SYNDYN — ART, SPORT AND ENTERTAINMENT

ANDRÉ RANGEL
CITAR — Centre for Research in Science and Technology of the Arts, UCP

ABSTRACT

Etymologically, *SynDyn* is a contraction of the Greek words 'syn', meaning 'together', and 'dyn', also from Greek, meaning 'dynamikos', or powerful, which is also associated with the term 'dynamics'. SynDyn is simultaneously a sport, public entertainment and artistic event that combines aesthetics, physical activity, technology and entertainment. This work exists as a hybrid between installation and performance. *SynDyn* transforms any existing sporting activity into an instrument of audiovisual expression. From ping-pong to windsurfing, with the appropriate configuration, sport can be aesthetically expanded and enhanced by *SynDyn.*

KEYWORDS

Public Art; Interaction and Sport.

ABSTRACT

Etymologically, SynDyn results from the contraction of the Greek words 'syn' 'together' and 'dyn' from 'dynamikos' which means powerful and is also related to the word dynamics. SynDyn is simultaneously sports, public entertainment and artistic event that merges aesthetics, physical activity and technology. This artwork exists as a hybrid between installation and performance. SynDyn transforms any existing sport into an instrument for artistic expression. From football to climbing, table tennis or windsurfing, with an appropriate customised set-up, sport can become aesthetically expanded and empowered by SynDyn.

KEYWORDS

Public Art; Interaction and Sports.



Figure 1 - Presentation of the SynDyn project at the Portuguese Catholic University.

INTRODUCTION

SynDyn attempts to master and disseminate the fusion of different digital and analogue algorithmic manipulation techniques. It also aims to develop an intermedia artistic system capable of provoking movements of various qualities, which amplify human gestures in an interface that facilitates the stimulation and participation of users in the creative process. The aim is to affirm the meta-concept, offering control and the advantages of final aesthetic decisions to the participants in the works, which exist as a space-time for integration, socialisation and communication, where audiovisual events are controlled through the body movements and gestures of the participants.

The work SynDyn can be considered as a concept of urban aesthetics that occupies space as a structural fusion of the human organism with its environment. This article develops a written rationale that explains the process of conception and elaboration of the work SynDyn, resulting from a process of reflective practical research that was considered relevant as a contribution to the evolution of knowledge in the field of public art and intermediate design.

WORK

SynDyn is an original concept that has earned numerous references and comments internationally, perhaps because it is an ambitious development, both in terms of its importance and impact, as well as in terms of all the logistics involved in its materialisation, documentation, and publication.

In the first implementation of this original and innovative concept, a racket sport was transformed into an event where players, while engaging in vigorous physical activity, control all the audiovisual events that occur in the space-time of the game. Players become performers in an audiovisual show. The work can be perceived as a game, but in fact, it is an autotelic activity, where there are no scores, winners or losers.



Figure 2 - Presentation of the work SynDyn at Casa da Música in Porto.

[1]Intrinsically motivated activity, related to the concept of flow proposed by Csikszentmihalyi. We suggest consulting the work 'The Concept of Flow' (Csikszentmihalyi & Nakamura, 2002).

The space where the event takes place is coloured with light that is controlled by the players' movements. Their arms and rackets are decorated with electroluminescent wire and the shuttlecock with an LED, providing vivid and dynamic scenic effects. At the beginning of each 'game', users choose a soundscape associated with colours and generative visuals for the ambient lighting system on an iOS device.

