

Chapter 8

Reflection on Tools

This chapter is a reflection on the development and use of two potential design tools trialled throughout the research projects. The two strands of investigation were (1) the adaptation of Suchman's analytic framework as a design tool and (2) the application of Laban movement analysis and Labanotation to the design of movement-based interactive technologies. The two potential design tools reflected on here are part of the contributions of the thesis.

8.1 Suchman's analytic framework as a design tool

This section discusses the adaptation and use of Suchman's analytic framework in the *Eyetoy* and *Bystander* projects. It shows the potential of the framework to be used as a design tool and to be adapted to design situations involving movement-based interactive systems.

8.1.1 *Eyetoy*

In the *Eyetoy* project, Suchman's analytic framework was applied to the analysis of the interaction between the player and the *Eyetoy* system, for the two games chosen. The framework was adapted to enable a close focus

The User			The Machine	
Actions not available to the machine		Actions available to the machine	Effects available to the user	Design rationale
User activity/action	Movement description	Motion detection via video camera	Output: Visual display and audio	Game context

Figure 8.1 Adaptation of Suchman’s analytic framework for use in analysing interaction of players with the Eyetoy games

on the physical actions and movements of the player and the corresponding detection and interpretation of those actions and movements by the machine. As depicted in Figure 8.1, the column labelled “Actions not available to the machine” has been split into two, to bring out the details of the movement description for the user’s actions. The column labelled “Actions available to the machine” describes the form of input, as the actions detectable by the machine are determined by the choice of input devices. In this case, it describes the input of the user activity via the motion-sensing video camera. The column labelled “Effects available to the user” consists of the output available to the user in the form of a visual display and audio. In the original framework, there is a fourth column on the right-hand side, labelled “Design rationale”, for the machine. We have relabelled this column “Game context” to clarify the game context in which specific actions are occurring. This describes the machine’s interpretation of the user action.

The analytic framework derived from Suchman was valuable in two key ways. Firstly, it made clearly visible the resources available to the user and to the machine for perception of action. Its prime function was to lay out the sequence of interaction and the interpretation of the interaction from both the human and the machine points of view. Secondly, and most significantly in terms of understanding movement, we were able to describe the movements as actions occurring in the context of a specific instance of game-play. The player’s actions were described at the level of activity in relation to the state of game-play and also at the level of physical body movements performed as part of their overall activity. This close focus on the body movements of the player enabled the separation of aspects of movement that were accessible,

The User Perspective		The Machine Perspective				Design Questions
Actions not available to the machine		Actions available to the machine	Effects available to the user	Internal machine behaviour not available to the user		
Scenario and Key Events	User Perception	User Activity: Movement/Stillness	Machine Effects (Audiovisual)	Machine State	Machine Perception	

Figure 8.2 Adaptation of Suchman’s analytic framework for use in exploring and mapping movement-based interactivity in Bystander

or not, to the machine. In the Eyetoy games, the implementation choices regarding the interpretation of video data input determined the access to the player’s activity and movement by the machine. This particular technology implementation makes no attempt to track or recognise human movements—it simply detects motion in predefined spatial and temporal zones according to the state of game-play. This then determined the actions of the user available to the machine, as depicted in the middle grey column of the table.

What this analysis also revealed was the kind of assumptions about user behaviour embedded in the Eyetoy system. Interestingly, the design choice not to track the moving body nor to identify specific kinds of physical actions performed by the user, enabled a wide range of diverse physical actions by the user to fulfil the interactional needs of the Eyetoy interface.

8.1.2 Bystander

In the Bystander project, Suchman’s framework was adapted to function as a design tool, termed the *interactivity table*. We followed the general principle used by Suchman of presenting the actions and available perceptual resources for both human user and machine in the interaction, but in a slightly different fashion, one more suitable for the purposes of exploring and mapping the interactivity between users and machine when human movement is direct input.

