Knightsmove

Russell Jordan **Samuel Mann**

Department of IT and Electrotechnology
Otago Polytechnic,
Dunedin, NZ
russellj@tekotago.ac.nz

This paper describes the development of a large scale interactive surface. The initial use was as a giant chessboard for marketing: "Knightsmove". Further uses include immersive games, music and control systems. It is also being used as a platform for research and teaching in human computer interaction.

The Knightsmove game was developed by the authors and constructed over a period of five days (and nights) by staff and students within our Diploma of Electrotechnology and Bachelor of Information Technology. The paper describes the development process, including lessons learned in the construction of "human scale computing".

1. INTRODUCTION

In this paper we describe our response to two significant challenges. The first challenge was to find a way of promoting a department that contains both Information Technology (IT) and Electrotechnology (ET). The second challenge was to build such a thing in a very short time span. The "Knightsmove" game was developed by the authors and constructed over a period of five days (and nights) by staff and students within our Diploma of Electrotechnology and Bachelor of Information Technology.

2. MARKETING THE "INVISIBLE COMPUTER"

The combined nature of our department, while unique in some ways, can be seen to be a microcosm of computing in general.

Various authors have discussed the trend of the invisible, or ubiquitous computer. Kaku (1997), for example, envisaged "millions of tiny intelligent systems embedded invisibly in our environment, in our clothes, jewellery, glasses, cars, furniture, and walls. They will be able to recognize our voice commands and carry out simple wishes". Similarly Weiser (1991) argued the goal of "integrating computers seamlessly into the world…does not just mean computers that can be carried to the beach, jungle or airport…such machines cannot truly make computing an integral, invisible part of the way people live their lives. Therefore we are trying to conceive a new way of thinking about computers in the world, one that takes into account the natural human environment and allows the computers themselves to vanish into the background".

This poses us a problem. In an educational environment where marketing our courses is a necessity, we are left with an invisible computer: we are selling an intelligent ether.

In the last year we have been approaching this challenge with a "Spot the computer" approach. Advertisements have contained quality images of anything but computers with text linking back to an exciting world in which computers are all pervasive, but invisible. The next stage was to replicate these ideas in an interactive form, suitable for use in careers expos, shopping malls, schools and the like.

We have previously been disappointed with installing innovative and exciting software on computers at events, only to have crowds walk past with an air of 'just another computer'. This is not helped by most of the other exhibitors using interactive software to sell their courses: cookery, defence forces and tourism.

Nielsen (1993) described non-command interfaces with a user focus. Rather than the "use of a computer often feeling like exactly that: the use of a computer, and not working directly on some task", he describes a two person card table where "users can then concentrate on the game and on moving the cards as they would in real life without having to issue specific commands to the computer". There is also considerable literature in the area of exhibit design. Walker (2001), for example, described how "the computer ceases to be a stand-alone box, and becomes so well integrated into the gallery that, in effect, the exhibition is the computer, and the artefacts, information, and visitors are the data it processes".

Kaufman and Kline (2001) argued that such systems should be direct, intuitive, and obvious. Rather than using a mouse or button which "only emphasizes the seam between the real world and the virtual", they suggest that "using the position and motion of a visitor's body as an interface device". This, they argued "not only make the interface more intuitive, they make the experience more engaging".

From these experiences and literature we concluded that we needed an interactive and physically engaging game experience that was not a computer but sold the message of an exciting career in computing.

3. KNIGHTSMOVE

The Knightsmove game developed is essentially a giant chessboard (Figure 1). Two players stand on the board and race each other to a target square moving only by the knight's move from chess. When one of them reaches the target square the target is reset and the chase continues. The winner is the player who reaches the most targets in a defined time.

3.1 Physical design

The Knightsmove game is played on two boards, each 3.6 m x 2m consisting of a 9 x 5 array of 400mm squares. Each board is made up from three 3 x 5 arrays. Each of these 3 x 5 arrays is physically separate and has an 8 wire cable connecting it back to a multiplexer board which in turn connects to the HC11 microcontroller (Figure 3). The microcontroller repeatedly accesses the 3 x 5 arrays separately and sequentially via the multiplexer. Development was first by prototype of an individual square, and by constructing a matrix board to test software (Figure 2a,b).

An occupied square is detected by a switch contact being closed. The switches are made from overlapping rows and columns of metal held apart by insulation down the edges of the squares. The weight of the player deforms the top layer of the metal and brings it in contact with the bottom layer thus closing the switch. A rubber bush aids the natural spring action of the metal to open the switch when the player moves off of a square. The occupied square can be identified by the row and column through which the connection is made as each 3 x 5 array has a separate wire for each row and column (8 wires in total).

