# Computational art experiments for the University: revealing culture, community and social spaces

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Universities are social entities that product cultural and narrative environments. They are made by people whom daily activities create dataset in the form of raw data, concealing information about the context they were born in. We are often unconscious about this flux of possible readings as they usually are intangible, unexpressed and hence unutilized. To give evidence and make visible this hidden amount of data, we have at our disposal many new contemporary tools and specific digital processes of data mining. This paper present two experimental concepts resulting from a course at the Design University of San Marino, which is located in the public space of the Santa Chiara monastery. The works explore the physical building through two different datasets characterising this institution. The projects focus on making visible invisible behaviours related to the social life of the University. To do that different dimensions, virtual space in the first case and physical space in the second one, have been taken into account.

Keywords: data meaning; digital art; installation; mapping art; data visualization; digital humanities

Subject classification codes: include these here if the journal requires them

## Overview and context

Any university is a public environment that deals with education and training of people, but it is also a particular institution dedicated to scientific research. In its spaces academic activities are conducted and they produce countless amounts of educational, cultural and scientific resources to improve common and scientific knowledge. At the same time, university is a social place, too, where defined activities are carried out every day by groups of people who communicate and interact with each other in certain environments of the institute to produce information. Among them, we find human behaviours typical of all of the human beings and which are necessary to be part of any contextualisation. In this case, the behaviours produced are linked to the production of

dialogues, human relations, production and dissemination of knowledge, interchanges of cultural or educational information, creation and participation on collaborative projects or writings and so forth. Even though many of these behaviours if closely observed may present a narrative value to tell a certain aspect about the environment, some remain hidden and unexpressed because of their intangibility. Similarly, human activities create a wide range of raw and abstract data containing information which remain mostly unused because of the lack of awareness about their presence. Due to the availability of new contemporary tools and specific digital processes of data mining, today it is possible to give evidence and make visible this hidden amount of data. Therefore, the research project explores invisible data – disseminated within the places of the academic institution – to reveal a conceptual meaning of the University itself. According to the potentiality of technology, the research explores the potentiality of data visualization to grasp the complexity of the world and helps to communicate abstract information and complex processes in a expressive visual form.

Nowadays, digital tools and computing are prevailing elements in some of the creative processes, which use customised instructions to develop new conceptual forms of art and communication. Due to the wide range of resources and techniques offered by software, each of existing form of media is capable of assuming new qualities of expression, where the code becomes a powerful medium to create complex and dynamic artworks (Reas et al., 2010). Software allows us to collect and process enormous quantities of raw information and transform them into new significant artistic representations. The influence of code extends its potentialities also outside the boundaries of the screen to control more aspects of the physical space through tangible computer-controlled artworks. On the basis of the considerations mentioned above, the result of this process transforms the representation into a interactive installation as final

utterance of data. In addition, this narrative form of expression becomes a spatial tool that direct involves the final observers, with the result of a complex interplay of physiological and psychological functions during the receptive process.

For this specific research, the project uses the potentialities offered by computational art to create two artworks related to the conceptual exploration of the Design department of University of San Marino using specific intern datasets. The School is a small reality founded in 2005 in the City of San Marino, located in an ancient monastery built in 1565. The contribution is extrapolated from some of the experimental works conceived within the Design Laboratory 2 conducted by professor Daniele Tabellini in last years, within the Master's degree in Interaction Design. The project involved different sets of data and produced various elaborations to illustrate the social and cultural dynamism of the University, showing at the same time some aspects related to its culture and identity. In particular, this contribution mentions two significant works.

**Objectives**

The research presented in this contribution concerns two experimental concepts related to Digital Art. The two projects aim to be study instruments to explore the expressive potential of contemporary digital technology, in the form of multimedia hybrid artefacts. At the same time, the goal was to realize working prototypes to open a theoretical discussion around Digital Art. The goal of the work was to ideate, make sense thorough meaning and physically build prototypes of these digital artworks that would be able to express the inner identity of the University of San Marino. In particular, a group of students was asked to ideate interactive installations to get spectators, visitors or locals, to know the existence of the University through the datasets it generates. The research started from the collection of raw data daily produced

in physical and digital spaces of the Design School of the case, analysing the interactions between the people from this tiny community. The main purpose was to give evidence of invisible and unexpressed behaviours, trying to seek the major goal of giving relevance to the presence of the School. The installations would become conceptual expression of data, showing hidden aspects of the University, to aware both producers and users of them about what is happening in it. This process is strictly linked to the support of digital technology as mean to gather information (i.e. through the use of sensors or database storages) and then to elaborate them with coding. This, to create new expressive forms.

