

Theory and Practice in the *City* Project

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Abstract

The *City* project focuses on a treatment of the city that deliberately blurs the boundaries between physical and digital media. We are combining mobile computers, hypermedia and virtual environments in one system, and allowing each person to interact with others even if they are using quite different media or combinations of media. We have found it useful to consider the many media, technologies and spaces as one design medium, because each person's experience depends on them all. People's activity continually combines and cuts across different media, interweaving those media and building up the patterns of association and use that make meaning. How people act and work is determined by the full combination of media that they can use and have used, and hence a narrow focus on technological media as the paramount determinant of activity underrates the influence of other media. Recent technological developments, including the ones we ourselves are engaged in, heighten or highlight a phenomenon already familiar through analysis of the effect of older media such as written text, maps and cinema. Our system is both driven by our theoretical approach and driving the development of theory. This paper describes some of the theoretical issues and directions we are exploring, and our ongoing system development. One of our long term aims is consistency between theory and design practice as we work in multiple media, support synchronous and asynchronous communication, and balance subjective and objective interpretations.

1. Introduction

A city's meaning is not just in its bricks and mortar, but also in our understanding and use of it. Physical space is just one of the media that affords activity and interpretation, and at any time one is likely to have symbols in a number of media available for interpretation and use. As I step out of a train station into a city square, the printed map in my hand, the voice of a colleague on my phone, and the signs informing me of exit routes and exciting shopping opportunities are all open for my interpretation and action. Temporally, symbols in an even broader range of media may influence me, as my interpretation and activity at any point in time is influenced by my past experience and my expectations of the future. Past experience may include my previous visits to that city, seeing television footage of the city, experience of magazines, books and films about urban life, and so forth. Our understanding and expectations of life in the city influence our activity as much as immediately perceptible physical phenomena such as texture, sound and light. For almost a century, a fundamental tenet of linguistics and semiology has been that such low-level physical phenomena are interpreted by a person via language, by the patterns of activity that the person has experienced in any and all media.

The *City* project aims to weave digital information into the physical streets, buildings and artefacts that people use, and to do this in meaningful ways i.e. ways that fit, show and support their activity. We wish to work with something richer and more complex than a collection of isolated pieces of information and media. We also wish to move beyond the traditional systems of classification and categorisation that too often over-objectify information and activity. Computer scientists tend to focus on the obvious differences between physical and digital media, and treat each one independently. Here, a broader viewpoint takes account of their similarities and interdependencies.

We are creating a growing and evolving body of individuals' paths or narratives through the people, places and artefacts associated with the city of Glasgow. An initially static collection includes images, textual descriptions, and references to locations in the city, to artefacts in museums and exhibitions, and to electronic resources such as web pages and virtual 3D environments. Later, we will allow this body of information to grow as people use it, making new associations between symbols and adding in new ones. These evolving inter-subjective patterns of association and use will thus complement the static or *a priori* categories, type systems and indices that partition artefacts, spaces and people. We are building systems that afford information access based on both objective and subjective bases.

While the project will gradually extend the range of places and topics it handles, the initial focal point is Charles Rennie Mackintosh, the architect, designer and artist. A rich body of 'people, places and things' related to Mackintosh exists here in Glasgow. Examples include his reconstructed house within the Hunterian Gallery and Museum, the exhibition room devoted to his life and work within the Lighthouse Centre, and of course the buildings he designed such as the Art School and the Lighthouse itself. The Hunterian and the Lighthouse have agreed to be partners and test sites in this project, and in other related projects within the six year, eight site and £11,000,000 consortium called 'Equator'. Equator (www.equator.ac.uk) is an 'interdisciplinary research collaboration' funded by the UK's Engineering & Physical Sciences Research Council and involving computer scientists, sociologists, psychologists, artists and designers. University College London, the Royal College of Art and the universities of Bristol, Glasgow, Nottingham and Southampton are taking part in the *City* project, with Glasgow as lead.

A phrase or motto often appears when Equator is first mentioned in papers and PowerPoint slides: 'to bridge the physical and digital.' As with other Equator projects, *City* addresses this issue both at a theoretical

level and at the level of technological systems and devices. In the next section, we will discuss the theoretical side of our work. The following section then focuses on ongoing system development and demonstration.

