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Article

# Digitization and Virtualization of Wood Products for Its Commercial Use

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**Abstract:** Augmented reality (AR) offers several advantages in the commercialization of wood products, increasing both the efficiency and the attractiveness of the process of presenting and selling them. The digitization and virtualization of wood features/products for the purpose of their economic valorization represent a significant advance in technology and its application in traditional industries such as wood processing and trade. We present a concrete process of digitization and virtualization of wood features through AR for the purpose of its commercial valorization. Three methods of object scanning are tested: convergent photogrammetry, LiDAR scanning using an iPhone, and handheld scanners. Wood samples with different textures, shapes, and surface properties were used for the research, while each method was tested on a trio of models. The methods showed specific limitations: convergent photogrammetry is time-consuming and prone to human error, LiDAR iPhone scanning provides lower output quality and struggles with reflective surfaces, while handheld scanners are expensive and require additional tools for capturing color. Convergent photogrammetry was evaluated as the optimal and available method for the widest range of users. The 3D models were integrated into the Virtual Wood Market application, created in the Unreal Engine environment. The use of augmented reality in wood product commercialization offers significant benefits, including enhanced material efficiency, improved design and fabrication processes, better supply chain management, and increased customer engagement. These advantages can lead to more sustainable practices and higher customer satisfaction, ultimately driving the success of wood product commercialization.

**Keywords:** augmented reality; visualization; wood; object scanning; 3D modeling; mobile application; wood products promotion; sale

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## 1. Introduction

The forest-based industry advocates its main material—wood as a substitute for non-renewable materials—through a vocal environmental agenda, which has the effect of simultaneously focusing policies on low-carbon production and consumption, as well as the possibility to recycle the material. However, it is clear that a material's renewability and its ability to sequester carbon are only two of a number of factors that play a role in individuals' purchasing decisions. Moreover, research has long shown that among psychological factors, environmental ones are considered but are not among the elementary ones for significant groups of consumers for various reasons. Outside solvent consumer markets, green products are perceived as expensive, and consumers lack clear information [1]. Studies also point to an intention–behavior gap, where even if consumers are interested in green products, they do not buy them [2,3] and/or are sensitive to other factors [4]. Further, greenwashing plays a significant role in attitudes towards the environmental attributes of products. According to a study by Janz et al. [5], greenwashing claims exacerbate consumer disappointment resulting from a failure to meet expected beliefs about product sustainability and quality. In addition to brand damage, this also damages the perception of green innovations. Similarly, the risk of not meeting needs with green products is highlighted by Jin et al. [6]. Innovative sales techniques can also support the development of the market for wood-based products and other bio-based materials.

Digitalization is naturally adopted, especially in the e-commerce environment, but it also innovates sales techniques in brick-and-mortar stores. Retail has acquired new tools to make products more attractive to customers. Three-dimensional product display models bring new possibilities for product presentation and visualization [7–9], and their effective use allows one to gain a competitive advantage [10].

Augmented reality (AR), which allows us to imagine products in their real context, is a trending tool in consumer marketing because it improves the customer experience [11,12], increases engagement (towards the brand), and can lead to higher satisfaction [10,13,14]. It also provides entertainment through interactive game elements [15–17].

Virtual tour options compensate for the lack of interaction with the product, which can be a challenge for online retailers, and ultimately help reduce the number of returns from customers [18,19]. Virtual interaction also reduces uncertainty and increases the perceived value of products [20]. User-friendly, intuitive control of virtual objects is essential for achieving an optimal 3D visualization experience in augmented reality [21]. Hilken et al. [22] report that AR stimulates purchase intentions more effectively than virtual reality (VR), and when appropriately deployed with AR, it can improve both purchase intentions and brand attitudes.

AR in marketing faces certain challenges in its implementation, including technical limitations (creating and making AR content available on different platforms and devices), the cost of developing and maintaining AR applications, consumer-facing challenges, and logistical and organizational barriers [14,20,23].

