The Ambient Wood Journals - Replaying the Experience

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ABSTRACT

The Ambient Wood project aims to facilitate a learning experience using an adaptive infrastructure in an outdoor environment. This involves sensor technology, virtual world orchestration, and a wide range of devices ranging from handheld computers to speakers hidden in trees.

Whilst performing user trials of the Wood, the activities of children participating in the experiments were recorded in detailed log files. An aim of the project has been to replay these log files using adaptive hypermedia techniques to enable the children to further reflect on their experience back in the classroom environment.

Categories and Subject Descriptors

H.5.4 [**Hypertext/Hypermedia**]: Architectures ; K.3.1 [**Computer Uses in Education**]

General Terms

Experimentation

Keywords

Adaptive Infrastructure, Record and Replay, Consolidation, Storytelling

1. INTRODUCTION

The Ambient Wood project forms part of the Equator IRC (Interdisciplinary Research Collaboration). It is an augmented physical space that seeks to facilitate a learning experience for children using an adaptive infrastructure situated in an outdoor environment.

The augmentation of the space involves the placement of sensor technology enabling location tracking to take place, along with electronic devices that permit the children to explore their physical environment by taking readings of moisture and light levels. Events taking place in the wood serve as triggers for additional information being presented to the children such as sounds from hidden speakers or images and voice overs displayed on their hand held devices. A Multiple User Dungeon (MUD) is used to orchestrate these interactions between the physical and digital worlds.

The activities of children participating in the experiments were recorded in detailed log files. The project aimed to replay these log files using adaptive hypermedia techniques to enable the children to further reflect on their experience back in the classroom environment.

During his Six Walks in the Fictional Woods [9], Umberto Eco remarks on page 28;

> There are two ways of walking through a wood. The first is to try one of several routes ... the second is to walk so as to discover what the wood is like ... Similarly there are two ways of going through a narrative text.

Using a combination of consolidation techniques, inference tools and storytelling devices, the events can be recreated in forms that both recount events that took place, but also promote different perspectives, allowing the children to gain new viewpoints on their activities, or alternatively to see their activities relayed as an entirely fictional adventure. This paper details the progress to date toward these aims.

2. THE AMBIENT WOOD

The Ambient Wood is a mixed reality space located in a Sussex woodland. A playful learning experience was developed where children could explore and reflect upon a physical environment that had been augmented with a medley of digital abstractions. The latter were represented in a number of ways, designed to provoke children to stop, wonder and learn when moving through and interacting with aspects of the physical environment. Representations were designed to be 'ambient' i.e. non-intrusive where possible, augmenting the environment by making the invisible visible.

A variety of devices and multi-modal displays were used to trigger and present the 'added' digital information, sometimes caused by the children's unintentional exploratory movements (wandering around a clearing), and at other times determined by their intentional actions (taking a measurement with their probe device). To this end, a field trip with 'a difference' was created, where children discover, hypothesise about, and experiment with biological processes taking place within a physical environment.

The Equator IRC is a multi-disciplinary project and as such the Ambient Wood project brought together researchers with backgrounds in cognitive science, developmental psy-

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chology, educational technology, interaction design, computer science, software architecture and hardware engineering. A more comprehensive description of the Ambient Wood project can be found in [15].

2.1 Project Goals

In terms of an 'experience', the project had a number of goals, chiefly to encourage the participant children in exploring, consolidating, hypothesising, experimenting and reflecting. Behind these lay a number of research goals which reflected the diverse research interests of the research groups involved. These included, but were not limited to:

