TwttrGraph: I Wish to Speak with You.

A Telegraphic Sound Installation

Paul Dunham, Mo H. Zareei, Dale Carnegie, Dugal McKinnon

Victoria University of Wellington
Wellington, New Zealand
paul@dunham.co.nz, dugal.mckinnon@vuw.ac.nz, mo.zareei@vuw.ac.nz, dale.carnegie@vuw.ac.nz

Abstract

The representations that real-time, always-on, data-driven technologies will enhance society like never before promotes an historical inattention that ignores the entangled genealogy of contemporary social media. As we live our lives increasingly in the public realm of social media, we are not only exposed to a human gaze. What happens when we slow down the present through the past? Using a media archaeological research approach, this paper presents Twitter and the telegraph as related forms of social media. Developed by the first author, *TwttrGraph*, an object-based sound installation utilising obsolete media technology, is presented as an audio-visual representation of a genealogy of connections between past media technologies and contemporary social media. *TwttrGraph* can be considered a return to the material representation of media through the physical re-presentation of Twitter messages transported as invisible digital media through the physical materiality of the telegraph key. By enabling the ability to hear the present through the past, *TwttrGraph* reconfigures the existence of the telegraph within a broader history of social media.

Keywords

Sound art, media archaeology, social media, Morse, telegraph, Twitter, obsolescence

Introduction

A quick look at Wikipedia's *Timeline of social media* page shows that today's social media has its origin in the early 1970s. [1] However, the same website's *Social Media* page states, "Social media may have roots in the 1840s introduction of the telegraph." [2] These brief examples highlight some of the debate surrounding the history of, and what is, social media. It is not the authors' intention to argue an origin or exact definition of social media but to use these differing perspectives to help inform a conceptual and aesthetic approach for the appropriation of obsolete media to create sound-based art. Using an approach grounded in media archaeology, the project builds on these differing perspectives to create an interpretative relationship between two forms of media whose origins are approximately 160 years apart.

This paper presents an object-based sound installation that, through a media archaeological approach, connects the telegraph and Twitter as historically related forms of social media. As an object-based sound installation, the work foregrounds the sound producing object, visibly connecting the sound to the sound source. The sound installation replays Twitter messages through a set of telegraph keys. Through their performative presence, we can hear the present through the past and establish a temporal connection between the telegraph as an early form of social media and Twitter, a contemporary social media platform. As such, *TwttrGraph* identifies the presence of the telegraph within a broader history of social media.

The next section contextualises social media between past and present social practices and media technologies within a broader representative paradigm. Following that section, the paper introduces media archaeology as an approach used to inform the first author's sound installation *TwttrGraph*. After a brief literature and repertoire review, the paper introduces *TwttrGraph* as an interpretative object-based sound installation. The paper ends with concluding remarks.

Social Media: Opposing Perspectives

Social media, as it is manifest today, is considered a part of the second media age. In its concept and application in the 21st century, the birth of social media is generally considered to have its origins in the emergence of Web 2.0 technologies. The term, Web 2.0, is often used to characterise the second generation of the World Wide Web supporting "user creativity and collaboration through participatory social media applications." [3] [4] In this context, social media are considered to be a set of web-based and mobile platforms that allow an audience to interact and share content or to participate in social networking. Social networking is the use of those platforms where audiences gather and interact in similarly interested communities. Facilitated by the development of online social networks, user-generated or self-published content allows individuals and groups to communicate and collaborate through a series of virtual communities [5]. However, today's now naturalised expression of sociality

through technologies may be seen as nothing more than a "way of realising what has existed in human nature for millennia." [6].

If social media is considered more than a collection of technologically-mediated platforms that are used to communicate and collaborate, what alternative perspectives exist? Zizi Papacharissi argues that all media are social by definition and that "socially based communication has always utilised platforms, digital or non-digital, which were somehow networked." [7] Tom Standish defines social media as "an environment in which information was passed from one person to another along social connections to create a distributed discussion or community". [8] Grant Bollmer posits that rather than social media being a "shorthand phrase for a specific articulation of technology", it should be used to identify a "specific manifestation of a massively complex social formation." [9] As such, these perspectives question the assertions that social media is a 21st century phenomenon and of defining the social via particular media technologies. By seeing the social in media in this way, lines can be drawn between past social practices and technological invention and today's social media platforms. This suggests a genealogy of social media rather than an origin grounded in the emergence of Web 2.0 technologies. Such a genealogy can be a way of seeing history differently through elements of the past that remain present in society and technology. One way this can be interpreted and contextualised is through media archaeology. Through this method of inquiry, a linear narrative of progress can be re-presented as interwoven temporalities between historical and contemporary media technologies.

