The Augmented Marketplace

Voices, robots and tricksters

Richard Coyne, Ramond Lucas, Jia Li, Martin Parker, John Lee
Architecture: School of Arts, Culture and Environment, The University of Edinburgh
http://ace.caad.ed.ac.uk/richard/
http://ace.caad.ed.ac.uk/InflectingSpace/
http://www.tinpark.com/
http://www.hcrc.ed.ac.uk/~john/

To advance the theme of communicating spaces we report on a case study of a market precinct known as the Barras, about one mile from the centre of the city of Glasgow and relate this to our investigation into intelligent environments. In the latter case we deploy Lego MindstormsTM RCX robot processing to explore interactions between a mobile sensing robot and simple environmental controls: movements of sliding screens in response to an autonomous mobile sensor. We speculate on the application of these techniques to augment physical marketplaces. We extend the lessons from these studies to a consideration of multiple modalities in sensory experience, multi-agent systems, and the use of sound, the human voice and repetition for defining and augmenting spaces.

Keywords: *market; sound; voice; robotics; intelligent environments.*

The Marketplace

The study of markets is instructive in understanding digital media. E-commerce on the Internet has been likened to a bazaar: chaotic, dynamic, and opportunistic in its organization (Bloor, 2000). We discuss the romance of the Internet as electronic agora elsewhere (Coyne, 2005). As rich, sensory environments, local markets may also be instructive on the theme of embodied computing (Dourish, 2001) as they bring into sharp relief interaction between the senses of vision, sound, smell, touch, taste, and movement. Our case study focuses on a market area in Glasgow known as the Barras, in which the cries of market sellers are prominent. The name "Barras," short for "barrowlands," refers to the environment in which sellers would gather with their barrows and call out to draw attention to their wares. The barrows are now replaced by market stalls, but the sounds persist. Marshall McLuhan highlighted the role of sound as providing potent metaphors for the character of the electronic age. We are immersed in the media of radio, television, and now computer networks, much as we are immersed in sound. Sound is the medium of the tribe, and the electronic age ushers in a new electronic tribalism (McLuhan, 1962; Coyne, 1999). The voices of the Barras compete for attention, and iPods, CDs, mobile phones and sound files are amongst the hottest consumer items in contemporary local markets, as well as on the Internet.

The Barras was established around 1920, and has a well-documented history and folk lore (Terry, 2005 p.197). It is a destination for tourists to Glasgow, but as yet has resisted gentrification. The increase in fash-

ionable new housing in the area suggests that the market environment will change, but such marketplaces persist in spite of advances in electronic commerce and online shopping. We visited the site on numerous occasions as part of our research, taking photographs and sound recordings, and conducting focus groups of people with expertise in sound, music, anthropology and architecture to help analyse the data. We have also made comparisons with data from other noisy public sites, such as auction houses, Camden Market in London, railway stations, football fields, and department stores in Japan.

What is the relationship between the Barras, digital media and "communicating space"? Goods on sale include digital devices and media. Like many local and regional sites the market is caught up in reconfigurations of the local and the global that involve communications networks. There is information about the Barras on the Internet. It features in tourist guides. It makes use of the global import economy. It is an example of local enterprise that is invigorated by globalisation, amplifying local and national identity (Giddens, 1999). The Barras are managed using digital technologies. Store-holders succumb to processes similar to those attributed to the micro-entrepreneur, whose business acumen is abetted by mobile phone networks (Donner, 2005). The environment is patrolled by police who use mobile communications. The Barras also submits to analysis using digital media. Google Earth provides a clear image of the market on a busy summer day. People take pictures of the market with digital cameras, and we recorded sounds using binaural in-ear microphones that look like iPod earphones enabling inconspicuous, high quality recording. We also deploy our own online system for storing and logging research data.

