

University of Porto

Masters in Multimedia

Interactive Digital Systems

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Assignment 3 – Interactive Installation

Digital De-Composition

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Context of the work

In an initial moment, we set up a meeting with the group where we had some ideas for carrying out the work forward. In this meeting, we heard the ideas of all the elements of the group. We came up with several ideas that we will mention below and, as we will see, although these ideas were different, we managed to bring some of them together in a way that would please all members of the group and also achieve the goals of this project.

One of the ideas was to turn anything into a musical instrument. Building a sensor that can connect objects and MIDI. Something with a tap, such as desks, computers, phone, etc. It can use the sensor to tap the MIDI keyboard to produce the sound of musical instruments. We would choose a theme, for example, “making people pay more attention to their life” and work around that.

The idea of using time as a concept was also discussed, in which everyday objects would become controllers to interact with the installation (using Arduino or Raspberry pi). The actions of the user would alter how fast or how slow the visual and audible occurs. This concept could make a statement about pollution since man made and organic objects take different times to decompose. Each object would have a corresponding time signature based on their decomposition time.

Another idea that was suggested was to create a gamified art installation using music/video that represents the level of environmental impact of the object "played" by the user. It could be a card, a puzzle, or a Gloria like game. The idea was to have some playing objects tagged with RFID tags. The sound and video would react to the material represented on the card, the score or both.

After hearing and discussing all the ideas we set up on a concept that adopts the best parts of the previous ones.

Project concept

The process by which organic substances are broken down into simple organic matter is known as decomposition. Decomposition is something that happens to everything, not just a simple bottle of water or a banana peel. Bodies of all living organisms begin to decompose shortly after death, for example. It is essential for recycling the finite matter through the nutrient cycle. Bacteria and fungi carry out the process of decomposition. These decomposers extract many of the useful substances for their own benefit and in the process help in the

rotting down of the dead organic material. Decomposition limits the competition of resources and provides a fresh source of essential nutrients for new generations of life.

Today we live in a society that relies heavily on the usage of disposable objects. Almost every day we consume and buy products to use them once and then throw them away. However, we become somewhat disconnected from this waste after we dispose of them in the trash can, often not thinking further about the fate of the garbage we produce daily. Many of those single usage objects take a lot of time to break down completely and decompose. Although recycling is a potential solution to this problem, many countries are far behind in their recycling goals, including Portugal.

According to the State of the Environment Portal, Portugal has been struggling in the last few years to achieve its recycling goals for 2020 while the production of municipal waste in the mainland has been increasing ("Municipal waste production and management | Relatório do Estado do Ambiente," 2019). To change this reality, it is necessary to increase environmental awareness.

A simple single takeaway meal commonly ordered by apps like Glovo or UberEats can produce waste that could take 400+ years to break away completely. An aluminum soda can takes 200+ years, a plastic bottle takes 400+ years to decompose and a styrofoam box (commonly used in hamburger packages) never decomposes at all (Bell, 2020).

It's important that we secure a future where we prevent pollution. In a way to try to explain and sensitize people about this theme, we created "Digital De-Composition". This project focuses mainly on the stark distinction of decomposition times between different kinds of materials. To better explain that distinction, we make use of commonplace objects that we have contact with on a daily basis. In the interaction loop proposed, the algorithm responds to the scanning of the RFID tags associated with the different materials and provides visual and audible feedback, according to the timespan that takes for each material to decompose.

Time is an important part of the concept of this project. Besides conveying the great difference in environmental impact that each material has by using a time scale that is easier for visitors to grasp (instead of 450 years visitors have to wait 5 minutes, for example) we also use the waiting for the decomposition to happen as a reflection point. In contemporary times, we often don't have 5 minutes to spare. Waiting 5 minutes for the digital decomposition to happen may feel like an eternity. However, putting this 5 minutes in contrast to what is the real time that actually takes for the object in front of the person to decompose, might change their perspective.

To offer the visitors another point for reflection, we also make use of trivias by the end of the timer that further highlight the enduring environmental impact of the objects. By using important historical events as an anchor, we can offer visitors a better perception of the decomposition times of each material.

Based on the definitions of human-computer interaction by Bongers, it's possible to conclude that this project is classified as a System-Audience interaction, as the software reacts to the scanning of the different RFID tags through the display of images and sound, which change according to the RFID tag that was scanned (Bongers, 2000).