Media Archaeology: Through the Looking Glass

Media archaeology, as an approach to the critique of contemporary media culture and history, is considered to formulate counter histories to the dominant narratives of technology and media. One approach to undertaking media archaeology research excavates the agency of the machine, a shift from understanding media history through discourse alone, to consider it through the use and remediation of a material artefact without human intermediaries. [10]

Accordingly, Wolfgang Ernst's media archaeology analyses "media-induced phenomena on the level of their actual appearance as physically real traces of past articulation, sonic signals that differ from the indirect, arbitrary evidence symbolically expressed in literature and musical notation." [11] Ernst argues that by operatively engaging with past media technologies, media archaeology can uncover a "*mémoire involontaire".* By doing so, he sees a way of creating a "sonic heritage" not through symbolic transcription but by listening to the non-musical articulations of the medium. [12]

Media archaeology as an approach to research allows for the exploration of the material possibilities of obsolete media through a practical, operative, and sensual engagement with the object. One way this can be interpreted is through the creative appropriation of the obsolete object for the production of sound-based art. Through this physical engagement with obsolete media in artistic practice, resituating an object in an unfamiliar context can transform the perception of an object's use and, placed in different contexts, can establish new forms of expression outside the object's normal utility. Mandy-Suzanne Wong argues that, unlike historical narratives, sound art is not a "description of the past but a presencing of past conditions in the present". As such, she considers the self-expression of the nonhuman in sound art along with the human as creating a multisensory history. [13]

The next section considers works that use social media and telegraphic representations in sound-based art to establish a relationship for TwttrGraph within the context of the object-based sound installation.

Related Work

Within the context of the object-based sound installation, this section briefly reviews the use of social media and telegraphic technologies as sources for creative sound-based works.

Previous forms of media exhibit characteristics that suggest them to be precursors to contemporary social media through a series of genealogies and prehistories that have made contemporary social media possible. Contextualising Twitter within a general history of communication media, Dhiraj Murthy reveals similarities with, and departures from, the electric telegraph. [14] [15] He argues that both mediums bought an immediacy and brevity to communication, compressed space and time and brought the private into the public. As such, the telegraph provided a significant advance in the global reach and immediacy of communication, an advancement amplified with social media platforms such as Twitter. In a similar manner to criticism of the telegraph that it would bring the downfall of traditional forms of communication, Twitter has been criticised for potentially threatening longer length forms of electronic communication. At the same time Murthy identifies a number of Twitter's characteristics that resemble those in other early social technologies creating a genealogy of affiliations with contemporary social media platforms and practices.

Social media services such as Twitter have been leveraged in the past by artists in a number of forms. Whether as live data or archived messages, social media are sources of material to create sound-based works. Specifically, Twitter data has been used in sonification

works that engage with such themes as surveillance, environmental issues, social sentiment and as a sonic representation of the real time flow of social activity. A cursory reading of the proceedings of the International Conference on Auditory Display (ICAD) shows a number of papers describing various works that sonify Twitter content. Indeed, its 2012 conference theme, *Listening to the World Listening*, ran a sonification contest based on extracted listening data from Twitter.

Aside from data sonification, Twitter has provided content for metaphoric and interpretive sound works. Noriyuki Suzuki's *"Oh my ( )"* (Figure 1) listens to Twitter for the keyword God in 48 languages and then plays "oh my (god, in the tweeted language)". [16] The work creates a metaphoric Tower of Babel as a way to perceive the limitations of human perception when trying to listen to and understand every voice. In another example, An Xiao Mina bridges the past and present by presencing early electric telegraph communication alongside Internet communications in *Morse Code Tweets* to examine the evolution of instant communication as an expansion of time, space and our sense of identity [17].

