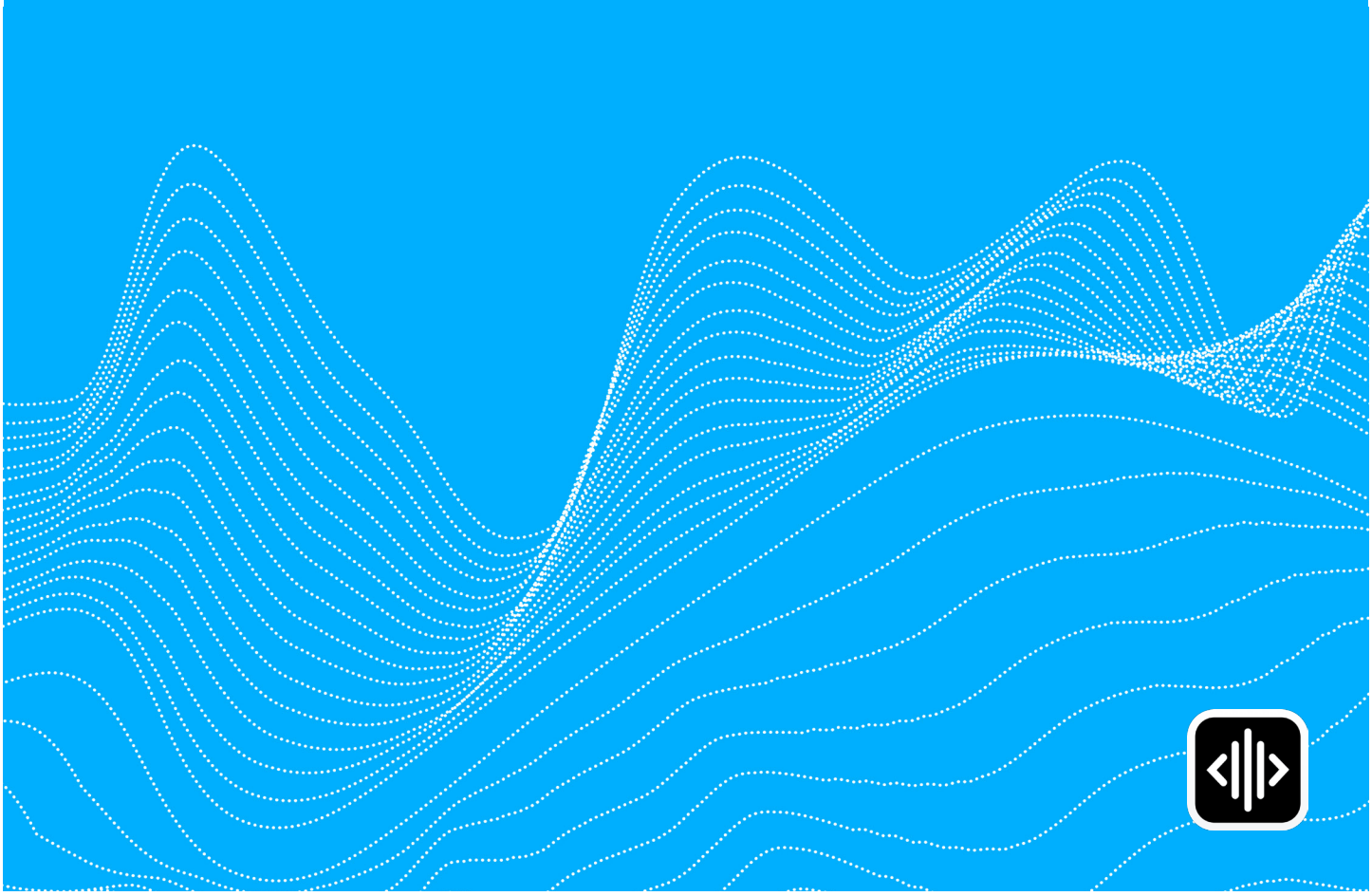
CUE Audio – Data Over Audio

Automatic Content Recognition using Bluetooth Low Energy on Mobile Devices



Contents:

Introduction:

A large and rapidly growing industry has evolved around the Automatic Content Recognition (ACR) of audio and video content, with use cases ranging from copyright protection and audience measurement to enhanced content and media synchronization between devices. While ACR has quickly proven to be a multi-billion dollar industry, ACR is still in its infancy in terms of what the tech can accomplish, how privacy concerns are handled, and how end users are engaged on mobile devices.

