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# Memory, schema and interactive video

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# Memory, Schema and Interactive Video

*Mike Leggett*

## Introduction

In the computer-based digital domain, interaction with video is becoming an everyday occurrence. Breaking away from our traditional regard for moving images organised along the linear principles of the filmic tradition we can now use motion pictures relationally, linking across and along shots and sequences. The artist and interaction designer can thereby share the making of the experience of the work with the audience, the active participant. In so doing, the creative experience is shared.

My experience as an artist working with film, video and performance was based on levels of audience engagement ranging from the reflexive to the physically active. The experience of a durational artwork relies on both short and long-term memory and the anticipation of its process of change. Aesthetic issues of this kind helped form the conceptual foundations discussed in this chapter.

The digital era, as a set of creative possibilities, began for me in the 1980s. Through experiments with early hypertext tools and the research and curation of interactive multimedia art for museums and festivals (Leggett et al., 1996), the ground was laid through the 2000s for my own creativeness in the field of interactive digital art.

These experiences helped identify my direction during doctoral research investigating the precept of interactive video, setting out to confirm knowledge previously intuited rather than explicitly recognised. Interaction with video for me has become a way of accessing and modifying the art experience through an approach to the 'open work', as proposed by Umberto Eco (Eco, 1979). The processes of practice-based research in the development of an artwork has enabled me to reach a better understanding of the relationship between the act of making and the act of participating or sharing the experience of art.

During my research, I investigated interaction with motion picture recordings – digital video files - such that duration and the relational ordering of individual scenes and shots could be determined by the participating viewer. A number of initial research questions were posed that were used to focus the investigations. During an

interactive encounter, can a unique narrative be created with different permutations and combinations, arranged from the same collection of video files? How is memory employed during interaction with the file collections and can mnemonics or 'memory objects', aid this process? What are the practical aspects of the interface, the site at which interaction occurs with the full-screen motion picture image?

The research developed from these questions into a rethinking of the material of the motion picture, as a process of perception, as a received cultural form, by way of studies of an interactive video system and participating audiences. From observations made and data analysed, it was possible to describe different styles of interaction with the system. The participants' experiences have been applied subsequently to the preparation of interactive installations for galleries and museums.

### **Interactive Video**

Interactive video follows on from the sequential tradition of television and cinema, where one item follows another in the act of telling a story and where words are used to convey meaning and significance of images. Although video games are exploring new avenues for advanced interaction, highly skilled technical teams manufacture the interaction experience using graphical images rather than photographic ones. Even with the accessibility of popular video channels like YouTube, or cable and internet television, interaction is effected by guessing or remembering words used in the titles and tags given to listed material. The content we generate, using cameras or mobile phones, is increasing exponentially and interaction with personal collections of movies has now become a realistic possibility. However, it is not easy to retrieve motion picture sequences by using words. Interactive video needs a structure that can be recognised by the participant, the core of an interactive system, and function consistently as interaction proceeds. The focus of my investigations into the browsing or exploratory process that commences interaction with a system focussed on our tacit knowledge of shapes 'in-the-world'.

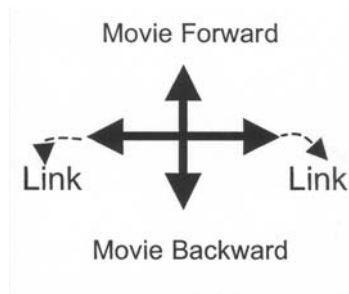
Explicit knowledge develops as a result of learning and is a product of observation and recall. This process of replication is central to creative participation with an interactive system and provides the framework for memory in response to visual and aural elements in a system. These have been described by Barrett as the basic building blocks of knowledge creation (Barrett, 2010) and earlier work in the study of memory by Bartlett (Bartlett, 1932) led him to formulate the schema or mental framework as a way of describing its functioning. This was later developed by others as a way of characterising our organisation of knowledge about people, situations and

events and the variables that could be introduced into otherwise stable information structures (Rumelhart et al., 1984).

The experimental system, *Mnemovie*, is based on similar frameworks and explored mnemonics, or memory images and events, as a basis for linking between digital video files. However, mnemonics are different for each interacting participant, between the implicit or the explicit association with meaning of an image and response to it. The *Mnemovie* system has been developed using practice-based research methods, rather than user-centred problem-solving design approaches. The difference is that the former is similar to an art making process, where the concept is developed directly through the practitioner's practice, applying knowledge, experience, skills and sense of creative enquiry (Schön 1983). The approach was extended with knowledge gathered from related research found in publications, together with an observation and evaluation process conducted toward completion of the research.