Similarly, Anna Friz utilises spoken Morse code in her radio artwork, *Radiotelegraph*. By using voice with recorded electronic signals, Friz attempts to blur the roles of the telegraph operator and machine. The work, conceived in Seyðisfjörður, Iceland, was inspired by two historic radio telegraph events. In 1906, the first audio transmission of the human voice by wireless means was achieved in the U.S. and Seyðisfjörður was the site of the first telegraph cable connection between Iceland and Europe. Broadcast at sunset in Seyðisfjörður, Iceland and Chicago, U.S. (Icelandic time), the work, as a beacon, "tells that long nights are coming, but we will not be alone." [18]

The telegraph has been utilised in works that reference historical aspects of communication in relation to current media formations. Silvia Ruzanka's (Figure 2) series of virtual reality works tells stories of online romance and the

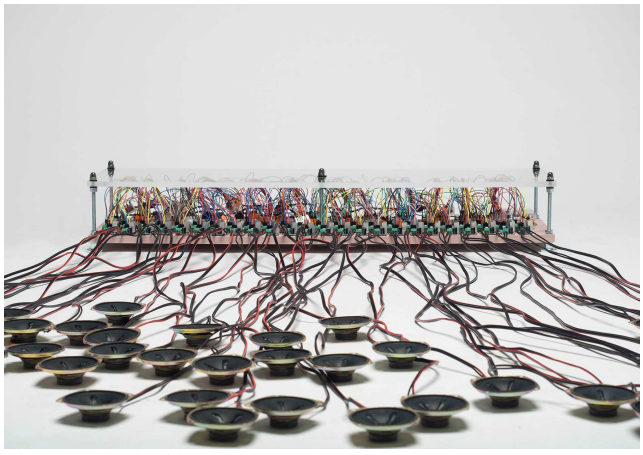

Figure 1. Noriyuki Suzuki's *"Oh my ( )"*

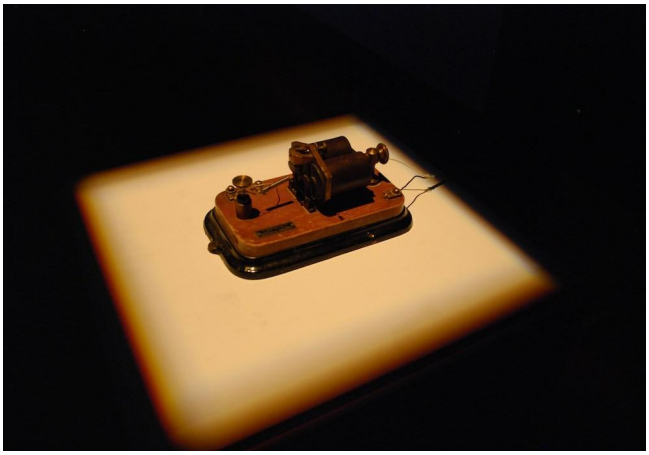

Figure 2. Still from Silvia Ruzanka's VR Telegraph Series

spiritual dimensions of telegraphic technology that prefigure the Internet, avatars, online dating, and the blurring boundaries between real and electronically generated worlds. [19] As such, she positions the telegraph as an early form of cyberspace. Paul DeMarinis uses early telegraph technology similarly in his work, *The Messenger*, to create an historical awareness that many of the Internet's features were anticipated by the cultural formations developed around earlier telecommunication systems. [20]

Discussion

This section has introduced the use of social media as a content source within artistic practice. In sound-based works, Twitter has been used for artistic data sonification, drawing parallels with a range of themes, and, as a scientific method, a way of listening for knowledge. Twitter's content has also been used for metaphoric and interpretive sound-based works. The limited number of these that connect obsolete media with contemporary social media is an opportunity to create a media archaeologically informed sound-based work.

As a research approach, media archaeology can be a way to contextualise and interpret contemporary social media through a past media technology to foreground characteristics of that past media that remain in the present. Material media archaeology, by physically and sensually engaging with the obsolete object, can be one way of understanding history through the object's operative enactment within a contemporary context; a way of representing what has remained of the past in the present through that past media. As such, the obsolete object, visibly and audibly present in the object-based sound installation, brings its sound making qualities to the foreground. In this way we can listen to the apparatus as an expression of itself as a delayed historical presence, listening to the symbolic codes and streaming data of technical media rather than relying solely on cultural texts or notation as a description of history. In this context, the

divergent perspectives of social media provide opportunities to explore traces of past media within contemporary social media that are represented as a sound-based installation.

It is the characteristic similarities between the telegraph and Twitter that has informed the ideation of TwttrGraph. Engaging with the physical, material, and technical properties of the electric telegraph, the following section introduces *TwttrGraph*, an audio-visual representation of the historical connection between the telegraph and contemporary social media.

