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DESCOBRINDO O MUNDO DA ARBORIZAÇÃO: Aplicando o Inventário de arborização do Parque Bosque Maia

DISCOVERING THE WORLD OF ARBORIZATION: An application experience in the afforestation inventory of Bosque Maia Park

DESCUBRIENDO EL MUNDO DE LA ARBORIZACIÓN: una experiencia aplicada en el inventario de arborización del Parque Bosque Maia

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Resumo: O presente trabalho consiste na aplicação de investigação e sistematização de informações sobre arborização na região da Grande São Paulo, com suporte do Design da Informação. O projeto tem como objetivo criar um modelo de interface físico-digital para sistematizar a identificação de espécies arbóreas, a fim de facilitar sua identificação, localização, planejamento e manejo. O Parque Bosque Maia, localizado no município de Guarulhos, será utilizado como estudo de caso e ponto de partida para a propagação dessa sistematização. Os procedimentos metodológicos incluem a transformação de um projeto de Iniciação Ci-

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entífica — no qual foram desenvolvidos protótipos de placas de identificação de árvores feitas a partir de madeira de poda — em um Projeto de Extensão, além da realização de uma visita técnica ao Parque Bosque Maia e à Serraria Ecológica de Guarulhos, local que fornecerá a madeira de poda necessária para a produção das placas.No projeto inicial, as placas contêm um código QR para escaneamento, que fornece informações específicas sobre os indivíduos arbóreos. O resultado final esperado propõe uma modificação do modelo inicial por meio da adição de placas de identificação em braille, tornando a experiência de aprendizado sobre espécies arbóreas mais inclusiva. Espera-se que a sistematização proposta contribua para promover o manejo local das árvores por meio de inventários arbóreos em ambientes urbanos.

Palavras-chave: Identificação de Especies; Parque Bosque Maia; Design Inclusivo

Abstract: The current work consists of applying investigation and systematization of information about afforestation in Greater São Paulo, supported by Information Design. The project aims to create a physical-digital interface model to systematize the identification of tree species, in order to facilitate their identification, location, planning, and management. The Bosque Maia Park, located in the municipality of Guarulhos, will be used as a case study and starting point to propagate this systematization. The methodological procedures include transforming a Scientific Initiation project—where prototypes of tree identification plaques made of pruned wood were created—into an Extension Project; as well as a technical visit to the Bosque Maia Park and the Ecological Sawmill of Guarulhos, the location that will supply the necessary pruned wood for the production of the plaques. In the initial project, the plaques contain a QR code for scanning, which provides specific information about the tree individuals. The expected final result proposes a modification to the initial model by adding braille identification plaques, making the experience of learning about tree species more inclusive. It is hoped that the proposed systematization will help promote local tree management through tree inventories in urban environments.

Keywords: Species-identification; Bosque-Maia-Park; Inclusive-design.

Resumen: El presente trabajo consiste en la aplicación de la investigación y sistematización de información sobre la arborización en la región de la Gran São Paulo, con el apoyo del Diseño de la Información. El proyecto tiene como objetivo crear un modelo de interfaz físico-digital para sistematizar la identificación

Contribuição dos autores segundo a Taxonomia CRediT

Autora 1: Fernanda Gomes Faust, FGF Autora 2: Beatriz Damilakos Kadayan, BDK FGF: project administration; supervision; methodology; writing – original draft; writing - review; editing ; conceptualization and supervision. BDK: investigation; visualization; resources; writing – original draft.

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de especies arbóreas, con el fin de facilitar su identificación, localización, planificación y manejo. El Parque Bosque Maia, ubicado en el municipio de Guarulhos, será utilizado como estudio de caso y punto de partida para la propagación de esta sistematización.Los procedimientos metodológicos incluyen la transformación de un proyecto de Iniciación Científica —en el cual se desarrollaron prototipos de placas de identificación de árboles elaboradas a partir de madera de poda— en un Proyecto de Extensión, así como la realización de una visita técnica al Parque Bosque Maia y al Aserradero Ecológico de Guarulhos, lugar que suministrará la madera de poda necesaria para la producción de las placas. En el proyecto inicial, las placas contienen un código QR para su escaneo, el cual proporciona información específica sobre los individuos arbóreos. El resultado final esperado propone una modificación del modelo inicial mediante la incorporación de placas de identificación en braille, haciendo que la experiencia de aprendizaje sobre las especies arbóreas sea más inclusiva. Se espera que la sistematización propuesta contribuya a promover la gestión local del arbolado mediante inventarios arbóreos en entornos urbanos.

