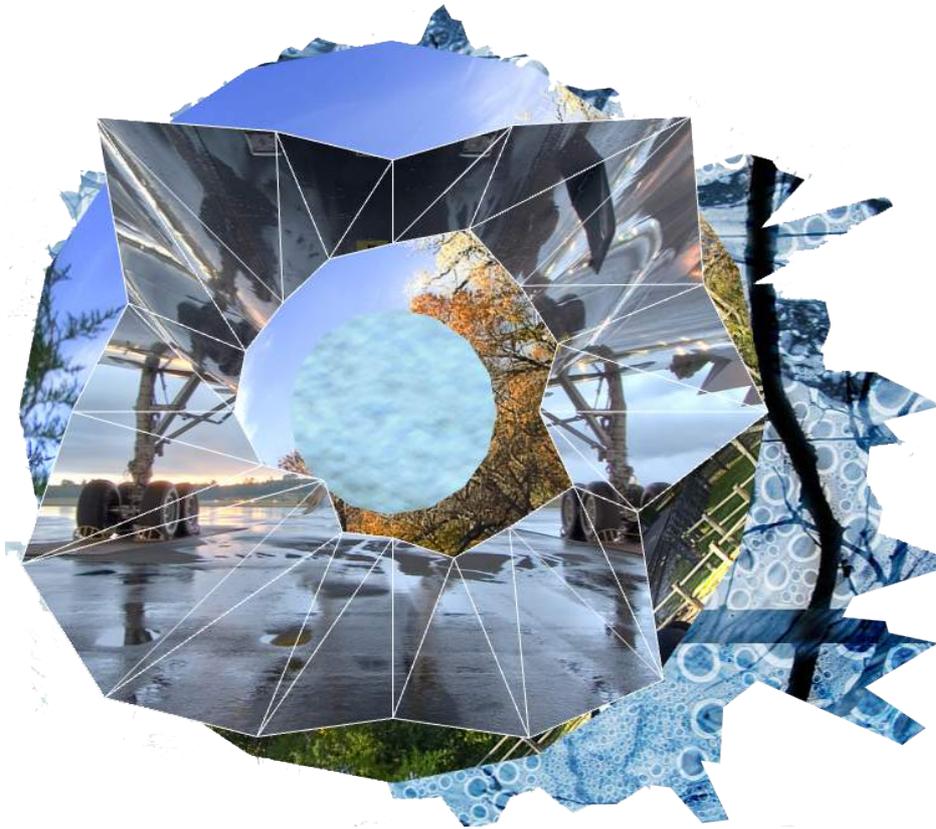


kaleidOk: Visually Communicating Emotions from Spoken Word



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Abstract

Most of the time technology inhibits emotional experience and deep social connection. This can limit our communication in almost all contemporary situations, especially in public spaces or in the sharing of collective information. There is a demand for engaging, interactive content for public screens, so we present an emotional spoken word image retriever and visualiser made with the goal of enhancing the emotional expression had with a display. We employed a method of applied research, which involved system development, artistic practice and user studies. Through this journey we found that by displaying affective visual feedback of speech people are more than willing to express themselves emotionally and, therefore, have a more meaningful experiences with the interactive content than is currently widely available.

Preface

The reason I am studying Art and Technology is to find opportunities that enhance creative communication between people with technology. For a long time I have had concepts for speech generated visual art and I was not willing to give up after proposal rejections. While visiting Berlin and having discussions with my friend/ kaleidOk collaborator David Foerster, the concept started to grow into a concrete goal. I found the components to make the proof-of-concept viable, and David confirmed.

Next, I approached the Art and Technology Department of Saxion with my idea. And the journey of my graduation project began. So I'd like to thank course director Ruben Sinkeldam, my teacher Kasper Kamperman, my supervisor Mettina Veenstra, and coach Rob Maas for allowing me to realise this idea. Their communication with each other and myself has allowed this to progress and their insight in experimentation is encouraging.

I specially thank David Foerster for helping with so much more than being the key programmer for kaleidOk. But he also helped me with applications for financing, my medical issues, and answering any question I had about computers or German bureaucracy.

David and I have had to piece together blocks of open-source projects to make kaleidOk; so we greatly appreciate Uros Kardianic for Synesketch, Joren Six for Tarsos DSP, and Florian Schulz STT for Processing/Java.

Kimberley Bianca Warren,
Enschede, 2015

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1 Introduction

This research report is focussed on the artistic and technical process of creating engaging, interactive content as a solution to a social concern as brought up by OBSERVE interactive screens project run by the research group Media, Technology and Design of the Academy of Creative Technology, of Saxion University of Applied Sciences; in utilising existing screens to keep people meeting in public spaces (city centres).

Our contribution to OBSERVE is an emotional spoken-word visualiser. The main question being how can we combine speech recognition, media retrieval and visuals generating to enhance the emotional experience with an interactive public display? We are further concerned with general user experience through Pilots and observational studies.

1.1 Motivation

A city centre should accommodate free activity and speech. If we want to keep people in city centres, there is a need to open space conceptually as well as technologically. Activities of free interaction play an important part in attracting people to public spaces. I'd like to witness a return to the public space to act on free speech, with technology being the mediator, and the artwork being displayed on the screen as a representative output of how a person's internal monologue can connect to a greater discourse through emotions.

1.2 Background

The background and theory topics justify my choices for each feature of kaleidOk. Smart Cities as the context; Free Speech as the motivator; Emotionally-mediated Synaesthesia involving inspiration and expanded work; and Image Selection as digital artefacts assessable to the public.

1.2.1 Engaging screen content in “Smart Cities”

One of the foundations of a “Smart City” is to create an ecosystem that engages more actively with its citizens. We are reshaping our urban environments, and Smart Cities are becoming a reality (Smart Cities, Streetline).

Experts in the field of public space are becoming increasingly aware of the importance of spaces that feel inviting for people to meet each other and stick around for discussion (Veenstra & Sijgers, 2014). Research is necessary to question, which social and urban situations occur around a screen, and how these situations can be identified and characterised (Veenstra & Sijgers, 2014). “Interactive displays main design requirement is interaction – the public's ability to browse, navigate and identify the information the display makes available” (Kostakos et al., 2013).

By exploring and creating forms of interactive content that are suitable for the specific context, we can reuse the content in different locations. An important aspect when designing content for an interactive public display is related to its visual appeal. Engagement cannot be seen as unique to individuals, but to the relationship between people and technology and elements surrounding them. Content must be created to fit all types of users (Kukka et al., 2013).



Figure 1.1. Interactive Urban Screen, Venice Biennale (DROPPSTUFF.nl, 2011)

1.2.2 Liberation Technology as Free Speech

Everyone shall have the right to freedom of expression; this right shall include freedom to seek, receive and impart information and ideas of all kinds, regardless of frontiers, either orally, in writing or in print, in the form of art, or through any other media of his choice.

(Universal Declaration of Human Rights, Article 19, Line 2.)

Speaker's Corners in public spaces are meeting places to share expressions and practice free speech. However, we have already witnessed an explosion of information and knowledge sharing through digital means (Schiller, 1995), and the Internet has become a popular soapbox. Although technology, in general, will not lead us to an information Utopia (Dias, 2014), the role of free speech as an inherent right could be better practiced. New possibilities for spreading flows of information and expanding discourse are readily available through the Internet (Diamond, 2010). Blogs, chat clients (open and encrypted), social media, torrent sites are all accessible for ordinary persons to share information viewable on any connected computer (Chander & Lê, 2013).