This whitepaper discusses the strengths and weaknesses of current ACR's ability to detect and recognize catalogued content on mobile devices and suggests a way in which ACR can leverage Bluetooth Low Energy to become a more effective consumer-facing and advertiser-friendly tool while simultaneously removing many of the privacy concerns that have so far impeded ARC growth and expanded use cases.

Smart TVs manufactured by Vizio, LG, Samsung, Sony, and hubs like Roku implement ACR in some form to collect viewership data and statistics.[1] This data can be used for post-purchase monetization via advertising retargeting and selling viewership statistics. User consent is required to collect this personal data and consequences regarding the failure to do so can be seen from the FTC's response after Vizio failed to disclose ACR usage to their customers in 2017.[2] Consumer pushback against ACR in a home viewership capacity is likely due to a combination of privacy concerns, a lack of utility for the end viewer, and a feeling of personal commoditization.

While ACR software operates on many Smart TVs and many Terms and Conditions include language for this purpose, mobile devices are a more private and user-defined environment; ACR therefore has less prevalence on mobile and generally does not operate unless it serves a brief and immediate purpose, like identifying the name of a song.

Notable Shortcomings of ACR on Mobile Devices Table 1

- Environmental noise causes frequent misdetections and failed recognitions
- Widespread privacy concerns regarding audio and video monitoring
- Difficulty accessing the microphone and camera on mobile devices
- With few exceptions, a mobile application requires a foreground state to automatically recognize content
- Low consumer utility

Only the first of these relates to a fundamental limitation of ACR as a technology; the others relate to the public perception of ACR with respect to privacy and audience measurement. Due to these difficulties, the mobile device has yet to play a substantial role in recognizing or reacting to televised content played in a home setting, which is untapped benefit for consumers and advertisers alike.

ACR Objectives Table 2

- Content enhancement
- Audience measurement
- Broadcast monitoring
- Media synchronization

While audience measurement is only one feature of ACR and benefits advertisers more than end users, other ACR features, like enhanced content, primarily serve the consumer.

"Given that the mobile environment is a more private environment than the Smart TV, we can expect to see the benefits of ACR on mobile (Table 2) only once the difficulties of mobile ACR usage (Table 1) are resolved"

A number of attempts have been made to showcase ACR as more consumer-friendly by providing end users direct benefits for participating. For example, Shazam had a notable "Shazam TV" feature in 2012 [3] and has produced an interactive game show called "Beat Shazam," hosted by Jamie Foxx, for multiple seasons.[4] Facebook also explored automatic content recognition of broadcast media for new social features, like television polling, in 2015. While these early efforts to increase mobile ACR adoption were innovative, most met with disappointing results. These results are likely attributable to two major sources. First, these use cases require the end user to answer a large call to action by having ACR active in the foreground of their mobile device for the duration of the televised content. Second, consumers pushed back against persistent access to the microphone and camera, and therefore were unable to receive passive prompts or notifications from televised content.

Participation in enhanced content ACR features on mobile devices would increase tremendously if the call to action to participate were more convenient to the end user. That is, if ACR on mobile could operate in the background of the device without posing privacy concerns. This is achievable using ACR in conjunction with Bluetooth Low Energy.