Thus, from the perspective of the contribution of AR in consumer marketing, the development of more sophisticated AR technologies and better integration with other marketing tools appear to be the decisive factors [13,24].

Object scanning capabilities differ in several key aspects. A crucial factor that differentiates them is cost, which often depends on the accuracy and ability of the technology to handle large objects. Expensive professional scanning systems are often used in industrial or scientific applications where the highest accuracy and reliability are emphasized [25]. Technological advances are generating alternative object scanning options, more accessible to ordinary consumers or smaller businesses, that offer reasonable accuracy and functionality at a significantly lower cost [26]. In addition to price, an important factor of scanning technologies is the difficulty to operate them. Some require specialized knowledge and experience to use them. This may involve training to use the software, setting parametric values, or properly positioning and calibrating the equipment [27]. Another difference between object scanning options is their ability to work with large or small objects [28]. Some scanning systems are optimized for large scales, such as buildings, machines, or entire cities, while others are designed for detailed scanning of smaller objects such as artwork, jewelry, or machine parts [29]. Rapid developments are democratizing the approach to object scanning and bringing new solutions in fields ranging from creative design to industrial manufacturing processes [30].

Scanning unique wood samples opens up new possibilities for accurate reproduction of their shapes and structures. Each piece of wood can have unique shape characteristics, coloration, and aesthetics, which directly affect its value. Scanning them thus seems ideal, as it allows customers to accurately perceive the shape and texture of a given piece of wood [31].

In this article we present an application (and the possibilities of extending its functionalities) designed as a supporting tool for the management of marketing communication for manufacturers and sellers of wood products. At the same time, we discuss the possibilities of wider implementation of digitalization and virtualization capabilities in the wood-based sector.

## 2. Materials and Methods

The digitization and virtualization of timber traits for the purpose of their economic valorization represent a significant advance in technology and its application in traditional industries such as timber processing and trade.

Three main object scanning methods were tested, namely, convergent photogrammetry, LiDAR scanning using an iPhone, and handheld scanners (laser and structure light scanners). Each of these technologies was analyzed in terms of accuracy in capturing wood details, difficulty of use, processing time, and economic cost. The research was carried out on wood samples with different textures, shapes, and surface properties to ensure that the results were representative. Those samples consisted of the following (see Figure 1 from left to right): oak (*Quercus petraea* (Matt.))—the robust part of the trunk with various morphological defects; poplar (*Populus alba* L.)—a thin model with a flat surface after cutting; and ash (*Fraxinus excelsior* L.)—a morphologically diverse sample because of deep structure defects. Each method was tested on a trio of models, allowing subsequent comparison of the suitability of the use of the methods.

**Figure 1.** The resulting 3D models created by the Lidar method showing medium model and texture quality compensated by ease of this method.

### 2.1. LiDAR

The use of LiDAR (Light Detection and Ranging) technology represents a major advance in the field of 3D modeling and digitisation, especially in the creation of detailed representations of real objects [32]. In this study, a mobile device equipped with an iPhone 14 PRO LiDAR sensor was used to evaluate the accuracy and efficiency of this technology in scanning wood samples. LiDAR works on the principle of emitting laser pulses that measure the time it takes for a light beam to bounce off the surface of objects. Based on these data, an accurate spatial map of the object is generated [33].

Scanning results using LiDAR technology demonstrated high accuracy in capturing the geometric details of the wood samples (see Figure 1). This technology allows the production of high-resolution 3D maps, even in low-light conditions, which has been proven by Spreafico et al. [26]. When scanning wood samples, reliable texture and shape capture was achieved, showing the advantage of scanning speed and low dependence on external illumination. This approach has greatly simplified the process of creating digital replicas that can be used for further analysis or applications such as augmented reality.

In comparison to other methods such as convergent photogrammetry, LiDAR was less operator-intensive and required minimal manual intervention during scanning. Nevertheless, the quality of the resulting models was sufficiently high, making it an effective solution for fast and accurate scanning of objects with irregular surfaces, such as wood samples.

