Internet Helicopter: An example of Internet mediated recreation

Jonathan Mark Crellin, Department of Information Systems, University of Portsmouth.

***Abstract*-- From its earliest days, human computer interaction research has paid attention to lessons learned from computer games (for example Malone, 1981; Carroll, 1982). These demonstrate the need to incorporate difficult to achieve goals, and skill like elements into a computer recreation. Computer games have developed highly detailed simulations (which can also be used to train users of real devices), for example (Gopher & Weil, 1992). Internet based games allow humans to interact via computer mediated systems (for example Multi User Dungeons or MUDS, Shotton, 1989), and to interact with real physical devices (for example Cox and Baruch, 1994).**

The Internet Fiesta gave us the opportunity to build an internet recreation based on an internet telerobot. Robotics research at the University of Portsmouth is well developed, (for example Luk, Collie, Piefort, and Virk, 1996). The project was implemented using an existing multiple rotor fixed 'helicopter' robot. We developed a short life internet telerobot with control software available for a wide variety of platforms. This used rapidly developed multiple platform custom applications, and existing video and web cam software. High level development tools make the development of custom internet protocol based applications very straightforward. Complex systems can be constructed by combining simple existing tools in novel ways. The software and hardware integration was developed over a period of three weeks, and ran reliably for three days, and attracted successful interactions from around the world.

The project demonstrated the importance of designing a recreational activity that includes Carroll's list of responsiveness, benchmarks, acceptable uncertainty, safe conduct, learning by doing, opportunity, taking charge, and the illusion of control..

***Index terms*-- game, helicopter, Internet, robot**

I. Introduction

What makes a computer game entertaining? Early work by Malone (1981), suggested that factors contributing to a successful computer games could be listed in a simple checklist (table 1). The games Malone considered were very crude by current multimedia standards, but it is also reasonable to point out that many internet mediated games are more like the simpler games of the 1980s. The checklist that Malone developed was a very simple approach, but it still provided a useful list of issues to consider in the design of any interactive recreation.

Department of Information Systems, University of Portsmouth, Portsmouth PO1 3AE, jonathan.crellin@port.ac.uk

1. **Challenge**
   a. Goal
      i. Does the activity have a clear goal? If not, is it easy for the player to determine goals of appropriate difficulty for themselves?
      ii. Are the goals personally meaningful?
   b. Uncertain outcome
      i. Does the program have a variable difficulty level?
         1. Determined by the student
         2. Determined automatically, depending on the student's skill
         3. Determined by the opponent's skill
      ii. Does the activity have multiple goal levels?
         1. Scorekeeping
         2. Speeded responses
      iii. Does the program include randomness?
      iv. Does the program include hidden information selectively revealed?
2. **Fantasy**
      i. Does the program include an emotionally appealing fantasy?
      ii. Is the fantasy intrinsically related to the skill learned in the activity?
      iii. Does the fantasy provide a useful metaphor?
3. **Curiosity**
   a. Sensory curiosity: audio and visual effects
      i. As decoration
      ii. To enhance fantasy
      iii. As a reward
      iv. As a representation system
   b. Cognitive curiosity
      i. Does the program include surprises?
      ii. Does the program include constructive feedback?

Table 1 (Malone 1981)

A similar analysis of computer games by Carroll (1982) related the issues of computer gaming to the generic issues of designing a computer interface. His list of typical problems faced by new users and computer game players is a useful set of issues to keep in mind. Table 2. He then went on to describe a set of features for interactive systems that would support learning of a new system.

Table 3 lists his characteristics of an exploratory environment. In a computer gaming environment the user is often learning to overcome a challenge.