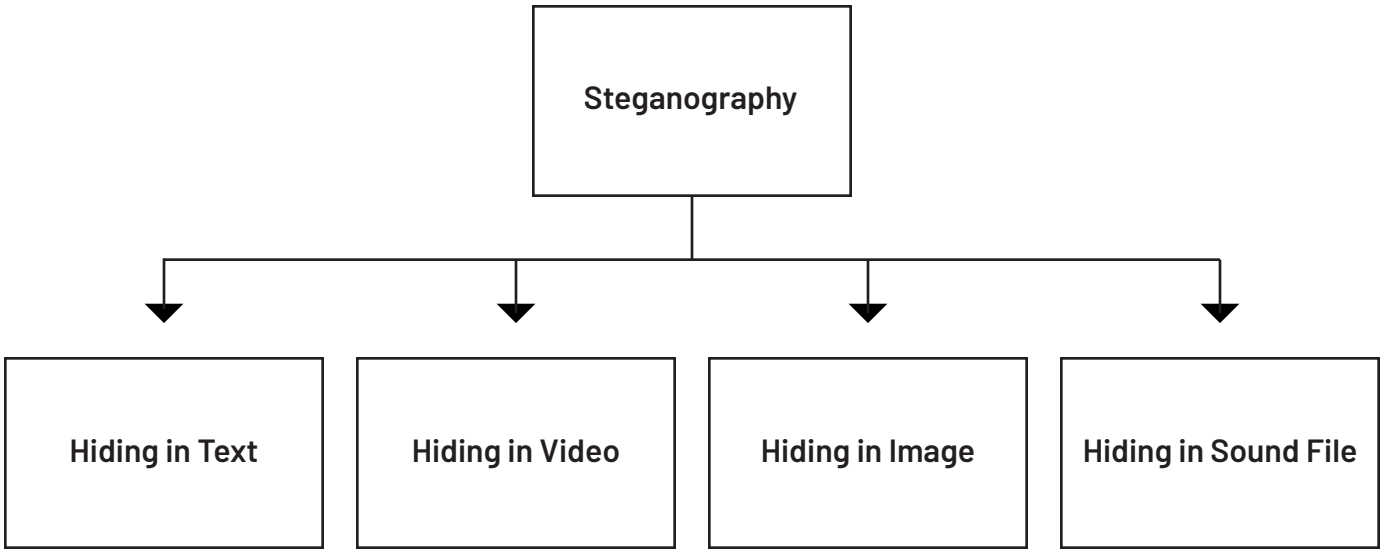
How CUE ACR Works

CUE's Bluetooth Low Energy protocol for ACR ("CUE ACR") is a new integrated system that solves the pain points of traditional ACR usage on mobile devices. Using steganography and Bluetooth Low Energy, CUE ACR has been modified to better fit a more private, mobile environment.

Benefits of CUE's ACR Table 3

- Can operate in a more inclusive set of environments (e.g., loud or noisy)
- Virtually zero recognitions and failed recognitions since audio and video feeds are not the content delivery mechanism
- Fewer privacy concerns without audio and video monitoring
- No permission requests for microphone and/or camera access and therefore a higher opt-in percentage of end users
- Runs in the background. Mobile applications do not need to occupy the foreground state.

Steganography Diagram: Steganography is the practice of concealing messages or information within other nonsecret text or data, like a video or audio file.

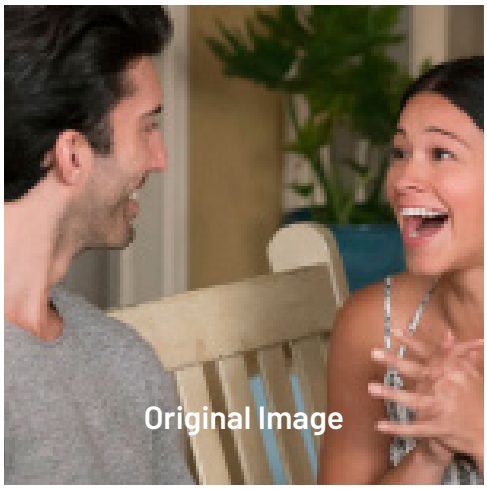


Steganography Example:

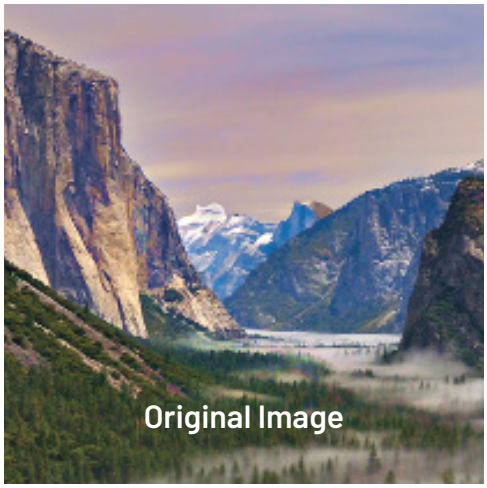
The images on the left are originals, while the images on the right contain steganographic data.

Actor IMBD:
Steganography Contains:
Actor: Jennifer Anniston
Content: Friends
Season: 3
Episode: 15
Timecode: 1530.25

Subtitles:
Steganography Contains:
TimeStart: 24.20
TimeEnd: 28.55
Subtitle: "I'm so excited!
Thank you."