- To investigate whether the coupling of physical and digital, i.e. the children's perceptions of the real wood (e.g. seeing the long grasses in the clearing) integrated with their existing knowledge and received information about the physical processes taking place in the habitat (e.g. "the meadow brown butterfly likes the warmth and lays its eggs in the grasses from May to September"), would facilitate the learners' ability to better integrate their disparate experiences and knowledge [17].
- Address the technical challenge of determining how to make the wood 'ambient', enabling digital representations to be pinged, accessed and sent around a range of mobile and stationary devices, including PDAs, wireless speakers and monitors. A robust infrastructure had to be built that could track the physical movement and presence of the children as they walked around the wood, and record and save a variety of real-time readings collected through the use of devices of certain variables in the wood.
- The design of the digital representations, including what form they were to be presented, as well as which physical interactions and couplings to use with which kind of digital representations, for example, when to present a sound or a visualisation and in response to what.
- To investigate how the highly dynamic experience can be recorded and then replayed in way which facilitate recollection and re-experience within a classroom environment.

It is the last of these that this paper will focus on, focusing on the relationship between hypermedia storytelling and the event orchestration processing infrastructure of the Ambient Wood.

2.2 The World of the Ambient Wood

A variety of digital information was also presented to the children via a hand held device, concerning different aspects of the habitat around them. Sounds, images and voice-overs were triggered to appear depending on the children's location in the habitat.

For example, upon entering the clearing, the sound of a chiff-chaff singing is heard from the wooded area. Five seconds later, the children's hand-held device displays an image of a chiff-chaff and a voice annotation of the chiff-chaff's preferred habitat is played (see Figure 2). Some example images are shown in Figure 1.

The realisation of this scenario involves a number of technologies deployed in a highly flexible adaptive infrastructure.

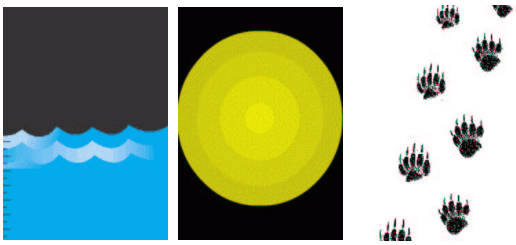

Figure 1: Displayed information in the Ambient Wood. A moisture reading, light reading and badgers tracks.

Figure 2: The children exploring the wood.

2.3 Adaptive Infrastructure

As the title suggests, a key requirement of the Ambient Wood scenario is for the technology to be as invisible as possible. Whilst, inevitably, the devices with which the children collect data about their surroundings form part of their attention focus, the other technological devices are camouflaged where possible.

Placed within the wood are small radio transmitters that periodically broadcast a unique identifier. These transmitters are called pingers. These provide physical contextual anchors for the hand-held's position, and therefore the position of the children, within a region of the Wood [14].

There are other 'probe' devices that provide contextual information over the short-range radio link, including small moisture and light probes and a GPS (Global Positioning System) pinger, embedded in the backpacks worn by the children.

Also hidden within the environment are wireless speakers providing an interface through which audio cues and event sonifications can be made to occur as ambient sound.

Networking in the Wood was achieved through the deployment of Linux-based laptops acting as 802.11b base stations in Host AP mode, providing one flat IP-based network with coverage of the entire Wood area. The Elvin notification service [20] was used to mediate communications among the various entities in the environment.

Part of the experience in the Wood involved a period of experimentation, where the children could modify the environment of the Wood through the use of tangible artifacts. For example, the children could add a "Can of Spiders" to the base of a tree in the clearing, signifying the introduction of a new species to the environment, the result being a digi-

tal visualisation of a possible future Wood based on the children's changes. These tangible devices, serving as abstract representations of significant changes to the environment, were 'tagged' with RFID (Radio Frequency IDentification) tags[1] that the infrastructure could sense when placed near camouflaged readers, embedded in the environment.

The speaker devices listened for notifications telling them to play certain sounds. The orchestration service, discussed below, monitored the Elvin traffic in order to update its state and trigger Elvin notifications to the rest of the infrastructure. The hand-helds both received Elvin notifications to play voice-overs and display images and initiated notifications giving pinger location information and probe readings, acting as proxies between the very-short range radio communication of the Pingers and the Wood-wide 802.11 network.