Palabras clave: Identificación de especies; Parque Bosque Maia; Diseño inclusivo.

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1 INTRODUÇÃO

As urban spaces grow rapidly and often without proper planning, the demand for the preservation of green areas becomes increasingly important. The presence of trees is essential in cities, as such spaces contribute to improving the population's quality of life — being associated with well-being, public health benefits, reduction of violence and aggressive behaviors, due to the calming quality of the color green and the presence of vegetation in public spaces (KUO, SULLIVAN, 2001; LEWIS, 1995). Likewise, they ensure the environmental quality of these areas by reducing air and noise pollution, intercepting rainwater, providing shade, and stabilizing temperatures, among other advantages (NUCCI, 2008; KAPLAN, 1995; MCPHERSON, 1997). Additionally, they promote spaces for rest, contemplation, and social interaction (Chang, Tsou, Li, 2020). Therefore, given the need for constant monitoring to maximize the benefits of urban afforestation, the forest inventory emerges — the process of collecting and researching data on the number of trees in an area, along with their characteristics and conditions (PODA LAB/FAUUSP, 2022). Such results can serve as a basis for the planning or re-planning of green areas, as well as for defining appropriate management practices.

Linked to the main issue of the need to care for green areas in public spaces, secondary concerns arise from the initial question: the necessity of raising sensitivity about this matter, as well as disseminating biological knowledge about different species. In this way, it becomes possible to connect academic thinking — typically confined to theoretical frameworks — with practical, everyday urban experience. That said, the extension project serves as a means to bridge this gap, considering the considerable number of unidentified and unregistered trees in cities such as Guarulhos. By contributing to the management of urban tree specimens, this undergraduate research project is generally aligned with Goals 11.3 and 11.6 of the Sustainable Development Goal (SDG) 11 – Sustainable Cities and Communities (UN, 2022), which encompasses the management of natural heritage and the promotion of inclusive and sustainable urbanization. These targets propose, by 2030, to "enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries" and to "reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management", respectively.

Thus, in partnership with PodaLab, an institutional project of the Faculty of Architecture and Urbanism of the University of São Paulo, originating from the USP Municipalities Program – USP Challenge: Sustainable Cities (Call 2021-1), and with the Municipality of Guarulhos, more specifically its Department of the Environment, the current extension project aims to promote the sustainable use of pruning wood for the creation of tree species identification plaques. These plaques feature a physical-digital interface, as they contain a QR code that, when scanned, reveals biological information about the tree species in question. In addition, the plaques made from pruning wood also include Braille plates, 3D-printed in PLA, a polymer developed from biodegradable materials derived from corn starch.

The Bosque Maia Park, the main green space in Guarulhos and a central gathering point for the local population, was chosen as the case study and implementation site for the proposal. Throughout the research,

several stages were developed, including: a literature review on urban forestry and botanical cataloging; study of species catalogs and definition of information sheet templates; laser engraving tests; development of tactile plaque prototypes using 3D printers; identification and georeferencing of species within the park; as well as technical visits to both the Park and the Guarulhos Ecological Sawmill, which is responsible for supplying the pruning wood used in the project.

The process resulted not only in the production of catalog cards and identification plaques, but also in their actual installation at Bosque Maia Park. These were inaugurated on World Environment Day 2025, in collaboration with the PodaLab FAUUSP team, staff from the Guarulhos Department of the Environment, and the local community. The experience was consolidated as a replicable model for systematizing urban forestry, integrating management, environmental education, and inclusion. In parallel, the results achieved were presented at ENSUS 2025 – 13th Meeting on Sustainability in Design.

2 METHODOLOGICAL PROCEDURES

The design of the research methodology begins with a deeper understanding of the uses and management of pruning wood. Accordingly, the material developed by the PodaLab team was used as a foundation for this understanding, as it covers technical aspects, species identification, and the definition of the urban forestry inventory, as well as pruning, removal, selection, drying, and treatment of urban trees.