In sum, this art project experiment is an interactive still life installation that features commonplace contemporary physical objects along with multimedia components. We hope to express some moods by producing music and videos, which will arouse people's attention to environmental protection.

Related work and Artists

We started to look for inspiration in works and artists that also used commonplace objects as their main subject. In this process, we came across still life, which is a type of work of art depicting mostly inanimate subject matter, typically commonplace objects which are either natural or man-made. We figured that our work could be a contemporary take of still life and extend it beyond the traditional 2D painting.

Drumming up some table tunes

Using ATmega32U4 based Touch Board, the Bare Conductive crew has transformed ordinary items found throughout the kitchen — oranges, a pan, a toaster, a coffee maker, a tea kettle and even some silverware — into sound. This project makes interesting use of common physical objects as interactive elements.



Figure 1. Drumming up some table tunes by Bare Conductive

Sunflowers 2

Inspired by Van Gogh's still life series sunflowers, Sunflowers 2 shows an arrangement of projected sunflowers. The video sequences are projected on a dark vase so that the shadow of the vase and the video merge.

The sun controls the video sequences. Sensors and solar panels measure and store the light and let the corresponding video sequences be projected on the vase and the wall. When it is sunny, the flower represented in the shade is alive and, when it is not, it is withered.

This project inspired us to make use of a projector to give the users visual feedback on their interaction with the installation.



Figure 2. Sunflowers 2 by Ursulla Palla

Contemporary Pieces

In her series “Contemporary Pieces” photographer Rebecca Rütten represents fast food in the manner of classic still life paintings. Her work aims to shed light on contemporary issues of class, financial status, and mass consumption. Even though her work does not feature interactive or digital elements, it is an interesting appropriation of classic aesthetics of still life and an interesting aesthetic composition of contemporary commonplace objects. Besides, it also portrays a contemporary consumption activity that generates lots of waste.



Figure 3. Contemporary Pieces by Rebecca Rütten

Generative music

In Terry Riley's *In C*, he wrote 53 musical phrases, and performers can choose different rhythms to perform short sentences. This provides good inspiration for our generative music. So we set up a short musical skit with four notes and used random speed to generate music. Since this is an environmental protection project, we want to make this music more meaningful, so we researched computer music expressing emotions. In Marco, Yun and Byung studied emotional expression in generative music. They used Pure data to create a program music generator. In Scirea's book, he mentioned using computer music to convey emotions and defined the types of musical emotions of the music generator.

Digital De-Composition

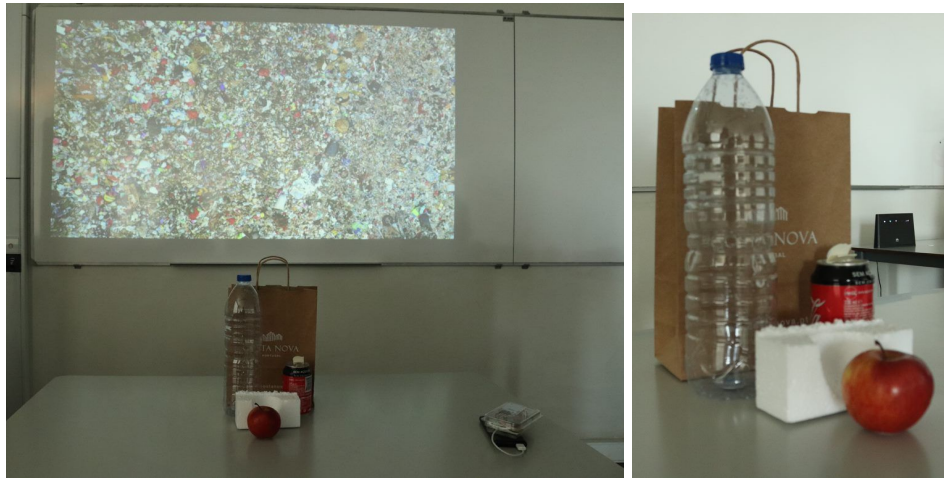


Figure 4. Digital De-Composition (our work)

As we can see from the related work represented in figure 1, there is a similarity in the fact that the objects are also on a surface. By using everyday objects, the installation gains physicality and a sculptural feel. However, while in the project "Drumming up some table tune" cables are used so that when touching the object they make music, our project has a simpler presentation. Since we use RFID, the table is cleaner, once it is only necessary to use the RFID reader to trigger the audiovisual response from the system. However, it bears a similar interaction to the first project seeing that the user also needs to physically interact with the objects.