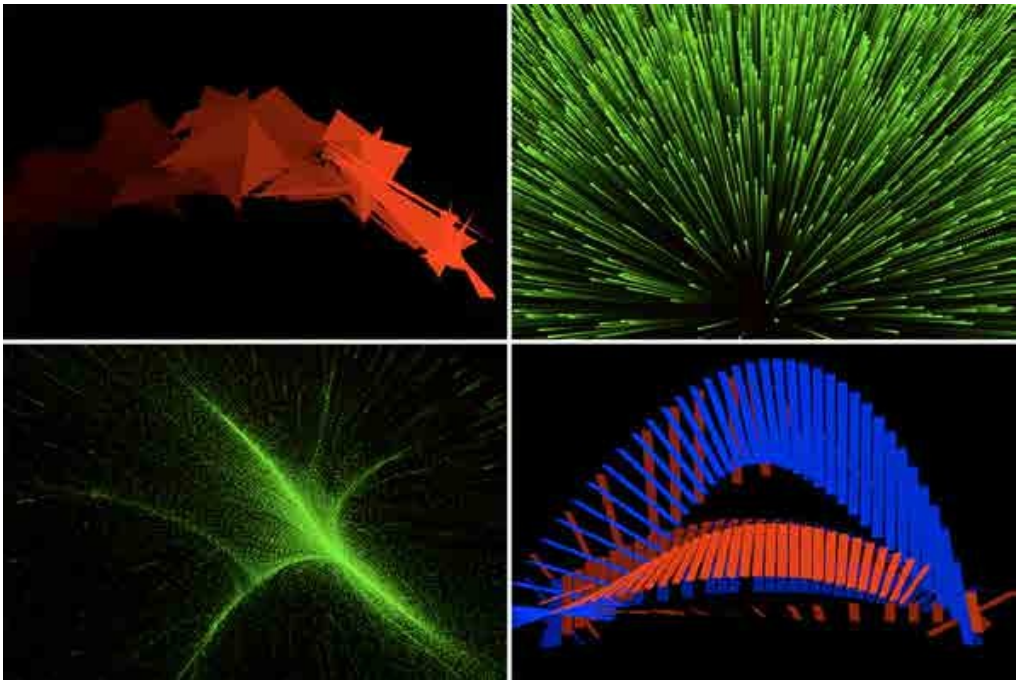


Figure 3 - Examples of images calculated in real time, triggered by the impact of the shuttlecock on the rackets.

In SynDyn, the rackets are equipped with sensors that detect each hit of the shuttlecock on the net. A radio transmitter transmits the data from the sensors on the rackets to a central processing unit — a computer. The hits on the rackets are accompanied synchronously by synthesised sounds and/or sounds reproduced in real time; by an instantaneous change in the colour of the ambient light, according to each user's previous choices; and by visual events, presented in video projection, also generated in real time.



Figure 4 - Diagram of communication between hardware.

[2] It is worth noting the effort made to attach each LED to a small battery in a robust but flexible manner. Some of the moments of this effort are described and documented later in this text.

[3] Practical research in this project also included the design and development of an application and its graphical interface to operate on mobile devices with the iOS system — iPod touch, iPhone, and iPad.

On an iOS device, a soundscape associated with colours and generative visuals is chosen for the ambient lighting system. Rackets equipped with sensors detect each stroke of the racket. A radio transmitter sends the sensor data to a central processing unit — a computer. The strokes on the rackets are accompanied synchronously by synthesised sounds and sounds reproduced in real time; by an instantaneous change in the colour of the ambient light; and by generative visual events, presented in video projection.

SynDyn enhances the space where it occurs — allowing for a unique interaction with the surrounding landscape — by transforming the lighting conditions and soundscape of the location where it occurs. As a performance, SynDyn undoubtedly interacts with and affects the perception of the infrastructure and physical form of the location, without damaging it.

IOS DEVICE



Figure 5 - Graphical interface on the iOS device for choosing sound and visual landscapes.

On the iOS device, a first menu with two options was designed. The first option accesses a menu with four buttons that configure four completely synthetic audiovisual landscapes. These landscapes are generated based on generative design principles, using particle generators and attractors in the visual domain and oscillators and digital noise generators in the sound domain. The second option opens a menu where each participant can choose a soundscape. This menu consists of eight rectangles in eight different colours, overlaid with eight words suggesting the soundscapes. Each soundscape is associated with a bank of dozens of sound samples that are chosen randomly by the system each time the racket is struck.

LIGHT PAINTING

In addition to the real-time audiovisual response described above, users can also obtain a visual memory of their performance. A camera, controlled by the central processing unit, covers the entire event area and takes long exposure photographs. This camera records the trails representing the trajectories of the luminous wheel, rackets and illuminated arms. This ensures the longevity and memory of an ephemeral work. Literally, the possibility of drawing with this work gives SynDyn its original and innovative character: it is simultaneously a sport, entertainment and artistic event that blends aesthetics, physical activity, technology and entertainment. This work exists as a hybrid between installation and performance.