Disorientation	The user/player doesn't know what to do in the system environment.
Illusiveness	What the user/player wants to do is deflected towards other, perhaps less desirable goals
Emptiness	The screen is effectively vacant in terms of hints as to what to do or what went wrong
Mystery messages	The system provides feedback that is useless and/or misleading
Slipperiness	Doing the same thing in different situations has unexpectedly different consequences
Side effects	Taking an action has consequences that are unintended and invisible, but cause trouble later
Paradox	The system tells the learner/player to do something that is clearly inappropriate
Laissez-faire	The system provides no support or guidance for overall goals

Table 2 Carroll 1982

Responsiveness	When you do something you get some feedback, at least information
Benchmarks	You can tell where you are within a given episode or session. You have the means for assessing achievement and development of skill
Acceptable uncertainty	Being less than fully confident of your understanding and expertise is OK
Safe conduct	You cannot do anything *too* wrong
Learning by doing	You do so that you learn to do, you design a plan, you cannot simply follow a recipe
Opportunity	Most of the things you learn to do work everywhere. You can reason out how to do many other things
Taking charge	If progress stagnates, something new is suggested or happens spontaneously
Control	You are in control, or at least have the illusion of being in control

Table 3 Carroll 1982

Multi User Dungeons (MUDs) represent one of the most developed and popular areas of interactive Internet based recreation. Although largely textual in their interaction, the ability to interact with real people, as opposed to simulated computer creations, increases the enjoyability of the recreation. MUDs are potentially so attractive to computer users that they have been identified as an area that contributes to 'computer addiction'. (Shotton, 1989).

Computer games have developed highly detailed simulations (which can also be used to train users of real devices), for example (Gopher & Weil, 1992). The American General Accounting Offices considers that there is sufficient evidence that computer simulations can contribute to the training of aviation pilots (General Accounting Office, 1999).

The University of Portsmouth Department of Electrical and Electronic Engineering has developed a number of robots as part of its robotics research, including the wall climbing robots (e.g. ROBUG III), smelling robots, and walking robots (Luk, Collie, Piefort, and Virk, 1996). There are a number of robots available for use in computing projects. This project describes the use of a commercial robot intended for teaching robotics and control concepts.

A number of remote controlled robots, controlled over the Internet have been developed over the last decade. The majority of these have been for recreational activities, although increased speed and reliability of the Internet makes non-recreational productive applications more viable. For example control of astronomical telescopes at the University of Bradford, which allows users on the Internet to request images from the part of the sky required. (Cox and Baruch, 1994)

II. The Internet Fiesta

This project was designed to be a rapidly developed, short life Internet recreation, an event in the Internet Fiesta. The Internet Fiesta originated in France in 1998. Founded on the model of the "music fest", the first "Internet Fest" was organized in France in 1998. In 1999, with the help of the European Commission, the Fiesta spread out over the World. The Internet Fiesta runs each year, and is designed to be a virtual fair, populated with Internet events across Europe. The whole Internet Fiesta is focused on an initiative to create an opportunity for as many citizens as possible to be able to see and feel what Internet is like. The organizers of the Internet Fiesta use the slogan "20% for 80%", meaning that the approx. 20% citizens using the Internet shall demonstrate to the other 80% what it is. The Festival events run over three days, and are usually fairly novel in their nature.

The second Internet Fiesta ran in 1999.

"For it's second edition, the Internet Fiesta gathered 65 local organizational committees in 50 countries over the five continents. A large numbers of events have been organized in Western Europe as well as in Eastern Europe, Africa, South America but also in Canada and in South Korea.
The purpose of the Internet Fiesta 1999 was chiefly to gather and present the numerous local initiatives it produced, events that were no more uniquely virtual actually took place in reality throughout the world, in order to attract attention from the media and the public. It was also used to promote the different uses of the web in order to facilitate exchanges. The goal was to encourage the daily use of the Internet and to allow more people to exchange experiences and to contribute to each other's project through the net itself."
(Internet Fiesta Organizers)

III. Internet Helicopter

In many computer simulator games, users are given control of a simulated vehicle. In some instances, these simulated environments allow users to interact with each other across the Internet. The Internet helicopter project differed in that it gave control of a real physical helicopter to users through the Internet. Although it was a real physical device, the "helicopter" was not a free flying model, but a commercially available bench mounted robot (Twin Rotor MIMO System), designed for use in teaching control and feedback engineering. It comprised a main rotor and a tail rotor mounted in a frame. The two rotors were controlled by variable speed electric motors enabling the helicopter to rotate in a vertical and a horizontal plane (pitch and yaw). The tail rotor could be rotated in either direction, allowing the helicopter to yaw right or left. The motion of the helicopter was damped by a pendulum, which hung from a central pivot point (see figure 1).

