

COST-287 STSM REPORT

SUMMARY

Applicant : Ag Asri Ag Ibrahim (*University of York, United Kingdom*)
Host Institution : *Bielefeld University, Germany*
(*Faculty of Technology – Neuroinformatics Group*)
Duration : 26th of March 2006 – 8th April 2006

ACTIVITIES

26/03/2006 (Sunday):

Arrived at Bielefeld

27/03/2006 (Monday):

9:30am : Visiting to several research Labs in Bielefeld – Robotic, iLab (Interactive Lab)
(With Dr. Thomas Hermann).
10:30am : Discussion with Dr. Thomas Hermann
-The objective and activities for the two weeks of STSM
-Briefing on the existing Model-Based Sonification (on Data Exploration)
2:00 pm : Discussion and Demonstration by Till Bovermann.
-Tangible Data Scanning Sonification Model
-Data Sonogram Modal
4:00pm : Continue discussion with Dr. Thomas Hermann
-Task Analysis and Model-Based Sonification Application

28/03/2006 (Tuesday):

9:30am : Discussion with Dr. Thomas Hermann (*continue*)
-Data Sonogram
12:00pm : *Data Sonogram Analysis*
2:00pm : Discussion with Dr. Thomas Hermann (*continue*)
-Data Sonogram Analysis
3:00pm : *Data Sonogram Analysis (Producing Analysis Diagram)*

29/03/2006 (Wednesday):

9:30pm : Generalizing Data Sonogram
2:00pm : iLab Meeting (*with master students*)
3:00pm : Discussion with Dr. Thomas Hermann
-Generalization of Data Sonogram
-Model and differences in all sonification techniques and interaction elements.
4:30pm : *Installing Supercollider for Windows environment.*
5:30pm : *Task planning for the remaining two days of the week.*

30/03/2006 (Thursday):

9:00am : *Supercollider*
-Improving the task analysis of Data Sonogram
2:00am : *Supercollider*

31/03/2006 (Friday):

9:00am : *Improving the task analysis of Data Sonogram*
2:00pm : Reading and understanding of paper that given by Dr. Thomas Hermann for a discussion on Monday

01/04/2006 (Saturday):

02/04/2006 (Sunday):

03/04/2006 (Monday):

9:00am : *Improving the task analysis diagram of Data Sonogram*
11:00am : Discussion with Dr. Thomas Hermann
-*About Spring Mechanism in Data Sonogram and how to shorten the process of computing in SuperCollider.*
1:30pm : *Modifying data explanation for Sonification in Data Sonogram*

04/04/2006 (Tuesday):

9:00am : Discussion with Dr. Thomas Hermann
-*Neural Gas Sonification Model*
2:00pm : *Analysis of Neural Gas Sonification Model*

05/04/2006 (Wednesday):

9:00am : Discussion with Dr. Thomas Hermann (continue)
-*Neural Gas Sonification Model*
2:00pm : Meeting with iLab research group
3:45pm : Presentation of my work to the committee.
4:30pm : Discussion with Till Bovermann
-*Tangible Data Scanning Sonification Model*

06/04/2006 (Thursday):

9:00am : Discussion and demonstration with Till Bovermann
-*Tangible Data Scanning Sonification Model*
2:00pm : *Tasks Analysis of Tangible Data Scanning Sonification Model*

07/04/2006 (Friday):

9:00am : Task Analysis of Tangible Data Scanning Sonification Model (continue)
2:00pm : Continue Task Analysis and Finalise for both Analysis.
5:00pm : Closing discussion with Dr. Thomas Hermann about overall STSM.

08/04/2006 (Saturday):

Departing for Manchester Airport

Task Analysis for Sonification Application Usability Evaluations

Aim

The aim of this STSM is to work with Dr. Thomas Hermann of the Neuroinformatics Group at Bielefeld University in Germany. It focuses on Task Analysis of at least two model-based sonification techniques which were developed in Bielefeld. The task analysis is based on the unified HCI framework for sonification application (my work The University of York). The models are Data Sonogram Sonification Model (DSSM) and Tangible Scanned Data Sonification Model (TSDSM). Both models are using the same model concept, however, TSDSM focuses

more on gestural movement where the user could explore the data freely in real space with virtual data.

Objectives

1. To do task analysis and analytical study on at least two models of Model-based sonification technique (*DSSM and TSDSM*).
2. To look at the advantages and disadvantages of these models (*TSDSM model focuses on gesture movement interactions*).
3. To look for the possibility of improving the model design especially on usability aspects.

