely interesting to watch these proceedings since the degree of interactivity and commitment was very high and there was the opportunity to address almost all the relevant aspects. Discussions among students lead to synergetic results where several proposals were combined into even better solutions.

5.2. Technologies (HTML and JavaScript)

The laboratory sessions dedicated to HTML and JavaScript languages had the objective of promoting the students' competence in these languages, through demonstration and exploration of the languages' concepts and constructs. This would later on ease the use of these languages when carrying out the HCI course project.

The pedagogical approach to both HTML and JavaScript was the same. It started with the presentation of the basic concepts and objects of each language. That was followed by language constructs of ever increasing complexity, always with the support of illustrative examples. Students were asked to carry out some assignments at some checkpoints. These assignments had the objective of making students apply the knowledge they had just acquired and, at the same time, provide them with self-evaluation feedback.

5.3. Laboratory Resources

Laboratory sessions took place in an electronic classroom equipped with networked PCs with Pentium II processors (300 MHz) and running under Windows NT. The network provided students with the access to the WWW, file server services and on-line help facilities. The later included tutorial texts full with interactive examples and on-line reference manuals. The tutorial texts were also available in packed format to allow students to take them home and learn in off-line mode.

5.4. The HCI Project

Students were proposed several project themes to choose from. Besides the obvious aim of carrying out an HCI project assignment, the themes proposed to the students were also aimed at developing students' awareness of the societal environment for which they will be working after graduation since the themes spanned from products for disabled persons to environment protection.

Theme A (Disabilities)

This theme addresses the development of an Electronic Book to help parents, social workers and therapists choose products for users with special needs and disabilities. Each Electronic Book had to describe three products with similar functionality or

objectives and provide product comparison data and selection guidance. The products could be either software or hardware products.

The actual product choice was left to the students in each project team. Students had to select a type of product and look for available products, collecting literature and examples, if any. Many browsed the WWW for this. All products picked had to have been designed for users with special needs (elderly persons, children) or disabilities (visual, hearing, motor, etc.). This requirement had the objective of making students aware that HCI solutions have a vast number of needs to address and are not restricted to satisfying normal person needs (see Figure 1).
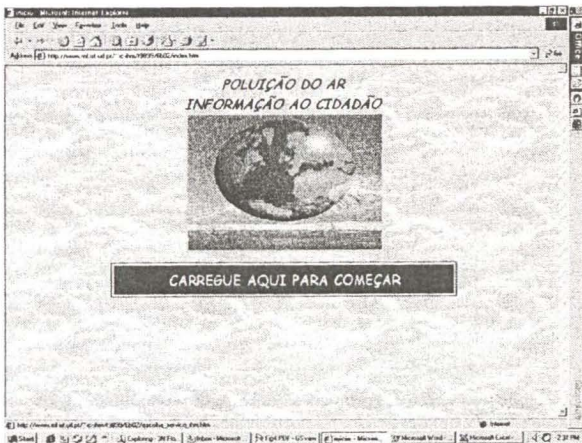

Figure 1. Example of Project A.

Theme B (Environment Protection)

This project theme addressed the development of services to the citizen to provide information on the environment, namely the quality of air in a region. Each project team had to select a type of end users from the following three types:

• general public
• school children
• environment experts

The service had to be designed with the provision of its deployment from information booths in mind. the service had to provide information on air pollutant measurements of sulphur dioxide (SO2), ozone (O3), carbon monoxide (CO) and nitrogenous oxides (NO/NO2) concentrations in the environment. The service also had to provide appropriate documentation.

The system had also to allow its users to select the data to be displayed, i.e., from the current day, the last week or the last month. Automatic data collection by the system was simulated with a data

file containing all needed pollutant concentration values to ease system construction (see Figure 2).

Figure 2. Example of Project B

Others projects

Some students proposed other type of projects some of them were accepted. The most relevant was the new site of the Informatics infrastructure that supports all the courses on Informatics, Electrical Engineering and Informatics Management, the RNL (*Rede das Novas Licenciaturas*) (see Figure 3).
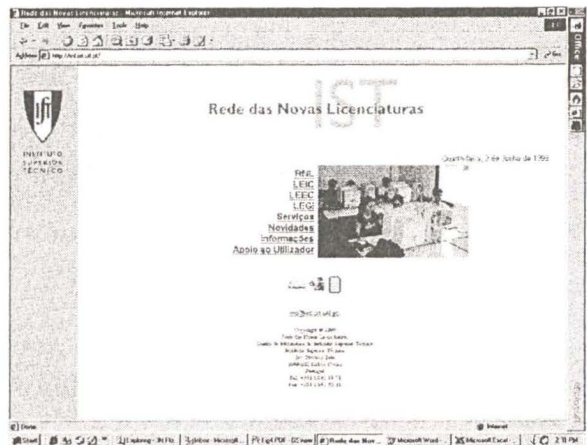

Figure 3. RNL Site

6. Communication Between Students and Professors

One of the subjects addressed by any HCI course must be Computer Assisted Person to Person Communication. Therefore it made all the sense to address this subject with very special care and demonstrate its usage and benefits when carrying out communication between students and the course's teaching staff. This systematic pedagogical

approach made all students to have intimate contact with different technologies used today for Person to Person Communication and realise the advantages and disadvantages of each of these technologies and when and how to use them.

In the HCI course the following three Person to Person solutions were used:

- electronic mail
- newsgroups
- a WWW site

The HCI course WWW site aimed at making available to students the most complete and up to date information on the HCI course itself. At the beginning the site contained only information on the course's syllabus, its teaching staff (with e-mail and personal WWW pages addresses), how the final mark would be calculated and important dates and deadlines.

As the semester went by other information was added like:

- marks achieved by students in test papers
- themes for the course's project
- tutorial sessions support documents

The objectives of the newsgroup that was set-up were to publicise general-purpose announcements and putting and answering general questions, including questions on parts of the course contents the students might not have understood. The newsgroup aimed at providing students with the means to anticipate the answers to students' recurring questions. Students were advised to peruse through the newsgroup before coming forward with a question or remark so that they could see whether that subject had already been put and answered.

One remarkable result was the speed at which students knew of their marks on test papers. Usually, these are posted at assigned places on the walls of the administrative area. The HCI course followed this rule but, at the same time, posted the marks on its WWW site and announced the fact through the newsgroup. The result was that many students came to know of their marks well before the administrative staff had time to post them at the usual places. Moreover, the number of students looking for their marks in the later place was very small.

Finally, electronic mail was used only when the questions and matters to attend to were of a private nature and for internal communication within the teaching staff.

7. Conclusion and Final Remarks

The experience gained in the 1998/99 academic year allows us to say that the HCI course at IST was successful since most of the objectives aimed at were achieved. However, there is still a long way to go before an HCI course with a stable syllabus is in place and that that course answers all learning objectives set. One important point to be addressed in the future is the publication of adequate and comprehensive literature and books. The other point is the creation and use of more interactive means for demonstration and exploration of the course's contents.

8. Acknowledgements

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