Our investigations of the Barras drew us inevitably to the main junction at the centre of the Barras, the asymmetrical crossing of the market's two major axes. People are drawn to the crossing, and researchers on the team identified independently the same setting as affording the most interesting sound recordings. A typical visit reveals a series of prominent stalls at the four corners of the crossing, which encroach on the roadway. There is a stall offering packets of confectionary at "three for a pound." There is a CD seller, and a towel merchant draws a crowd with interactive repartee. The stall holders and their entourages seem also to sustain a loud, familial banter inviting shoppers to eavesdrop on local affairs. Sellers at the junction use vocal calls to attract attention and to define their areas of trade. We are studying the use of the voice as an architectural element in such spaces, but in this article we focus on lessons applicable to intelligent environments, speculating on the design of an augmented marketplace.

Markets and multimodality

The spatial experience of a market involves all the senses. We can also deploy different sensory modes in the representation of the Barras: static photographs, sound recordings, aerial photography, PDA on-site sketches, 3d models (Figure 1), and sound processing imagery (Figure 2). No single mode reveals all that the site has to offer, particularly as so much of the site's character is revealed through sound and the deployment of the human voice. Our study therefore corroborates the simple observation that visual apparatus are insufficient to reveal the character and functionality of rich, multi-sensory environments like the Barras.

Sight plays an obvious role in the configuration of the Barras. Objects have to be clear to view, and sellers attempt to catch the eye of a potential customer. There are needs for visual privacy. Sound is also important, in terms of the acoustic quality of spaces. But our study indicates that the voice is not only supplemental, but could be said to be a major determinant in the spatial definition of the market, its ambience or atmosphere, its functioning, the temporal organisation and the layout of objects (stalls), the transient architecture of the space. As a material consideration in the configuration of the spaces, the voice is more time-dependent and mobile than

the devices of vision, but is palpable in its own way, independently of what is actually being said (ie its content).

What are the implications of this multi-sensory character for intelligent environments? If such places are to succumb to digital augmentation then they need to take account of the voice. Sound, ambience and voice are aspects of the environment to be moderated and configured as parameters in intelligent environments. They are characteristics to be sensed, and provide means of communication within control systems. They also provide challenges to visually oriented design. Attending to the peculiarities of voice spills over into design processes, and the way designers deal with all the senses.

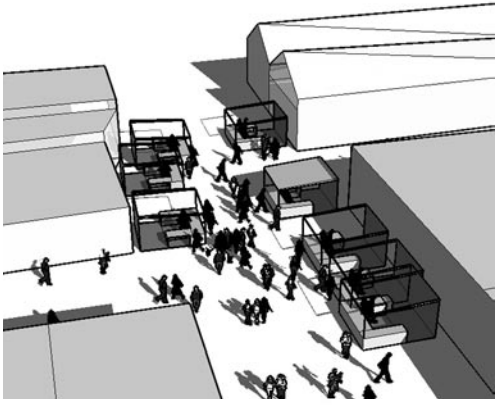


Figure 1
Sketch model of the Barras.

Figure 2
Melograph, visual representation of vocal inflection, a further representation of the Barras. The phrase is "three for a pound here."

Markets and repetition

Some stalls of the Barras are laid out in repetitive patterns. But the voice also features prominently as a repetitive element. The obvious means of defining space through the voice are volume, pitch, intonation, inflection, and the ambience created by voices overlaying and interacting with each other. As well as using the voice to communicate, people deploy the voice to manipulate their immediate environment. There are also emergent features of the voice outwith the control of any individual and that have a collective effect. In fact, in keeping with other observations of how people use music and sounds (deNora, 2000), we are not entirely willing agents in the use of the voice. In keeping with certain characterisations of language (Heidegger, 1981), the voice, or at least the incessant babble of voices, could be said to manipulate us. This is most obvious in the deployment of banal repetitions. Street sellers call out, almost in spite of themselves, and repeat their utterances to sustain their claims on space. Callers will even break away from normal conversation to assert their territorial claims.