The *interactivity table* presents the script of scenarios of audience activity and movement alongside the corresponding machine behaviour, so the design of the interactivity between user and machine can be systematically examined. Figure 8.2 illustrates the general structure of the interactivity table.

In Suchman's original framework (see Figure 2.1), the interaction between the user(s) and the machine is framed in terms of the resources available, or not, to either side. The two columns of the table labelled "Actions available to the machine" and "Effects available to the user" constitute the interface of the system that is available to both human and machine. We have retained this organisation in the interactivity table with the column, "User Activity: Movement/Stillness" positioned alongside the column, "Machine Effects (Audiovisual)"—indicated by the grey columns in the table. The actions of the user *not* available to the machine include the scenarios of user activity and the interpretation of the action by the user represented in the columns, "Scenarios and Key Events" and "User Perception", respectively. The interpretation of the action by the machine is represented in the column, "Machine Perception". This column together with "Machine State" equate to Suchman's original "Design Rationale" column and have been more appropriately named, "Internal machine behaviour not available to the user". The subsequent machine response available to the user is given in the column "Machine Effects (Audiovisual)". We added a new column on the far right labelled "Design Questions". This enabled design questions, issues and contentions regarding the mapping of audience input to system response to be explicitly linked to the particular instance in the script of user activity and machine behaviour.

During the development of Bystander, the machine interpretation of the audience input data was of some contention. The resources available to the machine for perception of the user action were determined by the video data input device. As the movements of the users were supposed to influence the behaviour of the system, it was a matter of deciding what particular aspects of the movement to detect and interpret. In the final design, the system detected presence, position, density of moving bodies and degree of motion in the space through a single overhead video camera. The representations of audience activity and movement (deemed to be actions available to the machine in the interactivity table)—textual descriptions and visual movement schemas—would reflect these design decisions regarding the choice of input technology and interpretation of the input.

The interactivity table was a very useful tool for identifying and explicating design assumptions about user behaviour, particularly understandings of the relation between audience engagement with interactive artworks and their physical activity and movement. Multiple interpretations of user intention can be derived from the same observable physical behaviour and patterns of movement, as revealed during user testing of *Bystander*. Recognising the inherent ambiguity in interpretations of intentional action from purely visual means highlights the challenges in using human movement as direct input to interactive systems. *Bystander* sidesteps this problem by diminishing the power of the user to control the system in any determinate way; instead, the user is left to make sense of the effects of the system by constructing their own meaning from the interaction.

8.1.3 Summary—Suchman’s analytic framework as a design tool

As can be seen from the above discussion, Suchman’s framework can be flexibly adapted as a design tool according to the particular needs of the design situation. The fundamental framing of the interaction in terms of resources available to both user and machine for action and perception was applied in both the *Eyeto* and *Bystander* projects. The framework was adapted to focus more specifically on the movements of users occurring in the context of user activity, as part of the human-machine interaction and correspondingly, on the machine detection and interpretation of those movements. The framework enabled exploration and mapping of the relationship between movements of the user and the machine response. It also proved valuable for making explicit design assumptions about user behaviour, in particular the meaning and interpretation of movement, that become embedded in movement-based interactive systems.

8.2 Laban movement analysis and Labanotation

This section traces the application of Laban movement analysis and Labanotation in the Eyetoy, Bystander and Falling into Dance projects. It discusses the potential strengths and weaknesses of the movement analysis system and notation for use in design of movement-based interaction.

8.2.1 Eyetoy

In the Eyetoy project, Laban movement analysis and Labanotation were applied to the movements of the player interacting with the Eyetoy games. The specific parts of Labanotation applied were the Structural description and the Effort description. The Structural description provides a visual representation of the movements of the player, with the body as the central focus. Symbols are used to indicate movement of body parts in terms of spatial direction, spatial level and time. The graphic representation of the body-in-motion provided by the Structural description is not immediately intuitive. Skill is required in reading and writing the notation. This may prevent easy uptake of the Structural description by designers. The Effort description provides a way of seeing and describing the dynamic, expressive aspects of movement in terms of a person's relation to motion factors of Space, Time, Weight and Flow. It has a corresponding notation, although this was not used in this project as the primary focus was on understanding and applying the Effort description. Now that computerised motion recognition systems can also detect to some degree the qualitative, expressive and dynamic aspects of movement, designers need a system and vocabulary for analysing and describing movement in its many forms—Laban movement analysis can provide this. Other researchers have adopted the language of Laban movement analysis into their work (e.g., Buur et al., 2004; Jensen et al., 2005).