Familiarization with the processes involved in urban tree pruning was followed by the study of tree species identification plaques. Through research, it was possible to locate a square near the University of São Paulo — allowing for multiple visits and on-site observations — that featured an applied plaque model: Província de Saitama Square. In this location, the plaques are made of plastic, covered with acetate sheets and supported by a metal structure, fixed directly into the ground. Scanning the QR code opens, directly on the phone's camera screen, a text containing technical information about the species, followed by: "Blog da Praça Província de Saitama – http://pracasaitama.wordpress.com." For example, in the case of the species below, the corresponding text reads: "Its flowering usually marks the first blooming ipê of the year, between May and July. The pods mature between July and September. It begins to flower at around 15 years of age and can reach up to 16 meters in height. Blog da Praça Província de Saitama – http://pracasaitama.wordpress.com." (Figura 1)

Another model found — this time applied on a larger scale — was the one implemented in the Municipal Urban Forestry Plan of the City of São José dos Campos (Figura 2). In this case, the plaques are made of aluminum and nailed directly onto the trees, which raised questions regarding the most suitable attachment method for this research. Previously, the city administration used wires tied around the tree trunks: "The nail is much better. The wire can end up strangling the tree as it grows and killing the specimen. The nail, however, does not pose that risk. Water rises through the inside of the stem, reaches the leaves, and enables photosynthesis. Nutrients then move down to the roots between the bark and the stem. If strangled at this point, the tree dies. With the nail, this hardly happens. It's much better than the wire or aluminum ring," explains

Figura 1 – Identification plaque of the Ipê-branco (White Ipê), located at Província de Saitama Square.

Fonte: photograph taken by the authors.

Ciro Croce, a forestry engineer and PhD in Forest Science from the Department of Natural Resources at the São Paulo State University (UNESP, 2011), in an interview with the regional news portal of São José dos Campos – SP, available at: <https://informa.life/pregos-usados-para-fixar-placas-de-qr-code-nas-arvores-nao-danificam-caules/>.

Figura 2 – Aluminum tree species identification plaque, nailed to a tree in the municipality of São José dos Campos – SP.

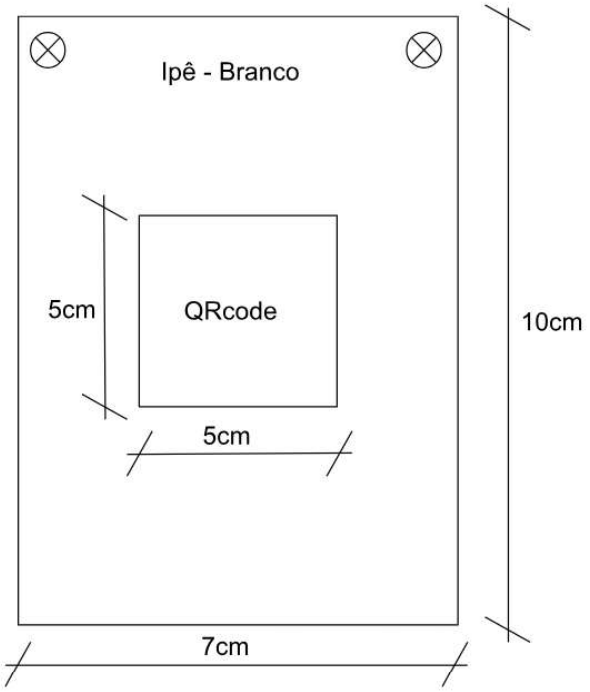
Fonte: LIFE INFORMA

Considering the references researched and the premise of using pruning wood as raw material for the production of identification plaques — as stated in the application document for the Unified Scholarship Program of the University of São Paulo (PUB USP), "DISCOVERING THE WORLD OF URBAN FORESTRY: Applying the Urban Forestry Inventory of the Transguarulhense Linear Park as a Physical-Digital Interface Design Practice" — this project chose to use the research project "Physical-Digital Interface Design: Contribution to the Urban Forestry Inventory of the Armando Sales de Oliveira Campus, USP" as its basis. This research aligns with the current proposal, as it not only utilizes pruning wood for plaque production but it is also situated within the University of São Paulo itself. This proximity facilitates both laser printing tests - due to the closeness to the facility where the plaques were conceived, the Technical Section for Models, Tests, and Construction Experiments "José Zanine Caldas"– STEMEEC / LAME FAUUSP — and the application of the

plaques in the field.