Logically both boards are treated together as a single 9 x 10 array and each square in the array has a unique number. When the HC11 detects an occupied square it transmits the unique square number via its RS232 serial port to the computer controlling the display projector. The system was designed so that the workings were hidden: even the projector was disguised in a pillar.

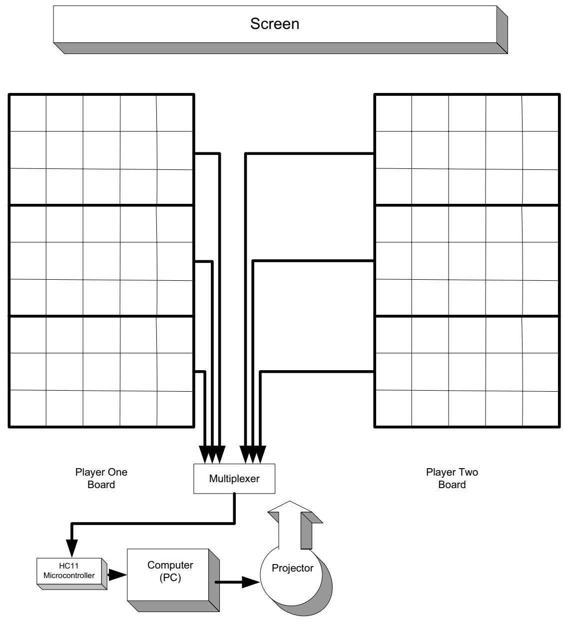

Figure 1: Knightsmove system diagram

3.2 Game software

The software for the microprocessor was written in assembly language. The visual and audio interfaces were controlled by an application written in Visual Basic 6, and running on a PC.

Pictures from the "Spot the Computer" campaign were used as the basis for the visual interface (Figure 4a). These were segmented into the board squares and arranged as contiguous pictures. The original plan was to project these images onto the playing surface, using two projectors to overcome shading. This, however, became too complex and, as we had no control over lighting at Expo sites, we opted to project onto the back wall. For each player we used a player icon to show current position and feet to show where they had been. The target square was shown with a computer icon.

We wanted to be the centre of attention at Expos and so used a lot of sound, both variety and volume. For each of "start", "bad", "good", "nearly time", "goal" and "reset" we compiled a library of 20 sound bites.

For every event received via the RS232, the controller checked if it was a current square (and ignored it if it was), otherwise it checked if it was a valid move and then if it was a winning move (found target). For invalid moves the system played a "bad" sound and flashed that square red. For valid moves the system played a "good" sound and moved the current player. For a winning move we flashed "goal" and refreshed the game board with a different "Spot the Computer" image and a new, randomly positioned target square.

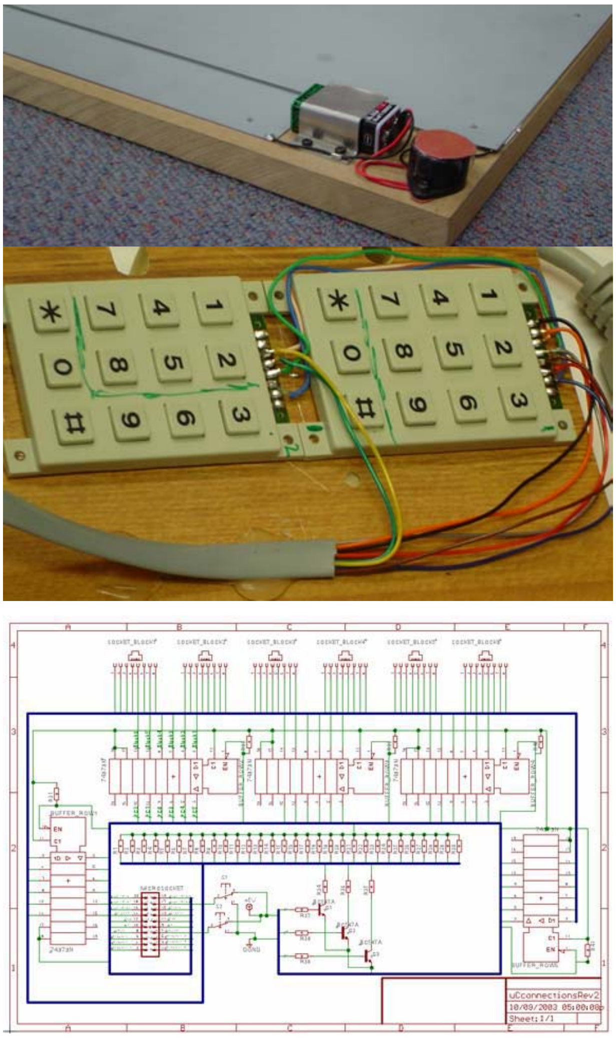

Figure 2: a) indvidual square prototype, b) testbed matrix, c) printed circuit board design