2.4 Scenario Orchestration

The first MUD was created by Richard Bartle and Roy Trubshaw at the University of Essex in 1979–80 [3]. Since then different kinds of MUDs have evolved, with various implementations. The MUD Frequently Asked Questions document states that:

> A MUD (Multiple User Dimension, Multiple User Dungeon, or Multiple User Dialogue) is a computer program which users can log into and explore. Each user takes control of a computerised persona (or avatar, incarnation, character). You can walk around, chat with other characters, explore dangerous monster-infested areas, solve puzzles, and even create your very own rooms, descriptions and items. [21]

Not all MUDs involve monster-infested arenas, nor the 'combat features' that characterise some. Our use of a MUD is a different approach to other research-oriented uses, where the focus is typically on providing direct support for collaborative work, for example task co-ordination [10, 7]. Rather, we envisage the MUD as an invisible, pervasive orchestrator of the physical world, reacting to, and generating events as appropriate.

The Ambient Wood MUD draws on the strong spatial and entity-based interaction model of the MUD, and is structured such that every interaction of relevance to the scenarios that occur in the physical world is modelled in the virtual world. The model includes all of the regions of interest within the wood, the participants and all of the physical devices, such as probes and speakers.

The coupling between events in the physical world and the digital model is the Elvin notification service. Participant devices in the Wood need not concern themselves with interaction logic, the state of other devices or their role in the scenario, they need only focus on their own functionality, and generate notifications that may be of interest for other processes. For example, location presence can be determined by radio 'Pings' detected by a receiver on the children's hand-held device. This event would then be forwarded as a notification containing the identity of the child using the device and the symbolic location identifier received from the Pinger. The process that mediates the Elvin notifications pertaining to children's location and the MUD's model then translates the symbolic location into the appropriate MUD room, updating the model and potentially generating more notifications as a result.

This approach enables the scenarios to include 'invisible objects' that the children can discover by wandering around a physical space. These artifacts can manifest themselves in a number of ways, perhaps a sound from a hidden speaker, or an image appearing on the display they are carrying.

All of the notifications generated throughout the children's participation in the scenario are captured and stored off-line so that the interactions can be analysed by the researchers defining the educational activity, or perhaps for the experience to be replayed 'virtually' by the children back in the classroom.

A more detailed description of the Ambient Wood infrastructure, including further motivation for the use of MUDs as an orchestration tool, can be found in [22].

2.5 The Experience of the Children

It is well known that learning through doing and experiencing is central to understanding. Many learning activities have been designed with this in mind, with traditional field trips being a particularly popular form of getting children to learn through 'observing' and 'doing'. One problem with this approach, however, is the difficulty children often experience when trying to relate their physical experiences with the more formal science they need to learn that is associated. In particular, children have a difficult time mapping experiences with the physical world that they can readily relate to (e.g. birds eating worms), and generalise from (e.g. animal Y eats organism X), with the higher level abstractions they are taught in the classroom. Example higher level abstractions would be ones that represent inter-related dynamic processes, for example "Food Web" diagrams representing energy flow in an ecosystem.

One goal of the Ambient Wood project was to see whether we could enable children to move between the different levels of knowing and understanding, allowing them to both experience the conditions and to hypothesise about, for example, investigating and predicting the processes that enable a particular habitat to thrive or not.

In the first phase of the experience the children explored the wood using their devices and, at various sensed locations, were sent information about plant and animal life in their proximity. The children also used probe devices to take moisture and light readings. The information was modified by their movement through the wood, with different information being delivered when a particular location was revisiting, often building on the information provided as part of their first visit. At any given moment, there were a number of pieces of information that could be accessed by the children through their physical movement or activity. These choices were not explicitly presented to them, the primary interaction being through exploration and discovery. The available information changed depending on their previous discoveries and also the overall 'phase' of the experience, discussed later. This could be loosely described as 'walking the hypertext' of the information space, with the links being anchored on specific locations, selected implicitly via computed context, and the destinations being the production of information in the form of sounds from speakers or graphics on the hand held device.