Figure 1. Three photos that represent the entrance of University of San Marino: the entrance, on left; the facade, on top right; the hall, on bottom right. Photo: authors.

Another interesting side of the experiment, was the continuous reference to design method, close to traditional design processes, where, although a subjective component related to the author, other constraints deriving from a commissioning (which in this case is the University course brief) must be taken into account. The experiment aimed at making final installations concretely feasible and to use them as communicational elements of the University. The installations must be designed to be displayed at the entrance of the institute, to make of it a space for reflection and, at the same time, they must be recognisable as landmarks of a specific cultural space located in the ancient monastery of Santa Chiara, in San Marino, headquarter of the School. Indeed, the purpose of the research is to attract observers and arouse curiosity in the University.

Finally, taking into account the close reading of the datasets produced by the University, the experiment must involve the public through an interplay of

psychological and physiological interactions taking place experiencing the installations. In the next section, it will be presented the design process that has contributed in producing the two final results of this experimental research.

**Methodology**

Aiming to transform digital data in a physical experience, the work started from a stage duly named *Dataset*. First of three macro-steps, this phase was designated for the discovery of meanings related to the physical space of the Design department at University of San Marino. The specific goal of it was to expose all of the existing datasets related to daily life hidden in the digital realm. Many narrative potentials were discovered at this stage and the choice between all of the options found was dictated by the interest in highlighting contents that would have brought out the richness of the tiny School (Cairo, 2013). Examples of these options were the dataset about source and destination IP address to describe a trip, archived datasets owned by the university secretariat, the quality of the air in the spaces, the resources feeding the University both in a physical and in a conceptual way, the movements within the building and so on. The two project presented in this work in particular set as their project material sound and virtual social relations. The second step, *Dataviz*, concerned visual processing of the data in order to find the most appropriate form to express the humanity of the chosen datasets (Lupi and Posavec, 2016). To do this, it was necessary to acquire deep understanding of the data itself. The investigation focused on where data came from, what they were made of, who produced them, which variables they stood for and what their relation with the fourth dimension was (Tufte, 1983). Simanowski talk about time as founding asset of any dynamic interaction (Simanowski, 2011). Indeed, our *Dataviz* ended with different real-time mapping of data.

In the end, with the final phase *Dataphys* the previously digital depictions evolved from shapeless information into physical interactive installations. The prototypes of these tangible artefacts were implemented with open source tools like Processing+ (software) and Arduino (hardware) and customized coding programs were written to access, process and visualize information (Reas and Fry, 2014).

**Results**

Through the use of the aforementioned methodology, the research has produced hybrid and multimedia artefacts (Manovich, 2010), which have made visible and legible some of raw data hidden in the crowded spaces of the institute. As indicated in the objective section, two digital projects that has been thought to be positioned at the entrance of the University of San Marino. Each of them has utilized specific datasets which was generated by intern people but also easy to acquire within the examined context. Subsequently, data have been analysed and elaborated through a computational process, in order to be expressed into a visible and tangible form by a customized algorithm. The two projects arisen from this research are *Metadata Juice* and *Vibrancy*. Both of them are mainly concentrated on hidden data generated by human behaviours of people who everyday use the several places of the institute, but they are focused on two different dimensions. *Metadata Juice* works on the virtual space of Internet, whilst *Vibrancy* explores data produced on the physical space.

*Metadata Juice*

The first project, called *Metadata Juice*, is an experimental real-time web installation that explores social and cultural relationships between people mediated by internet. In fact, with the growth of web and social media, nowadays it is possible create new social structures, modes of production, and cultural formations that alter the way information

is produced and exchanged, enabling a global and networked world of decentralized sharing, collaboration, and diffusion (Burdick et at., 2012). The main purpose is to make visible the intrinsic social aspects of human communication, daily generated by people on the virtual space. In particular, the opera takes into account the most preferable social networks utilized on the web, which people use to dialogue, exchange information, emotions but also to work and provide or consume multimedia resources. The scope is to let emerge human characters that influence and affect the virtual society, in terms of cultural and social space, through their hidden behaviours and expressions.