2. Spaces, Media and Technologies

We often focus on the obvious differences between physical and digital media, and treat each one independently. This is the case in contemporary HCI and computer supported co-operative work (CSCW), and the distinction between space and place is a recurring topic in HCI theory and design discourse, in part because of new digital and informational 'spaces' (Harrison and Dourish, 1996, Chalmers 2001). Here, we emphasise the similarity and interdependence of media, and explore notions of information and language based in (Wittgenstein 1958) and the philosophical hermeneutics of (Gadamer 1989) and (Ricoeur 1981). Our information, understanding and expectations of life in the city influence our activity, and are resources for activity, as much as physical structure. As with the word or the text, and to paraphrase Wittgenstein, a city's meaning is its use in the language.

Space is interwoven in our activity and language. Shaping and motion are interpretive acts i.e. we consider spatial activity as part of language. This is not to imply that every action is consciously constructed and explicitly performed. Such activity can be explicitly planned and crafted, as in the design of a building, a choreographed step, or a sprint to catch a bus. It can also be mundane to the point of being implicitly or unconsciously done, e.g. in how one puts a book on a table, faces someone while chatting, or strolls a supermarket aisle. We consider a 'place' to be a space interpreted as a symbol in language, given meaning by its patterns of recurrence in human use. This interpretive act happens in the same way that a pattern of sound waves can be a word, a curve of ink can form a letter, a move of the hand a subtle gesture. In each case, the former is a perceivable pattern in one or more physical phenomena, which has the potential to be used symbolically, while the latter is the symbol in language. We continually mix phenomena in our everyday communication, and spatial media are an essential part of that mix. While space has its unique characteristics that differentiate it from other media, it has no privileged position above or apart from them. The meaning of a space is its use in the language, as understood in and through the activity of those who use it.

Media spaces, virtual worlds and all technological forms of representation would be useless if they did not overlap with and share references to the patterns

of symbolic activity of verbal, written and gestural language, and hence with the activity in everyday physical space. As Harrison and Dourish put it, "after all, a virtual world filled with virtual offices and virtual desks isn't populated by virtual people, but by real ones."

Although we continually explore new combinations of media, many combinations that include technological media are now insignificant, mundane, and everyday. For example, if I read an email and then speak to a colleague across the room about the message, neither of us would comment on the bridge between electronic and face to face communication. If I look at a sculpture then glance at its caption, all the while listening to an audioguide, the correspondence between the three media is unlikely to strike me as remarkable in itself. It is not that there is no difference between communication via email and talking to someone in the same room, or between sculpture, text and speech, but we are familiar enough with the constituent objects, tools and media to act through them i.e. to act in normal, everyday manner. They are so interwoven with everyday life that they are no longer worth noticing as special, novel, or even distinct.

We can not claim that the distinguishing feature of technological media is their difficulty of use, in that they limit or transform our perception or communication. This is a feature shared by all media. The limited field of view of the eye and the compression of perspective, a city street's constraints on view and motion, and one's finite experience and current context—these also limit and transform what one perceives and hence influence how one interprets the 'natural' world. What makes a medium distinct or differentiable from others *is* its characteristic limitations and transformations. One can understand a new medium, technology or design in terms of what it physically affords, but also by understanding it in terms of issues such as individual and social, focal and contextual, local and remote, and past, present and future.

Many electronic and digital media are familiar and assimilated into everyday life, so that activity is no longer exotic, foreign or 'virtual'. Do we imagine that when the telephone was invented, its use was not just as difficult and disjointed as that of 'virtual worlds' today? And why, for example, don't people say that they are 'entering cyberspace' when they talk on a digital phone, play a CD, or watch a digitally-recorded film? Only a few years ago, wide-eyed Wired readers often used 'cyberspace' when referring to email, newsgroups and the Internet. Nowadays this term seems slightly embarrassing and gauche, and 'virtual worlds' and 'virtual reality' are heading the same way. Why don't we use these terms to describe computer

games, for example? The technology and the media involved are either the same or similar to VR, but the familiarity and design quality are not. Virtual worlds may, for the moment, strike us as strange and separate but they are part of the same reality and the same world—of work, leisure and society—as other media. Their novelty will pass if we use them, as happened a long time ago for the book, cinema, television and radio, and is now happening for email, computer games and the Web.