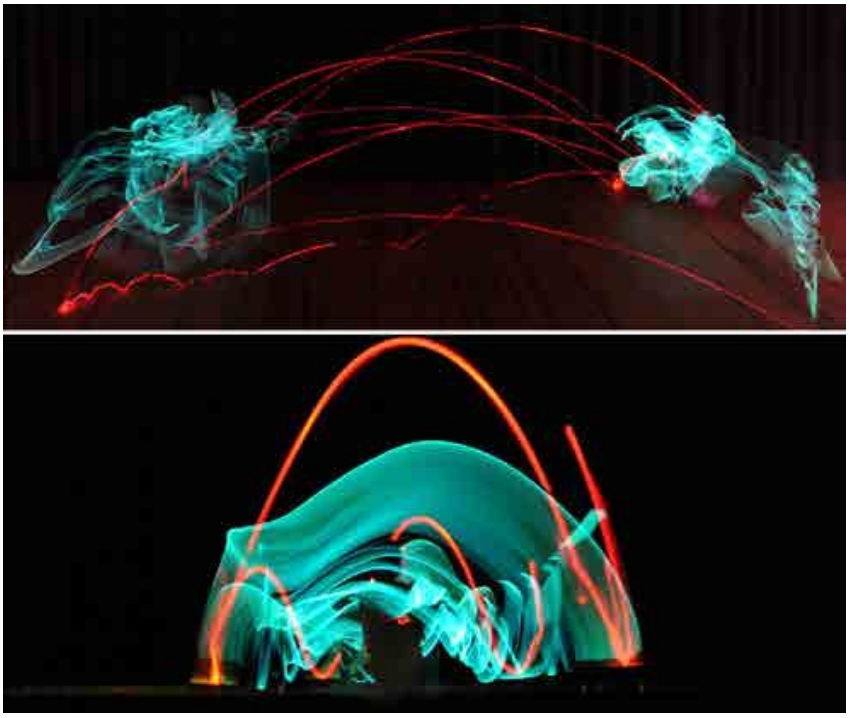


Figure 6 - Light drawings in SynDyn.

URBAN SPIRIT

In SynDyn, the free and rebellious urban spirit is enhanced by a youthful and aggressive image, which, associated with the idea of speed, power control and precision, seeks to attract urban tribes who play in unconventional places. SynDyn allows the appropriation of entertainment venues in the city, emphasising concepts underlying the practice of sport — audacity, freedom and rebellion (parkour/ graffiti) — in the sense of adapting conventional sports to the urban context of the city, taking advantage of its equipment, obstacles and architecture. It is a 'clean' sport that does not require special infrastructure and does not have a permanent negative impact on the landscape, a factor that denigrates the image of extreme urban sports. In this sense, SynDyn is an urban experience that uses urban infrastructure as a backdrop and citizens as performers and spectators, thus pointing to future possibilities for the city and for urban sports.

INTERACTION WITH SPACE

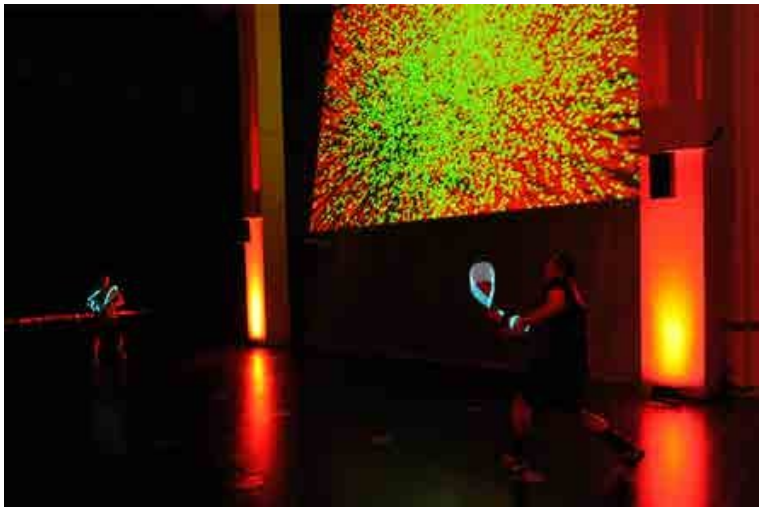


Figure 7 - Use of urban infrastructure.

The SynDyn work enhances the space where it takes place — it allows for a unique interaction with the surrounding landscape — participants in the event control changes in the colour of the light in that space as well as its soundscape. SynDyn aims to be a spatial project that, in an urban context, can take the form of street art, mixing technology, digital media and community. SynDyn aims to encourage the reuse of urban, rural or natural spaces, temporarily giving them a new function: to be simultaneously places for artistic and sporting practice and exhibition.

By transforming the lighting conditions and soundscape of the location where it takes place, SynDyn, as a performance, undoubtedly interacts with and affects the perception of the infrastructure and physical form of the location, without damaging it. Light is essential for vision, and SynDyn strongly affects the quality of light where it occurs, so the visual impact is very strong. In order to ensure low energy consumption, SynDyn uses LED luminaires that consume much less electricity than traditional incandescent luminaires.

METHODOLOGY

The methodology affecting the reflective practical research approach that resulted in the SynDyn project is determined by the research process itself. It is therefore more of an iterative methodological process, in which the research methodology itself is continuously analysed, reconsidered and redesigned to respond to the needs of each new stage in the research process. In other words, the research process integrates, shapes and determines the methodology, rather than the methodology determining the research process.

DMX AND RADIO

Light and lighting are fundamental to the perception of any space. Their design and control make it possible to transform the appearance of certain spatial and architectural contexts. For the development of this interactive intermediate work, communication protocols were investigated that allow the interaction between the user and the environment, as well as the interaction between the user and the environment and the environment itself.

has real-time control of lighting devices. Two main protocols have been identified: the X10 language[4], which is more geared towards home automation and domestic applications, and the DMX protocol[5] ,which isused professionally in the entertainment world.