We conducted an experiment to test the strength of the voice as a means of defining space in contemporary market situations. We set up a room involving three sound stations, each with a loud speaker connected to a digital sound system emitting a repetitive call as an abstract representation of the market setting. We could have used recordings from the Barras, but the scenario seemed contrived and inadequate in a small interior space. Instead, we used recordings of a voice calling out the FTSE100 stock listing, an auctioneer and a telephone train booking transaction. In fact we thought the content of the repetitive calls less important than the rhythms and inflections they deployed. We invited twenty subjects to occupy the space and carry out a series of paper-based tasks

designed to elicit spatial responses. When interrogated about the spatial character of the repeated calls people referred to the "hypnotic effect" of the repetitions, and some were able to draw spatialisations of the sonic environment. We were not looking for direct spatial correlations, but simple corroboration of the territorial nature of the repeating voice. We also note in our observations of auctioneers how repetition and rhythm are required to keep audience and buyer attention, and to maintain the integrity of spatial boundaries. When the repetitions cease then people wander away, as if invisible walls have been removed. Is there a roll for the artificially propagated voice as a means of defining or augmenting space in intelligent environments? Repetition re-enforces the palpability of the voice. Intelligent environments are under the sway of the relentless repetition of monitoring processes. We conjecture that repetition as such determines spatial boundaries as much as screens and partitions. At the very least, repetition, whether sonic, visual or material, can be manipulated as a spatial variable.

Markets and co-operation

Market stall holders set up a rhythm amongst themselves. Their positioning is determined by the size of the stalls, but also the reach and influence of the voice. The towel merchant has an assistant who echoes the key components of the merchant's utterances. Intentional and accidental vocal co-operation produces cycles and patterns of aural ambience. It is also a determiner of where customers and browsers go and how they move around. Co-operation is also a major component in the workings of intelligent environments.

Markets and the trickster function

The Barras is a site of play, with other entertainments, including a ballroom, built into the fabric of the market. People attend the market recreationally, and to be entertained. It is a place to enjoy local dialects, and boasts a particular brand of "Scottishness." The Barras is also notorious as a site of hustling, mischief and illegal trading that attracts both bargain hunters and voyeurs. On more than one visit we observed a familiar scenario involving the sale of bootlegged CDs. A seller positioned himself on the road at the crossing with a card table covered with a tablecloth scarcely concealed by a small crowd of customers. Before long a lookout signalled a warning. The produce (CDs) were scooped into the table cloth and spirited away. The table was speedily carried off the street, and the sellers and crowd continued as if nothing had happened. A few minutes later two police personnel strolled along the street on their customary patrol. To the extent that the Barras participate in the "black market" environment it participates in the tricky off-beat economics popularised by the economist Steven Levitt, and characterised as Freakonomics (Levitt, and Dubner, 2005). The trickiness of the environment is perpetrated in no small part by the voice. The lookout signals a warning of the police approach via the voice.

The voice is tricky in any case. The ability of people to deceive with words has been observed since Homer, and Plato opined on the trickiness of speech. The cross-roads constitute the main arena of the Barras. According to the literary theorist Lewis Hyde the crossroads are where commerce springs up, and is the habitat of the Jungian archetype of the trickster: "He is the spirit of the doorway leading out, and of the crossroad at the edge of town (the one where a little market springs up). He is the spirit of the road at dusk, the one that runs from one town to another and belongs to neither" (Hyde, 1998 p.7). The trickster is the middleman, and a confuser of distinctions: "Trickster is the mythic embodiment of ambiguity and ambivalence, doubleness and duplicity, contradiction and paradox" (p.7).

The workings of the trickster resonate with those of the contemporary designer. The designer as trickster plays with the space between the strange and the familiar, or at least uses strange juxtapositions and unusual encounters as a stimulus to design (Ts-

chumi, 1994; Tschumi, 1994). What would it be to like to automate the culture and operations of the Barras? What would a robot in the Barras do? What if intelligent environments were modelled on the marketplace? We use the voice of the market as provocation to the operations of communicating spaces and intelligent environments.