The orchestration of the information delivery was prescripted for the experience and automatically triggered based

[1] `http://www.tiris.com/`

on the location as represented in the MUD. The first phase was thus about gathering information which was recorded for them by their hand held device.

The children then came together in a 'den' to form hypotheses about the habitats that they had explored. The children were presented with a number of possibilities, such as introducing a large amount of water to the habitat, or alternatively sucking water out of the habitat. They could also choose to introduce new creatures or plant life into the habitat. Based on these premises, they construct hypotheses about how the habitat would change.

Armed with these hypotheses, the children went back out into the wood and tested them by further exploration and experimentation. The information model in the MUD was altered to reflect the new context, for example the MUD could be artificially flooded with water. On revisiting the clearing habitat children were presented with new information such as the sound of a heron, or information on the increased marshland in the area, which allowed them to test their predictions. The new information became available as changes were made to the underlying model of the wood, through the children injecting or removing water (virtually) or introducing new creatures by placing tagged objects at specific locations.

All the information during the two phases was collected allowing for subsequent reflection in the classroom environment.

2.6 Recording the Experience

During the experience we are capturing a large number of discrete events. These are time-coded and contain some information that can be used to assess the event after the fact.

No causality is recorded in the logging of our current system. A speaker is requested to play a sound. There is no information in the trigger event that this was caused by one of the teams of children entering a certain area. The 'game' logic is embedded in the orchestration tool, the MUD, which decides on appropriate triggers based on information received and the current system state.

Below are a small selection of the types of events recorded in the log files.

```
--- 26 Sep 2002 14:16:36 ---
Team: "badgers"
Position-Label: "habN"
WOOD: 1033046310000L
Measurement-Type: "location"
```

The 'badgers' team receives a ping from the *'habN'* pinger.

```
--- 26 Sep 2002 14:20:29 ---
Team: "badgers"
Measurement-Type: "light"
WOOD: 1033046429794L
Measurement-Value: 234
```

The 'badgers' team has used their probe to take a light reading.

```
--- 26 Sep 2002 14:20:30 ---
Display: "lum03"
Device-Id: "badgers"
WOOD: 1033046544000L
```

The 'badgers' display is asked to display the image *lum03*.

```
--- 26 Sep 2002 14:54:30 ---
Interpreted-Value: 8
Team: "squirrels"
WOOD: 1033048470388L
Measurement-Type: "moisture"
```

The 'squirrels' team take a moisture reading.

```
--- 26 Sep 2002 14:54:30 ---
Display: "aqua01"
Device-Id: "squirrels"
WOOD: 1033048470389L
```

The 'squirrels' display is asked to show image *aqua01*.

```
--- 26 Sep 2002 14:12:36 ---
Device-Id: "clearing"
Play: "clearing/1/s-grass"
WOOD: 1033045956418L
```

The device 'clearing' (a speaker hidden in the grasses) is asked to play the audio file *clearing/1/s-grass*.

At the end of the experiment, the log contains all of the events that have been passed around the system, reflecting the discrete events in chronological sequence, that occurred in the wood. This becomes, in effect, our *fabula*, as proposed by the Russian formalists such as Propp [13] and Thomashevsky, "a series of logically and chronologically related events that are caused or experienced by actors" [2]. In our case, the construction is part authored/scripted by the constructed scenario of causalities held within the game logic of the MUD and part created through the experience of the children, our actors in this story.

With a fabula in place, we can use this to construct a *sjuzhet*, the discourse that sits on top of the fabula.

3. BUILDING THE JOURNALS

The initial part of the experiment was to enable an interactive experience where the children could explore and reflect on the physical environment augmented with digital artifacts to 'make the invisible visible'.

