Interactive Classification Using Spectrograms and Audio Glyphs

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ABSTRACT

The VAST Challenge 2018 aims to clarify the situation of the Rose-Crested Blue Pipit’s population in the Boonsong Lekagul Wildlife Preserve. We propose an interactive spectrogram and a representative novel audio glyph to support the classification of bird calls. The second visualization of our system helps to identify spatio-temporal patterns of bird species in the preserve. Using the system, we are able to solve the Mini Challenge 1 (MC1) tasks to classify claimed pipit calls and detect multiple spatio-temporal migratory patterns in the preserve. We find evidence that the pipit population is declining, but we can not identify any clear evidence that the accused company is responsible for the decrease of the pipit population.

Index Terms: Human-centered computing—Visualization—Visualization application domains—Visual Analytics;

1 INTRODUCTION

Mini Challenge 1 of the VAST Challenge 2018 succeeds the previous year's tasks to unveil the impact of environmental pollution on the pipits in the Boosong Lekagul Wildlife Preserve. MC1 provides multiple data sources to clarify and reveal the current situation in the wildlife preserve. The tasks include the spatio-temporal analysis of the bird populations and their habitats in the preserve. Furthermore, the accused Kasios Furniture company provided pipit call recordings to prove their innocence.

We propose a Visual Analytics (VA) [1] system to solve the tasks of MC1. The tool provides two main components that combine machine learning techniques, visualization, and human interaction to allow the exploration of the provided datasets. The first component allows examining the temporal and spatial characteristics of the bird populations and habitats in a basic spatial scatter plot with filtering options for bird species and time to identify trends and anomalies.

The second component on audio analysis (Figure 1) helps investigating the Kasios recordings using interactive classification and a novel audio glyph. Using our tool, we are able to detect a decrease in the pipit population and multiple spatio-temporal migration patterns of different bird species. As well, we conclude that most of the bird calls provided by Kasios company are not of the pipit species.

2 DATA AND PROCESSING

MC1 provides four datasets. The ground truth dataset contains more than 2000 verified bird calls which were collected during the last 35 years. Metadata about the bird calls, e.g., date and time, species, vocalization type (call or song), quality, and geo-spatial position complements the audio data. A bitmap of the preserve for the geographic locations provides the spatial references. The most important task was to verify the 15 claimed pipit call recordings from the Kasios company. The analysis of these data sources is challenging since the recordings vary in quality (e.g., purity, background noise), and in frequency fluctuations in each specific bird species. Further, it is difficult to interpret the spatial patterns due to the variations in the sampling strategy and vocalization types over the years.

To increase the quality of the bird calls, we preprocess the files by removing noise and silent moments from the recordings. Also, we normalize the bird calls using amplification to prepare the bird calls for the classification.

3 ANALYSIS APPROACH

Our analysis approach includes the extraction of more than 280 million fingerprints from the cleaned calls of the bird library. In general, many audio querying tools use fingerprints to classify audio files, which correspond to a given query snippet, such as Shazam [2].

We incorporate the user in an interactive classification process to categorize the claimed pipit calls of the Kasios company. First, the user selects a claimed pipit call. Consequently, the system displays the selected recording as an interactive spectrogram (see Fig. 1 (A)) that can be used to replay the bird recording. The user can then explore the spectrogram of the claimed pipit call using zooming and panning. The spectrogram enables the user to classify
Multiple interactions such as highlighting and zooming allow the exploration of the bird data in its spatio-temporal context. The application enables the user to focus on selected bird species by time intervals of interest to visualize the vocalization type, the convex hull for each species, and a heat map. We propose visual mappings that support the analysis of the evolution of changes in bird species characteristics over time in the preserve. For instance, Figure 3 shows that the primary habitat of the pipits was in the north-east until 2014 after which it moved southwestwards. We assume that the pipits are migrating due to the contamination in this area. Figure 3 also illustrates that some pipit recordings are in the other areas in the preserve.

4 Conclusion

The proposed system supports the exploration of all available data sources of the Mini Challenge 1 in an interactive manner. After exploring and analyzing all datasets, we are not able to identify a clear cause for the decline of the pipits. Yet, we are able to identify multiple patterns of the bird populations and their habitats. For instance, the decrease of the pipits and migration away from the contaminated area in the preserve. Overall, the audio recordings from Kasios do not back up their claim that the pipits are thriving and are not affected by any environmental pollution, since most of the claimed pipit call recordings belong to different bird species or provide a recording location outside the known pipit habitats. The fact that most of the alleged pipit recordings belong to other species does not support the claim that Kasios is responsible for the decrease of the pipits. Nevertheless, we suspect that Kasios may have provided misleading information about the thriving of the pipits across the wildlife preserve to distract from other potential negative impacts of their environmental pollution. Using our system we are able to solve the tasks of the challenge. The main contribution of our proposed tool is the interactive classification of the claimed pipit calls using the interactive spectrogram and the novel audio glyph. The audio glyph facilitates the identification of differences and commonalities between bird species. Gathering and investigating further and more exact data is required to obtain deeper insight into the current situation of the bird populations in the preserve and to strengthen the hypothesis that Kasios is responsible for the decline of the Rose-Crested Blue Pipit.

References