One of the strengths of transcribing movements with Labanotation was the learning of the Laban system of movement analysis. Learning took place

by observing, transcribing and re-enacting movements. Understanding of the system of movement analysis was anchored in a bodily understanding through physical exploration.

8.2.2 Bystander

In *Bystander*, Labanotation floor plans, intended for group choreography, were used for representing the social and contextual aspects of interaction that influence how and where people move and locate themselves in the space in relation to others. Spatial trajectories were mapped onto floor plans indicating the position, orientation, direction and path taken through space and time of individual and multiple people, for various scenarios of user activity. Here the notation was used for both descriptive and prescriptive purposes. On the one hand, it describes the imagined activity of the visitors to *Bystander*, where that activity is grounded in observations of actual audience behaviours to similar immersive exhibits. On the other hand, the notated movements then become a prescription for enacting and evoking movement during user testing. The floor plans provided an easy-to-read visual representation of audience movements corresponding to the textual descriptions of scenarios of audience activity. They also assisted reasoning about potential movements and corresponding machine responses.

8.2.3 Falling into Dance

For the *Falling into Dance* project, Effort-Shape analysis was applied to the movement sequences of people performing actions of falling in Study I and choreographed phrases of movement in Study II. The action of falling and the choreographed phrases of movement are complex forms of movement with dynamically changing relationships to space, weight, time and flow. The use of the Effort description ensures these aspects of movement are observed and described. The Shape analysis provides a range of descriptors for observing and describing the changing spatial forms and spatial qualities of the moving body. Both Effort and Shape characteristics of the body-in-motion can be used as parameters to computerised motion recognition systems. Existing

systems such as EyesWeb provide available, off-the-shelf technology for the recognition of expressive and dynamic aspects of movement (Camurri et al., 2000, 2003a,b).

Labanotation floor plans were used to represent the overhead view, corresponding to the machine input view, of the spatial trajectories of multiple movers for the choreographed phrases of movement in Study II. This was useful for reasoning about the interactive treatment of the movements from the machine perspective.

8.2.4 Summary—Laban movement analysis and Labanotation

It is clear from the above discussion that there is value in adopting Laban movement analysis into the discourse and practice of interaction design. It provides a language and vocabulary for talking and reasoning about movement across disciplines. It is also valuable for developing movement sensitivity, bodily understandings and observation skills of the body-in-motion. Labanotation offers a range of symbols for notating the specific details of the moving body in space and time (Structural description), the dynamic and expressive qualities of movement (Effort-Shape) and spatial paths and configurations of individual and multiple bodies (floor plans). Of the three symbol sets, the floor plans are the most readily accessible to the untrained eye. The other two require a level of training, skill and effort that may outweigh the utility of the notation for designers. The specific use of any of the forms of notation will depend on the needs of the design situation and the aspects of movement deemed to be of significance.

8.3 Summary—Reflection on Tools

The exploration of existing analytic frameworks and systems of analysis to use as design tools resulted in tools that could be included in the proposed design methodology, presented in the next chapter. The adaptation of Suchman's analytic framework as a design tool provides the necessary resource

for interrogating the nature of the interactivity between human activity and movement and corresponding machine behaviour, through a systematic appraisal of the possible alignments and slippages between the two. The application of Laban movement analysis and Labanotation in design of movement-based interaction provides a language, vocabulary and notation for reasoning about, representing and experiencing the moving body. The part of the notation for group choreography is the most readily accessible to designers untrained in the system.