The stream of information analysed in the first phase of the methodology (*Dataset*) was extrapolated from the local firewall of the University of San Marino. Specifically, it was analysed the traffic of every activity executed on web, which was logged by the system into a database and reported onto a periodic data log, in *json* extension format. Data generated by human beings were divided from machine data and, in turn, it was selected only information of the users' sessions related to their social interactions and activities, in which it is visible a human aspect.

In this case, this project wanted to be a visible and tangible response to the greatness and the immediacy of internet communication that everyday is produced in the University space but it is invisible towards the human sensory perception. Analysing the entire data log, twenty web applications were chosen to create the concept of the mapping art and subsequently they were divided into six categories, which essentially regard data generated by social networks (Facebook, Twitter, Instagram, Google+, LinkedIn, Pinterest, Tumblr), instant messages or direct conversations (FaceTime, WhatsApp, Skype), cloud storages (We Transfer, Dropbox, Bit torrent, iCloud), mails (Outlook, Gmail) and multimedia content platforms (Spotify, iTunes, Vimeo, YouTube).

The idea of using a specific dataset – specifically derived from the analysis of internet communication provided by the University firewall – was inspired by *Words of a middle man* of Christoph Steinlehner, Lino Teuteberg, Jeremias Volker. The project transforms a wireless router in an active narrator of the Internet traffic that it is required to monitor and manage inside its system. It highlights the invisible data generated by the interactions between the various users during their navigation, reporting them in the form of a natural dialogue. In this process, the project explores the human relations that emerge into its interior, showing to observers the human aspects of this artificial process, which may seem only artificial and understandable at the first glance.

Figure 2. System layout of *Metadata Juice*. Photo: authors.

In the second phase (*Dataviz*), data of human habits of the community mapped was translated into a visual and dynamic representation. To create the mapping art, it was created a specific code through Processing 3.0, where the *json* file of the firewall data log, was processed to recognize only the user sections associated to the selected web applications. Since the project was linked to the virtual space, the aesthetics took inspiration from the digital language, in particular to binary code syntax. The mapping of data stream is visualised onto a matrix grid, where in the x-axis is represented a minute of the time flow and in the y-axis is showed the categories of the social applications. Time is expressed in seconds, because on one side, the project wants to elicit the immediacy of digital traffic, but on the other side, that time rate wants to provide a compressible readability to observers, according to the time of real world.

The categories are identified through a specific striking colour and are represented by multiple square cells as being pixels. Every second, the code monitors Internet traffic of those specific social platforms and then, it transforms raw data into a

dynamic visualization. The flow of data stream is visualized starting from the right side of the opera, and overpass all the display. If someone of the University make an access in a precise time on a particular web application, a coloured cell appears on the corresponding row. Whilst, if nobody sends a request to that application, anything happen in that time, leaving a black space on the related row. In this case, following the binary syntax, information was represented in a form of bits with only two possible values: "0" and "1". Each coloured cell corresponds to the symbol "1" and the blank space to the symbol "0". All cells together create a synoptic framework of the overall opera, but at the same time they generate an expressive, narrative and pixelated image of the University's web flow. A comparison among the social categories helps observers to better understand what the social networks are the most privileged inside the University and make its inhabitants more aware of their virtual behaviours as well.

About the phase of *Dataviz*, an important inspiration came from the art project of Ryoji Ikeda, called *Datamatics*. This opera is represented by a series of audio-visual concerts that use pure data as a potential source to create dynamic computer-generated imagery in real-time computing. Also in this project, the author focuses his attention on the invisible multi-substance of data that permeates our social spaces. The abstract aesthetics generated for this opera follows the same mathematical processing of binary syntax, which provide to the final observers and essential and unique identity of the entire representation.

Figure 3. Three photos that represent *Metadata Juice*: a conceptual image, on left; the installation of the analytical reading in the hall of University, on top right; the poetic installation at entrance of University, on bottom right. Photo: authors.

In the third and final phase (*Datphys*), the data stream of all social relations – generated inside the digital environment through computing processes – was translated

into a physical installation. As described in the objectives, the final goal of all process was to give a significant identity to pure and invisible data, which would be expressed through a tangible representation of themselves in the real spaces of the Institute. For this reason, the project assumes a proper identity as a peculiar landmark of that specific place, through a tangible narration of the anthropological and virtual image of the University, which is daily generated by its own ITC system.