There is a very real threat to free speech and public sharing of information (Five new threats to free speech today, 2015). Comprehending the structure of free speech of current cyber-law allows us to pre-determine, and work for the future of free speech rights (Chander & Lê, 2013), and propose

alternatives through other mediums. The On life Manifesto from the European Commission writes, “Endorsing responsibility in a hyperconnected reality requires acknowledging how our actions, perceptions, intentions, morality, even corporality are interwoven with technologies in general.” So what can we do to create new platforms, spaces, and open networks that continue to enable free speech in the future?



Figure 1.2. Megaphone Interactive Speakers Corner, Montreal, Canada (Moment Factory, 2013)

We are re-inventing our use of voice interaction with media (Pierce, 2015). The use of speech recognition tools and voice applications are allowing us to approach this medium with improved insight, skill, and creativity (Pierce, 2015). Therefore, we could utilise new technologies to maintain our most natural mode of communication- speech (Schafer, 1995)- to come up with solutions.

1.2.3 Emotionally-Mediated Synaesthesia

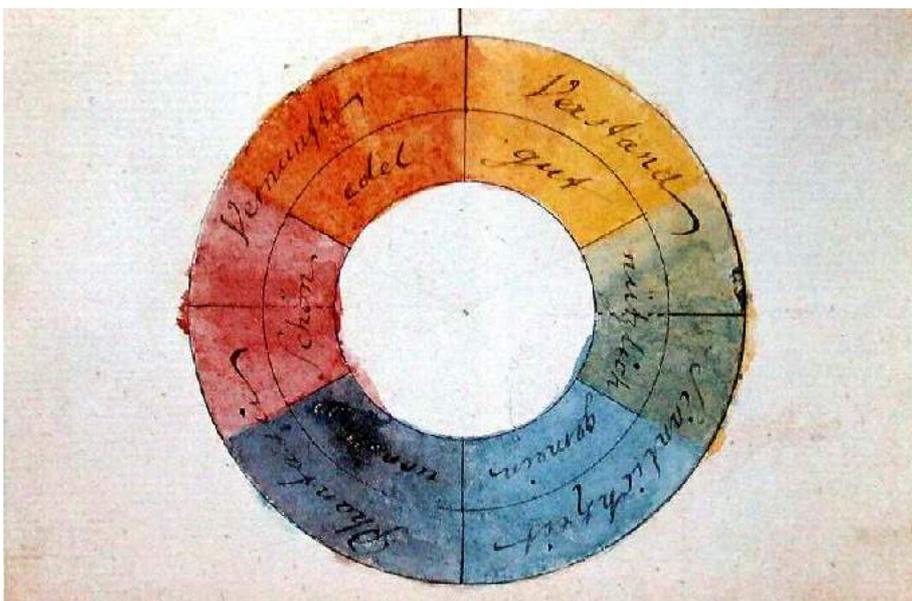


Figure 1.3. Goethe's colour wheel with 'reciprocally evoked colours' (Goethe, 1809)

Synaesthesia is a neurological trait in which the different sensory modalities communicate with each other or crossover involuntarily, and it is also used as a device for literary or artistic concepts (“Synaesthesia”, 2015). I am interested in the way we subjectively construct meaning with our external environment. Marshall McLuhan’s contribution to the discourse of a sensorium demonstrates that the phenomenon of synaesthesia; is a relationship between media, culture and our senses (Morrison, 2000).

A project we have expanded upon, Synesketch (Krcadinac, 2008) is an open-source software library made for digital artists. Their code is a medium of words, emotions, and visuals. The Synesketch approach centres on the idea that affective computer systems should be able to communicate and influence or evoke human emotions (Krcadinac, 2010). Mapping emotion to color encounters problems of subjectivity and cultural constructs (Krcadinac, 2010). The Synesketch color palettes try to avoid subjectivity by using the results of research by Pos and Green-Armytage, which come from Ekman’s emotional types groups (Pos and Green-Armytage, 2007). They studied how people from different cultural backgrounds associated colors with emotional types and no statistically significant differences were found between study groups.

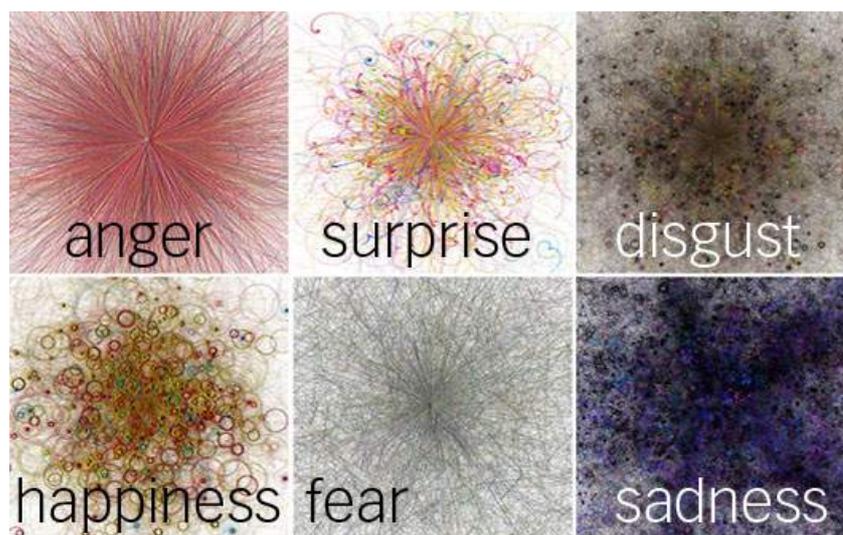


Figure 1.4. Synesketch “Synemania” results based on Ekman’s 6 emotion types and Pos and Green-Armytage’s colour mapping (Krcadinac, 2010)

Other forms of synaesthesia that are of interest to this project are voice induced synaesthesia, auditory-visual synaesthesia and emotionally-mediated synaesthesia, and texture and tactile associations. There have been many claims that position synaesthesia (either naturally triggered or learned), as a universal language medium. Moreover, by manipulating and controlling our sensory experiences, we can also control our emotions.



Figure 1.5. Vocal Vibrations Sensory Installation (Le Laboratoire Paris & MIT Media Lab, 2014)

Vocal Vibrations by Le Laboratoire Paris (see *figure 1.5*) and MIT Media Lab, is an interactive environment to explore voice and vibration through three sensorial journeys. In Vocal Vibrations, Composer Tod Machover describes his attempt to, “unleash the vast potential of personal vocalizing, for aesthetic pleasure as well as for cognitive and physical stimulation and relaxation”. The seeker is encouraged to use their voice to discover where different senses and concepts meet. Moreover, by enhancing one's awareness of their intentions, people are more likely to broaden their range of emotional, cognitive and physical transformations (Valentine, 2014).

1.2.4 Digital Artefacts

The image selections in kaleidOk are *digital artefacts*, interactively accessible to the public- “A product of the mass itself”, (Cham, 2006). I chose to use the globally accessible image database Flickr because I consider this to construct the most suitable and immediate results, both from a technical perspective and for representation of the concept.