A second aim of the experiment was to take the accumulated log information from the experience and enable it to be replayed in the classroom environment, enabling the children to reflect on their experiences and discuss them with their classmates.

The process of building the journal has a number of parts, reflected in the architecture shown in Figure 3. First, a story needs to be selected, from the many possible stories that could be told from the raw information available. Then, the events have to be consolidated down to the key events that are to be relayed as part of the story. Finally, the events are turned into a discourse in a particular form, both in terms of media, style, genre, focalisation etc. Each of these sections will be covered in more detail below.

The process is similar to that used in the Artequakt project, where facts harvested from web pages were automatically constructed into biographies, using consolidation, selection and rendering techniques [1]. This approach differs from model of computational storytelling as proposed by Brooks [5] in that the author/artist is involved in the creating of the rules and fragments used by the system but the continual feedback loop is absent.

3.1 Selecting the Journal

The fabula we have at our disposal represents the totality of the recorded interactions that took place in the wood during the individual trials. Each trial had two groups,

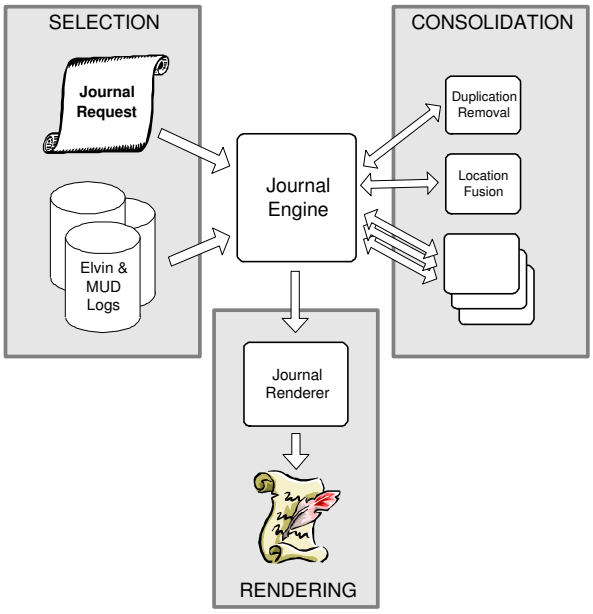

Figure 3: The journal builder architecture.

Squirrels and *Badgers*, that were exploring the wood concurrently. Each of these teams might be chosen as the subject for a story. Other constraints might be placed on the story. Perhaps there are no audio devices available and the story can only be constructed using text and graphics. Alternatively, a story might be composed from the viewpoint of a fictional animals that wander their own path through the wood encountering the different teams at different points, the Rosencrantz and Guildenstern of the Ambient Wood. The decisions made as to the type and content of the journal will have potential impact on the consolidation process that is to follow.

Narrative elements such as focalisation, Genette's term for the inescapable adoption of a (limited) perspective in narrative, a viewpoint from which things are seen, felt, understood, assessed [11], will have also have an impact on the final rendering of the story. If the journal is a personal experience it may be appropriate to construct the journal using an appropriate deixis that grounds the discourse to the individual. This perspective will necessarily affect the selection of events, allowing only those that could be perceived first hand by the individual. Inference across the events will also be more apparent where an individual reads about their own experience and can compare the narrated events to a first hand account.

3.2 Consolidating the Event Log

Consolidation has a number of purposes. Primarily it serves to reduce the number of events to a more 'manageable' amount as the raw logs for the user trials grew quite large. The location pingers were sending information every second, along with additional GPS pinger information at the same rate. The act of taking a moisture reading with the probe would result in a number of events occurring. The probe sends an event stating that it has taken a reading, ultimately the display of the children would receive and instruction to display an appropriate image representing an abstract impression of the moisture reading. To the children these would appear as a single event, however to the system they are multiple events connected implicitly by the game logic.

The logs can be modified by applying a number of operations:

Match and Delete: If an event or events match a pattern, delete them. If we wish to view a journal just for the Squirrel Team, any events directly associated with the Badger Team can be discarded.