Based on the tree identification plaque models researched, such as the one used by the Department of the Environment of São José dos Campos, a draft was developed. This draft served as a template for modifications and annotations, and as a basis for a meeting with the author of the research project "Physical-Digital Interface Design: Contribution to the Urban Forestry Inventory of the Armando Sales de Oliveira Campus, USP," Rodrigo Passos Vasconcelos, an undergraduate Design student at FAUUSP.

Figura 3 – Draft of a tree species identification plaque based on researched models.



Fonte: drawing created by the authors

From the decision to transform Rodrigo Passos Vasconcelos's Scientific Initiation project into an extension project, some parameters were maintained for the production of the identification plates, such as: the use of pruning wood as the raw material for the fabrication of the tree species identification plates; the use of Autodesk AutoCAD software for the plate layout (Figura 3) ; the choice of a 6 cm x 6 cm QR code, with a slicing interval (scangap) of 0.5 mm, as the best result obtained according to the tests carried out in the Scientific Initiation project; and the varnishing method of the plates — according to the results obtained through laser marking tests conducted by Rodrigo, the most effective way to varnish the plate without compromising QR code readability (Figura 4). Therefore, the best way to ensure the permanence of the soot generated by the laser's burning of the wood is the double application of varnish before laser marking and a single coat afterward . In this case, Sparlack® Extra Marítimo Exterior/Interior Colorless Satin Finish Varnish was used. Additionally, the UTM Geo Map software was used for species geolocation — an Android application capable of performing mapping tasks such as coordinate identification, map generation, GPS, GIS, and spatial analysis. The collected information was exported in XML format to be added to a map created using the Google My

Maps tool.

Figura 4 – Prototype and Finished tree species identification plates made from pruning wood.

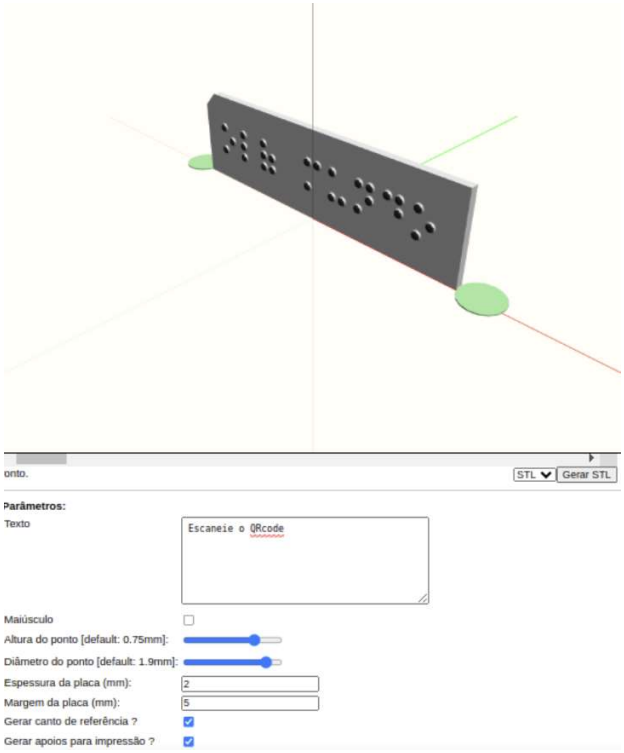
Fonte: Rodrigo Vasconcelos and authors.

While the extension project maintained the same approach of placing the identification plates on the ground as in the original Scientific Initiation project, the purpose behind this choice took on a new meaning, marking a key advancement in the extension phase. In this stage, the decision to position the plates at ground level was guided by the goal of enhancing accessibility for individuals with visual impairments, who are more likely to locate the plates through tactile exploration with a cane. This design choice is particularly relevant considering the main innovation introduced in comparison to the initial prototype — the addition of tactile Braille signage plates, 3D-printed in PLA.

In line with the principles of inclusive design, Braille plate prototypes were created (Figura 5) using Text2Braille3D, a 3D Braille plate model generator developed by the Accessibility Technology Center (CTA) of the Federal Institute of Rio Grande do Sul. The tool operates online, allowing users to input parameters such as text content, dot height and diameter — both constrained by the accessibility standards established in NBR 9050 — as well as plate thickness and margins. The phrase “Scan the QR code” was selected for the plates due to its ease of replication because of the text consistency, in addition to align with the minimal dimensions required for Braille signage within the scope of this research. After the online modeling process, the tool generates an STL file, which is then made available for download. STL is a file format commonly used for 3D printing and computer-aided design (CAD). As Adobe explains, “The name STL is an acronym for stereolithography, a popular 3D printing technology. It may also stand for ‘Standard Triangle Language’ or ‘Standard Tessellation Language.’” The 3D printer reads the STL file, ultimately producing the physical Braille plates.