Making an analogy regarding the work done by Ursulla Palla called "Sunflowers 2", there is also a projection on our work that indicates the state of the system. Palla, shows us the state of a flower according to sensors and solar panels. In our project, we also present a visual feedback of the state of an object in our system, however, this is focused on raising awareness of the decomposition time of various objects. As you can see in figure 4 shown above, there is a projector that shows the corresponding state based on the RFID reading.

Regarding "Contemporary Pieces" we also tried to find fast-food style materials or single usage packaging and commonplace objects. In this way, we are also sensitizing to the waste of contemporary lifestyle, since once we finish consuming, we will not reuse the materials and will only dispose of them. This is also a representation that this type of material is only useful for that brief meal and that many of these objects will take several generations to decompose, or even never disappear.

System architecture

We selected five objects, representing five different types of materials, to be exposed on the table. Each of the five objects on the table has an RFID tag that could be scanned by an RFID reader connected to an Huzzah Feather ESP8266 (Arduino compatible). Each tag triggers an audiovisual response that is projected on a wall in the room of the installation.

Materials and other technical requirements:

- 5 commonplace objects
- 5 RFID sticker
- Huzzah Feather ESP8266 (Arduino compatible) with an RFID reader
- Computer running Pure Data and P5.js
- The WI-FI access point or network router, to create a local network for the installation
- Digital projector
- Sound speakers

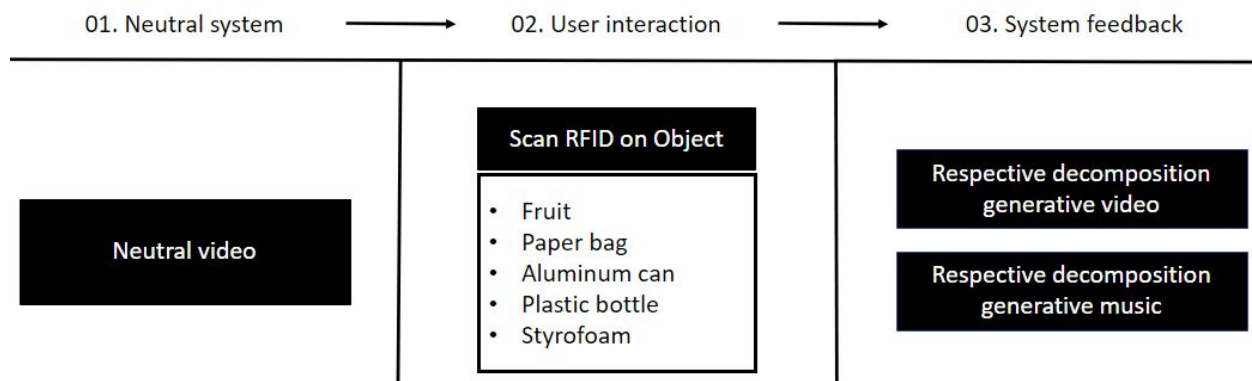


Figure 5. Simple diagram of the interactive loop.

In this system, the neutral video corresponds to a video of a landfill, creating a parallel between the objects in the table and the trash in the landfill.



Figure 6. Landfill used for neutral video

When the user scans the RFID of the chosen object, the arduino/rfid scanner system sends an OSC message to the computer running Pure Data. This starts the audio response of the system. In parallel the pd patch sends an OSC message to P5.js, which in this case is running on the same machine, but could be in a totally different one, upon receiving this message the P5 component of the installation starts the visual response, for the defined time.

When the visual presentation ends, P5 sends an OSC message back to PD in order to stop the audio.