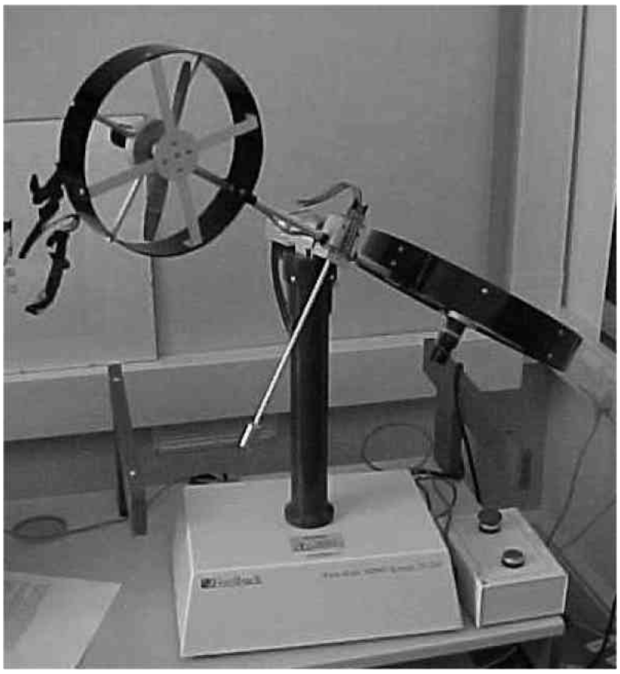

Figure 1: Twin Rotor MIMO System

The robot was difficult to control, even when the user was in the same room with the helicopter. Like many systems it would overshoot the desired position. In a computer-controlled feedback system, sensors located in the arm would have provide feedback on the position of the helicopter. A human user would normally use visual feedback to control the helicopter.

The aim of the Internet helicopter project was to provide both control and feedback over the Internet. Control would be provided using an Internet ‘remote control’. Internet mediated video from web cams and visual conferencing systems provided feedback. Existing software tools were used where possible.

A camera was mounted on the pendulum, giving a view of the main rotor, and the ‘direction’ that the helicopter was pointing in. The video feed from this camera was transmitted on the Internet using a freely available video conferencing system (CU-SeeMe). A second camera had a fixed mounting, giving an overview of the system. The video feed from this camera was transmitted on the Internet using web-cam software.

The ‘remote control’ software was designed using a cross platform development environment (Real Basic), so that executables could be compiled for MacOS and Windows platforms. An application specific communication protocol was devised. A server was developed which ran on the computer connected to the helicopter. The two applications are illustrated in Figure 2. Users would normally only seen the remote control application, [left panel]. The server [right panel] would normally only be visible on the server PC. The server communicated with the helicopter driver software, and relayed commands received over the Internet to the helicopter.

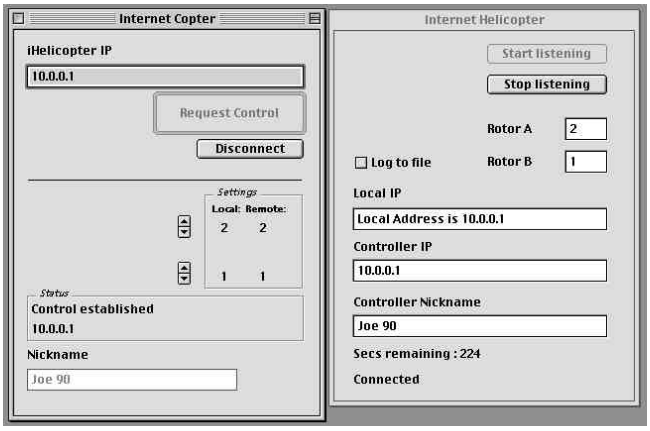

Figure 2: IH remote control and server

IV. RUNNING THE SYSTEM

The Internet Helicopter web site provided a web-cam overview of the helicopter location. Download links to the different versions of the remote control executables were available from the home page. Links to download sites for the videoconference software (in MacOS and Windows versions) were available. ‘Opening hours’ were listed on the home page. Although the helicopter was quite robust, it was vulnerable to damage if slammed against the end stops, which was a possibility. Therefore the helicopter was staffed by ‘minders’ during ‘open’ periods.