In addition to the inclusion of Braille plates, the extension project introduced several other modifications compared to the Scientific Initiation project on which it was based. Beyond the change of location—from FAUUSP to Bosque Maia Park, in the municipality of Guarulhos—the collaboration with the Serraria Ecológica de Guarulhos (Guarulhos Ecological Sawmill) (Figura 6), for the fabrication of the tree species identification plates enabled production on a larger scale, thereby ensuring the project’s long-term continuity and implementation. The sawmill receives logs and wood residues from urban pruning activities throughout the municipality, processing them into finished wood products such as boards, planks, and urban furniture, which are distribu-

Figura 5 – Demonstration of 3D Braille plate modeling using the Text2Braille3D tool.



Fonte: the authors.

ted to the City Hall. The wood is fully utilized, as branches and leaf fragments are also shredded to produce compost used in the city's parks and public squares. Located beneath the Cidade de Guarulhos Viaduct, the sawmill occupies an area of approximately 16,200 m². A visit to the site, conducted on January 8, 2025, was crucial in establishing the feasibility of producing the plates, an opportunity that emerged through conversations and exchanges with the sawmill's staff and partners. The team proposed cutting the pruning wood into boards with the specified dimensions of 15 cm × 15 cm × 1 cm. Additionally, the researchers were kindly gifted handcrafted wooden boards produced by the sawmill's workers.

Figura 6 – Guarulhos Ecological Sawmill.

Fonte: the authors

Another key difference from the initial research concerns the identification of tree species. While spe-

cies confirmation—initially based on identification using Daniel Saueressig's Dendrology Manual (Saueressig, Daniel, 2017) and Paulo Ernani Ramalho Carvalho's Brazilian Tree Species (Carvalho, Paulo Ernani Ramalho, 2014)—was conducted by faculty members of the PodaLab team, in the extension project this task will be carried out by a biologist from the Guarulhos Municipal Environmental Department, using the list of the most common tree species in the municipality as a reference. Additionally, it was decided that the entire plate, including the supports in contact with the ground, would be made entirely from pruning wood.

Following the visit to Bosque Maia, the most suitable location for the initial implementation of the tree species identification plates was identified: the children's playground area (Figura 7). This choice was guided by the assumption of children's intrinsic curiosity and the need to continually stimulate their inquisitive nature. In a setting where plates are placed near the playground, parents—or even the children themselves, depending on their age—can scan the QR codes to access information about the species. This approach not only introduces a playful element, encouraging children to explore and discover surrounding species as if in a game, but it also has the potential to foster lasting habits. By engaging with the environment in this way, children may develop into adults who are more environmentally conscious and attentive to urban green spaces. The playground area covers approximately 210 meters in perimeter and 2,120 m² in total area.

Figura 7 – Children's playground area, Bosque Maia Park.

Fonte: the authors.

As a fundamental component of the final product of this research—the tree species identification plates for Bosque Maia Park—the project also includes the development of catalog cards for each species. These cards serve as the destination for users who scan the QR codes and encompass the full set of species documented on the PodaLab FAUUSP team's website. The catalog cards provide detailed information for each tree, including origin, height, DBH (Diameter at Breast Height, measured at 1.30 m above ground), application, wood characteristics, and recommended uses. DBH is a standard measurement used in forest inventories to calculate volume and assess individual tree growth. This information was gathered from bibliographic sources such as Harri Lorenzi and Daniel Saueressig. In addition to defining the structure of the catalog cards, the content produced by the team was crucial for deepening the understanding of the uses and management of pruning wood, the material designated for the fabrication of the identification plates.

Prior to the development of the catalog cards (Figura 8), an investigation into the native vegetation of Guarulhos was undertaken to expand understanding of the city's landscape composition and to guide the selection of the broad range of species for the tree identification plates. According to Sesc Guarulhos (2019),

Figura 8 – Catalog card of Pau-Mulato.

Fonte: the authors.

