EXTENDED ABSTRACT
A Field Computer for Animal Trackers

Edwin H Blake

Collaborative Visual Computing Laboratory
Computer Science Department, University of Cape Town
Rondebosch 7701, South Africa

edwin@cs.uct.ac.za

ABSTRACT

The field computer system has been developed to gather complex data on animal behaviour that is observed by expert animal trackers. The system is location aware using the satellite Global Positioning System. The system has been designed to empower semi-literate trackers. User testing showed that trackers were easily able to master the interface. They benefit from greater recognition, while the wider community gains from access to the knowledge of the trackers on animal behaviour.

Keywords

User Interface, Empowerment, Location Aware, Context Aware, CyberTracker

INTRODUCTION

Expert animal trackers play an important role in providing information on the distribution and behaviour of animals, which is overlooked by current surveillance techniques. The best trackers, however, are found in hunter-gatherer communities with oral traditions and who cannot read or write.

Computers could be regarded as devices that disempower marginalized people. We describe the design of an interactive computer system that supports and empowers such a group: semi- and ill-literate animal trackers. We have developed a field computer with a graphical user interface that enables trackers to record their observations. A pen-based handheld computer system for observations, and satellite Global Positioning System (GPS) receiver to obtain position data, constitute the field data collection system, while a base station PC system serves for long-term data storage and visualisation.

Our novel computer system has enabled functionally illiterate trackers to communicate their expertise to the research community. The initial system ran on an Apple Newton and it now runs on Palm handhelds and compatibles.

Our system was initially developed from February 1996 and tested in the Karoo National Park in June and September/October 1996. It has been continually refined and updated since. The system has subsequently become a successful product [1] with a number of applications.

CONTRIBUTION

We developed a user interface for functionally illiterate users. The interface is adaptable for varying educational, cultural and language backgrounds.

Trackers are experts in their own right and have access to very sophisticated and complex information about the environment. This knowledge is not available to the wider community, mainly because of the barrier of illiteracy. Our first *hypothesis* was that trackers are very familiar with the way signs point to meaning and so should have no trouble in attaching meaning to the icons of a well designed graphical user interface. We *further hypothesized* that such an interface will give the wider community the benefit of the knowledge of the expert trackers. Finally *we believed* that such a system would empower the trackers and allow them greater recognition and rewards for their skills.

The system was developed as a *critical action research* project and it has gone through a number of cycles. The trackers participated in an iterative design process and themselves validated each aspect of the interface. The success of the intervention can be judged by the impact of the users being recognized as experts in their field [2,3].

Context Aware Computing

A similar independent project was initiated under the banner of "Context Aware" computing by Pascoe *et al.* [4] shortly after our first field trails. Our research constitutes a critical action research intervention. Though illiterate, our co-designers, the trackers, have skills that well equip them to design and use handheld computer interfaces. Our success depended on following a traditional approach of *empowering users*. We believe that the notion of context-aware computing is a distraction in our type of application.

We needed to record complex observations and inferences about the world. The machines are best regarded as marginal annotators: merely providing the space-time coordinates of the observation.

THE FIELD COMPUTER SYSTEM

The field computer enables trackers to record all significant observations they make in the field. Visualisation on the base station makes it possible for scientists to have instant access to all the information gathered over a period of time.

Icons allow the tracker to select options by simply touching the screen a pen-based computer. The tracker goes through a sequence of screens until all the necessary information is recorded. When the tracker saves the information a date/time stamp is added and an integrated Global Positioning System (GPS) automatically records the location of observations.

When the tracker gets back to the base camp he follows a very simple procedure to transfer the data onto the base

Design of user interface

Trackers are expert interpreters of signs. This ability can be exploited in the design of a user interface. The tracker connects a sequence of artificial signs corresponding with a sequence of natural signs.

In our iterative design methodology (or action research method) the trackers were consulted at every stage of development on both the visual layout and the behaviour of the system. Their input was incorporated into subsequent designs, and they could witness their input being immediately acknowledged. The interface includes text where appropriate as requested by the user's themselves. The level of literacy varies from illiterate to limited secondary schooling.

