Integrating Bird Survey Data into Real Time 3D Visual and Aural Simulations

Ed MORGAN, Lewis GILL, Eckart LANGE and Martin DALLIMER

1 Introduction

URSULA, Urban River Corridors and Sustainable Living Agendas, is a major interdisciplinary research project examining the complex problem of sustainable development of urban riverside landscapes. It is generating large amounts of data which is to be used to aid the process of sustainability analysis, both from simulation models and from ecological surveys. Much of this data is “geospatial” but not directly visual and so there is interest in how such data sets can be visualised. HEHL-LANGE (2001) shows how abstract information on the distribution of species of wildlife can be visualized through colour-coding the 3D terrain model, also in combination with draped true color ortho-photography. TRAPP et al. (2009) describe a method of doing this with projective textures. Data-driven colourization will certainly be useful within the URSULA project, but whilst it is effective in integrating the data into the 3D visualisation it also obscures the photorealism present in the visualisation model.

Ecologists are surveying the rivers in Sheffield for existing wildlife and this data could be represented by colouring the visualisation model. However, for birds, which are one of the more charismatic elements of urban biodiversity, other methods may be more appropriate. For example, many birds are vocal and make sounds (e.g., calls and songs). Such vocalisations differ between species and are readily identifiable by experts and can also be distinguished by members of the public. Therefore a different approach to colouring, such as to introduce sounds into the visualisation to represent the data distribution, could be of particular relevance to bird survey data sets. This technique also makes sense as it translates the survey data back into a form which adds to the realism of a 3d real-time visualisation rather than diminishing it. Bird diversity and abundance are also good indicators of biodiversity, not least because for many species in the UK, cities can hold important populations of nationally declining species (FULLER et al. 2009). Although the number of species and individuals can be affected by the type and quality of the urban form (CHASE et al. 2006), the impact of urban developments on birds are rarely incorporated into the decision making process in a way that is readily understandable by members of the general public.

Serious games using interactive 3D landscape visualisation have been produced (MACH 2009), and have been shown to be an effective way of communicating a lot of sophisticated data and information to the end user of the game. In this paper, we describe methods of translating the bird survey data into bird sounds within a real time visualisation so that the sounds are originating from areas in which the birds were spotted. We then describe a serious game which evolved around the bird sound integration which allowed children to walk-through a virtual model of Sheffield riverside and spot different species of animals including some birds.
LANGE (2005) considers the inclusion of abstract and non-visual phenomena in visualisation in order to better communicate possible consequences of alternative future scenarios. As already stated, URSULA is producing much abstract data which could be beneficial to represent in visualisation models. Realism has been shown to have an effect on the perception of the viewer (LANGE 2001), and more accurate modelling of birds with 3D representations in the model, both visual and aural, should add to the level of acceptability for a viewer. To this end one particular data set, bird survey data, was selected and various ways of representing this in the visualisation model are described, firstly through colourisation, and then through the use of audible bird models. This approach is extended by introducing other animal representations within the visualisation model in order to create a serious wildlife observation game.

2 Converting Bird Survey into Virtual Bird Sounds

The following section describes the process undertaken to convert bird survey data into virtual bird sounds that play within existing virtual models.

2.1 Existing visualisation workflow

URSULA has already an established visualisation workflow (MORGAN et al. 2010) through which it has constructed several detailed 3D urban models, using visualisation software called Simmetry3d to allow real time walkthroughs of landscape models. This software is capable of playing sounds within a visualisation, both positional and directional with 6 different attenuation models, and also of animating objects within the virtual model. It also has an “action” based system which allows for animations or sounds to be triggered either when the user approaches an object or when an object is selected manually. It also has a plug-in API that allows extra features to be easily added without needing to change the host program itself.

2.2 Bird survey data

Six visits to the case study site in Sheffield were made during spring and early summer (April to June) 2009. This period corresponds to the breeding season and is therefore the time when birds are most active and readily observable. On each occasion the location, number, gender, activity and species of all birds was mapped using an approach similar to that recommended by BIBBY et al. (2000) for determining the territories of breeding birds. Subsequently bird locations were transferred to a GIS. For each species, the Density function of the Spatial Analyst extension in ARCView was used to construct a density surface. High values on this surface represented areas where bird species were more likely to be encountered. The surface could be output from GIS as a grey-scale image which could be used within the visualisation software; one of which is shown in figure 1.
2.3 Colourisation technique

As a first attempt at conveying the bird survey data in the visualisations, the grey scale image was used to shade the visualisation model according to where the image was lighter/darker.