Match and Modify: A probe reading event would only contain the probe ID and the reading taken. When matched, additional information could be added to the event, for example the location of the probe when the reading was taken.

Match and Replace: The pingers were designed to emit a 'ping' every second and consequently while a team was in range of a pinger, a location event was received every second. Multiple events for the same location could be replaced by a single event including duration information.

Match and Add: The matching of a location event for location X followed by a location event for location Y could have an additional event 'Moving from X to Y' add to include additional inferred information.

3.3 Meta-Structure

As was mentioned above, the causality of the game logic often resulted in a number of events forming a natural change of effects, such as taking a moisture reading. A moisture reading meta-event would be comprised of a moisture sensor event being translated into a moisture display event, causing an image to appear on the hand-held. The consolidation could seek to combine these discrete events into a meta-event that explicitly identifies the causality. This causality, already captured in the game logic, could be re-purposed in the journal construction to facilitate this. A more comprehensive authoring tool for the scenario construction would help tie these two parts of the process together in a more coherent fashion.

3.4 Location Fusion

The pinger design results in location information being sent every second while the children's receiver is in range of a pinger. When moving from location to location, there may be dead spots (areas of the wood where there are no pinger events received from the location pingers), or there may be mixed location signals where the pinger ranges are overlapping. Where the children carried GPS receivers in their backpacks, a micro-controller abstracted the received co-ordinates into 'virtual pinger' locations. This enabled the location data to be used entirely in a topological framework with no real world co-ordinates.

There are a number of actions needed to consolidate the location events:

- The simplest is to remove duplicates, leaving only one location event where a number occur consecutively at the same location (Match and Delete).

- It may be that we are more interested in arrival and departure events, so the first and last occurrences of pings in a location can be taken, to form arrival and departure events (Match and Replace).

- Where location 'confusion' occurs, i.e. pings from multiple sensors, a thresholding technique could be used to only maintain the current location until a given amount of time has passed without a ping from that location, 5 seconds for example (Match and Delete).

- Story function in part on action, and the pings are in some respects a passive indicator of a moment in time, 'I'm at X. I'm at X. I'm at Y. I'm at Y.'. It may be that the more interesting events are the meta-events we can infer from this sequence, chiefly the 'I've moved from X to Y' event. Whether this inference takes place at the consolidation or at the rendering is open for debate. In some respects the act of generating new meta-events is in part adding to the discourse and might be better left to the final rendering engine (Match and Add).

- It should be noted however that the designed non-overlapping topology meant that the spatial model included a void region where the participants were placed whenever no pinger information was received. It might be that were two location events are a large time apart with nothing in between an additional event is added to indicate a 'limbo' location (Match and Add).

3.5 Rendering the Event Log

Once a consolidated event log has been produced it can then be rendered. This activity is kept separate from the consolidation to allow multiple renderings of the same log to be achieved. The rendering might vary according to the media, i.e. the events could be written as a simple textual story, or rendered into a multimedia documentary using tools such as SMIL.

The final rendered story is constructed from fragments stored as a linkbase building on the narrative construction techniques proposed in [4, 23].

Each fragment represents an possible element of the story, with the source being the event, or events, which might be replaced the story fragment. The source can be generic, for example only events that refer to team squirrels, or could be very specific, e.g. at this location at this time if this reading is taken, this fragment can be used. The fragments can also contain variable elements that can be replaced by information from the system. This might be information held within the event being processed, for example the fragment may refer to the specific image being displayed and extract that information from the event. Alternatively, it might be a global context piece of information such as the current location of the team at the present position in the story. By applying constraints on the events associated with each story fragment, a level of rhetorical structure can be overlayed on top of the underlying hypertext structure [16].