### 2.2. Convergent Photogrammetry

Photogrammetry is a three-dimensional imaging system for creating 3D models from photographs. We used rear camera on Samsung Exynos 1380 smartphone with following settings: image ratio 9:16, resolution 2296 × 4080 pixels, brightness f/1,8 with optical image stabilization turned on. The input is a number of shots of an object from different sides, and the output is a 3D model created using specialized hardware and software [28]. Photographs from at least two positions, called "lines of sight", allow the generation of a point cloud that creates a virtual object. Agisoft Metashape software (Version 2.1.1 built 17803) recommends overlapping photographs of at least 60%–70% to achieve a good quality model. From the point cloud, by connecting the points, surfaces, most often triangles, are formed, and by connecting them, a 3D object is created [34]. In convergent photography, it is important to ensure as much overlap as possible between the individual images so that even complexly structured objects can be generated using specialized software [35]. Images are usually taken from a short distance from the object with wide-angle cameras, and to ensure the accuracy of the model, the overlap must be at least 60% [28]. There are two methods of imaging: short-range ground-based and airborne photogrammetry, with a variety of techniques including vertical, oblique, trimetrogonal, and convergent imaging [29]. In our case, the resulting wood sample models produced by convergent photogrammetry contained a very large number of surfaces. Such high detail is technically problematic for the purpose of interactive imaging on mobile devices, where there is a requirement to optimize computational complexity. Therefore, decimation is required—reducing the surfaces to a level that allows smooth user interaction while maintaining reasonable visual quality of the object.

Decimation is performed using sophisticated algorithms that analyze the topological structure of the 3D model, reducing the number of triangles while preserving key details of the geometry. This process is essential because it allows the size of the data to be optimized, minimizing the memory and computing power requirements of the devices on which the models will be displayed. Additionally, models with a high number of faces can significantly slow down the performance of mobile applications. After decimation, the model remains detailed enough to faithfully represent the wood structure, which can be clearly seen in Figure 2. At the same time, the model is adapted for smooth display across mobile platforms.

### 2.3. Structured Light

Structural light scanners are sophisticated technological tools that offer an innovative approach to three-dimensional scanning of objects [36]. Scanning has proven to be an extremely accurate method for creating detailed 3D models of wooden products. The principle of this technology involves the projection of structured light onto the surface of an object, where the pattern deformations caused by surface irregularities are recorded by sensors and subsequently processed into a high-resolution three-dimensional digital model. This technology excels particularly in complex surface structures where it is important to faithfully capture fine details [37].

Despite these advantages, this method is quite challenging to master. Unlike other scanning techniques, the handheld scanner needs to be constantly connected to a powerful computer by a cable, which limits flexibility and makes handling difficult. In addition, a quality scan requires optimal lighting—dark, black, or shiny objects cannot be scanned accurately because they absorb or reflect light in the wrong way, interfering with the proper functioning of the sensor. Another important limitation is the absence of a color sensor in the basic scanner configuration. This means that the resulting models were monochromatic, displayed only in shades of grey (Figure 3), missing the color texture of wood, and a special sensor had to be purchased additionally to obtain the color texture. Additional coloring of models is possible, but the final output may not accurately represent the real object, even if there is a minimal shift or rotation of the texture on the 3D model.

**Figure 2.** The resulting 3D models created by the convergent photogrammetry method representing detailed models at cost of higher demands on processing skills.

**Figure 3.** The resulting 3D models created by the structured illumination method producing highly detailed 3D models. Lack of color is caused by absence of color sensor.

Although the models are generated in real time and displayed instantaneously on the screen, the overall time complexity of this method makes it one of the most time-consuming among the techniques studied.