The choice of one of these two communication protocols was based on the speed of operation of each. Thus, given that the DMX protocol operates at 250 kbaud[6] and the X10 protocol operates at only 20 bps[7] , the faster one was chosen without hesitation: the DMX protocol. After choosing the protocol to be used, part of the practical research developed in this project focused on choosing the DMX interface to be used. In order to design the lighting system and the computer programme that integrates the SynDyn work, two interfaces were tested, which allow the connection between a computer and a lighting network, composed of devices capable of executing DMX commands. The Enttec DMX USB PRO[8] and Lanbox LCX[9] interfaces were used in this phase of the research. The Lanbox LCX interface was chosen because it is more robust and also more versatile, allowing connections in various formats: MIDI, USB or Ethernet.

Still related to communication protocols and audience interaction, whose participation in the work is achieved through the body and its movement, in SynDyn, the aim was for users to have

[4] http://en.wikipedia.org/wiki/X10_(industry_standard)

[5] DMX or DMX512 — Digital Multiplex — is a communication protocol that allows remote control of various lighting-related devices, from motorised luminaires to smoke machines. http://en.wikipedia.org/wiki/DMX512

[6] 250 kbaud = 250,000 symbols per second. For more information on baud rate, please visit: http://en.wikipedia.org/wiki/Baud and http://en.wikipedia.org/wiki/Symbol_rate

[7] 20 bps = 20 bits per second. For more information on bit rate, please visit: http://en.wikipedia.org/wiki/Bit_rate

[8] http://www.enttec.com/?main_menu=Products&pn=70304

[9] http://www.lanbox.com/lcx.php

the greatest possible freedom of movement. To achieve this, the sensor placed on the racket could not send the digitised data relating to the ball hits on the racket to the central processing unit via cable. A data transmission cable between each user and the central processing unit would greatly constrain the users' free movements and gestures, so a wireless system was chosen to ensure the transmission of data from the sensors in the rackets to the central processing unit. In the initial phase of designing the response to this challenge, the use of one of the following systems was considered: the Wi-microSystem[10] and the Eobody2 HF[11] .

Although these two systems are easy to configure, their high cost led to the decision to build a wireless communication system. The choice was made to build a radio communication system that would ensure data transmission between each participant's racket and the central processing unit. This system consists of a piezoelectric ceramic sensor, which detects the ball hitting the racket, connected to an Arduino microcontroller, which digitises the sensor data. The microcontroller is in turn connected to an XBee radio[12] that transmits the digitised data to the central processing unit, to which a radio receiver is also connected. This required studying the syntax and structure of the AT command language [13] ,which enabled the design and implementation of programmes that ensure the radio transmission of data from the sensors in the rackets.

LUMINOUS STEERING WHEEL

In order to obtain a luminous steering wheel that could be visible in a darkened environment and act as a drawing medium for long exposure photographs, a customised solution was designed, in which a light source was inserted inside the steering wheel. In the initial phase of practical research into the design of this component of the SynDyn work, fluorescent substances were considered, but it was quickly realised that the luminosity emitted by these substances would not be sufficient for the desired effect.

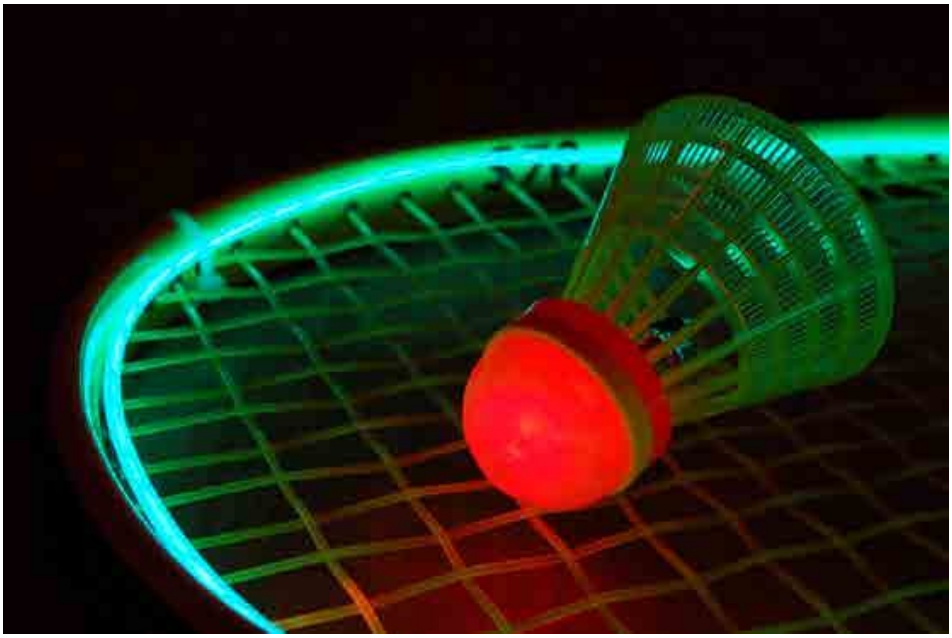


Figure 8 - Luminous steering wheel.