There are interwoven fields of visualisation that relate to this research: A pragmatic approach with technical and analytical orientation; and culture oriented to aesthetics and metaphor. I am interested in Baudrillard's theory of a “hyperrealist world” (Baudrillard, 1981). Although expressing different origins of the simulacrum/ spectacle (Cook, 1998), Baudrillard and Debord speak very similarly about direct experience of the world being replaced by televised (computerised) images (Baudrillard, 1994; Debord, 1967). KaleidOk's image retrieval and presentation aim to embody this theory. These concepts and theories induce a deeper critical context in the socio-visual aspect of kaleidOk.

1.3 Scope

The scope of the development and research has involved the system and software development of kaleidOk, the artistic choices and rendering of aesthetic features, proof-of-concept testing which involved demo's and preliminary tests of the interactive content produced, and the analysis of user engagement in which observations of kaleidOk interventions took place in the form of Pilots.

Some key inquiries remain outside the brief of this current study; how can we measure the effectiveness of kaleidOk at enhancing emotional expression? How would kaleidOk presented over the mid to long-term bring about shifts in subjectivity? And what makes users more comfortable with speech interfaces? KaleidOk could popularise itself over the longer term through its effectiveness to provoke change. However the scope of a study that could determine such connections would require long-term, sociopolitical and psychological studies of types far beyond the scope of this current investigation. Nevertheless, interviews and comments collected from participants are analysed as supportive of the proposed effectiveness.

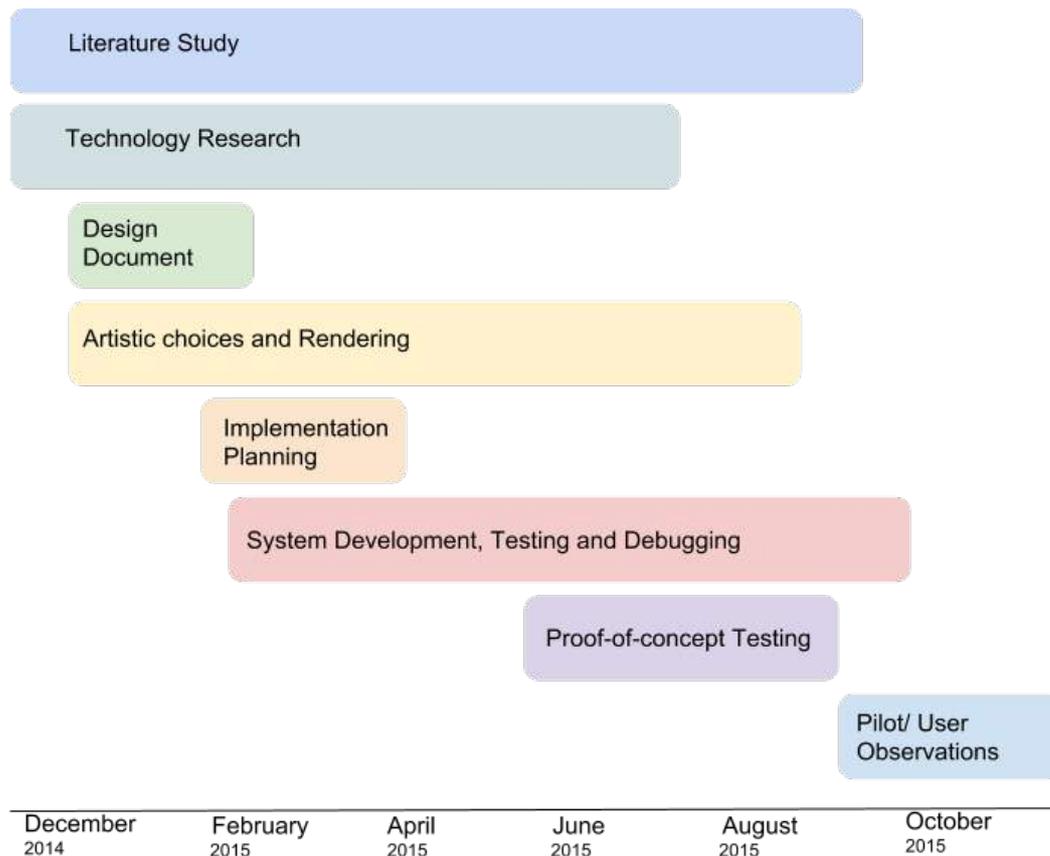


Figure 1.6. kaleidOk timeline of production and research

2 kaleidOk

KaleidOk emotional spoken-word visualiser, works by retrieving images from Flickr (Yahoo!), and displays them as an artistically designed sequence made in Processing (Reas & Fry) to the participant. This works by the speech being converted to text using Google Speech API (Google Inc.). Then emotional weightings are generated based on the lexical content provided by Synesketch (Krcadinac, 2008), and simultaneously the incoming audio signal and spectrogram is visualised using Tarsos DSP (Six, 2014). The text that has been converted from the speech using Speech to Text for Processing/Java (Schulz, 2013) performs two procedures; the words detected from the Synesketch lexicon are used to

search for images by theme, and as each emotional weighting is assigned to a colour palette, these results contribute to the search for the images, using Chromatik (Exalead, 2009) Colour image search engine.

Digital technology plays an important role in kaleidOk. It is used to stimulate the process of cross-modal association that involves the construction of meaning; the way in which a synaesthetic stimulation can trigger association and emotion. These associations allow people to explore connections between their inner dialogue and the outside world.

Other than the contributing modules outlined in the System Development, we were unable to find any directly related work to kaleidOk.

2.1 System Development

KaleidOk started out as a collection of Processing sketches and later plain Java applications based on the Processing core library. They served as design concepts and technical proofs-of-concept for the various data sources, of which kaleidOk makes use; audio analysis, speech recognition, emotional text analysis and colour-based image search, and to familiarise ourselves with the involved libraries and APIs. We used the source code revision control system Git hosted by GitHub to track changes from very early on in the development phase. Shortly thereafter, we began to use the issue tracking system provided by GitHub and the integrated development environment IntelliJ IDEA by JetBrains.

In May 2015, we integrated the code and functionality of the individual proofs-of-concept into modules of a single application dubbed “Kaleidoscope”. The incompatibilities between some of the employed software libraries uncovered during integration process led to their substitution by or supplementation with a similar library Minim vs. TarsosDSP or a nearly complete rewrite of Speech-to-Text.

It then became apparent to us that a single-threaded, serial execution of the graphics renderer and requests to network services Google Speech API, Chromatik and Flickr are not feasible for usability in the long run, this led to the conversion of network requests to task objects, that would be handled by concurrently running worker threads. This execution is incompatible with the service connector libraries and required their partial re-implementation.

Since an increasing amount sketch parameters are subject to frequent changes, it became necessary to extend Processing’s sketch framework, which is based on Java Applets, to support run time configuration. Other necessary extensions included setting up the applet container to fit presentation needs better, most importantly a flexible full screen display of the sketch as well as graphical user-interface elements like text fields and buttons.