Introduction

The task analysis is based on the unified HCI model for sonification application (my work with Dr. Andy Hunt at The University of York). The task is divided into 9 (nine) different tasks as in the following table:

Table 1: Tasks for Sonification Applications

	user	Interaction/manipulation	Application
Data perspective	1. Data User Tasks	2. Data Manipulation Tasks	3. Data Application Tasks
Acoustic perspective	4. Acoustic User Tasks	5. Acoustic Manipulation Tasks	6. Acoustic Application Tasks
Sound Representation Perspective	7. Sound Representation User Tasks	8. Sound Representation Manipulation Tasks	9. Sound Representation Application Tasks

The tasks are classified based on three different perspectives (*based on input/output transformation*) namely data, acoustic and sound representation perspective. Each perspective is further divided into three different contexts namely user, interaction and application. The combination of these three different perspectives and three different contexts produce nine different types of task as shown in Table 1 above. These task categories are used as ‘a framework to do tasks analyses’ for sonification applications. By doing this, it will add more valuable information about tasks and work context that could improved the quality of usability inspection results.

As we know that, most sonification applications, for instance, data exploration applications are highly interactive and do not have a linear sequence of steps. This is the reason why it is difficult to specify the steps to achieve its goals, which mostly required in existing task analysis method. However, in this tasks analysis, we assume that the user has at least an initial goal to use the application with also at least a linear sequence of interaction to achieve the goal.

On the other hand, the user might also start with an unclear objective. They will explore the data and decide on what to do next according to the feedback of the data being explored. For instance, to find a pattern in the data (*as the initial goal*), the user might need to listen to the overall sound (*as the first linear sequence steps*). They might focus on the interesting area and start to use any available ways of interaction (*as what to do next*). However, the users’ goal and users’ actions are still interdependent. The actions will be presented as a list of reasonable alternatives.

Every task has at least one output or both input and output. The input/outputs of the application are the data being transformed into sound representations. It includes raw data, data attributes, information, acoustics parameters and final sound representation. These new forms of data after

each transformation processes (*including acoustic and sound representation*) are also described in this analysis. In general, in this analysis, we look into these nine tasks analysis as well as the input and output of each transformation processes.

Applications (Model-based sonification technique)

Two model-based data exploration models were analyzed:

1. Data Sonogram Sonification Model (DSSM)
2. Tangible Data Scanning Sonification Model (TDSSM)

Research Works

The Research works during the two weeks STSM are as the following:-

1. Interview and Discussion with:
 - a. Dr. Thomas Hermann (*Model-Based Sonification Technique and Data Sonogram Sonification Model*)
 - b. Till Bovermann (*Tangible Data Scanned Sonification Model (TDSSM)*).
2. Analysis these sonification designs through Task Analysis using unified HCI model for sonification applications (Diagram form).

Result Analysis

In General, below are examples of analytical analysis of the application through the attached diagram.

Table 2: Summary of Data Sonogram and Tangible Data Scanned Sonification Model

Data Sonogram Sonification Model (DSSM)	Tangible Data Scanned Sonification Model (TDSSM)
A. Example of tasks in general that the users might use as their first intention on what to achieve using the application: (<i>Both DSSM and TDSSM</i>)	
<ol style="list-style-type: none"> 1. Spatial data understanding 2. Topographic organization understanding 3. Finding number of cluster 4. Understanding of cluster dimensionality 5. New knowledge discovery 	
B. Designer’s assumptions in data perspective (towards the user) (<i>Both DSSM and TDSSM</i>)	
<ol style="list-style-type: none"> 1. Imagination of data in 3D space 2. Features as axis 3. Presumption the number of classes 	
C. Designer’s assumptions in Acoustics Understanding (towards the user) (<i>Both DSSM and TDSSM</i>)	
<ol style="list-style-type: none"> 1. Differentiate different timbre 	
D. Designer’s assumptions on Sound Representation (towards the user) (<i>Both DSSM and TDSSM</i>)	