This produced an interesting way of visualising the dataset albeit in a rather cryptic fashion. A screen shot of this technique is shown in figure 2.
2.3 Integrating birds into the visualisation model

The data to be used to “visualise” a particular bird species was as follows:

- A density surface image (DSI) for the particular species
- One or more sound files (.wav) for each of the bird’s calls
- A 2D (billboard) or 3d model of the bird, dependent upon availability of models

Each bird model was imported into the visualisation model, along with its sounds, and its DSI and then tagged with meta-data which linked these items together. There were two mechanisms experimented with, described as follows:

1. A bird model could be configured to play a sound when a person came close enough to hear it; a bird could be positioned in the visualisation model either roughly where the DSI suggested or by placing it exactly where it had been spotted in one of the surveys. This was essentially a manual approach, but quite easy to achieve, taking only a few seconds to place a bird in the correct spot. This method was extended to animate the bird along a pre-defined path. This was necessary as some birds were only spotted flying during compilation of the survey data.

2. A plugin to Simmetry3d was written to control the bird sounds in the real-time walkthrough viewing mode, which automatically mapped a bird DSI to positions where a bird sound could possibly be heard from, and then randomly positioned a bird, and made it sing based on the generated positions, the number of birds observed, a bird call sound, and the frequency at which they were to sing.

2.4 Wildlife Observation Game

A serious game was created as an extension to the bird visualisation which added other species found in UK urban river environments. This effort was motivated by an opportunity to do some outreach work through an invitation to participate and to engage with children at the ”Wildlife of our Waterways” event in Sheffield. The overall event was held in the Weston Park Museum in Sheffield, a major museum focusing on natural and cultural history, as well as in the adjacent Weston park. There were many events to engage children, presented in a fun and welcoming format and focusing on and around wildlife in urban rivers.

A game concept was conceived which would allow children to walk around a virtual environment, with the task of identification of the wildlife in this virtual model; children would be given a paper checklist of wildlife they could spot along with points for each one depending on difficulty. The manual positioning method mentioned in the previous section was used to position various species into an existing urban river virtual model. This
extended the work to introduce birds into the visualisation, by adding some static and animated 2d(billboard) and 3d representation of various animal species, and by using a pair of virtual binoculars to allow the children to zoom in and better identify the animals they spotted. Movement was controlled through a hand held game controller.

The aims of the game were as follows:
- Raise awareness of biodiversity
- Show children the possibilities of nature in the urban riverside environment
- Help children to identify specific species
- Provide a fun environment in which the previous aims could take place

The game was presented inside the museum using a laptop and data projector. The ages of children attending ranged from four to eleven, and about 30 children attempted to spot some virtual wildlife in about a 4 hour period. Figure 3 shows the game in action on the day, where parents and their children could sit down in front of the projector screen and control their path through the virtual environment.

![Fig. 3: Some participants playing the game on the day](image)

### 3 Results

The workflow developed to incorporate animals and their sounds proved quick and effective, providing the ability to create a serious game using it. The game proved to be a hit with the children; most were familiar with a game controller and accepted the virtual
environment without issue. It was played both individually and with groups of up to three children. Every child who participated determinedly stuck at the game to find all the species listed. Not all the children were familiar with all the species listed, but this proved not to be a problem, and by the end of the game they were able to recognize and name these species. Some guidance was necessary to enable some of the participant children to find the gamut of species, and this was provided by parents or URSULA team members. The points system worked well to keep interest in the game and provided a sense of achievement once all species had been found.

Figure 4 shows a screen shot taken when the virtual binoculars were in use; the children enjoyed using them, and they allowed for a much better view of the smaller animals. The binocular effect was achieved by narrowing the viewing angle of the virtual camera by a factor of ten, and then overlaying a binocular-shaped mask on the view. In addition to this, the sensitivity of the controls for looking left, right, up and down also needed to be scaled by a similar amount to allow for finer scale adjustment of the view direction.

![Figure 4: A view of a kingfisher through the virtual binoculars](image)

### 4 Conclusions and Outlook

A simple approach for translating bird survey data into both static and animated bird sounds has been described, along with its extension into a “serious game” which allowed children to walk through a virtual environment and learn to recognise different species of wildlife. This work highlights the potential for engagement and education of children using virtual landscape environments with objectives. Including bird sounds in the visualisation does
provide an indicator of biodiversity and we intend to investigate some predictive modelling strategies which could alter the density surfaces in response to changes to the physical environment.

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