The story could also be adapted in terms of style and genre. By using stylesheets and different fragments in substitution of events, the story could be rendered in different ways. It could be as factually accurate as possible, trying to recreate the experience the children had in the actual wood. Alternatively it could be told as a story about a group of explorers discovering a lost world or perhaps as a scientific away team from a space exploration craft. A screenshot showing an example journal can be seen in Figure 4.

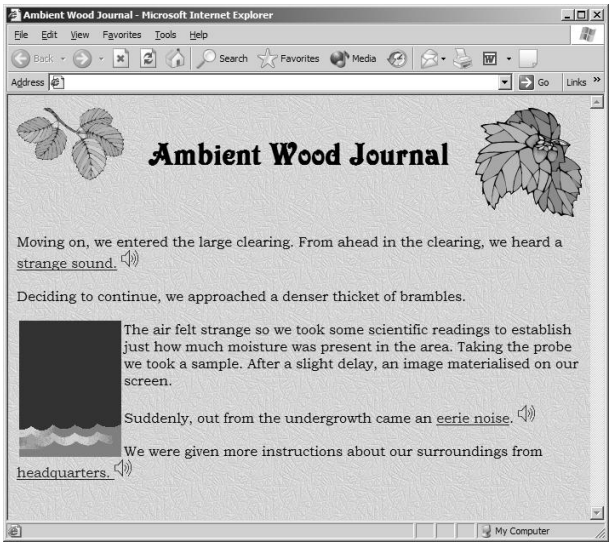

Figure 4: A generated journal.

4. DISCUSSION

A number of areas from discussion have arisen out of our preliminary work on the Ambient Wood journals.

4.1 Who are the Authors?

It might be wondered who the author(s) are of these journals, and indeed, what is the nature of the journals? By referring to the events in the log as the fabula, this was an over simplification. An alternative view would be that they represent virtual references to historical events that form part of the fabula, i.e. participants of the experience are aware of the occurrences of the story which are referenced as events. These events are then converted into new elements as part of the journal production which may or may not reflect the events as experienced by the children.

Two authors of the journal (the narrative reflecting the experience) can be readily identified. The person who writes the individual fragments that are substituted for the events in the rendering process. The 'words' of the journal are produced by this author. Also, the children themselves could be considered authors of the journal as they are generating the events that the journal is constructed from. As part of this, the game logic encoded in the MUD orchestrates events, directing the story by following cues and initiating actions within the wood. Finally, the selective inclusion of events also has a bearing on the final constructed journal, and this selection relies on the decision encoded in the consolidation processes.

Much of this discussion depends on what we are considering the authoring process. Whether the it is just the final rendering of the journal, or the construction process of the entire Ambient Wood experience including the capturing of activity as well as the encodings in 'game logic' and rendering selection processes.

4.2 Non-fiction vs Fiction: Which lie did I tell?

As has been discussed previously, the events themselves are reflections of actual occurrences in the wood. We can take a location event and know that the children now are within the range of a pinger located in the wood but any rendering of this event will almost certainly involve speculation as to 'why' the event occurred. The sentences 'We arrived in the clearing', 'The trees parted and the clearing appeared in front of us'. 'We wandered on', might all be renderings of the event but none of them might reflect the true feeling experienced by the participant.

Rather than trying to reproduce a factually accurate account of what happened we may choose to play on the ambiguity in the system or stretch it further to become a fiction loosely based on the facts as perceived by the system. 'Entering the unknown, we cautiously wove our way through the undergrowth', 'The buzz of the teleporter a distant memory, we continued to take readings of our strange surroundings'.

A similar approach was taken in Calvino's 'If on a winter night a traveller' [6], where the author takes the single event of 'the reader is reading the book' and constructs the whole of chapter 1 based on inferences on this, ranging from the current seating position to the reader to the process of selecting the book in the bookshop. By addressing the reader directly, the engagement is heightened despite any discrepancies between the inferred events and those that actual might have, or be, taking place.

