1st EAA – EuroRegio 2010
Congress on Sound and Vibration
15 - 18 September 2010, Ljubljana, Slovenia
With Summer School for Young Researchers from 13 - 15 September 2010

Predicting the attractivity of a sound by its features – A tool for sound design in casino game industry

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ABSTRACT

Casino Gaming Machines ("Slot Machines") are used throughout the world. Slot machines have been continuously improved since the days of mechanical Las Vegas style steppers. In recent years, culture specific game design became more and more of a topic. Localizing graphics and or game themes lead to increased sales potential. The assumption is that this also applies to the design of sounds. Goal of this project is to get a better understanding if and why specific groups of players react differently not only to graphics but also to sounds. For that, player preferences should be collected via standardized player focus groups. Subsequently, the sounds will be analyzed with regards to psychoacoustic criteria with the ultimate aim at predicting player preferences.

It was possible to successfully analyse the data of seven player focus groups to create an analytical model that is able to predict the attractivity of sounds. To do that, all sound samples were characterized by 175 music retrieval parameters, by sex and by geographical descriptors. Subsequently, the model was tested at a final player focus group in March 2010 with good results.

1. INTRODUCTION

The overall goal of this research project of ATRONIC and JOANNEUM RESEARCH within the K-project “Advanced Audio Processing (AAP)” [1] is to get a better understanding about the psychoacoustic success criteria that are relevant to casino gaming machines. After analysis of the players´ preferences a psychoacoustic model should be built, which is able to predict these preferences for new sounds.
An analysis was done whether psychoacoustic prediction models perform for win sounds or not. Therefore sounds were tested in various player focus groups around the world. These data was then used to build a statistical model out of the extracted audio features.
The results are very promising so that a prediction of the attractivity of the sounds should be possible.

2. PLAYER FOCUS GROUPS

Between 2008 and 2009 a total of n=464 persons were questioned about their sound preferences. The investigations took place at 6 different locations in Europe, North and South America and Asia. The preferences were analysed separately for each player focus group, as well as combined in one “psychoacoustic” model.
An overview of all player focus groups is given in Table 1. The cells printed in grey represent the win sounds used at the respective player focus group where the number of sounds ranges from 7 to 9 sounds.

Table 1. Overview of player focus groups and sound labels

		PLAYER FOCUS GROUPS						
	Sound Number	**America1** February 2008 n = 73	**Asia1** April 2008 n = 86	**Asia2** May 2008 n = 45	**America2** May 2008 n = 30	**Europe** September 2008 n = 42	**Asia1** February 2009 n = 133	**America3** May 2009 n = 55
SOUND LABELS (number of sound label)	1			■	■	■	■	■
	2	■	■	■	■	■	■	■
	3	■				■		
	4	■	■	■	■	■		
	5						■	■
	6						■	■
	7	■	■	■	■	■	■	■
	8		■					
	9			■	■	■	■	■
	10	■						
	11		■			■		
	12	■	■	■	■	■		
	13						■	■
	14	■	■	■	■	■		
	15						■	■

At each player focus group the sounds were presented to the participants to question them about their sound preferences (“Would this win sound be pleasing for you in a slot machine?”).
A logistic regression model was used for each player focus group to predict the sound attractivity based on covariates such as the sound labels, the sex as well as the age of the participants, the station number at the player focus group and the question “Would you play on a slot machine when the sound is completely turned off?” Additional information about the player behaviour (favourite

denomination, favourite game etc.) was collected within a questionnaire at the player focus groups in Asia1, Asia2 and Europe.
The model for the attractivity of the sound is given by

$$P(Y_i = 1 \mid X_i = x_i) = \frac{\exp(x'_i \beta)}{1 + \exp(x'_i \beta)}, \quad (1)$$

where x'_i is a vector of known covariates and β is the corresponding vector of unknown parameters. The variable Y_i represents the sound preferences of the participants and is binary-coded. The attractivity of a win sound depends on the sound label at all player focus groups. In Asia1, sex significantly affects the sound attractivity, whereas an effect of age is only observed in Asia2.

3. EXTRACTED AUDIO FEATURES

Feature extraction is the process of computing a numerical representation that can be used to characterize a segment of audio. This numerical representation, which is called the feature vector, is subsequently used as a fundamental building block of various types of audio analysis and information extraction algorithms.
Music Information Retrieval (MIR) is an emerging research area devoted to fulfil users´ music information needs. MIR encompasses a number of different approaches aimed at music management, easy access, and enjoyment, whereas most of the research work on MIR are content based. The main idea underlying content-based approaches is that a document can be described by a set of features that are directly computed from its content.
Within this project 175 different sound features were extracted from each audio file. Thereby, the features can be categorized into rhythm-, pitch-, timbre- and tonal features and their different statistical variants. Subsequently, the whole feature set was used to develop the statistical model.

4. STATISTICAL MODEL

The psychoacoustic analysis uses 175 features of the sounds to describe their objective characteristics. These features are used in appropriate models to predict the subjective sound preferences. The predictive power of this model is investigated by a cross-validation technique. For this purpose the total sample is divided in a training sample and a test sample. We took 75% of the data as training sample and the remaining 25% as test sample. The data for the training sample were chosen randomly within the cells that result from combining the factors location and sex.

The overall procedure of the psychoacoustic model is given in Figure 1. To predict the attractivity of a new win sound, the objective sound characteristics (audio features of this sound) are extracted in a first step. Then these highly correlated vectors are transformed into a set of orthogonal components T using SVD. Based on this information the attractivity of the win sound is predicted by the psychoacoustic model.

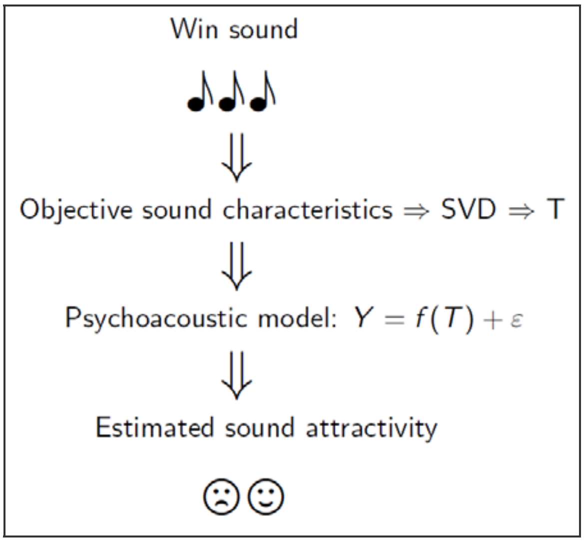

Figure 1. Psychoacoustic Model

5. SUMMARY AND OUTLOOK

The psychoacoustic analysis uses 175 features of the sounds to describe their objective characteristics. These features are used in an appropriate model to predict the subjective sound preferences. The predictive power of this model is investigated by a cross-validation technique.
The results show a very good performance of approximately 90% true prediction. This is a very high value for such a model and promises good results for the following external evaluation.

Next step to be done will be the external evaluation of the psychoacoustic model. The attractivity of several sounds which are new to the model will be predicted. Afterwards these new sounds will be tested in an upcoming player focus group.
On the other hand feature extraction and psychoacoustic modelling are now implemented within a development environment. For better usability especially for the sound designer this prototyped code will be implemented in a stand-alone executable software.

ACKNOWLEDGMENTS

This project is funded by the Austrian Research Promotion Agency (FFG), the Styrian Government and the Styrian Business Promotion Agency (SFG) under the COMET programme.

5. REFERENCES

[1] http://www.comet-aap.at/