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l.hastilow@londonmet.ac.uk**Cubed****A Networked Physical
Gaming System**

Commissioned by Folly as part of its Portable Pixel Playground (PPP) project, Cubed is a networked set of gaming objects that enable the exploration of diverse physical spaces and helps to develop relationship-building skills. The project was launched at the Abandon Normal Devices (AND) Arts Festival held at Grizedale Forest Park, Cumbria, 2nd April 2010.

Cubed makes use of recent advances in embedded technology to deliver a unique platform for kinaesthetic engagement and creative play. A set of eight programmable plastic blocks – wirelessly interconnected to form a meshed system – Cubed enables a range of different individual and team-based games and offers the capacity for further game developments utilising feedback and input from participants.

Conceived as a system of Cellular Automata, Von Neumann (1966), Cubed enables populations to work as open systems of communication. In such systems programs can exist across individual components or nodes. Rather than standing independently, each cube benefits from its changing relationship with others in the system. Such organising principles can be extended further, by taking into account each player and their relationships with other players, as well as the associations between players and cubes. Taken as a whole, these interactions form a complex web of reflexive relationships, heterogeneous assemblages of playful engagement.

Each cube consists of a hard-wearing translucent plastic housing, containing a Printed Circuit Board (PCB) that hosts a Microcontroller (μC), battery, interface electronics and transducers. On each face, an infrared LED and photodiode form a short-range transceiver, facilitating communication between cubes and detecting surface proximity. The primary user feedback method is an RGB LED array diffused to illuminate all faces of the cube. Integrated peripherals within the μC enable communication, sensing, data storage, and software control in response to hardware events.



Fig. 1: Colour Cube Photo: Giles Askham

The software running on each device is architected upon the automata-based programming paradigm utilising Shalyto's (1991) approach in which distributed Finite State Machines (FSM) interact to form a complex, self-organising system. Each device communicates and senses using event-driven procedures in order to maintain an environmental model of the gaming system as a whole. It is this model that determines game state transitions and thus the state of play.

The selected game in play is actuated through a particular physical interaction; e.g. hiding the cubes under clothing for a specific time period. Games are written as FSMs, and a structured high-level scripting language is in development to support open and accessible game authoring. Future technical developments include wireless induction charging and software re-programmability via infrared (IrDA), enabling each device to become a completely wireless entity.

The AND festival provided an opportunity to field-test and observe Cubed in use. Members of the public were able to play two games, Colour Cube and Treasure Hunt. Colour Cube (see figure 1.) is a simple mimetic game in which participants match the colour of cubes to that of a system-allocated control cube. The control cube cycles through each of its six colours periodically and the colour of the remaining cubes is determined by their orientation, which players change via physical interaction.

In Treasure Hunt, six cubes are hidden in the local environment and the two remaining cubes are given to two teams or individual players. Each of the cubes in the local environment takes on a different colour, and the

players' first objective is to find the hidden cube that matches the colour of their own. When these two cubes are placed in proximity to one another, the colour of the players cube changes, giving them the colour of the next target object. The first to find all of the hidden cubes wins the game.

There was a positive response from the public to both of the games and the tactile, physical nature of the system was commented upon. The system has since been used in a variety of contexts as part of the wider PPP project. Treasure Hunt was effectively used in a museum setting, enabling the exploration of various exhibition displays. It would seem apparent from this informal feedback that Cubed is effective in its aims of moving away from desktop paradigms of sedentary behaviour, and that it provides an opportunity for a physical activity enabled by technology.

Cubed is currently in its second phase of development, aiming to utilise advanced digital manufacturing and implementing 32-bit embedded micro-controller technology. Cubed seeks to carry out computation in the physical realm, and to provide a unique form of engagement. It is a new object to think with, and may even provide us with a window onto the machinic phylum, DeLanda (1991) of non-linear systems of interaction.

References

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