4.3 Interactive Journals: Walking the Woods

The rendering of the event log into story fragments could also be considered similar to the creation of a hypertext story, since for every event there may me multiple story fragments that are possible renderings. The actions of the children in the wood could result in a completely serialised story, where the renderer chooses from available fragments. Alternatively, a rendering could be designed to deliberately leave choices for the reader. The exploratory aspect of the Ambient Wood trial design lends itself to this option. The resulting interactive journal would allow the children to review and re-explore their experience in the wood.

Links and paths that readers take in the hypertext could also generate events, thereby augmenting the existing log. These events could feedback into the rendering process dramatically altering the hypertext.

4.4 Real-time Rendering

An alternative to rendering complete logs retrospectively would be to act on the logs in real time as the events are being produced. This would generate a live story that unfolded as children explored the wood. This could be especially useful as a tool to monitor the activity of the children to aid on-lookers such as facilitators and technical people running the wood infrastructure. Currently, log events can be observed but require careful interpretation and the sheer volume of information can mean that key events shoot past in an avalanche of positional information.

The difficulty and challenge with this application is that the consolidation and rendering process does not have a complete set of events. Some simplifications might be required, for example location fusion might discard repeated pings from the same location, but the production of events which require looking over a chronological span of events becomes more problematic. It is hoped that future trials in the wood will make use of this facility.

5. RELEVANT WORK

In the Ambient Wood project, rapid prototyping meant that we did not seek to abstract away from the raw sensor information being passed around the system. There are a number of systems that would facilitate such an abstraction, reducing the consolidation required on the event logs.

The Context Toolkit, developed at Georgia Tech [8] is an architecture that helps in the construction of context aware applications by abstracting away the sensor information applications.

Similarly, the TEA system [19] abstracts a sensor layer to a scripting layer allowing application developers to focus on context issues rather than having to understand the nature of the sensors providing that context.

An alternative approach to sensor driven storytelling can be found in the Vampire system [12] where children could view a scary story on the belly of a vampire model, influencing the story by placing different objects on the palms of the model. The vampire also asked questions of the audience, with speech recognition analysing the responses and altering the story accordingly.

Schäfer et al [18] have been looking at virtual storytelling of co-operative activities in a system called DocuDrama which generates interactive narratives based on activities in a collaborative virtual environment.

6. FUTURE CONSIDERATION

The current system works as a post processing construction tool, with the event logs being manipulated in their totality. For the next set of trials, we aim to use the tools in a live situation where the trial is being automatically rendered as a journal.

During the trials, video of the participants was recorded and the children were in constant contact with the home base via walkie talkies. They were encouraged to use their radios to report back their experiences, promoting reflection on events around them and communication skills as they attempted to relate a visual/physical experience via a voice only communication channel. Although recorded in the previous trials, the audio and video recordings were not synchronised with the events as captured by the event log of the MUD. For future trials we are looking at recording the audio in the same time frame as the event log to enable the inclusion of sound bites from the walkie talkie transmissions as part of the Ambient Wood journal.

7. CONCLUSIONS

This paper has introduced the Ambient Wood project, presenting initial results from analysing data captured during a number of user trials. Drawing on adaptive hypermedia and sculptural hypermedia techniques, we have sought to extend the Ambient Wood experience beyond the field trip back into the classroom, allowing reflection and discussion.

Logs of events captured during the trial provide a rich source of discrete information but need to be consolidate and reasoned about in order to generate information and interesting narratives. Our component based approach allows the combination of generic tools, such as simple duplicated event removal to be combined with more powerful, domain specific tools, e.g. the location fusion tool. The

separation allows rendering decisions to be abstracted away, enabling different narrative generation techniques such as fiction/non-fiction or first person vs third person, to be explored.

The replaying of events captured in augmented spaces extends beyond the teaching scenario explored within the Ambient Wood. The techniques would be equally valid applied to providing record and replay of impromptu meetings based on context gleaned from sensor data and digital interactions.

There are a million stories in the Ambient Wood, this was one of them.

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