### *2.4. Application Development*

The Unreal Engine, which provides robust tools for implementing augmented reality (AR), played a key role in the development of the *Virtual Wood Market* application. This engine enables the construction of highly interactive environments in which 3D models are accurately integrated into the real world with respect to physical and optical properties.

The Unreal Engine uses advanced algorithms to render 3D models in real-time, relying on ARKit (for iOS) and ARCore (for Android) technologies. These frameworks enable precise tracking of the device's position in space, detecting planes and surfaces in the user's surroundings, on which virtual objects are then placed. A key aspect of AR in Unreal Engine is the environment mapping, which ensures that 3D models are placed on real surfaces with an emphasis on their proportions and perspective.

The creation of the *Virtual Wood Market* application consisted of three main steps. The first step was to create and populate a database with scanned wood species and then implement it into the mobile application. The second step was to tackle the use of augmented reality for image recognition, scanning the real environment, and placing wood samples directly into the real environment. The third step was to create an intuitive user environment that enables efficient interaction with the application and enhances the user experience for visualization and product selection.

The biggest challenge was image recognition and sensing the environment around the user. Accurately identifying and analyzing the scanned images on which the 3D models are placed required complex image processing algorithms and thorough testing to ensure a high degree of recognition accuracy and speed. This process involves the use of machine learning methods to optimize the application's ability to identify relevant objects and their characteristics in real time. The flowchart in Figure 4 shows the basic principle of scanning a real environment with the combination of recognizing images on which the associated 3D models from the mobile application are placed in real time.

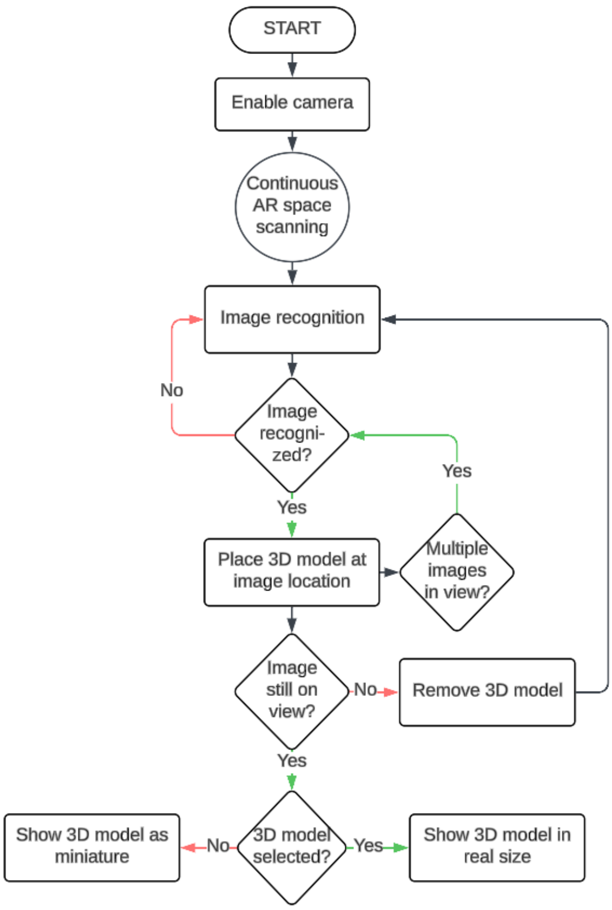


**Figure 4.** Flowchart of the process of environment scanning, image recognition, and 3D model display in AR.

App optimization was another key aspect, which included improving performance on mobile devices. The Unreal Engine provides efficient memory management tools and minimizes CPU and GPU load, which are essential for the smooth operation of the app, especially when working with complex 3D models. Optimization has focused on reducing polygonal complexity of models, optimizing textures, and leveraging techniques such as Level of Detail (LOD), contributing to faster loading times and smoother interaction in augmented reality environments.