Difficulty in using such a combination of media stems not so much from the fact that a combination is involved, but that the particular representations and interactions in that instance of a combination, i.e. the overall design, is a poor fit with the people and their activity. Willem Velthoven suggests that multimedia is just a combination of sound and image that is too badly designed to be called 'film'. He exhorts us to get over the novelty of 'new' media, and to use and combine them with all our other media. Focus on good design and communication—on *monomedia* (www.monomedia.org).

As we use novel media and combinations of media, we weave them together, appropriate them for our own ends, and make them part of our everyday lives. When we recognise that many digital and electronic media are already part of our everyday lives, Equator's aim to 'bridge the physical and digital' might seem rather antiquated or odd. Since we can now see that these two are already aspects of the same world, the boundary line of Equator is not between physical and digital media as such, but in that area where appropriation of mixed media is happening and where we make appropriation happen. Equator should be seen not as a static line between physical and digital, but as a shifting and shadowy grey area between familiar and unfamiliar combinations of these media, between everyday and novel, between appropriated and experimental.

The combinations of technologies and media that Equator explores will initially be novel or unfamiliar enough that the combination is itself the focus of attention. Our work will then be directed towards making the media workable as much as towards working with it. At first this will mean workable by us, the technologists, but we must aim to widen our view and loosen our control so that others can experience, explore and express themselves through these media. New mechanisms, devices and systems afford new forms of design, work, leisure and society. Our work should be based on an understanding of how they might be appropriated into everyday life as well as some idea as to what aspects of life they may create or destroy.

Therefore, we should show a balance between being technologically driven and critically aware.

We should be selfish and creative while also being socially responsible and responsive. This may at first seem contradictory, but it is a necessary reaction to the fact that, as with anything we create, we cannot fully predict how new technology will be used and appropriated. Making something new demands difference, creativity and individuality. It is technologists' awareness of the use and effects of their work that are often criticised, rather than their creativity. Artists' and designers' work is very similar, as they express new possibilities for use and interpretation in their work too. Both groups simultaneously create individually and intervene in others' lives. The 'users' of one group are the audience of the other, and the community, market or habitat of both. Our work with people such as the RCA Computer Related Design group requires our understanding and integration of contrasting and (happily) contradictory uses and interpretations. Opening up our work to public view lets more of the people whose lives will be affected by technology and design influence their development. If we claim that our work will ultimately help, enrich or inform them, they can help, enrich and inform us by offering interpretations and uses that change and intervene in our activity.

3. System Design and Implementation

We are beginning with a relatively small, controlled environment, the Mackintosh exhibition room in the Lighthouse, where visitors can use a mixture of technologies to get information tailored to ongoing activity. This tailoring is based on their ongoing motion through the room with the artefacts and information they have recently shown an interest in, and how these relate to the ways that other people have interpreted them. We then aim to extend the work to the Hunterian's Mackintosh House, and then to streets between the two, to more people, to a wider range of information, to a larger city area, to different cities... and so on, as far as our interest takes us.

Our work involves combinations of static and mobile devices: small portable devices communicating via wireless networks with each other, with large, static display devices, and with server machines across the network. Later GPS and other larger-scale communications media will be added. Servers store historical and cultural information as well as people's paths, tours and explorations. Large static displays can offer the resolution and space to show information too detailed and large for small mobiles to handle. Mobiles can be 'ready to hand' tools that afford not just portability but also individual control of shared technology. For example, a mobile can be used as an input device to control a large display, and of course as a personal source of audio and graphics. It does not

just allow a person to carry with them his or her own ongoing information. It can serve that person as a key that represents a role or capability that he or she has, as an identifier to say who he or she is, or as a locator to say where he or she is.

