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AN IMPROVED PRIVACY-AWARE SYSTEM FOR OBJECTIVE AND SUBJECTIVE ECOLOGICAL MOMENTARY ASSESSMENT

WHAT IS THIS ABOUT?

We present a system for **Ecological Momentary Assessment (EMA)**[1] that is

- user-friendly
- privacy-aware
- flexible
- extensible
- compatible with hearing aids
- open source

to capture acoustical as well as situational and subjective parameters of test subjects in a long-term study.

The system features

- open hard- and software design
- is highly customisable

to simplify reproduction. Collaboration is further facilitated by a **shared database**.

ACOUSTICAL FEATURES

Objective features include[2]:

- Stereo RMS Level
- Power Spectral Densities (PSDs)
- Zero Crossing Rate (ZCR)

Real-time online calculation of above parameters allows for further metrics.

Standardised **plug-in framework** being developed to simplify implementation of external estimators.

PRIVACY-AWARENESS

Current features in accordance with German regulations:

- **No audio** data is stored
- Information **cannot be reconstructed** from extracted data[3]

ROADMAP

- Addition of new acoustical metrics based on **plug-in** architecture
- Development of new questionnaire **formats** (e.g. utilisation of built-in camera)
- Creation of a **database** for international collaboration and **data exchange**
- Incorporated in behavioural study - see poster P.36 "Overview of new outcome tools addressing auditory ecological validity: Analyses of behavior in real life listening environments"[4]

SUMMARY

- Easy to use EMA system with open design and **extensibility**
- Simultaneous assessment of objective and subjective parameters
- Privacy-awareness incorporated in acoustical features
- Highly **customisable dynamic** questionnaire with simple user interface
- Hardware and software are **open source**

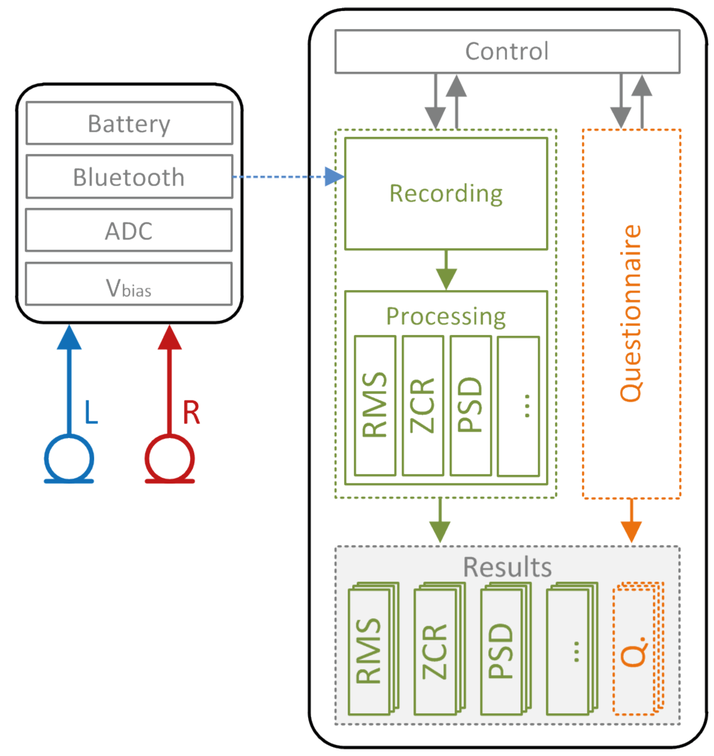
HOW DOES IT WORK?

Hardware:

- Microphones attached to glasses
- Pocket-sized Bluetooth device
- Wireless stereo transmission of data directly to phone via A2DP

Software:

- Based on Android **Automotive** OS enabling smartphone to act as Bluetooth stereo audio receiver
- Background **service** for data handling and extraction of acoustical features, foreground **application** for status display and questionnaire
- Flexible questionnaire design in **human-readable** format with functionality, constraints, schedule, ramifications

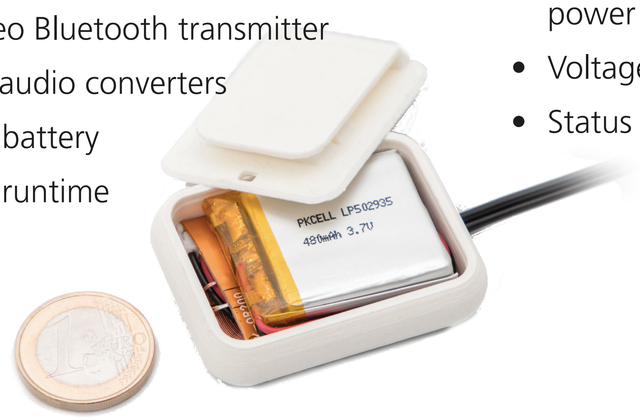


TRANSMISSION VIA BLUETOOTH

Clip mounted transmitter box contains:

- Stereo Bluetooth transmitter
- A/D audio converters
- LiPo battery
- >8h runtime

- Multiple charging options: USB, induction coil, power supply
- Voltage safeguard circuit
- Status LEDs



CUSTOMISABLE DYNAMIC QUESTIONNAIRE (XML-BASED)

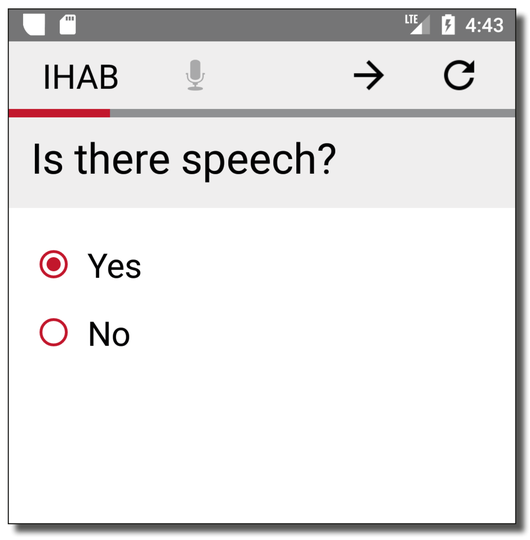
```
<question id="170752"
          type="radio"
          filter="!001,002">
  <label>
    <text>Is there speech?</text>
  </label>
  <default id="003">
    <text>Yes</text>
  </default>
  <option id="004">
    <text>No</text>
  </option>
</question>
```

Answer type:
`radio` → Radio button (exclusive choice)

Constraint:
Option ID `001` has **NOT** been previously chosen, ID `002` must have been

Question:
„Is there speech?"

Answer options:
- „Yes" (default)
- „No"

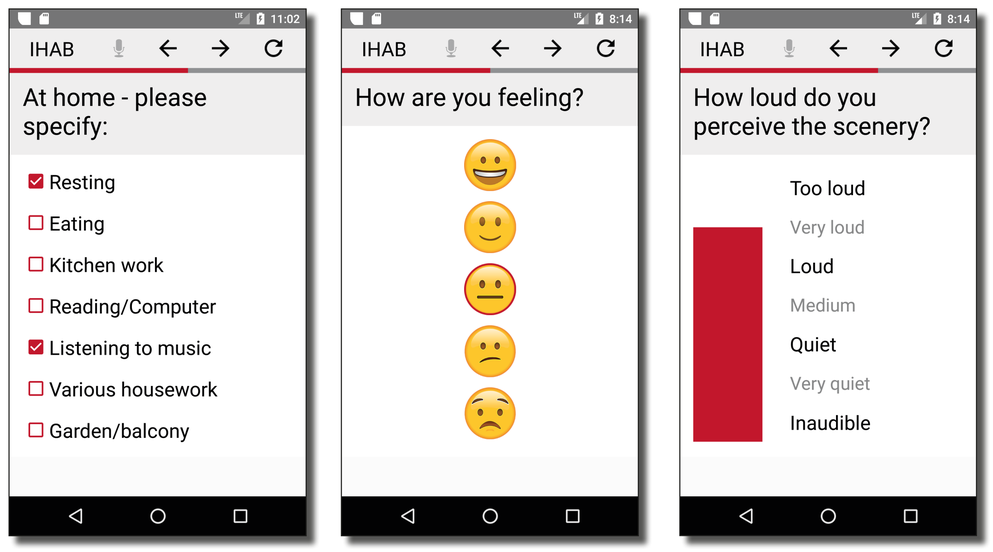


HOW DOES IT LOOK?

Answer formats include:

- Radio buttons
- Checkboxes
- Emojis
- Sliders
- Free text
- ...

creating an **intuitive framework** for the assessment of subjective parametres.



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[1] Shiffman *et al. Ecological Momentary Assessment*. Annual Review of Clinical Psychology, **2008**, 4.

[2] Bitzer et al. *Privacy-aware Acoustic Assessments of Everyday Life.* JAES, **2016**, 6, Vol. 64

[3] Kissner et al. *A smartphone-based, privacy-aware recording system for the assessment of everyday listening situations*. Proceedings ISAAR, **2015**, 445.

[4] Meis et al. *Overview of new outcome tools addressing auditory ecological validity: Analyses of behavior in real life listening environments*, ISAAR **2017**

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