Location:
Steganography Contains:
Name:Yosemite National Park
Country: United States
2Dcoordinates:
Latitude: 37.865101
Longitude: -119.538330
Metadata: El Capitan Cliff



The steps by which CUE ACR enables a more private and persistent line of communication between televised content and nearby mobile devices are:

1. Embedding a steganographic software-layer decoder into the Smart TV or within a streaming application running on the Smart TV
2. Embedding steganographic data into the televised content
3. Converting the steganographic data into BLE packets upon detection
4. Broadcasting the BLE packets to nearby mobile devices running apps listening for this data, either in the foreground or background state. No microphone or camera access is required to recognize the content

Examples of consumer-oriented mobile features that CUE ACR enables:

- Timely alerts to view related or behind the scenes content
- Prompts to relevant or trending social posts related to what is currently on-screen
- Media synchronization between television and mobile devices for viewer engagement and entirely new show genres, like interactive game shows

The broadcasted BLE advertisements to the mobile device can contain info like the name of the show being viewed, its episode number, and even a precise timecode of where the viewer is currently positioned. **Effectively, content producers can embed a non-audiovisual channel into their broadcast, which contains a constant and curated flow of media and messages to nearby mobile devices, selected by the content producers themselves.** Mobile devices receive this data in the background and can respond with prompts and timely notifications for behind the scenes content, relevant in-app discounts and exclusive offers, related social media channels, or can even passively collect data to improve the viewing experience. Moreover, the advertisements function in a one-to-many relationship, enabling multiple mobile and even IoT devices to receive synchronous messages from the streamed or televised content.

CUE ACR prioritizes an easy opt-in process for the consumer by removing privacy concerns, including microphone and camera access, and enabling new consumer-facing features in a new, non-audiovisual channel that are accessible via background detection. By making CUE ACR both convenient and beneficial for mobile users, adoption will begin to increase dramatically and provide a wealth of untapped potential to the multi-billion dollar ACR industry. **Moreover, without the need to access audio, video, or operate solely in the foreground, consumers do not need to actively seek these ACR benefits out; they can passively receive them.**

Enabling CUE ACR not only stands to improve two major tenets of traditional ACR, content enhancement and audience engagement, but also greatly improves the capabilities of ACR to service another of its major tenets: audience measurement.

Using CUE ACR, advertisers are able to:

- Cooperate in ad retargeting, informing the mobile device of which ads the user has viewed on tele vision and vice versa.
- Create a union of two distinct data sets: the user's customer profile as known by the Smart TV and the user's customer profile as known by the mobile device, thereby enhancing the overall value of the customer data set.

Second Screen and Enhanced Content Applications

More than 45% of TV viewers "often" or "always" engage with a second screen, like a smartphone or tablet, as they watch television[5], up from just 15-17% in 2013.[6] More often than not the second screen is used to augment primary-screen content. TechCrunch reports, *71 percent said they use their device to look up something related to the TV content, while 41 percent said they text, email or message someone about the content. Thirty-five percent said they shop for a product or service being advertised and 28 percent write or read social media posts about the content they're viewing.*[7]

Despite frequent simultaneous usage of a television and mobile device, traditional ACR is rarely used to identify primary screen content on mobile devices; instead, users choose their own relevant search terms or rely on displayed prompts on-screen, like social media hashtags, to find associated content online. With Bluetooth Low Energy-based ACR, broadcast media can expand to contain three distinct channel types: audio, video, and BLE, all of which are defined by the content creators. Functioning like a broadcast hyperlink, this new, third broadcast channel will tightly integrate broadcast media into the web and Internet of Things.

Endnotes

1 https://www.flatpanelshd.com/focus.php?subaction=showfull&id=1518081245

2 https://www.ftc.gov/news-events/blogs/business-blog/2017/02/what-vizio-was-doing-behind-tv-screen

3 https://techcrunch.com/2012/09/16/shazam-for-tv/

4 https://techcrunch.com/2017/07/09/beat-shazam/

5 https://techcrunch.com/2018/12/12/nielsen-the-second-screen-is-booming-as-45-often-or-always-use-devices-while-watching-tv/

6 https://variety.com/2013/biz/news/getglue-sale-let-the-second-screen-shakeout-begin-1200802284/)

7 https://techcrunch.com/2018/12/12/nielsen-the-second-screen-is-booming-as-45-often-or-always-use-devices-