Users were able to download the remote control application, and videoconference package. Both were configured to connect to the correct servers when run. The user was required to enter a ‘nickname’ into the nickname field of the remote control application, and could then request control of the helicopter. When the server received a control request a link was established. The user would retain exclusive control of the helicopter for three minutes, unless they disconnected earlier. After three minutes the server would disconnect to let new users take control. The user could issue commands to the two different rotors. Commands were issued by using spinner controls. The setting for the spinner control was displayed in the application, and was echoed back to the remote control application by the server for confirmation. When the server received new rotor settings it sent the settings through to the helicopter, increasing or decreasing the speed of the rotors.

As the helicopter moved a (slightly delayed) video image from the camera attached to the helicopter was fed to the user via the videoconference package. This gave a ‘pilots’ eye view. The frame rate achieved by the videoconference package was in the range 5frames per second to 1 frame every 3 seconds, depending on network traffic. The web-cam view was refreshed every ten seconds, and was therefore less useful in helping the user control the package.

A competition element is necessary for a game. In this Internet recreation users had to identify the items situated around the helicopter. These consisted of a collection of Pokemon™ character soft toys.

The project ran for three days, with three or four hours of 'opening hours' per day. During the opening hours the machine was manned to ensure that the robot was not damaged by too exuberant operation. In practice users often lost control of the helicopter within about two or three minutes, and the operators needed to reset the helicopter into its starting position.

V. Discussion

The Internet helicopter was accessed on each day of its operation. About 700 interactions by 15 users were recorded in the usage logs. Users logged on to the web site, downloaded the files, and interacted with the helicopter model. Many of these interactions were not particularly successful in terms of control of the helicopter. In most cases the helicopter responded to the first few commands, and then the feedback delay took its toll, and the minders had to resume control of the system.

No user managed to complete the fantasy task, identifying the location of all the soft toys.

Later feedback from users suggested that the instructions for download and operation were weak in some respects. The interface relied on some knowledge of computer terminology. Given the probable user population this seemed reasonable, but in retrospect the assumed knowledge was inappropriate. An online form was used to collect feedback from users.

Reviewing the performance of the system in terms of Malone's checklist one can identify certain successful and certain unsuccessful aspects of the Internet helicopter project.

Goal: The goal for users was fairly clear, establish control of the helicopter and find the mystery objects (soft toys). The goal was not particularly meaningful for the user population. Users established control of the helicopter but few were able to complete the identification goal.

Uncertain outcome: The Internet helicopter had uncertain outcomes, in that the skill involved to complete the task was quite high. There were not multiple goals to achieve, or a scoring mechanism to indicate these, but this could have been included in the system. The system was difficult to control because of feedback issues, but there was not a random element in it. There was an element of the revelation of hidden information, as different soft toys were discovered, however the necessary skills to get to the required level of control were more difficult to achieve than had been anticipated.

Fantasy: The activity did have a fantasy element, the appeal of controlling a helicopter over the Internet. However the goal of finding the soft toys was not particularly consistent with this fantasy element. The learned skill was not particularly relevant to the secondary fantasy.

Curiosity: The visual feedback from the video feed attached to the helicopter was quite evocative, with the rotors visible, moving at the top of the frame. There was no auditory feedback to the players. However the minders were instantly aware of user interaction as the helicopter motors revved up as soon as a user started to issue commands to the helicopter. This was quite an eerie experience. There was a cognitive curiosity element in the system, the views from the helicopter changed, and new vistas presented themselves. The feedback was often not very constructive though, and the low resolution of the video images reduced the quality of the reward.

VI. Conclusion

The Internet Helicopter provided a good opportunity to build a simple Internet based recreational system, designed for a predetermined short life. In 2002 a second system is being designed, as part of an undergraduate project. Lessons learned from this project will be applied.

VII. Acknowledgements

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Twin Rotor MIMO System is manufactured by Feedback Instruments Ltd., Crowborough, E. Sussex, TN6 2QR, UK.

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