## 3. Results

### 3.1. Scan

In the research, 23 different wood samples were selected, three of which were chosen as reference samples to demonstrate the varying difficulty of scanning and to validate the different methods. These reference samples were then scanned using available methods for converting physical objects into virtual models, and the resulting models were compared. Among the methods used were convergent photogrammetry, iPhone scanning, and scanning with structured illumination techniques. Each of these methods provided varying levels of detail and accuracy in the generation of 3D models.

Comparison of the methods based on our experience (Table 1) showed that convergent photogrammetry, although more difficult to use and requiring more steps in model creation, provides better control over the process of generating 3D models, resulting in higher quality of the resulting objects. This method allows detailed adjustment of model parameters to specific project requirements. On the other hand, scanning with an iPhone, specifically using the Reality Scan app, offers a more user-friendly process, which is advantageous to a wider audience. Although this method does not allow the same level of control as photogrammetry, it is a suitable alternative for less technically proficient users.

**Table 1.** Comparison of evaluated scanning methods.

| | **Convergent Photogrammetry** | **Lidar iPhone** | **Handheld Scanner** |
|---|---|---|---|
| Difficulty of control | high | low | medium |
| Decimation | yes | no | yes |
| Output quality | very high | medium | very high |
| Possibility to scan shiny surfaces | no | no | yes |
| Interference to model creation | high | low | medium |
| Skills needed | medium | low | medium |
| Time spent | 20–360 min (depends on hardware performance) | 5–20 min | 15–35 min |
| Color texture | yes | yes | no (additional sensor needed) |

Based on an analysis of various factors such as financial cost, difficulty of operation, and quality of output, convergent photogrammetry was evaluated as the optimal method for achieving maximum scan quality. Out of a total of 23 wood samples, 21 objects were successfully scanned and converted to virtual form. These 3D models were subsequently modified in Blender for efficient display on mobile devices. The models were then integrated into the Virtual Wood Market application, created in the Unreal Engine environment, where they were made available through a pre-prepared database for further user interaction.

### 3.2. Mobile Application

The Virtual Wood Market app is an innovative solution that uses augmented reality technology to visualize wood products in the user's real environment through the mobile device's camera. The basis is advanced algorithms to identify planes, such as floors, walls, or tables, to place 3D models on these surfaces. Image recognition, rendering of 3D models, and an intuitive user interface are also included. The application is designed to provide easy navigation and intuitive use, reducing barriers for less technically experienced users.

The main technological pillar of the application is the implementation of augmented reality, which allows the display of realistic 3D models of products through the camera of the mobile device in real time and space. This process combines advanced image recognition algorithms, rendering optimization, and interaction through a modern user interface. The "Home Screen" (Figure 5) offers the user several main functions. From the product selection in the SHOP, the user is taken to a screen listing the available range of goods or semi-finished wood products. After selecting one of the goods, a screen of that wood will open. Figure 6 shows the user interface structure of the Virtual Wood Market mobile application.