CONCLUSION

Technology can be developed to enhance human skills in a way that have social and environmental benefits. Rather than consider how technology can become context aware we preferred to consider how computers can assist the awareness of humans.

Over tens of thousands years hunter-gatherers developed a highly refined perception of nature through the interpretation of signs. At a time when traditional hunting is dying out, the field computer system helps to revitalise the art of tracking and develop it into a new science with far-reaching implications for the conservation of biodiversity.

We have shown that trackers are well able to use icons and other elements of a graphical user interface. Trackers are reluctant to use hierarchies and easily adopted identity maps. They are well able to use icons and other elements of a graphical user interface. However this is only true if the icons are designed with careful consideration of the cultural background of the users. The criteria used for icon recognition are clearly different from those used by the researchers.

The system has proven to be enormously useful and has had considerable impact. It has been used in four African National Parks: Karoo National Park and Kruger National Park in South Africa, and the Odzala National Park, Congo. It has also been adapted to record observations on the Cape Floral Kingdom for Cape Nature Conservation (see [1] under “Projects”). The first evidence of wider appreciation of the expertise of trackers is apparent from the publications based on their work as well as the exposure on the World Wide Web of the CyberTracker product. We have clearly shown that our system empowers trackers and does not deprive them of their roles.

The original Newton Design and separate GPS system has become an integrated system on PalmOs machines. The initial interface design has stood the test of many years of use very well and remains essentially unchanged. The hardware has developed in the past years and is now smaller and much faster and GPS is now much more accurate. The software has been released as free software.

ACKNOWLEDGEMENTS

Thanks to Lindsay Steventon, Jacqlyn Edge and Andrea Foster for development and research. Louis Liebenberg for the problem and many solutions; Leighton Hare, Karoo National Park and the trackers, Karel Bernadie, Chocolate Bosch and James Minye, for their contribution to creating the system; to Dr Gary Marsden for his helpful comments.

REFERENCES

1. CyberTracker. http://www.cybertracker.co.za/
2. Louis Liebenberg, Edwin Blake, Lindsay Steventon, Karel Benadie and James Minye “Integrating Traditional Knowledge with Computer Science for the Conservation of Biodiversity” In *8th International Conference on Hunting and Gathering Societies Foraging and Post-Foraging Societies: History, Politics, and Future*, Osaka, 26 - 30 October 1998.
3. Louis Liebenberg, Lindsay Steventon, Karel Benadie and James Minye, “Rhino Tracking with the CyberTracker Field Computer” in Pachyderm, Jan-Dec 1999, Number 27. www.cybertracker.co.za/RhinoTracking.html
4. Jason Pascoe, Nick Ryan, and David Morse. “Using While Moving: HCI Issues in Fieldwork Environments” ACM Transactions on Computer-Human Interaction, Vol. 7, No. 3, September 2000, Pages 417–437. See also www.cs.ukc.ac.uk/projects/mobicomp/Fieldwork/

Proposal

Edwin Blake

RESEARCH

My research activities are mainly in the field of Human-Computer Interaction (HCI) and my current research focus is on Collaborative (Shared) Virtual Environments (CVEs). The particular problem relates to how people can effectively use CVEs – a common theme in my work. I am continuing work in Visualization and Computer Graphics. My research methodology is, with some exceptions, experimental: theoretical analysis has an important role but the proof of success derives from experimentation with a prototype system.

Virtual Environments are a special kind of interface between computers and people. Virtual Environments provide users with a sense being in the place specified by the virtual environment, and forgetting being in the real world, in favour of the virtual world. For such systems to be successful they have to provide a realistic experience and a sense of 'being there'.

Collaborative Virtual Environments (CVEs) offer the potential to radically alter the way we use computers to communicate with each other. CVEs may become the distance communication paradigm of choice; replacing the familiar phone calls, faxes and occasional teleconference as the integrated meeting ground of people at work and play.

CVEs differ from other interactive systems in that the user becomes an explicit and important part of the system. Participants are represented by virtual representations called *avatars*. The avatars can move around, converse and interact in a common context of information and applications. Avatars become a means to interact socially with a group of participants.