We do not consider the images and fragments of text as our fundamental or central data. We wish to avoid making yet another database full of sterile bits and pieces about dry exhibits, dead people and empty buildings. We represent the paths or narratives through such symbols, i.e. points of view and interpretation of how people have used them, possibly implicitly expressed, that in turn afford reinterpretation. Also, we are not focusing on more tightly structured or scripted activity characteristic of traditional work. To use Schmidt's metaphor, we are focusing on maps not scripts (Schmidt 1997) i.e. on resources for activity and interpretation. We mix the work of the author, curator or guide with the leisure of the tourist or visitor in the cultural city setting. We do not intend to make these paths just by ourselves, but to have a number of parties contribute their own interpretations of the 'raw' data and of existing paths. In the course of this creative process, they might wish to bring in additional images, references and so forth, and we will support this. We will begin with the official or 'high culture' views of Mackintosh and the city, with our editors or authors including Mackintosh curators as well as other workers within cultural information and institutions in Glasgow. Then we will open their paths or narratives to visitors and residents of the city from a number of communities and backgrounds, and activity will be recorded and added to the set of paths.

We are now building a central information resource, accessible via a variety of media and devices, that stores the paths/narratives in our system as well as the elements or fragments combined within them. While we have started with a static collection in our first prototype, this resource will later support additions, deletions, annotations and associations that are, ultimately, necessary to make the collection reflect ongoing use by a widening set of users. Here we draw on Southampton's experience in hypermedia systems, and work at Bristol and Glasgow with dynamic information services tailored to small handheld computers. Nottingham has developed a new and highly flexible middleware system, Equip, that offers a shared and distributed data modelling. This serves us well in integration work within the City project, and we expect that it will ease later collaboration and co-development with other Equator projects such as CityWide, a project centred in performance and involving

Nottingham, Southampton and the theatre group Blast Theory.

Another piece of infrastructure that is used by one or more devices is a set of systems for location tracking. In the case of location in a virtual environment, each person's location is easily obtained from the VR system. In the case of someone using a hypermedia document system, 'informational location' in terms of the recently used documents and links can also be obtained relatively easily. More difficult is physical location in the city or in a room. We can use GPS tracking and RF tags (often used and to more roughly and intermittently track location in the city. We are initially working inside exhibition rooms, where we use more fine-grained and continuous ultrasound tracking from U. Bristol. We can track a handheld computer to within 20cm at an update rate of roughly once per second. Note that a person can have a location or context that involves all three media. For example, he or she may be standing in a particular square in the city, reading a document describing its history, and using a virtual model of the city to fly around it and get a feel for the neighbouring streets and skyline. More generally, and reiterating a point from the earlier section, the project wishes to explore the interwoven and interdependent nature of such media, treating them as one holistic design medium, i.e. human activity, rather than as isolated parts. We do not treat any one aspect of location or context as ultimately dominant, but instead try to support one's shifting focus, use and combination of them.

We intend to afford access to paths via audio, wearable computers, tablets and VRs. In the first case, we would generate a stream of verbal and non-verbal audio, supplied to a phone or a computer that a person would carry. The audio would describe the artefacts close to the person, adjusting the information given based on his or her location and motion, and the choice of paths and expressions of interest in artefacts and information along the way. Steve Brewster at Glasgow has experience in using positional audio, that makes sound appear to emanate from a particular direction around the person's head. This can be used to guide the user and to aid discrimination amongst multiple sources of sound. In the second case, we refer to a wearable computer with relatively small graphical displays, audio interfaces and a variety of context sensors integrated into a 'CyberJacket', as developed by U. Bristol. These wearables are of particular applicability to places such as the Mackintosh Room, where we use available fine-grained tracking of location and direction. A tablet refers to a laptop-like computer with wireless network communications, and it may have greater computation and display facilities than a wearable. Again we can do some fine-grained tracking here, but we can show textual documents, 2D



Figure 1. The view of a VR visitor in our first partial prototype, with Mackintosh information and representations of a physical visitor. The physical and digital rooms are the same size, and have similar posters and furniture in matching locations. Video from the physical room was streamed into the digital room, showing the physical visitor (Cliff Randell). Cliff's handheld computer is tracked via ultrasound detectors, and this position is represented by the blond pigtailed 'avatar' in the centre of the image. The VR visitor is also tracked, and shown as a labelled dot moving on a room map on the handheld. Audio streams support direct communication between the two people. The text to the left is reversed as it is on the wall nearest to us—made transparent to let us gain this image.

and 3D graphics and animation, and so forth. In VRs, we refer to more high-end graphics systems that convey sophisticated 3D graphical and audio display of virtual environments, including immersive displays such as that of UCL and another Equator partner, the Glasgow Science Centre. Using such a system, a person would see a graphical model of the city with the paths overlaid, linking and interweaving the artefacts and spaces that make up the exhibition. VR and handheld/wearable systems are now inter-operating so that a person using a PDA can see another person using the 'same' room, and vice versa, as in Figure 1.