The concept of the project was designed to maintain the pervasive sensation produced by the web space in the real world, making it more visible at eyes of final observers. The intrinsic meaning of the opera was translated into reality through the use of a hydraulic system as a tangible display, which permitted to produce the same visual language ideated for the *Dataviz*. The identical syntactic scheme of binary code takes shape in the analogic space due to the combination of two fluids with different unit weights, in such a way that the distinction between bits was clear. In this case, the digital flow of every web application is similarly displayed by a transparent hose in which is present a specific data stream. For every bit with a numerical value equal to zero (i.e., the value means no access), information are simply represented by transparent water. While, for every user session with a value equal to one, data is transmitted through a small volume of paraffin oil, which is coloured according to the colour associated to its corresponding category. For the realization of every single circuit (related to a web application, it was necessary a microcontroller (for this project it was used Arduino Uno) that was able to manage the flow of the two different fluids in the hose, through the simultaneous control of two water pumps. According to the value obtained to the data log of firewall, the microcontroller opens or closes (through a relay) the pumps that together combine the two liquid flows, in order to recreate the

visualization generated by code processing. The hoses of the two different liquids are connected together through a hydraulic "T" connector.

Due to this hydraulic wiring of the University server, it was possible to divide the *Metadata Juice* in two specific levels of reading, which offered to observers two different experience of fruition. The first level of analytical reading was located in the hall of University and regards an analytic visualization of data that reflect perfectly both the image and the close reading proposed in the phase of Dataviz. The circuits were horizontal aligned on the wall of the hall, in order to replace the grid scheme of virtual mapping.

Hence, the configuration allows to observers a qualitative and understandable data visualization that is very close to the discipline of infographics. However, the project continues outside the hall, precisely hanging on the entrance space of University, in which the hoses lose their meticulous alignment to become an expressive opera that involves observers through an auto-visual experience. Indeed, the circuits are arranged casually in the space, where at a certain point of the flow, the hoses are cut off, in order to overflow the liquids outside the hydraulic system. Some funnels are predisposed below the hoses to recover the liquid, in such a way that the data stream was subsequently reinserted in the overall circuit.

Therefore, this falling process of fluids cause a temporary time in which digital data is visibly revealed in the real world, producing in the same time, an audible sound similar metaphorically to a "data rain". In this case, the installation becomes an invitation to know the University in a conceptual point of view, stimulating the observers to get a deeply mediation of the experience through a poetic and multisensory narration[1].

Figure 4. Real and working prototype of *Metadata Juice*. Photo: authors.

Also in the third phase, the installation took inspiration from two principal examples, which are: *Data Furniture* of the collective Domestic Data Streamers and *Bit.Flow* of the artist Julius Popp. The first installation regards a social polling system designed to vote the best video project of 2014 at the *Haikurts Festival de Micrometratges* of Barcelona. The polling system was made up by a hydraulic installation, where every project of the award was represented by a specific coloured liquid. When someone voted a project, the system pushed a determined volume of fluid (equivalent to one vote) into a transparent hose, which in turn, showed the symbolic visual representation of the overall voting system. Then, every beat of liquid flowed into a transparent cylindrical container that displayed the real quantity of votes received by each project. This time, the effects of the bit rate created by the liquid was combined together with air. Instead, the second opera concerns in a hydraulic installation made up several transparent hoses that let constantly flow inside them small bit of coloured fluids. At the first glance, every sequence of bits appears chaotic without any type of sense or logic. But at particular times, from a certain point of the circuit, data are visually composed to each other to display letters, in order to produce meaning.

The two described installations were very important to conceptualize *Metadata Juice*, as they have contributed to better define aesthetic and poetic aspects of the opera itself, maintaining the visual relation of data between digital and analogic stable.

### *Vibrancy*

Big Data's value lies in their quantitative availability, in their variability and in the parallel meanings they are able to create. Between the different possibilities offered by the community of San Marino University, the project material elected was a constantly changing, as lively as us students, extremely variable within a day dataset:

the one related to the sound. In contrast to the mutism that often afflicts the streets of the historical centre of San Marino, there seems to be a remarkable fidelity between the daily life of the University and the noise that derives from it. The higher the noise, the higher UNIRSM vitality. *Vibrancy* is an interactive installation with the objective to show the vivacity of the Design School located in Santa Chiara monastery. The University in question is so hidden to seem apparently inexistent and it is narrated using a special software that detects noises and translates them in a visible flow of physical material. *Vibrancy* is a physical evidence of the busyness of this lively community: laughter in the garden, drills in the mock-up lab, buzzes in the classrooms testify that UNIRSM produces human relationship, ideas and knowledge in the form of noise. As described earlier before, the signal affecting *Vibrancy* software is sound. That is, technically, a vibration propagating in the air, that forms areas of variable pressure. We are talking about an analogue signal. The Wi-Fi microphones scattered in various crucial spots of the building, perceive the intensity of the pressure variations and translate them into the digital value to be transmitted to the hardware component of the installation. The more this is high, the more amount of air will move the material enclosed in *Vibrancy*.