TwttrGraph

Developed by the first author, *TwttrGraph* (Figure 3) is an object-based sound installation that uses a media archaeological research approach as the core of its conceptualisation and realisation. By physically engaging with the telegraph key, the work aims to explore an obsolete object, utilising its physical properties and historic materiality. As such, placing the telegraph key in a new artistic context – making the familiar strange – alongside Twitter as social media creates an awareness of characteristics manifest in earlier media remain in contemporary media. This approach provides a media archaeological short circuit between historically separated times to provide a new perspective for the listener's engagement with and interpretation of sound by hearing the present through the past.[1]

Appropriating obsolete telegraph keys and foregrounding their sound making qualities, *TwttrGraph* replays Twitter messages as Morse code. Playing the messages in this way re-presents, what some consider, one noisy medium (the socio-communication of social media) through another (acoustic key clicks) to create a presence of telegraphic communication within the contemporary realm of social media. *TwttrGraph* is seen as a return to the material representation of media through the physical re-presentation of Twitter messages transported as invisible digital media through the physical materiality of the telegraph key. As such, by re-engaging the material analogue world in tandem with the digital it can be considered a return to the tactility of pre-digital media. [21]

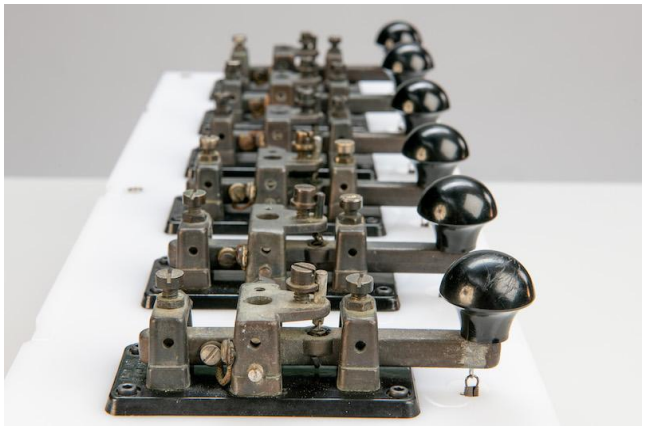

Figure 3. *TwttrGraph*

[1] Short videos for *TwttrGraph* can be seen at https://www.youtube.com/watch?v=YNKPfeF_k0Q and https://www.youtube.com/watch?v=PH3_uX5QmHg

System Overview

As a sound installation, *TwttrGraph* is the audification of Twitter messages replayed as a series of Morse encoded telegraphic messages. As an object-based sound installation, the work presents a line of six obsolete telegraph keys atop a plinth. In its minimal prototypical state, *TwttrGraph* is based on the use of a single telegraph key (Figure 4). Reduced to a basic sounding object in this way foregrounds the key's sonic materiality. This materiality is heard as a double click when the key's contact points engage and disengage. As such, the compositional palette is limited. The raw building block of a single telegraph key is extended to six keys as an iteration of the single unit to create a richer audio-visual experience by exposing the nuances of each key and expanding the compositional palette. The significance of six keys is elaborated in the next section.

Each telegraph key has been electromechanically prepared to operate by actuating a solenoid. Each solenoid is powered and controlled by a custom made circuit board. The circuit board receives input signals from a microcontroller (a Raspberry Pi) to programmatically control each solenoid. The microcontroller runs custom code developed using Processing 3.

Connecting to Twitter via the Internet, messages are extracted, transformed from alphanumeric symbols to Morse elements and translated to digital pulses that trigger the solenoids. A high-level system overview is shown in Figure 5.

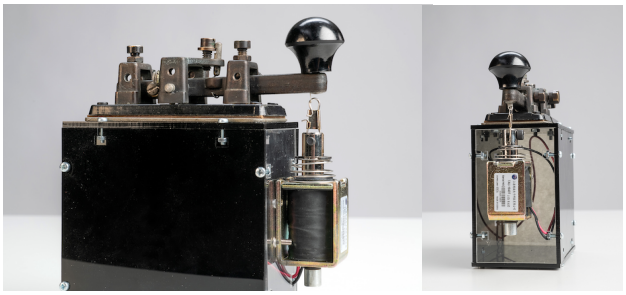

Figure 4. *TwttrGraph* Single Key Prototype

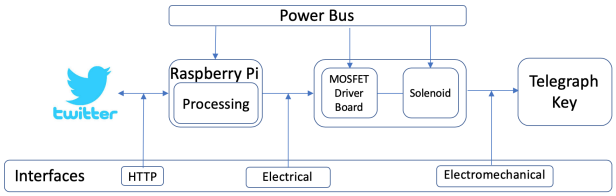

Figure 5. *TwttrGraph* System Overview

TwttrGraph's primary sonic material is provided by each telegraph key. An additional sonic cue is provided by a sine tone that is always on. The use of this sonic cue is expanded in the following sections.