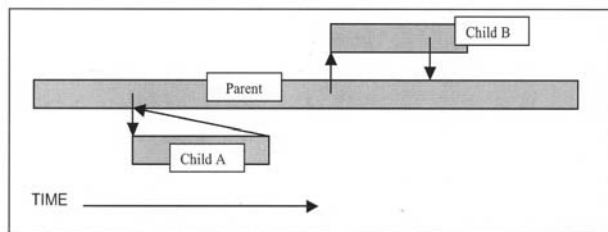
The process of interaction can be compared to hypertext linking in Web-based systems, where objects across the Internet can be linked via a word or an image - hypermedia. Linking individual frames from a video file across the Internet to other video files - 'hypervideo', whilst theoretically possible, is not currently practical because, at this point of time, very high-speed bandwidth is far from universal. The focus of my research, therefore, examined the principles of interactive video located as linked digital files on the desktop computer or Personal Digital Assistant (PDA), sites for practical experiment within the constraints of existing network infrastructure capabilities.

Four gestures were employed as the principle for interaction with the moving images on the computer screen. Initially, the mouse was employed to run the movie forwards with an upward motion, backwards with a downward motion, or to link to other video files by gesturing to left or right. Subsequently, the arrow keys on the keyboard were employed to effect a four-way interaction (see Fig 1 below). Later, using a touch-screen interface, larger gestures became useful and appropriate.



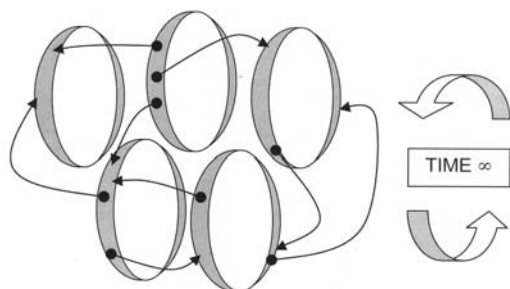
**Fig 1: 4-way interactive movie navigation schema**

Two paradigms are described as a means of outlining the principles of linking. In the first, a 'linear' schema (see Figure 2), with finite durations, links from what may be termed the 'Parent' to the 'Child', including a return to the Parent, either to the point of departure (A), or to an equivalent point on the Parent time-base (B). The parent-child concept is one where a prime element, the parent, has links to subordinate elements, the children possibly having have links to their own 'children'. In the *Mnemo* system, interaction obliges the participant to initiate the link (to either A or B), whereas the return link can be either initiated or automated.



**Fig. 2: linking schema: Child A: linked video returns at end to point of departure from Parent. Child B: linked video returns to equivalent time base of Parent.**

Looping, a function of the motion picture image in both the analogue and the digital domain, (Manovich, 2001, 2002) is the basis of the second paradigm, a relational 'hypervideo' schema, linking between loops of both short and infinite duration (Fig 3).



**Fig.3: linking schematic - motion picture file loops and linking paths**

## Methodology

Together with other researchers, a methodology was developed for studying audience participation with different interaction models. This was possible once the technical development of the *Mnemo* interactive video system had reached a sufficiently mature level for it to perform reliably.

At the heart of the *Mnemo* system is a 'presentation engine'. The “..presentation engine allows content authors to describe ... content through associated XML [and .dcr] files. Interpretation of those files, content layout, and all ... communication is automatically handled by the presentation engine..’ (Mentor, 2006). This is a common approach to building an interactive system that simplifies the technical implementation, for non-programmers in particular. It thereby enables the practitioner to concentrate on making models that combine a linking schema with a particular movie collection. The *Mnemo* engine comprises a software framework made up of the presentation engine and the media database.

Root Directory of Model	Presentation Engine	Media
<u>Mnemo</u> b3	<ul style="list-style-type: none"><li>• MNEMOVIE (application)</li><li>• <u>Mnemo</u>.dcr</li><li>• <u>movie_data.xml</u></li></ul>	MOVIES (video files directory)

**Table 1: Mnemo conceptual data model**

Links between movie files are established by entering file names and time-code values from the movies into the presentation engine files using a word processor. The process in this exploration stage is painstaking and involves careful note and checklist keeping. Interaction outcomes however, can be checked immediately and adjustments made to values accordingly simply by launching the *Mnemo* application.