The project brief inextricably linked the installation to the entrance of the University, a place where it is rare to meet people unrelated to the School, despite it is a public city street. *Vibrancy* suggests a dialogue with the City of San Marino and its visitors from a territorial point of view. It was born to highlight location and presence of the Design School, inviting people to enter, get to know the students and see them at work. To give even more visibility to the University, *Vibrancy* will also live outside School headquarters. Indeed, spreading clones of the installations in the streets of San

Marino is supposed to attract fluxes of visitors to the School and bring the identity of the University in the urban context.

Figure 5. System layout of *Vibrancy*. Photo: authors.

The most significant references to deepen the possibilities for translation of sound in the concrete domain are *Yukikaze* and *Hover*. The first, was useful to understand software operation method and create a customized version of it for *Vibrancy* interactive installation. *Yukikaze* makes audio frequencies visible by activating fans that move EPS. Basically, *Vibrancy* will display noise in the same way. Each of the six fans of *Vibrancy* will produce an amount of air which will be proportional to the average of perceived noise at the University. On the other hand, *Hover* testifies that noise is part in any work, both in a mental and in a physical way. *Hover* is a kit with two objects: one allows the display of the noise produced, the other, when necessary, enter the right level of white noise in the workplace, to promote global concentration.

Once the dataset to refer to was clear, the project moved to *Dataviz*. This phase allowed to get closer to data, forcing to answer crucial questions for the purpose of the attribution of meaning to the whole project. Is it necessary to distinguish the origin of the sound? How often and why does the noise we make change? What is the visual feeling of sound? What is the qualitative difference between the representation of a frequency and an intensity? To visualize means to seek for meaning, and, from here, it was very natural to take a firm direction within the project.

The first raw data visualization proposal was sketched by hand and, only later, coded via Processing 3.0. The variables involved were essentially two: time and intensity. Intuitively, you connect the time to the concept of clock and took as reference a lap angle. Each second, a ray would indicate the intensity of the volume perceived by

the microphones, showing its variations and regenerating once a minute. To create the needed representation, different sketches were modified and mixed: the one depicting an audio input detected through the integrated microphone of a PC, from the *Minim* library and the one showing a circle constantly rotating around the same point. Shortly, the microphone input became my dataset and the circle became the radius at every second. Length and thickness of the radius were proportional to the value of the audio input. A few corrections were made: input variable in Minim, did not actually perceive an intensity but a frequency. Moreover, the input value recorded by the microphone of the PC was relative to a timely instant. It was only by using an *array* that it was possible to store sixty values for each second and to pass the arithmetic average to the displayed radius, reaching a more real image[2].

Figure 6. Real and working prototype of *Vibrancy*. Photo: authors.

*Dataphys* phase consisted of the construction of the hardware prototype of the installation: a polycarbonate column containing granular EPS, at the base of which is positioned a fan. The software makes use of Processing to "listen" to the audio input of the built-in microphone of a PC. The arithmetic average of the audio input values, mapped and treated appropriately, gets to an Arduino card which activates the fan at different levels, depending on the signal. In the end, the movement of the EPS is directly proportional to the noise perceived by the microphone. That is how you make sound visible and concrete.

The strength of *Vibrancy* lies in the parallel meanings it is able to transmit on the territory of San Marino, and in its engineering process to be considered very simple. A possible continuation of the project would be a code deepening, to refine the relationship between noise perception and air production besides the study of visitors

flows to be intercepted and attracted to the Design School. *Vibrancy* make of sound a mean to tell the outside world the existence of the University of San Marino and to stimulate interest in it.

**Discussion**

This theoretical and formal research has allowed the realization of two digital artworks for which computing and data processing are the main executive mediums, code is the primary form of performative expression and is used, in this case, to extrapolate meaning from a complex context (Reas et al., 2010). In fact, the two projects enable code as a form of communication that, through the writing of specific and personal instructions, allowed the authors to develop abstract concepts in new visual and tangible forms. In addition, the daily life context of the University and its social spaces become databases from which to extract datasets for the final artefacts.