Fortuitously the refreshing individual segments of images occurred in random order, giving an impressive change effect.

4. PLAY DAY

Knightsmove had its first outing at a two day careers expo in October 2003 (Figure 4). The game was a hit and used almost continuously with queues. The feedback was fantastic and we won the Award for the best display.

Several modifications were made during the first day's play. We added a static diagram showing the pattern of allowable moves and put numbers on the squares to make it easier to assist players. We also changed the points system, by removing the negative feedback of losing points for wrong moves. We found that the time advantage of skilled players outweighed any points loss. To aid weaker players we reset their current position to their physical position when a new round started.

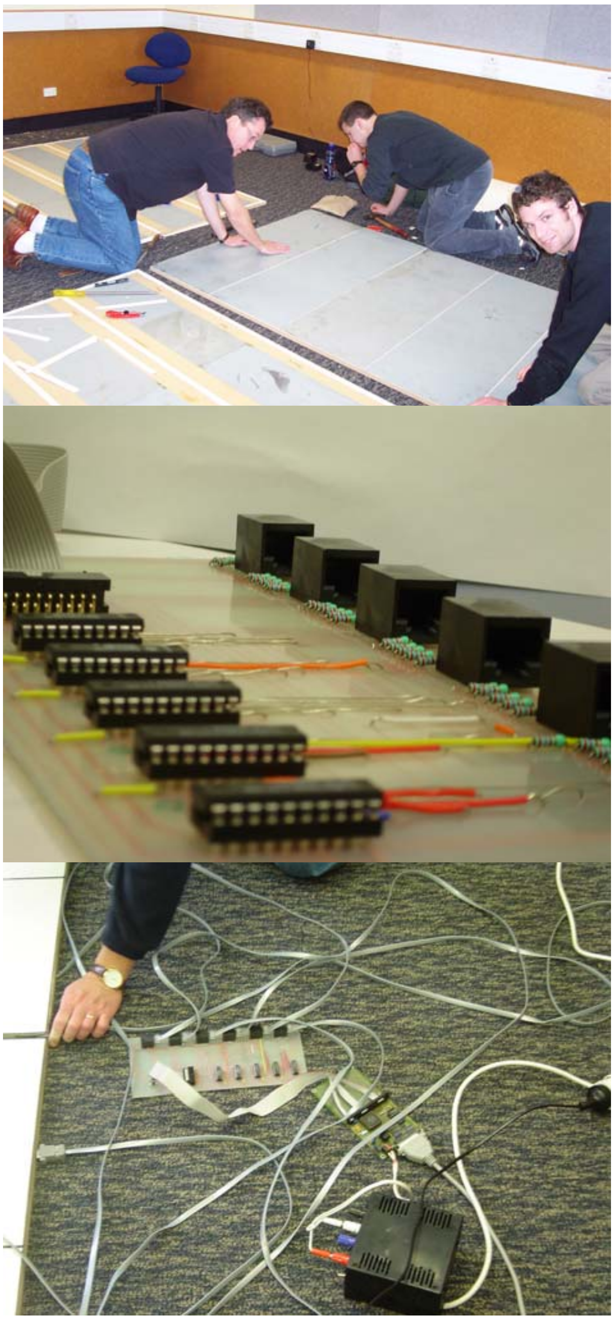

Figure 3: a) construction of playing board, b) multiplex unit, c) testing hardware

Although the intention was to hide the workings of the system, we found that we were inundated with "how did you do that?" (see also Schell and Shochet 2001). We realised that, unlike Disneyland or museum exhibits, it would not "spoil the illusion" to expose some of the workings. On the first day we made visible debugging aids (a scrolling text box of the RS232 input), and on the second day moved the multiplex and microcontroller to a desk at the front of the system.