[10]http://infusionsystems.com/catalog/product_info.php/products_id/98
[11]http://www.eowave.com/products.php?prod=57
[12]https://www.sparkfun.com/products/11215
[13]http://en.wikibooks.org/wiki/Serial_Programming/Modems_and_AT_Commands#What_are_AT_Commands.3F

In the search for high-brightness lighting sources small enough to fit inside the shuttlecock, LEDs were found to meet the requirements for implementing the luminous shuttlecock. However, LEDs require a power source that would also have to be integrated into the shuttlecock. Thus, practical reflective research was carried out to integrate an LED and a small lithium battery into a badminton shuttlecock. The first step towards the desired result was to drill a hole in the base of the shuttlecock, exactly in its centre. This hole has a diameter that allows the LED to be inserted under pressure. The precision of this hole is essential to ensure that the LED does not come out of place with the strong impact on the racket strings, and also to keep the shuttlecock balanced and stable during flight.





Figures 9 and 10. Bending the cathode and anode to secure the battery.

The next challenge was to solve the problem of attaching the LED to a 3V lithium battery. In order not to add too much weight to the steering wheel, early experiments to solve this challenge determined that the system should be constructed using as few materials as possible. Thus, after a tacit dialogue with the LED and the battery, a hypothesis was constructed in which, through a folding process, the cathode and anode of the LED would function as a spring that secures the battery. This solution may have been inspired by the tacit knowledge of using the classic clip. In this approach, the disc-shaped battery is placed parallel to the base of the steering wheel. Given that the LED cathode is shorter than the anode, the LED is mounted orthogonally to the base of the battery, touching its negative polarity side. In this way, it was possible to bend the anode so that it would wrap around the battery to its positive polarity side. The battery is held in place under pressure between the cathode and anode of the LED. Given that the anode has to travel the distance of the battery radius, pressed against the negative polarity side, a segment of heat-shrink tubing was used to prevent contact, as shown in Figure 10.

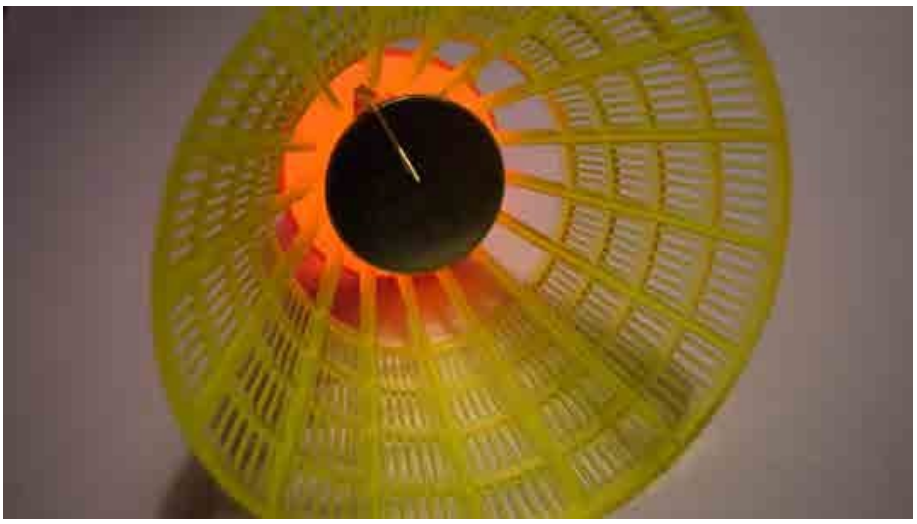


Figure 11 - First fixing system.

Although this solution added very little weight to the steering wheel, it did not have the necessary robustness to withstand all the stress caused by the strong impacts of each blow of the steering wheel on the racket, as well as

from the vibrations resulting from this action. After several tests, it was found that with this system, after about 3 to 4 minutes of intense use, the elastic stress limit[14] of the metal of which the cathode and anode are composed was exceeded and one of two situations occurred: either one of these elements broke, preventing contact between the two poles of the battery; or the cathode and anode no longer exerted sufficient pressure on both sides of the battery to maintain contact. This happens because when the stress applied to the material (of which the cathode and anode are composed) stresses it in its elastic range, it always returns to its initial state — shape — but once the elastic limit stress point is exceeded, the material is stressed in its plastic range and does not return to its initial state, i.e. it deforms or breaks.

Reflective practical research was carried out with a view to developing a system that could mitigate the tension exerted on the cathode and anode or alter the elastic limit of the material of which these elements are composed. Given the success of LED Throwies[15], it was decided to use a similar configuration for the system used to attach the LED to the battery. In this configuration, the battery is wedged between the cathode and anode of the LED, without any bending. Adhesive tape is used to secure the LED to the battery. The LED Throwies system is not robust enough to withstand the stresses caused by impacts on the rackets. Therefore, a solution was developed that transforms LED Throwies into a much more resistant system.