Aesthetic Approach

An important aesthetic element of the object-based sound installation is foregrounding the visibly present sounding object. The telegraph keys' position atop a white plinth draw attention to the primary audio-visual elements of the work. This is shown in Figure 6. Other electromechanical components are contained inside the plinth to reinforce the presence of, and maintain of focus on, the sound making object (Figure 6).

Two additional elements of the work reinforce the audio-visual relationship with the telegraph keys. A sine tone waits for a signal to disrupt its presence. The "always on" of the telegraph circuit waits for an "always on" social media. The use of the sine tone, based around the frequency of wireless telegraphic transmission, provides a further aural connection to the visual movement of the telegraph keys and the inherent rhythm of the replayed message. A visual representation of the replayed message is projected as video.

Based on the technical properties of Morse code, using six keys allows letters, numbers and punctuation to be encoded, creating the ability to play an extended range of alphanumeric symbols. For example, a letter can be one to four Morse elements, numbers are five elements, punctuation symbols are five or six elements. As Morse elements (the dots and dashes) are received, keys tap sequentially from left to right. The inherent rhythms of the

Figure 6. Telegraph Keys as Visibly Present Sounding Objects

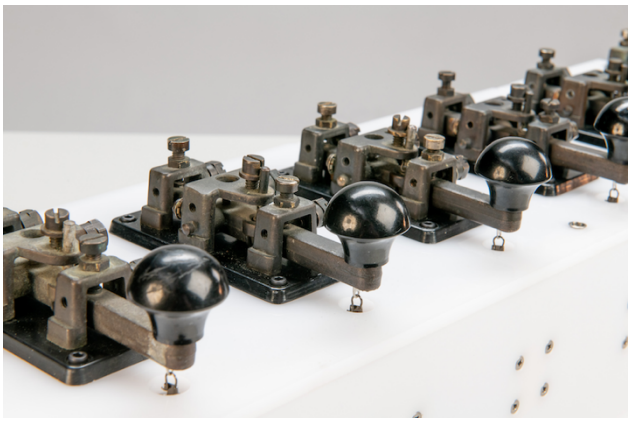

Figure 7. The Material Sound Making Object

digital media stream are revealed through this material transformation. Manufactured to the same specifications, time has eroded each key's mechanism in different ways (Figure 8). While mechanically the same, through this material change in each key we can perceive, at times, small differences in their mechanical operation and to their sound producing qualities. The barely perceptible mechanical differences disrupt an otherwise robotic approach to the work. By iterating the single sounding unit in this way, a variation in the inherent sound making qualities of each key can be heard.

Compositional Strategies

The technical signalling properties of Morse code are used to inform the primary compositional strategy for *TwttrGraph*. Some of these properties are used in the timing of the Morse code and establish the tempo of the work. The timing of the work's Morse sequences are directly related to the timing for Morse code. The tempo for the compositions is based on Morse code's typical word method used to determine a standard transmission speed. The words used are PARIS, reflecting a natural language word rate, and CODEX, reflecting a random letter word rate. As such, these provide quantised time periods of 60ms (PARIS) and 50ms (CODEX) for each mark and space (see Table 1) and have been used to determine the tempo for message playback with *TwttrGraph*. The tempo is fixed by the selection of one of these transmission standards with the length of each mark and space determined by the Morse element. Each Morse element used by *TwttrGraph* is represented by a single key. Within a musical paradigm, each mark and space, as quaver notes and rests, provide tempos of 125bpm (PARIS) and 150bpm (CODEX). The tempo of the work is able to be changed at initialisation by selecting one of the timing standards.