Questions to emerge include: Does the ordering device function, as a way of retrieving a specific digital media file? Is there a limit to the size of the collection or quantity of files that can be addressed using a paradigm model? How might this paradigm be expanded, or related to another? Could there be qualities in each that

might combine to form a new model? Is there value to maintaining text-based indexing?

Each of the paradigm models progress in parallel with one another, as collecting and preparing digital video files is as time-consuming as preparing each of the engine schemas. Personal reflection, combined with comments from friends and colleagues, informed the progress of each paradigm. This form of formative evaluation anticipated outcomes and guided the development of each of the schemas and the interactive models.

### Two Schema Models

The Circle schema describes the way in which the collection is accessed based on a repeating or looped duration of video. The 'Parent' is a sampled or 'skimmed' version of the twelve 3-minute discrete movies. The motion is very fast and is read as "speeded up". This loop enables the user to launch the 'Child' movies, choosing from one of the twelve 10-second extracts in the loop, using control of forward and backward movement and selecting using movement to left or right. This is goal orientated searching, based on an image being recognised on the first run through as a cue to selecting the three-minute movie at normal speed, the images on the 'Parent' loop functioning as a mnemonic tool. To the user familiar with the attached 'Children' the mnemonics act as symbols; to the user not familiar with the child movies, they act as an index based on the interpretation of the visual information represented.

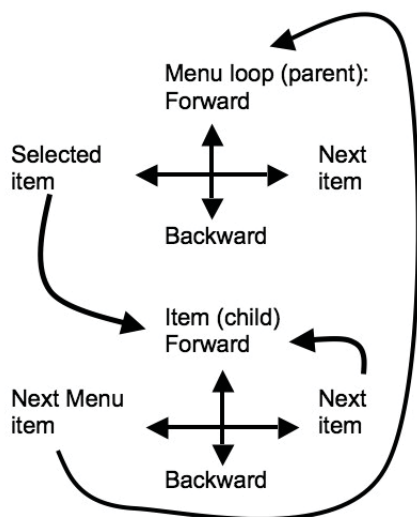


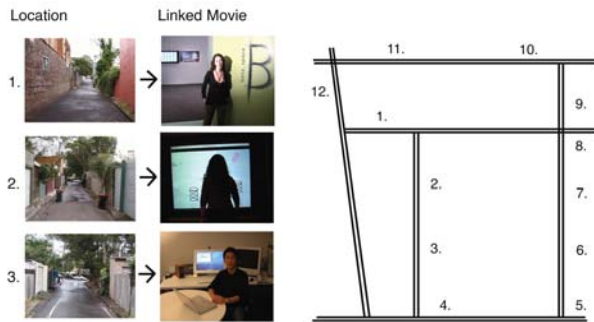
Fig. 4: Circle as Menu Loop, interactive schema

The interactive 'Circle' schema (Figure 4) describes the relational elements between the 'Parent' and 'Child' movies that are run forward with the  $\acute{e}$ -key, or in reverse using the  $\hat{e}$ -key. Using the  $\leftarrow$ -key or the  $\rightarrow$ -key links from the visible extract in the parent to the complete version in the child. Exiting using the  $\leftarrow$ -key, returns to the parent, the  $\rightarrow$ -key to the next of the twelve movies, complete with title and name of presenter. By repeated use of this key, a succession of titles appears on the screen, similar to the act of reading down a list. Interaction can thus proceed based on the visual imagery presented in the loop, or, alternatively, based on the titles of each discrete movie.

In another schema, tacit knowledge of the shape of a grid was employed. We know that through a combination of turns to the left and the right, we can move diagonally across a grid pattern or shape to its far corner. If the grid is a pattern of inner city streets, we know from prior experience that we have a reasonable chance of arriving at a point on the grid using trial and error and an exploratory spirit. We navigate the grid, counting or noting the turns as we go, or simply recognising and remembering visual features along the way: the pub on the corner, the bus stop near the red house, the traffic lights at the main road, etc; the shape of the grid is augmented with this information. This acquired knowledge we can use to retrace our steps, or intuitively follow alternative routes using a combination of (now) learned knowledge transcribed into the overall bounded area. It is an example of the visuo-spatial sketchpad, (Baddeley, 2000) a model of working memory, the means by which at an everyday level action and context or 'situated action', (Suchman, 1987) might occur.