Figure 12 - Means of the second LED-battery fixing system.

This transformation consisted, first, of reducing the distance between the battery and the flat face of the LED, so that the cathode and anode were in contact with the battery along their entire length. Otherwise, the battery would act as a pendulum, increasing the mechanical stress on the cathode and anode. Secondly, the adhesive tape was replaced by a section of rubber sleeve that fulfils several functions: it absorbs part of the vibrations and tension, exerts pressure on the cathode and anode against the battery, acting as a fastener, and simultaneously protects the entire assembly. To ensure greater robustness of the system and because the rubber sleeve did not exert pressure on the first few millimetres of the cathode and anode, in the area near the LED head, this area was filled with a thermoelastic adhesive that performs the same functions as the rubber sleeve, acting as an extension of it. Given its efficiency and robustness, the solution described above was chosen for the SynDyn project.

[14]http://pt.wikipedia.org/wiki/Limite_elástico
[15]http://www.instructables.com/id/LED-Throwies/



Figure 13 - Second LED-battery mounting system.

The assembly process for this system comprises a sequence of three actions: the LED is inserted into the rubber sleeve under high pressure, then the cathode and anode are inserted between the rubber and the battery, and finally the thermoelastic adhesive is applied. This means that in the second action, the LED is switched on, emitting light and consuming the battery's energy. Given that it was necessary to have several flywheels ready for use during the presentations of the work, the LED-battery system had to be assembled in advance. However, the LED had to remain switched off until it was needed, which meant that a power switch was required to turn the luminous flywheel on and off. The solution was extremely simple: a piece of acetate film was placed between the cathode and the negative polarity side of the battery, interrupting the flow of electrical energy. Thus, the LED-battery system could be assembled on the steering wheel and turned on only when necessary.



Figure 14 - Illuminated steering wheel switched off.

One may question the importance of developing and describing this system in the context of a research project, but in fact, this system is central to the SynDyn work. The absence of this system would render the work unviable, as the luminous wheel is a 'scratching' material in the light drawings that result from the SynDyn work. Affirming the equality of the means in the intermediary process, it should be noted that in the context of the present research, the LED-battery system as a means, resulting from the fusion of means, was treated with the same dignity as any other means that integrates the SynDyn work. In this work, the rubber sleeve is a fundamental means in the fusion process that results in the new means — LED-battery. The rubber sleeve has a value equivalent to that of the modern computer, the algorithm it executes, or the programming language in which that algorithm is described and constructed. SynDyn depends equally on all media and their interaction in the intermedia dynamics from which it results.

HARDWARE INTEGRATION

The integration of radios and Arduino microcontrollers sparked a new series of questions in the reflective practical research developed in this project, namely, where these devices should be placed — on the racket or on the users' bodies — and how they should be mounted and protected. The answer to this dual problem essentially resulted from dialogue with the specific situation and the materials that were considered for use. Ultimately, this is a semantic design, as the material options in the context of SynDyn's production are also semantic options. Initially, it was considered to place the devices — radio and microcontroller — on the racket itself, but it was quickly understood that this hypothesis, in addition to altering the dynamics of the racket itself, would require a large investment in miniaturisation. The second option considered was to place the devices on the users' arms, but given that, as it is a racket sport, the physical activity performed in SynDyn involves intense use of the arms[16], it was decided to leave them as free as possible. To ensure the physical integrity of the players and the devices, it was decided to place them on the players' backs, secured in a hybrid harness and strap system.



Figure 15 - Simplicity of elastic band placement.

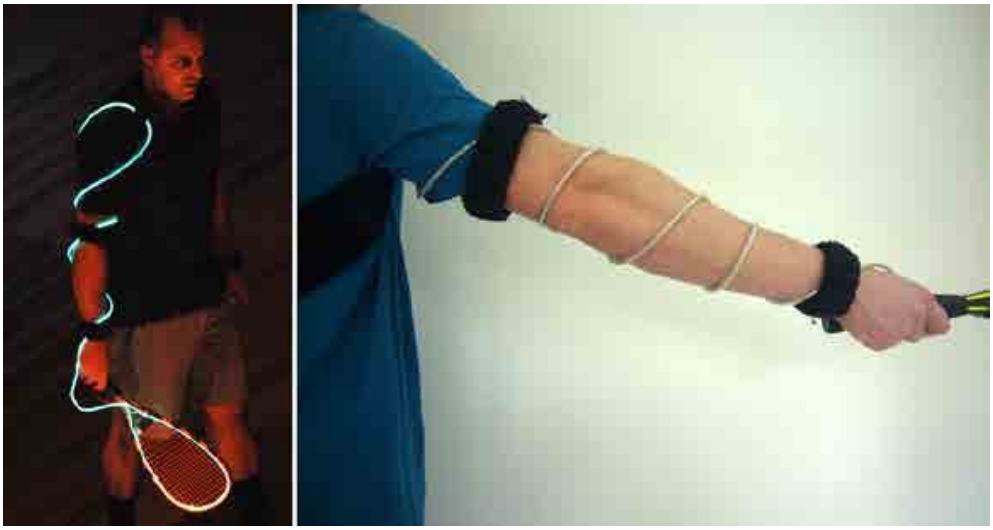


Figure 16 - Illuminated data transfer cable.