Unexpressed data already existing in the physical place became project material to be rearranged and represented in an original visual form for new narration (Downing et al., 2000). Information itself, in fact, does not have a specific shape and therefore it is possible to make a transition between different states of materiality (Paul, 2003). From this first assumption, among the different characteristics that the artworks take, it is particularly interesting to note how the artefacts are linked to two specific kinds of art investigated and described by Simanowsky, such as mapping art and real-time information sculpture (Simanowski, 2011). In fact, in the beginning the design process took care if the expressive bases of the computer as a tool for manipulating datasets into other forms that could be expressed through dynamic images. The data were mapped to generate a data visualization in which the information values were not merely a simple assembly of reality, in a statistical way that is usually expressed in infographics, but to include a deeper aspect of reading. Therefore, significant choices of specific forms of

visualization used by *Metadata Juice* and *Vibrancy* revealed information about the University environment for creating awareness about certain aspects of the place they live in.

The first project was dedicated to explore when and where social relationships on the internet happen during the day. The second mapped the most hectic places used by people within the University. However, and in the same way, the two different points of view chosen to represent the data revealed that visualization is a tool to create poetic narrations, subjecting the stream of data to an anthropomorphization of information rather than a simple natural expression, inserting in the perception of data even a social experience. Subsequently, the analysed data were reproduced in the reality, creating installations that took shape in real space and used it as a meeting point between the works and our senses.

In this case, the physical form shows the observers the image of ourselves, as direct producers of the consequences represented by the work and the latter becomes a real-time living picture of what the community thinks and acts everyday in the University places (Legrady, 2005). Again, the works creates new ways to structure the experience of ourselves and of the world and to make it more intimate, so that the close reading of data takes place through a poetic point of view, exceeding the mere utilitarian content, in favour of an emotional narration (Simanowski, 2011).

For both projects it is possible to notice that the interaction and the dynamism of the work is linked to the data produced constantly by the current status and by the behaviour of people in certain spaces. As a service platform, without the presence of an active community and a constant interaction with a specific place, the final result of the user experience – achieved by the two works – would not be possible (Bagnara and Pozzi, 2011). Both works are therefore a mirror of the University community but in two

different manners. As regards *Metadata Juice*, it is a proof that confirm how Internet is used as a medium in the creation of relationships in a social environment which is extended in a conceptual space broader than the reality, rather than a simple device (Nunes, 2006). In this extended form of communication, the work reflects social aspects of the University at a given moment that are part of a parallel reality and where the single action is combined with the public space of the web.

Instead, *Vibrancy* creates somehow a responsive space, which makes people's body a medium to create an inner dialogue with the work. In this case, unlike other interactive works, the relationship with the body is not direct and physical, but occurs through the consequences of human gestures, that, with their movement, produce noise that feeds the installation. Moreover, although the project reflects an implicit and statistical view of the liveliness of the University, it still leaves a margin of direct involvement of the observers, who can explicitly influence data collection through their active and conscious participation.

From a practical point of view, the two works remain in a state of concept but they produced the results required by the client and that was verified through some tests that confirmed their validity and feasibility. Both prototypes work in terms of code and visual representation, but they need additional steps to improve the physical installation. The simplicity with which the *Vibrancy* prototype shows its concept allows it to be easily engineered to a larger scale. *Metadata Juice*, instead, should primarily solve the complexity of its hydraulic circuit in order to improve the management of liquid doses. Currently the water circuit is working but it has difficulty regulating the flow between the two liquids in order to insert the right amount of liquid that can simultaneously represent the digital visual representation. Although *Metadata Juice* used restrictive measures to maintain the privacy of the users, another aspect that must be addressed is

right related to the privacy. The data processed represents personal information, indeed, therefore future steps will require the authorisation of their owner.

**Notes**

1. For more information of coding, refer to the following links: https://github.com/Fupete/ID2-2015-UNIRSM/tree/master/3_dataphys/Gian. Accessed on 15 December 2018.
2. For more information, videos and sketches related to this phase, refer to the following links: https://github.com/LoreCame/ID2-2015/blob/master/2_dataviz/LorellaCamellina/dataviz-4.md. Accessed on 15 December 2018.

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