Material	Decomposition time	Correspondent time in system
Apple	0.1666667 years	5 sec
Paper bag	0.1533196 Years	5 sec
Aluminium can	200 years	133 sec (2:20 min)
Plastic bottle	400 years	300 sec (5 min)
Styrofoam	1 million years	666666.67 sec (7.716 days)

Generative art

For the audiovisual piece, we chose to follow a generative approach in order to have different outcomes. Every material has two possible images where the algorithm could operate over. Inspired by French chemist Antoine Lavoisier in 1774 saying "In nature, nothing is created, nothing is lost, everything is transformed", the image is rearranged by copying and moving a piece of the photo to a random position of a determined range. This range and the size of the piece being moved vary depending on the decomposition time of the material. That visually represents a more or less drastic alteration of the material since more environmentally friendly materials decompose faster. This algorithm makes the image being continually altered until the end of the timer when it is potentially unrecognizable due to its transformation.

Additionally, the generative art has digital "worms" that crawl over the screen to transform it even further in a more organic way. This was made by using a boid algorithm model that was first developed by Craig Reynolds in 1986. This algorithm simulates artificial life by using rules to determine the separation, alignment, and cohesion of each individual agent.

Below is the test made of the generative art after 5 minutes of letting both algorithms run over an image.



Figure 7. Plastic image before "digital decomposition"



Figure 8. Plastic image while "digital decomposing"



Figure 9. Plastic image after "digital decomposition"

Complementary to the generative visual part, the interaction triggers generative music that also responds to the variable time decomposition of materials. In the sound part, we set

four notes and set a random playback speed. According to different garbage decomposition times, we set the range of random rhythms from fast to slow. Based on the research on using computer music to express emotions we divided the music into two emotions according to the degree of garbage decomposition. For more decomposable garbage, we used some music that can express positivity and vitality. For waste that is difficult to decompose, we used some music that can express sadness. In the expression part, we did not use traditional notes, such as Major thirds and minor thirds, but used envelope sounds to describe the sound's emotion.

After each material timer is over, the program triggers a trivia screen corresponding to the material that offers the visitor some contextual information to give a better perspective of the decomposition.

- ALUMINIUM CAN -
200 YEARS TO DECOMPOSE

200 YEARS AGO:

FORMER FRENCH EMPEROR NAPOLEON BONAPARTE
DIED AT THE ISLAND OF SAINT HELENA

THE CONVENTION OF BEBERIBE MARKED THE BEGINNING OF
THE WAR OF INDEPENDENCE OF BRAZIL

- APPLE -
2 MONTHS TO DECOMPOSE

TWO MONTHS AGO, JOE BIDEN BECAME THE FIRST DEMOCRAT
PRESIDENTIAL CANDIDATE IN 28 YEARS TO WIN IN GEORGIA

IN A SPAN OF TWO MONTHS, HUMAN HAIR GROWS AROUND 2,54 CM

- PAPERBAG -
8 WEEKS TO DECOMPOSE

8 WEEKS AGO, DONALD TRUMP FIRED CYBERSECURITY OFFICE CHRIS KREBS,
WHO DECLARED THAT THE 2020 ELECTION "THE MOST SECURE IN AMERICAN HISTORY"

8 WEEKS AGO, ANALYSIS RESULTS SHOWED THAT
PFIZER-BIONTECH COVID-19 VACCINE IS 95% EFFECTIVE

AT 8 WEEKS OF PREGNANCY, THE BABY HAS ALREADY STARTED
DEVELOPING ITS ARMS, LEGS AND FACIAL FEATURES

- PLASTIC BOTTLE -
450 YEARS TO DECOMPOSE

450 YEARS AGO:

GERMAN ASTRONOMER JOHANNES KEPLER - WHOSE WORKS PROVIDED ONE OF THE
FOUNDATIONS FOR ISAAC NEWTON'S THEORY OF UNIVERSAL GRAVITATION - WAS BORN

QUEEN ELIZABETH I REIGNED AS QUEEN OF ENGLAND AND IRELAND

- STYROFOAM -
1 MILLION YEARS TO DECOMPOSE

1 MILLION YEARS AGO:

HOMO ERECTUS WAS THE CURRENT SPECIES OF THE HOMO GENUS TO ROAM THE EARTH,
AND WERE THE EARLIEST HUMAN ANCESTOR CAPABLE TO USE FIRE