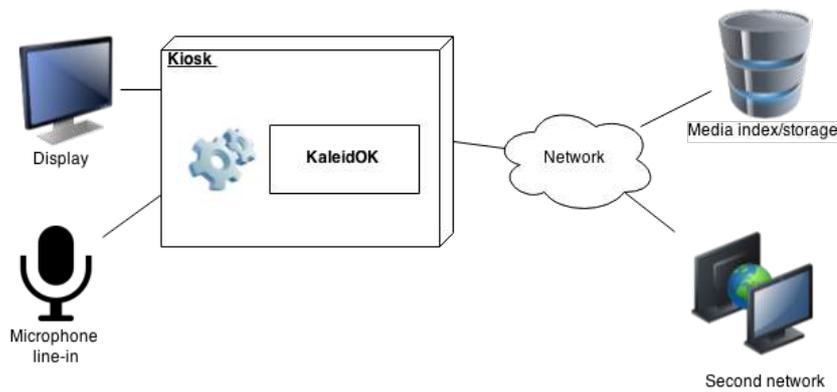


Figure 2.1 System Diagram: General Overview

KaleidOk is deployed as a Java application with all the necessary library dependencies most importantly Synesketch and also Apache Commons, Gson, javaFlacEncoder, DiskLRUCache, and Wiremock. The computer connects to an external display (a monitor, large screen or a projector) and a microphone. A network connection is required to allow access to media indices and archives and optionally other KaleidOk deployments of collaborating participants. To reduce the amount of network traffic and the waiting time for the display of images, we integrated a cache for HTTP requests.

One important requirement of further research is the documentation of test results, which led to us integrating a tuneable, structured logging facility into kaleidOk. On top of textual logs, kaleidOk now stores local copies of the audio records used for speech recognition and screen shots of the sketch for every new image appearing in it.

2.2 Artistic Choices and Rendering

Firstly, I determined current knowledge to inform my artistic design. I had to learn new creative and technical skills such as programming, audio analysis, and the application of colour theories. By referring to literature, undertaking tutorials, and practicing, I was able to expand and deepen my skillset substantially.

Finding a suitable media search index proved more difficult than expected. For now using Internet search engines proves successful and with interesting results on a technical and visual level. We are using Chromatik as images can be searched by colour proportion and keywords. As indexed pictures are obtained from FlickrR API, Chromatik takes benefit from available metadata (location, tags, license) to improve the browsing. We use information from the emotion recognition result by Synesketch as search criteria for appropriate images within Chromatik, a searchable index to the image hoster Flickr: the colours associated with the strongest emotion and the words with largest contribution to the emotional evaluation of each phrase. We pick two of these colours at random and up to two keywords for the image search.

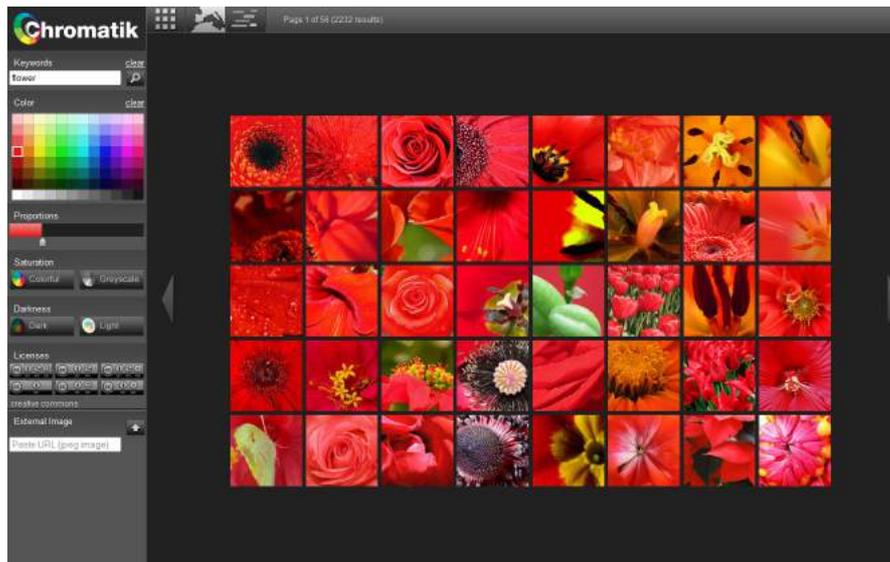


Figure 2.2. Chromatik Colour Image Search Engine by Exalead; interface and search results

We used the graphical programming environment Processing to create the visual design output of kaleidOk. By following the “Geometry, Textures & Shaders with Processing tutorial (Owed, 2013), I created custom shapes and learned how to place images onto geometry and feed information to animate the imagery. Aspects of the audio analysis using TarsosDSP (Joren Six, 2014) information were applied to the motion of the imagery to improve aesthetics and to act as an experiment for further research in this area.

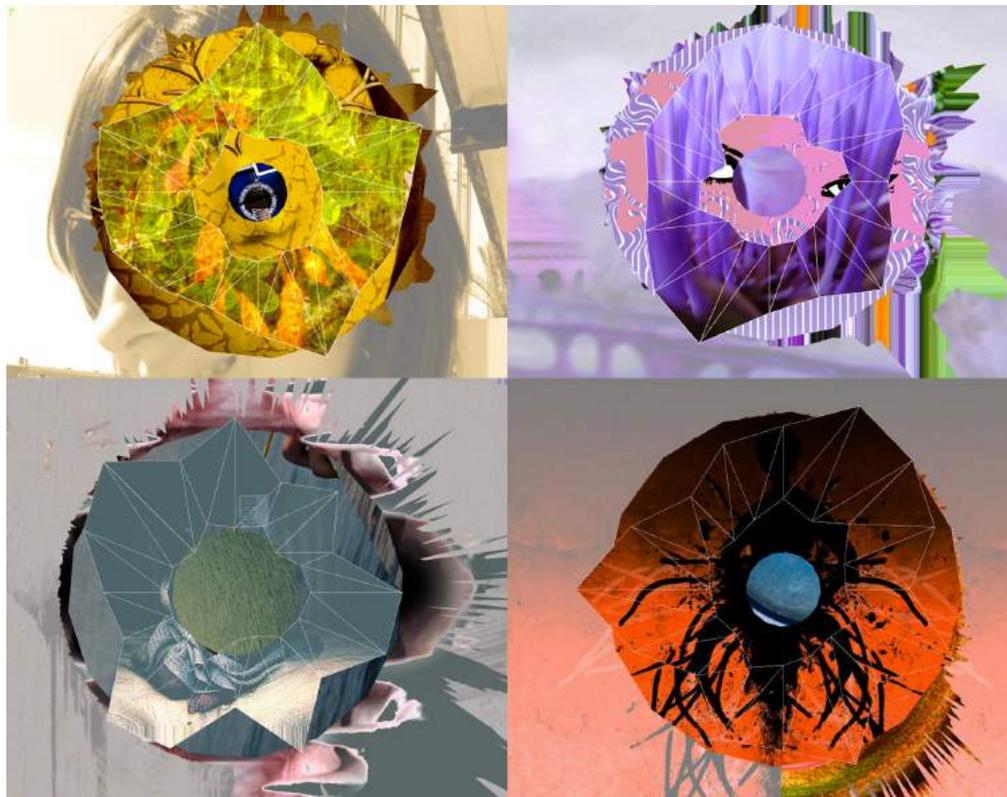


Figure 2.3. kaleidOk results (left to right); Happiness, Surprise, Fear, Disgust

2.3 Proof-of-Concept Testing

Concept testing began early on, during the system development phase, and continued up until the first Pilot in to determine the appropriate use-case. I attended and set-up kaleidOk at two creative technology events; Live Performers Meeting in Rome from the 29-31 May, and HackTheVisual in London, from the 27-28 June, in which kaleidOk was tested with an appropriate system testing audience of creative technologists. I then presented a functioning demo at the Observe meeting in July, after which I had a discussion with other people involved in the research and was able to understand more how kaleidOk relates to the other projects within Observe.