Morse element	Time Unit	PARIS Time (mSec)	CODEX Time (mSec)
. (dot)	1	60	50
- (dash)	3	180	150
Element space	1	60	50
Letter space	3	180	150
Word Space	7	420	350

Table 1: Morse Elements as Compositional Input

Morse code is a text-based communication medium. As such, the rich content able to be included in a tweet cannot be represented by Morse code. Emojis, video and some text characters are not able to be played by *TwttrGraph*. Therefore each message's content is reduced to its base Morse elements by removing symbols that are not represented in the Morse system. As previously stated by Murthy, both Twitter and telegraphic communication received criticism for their brevity threatening longer forms of communication and a general dumbing down of society through the "impoverishment of grammar, vocabulary, spelling and so on." [22] *TwttrGraph*'s need to "dumb down" Twitter's messages can be perceived metaphorically as being situated within the moral decline of communication of which both technologies have been accused.

Exploring different ways to replay messages can be a way of interpreting and unfolding the patterns and rhythms within the encoded message. Where the replay mode allows it, a continuous sine tone plays, only interrupted by a key's actuation. This acknowledges that telegraph systems were always on as a method of knowing whether the communication circuit was live and as a metaphoric connection with an 'always on' social media. Messages of archived tweets, based on the keyword phrase "What hath God wrought?", are stored by the microprocessor. This keyword phrase is used to acknowledge the first Morse coded transmission between distant locations in 1844.

Sequential Message Replay

This replay mode isolates each message character and replays each character's Morse elements sequentially across the keys. Playing the message in this way exposes the characteristic nuances of each key's physical properties and material sound. The sonic property of the object's sound is heard as each key is engaged and disengaged. Replaying messages in this way connects together the audio and visual elements as a way to emphasise the rhythmic patterns inherent in the Morse code.

Polyphonic Message Replay

Using the same information source noted previously, one way these rhythmic patterns can be explored is to replay the messages polyphonically. While still breaking each character into its individual Morse elements, they are replayed in parallel. In this way new patterns, such as syncopated rhythms, may emerge as keys engage and disengage at different times.

Additional Replay Methods

In addition to different modes of replaying the message, other methods of representation can be explored. An interactive installation can be a way of engaging an audience. *TwttrGraph* can listen for a message that includes a keyword, and, when detected, can replay the message. The replay can be sequential or polyphonic. In this way an audience can explore phrases, word or character sequences as a compositional approach to find rhythmic patterns in their messages. By engaging an audience in this way, it may also allow them to reflect on the interwoven temporalities that exist between past and present media technologies.

While utilising either of the previous methods of replaying a message, an approach can be to listen only for new incoming messages. With social media platforms expanding and evolving and the amount of information seen by some as overwhelming, there can be a sense of getting lost in the noise of social media. Rather than endlessly scrolling through inane posts, advertising content and reading expanded conversations, this mode could be seen as a return to earlier pre-electric communications by creating a long wait for a message to arrive.

Conclusion

This paper has introduced *TwttrGraph*, an object-based sound installation. Utilising social media and obsolete objects, *TwttrGraph* uses telegraph keys to replay a series of Twitter messages as Morse code thereby creating a presence of past media alongside contemporary media technologies. A number of compositional strategies have been presented to explore and emphasise the rhythmic patterns embedded in the source material. Blurring the temporal boundaries between the past and the present can be a way to disrupt the linear narrative of progress. As such, *TwttrGraph* is an audio-visual representation of a genealogy of connections between past media technologies and contemporary social media. Using a media archaeological approach to research, the obsolete object, in this case the telegraph key, is able to be contextualised alongside contemporary media technologies thus creating a presence of the past in the present. Considering the object from the material perspective of media archaeology allows one to physically and sensually engage with the technical and operative features of the object and to utilise these in a creative way. Through the operative enactment of the telegraph key an audience is able to see and hear this past media as an expression of itself although its world has been rendered obsolete. Excavating the past in this way, an archaeological dialogue emerges in finding something new

in the old and the relationship between past and present media. By utilising obsolete telegraph keys, *TwttrGraph* also speaks to the historical materialism of objects left behind or 'defeated' in the march of technological progress. Human communication from the written word to contemporary social media has been transformed over the ages by a series of expansions of time and space. By appropriating the telegraph key and creating a new cycle of life as the object-based sound installation, *TwttrGraph* is part of a historical continuum through a genealogical connection between the telegraph and social media.