"among the mapped flora species in the region are capororoca (Myrsine umbellata), caxeta (Psychotria vellosiana), jacarandá-bico-de-pato (Machaerium nyctitans), peroba-vermelha (Aspidosperma olivaceum), angico-rajado (Leucochloron incuriale)—with individuals preserved on the Sesc Guarulhos site—canjarana (Cabralea canjerana), café-do-mato (Amaioua intermedia), guaçatonga (Casearia sylvestris), copaíba (Copaifera langsdorfii), tapiá (Alchornea triplinervia), jerivá (Syagrus romanzoffiana), jacarandá-paulista (Machaerium villosum), canela-cheirosa (Ocotea odorifera), and palmeira-juçara (Euterpe edulis)". Using the illustrated guide of tree species in Guarulhos presented in the book Veredas Urbanas, it was possible to gain a deeper understanding of the region's flora, including species found in the children's playground area of Bosque Maia, such as Cerejeira-do-rio-grande, Eucalyptus, Grumixama, and Jacarandá Mimoso.

Not all the images required for the complete assembly of the catalog cards—trunk, leaves, fruits, flowers, and a full-view photograph of the tree—were available in the reference bibliographies used. Therefore, it was necessary to capture original photographs directly at Bosque Maia during one of the park visits, with the support of equipment provided by the Technical Audiovisual Section of the Faculty of Architecture, Urbanism, and Design at USP (FAU-USP) – FotoVideoFAU. The original photographs included in the catalog cards on the PodaLab FAUUSP website feature the leaves and trunk of Palmeira Cica (Cycas revoluta); the leaves of Pau Mulato (Calycophyllum spruceanum), Goiabeira (Psidium guajava), Pata-de-Vaca (Bauhinia forficata) and Cerejeira-do-Rio-Grande (Eugenia involucrata); and the leaves of Jerivá (Syagrus romanzoffiana).

3 APPLICATIONS, RESULTS ANALYSIS AND DISCUSSION

The challenges encountered in the project included the production of the Braille plates, the selection of an appropriate method for waterproofing the pruning wood plates, and the placement of the plates in compliance with NBR 9050 standards. One of the main outcomes of the research was the creation of the first 3D-printed Braille plate prototypes using PLA filaments, in addition to the design of the tree species identification plates in

Autodesk AutoCAD, the development of catalog cards for each tree species, and the mapping of these species in the selected area. Finally, the project produced physical-digital interface plates made from pruning wood. The Scientific Initiation project "Design of Physical-Digital Interfaces: Contribution to the Arborization Inventory of the Armando Sales de Oliveira Campus, USP" served as the primary foundation for the extension project, as the current plate design was developed based on the initial wooden plate prototype (Figura 9). Moreover, this document attests to the expertise in producing the prototype.

Figura 9 – Layout of the tree species identification plate, created using Autodesk AutoCAD.

Fonte: the authors.

The Braille plates are still in the testing phase, as the team is seeking the most suitable material—potentially ABS, a 3D printer filament derived from petroleum—due to small defects in the dots that hinder readability for visually impaired users. From the first prototype to the second, printing quality was improved by reducing the scan gap from 0.2 mm to 0.05 mm and increasing the number of layers from 13 to 30, which consequently extended the printing time from 34 to 50 minutes. The plate thickness was also reduced from 2 mm to 1 mm. The prototypes, produced on the STEMEEC / LAME FAUUSP 3D printers, are presented below. These challenges highlight the need for testing the Braille plates with visually impaired users to ensure their effectiveness for reading.

Due to the extended printing time and limited availability of 3D printers, subsequent models were produced at Hubic (Hub for Innovation and Digital Construction) (Figura 10), a Technical Cooperation Agreement between USP and ABCP aimed at developing cooperative innovation environments specialized in promoting innovative digital construction solutions. These solutions focus particularly on the cement value chain, aiming to be competitive for developing countries while maintaining a low environmental footprint, high productivity and quality, and fostering practices that prepare the sector and society for a transition to a digital and circular economy. Before fully transitioning to the Hubic facilities, a final test was conducted on a prototype printed

with the Braille plate fixed in a perpendicular orientation. Small round supports were also 3D-printed for the plate, one at each end, as illustrated in Figure 7, to ensure proper execution and stability.

Figura 10 – Braille plate printing tests, in order of production.

Fonte: the authors.