An important aspect of this variety of media and devices is that we expect people's activities in each medium to be perceptible in all media. This will mean that synchronous users, possibly using different media, are made aware of each other and can directly communicate with each other. An example would be that of a person walking along the physical Buchanan Street, with a wearable that is tracked. That person's activity would be represented inside a virtual model of the city. Someone in London, exploring that virtual city, would have his or her activity tracked too, as would someone in Iceland browsing the hypermedia documents about that street. The first person's wearable could show if the Londoner and Icelander were available for a chat, the Icelander's

documents could have temporary annotations with similar information, and the Londoner would see graphical representations of the Glaswegian's and the Icelander's activity and approachability. Again, we see human activities that span and connect media as being at least as important as the characteristic design affordances that differentiate and distinguish particular media.

Our design approach also means that use of each medium would be recorded in the central information resource, and made available for interpretation by people using the system later. This asynchronous communication will be in the form of explicit annotations and additions, in graphically presented paths/narratives of earlier authors and visitors, and in contextually specific recommendations of people, places and things. In the latter case we would use Glasgow's *Recer* system (Chalmers et al. 1998) that makes recommendations by comparing each person's ongoing context with his or her past activity and/or the past activities of others. Past activity here is represented by a time-stamped log of locations, documents, artefacts and people that each person has interacted with in all of the media we can: that person's *path*. As discussed in (Chalmers 1999), this approach to representation is based on a combination of aspects of the urban design theory of (Hillier 1996), structuralist (and post-structuralist) linguistics

(Saussure 1906/1983), and the trails of *As We May Think* (Bush 1945).

Irrespective of the media involved in logging and display, our algorithms for searching, matching and recommending do not rely on distinctions between these original media. They rely on their patterns of co-occurrence in human activity and hence in common semiological use. It is this change in emphasis that lets recommendations bridge across media usually held as separate in information systems, and lets us work with this everyday mix of types rather than against it. For example, a person who has been looking at the original chairs and tables made by Mackintosh may get recommendations of other physical artefacts to look at, but also of digital documents and virtual locations that might be of interest. These recommendations may come from people who have never seen the physical furniture, but have explored related digital information. One is offered information based on one's current location and the route one has recently taken, the information read and written, the artefacts one has shown an interest in—and how this activity relates to the activity of earlier readers, authors and visitors. The past routes and paths of curators, designers, authors and visitors are combined with current context to suggest recommendations for the immediate future.

At the time of writing, we have not integrated a hypermedia interface to the same room yet, but will do within the next month. We will also integrate the recommender system within two months. We are currently collecting our first authored paths, and installing equipment in the Lighthouse's Mackintosh room. Apart such technology development tasks, we have recently begun a study of the combination of traditional and new media, through a series of semi-structured interviews with curators and exhibition designers in a number of UK museums. We are also just about to start a sociological study of the activity and interaction of city visitors and residents. We continue to explore the philosophy of language, phenomenology, neuroscience, evolutionary linguistics, and urban design theory. These studies and readings will feed into later system design work and in reflection on our first full prototype. We plan to be able to demonstrate this prototype by October 2001, with synchronous and asynchronous awareness across all three media supported, paths interweaving symbols from all media and used as a resource for recommendations, and first experiences of non-Equator people to report and discuss. More up to date information can be found via the author's web pages.

4. Conclusion

Activity stems from previous understanding, but also feeds back into understanding by creating or reinforcing associations between individual objects, individual spaces and individual people. Individual action in its social context binds technological systems and artefacts into our everyday work, leisure, language and culture. A person's movement through data, through the city and through society adds to his or her understanding of information, places and people. The City project aims to support and explore this interpretive process. It also aims to explore technologies that blur the boundary or distinction between physical and digital media, to improve information systems by representing and adapting with activity in multiple media, and to make manifest more of the design, communication and understanding that changes the city from space into place.

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