Smartphone-powered Citizen Science for Bioacoustic Monitoring

Website
http://newforestcicada.info

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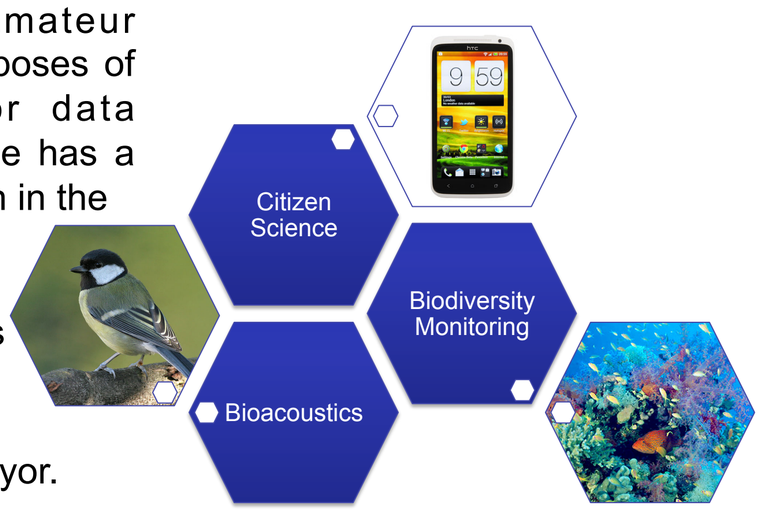
Citizen Science with Mobile Phones

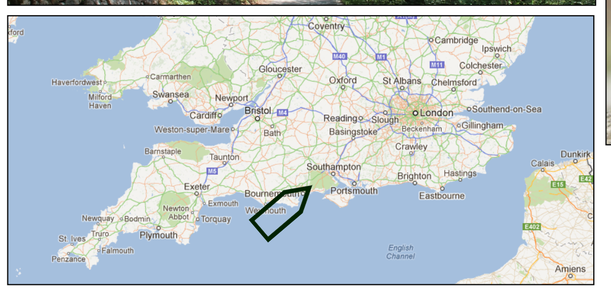
Crowdsourcing is a process that involves outsourcing tasks to a distributed group of people. Citizen Science is science conducted by non professional or amateur scientists for the purposes of data collection or data analysis. This practise has a long standing tradition in the field of biodiversity monitoring, but conventional methods are time consuming, slow and require high expertise of the surveyor.

Our target is to use CITIZEN SCIENCE methods combined with the power of modern smartphones to monitor biodiversity using SOUND.



The New Forest Cicada

A highly endangered insect with some characteristic properties

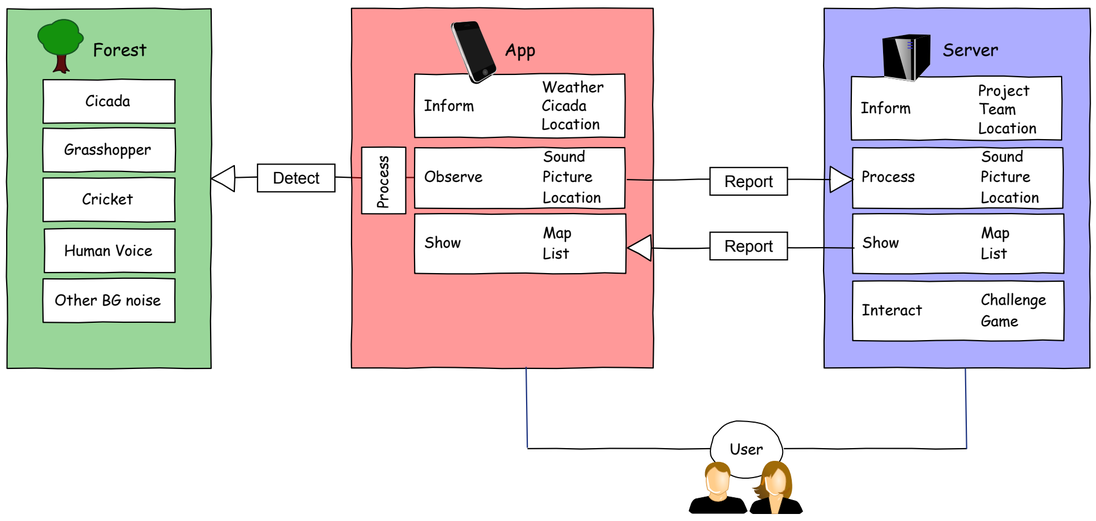


- Only cicada native to the UK
- Only present in the New Forest
- High pitched call at ~ 13.5 kHz
- Difficult to hear for people > 40