Augmented environments

So-called intelligent environments (which we prefer to call "augmented environments" for the purposes of this investigation) rely on sensor technologies for making adjustments to the environment: eg configuring sun controls, lighting, and natural and artificial ventilation (Lee & Kalay, 2005). The field of research extends to all building systems, and even variable spatial configurations. Weather and environmental control is an obvious issue in open-air markets. One could imagine an elaborate, augmented marketplace in which awnings are extended automatically, screens appear and disappear, sound masking or augmentation is activated as needed, and CCTV devices play an instrumental and automated role in site management. Such control is arguably antithetical to the operations of the market, and is more in accord with the commercial shopping mall. It is tempting in the marketplace context to see the introduction of digital augmentation as a means of enhanced policing, but we would rather pursue digital augmentation to promote the trickster function of the market, by design. It is also tempting to equate digital augmentation with advertising — electronic billboards, dynamic signage, and direct marketing via text-messaging — rendering the calls of the market-sellers redundant. We resist these aspects of marketing in this study, and focus rather on digital technologies as a means of augmenting the way spaces function.

To test the possibilities of augmented environmental control, we created a physical model of cardboard, pulleys and robotic controls: a model with moveable partition elements controlled by a Lego Mindstorms™ RCX processor and motors (Figures 3 and 4). A second RCX robot (Figure 5) acts as a mobile sensor that moves around on wheels, avoids obstacles, takes readings from its environment and passes these by infrared (IR) communications to a stationary laptop computer. We note experiments with robotics in architecture by others, notably (Zwölfer & Koch, 2003) and (Shih & Su, 2004). Ostensibly, the justification for using mobile sensors over static sensors is the economic advantage that might ensue in using a roving sensing device that sends signals to static control mechanisms. There could be several such co-operating mobile devices in any space, which operate obsequiously when no one is around. Multiple agency is often dealt with as a marketplace of co-operating agents. We are not yet ready to model the Barras as an intelligent environment. But there are lessons from our Barras case study.

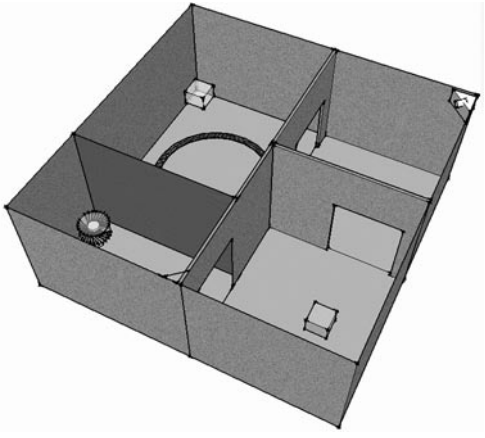


Figure 3
Computer model of the augmented environment: a series of rooms with simple tasks, obstacles and sensory stimulations. The mobile sensor robot signals to the environment to raise the screen to enable it to complete a circuit.

Robots and multimodality

Our fledgling augmented environment uses the various sensor technologies available in robotics, and in particular the Lego Mindstorms™ kit. The main modalities are sight (light) and touch (pressure), with the promise of colour and ultra-sonic distance sensors with the subsequent generation of NXT robots. Sound, and particularly voice, is an obvious modality in intelligent environmental control, and

Figure 4
Environmental control mechanism.

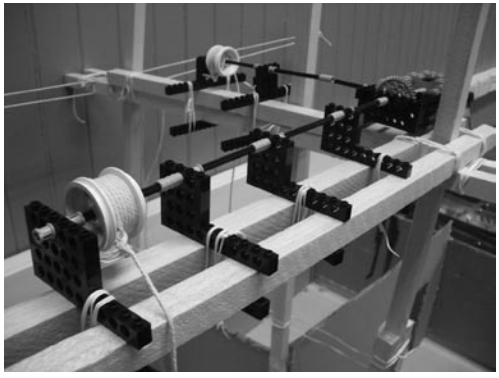
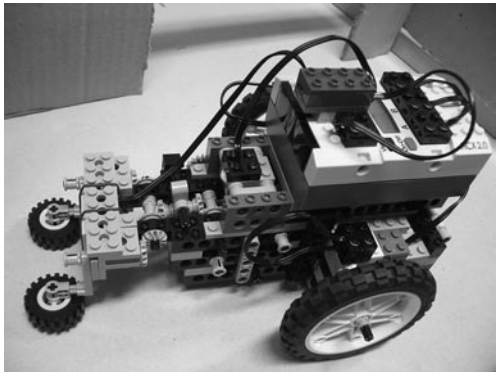