The Grid model simulates the grid structure of an inner city block, (as seen on the right of Figure 5), and is the concept schema for locating each of the same twelve movies encountered in the Circle schema. On the screen the participant sees an image of walking down a street from the point-of-view (POV) of the participant. An interactive route is followed to navigate from Location 1 to 3 (left of Figure 5) and the Linked Movie associated with the image of the locations. As with the 'Circle' schema, interaction follows the same three principles: Navigation, Linking; and Returning. The  $\acute{e}$ -key runs the Point-of-View (POV) movie forward; the  $\hat{e}$ -key turns the viewpoint through  $180^\circ$  and retraces the previous viewpoint. Linking using the  $\leftarrow$ -key or the  $\rightarrow$ -key will achieve one of two outcomes: a) when adjacent to a street corner a link is made to the movie POV of the adjoining street; b) relational to its location on a section of the street, a link is made to one of the twelve movies. For example, location 1, 2 and 3 (Figure 5) are the 'places' with which a link to the movie is associated (left of Figure 5).





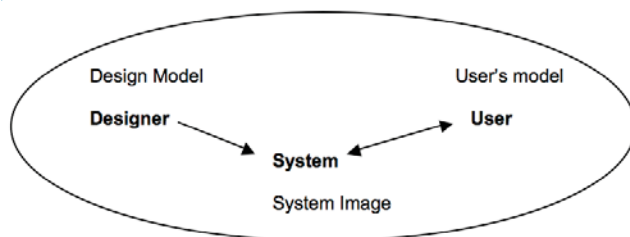
**Figure 5: Test Model, 'GRID' navigation schema.**

In the Grid model as in the Circle, the participant has a choice of accessing and viewing a movie using either the visual cues learnt during initial exploration, or the text-based Titles accessed using the →-key.

### Participation and Evaluation

An evaluation of three selected models was conducted with a small representative sample of participants with different levels of experience of viewing movies on computers.

Putting visitors through task hoops, with shades of authoritarian and manipulative engineering, is the least attractive option in evaluating interaction design setting out to appeal to creative participation. Instead, the purpose here is to stimulate the mind with each of the models, within a framework that provokes or enables a critical and intelligent response, and evaluate the outcomes. Preece defines evaluation as “the process of systematically collecting data that informs us about what it is like for a particular user or group of users to use a product for a particular task in a certain type of environment.” (Preece et al., 2002) 317. The quixotic relationship between users and the system designer in understanding the conceptual model is summarised in Figure 6, the important issue being to try to bring the design model and the user's model close together:



**Figure 6: System image as concept**

This approach proposes that the researcher defines what is to be achieved by participation in the interaction design as a 'problem-setting' or 'problem-finding' experience (Schön, 1983), a creative rather than a reductive process. It becomes possible using several evaluative approaches to assess not only the data gathered during interaction by the user-participants with the designer's model, but also the quality of the overall experiences represented by their reflections on the system. As Candy has pointed out: "In participatory research, there is explicit recognition of the inter-related roles of the personnel involved.." where "..the research and design activities operate as an iterative cycle of investigation, analysis, results and feedback into design and development." (Candy, 1995). At the point of preparing to observe how participants would interact, comparisons between different model schemas was identified as likely to reveal the creative component of the interaction process.

The *Mnemo* test models were evaluated using a modified user studies approach as outlined above, employing evaluation paradigms adapted from accepted techniques (methods) appropriately (Table 2). These include usability testing and observation of user activity in a controlled environment followed by questionnaires and interviews. (Preece et al., 2002: 340).

Data objects	Paradigm
Modelling users tasks	<u>comparative evaluation</u>
User opinion - interview	<u>predictive evaluation</u>
Observational studies	<u>in the field</u>
Questionnaires	<u>usability studies</u>

Table 2: data objects and evaluation paradigms employed.

A key finding emerged revealing the style of interaction as a factor for further analysis. Characterised as 'Quickies' and 'Explorers', the Quickie personas exhibit a desire to complete a task rapidly using ready-to-hand prompts, or affordances. Explorers, on the other hand, enhance the process and the experience by gathering knowledge more generally from within the system. Their process of investigation thereby amplifies the development of a visual syntax – or schema - by the participant. Cognitive learning and responses lead to interaction 'styles' that are characterised laterally and relationally, rather than vertically and sequentially. The aids to memory using mnemonics are critical to interaction of this kind, being one of the system affordances that enabled creative interactive behaviour.