Presence and Co-Presence

Presence has become a key concept in characterizing and evaluating Virtual Environments. Our contribution is to show that current measures of Presence, as a metric of users' experience of Virtual Environments, are highly problematic: results from the literature cannot be repeated and it lacks a theoretical basis.

Together with my masters student Juan Casanueva we have developed an instrument to test Co-Presence and evaluated it and a number of related measures in a number of experiments. This work has revealed the fundamental weakness in current measures of Presence and Immersive Tendencies. We see this a contribution to the continued dialogue on what characterizes effective Virtual Environments. We have generalized from this experience and together with David Nuñez we are developing a cognitive model of "Presence".

Visualization

The standard interface to visualization toolkits is that of visual dataflow programming. Another standard interface popular with users is that of Spreadsheets. I observed that spreadsheets and dataflow are, in their pure form, both examples of declarative languages (referential transparency, no side effects, etc.). It is therefore interesting to develop a spreadsheet-based interface to a visualization toolkit. Such a toolkit can be purely functional, which has benefits for the user, and one can translate between a dataflow and spreadsheet representation automatically. Fabian Nuñez implemented these ideas in a system we called ViSSh—itself a descendent of our earlier visualization system which was essentially a TCL wrapper round SGI inventor.

The system was successful both as a theoretical computer science exercise and as a practical user interface. It showed the use of a consistently declarative user interface. The system allowed one to generate an equivalent dataflow system for the spreadsheet: this was also useful in terms of the spreadsheet in that it made dependencies explicit. The system was tested on a couple of real datasets that had been visualized by other means and also evaluated by means of Green's cognitive dimensions framework.

INFORMATION TECHNOLOGY POLICY FORMULATION

I have felt that the importance of the emerging Information Society was being undervalued and that South Africa was in danger of getting the benefit of revolution taking place as a result of information technology.

The world is moving towards an information society — a new society that will have a major impact on the way all of us live and work. It affects both manufacturing and services; it affects education and communication; it will change health care and it will change government. In short, unless our nations are to become impoverished in new and particularly debilitating ways, no aspect of our lives is going to be untouched.

The industrialized nations are at the forefront of the information revolution.

It is a revolution whose rate of change is rapid and constantly accelerating. The forces driving this accelerating change are being eagerly embraced by many of our developed nations. The positive feedback loops are in place: each advance affirms the development and adds another push to the speeding train.

An Information Community?

Information infrastructure is not an end in itself, but simply a means to an end. Appropriate, timely, culturally relevant content and applications must be made available. The creation of useful applications and appropriate content is the sole reason for the development of infrastructure. So terms such as "Information Highway" or "Global Information Infrastructure" rather miss the point.

To ensure that all people will have a stake in the information society we must develop an inclusive vision of such a society: a vision of the Information Society becoming an Information Community. It balances the advantages offered to individuals with a renewed emphasis on the benefits for social groups, local communities and societies.

Social issues are already taken into account in current thinking on the information society. But the bias still tends to be that of individual advancement via personal universal service. At a public level the focus is on competition between firms and nations. Nationally, regionally and internationally, there must be an equitable information order. An Information Community depends on the way communities can co-operate, bridge differences, and work for mutual upliftment. An Information Community sets out to meet basic needs, and redress under-development. The Information Community perspective aims to ensure that the information revolution benefits society as a whole.

An Information Community counteracts the disadvantages of globalization by operating at local level and empowering local communities.

Areas of Diverging Interests

The information age has not so far contributed to a reduction of inequalities between people, regions and countries. A major result of the information age thus far has been the further globalization of economic and particularly financial activity. It has contributed to a global culture of increased competition and increased risk. World-wide the information infrastructure has been used as a justification and a lever to achieve greater liberalization and privatization. Where it has entered the social arena, information technology has to date served to concentrate wealth and power.

The information age has also seen a globalization of culture that is characterized by local cultures being submerged in a global trade of cultural "goods and services", although the potential exists to record and distribute previously inaccessible indigenous culture in new ways. The technology should "fit" the circumstances in all respects, being not only technically and economically appropriate, but also culturally and socially integrated. The approach to the information society should be development that is focused on people at a local level.