Figure 5
Mobile sensing robot.



the NXT processor will facilitate voice-activated processes. The current state of our experiment deploys IR communication between two RCX processors: one that controls the environment, raising and lowering screens in a physical model to permit passage for a mobile RCX robot. So the agents in intelligent environments can use multiple modalities to communicate with one another and with environmental controls. The environment is also treated as a multisensory space. The imagination jumps readily to the prospect of mobile robots of various shapes and sizes modifying the comfort, ambience, functioning and security of the local market, or, in even more fanciful scenarios, conducting business. The relationship between architecture and such science fiction scenarios is a research theme of our colleague David Fortin.

Robots and repetition

The repetitions of the Barras are important in defining spaces and territories. Our mobile robot performs repetitive operations to command space. It is programmed to undertake a circular journey around a kind of obstacle course of sensor stimulations to test responses and test the extent to which the robot can influence its environment. There is a rhythmic response to light and dark as these are easy to process, but we will extend the sensing technology to sound. With ultrasonic sensors, the system will define its spaces by emitting periodic signals to determine distances from target objects. Our studies into inflection will also play a role in augmented commands (Figure 2).

Robots and co-operation

Our system shows a rudimentary presentation of a multi-agent system (Lee & Kalay, 2005), in this case with just two agents: the RCX that controls the surfaces in the environment, and the mobile sensor robot that moves about and signals changes in the fabric of the environment (raising and lowering screens). The mobile robot carries out information collection and simple tasks. In the augmented marketplace one might expect modification and control of various parameters, including sound, to enhance comfort and ambience.

Robots and the trickster function

The Lego Mindstorms™ kits are between a toy and a serious research tool. The environmental controls concentrate on threshold conditions, transitions between states in the environment. In keeping with behaviour-based robotics (Clark, 2003), the mobile RCX behaves locally, a trickster function of sorts, with no regard for goals or a grand plan. Many agents operating in their own interest are thought to produce an emergent global effect, as in the case of termites constructing elaborate structures (Langton (ed),

1997; Castle, 2004). By a slightly different reading, the trickster function draws attention to the rogue robot, who upsets the operations of the swarm. In our imperfect study it is easy to observe aberrant, amusing and uncontrolled behaviour in the mobile RCX. We tried mounting a wireless camera to the robot. This introduces "sneaky" behaviour to its repertoire. In so far as the augmented marketplace is a possibility it will be the poorer for the imposition of strict environmental control. Environments need space for the trickster function if they are to resist conformity to non-place (Augé, 1995) standardisation.

Conclusion

Were we to follow through with these investigations and design a fully augmented marketplace then it would no doubt have a different character to the Barras. Substantial resources are rarely injected into such environments without turning them into entertainments or themed shopping malls. But thinking about augmented marketplaces provides insights into intelligent environments in general. Our studies confirm the importance of all the senses, and their availability for stimulation through augmentation technologies. We suggest that sound, the voice, and repetition, are important spatial determinants, open to digital augmentation and manipulation. What would it be like to inhabit spaces where the movement of people and processes is under the sway of carefully modulated and responsive sounds? Mobile sound masking is one important area of opportunity. Our experimentation with RCX robotics provides an environment populated with mobile sensors that manipulate screens. The process will soon be abetted by sound sensing and generation. But the environment could also be configured sonically. Not only can robots be controlled by sound, but, as attested by various digital installations (eg Pedro Rebelo, Sonic Constructs, www.sarc.qub.ac.uk/~prebelo), they can be complicit in creating sonic environments for human habitation and pleasure. There is scope for applications of obsequious mobile sensor technologies that deploy and modify sound in the environment.

Acknowledgements

This work is supported by the UK Arts and Humanities Research Council. We are grateful to Pedro Rebelo for drawing our attention to the possibilities of sound and Lego Mindstorms™ robotics.

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