System Affordances	Interactive Behaviour	
	<i>Quickies</i>	<i>Explorers</i>
Interactivity	Infrequent	Frequent
Navigation	Options taken infrequently	Options taken frequently
Mnemonics	Text preference	Image preference

**Table 3: Summary of interactive behaviours observed between Quickies and Explorers and the affordances of the interactive system.**

The interactive behaviours listed in Table 3 are summarised as follows: Quickies reduce the number of interactive events and use familiar devices such as the alphanumeric indexing option. The frequency of navigational options was also observed to be at variance between both groups. Explorers, in taking time to interact with the system, have a preference for using images as mnemonics experienced during the familiarisation stage. The reasons for doing so are many; in the words of one of the participants, “I valued the maker crafting a path, resulting in a satisfying experience.” Another participant “...was totally surprised at how different the beginning and end experiences were ... just navigating the same corpus..” (collection of video files). The Quickie experience as one of the participants described would be more “...like reading a book ... like jumping links on the internet really ... something to do by yourself as your mind goes from one track to another”.

Building on these characteristics, the design qualities of the interactive experience for both groups are outlined in Table 4. Whether encountered by a participant or designed by an artist or interaction designer, the style adopted will include some if not all these affordances, or possible design qualities, within the system.

Interactive Experience	Design Qualities	
	<i>Quickies</i>	<i>Explorers</i>
Interactive options	Sparse	Rich
Navigational options	Less	More
Movie speed	Fast	Slow
Mnemonics	Familiar cultural coding (text; actors)	Subtle coding (discovered; intuited)

**Table 4: interactive experiences as design qualities**

In choosing to take their time, Explorers employed a richer approach to interactive experience than Quickies, taking more navigational options and thereby discovering subtler use of mnemonics and nuanced use of the memory objects, accessed through the system.

The participants revealed that alphanumeric indexing in conjunction with visual cueing explicitly aids interactivity for both groups. Tacitly and implicitly established relational links to other files in a movie collection encourages participants, (particularly those with highly developed language skills), to investigate for themselves means of indexing motion picture information that go beyond the currently constrained approaches used by alphanumeric systems.

### **Implications for Interaction Design**

Reflections on the data gathered to this point in the investigative process has revealed that creativeness in the act of navigating a collection of movie files is as essential as creativeness in the process of aligning the links between them. In June 2006, one of the handful of invited delegates to the Symposium on Supporting Creativity with Search Tools, Washington DC, affirmed the activity of searching a database or collection as “...part of a creative process.” (Kules, 2006).

Modern audiences are not simply ‘users’ but creative minds (Edmonds et al., 2009, Edmonds et al., 2010) interacting with documents of the past, requiring us increasingly in the contemporary context, to acquire, order and link collections of motion picture files.

Engaging with ‘hypervideo’ and interactive video systems, where the boundaries between authoring and viewing are blurred, will need to encourage minds to be creative with collections of motion picture documents of the past, ordering and linking together into the present. Shneiderman’s three categories of creativity: the structuralists, the inspirationalists, and the situationists – (Shneiderman, 2007), apply equally to participants interacting with memory systems of this kind, as it is to the designers of systems. The act of creating a narrative, a ‘sequence-image’, is thus a task of making meaning shared with the author or designer of the interactive video collection.

“... the sequence-image as such is neither daydream or delusion. It is a fact – a transitory state of precepts of a ‘present moment’ seized in their association with past affects and meanings”. (Burgin, 2004, 21).

Participants identified in this research have distinct needs:

**the individual artist, researcher or designer** creating systems to be deployed in contexts specific to their practice. The implications for artists and designers of the findings is that the interactive experience with design qualities tuned to the Quickie and the Explorer personas, will encourage creative tendencies that move away from traditional notions of experiencing the individual artist's singular 'statement'. The shared artefact becomes an entity open to taking account of the participant's interaction style, the experience becoming an art or cultural practice explored by both parties as an act of shared expression.

**the specialist community** who are enabled to define from within a toolset, (such as that used for building the experimental models used in the current research), the needs to be addressed by a system. Domains of particular interest for further work in this respect will be interactive systems designed for trans-lingual contexts, and domains in which knowledge classification is explicit, for instance zoology, geology, anthropology etc. Anthropologists have been increasingly embedding visual technologies into their research, including digital media and hypermedia, suggesting:

“..two important types of engagement: first with mainstream anthropology and its methodological and theoretical currents; and second with digital work developed in other disciplines, arts practice and theories of representation and communication.” (Pink, 2006: 20).