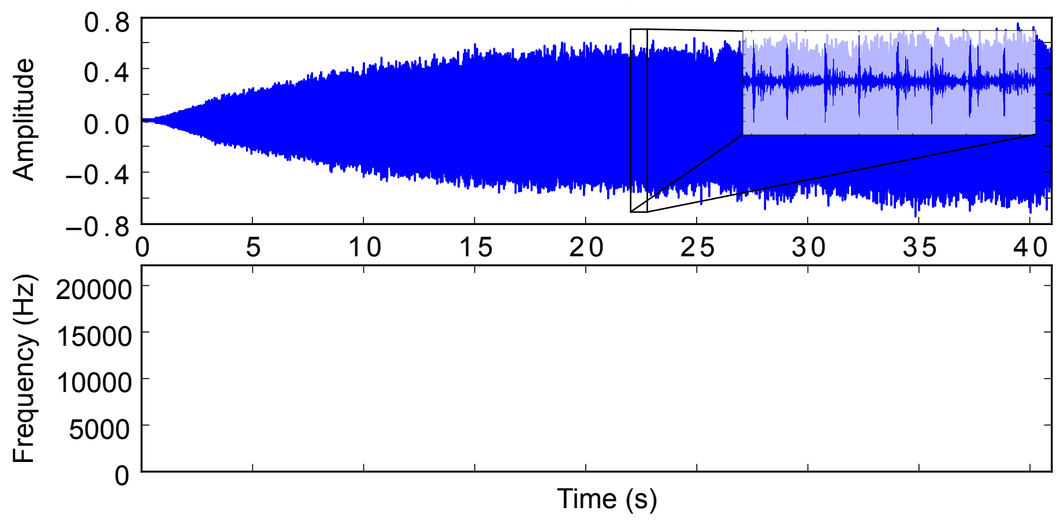
Can citizens and their smartphones prevent its extinction?

Tools and System Architecture

We designed a system that enables to collect sound observations with mobile phones, while at the same time informing the user on what to look out for.
An app will process sound locally on the phone, timestamping and geo-tagging the recordings. When the network is available, the app will send the recordings to the server for further processing.

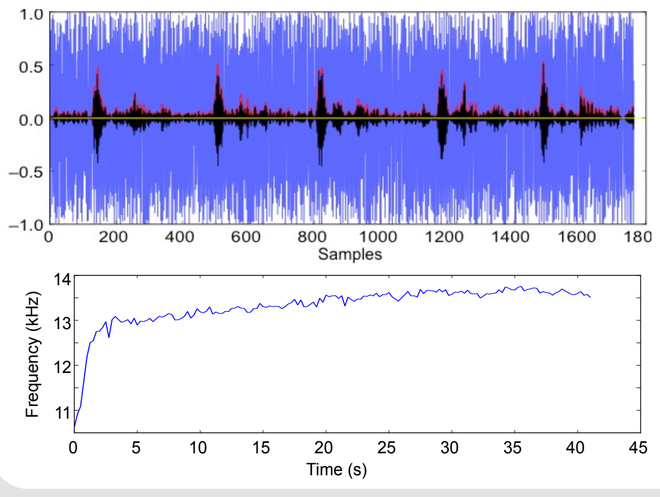


Sound Analysis



Three features have been identified in the *Cicadetta Montana* call:

- A strong 13.5 kHz carrier wave signal
- A strong increasing amplitude
- A weak 7–8 ms amplitude modulated repeating pattern

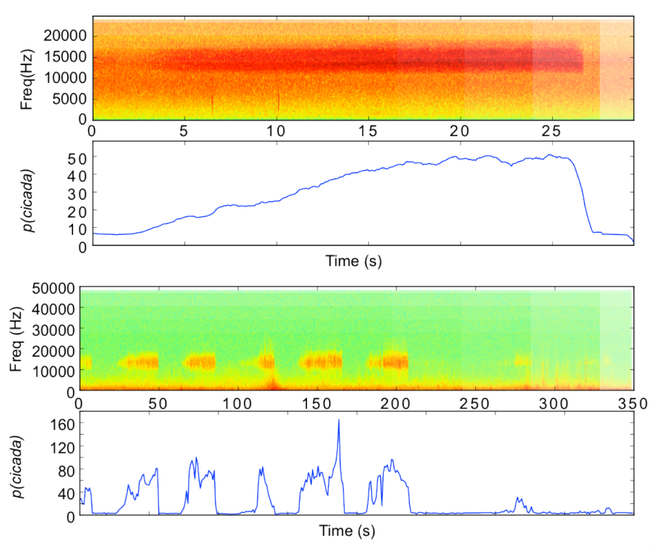


A short extract of the song (~1800 samples of a 44.1kHz recording, in black) with its Hilbert envelope (red) and carrier wave (blue), obtained by dividing the original signal by the envelope. The carrier (below) grows to eventually settle around 13.5 kHz.

Classifying Sound

An initial classifier considers the main frequency component of the call, centered around 13.5 kHz and spanning mainly between 11 and 17 kHz. The ratio between this and a range where little noise is present (8–9 kHz) is a measure of the acoustic energy of the cicada call, as can be defined as:

$$p(c) = \frac{\sum_{i=11}^{17} \Omega(i)}{\sum_{i=8}^{9} \Omega(i)} \quad [\text{kHz}]$$



Two recordings of the cicada call with an iPhone (above) and a professional Telinga parabolic microphone (below) with the corresponding instantaneous value of p(c).

Future Work

Detect four similar insects
- New Forest cicada,
- wood cricket,
- Roesel's bush cricket,
- field grasshopper

Incentivise citizen's participation
Exploring through simulation model how different incentive mechanisms, such as monetary or competition, could affect the search.

Develop the app to an industry standard
- Real-time sound classification
- Efficient battery use
- Data storage and communication
- Professional graphics

Simulating people's movement
Around the New Forest, exploring whether a sufficient part of the area is covered to make assertion on the presence of the cicada with sufficient confidence.