References

[1] Wikipedia, "Timeline of social media (2019)", Wikipedia website, accessed 28 September 2019, https://en.wikipedia.org/wiki/Timeline_of_social_media

[2] Wikipedia, "Social Media (2019)", Wikipedia website accessed 28 September 2019 https://en.wikipedia.org/wiki/Social_media.

[3] Lincoln Dahlberg, "Which Social Media? A Call for Contextualization", *Social Media + Society,* vol. 1, no. 1 (2015), 1

[4] Robin Rymarczuk, "Same old story: On non-use and resistance to the telephone and social media," *Technology in Society,* no. 45 (2016), 45

[5] Jonathan A. Obar and Steve Wildman, "Social media definition and the governance challenge.," *Telecommunications Policy,* vol. 39, no. 9 (2015), 746-747

[6] Grant Bollmer, *Inhuman Networks: Social media and the archaeology of connection*, (New York: Bloomsbury, 2016), 6,11,46.

[7] Zizi Papacharissi, "We Have Always Been Social," *Social Media + Society,* vol. 1, no. 1 (2015), 1

[8] Tom Standage, *Writing on the Wall: Social Media - The First 2,000 Years*, (New York: Bloomsbury, 2013), 3.

[9] Grant Bollmer, *Inhuman Networks: Social media and the archaeology of connection*, 15.

[10] Jussi Parikka, "Operative Media Archaeology: Wolfgang Ernst's Materialist Media Diagrammatics," *Theory, Culture & Society,* vol. 28, no. 5 (2011), 53

[11] Wolfgang Ernst, *Digital Memory and the Archive*, (Minneapolis: University of Minnesota Press 2013), 174-175.

[12] Wolfgang Ernst, *Digital Memory and the Archive*, 173.

[13] Mandy-Suzanne Wong, "History, Archaeology and De-Anthropocentrism in Sound Art," in *The Routledge Companion to Sounding Art*, ed. Marcel Cobussen, Vincent Meelberg and Barry Truax (London: Routledge, 2016), 363.

[14] Dhiraj Murthy, "Twitter: Microphone for the masses?," *Media Culture & Society,* vol. 33, no. 5, 780-781, 2011.

[15] Dhiraj Murthy, *Twitter: Social Communication in the Twitter Age*, (Cambridge: Polity, 2013), 16,20,21,147,148

[16] Noriyuki Suzuki, "Oh my ( ) (2017)", Noriyuki Suzuki website, accessed 21 October 2019, https://noriyukisuzuki.com/ohMy.html

[17] An Xaio Mina, "Morse Code Tweets (2009)" An Xiao Mina website, accessed 17 October 2019, http://memestomovements.com/art/morsecodetweets.html.

[18] Anna Friz, "Radiotelegraph (2013)" Desperado Philosophy website, accessed 14 November 2019, https://desperadophilosophy.net/2013/10/21/here-for-the-night/

[19] Silvia Ruzanka and Ben Chang, "Art (2008-2011)", Silvia Ruzanka website, accessed 19 October 2019, http://silviaruzanka.com/art/

[20] Paul DeMarinis, "The Messenger (1998/2005)", Paul DeMarinis website, accessed 25 February 2019, http://pauldemarinis.org/MessengerText.html

[21] Calum Scott, "An Exploration of the Notion of Sound (Re)Production Through Media Archaeological Creative Praxis," *eSharp,* no. 26, accessed October 8, 2019, https://www.gla.ac.uk/media/Media_603129_smxx.pdf#page=100

[22] Dhiraj Murthy, *Twitter: Social Communication in the Twitter Age*, 48

Bibliography

Edosomwan, Simeon, Prakasan, Sitalaskshmi Kalangot, Kouame, Dorian, Watson, Jonelle and Seymour, Tom, "The History of Social Media and its Impact on Business," *The Journal of Applied Management and Entrepreneurship* 16 (3), (2011)

Guffond, Jasmin. "Art (2019)", Jasmine Guffond website, accessed October 16, 2019. http://www.jasmineguffond.com/

Holmes, David, *Communication Theory. Media, Technology and Society*, (London: Sage Publications, 2005)

Hermann, Thomas, Nehls, Anselm V., Eitel, Florian, Barri, Tarik and Gammel, Marcus. 2012. "TWEETSCAPES — REAL-TIME SONIFICATION OF TWITTER DATA STREAMS FOR RADIO BROADCASTING," (paper based on a talk presented at ICAD, Atlanta, GA., 2012). *International Conference on Auditory* Display, https://smartech.gatech.edu/handle/1853/44424

Jones, Daniel. 2012. "The Listening Machine (2012)", Erase website, accessed October 16, 2019., http://www.erase.net/weblog/2012-06/the-listening-machine.