**the general audience**, encountering a system in a public place and without prior knowledge, will need to be encouraged and guided within an interactive navigation schema. Though the general population in many countries are alert to computer-based systems and the everyday use of mobile phones and other devices, there is the need to signal the central theme or rule that govern the relationships created by author and designers for interaction with a collection of movies.

A development of the general audience's participation could advance to providing interactive designs coded as schema templates; video files shot and captured by a participant are uploaded into the system and by following specific file naming conventions, enable the collection to be navigated according to the schema selected from a suite of templates.

During interaction with *Mnemovie*-based models, the audience is between the state of making and that of participation, of creatively sharing work as a means of modifying the abstraction of their experience, abstracted from the everyday, inserted as an encounter with maximum affect, broadening and stimulating our understanding of the world. The arena of audience involvement with art specifically, will shift and mutate towards what Toft has described as creating human computer

interaction of a different order, between respondent and correspondent (Tofts, 2005). The role of initiator and auteur is becoming attenuated, less 'in charge' of how an encounter with motion pictures may proceed. By bundling and linking a variety of electronic and microprocessor devices, this approach moves the art activity decidedly away from the geographically installed and hard-wired artefact towards systems and processes that are multi-valent or interdisciplinary, more mobile and harder to classify within the taxonomies of art, becoming instead phenomena of social behaviour. For instance, recent research that described, "an algorithm for a prototype system that generates a sequence of video clips from YouTube ... usually referred to as scenarios, storytelling, contexts, etc., could be stimulants for human creative activities." (Amitani et al., 2008)

### **Future work**

My work as a practicing artist has been concerned primarily with the moving image, expressed through the mediums of film, video, sound and performance. It is represented in collections and archives internationally and is presented in the cross-disciplinary contexts of galleries, festivals, conferences, cinémathèques<sup>i</sup> and through publishing in paper and online. The aesthetic content of the work foregrounds the processes of perception, memory and affect as embodied experience. During the period of postgraduate research outlined here, I investigated computer-based interaction with projected video images. Strategies using visual schemas to guide interactive navigation of the video file collection employed the proprietary software engine, *Mnemo*. This was designed as an artist's tool to avoid learning complex programming routines, instead concentrating on the links between the various movie files. The physical interaction through gesture using the mouse or arrow keys, the most basic of interactive devices, likewise adequate served to facilitate the required investigation. The findings from an evaluation of the sample group interacting with four different schemas, demonstrated a range of responses to the aesthetic content that will be useful during further development of the precept.

New work will be developed for installation in gallery or public spaces, and for collaborative work in performance. The focus will remain on qualities intrinsic to the single-channel video image and the narrative resonances produced during interaction with collections of shots and sequences. But the emphasis will shift from the function of searching for specific images to interactivity heightening Burgin's "transitory state of precepts of a 'present moment' seized in their association with past affects and meanings". Primarily the approach to making new work is concerned with the gallery

visitor encountering large high-resolution projected images in a darkened space. In addition, the physical context within which the interactive video system is encountered will need to be considered further in affecting research design.

The first of these spaces is the privately viewed computer monitor capable of revealing a local collection of movies augmented by access to a networked collection. Collaboratively assembled onto a server and modified by both contributors and invited curators, such a system is dynamic not only in a style of interaction but also as a constantly evolving experience. The second space is the larger immersive setting of the cinematic installation where interactive gesture is incorporated using a combination of sensors, trackers and touch sensitive screens (an initial starting point for this research). The installations will share between participating viewer and artist, recursive patterns of recorded events, place in space, place in time. Interaction will engage short-term memory in the sharing of long-term memory, personal and public histories. Working with video images gathered from the streets and other landscapes, from public and private collections and archives, the experience of narrative flow will become subject to simple reckonings by the participant, with complex outcomes: determinations of image duration; causation of order change and visual sequencing (montage); and the meshing between artist and audience, mediated using the machine as medium. As a filmmaker having moved on from analogue practice, in the digital domain the possibilities for reinventing the cinematic experience begin to emerge.

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<sup>1</sup> a French word used to refer to a film archive with small cinemas that screen mainly classic and art-house films.