[16] Furthermore, when playing racket sports, the arm holding the racket often comes into contact with the player's chest and head during certain movements, so placing a rigid object (containing the radio and microcontroller) could injure or inhibit the players' movements.

[17] The design of this system for attaching the devices to the body was inspired by the functioning of an armpit holster.

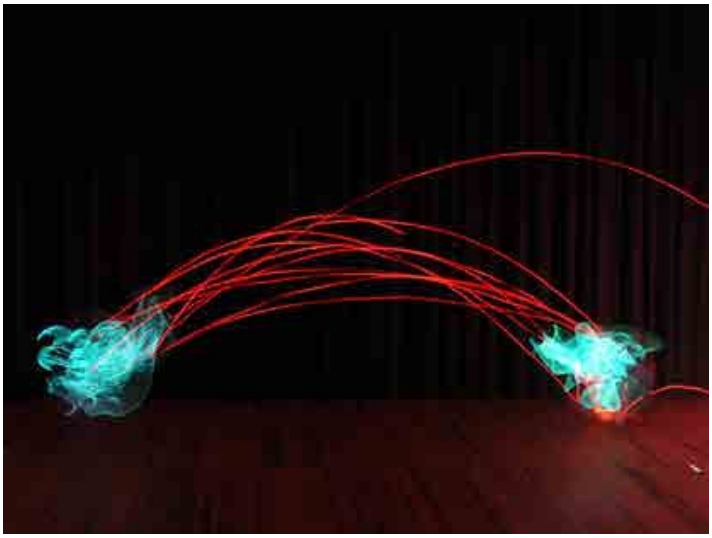


Figure 17 - Light design at the Portuguese Catholic University.

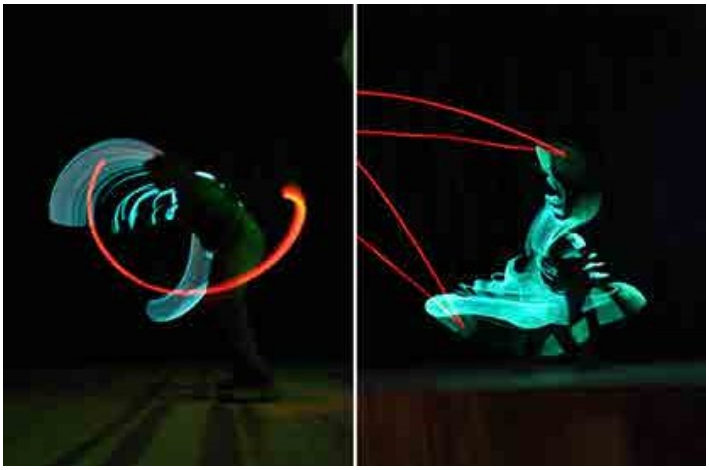


Figure 18 - Light design at the Portuguese Catholic University.

The answer to the second question posed earlier in this section — how the devices should be assembled and protected — is designed with two factors in mind: waterproofing and shock protection. Given that intense physical activity invariably causes sweating, it was necessary to house the electronic devices inside a waterproof box. At the same time, given that this box would be used close to the participants' bodies, who could suffer a fall during physical activity, the box would have to be hard enough to protect the electronic components inside and flexible enough not to break and injure users.
The reuse and subversion of means was also part of the reflective practical research that resulted in Syn-Dyn. From the flexible rubber tube, designed for medical purposes, for transporting fluids, used in SynDyn as a protective and insulating means for cables or as a means of attaching the LED to the battery, to the rackets themselves, designed for sports performance, used in this work as drawing tools, to the RJ11 plug, designed for landline telephones, several means were subverted in SynDyn, giving them a new function and utility.

RESULTS

In order to validate this work in the context of academic research, and given that the knowledge generated in this research cannot be expressed linguistically, it is stated that SynDyn, as the result of reflective practical research, as well as the audiovisual documentation on the work, are valid in themselves as a means of transmitting knowledge.