Figure 2.4. Concept testing at HackTheVisual, London July 2015, Photo provided by Hercules Fisherman, 2015

In these environments, I could determine the needs of the audience and see how people responded to kaleidOk, and also how kaleidOk responds to users other than myself. This allowed me to prepare the Pilots based on challenges that arose from the proof-of-concept testing such as, dealing with slow internet connection #a22e5cf (See Appendix E), errors and visual glitches when exceeding maximum audio threshold #4c80ccd, how to manage external screens and full screen modes #ada1086, #2701770, #ee53582, how long people need to say a phrase #b508abd, and how to offer typing of text as an alternative interaction form. Before the Pilot's began I ran another test with the updated version of kaleidOk and the framework of the further user studies, in my own studio with friends and acquaintances. With this final proof-of-concept test I was able to ask the users about their comfort and expression levels and where kaleidOk may fit into their communities, it gave me a base to test the research procedure on and I was able to gather and analyse preliminary data.

3 Research Methods and Evaluation

We have demonstrated how we can combine speech recognition, media retrieval and visuals generating (with the aim of evoking emotions). The second piece of knowledge needed to answer our main question is in enhancing the emotional experience with an interactive public display.

By following usability evaluation methods common to Human Computer Interaction (HCI) we were able to identify usability problems that kaleidOk has, collect qualitative empirical data on users' performance, and determine users' engagement with the product (Huang, 2009). By combining methods of observation, interviews, video/audio recordings, and system loggings, we aimed to triangulate our findings (Preece et al., 2007).

3.1 Research Questions

An essential part of the process of doing empirical research is to identify some research questions that we seek to gain insight into through gathering of qualitative data and analysis.

The following research questions were posed for this study:

- ❖ Q1 Is kaleidOk user-friendly?
- ❖ Q2 Does kaleidOk encourage people to be more emotionally expressive?
- ❖ Q3 Do the users see their emotional input reflected in the imagery?
- ❖ Q4 What are the potential uses of kaleidOk in social contexts?

3.2 Study Design

New empirical qualitative data was gathered through the analysis of direct and indirect user observation with the system in public contexts i.e. semi-controlled environments. The *Shadowing* method made it easier to follow the user in their actions. And the *Think-aloud Technique* allowed us to understand what is going on inside the head of the user (Aasbakken, 2011) by speaking with the user during or in between breaks of the interaction period.

The observations were broken down into four Pilot interventions, and all questions were addressed within these interventions:

- ❖ Saxion University, Enschede on the 1st October 2015 between 14:00 and 16:30
- ❖ Innocent, Hengelo City Centre on the 10th October 2015 between 21:30 and 23:00
- ❖ Panke, Berlin on the 21st October 2015 between 18:30 and 21:00
- ❖ Platoon, Berlin City Centre on the 23rd October 2015 between 19:00 and 21:30

Using observational methods and guidelines by (Spradley, 2005), I performed the following evaluation on passers-by, onlookers and active participants.

Observation	Evaluation criteria
Behavior	Who speaks to whom and for how long; languages or dialects spoken; tone of voice; are they shy or outgoing?
Interaction	Who initiates interaction, how long is the interaction for, are the instructions comprehended, do they hesitate, do they laugh, smile, cringe, get anxiety?
Proximity	Who comes to the screen; who interacts; or are there onlookers?
Profile	Are they alone; in a group; or mingling afterwards?

Table 3.1 Themes and criteria for Observation Document (see Appendix A)

After I had recorded an observation, I interviewed the active participants and had alternative questions for the partners of the participants who were not interacting themselves. These *Semi-structured interviews* were a combination of unstructured and structured interviews. Through the combination of methods I sought a deep understanding of what the interviewee experienced. However by predetermining the same for each user I was able to gather specific data.

Theme	Evaluation criteria
Use of System	Had the user tried something like this before? Did the user understand how to interact with kaleidOk? Are people comfortable speaking to a computer in a public space?
Perception	Did the users see their emotional content and word use reflected in the imagery? Were they surprised with what they saw?
Emotion	Did it bring out new emotions, highlight existing emotions, or make the user be more emotional than usual?
Interest	Is it so interesting that people would bring others to try it out? Can people see any potential uses of kaleidOk within their city or community?

Table 3.2 Themes and criteria for Interviews (see Appendix A)

Photography, Video and Audio recordings were made during the studies for data recording as well as for documentation (presentation) purposes. Critical incidents could be identified. This method is a permanent original record (Preece et al.,) that can be revisited in further studies.

We also logged the system input and output (See Appendix F), which gives us valuable insight for further analysis in how kaleidOk has been used concerning transcription effectiveness and emotion recognition accuracy. These results have not been analysed for the user study questions. However they served as a suitable guide for fixing errors such as noise, incorrect settings, noticing bugs, and providing the user more accurate feedback on the fly to help them be more emotional on their next attempt.

3.3 Pilots

3.3.1 Enschede, Epy Drost Foyer: Saxion University of Applied Sciences

This experiment was set up in the main foyer of the building of the Academy of Creative Technology. It needed a public space that was also allowed in the school facilities borrowing restrictions. I borrowed a portable HD TV monitor and connected my laptop to it. The initial space was beside the main escalators and under an existing screen. This spot attracted no participants and only a few onlookers.

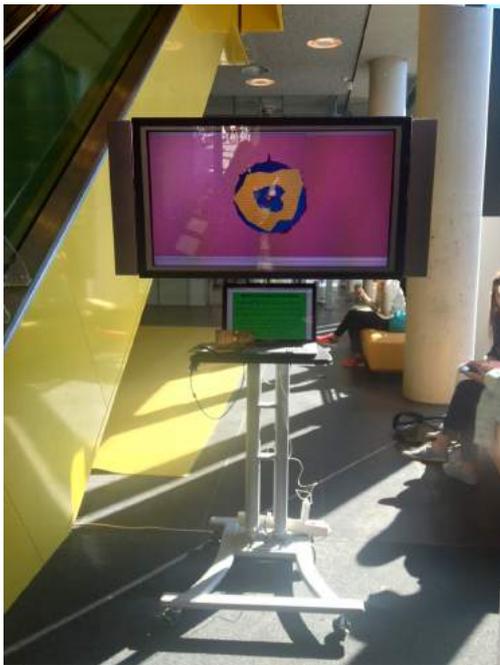


Figure 3.1. Console setup first attempt

After 45 minutes, I decided to move the installation to a corner in proximity. Even though it was more secluded, this space was darker and more inviting, and it attracted people, both participants and onlookers. There were mostly students and staff who came to the proximity of the display with about half interacting and completing the questionnaire. The audio issues worsened during this test and eventually I managed to find a workaround by using a different microphone. Unfortunately, this was after I had a group of eager students all there at one time. However, again I encouraged text input and spent time with them showing the software and code.