<ol style="list-style-type: none"> 1. Interpret sound from an object 2. Sound density perception 3. Sound sparseness perceptions 4. Identify object location in space 5. Experience spatially surrounding sound 6. Detecting the border of cluster 7. Understand the spatial spreading of the sound scape 8. Rhythmical interrelation understanding 	
E. The Available Interactions / Flexible Setting	
<u>DSSM</u>	<u>TDSSM</u>
<ol style="list-style-type: none"> 1. Assigning of new spring model properties <ol style="list-style-type: none"> a. Set new Mass value b. Set new stiffness value c. Set new damping value d. Set new resonance value 2. Assigning new value of acoustic parameters <ol style="list-style-type: none"> a. Set new amplitude value b. Set new velocity value c. Set new frequency value 3. Select center coordinate <ol style="list-style-type: none"> a. Click to the GUI display (Data in graph form display) 	<ol style="list-style-type: none"> 1. Assigning new value of acoustic parameter <ol style="list-style-type: none"> a. Set new amplitude value b. Set new velocity c. Set new frequency value 2. Select current 3D dimension <ol style="list-style-type: none"> a. Select axis to display b. Rotate the display 3. Navigate TUIO in real space (Gesture) <ol style="list-style-type: none"> a. Move in any direction in space 4. Change navigating setting <ol style="list-style-type: none"> a. Set size of plane
F. Devices used	
<u>DSSM</u>	<u>TDSSM</u>
Mouse	TUIO (Tangible User Interface Object)
G. Interaction Aid (to guide the interaction)	
<u>DSSM</u>	<u>TDSSM</u>
GUI (3D- Graph)	<ol style="list-style-type: none"> 1. GUI (3D-Graph) 2. Virtual Space

Explanations below are based on the table above and the attached diagram;

B. Designer's assumptions in data perspective

1. TDSSM has more advantage on '3D imagination' because the interactions are done in real space using TUIO gesturally besides its graphical representation.
2. Since it is a must in TDSSM to transform the data into 3D space where features are used to represent axis, problem might be occurred if the data has more than three features. In this case, mathematical or statistical methods such as PCA (Principle Component Analysis) need to be used to reduce the data dimensionality. This constraint is happened because of the 'real space interaction' style, where the users will always relate the data to be as the same dimension as in real environment (3-dimensional). However, in DSSM, the number of dimension can be more than 3. This can be done by assuming that the display (a graphical graph where the user will interact using mouse) is just to show the perspective of dimensions (shows the current selected axis).

C. Designer's assumptions in acoustics understanding

1. To differentiate timbre is not a problem for both models, the only problem on this might be in the process of deciding on how many classes are there in the data.
2. DSSM seems to have more flexible, where the model allows the user to change the properties in data level. This will produce a lot more variety of sounds. However, some inputs seem to be "physics oriented" where the user might require understanding on what the variables for, for example 'damping', 'stiffness' etc.

D. Designer's assumptions on sound representation.

Based on the summary of both models as shown in Table 2 above, TDSSM seems to have more advantage than DSSM on accomplishing the following tasks.

1. Identify object location in space
2. feel the spatially surrounding
3. understand the border of cluster
4. understand the spatial spreading of the sound scape

This is because;

1. All of the tasks above involve space or spatial
2. Interaction is in free space (gesturally) using TUIO where the user is surrounded with data.

E. The available interaction

1. Synchronization and real time feedback between the sound produced and interaction must be as fast and natural as possible; as this will demand a powerful computing processing.
2. TDSSM has more freedom to explore the task than DSSM. This is suitable a tasks with unclear objective.

F. Device Used

1. Changing the size of plane without changing the size of real plane (TUIO) will cause a bit confusing especially to determine the position of object.

G. Interaction Aided display

1. Interaction with virtual data in real space forces the design to transform multidimensional data into 3D space with 3D coordinate.

Conclusion

As the conclusion of this STSM:

1. Within two weeks STSM, we have analyzed two model-based sonification namely Data Sonogram Sonification Model (DSSM) and Tangible Data Scanned Sonification Model (TDSSM). Both analyses are shown in the attached diagram. Based on both models, it is analytically shown that TDSSM has introduced gestural technique of exploring data. This kind of interaction is seen to give better mental representation and interpretation of the data especially if the objective involves the spatial data relationship, topographic organization, identify object location etc.
2. Better understanding of Model-Based Sonification Technique.
3. 'Gestural interactions' seem to have an important role in sonification interaction which could help in task completion especially in unclear objective tasks.

References

Hermann T. 2002. *Sonification for Exploratory Data Analysis*. PhD Thesis, Faculty of Technology. Bielefeld, Germany, Bielefeld.

Hermann ,T. & Ritter ,H. 1999.*Listen to your Data: Model-Based Sonification for Data Analysis*. Baden-Baden, Germany, Advances in intelligent computing and multimedia systems, 189--194, Int. Inst. for Advanced Studies in System research and cybernetics, 1999

Bovermann ,T. & Hermann ,T. 2006. *Tangible Data Scanning Sonification Model*. (Accepted paper) International Conference on Auditory Display, London, June 20 – 23, 2006.

Ag Asri Ag Ibrahim 2006. *Usability Evaluation for Sonification Applications*. Transfer Report. Electronic Department, The University of York.