Regarding the ineffability of the work, Grady (2011) reports that SynDyn 'is one of those projects that is practically impossible to present in words' [18]. The public recognition given to this work is evident from the number of publications on websites and blogs. Poyau (2011) publishes an article dedicated to the Syn-Dyn work on the blog the creators project, where he states that 'digital and new media artists are recognised for their ability to appropriate diverse creative fields and disciplines. Most of the time, this synthesis remains hesitant, limited and within the strict boundaries of the classic encounters between art, science and technology.' Poyau also considers that SynDyn firmly breaks this monotonous cycle and explores new horizons. Underlying this criticism, one can argue the undisciplined nature of the SynDyn work. In the same text, this work is considered 'an ambitious creative experiment that aims to merge aesthetics, physical activity and leisure.'[20] 458 Poyau ends his text by emphasising the hybrid nature of SynDyn and, in a way, its ineffability and unclassifiability:

Is it a sport? Is it a game? Is it art? Frankly, we are not sure, nor are we certain that it still matters. The traditional barriers of distinction are continually being subverted by artists to the point of obsolescence, and this hybrid project is just one example of an interactive environment that positions artistic creation as an integral and inevitable component of the experience. And we are advocates of that. [21] (Poyau, 2011)

A few months later, the same author mentions that SynDyn may even have inspired IR-CAM[22] to develop a similar performance applied to basketball[23] . Modug-no (2011) publishes documentation about the work on his blog with the following description:

Alternatively, there are those who try to change the rules, to insert something innovative into a game as old as the world itself, something capable of leaving us speechless, of opening our minds, of making us feel envious, because we would have liked to have done it ourselves, but did not for reasons beyond our control. (Modugno, 2011) [24]

The documentation on the work was disseminated by different blogs and web pages with varying themes. from architecture to art, design, video games, technology, among others. This dissemination of documentation about the work has allowed the video report[25] on SynDyn to be viewed more than 14,600 times to date. The work's participation in the FILE Festival, which attracted more than 40,000 visitors, where 22,000 magazines and 1,000 catalogues were distributed, has certainly allowed the idea of the work, or information about it, to be disseminated to an unknown number of people. Another reference to the work, of great importance in the international context, is the inclusion of a hyperlink to the documentation on the work in the list of references on art, science and technology in Leonardo magazine, more specifically in the section on synesthesia[26].

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[18]Author's translation from the original: *'This is one of those projects that is almost impossible to put into words*'. (Grady, 2013)

[19]http://thecreatorsproject.vice.com/blog/can-sports-and-art-finally-come-together-in-this-interactive-installation

[20]Translation by the author from the original: *'[...]is an ambitious creative experience that aims at merging aesthetics, physical activity and leisure.'* (Poyau, 2013)

[21]Author's translation from the original: *'Is it sport? Is it a game? Is it art? Frankly, we're not sure and we're also not sure it really matters anymore. The traditional barriers of distinction are continuously being subverted by artists to the point of obsolescence, and this hybrid project is just one example of an interactive environment that positions artistic creation as an integral and unavoidable component of the experience. And we're all for that.'* (Poyau, 2011)

[22]http://www.ircam.fr/

[23] *'Some time ago, we told you about SYNDYN, a project combining digital art, sport and leisure. (...) A work/game that seems to have inspired IRCAM, a research centre for contemporary music, institutional and highly theoretical, which has created a similar performance*.' (Poyau, 2011b)

[24] Author's translation from the original: *'There are those who try to change the rules, to insert something innovative into a game as old as the world itself, something capable of leaving us speechless and opening our minds, making us feel a twinge of envy because we would have liked to have done it ourselves but, for reasons beyond our control, we did not*.' (Modugno, 2011)

[25]Video report available at: http://vimeo.com/20859799

[26]http://www.leonardo.info/isast/spec.projects/synesthesiabib.html

CONCLUSION

SynDyn presents itself as a concept of urban aesthetics oriented towards the outside of conventional artistic circuits and theoretical artistic discourses. It is a work that takes place outside the spaces of the museum, gallery or studio, which exists in the relationship established with the places where it is presented, promoting an aesthetic approach to those same places. This work, to paraphrase Hawkins (2012), relates to geography; it is an artistic practice based on sites and integrated into their social contexts. In this work, the social site, including its community, is the subject, material and audience of the work itself. SynDyn is a space for sensory exploration, in which the presence of the body and its senses are indispensable to understanding the artistic experience, which, not limited to an intellectual act, is apprehended 'by the complex perception of the body as a whole' (Hawkins, 2010). As a space of distributed agency, this intermedia work can easily be identified as what McCormak (2008) considers a place for thinking about the relationships between bodies, concepts and materials of various kinds, affirming the equality of means. Bodies, concepts and any material are means in the context of art and intermedia design. Thus, in the context of the reflective practical research developed in this work, McCormak's identification is updated, considering SynDyn only as a place to think about the relationship between means. SynDyn therefore aims to reaffirm and promote a condition of equality of means in the process of creating hybrid works that should not be constrained by conventional and recognised genres such as painting, sculpture, sound art, visual art, digital art, video art, music, architecture, the various genres of design, interactive art, animation, among others.

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