Figure 3.2 Console setup second attempt, with participants

The most interested participants were two pairs, a young man with his cousin and two friends. These participants were not Saxion students, but from the neighbouring technical college ROC van Twente. They interacted with kaleidOk mostly without my input. We ended with the interview and a further discussion on the potential uses of kaleidOk in other contexts.

3.3.2 Hengelo, City Centre: Innocent Subcultural Youth Centre

The experiment in Hengelo, next to club Innocent was organised to be most like a Speakers Corner. It was the first experiment David could join me on physically. We were able to transform a derelict public space, which most people use for parking their cars or bicycles or hanging out during the shows of the clubs, into an interactive speakers corner. There was a wall on the side of a building in which we were given permission to project on to, this then became a large public screen.



Figure 3.3. The display (video projection) and speaking space in the city centre of Hengelo

We set up the speaker's space with a microphone, a vintage lamp, and some books to recite from. Our equipment was set up nearby the speaker's space. We had high-speed Internet connection through Ethernet cable from the club. This allowed us to get as fast enough results as kaleidOk requires. Intending to use two different microphones this time, we were able to compare the performance of them and their suitability for kaleidOk. On one hand we liked the shotgun microphone as it only picked up people speaking. However, the stage microphone allowed for the audio detection on surrounding sounds to keep kaleidOk moving, and then would get more intense with speaking.



The general audience was of mixed ages and activities. The passers-by were mostly going out for the night, or parking their scooter or bicycle in the corner. The users were organisers and patrons of club Innocent, a politically active cultural centre, and also some came from a neighbouring art gallery-bar. On this occasion, there were mostly local adult males who intentionally interacted with kaleidOk, and much more onlookers over the period. It was very cold, and people did not want to stand still or stay outside for too long.

Figure 3.4. Interacting participant

Several times I made recordings of kaleidOk and took the microphone to people so as kaleidOk could pick up a range of content. This was experimental, and we have the logged results for further analysis.

3.3.3 Berlin, Cinema: Panke Cultural Centre

I met up with David in Berlin to run the remaining two interventions in Berlin. The first venue, Panke, is an alternative cultural centre open to the public six days and nights a week. The events there are run by the community and are of hackathons, art exhibitions, cinema screenings, open and free workshops. We were able to install kaleidOk in the cinema for a couple of hours before the film started and used their screen and projector, and even microphone. In the first hour or so the audience was people who work within the Panke community, until the last 30 minutes in which the film audience was exposed to kaleidOk by surprise.



Figure 3.5. A cinema attendee trying out kaleidOk

The audience was first confused about what was happening with the film night, or if they had incorrect information. After some time and user interactions people started to understand and discuss what was going on, and inform newcomers to be quiet so people could use kaleidOk better. I managed to make several video recordings of user interactions. We were forced to pack up while someone had extended play with kaleidOk due to the film program commencing.

3.3.4 Berlin, City Centre: Platoon Kunsthalle

Platoon Kunsthalle is a multi-purpose, architecturally renowned building in the centre of Berlin. For this experiment we setup for 1.5 hours inside Platoon Kunsthalle on a public screen display and 1 hour outside on an external facing public display. The screens and cables were provided by the venue. All we had to set up was a computer and the microphone input. For this experiment we decided not to use

a handheld microphone, rather we used a soundcard (Apogee One) with an internal condenser microphone (see *figure 3.6*). This seemed to work just as well for transcription as the other microphones but allowed the user to have more physical freedom.



Figure 3.6 KaleidOk setup inside Platoon with Apogee One internal microphone

There was an exhibition sponsored by Adidas running inside Platoon, which is also a design and marketing house, café, venue, and open cultural centre. The Adidas situation led onlookers to be confused, as they wondered if kaleidOk was a product of Adidas. When inside, we were placed near an Oculus Rift exhibit, which was the only other interactive piece in the building, however it wasn't working.

We then moved outside Platoon to their front entrance area on the street. And although there were less active participants, there were more onlookers (as in Hengelo). Berlin is very fast paced and people come and go very quickly. Over the 3 hours I managed to make several observations and interviews, including video of each participant.



Figure 3.7. KaleidOk setup outside Platoon

3.4 Results

3.4.1 Observations

The following qualitative observations were made during the Pilots (see Appendix B for detailed results to support this results section). There was a total of 30 observations made, a mixture of onlookers, people at the screen, and participants. Note that these are based on too few observations to draw hard conclusions on their own and should be viewed as speculative.

Proximity and Profile:

About half of people who came to the screen and interacted were alone. Fewer people came in groups. However, pairs and groups typically stayed longer interacting or mingling by the screen. At Saxion, there was the unique case in which a whole class was sent down to have a look. Other than this there was the man in Hengelo who brought some of his friends from the neighboring bar, although they did not stick around. Onlookers in Berlin seemed to be on their own more so than in Enschede or Hengelo.

Behavior:

At Saxion all participants spoke English as a second language, however with near bilingual proficiency. In Hengelo there was more trouble with speaking English, however there were two participants who tried to use kaleidOk in Dutch and in French. At both venues in Berlin, people were mostly speaking in English, although, having kaleidOk only working in English did make an elderly couple too shy to try it out, and they walked away.

People are most often quite shy or modest. Some of these people noticeably begin to open up with use of kaleidOk. There was one person at each intervention who was more outgoing tried to encourage others to participate.

The Hengelo intervention generated the most social atmosphere out of the four. People who did not want to use kaleidOk were staying around to see what was going on or how it works. People even left and came back bringing their friends to have a look.

Something noticeable about all experiments is that the discussions surrounding kaleidOk were mostly of a philosophical nature, between friends and strangers.

Interactions:

Most users through all venues hesitated at first. Either they are not sure if they want to participate, or after they have already decided to they begin to freeze up. This hesitation usually passes quite soon after speaking and getting into a flow. With a very brief explanation, people seemed to comprehend quite easily how kaleidOk worked and what the interaction form involved. Some people had freeform

emotional speech come to them naturally, and others needed time to think about what they intend to say. As there was no time constraint and no pressure on the users to perform or not, the words always came. People were often laughing and smiling at themselves, or at their loved ones who were speaking about them. People stayed much longer with kaleidOk than I had anticipated, approximately 5 minutes per user, but this may be only 1 minute of speech interaction, and the rest of discussion and reflection of the imagery.

Place	Interactions
Saxion, Enschede	7
Innocent, Hengelo	6
Panke, Berlin	6
Platoon, Berlin	5
Total	24

Table 3.3 Number of interactions per venue

The number of interactive participants cannot determine the effectiveness of kaleidOk within our research questions at such a small scale of studies. However it is useful to see that with each venue, over a 2.5 hour period, there wasn't such a big difference with the amount of interactions. What was significantly different was the amount of onlookers and people at the screen (although not interacting). Both outdoor locations in Hengelo and Berlin attracted between 20 and 40 onlookers, but less people in close proximity to the screen. The indoor venues attracted fewer onlookers from afar and more people standing at the screen, or by the participant to see what was going on.

3.4.2 Interviews

There were 19 interviews conducted during this study (see Appendix C). The interviews were a semi-structured, based on the questions found in the observation document, and included follow-up questions as the interview went on.

Use of System:

None of the participants so far have used something like this before. However, one onlooker said he had seen something like this before, in the late 90's in France.