THE HOMO SAPIENS WOULD NOT APPEAR UNTIL AROUND 650.000 YEARS LATER

Figure 10. Final trivia messages

Additional info

Development

The development of the project was marked by learning and experimenting with different approaches to solve the problems we encountered along the way. One of the challenges was to determine the time scale for each material related to its decomposition time since materials had a considerable difference between them. The scale used is a compromise between a timer that is not extremely short or long for most materials while still conveying the desired message (give people perspective of decomposition times in a time scale that is more familiar and, therefore, better grasped by us). Set the timer in P5.js also proved to be a challenge in itself. The first approach explored was to set a timer based on the framerate of the draw function. However, this method was not very consistent, reliable, or precise. After some research, we were able to implement a timer that was set in milliseconds and not dependent on the frame rate. This solution proved to be much more reliable.

Our first idea for the boid algorithm was to have a "swarm of insects" (represented by dots) that would move organically throughout the screen. However, due to the way the code was made, the dots were showing as lines since the background in the draw was not being refreshed every frame (due to the image shuffling algorithm). After tweaking with the code and finding a way to display the dots, we felt like the lines we later called "worms" were more visually interesting and chaotic. We made the decision to go with the "worm" lines instead of the "insects" dots.

During the process of researching trivia to each material, the group was taken aback by the actual scale of time needed for some of the materials to decompose. This process made us reflect further on the relationship between time and our impact on the planet with what seems like trivial and non-important choices.

Missed attempts and potential improvements

In the initial stages of the project, the idea was to have neutral music working as a background track when no objects were scanned. However, in the end, to offer a better contrast with the decomposition and also offer a more somber mood, we opted to use silence

as the soundtrack to the neutral state of the work. In the future, we could include generative music as a soundtrack to the neutral state as well.

In a scenario of unlimited resources and time available for the project, we could approach some aspects of the work in different ways to improve it. One problem not foreseen by the group was the interference of the aluminum on the RFID readings. We improvised a workaround using paper to allow for the interaction on the prototype presentation day. However, it would be necessary to research better approaches to resolve this particular problem in future expositions on the installation.

One possibility would be the use of barcode scanners as an alternative to the RFID. The interaction of scanning the barcode would, to some extent, emulate the act of purchase, better conveying the message of the installation about consumerism and making the interaction more meaningful while still making use of alternative controllers. That would also potentially resolve the aforementioned issue of the aluminum interference on the RFID readings as we could use the barcode embedded in the product.

Improvements could also be made to the context given to visitors to the installation. As additional support, we could provide visitors with a sheet of tasks such as guessing which are the materials that are going to decompose faster or slowly. We since made a mockup of a possible sheet, available in the attachments of this report, to exemplify how this could work out. Another suggestion made to the group was the usage of narration or presentation of materials to better convey the message.

Furthermore, in the event of the installation being exhibited on several different dates, the trivia screen at the end of the "digital decomposition" of the materials could also be automatically updated by connecting it to a news outlet or Wikipedia, for example.

Another potentially interesting idea would be to make a room that mimics a landfill with a great quantity and diversity of objects.

Members contribution

Alexandra Rosa

Report

P5.js implementation and testing

Project managing

Similar Research

Image searching

Concept

Isabella Barbosa

Report

P5.js implementation and testing

Project managing

Similar and trivia research

Image searching and production

Concept

Lucas Rocha

Report

P5.js implementation and testing

Project managing

Similar and trivia research

Concept

Marcos Ferreira

Research

P5.js implementation and testing

Production of the demo video

Concept

Paulo Silva

Report

Javascript, RFID, P5.js, Pure Data, Huzzah Feather and other technology implementation and research

Project managing

Installation production

Concept

ZiJing Cao

Pure Data patch creation

System testing
Installation production
Project managing
Concept
Report

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Attachments

Digital De-Composition



This project is an interactive still life installation that features commonplace/contemporary physical objects along with multimedia components.

The interactivity of the work aims to make a point about the impact of the everyday consumption of products that produce waste materials that take a long time to break down (e.g. Takeaway packages). The user can pick up and scan the physical objects of the still life to make the audiovisual components react according to their decomposition time.

Pick an object of the table:
What is the order of decomposition of objects on the table?
How long do you think it takes each object to decompose?

A project by:
Alexandra • Isabella • Lucas • Marcos • Paulo • Zijing




Figure 11. Example of a "folha de sala" for the installation