5. DISCUSSION

Future work on the physical platform includes losing the board altogether using sightlines and infrared sensors. We are also investigating using virtual and

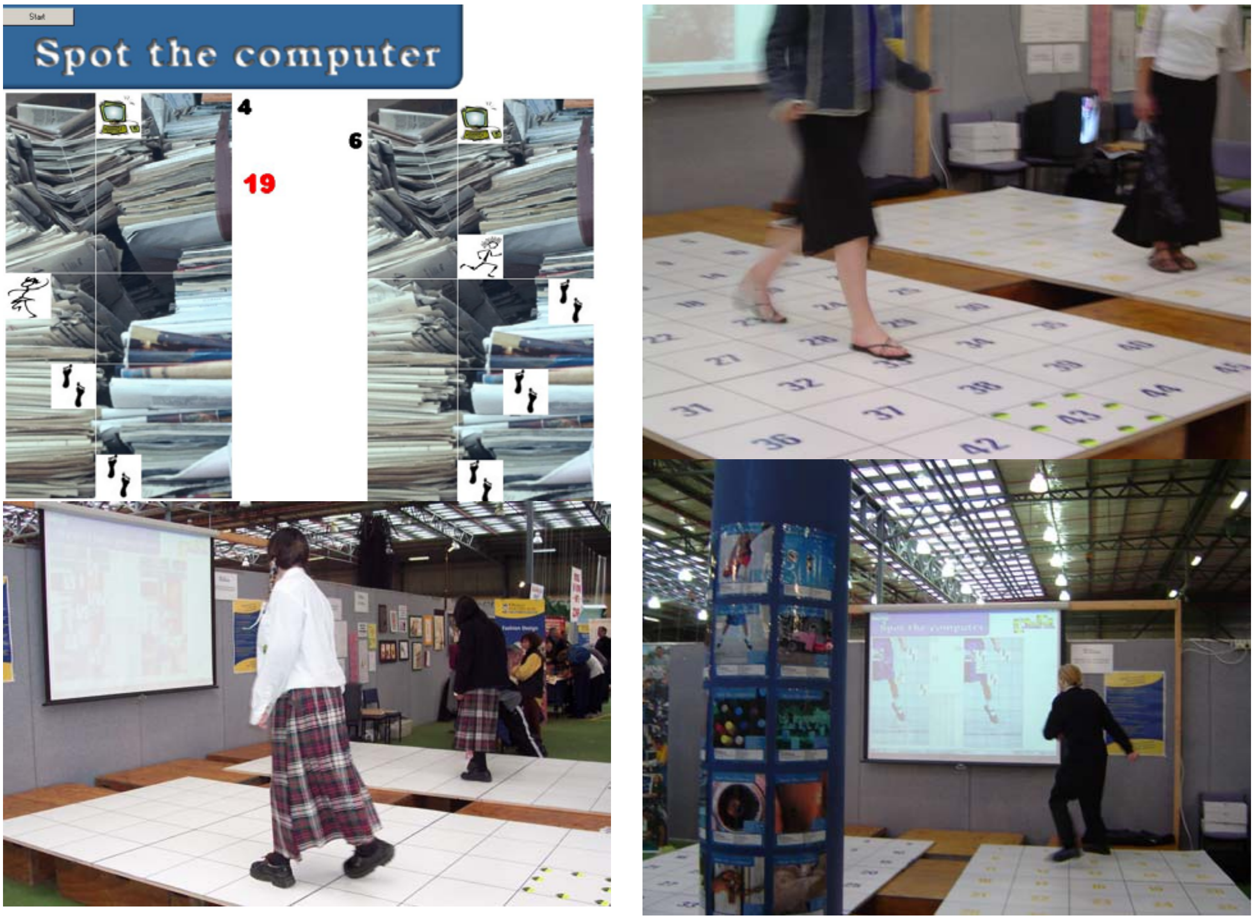

Figure 4: a) Interface and b) gameplay

augmented reality to enhance the player experience (virtual obstacles, etc).

Further uses include immersive games, music and control systems. It is also being used as a platform for research and teaching in human computer interaction. We intend using the game as a platform for developing and testing measures of performance in human computer interaction where the computer is not really part of the equation (Shneiderman 1992, Shelley 2001).

The game was intended to bring together infomation technology and electrotechnology. It did this in more than one way . An unexpected benefit was the two groups of students working together. Students also found benefit in a real task (outside any assessment perogative) and a real deadline. The Knightsmove game has demonstrated that a trend towards invisible computing poses problems but gives rise to significant opportunities for marketing.s

Acknowledgements

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