A little more than half of the users found it "a bit difficult" to use, this was skewed as the system was still buggy. Users who used the system without bugs said it was rather easy. Some users needed to be guided, after that they were able to understand the interaction easily. The comfort of speaking in public space depends on per person basis.

Emotion Evocation:

All users so far have said it has evoked an emotional response to some degree. This includes bringing out new emotions, which most said- happiness. And in highlighting existing emotions most said- happiness, frustration and nostalgia. Every user questioned has said the use has encouraged (even forced) them to be more emotional.

Content Perception:

Most users said they saw their emotional content and word use reflected in the imagery. Others subjectively saw their emotional content reflected. Some users were unsure what they were seeing but enjoyed it anyway. And users with no emotional words said they saw no emotional reflections. All users except for one were “surprised” with what they saw, and someone reported being “shocked”, the one exception saying that there’s nothing surprising left in Berlin. All users thought it was aesthetically pleasing and interesting.

Interest:

All participants said they would bring people to try it out, such as their friends, family and classmates. However, the exception I gave them in a discussion being that “if kaleidOk was in a more user-friendly stage of development”. Most participants had suggestions for usage of kaleidOk in other contexts, i.e., in their city or community. These potential uses are recorded as- in education, rehabilitation, cultural centres, and in learning English. Nearly half of the people think it would work well in public spaces, and with the ones that do, they think it can make a good icebreaker or a positive intrusion into “small talk” people typically have in public.

3.5 Discussion

This user study was undertaken in the context of a public interactive screen inside two publicly accessible venues and two locations outside in the public space. The four research questions investigated relate to participants use the system, emotional experience with the interaction, the perception of the content, and of a greater social interest in the project. The results demonstrated that most importantly kaleidOk proves to enhance the emotional experience with an interactive public display, however with much room to improve on in regards to user experience design.

Q1 Is kaleidOk user-friendly?

The first research question of this study concerns the usability of kaleidOk as an experience. As no users had used anything like kaleidOk before, and only one seen something like this before, there are very little examples for the users to compare it to, and to fit within a specific methodology. However, near to the end of my study I began to find certain frameworks for unique studies in which my research would benefit from in the future.

KaleidOk, without intrusive technical error, and without instruction, is extremely easy to use. This is due to the nature of speech; there isn't any problem solving involved in making it work with the act of speaking. Of course this means it would be a good point to run user testing on people with speech impairments, and this is possibly where we could find a useful purpose for kaleidOk. If we highlight that by technically making it work is down to the emotional word input, then the assessment of ease of use doesn't mean much without the second research question.

Addressing the comfort of speaking in public space would give us a much stronger basis for this question of user-friendliness.

Q2 Does kaleidOk encourage people to be more emotionally expressive?

The second research question of this study concerns emotion evocation and intent to express. On one hand the user is rewarded by more fantastical results if they are more expressive with their word choice and use, and on another they understand that this is the task. It would be wise to run this study without the users knowing their task; speaking emotionally, and then we could determine if people speak differently and analyse the log input for this also. It is promising that so many users expressed happiness, as this is ultimately a goal for many public art makers to have for people.

Many users said that they felt they were pushed out of their comfort zone and that it felt forced. Whether this is something I would like kaleidOk to continue facilitating or not is undetermined. With these feelings, also come that it was stimulating, encouraging and challenging. These are aspects to facilitate. So the frequent negative reactions may be uncontrollable.

Q3 Do the users see their emotional input reflected in the imagery?

The third research question of this study concerns the subjective response from the user, as well as the quality of kaleidOk, and the effectiveness of the system.

Although there were some extraordinary results and experiences had with kaleidOk by some users, it was clear from my knowledge and experience with the system that many of the images retrieved had no connection with what the user had spoken. However, quite often those results still seemed to

resonate with the user, and this may be to their personal reasons beyond my understanding. It would be beneficial to analyse the log results extensively to see if the transcription results and the imagery selected do indeed match. However, this would be affected by the subjectivity of the assessor.

Nevertheless kaleidOk seemed generate surprise in many viewers. Surprise could be an interesting further concept direction.

Q4 What are the potential uses of kaleidOk in social contexts?

The fourth research question sought to find and develop a near future progression of kaleidOk. However this question also tells a bit about what people want interactive public displays used for or where. The feedback gathered from the interview gave a lot of data about our previous areas. However the potential use was discussed mostly as follow-up discussion after the interviews, or discussions in general with onlookers and people at the screen, and also discussions I have had with many different parties in the last ten months. I regret not thoroughly recording these discussions, however the answers from the structured interviews do resemble the responses in my experiences. I am somewhat hesitant to go into the health industry with kaleidOk, even with all the eager suggestions. In education and cultural centres is the preferred context for kaleidOk. KaleidOk is currently too risky to bring it to large-scale city centre screen projects.

4 Conclusion and Further Work

We produced and demonstrated how to visually communicate emotions from spoken word, which encourages the user to be more expressive, within the context of public screen-mediated interactions. Features of kaleidOk include computing emotion from speech, retrieving images based on emotional input, and displaying them artistically with vocal attributes. The design is based both on empirical premise and our subjective criteria. KaleidOk has been implemented into the public as a Pilot and is available as free open-source software.

The user testing showed that the use case of a more intimate screen interaction experience was most effective, so kaleidOk will continue as a console-based setup. KaleidOk was deployed in a wide variety of contexts, from hackathons to a café-cinema, in a university, and public spaces. Through the observation and interviews it became apparent people are quite afraid of public speaking, speaking to a computer in general and expressing their emotions in a public setting. However, people are genuinely interested in the potential future applications of speech recognition based creative technologies.

Based on user responses, kaleidOk is received as an innovative concept, it's interesting and engaging, it's aesthetically pleasing, it reflects the user's emotional input, and it makes the user more aware of

their current emotional state. KaleidOk seems to work best in a more secluded environment, either alone with the system, with a friend, or in a performance setting.

In our further work, we will address aspects of emotion detection from the voice, and updated developments on emotion in speech recognition. Firstly we will employ an alternative speech to text service (currently experimenting with CMU Sphinx). It would be a great enhancement to use analysis of tonal features to contribute to the colour search and texture generation, so not only speech but also singing and other vocal expressions can enhance the interaction and results. It is most desirable that we use an alternative image search index, and one that can be accessed and contributed to by a local community audience. User studies will need to address other factors such as user experience design and interface design. We will also find a research methodology to test emotional accuracy, and for reproducible outcomes.