Luxloop. 2015. "Social Sound, (2015)", Luxloop website, accessed October 16, 2019, http://socialsound.luxloop.com/.

—. 2015. "Social Sound (2015)", Luxloop website, accessed October 16, 2019. http://www.luxloop.com/projects/socialsound

McCay-Peet, Lori and Quan-Haase, Anabel, "What is Social Media and What Questions Can Social Media Research Help Us Answer?," in *The SAGE Handbook of Social Media Research Methods*, ed. Sloan, Luke and Quan-Haase, Anabel, (London, SAGE Publications, 2017)

Neumann, W. Russell, *Media Technology and Society: Theories of Media Evolution*. (Ann Arbor: University of Michigan Press, 2010)

Park, John, and Bellona, Jon. 2014. "#Carbonfeed (2014)", #Carbonfeed website, accessed October 16, 2019, https://carbonfeed.org/.

Poster, Mark, *The Second Media Age*, (Cambridge, UK: Polity Press, 1995)

Rymarczuk, Robin, "Same old story: On non-use and resistance to the telephone and social media." *Technology in Society* (45), 2016

Vallis, Owen, Hochenbaum, Jordan and Blasco, Jasmin, "Convergence by the Noise Index." *Leonardo Music Journal* 24, 2014

Winston, Brian, *Media Technology and Society. A History: From the Telegraph to the Internet,* (London: Routledge, 1998)

Authors Biographies

Paul Dunham is currently a PhD candidate at the New Zealand School of Music (NZSM), Te Kōkī at Victoria University of Wellington (New Zealand). He holds a Bachelor of Music (Composition) with First Class Honours. He has produced a number of sound-based works across different media. His current research is focused on creating a series of sound sculptures that, within the transdisciplinary frame of media archaeology. This research aims to establish a narrative through the convergence of obsolete and current media technologies whilst exploring the sound producing qualities of these media in his work. Previous works have been exhibited and presented at The Dowse, Adam Art Gallery, Victoria University, The Pyramid Club (Wellington) and at the Australian Computer Music Conference (Sydney), International Symposium on Electronic Art (Durban) and xCoAx (Milan).

Mo H. Zareei is an Iranian sound artist and researcher based in New Zealand. Using custom-built software and hardware, his experiments with sound cover a wide range from electronic compositions to kinetic sound-sculptures and audiovisual installations. Regardless of the medium, Zareei's work aims to highlight the beauty in the basics of sound and light production and reductionist audiovisual elements that draw inspiration from physical and architectural principles.

Zareei has presented his work at various international events including International Symposium on Electronic Art (Vancouver/Dubai), New Interfaces for Musical Expression conference (London), International Conference on Auditory Display (New York), International Computer Music Conference (Perth), New Zealand Festival (Wellington), SETxCTM Festival (Tehran) and Tehran Annual Digital Art Exhibition (Tehran). His installation work "Rasping Music" was the recipient of the 1st prize for Sound Art in the last iteration of the Sonic Arts Award in 2015.

Professor Dale Carnegie has a BSc. in theoretical physics and applied mathematics, an MSc (first class honors) in applied physics and electronics and a PhD thesis in computer science. He was a lead developer of the Engineering Programme at Victoria University of Wellington and established the University's first Mechatronics Research Group. He is currently the Dean of Engineering.

Professor Carnegie's current research interests are in the area of mechatronics, autonomous mobile robots, sensors, embedded systems, adaptive control, mechatronics in music applications and engineering education. Specific areas of on-going research include autonomous search and rescue robots and full field image ranging systems. He has published and presented over 200 research papers in various journals, book chapters, conferences and patents and founded the Electronics New Zealand Conference series which is held annually.

Dugal McKinnon is Deputy Director of the New Zealand School of Music – Te Kōkī at Victoria University of Wellington where he teaches sonic art and composition, and directs the Lilburn Studios for Electronic Music. He has been a resident artist at IEM (Graz, Austria) and ZKM (Karlsruhe, Germany), and STEIM (Amsterdam). His artistic research spans instrumental and vocal composition, electronic music, sound and installation art. As a scholar he has a particular interest in the ecological and material dimensions of sound-based art and electronic music.