WORKS JUST LIKE CLOCKWORK:
Model Making for Teaching Computing Concepts

Dr Samuel Mann, Mike Goodwin, Jo Bagrie
Department of Information Technology
Otago Polytechnic
smann@tekotago.ac.nz

While computing is becoming ubiquitous, it is the *use* of computers rather than the computers themselves that are catching the public's attention. This project aims to put some explanation and some fun into the field: a set of physical models is being developed that will form the basis of an exhibition and also used for investigating pedagogical issues.

This research investigates the value of physical models and model-making as learning tools in understanding abstract computing concepts eg binary, logic, etc. Demonstrating the abstract concepts involved in computing by using models is engaging and understandable for students.

Various authors have discussed the trend of the invisible, or ubiquitous computer. 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 we are faced with an invisible computer: we are teaching about intelligent ether. While this has some advantages (for example Milekic, Gaia *et al.* 2006 discusses notions of "magic" in technology development), abstract concepts and even the physical boxes are increasingly ethereal.

We have previously developed 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 a large scale interactive form: *Knightsmove*). Although the intention was to hide the workings of the system, we found that we were inundated with "how did you do that?". We realised that, unlike Disneyland or museum exhibits, it would not "spoil the illusion" to expose some of the workings. In the current project we try to take the 'exposed workings' to the extreme and make them the focus of attention.

An interface is all that most students get to know about computers, and the working mechanisms are getting harder to observe, much less get your hands on! Students who learn with models therefore, are more exposed to the combinations of mechanics and logic to forge a unique kind of connection between hand and mind.

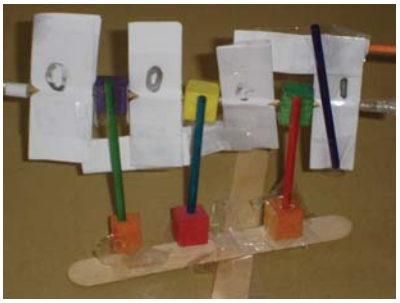
We developing an integrated set of models aimed at demonstrating different components of computing. For each subject there would be four models:

- A large kinetic model
- A paper automaton kit of that model
- A computer simulation of the model
- A representation of the actual use of this concept in computing

The use of a paper model is intended to meet three needs. First it gives a sense of 'cool' (the same reason pop-up books have become so dominant in recent years). Secondly, it provides a vehicle for engagement. Thirdly, it is hoped that by reducing the components of the computer to something that people can actually make, it will reduce some of the mystery around computing. For example, "here is a technology (or at least some of it) that I can actually make". Precedents include "make your own working paper clock" and papers published on the pedagogy of cardboard models.

Subject areas include: Binary counting, bits, bytes; Binary logic; CPU operation; Hard drive function, file structures; Network protocol; Programming constructs – if/then; Procedural Programming constructs – do/while; Procedural Programming constructs – function call; Object concepts – objects (inheritance, collections); Sorting algorithms; Database ISO model; Relational database; Data acquisition; Laser printer; Speed of operation – Moore's law; XML/HTML constructs; Web 2 Social constructs (Wikipedia etc).

Figure 1: Paper based prototypes for binary odometer (with Mike Lopez left, with Rod Markham right)



Poster paper in the 20th Annual NACCQ, Mann, S. & Bridgeman, N. (eds) Nelson NZ, July 8-11 2007 www.naccq.ac.nz