5 Recommendations and Products

5.1 Annex A: kaleidOk Application Software Package

Software Access Link: Please proceed to www.kaleidok.co and select **[Download Application]**

Development and source code: <https://github.com/davidfoerster/KaleidOK-examples>

Blog: <https://kaleidok.wordpress.com>

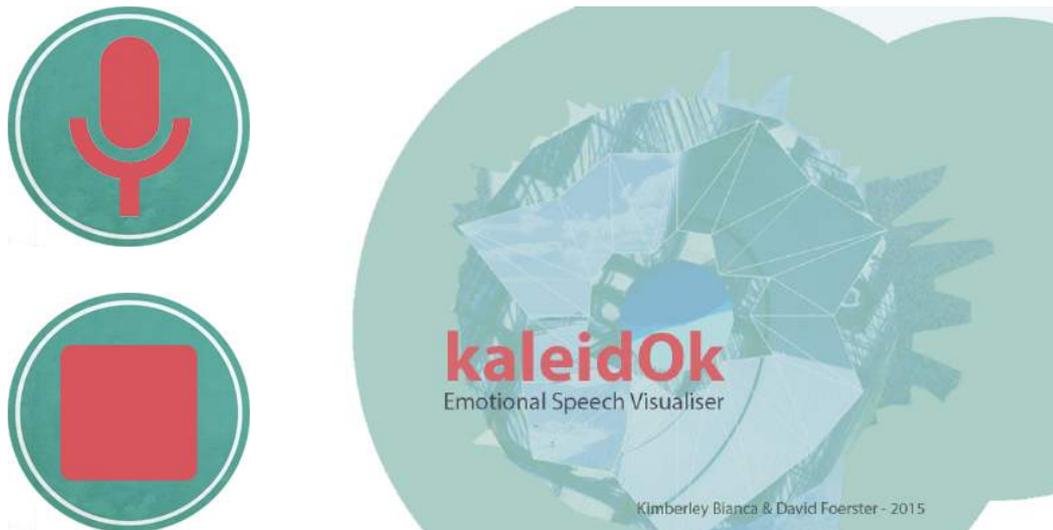


Figure 5.1 Some interface elements of kaleidOk

KaleidOk invites participants to use a new kind of interactive media tool and take part in an emerging experience, which explores speech recognition, media retrieval and visuals generating in a collaborative context between people, and between people and computers.

Included in the software package is the .jar file containing the application, the necessary library dependencies, and a detailed instruction guide (README).

My independent roles in the software development were in project management, creative direction, preliminary technical research, selecting all the current modules and components implemented in kaleidOk, programming the artistic display (the kaleidoscope dials), and interaction design and interface design. Together I worked with David Foerster on the system architecture, testing the modules, testing equipment and testing the system. David is the lead developer and programmer of kaleidOk.

5.2 Annex B: kaleidOk Pilot's

Video Access Link: <https://vimeo.com/kaleidok/pilots>

The kaleidOk Pilots' purpose was for more than for research, testing and user studies. KaleidOk is inherently an interactive art project within a greater social and technical context, and art requires exhibition or installation to be received as artworks. I encourage for the kaleidOk Pilot's to be perceived as such, and therefore as a product for my graduation in Art and Technology. The video of the kaleidOk pilots serve a few purposes. It counts as documentation of my research, documentation of the Pilot's running as an artwork, and as a presentation format to share as part of the visual identity of kaleidOk which can be shared amongst departments and used for applications for further opportunity.



Figures 5.2 photo documentation of kaleidOk pilots (left to right); Panke, Hengelo, Platoon, Saxion

5.3 Annex C: kaleidOk Presentation (Website)

Website access link: <https://kaleidok.co>

The visual presentation and identity of kaleidOk are important. For a project that crosses different disciplines, it is vital to present kaleidOk in as much of a holistic form as possible. This will help people understand better what kaleidOk is, how it works, how it was developed, why it was made, view examples all in one place, and is a much more publically accessible form than reading a report. It also allows for more easily sharing between departments and projects, and aids in presentation for further funding or pilot applications.



Figure 5.3 Screen-shot of a part of the kaleidOk website

The four-page website is hosted and published, with appropriate links. The site also includes a development blog within it. I created it with Wix.com, a cloud-based web development platform. This made it possible to make a presentable site on my own in a short amount of time. The text is original. Buttons and icons used are a combination of sourced, and of my own design. I started with a template and altered it to fit in with the visual identity of kaleidOk since the beginning.

5.4 Annex D: Anecdote of Detroit

Video Access Link: <https://vimeo.com/kimberleybianca/detroit>

Anecdote of Detroit is coverage of a few days in Detroit. I was seeking to sense the loss, the inspiration, and the potential, otherwise- the narrative of a notorious city.

Through documenting anecdotes, I can accumulate experiences of people and these can serve as evidence to inform and positively influence my practice.

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Appendix A: Observation and Interview Document (2 Pages)

<https://drive.google.com/file/d/0BwbcYwZE23T1aGE5Q3U0THhYSUE/view?pli=1>

Appendix B: Observations (5 pages)

<https://drive.google.com/file/d/0BwbcYwZE23T1eVpyZ2p5OWpMRzA/view?pli=1>

Appendix C: Interview responses (1 page)

<https://drive.google.com/file/d/0BwbcYwZE23T1UkZSLUhCUFRwYU0/view?pli=1>

Appendix D: Design Document (36 pages)

<https://drive.google.com/file/d/0BwbcYwZE23T1clJqLWJoMU5ac1U/view?pli=1>

Appendix E: kaleidOk Git Graph (7 pages)

<https://drive.google.com/open?id=0BwbcYwZE23T1d1k5enRESmpGaTg>

Appendix F: kaleidOk Analysis Log Sample (2 pages)

<https://drive.google.com/file/d/0BwbcYwZE23T1Wm1yUWE1V0pvYk0/view?pli=1>

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Academie Creatieve Technologie
Behandeld door: Angela Vorsselman

Datum 30 maart 2016

Pagie 1 / 2

To the Review Committee,

I highly recommend Kimberley Bianca Warren as a candidate for graduate school. I have worked with Kimberley in my position as her lead graduation supervisor and as Professor in the Media, Technology & Design research division of Saxion University of Applied Sciences.

While a student at Saxion University of Applied Sciences, Kimberley was employed by our research department to carry out her final project and thesis in the framework of our research interest. Observe is a collaboration of the research groups Media Design Technology, and Ethics and Technology of Saxion University, University of Amsterdam and the University of Leuven. Participating also is an extensive group of creative and outdoor media companies.

Her tasks included writing a research proposal, creating a design document, systematically collecting literature, defining and analysing a practical problem in an adequate manner, conducting research and experiments, observational studies and user testing, documentation of all stages of the project, presentation, and three deliverable products.

Her report showed insight in relevant concepts and methods from the field. Kimberley is the kind of student that will initiate her own educational path and combine formal methods of our department with those more suited to her style of project. Kimberley proved that her approaches were achievable, and with strong reasoning. She accomplished all these tasks with great initiative, including during times of medical related hardship, and with a positive attitude.

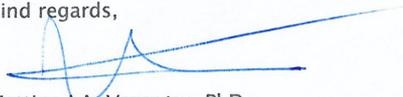
Kimberley managed her internship stipend well, and we were surprised on how much work Kimberley could execute and people she was able to get involved considering the resources available. Even when we were not able to provide her with the dedicated public screens of the OBSERVE project in due time, Kimberley independently worked with three other organisations to schedule screenings.

saxion.nl

Her ability to form a team, connect with department staff, and her talent at expressing concepts, as well as more advanced topics, are superior. She has excellent written and verbal communication skills, is organised, reliable, and computer literate. Most importantly Kimberley successfully delivered her graduation project fulfilling all her proposed goals.

Kimberley would be a tremendous asset to your program and I recommend her to you without reservation. It would be ideal if Kimberley were awarded financial assistance, and her work is well deserving of it. I would also like to welcome Kimberley back to the Netherlands if she were to try to make a connection over here with her new research. If you have any further questions with regard to her background or qualifications, please do not hesitate to contact me on +31(0)653217668 or m.j.a.veenstra@saxion.nl.

Kind regards,



Mettina J.A. Veenstra, PhD
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