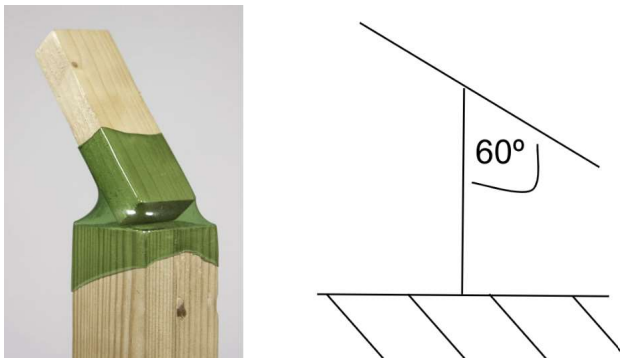
An important piece of information to be included in the QR code is the canopy size of the trees. The canopy not only provides shade but also establishes a spatial, physical, volumetric, and visual relationship with surrounding trees. It is therefore essential for urban planning to consider canopy dimensions. Proper attention to this aspect helps prevent unnecessary pruning and promotes the optimal growth of each species, as individuals that are spaced appropriately do not compete for resources such as sunlight, nutrients, and soil moisture (Filho, 2002).

The decision to design the identification plates entirely from wood necessitates waterproofing, particularly for the areas in direct contact with the ground. While the waterproofing method has not yet been finalized, several approaches are being tested based on suggestions from the staff at the Guarulhos Ecological Sawmill. One option involves using PU thinner to dissolve styrofoam, creating a mixture that is applied to the wood and allowed to cure for three days before use. Other possibilities include pitch or epoxy resin, both of which act as waterproofing agents. Finally, a practical solution involves using a PET bottle mold with the aid of a torch beneath the plate supports, preventing the wood from coming into direct contact with the soil.

The concept of angle positioning for the plates was refined to ensure accessibility for wheelchair users. In accordance with NBR 9050, the plate should be positioned at a 30° angle relative to the reader's horizontal line of sight, which corresponds to a 60° angle relative to the plate's support (Figura 11).

The plates were inaugurated during World Environment Day 2025, an event featuring activities focused on ecology and sustainability at the study park, in collaboration with the PodaLab FAUUSP team, staff from the Guarulhos Municipal Environmental Department, and the local community. The inauguration was successful, with active participation from park users—including children—in the installation of the plates (Figura 12). The stakes, also produced by the Guarulhos Sawmill, measured approximately 130 cm. This length met the 110 cm

Figura 11 – PET bottle molded in wood and Plate inclination by NBR 9050.



Fonte: the authors

maximum reading height for wheelchair users as required by NBR 9050, with an additional 30 cm of depth for soil insertion.

Figura 12 – Inauguration of the tree species identification plates at Bosque Maia Park.

Fonte: the authors.

4 CONCLUSION OR FINAL CONSIDERATIONS

The study reinforces the importance of urban tree coverage and the need for efficient systems for its identification, monitoring, and management. The implementation of the arboricultural inventory at Bosque Maia Park through physical-digital identification plates proved to be a feasible and innovative solution, combining inclusive design with sustainability. Alongside the development of an optimal model for tree species identification plates, the use of pruning wood as the primary material demonstrates an ecological and replicable approach, offering potential applications in future urban projects.

One of the main contributions of this work is the incorporation of Braille plates, ensuring accessibility for individuals with visual impairments. This feature highlights the importance of inclusive design in public spaces and expands the project's social impact. Furthermore, placing the plates in strategic locations, such as the children's playground, stimulates interest among diverse audiences, encourages learning about biodiversity, and fosters environmental awareness from an early age. Aligned with the Sustainable Development Goals (SDGs), the project reaffirms the significance of inclusive design and the use of technology to enhance the public's interaction with urban green spaces, while also contributing to the existing body of knowledge on urban tree inventories.

The main outputs of this research include the development of a functional physical-digital plate model, a georeferenced database of tree species at Parque Bosque Maia, and guidelines for future expansion of the project to other urban spaces. In this way, the study paves the way for further investigations, suggesting exploration into public space and environmental awareness, tree species identification, and the integration of physical and digital environments.

The project's continuation has the potential to strengthen public policies for environmental preservation and contribute to making cities more sustainable and accessible. Therefore, the impacts of the extension project are not only social but also ecological in nature.

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