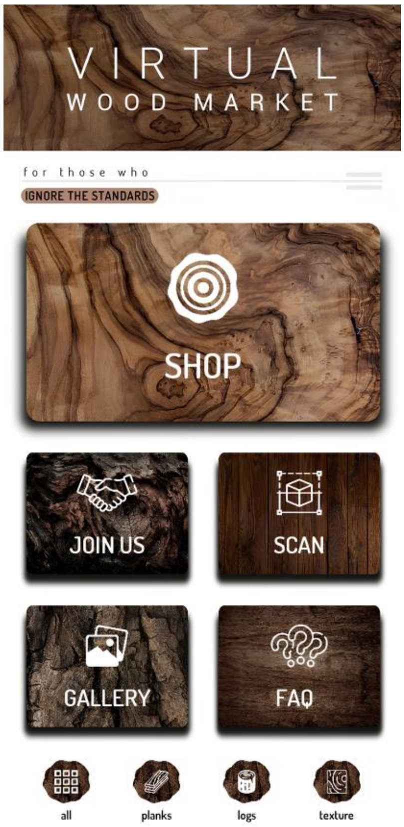


**Figure 5.** Virtual Wood Market home screen.

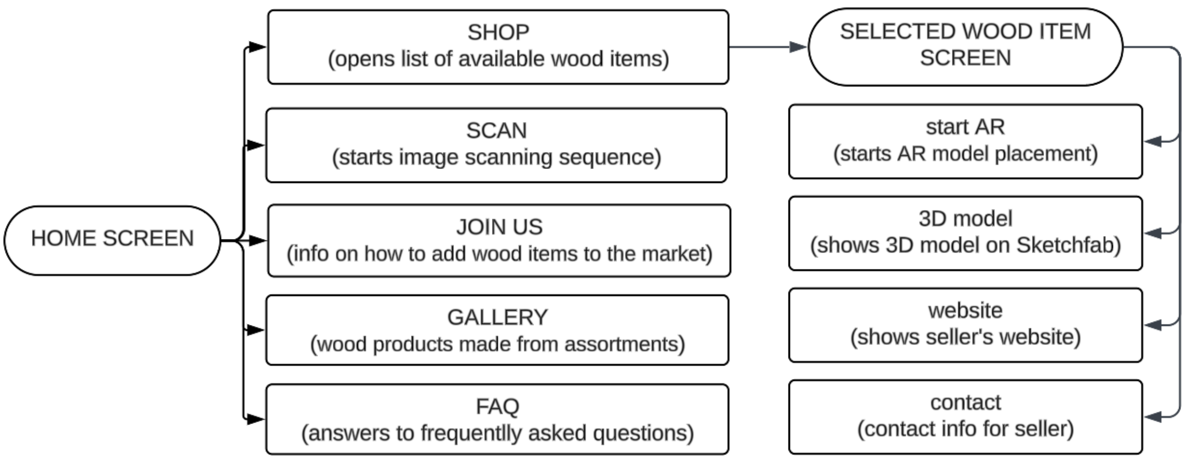


**Figure 6.** Virtual Wood Market application structure.

The application uses machine "vision" algorithms to identify specific markers, such as image tags or other graphical elements found on promotional materials. Once a marker is successfully recognized, the application automatically renders a realistic 3D model of the product in question. The models are optimized for mobile devices to combine detailed textures and geometry with a low load on device performance. Rendering includes features such as dynamic lighting, shadow generation, and adjusting the model according to the lighting conditions of the environment to achieve a high level of realism.

### *3.3. Virtual Wood Market Application Modules*

The Virtual Wood Market application includes two main modes that provide the user with flexibility in exploring and interacting with the products:

#### 3.3.1. Flyer Scanning Mode

This mode provides the user with the ability to use the mobile device's camera to identify printed promotional materials such as flyers, catalogs, or other marketing materials. The application uses special markers that are integrated into the design of these materials. Once recognized, the application can instantly identify a specific product, retrieve its three-dimensional model, and visualize it through augmented reality technology, as can be seen in Figure 7.


**Figure 7.** Manipulating the model in augmented reality on the basis of a printed leaflet.

The 3D product model thus displayed becomes an interactive object that the user can manipulate in real time. It can be moved and rotated around all axes as required. This process allows a detailed examination of the product, giving the user a realistic idea of its size, shape, structure, proportions, and color scheme. This level of detail and interaction far surpasses traditional two-dimensional photographs or illustrations in printed materials.

The feature is useful for companies that use printed promotional materials as a key tool to showcase their product range. By combining traditional and modern technologies, it provides an innovative experience for customers and allows them to engage with visual content from promotional materials in an interactive and engaging way. This enables companies to present their product range more effectively and communicate better with potential customers, increasing the chances of a successful sale.

#### 3.3.2. Digital Catalog Mode

After selecting a specific product, the application displays a screen with detailed information about the selected wood product. This information includes its weight, dimensions, price, and other data relevant to the user (Figure 8b). In addition, options for further interaction are also available on this screen, such as links to the retailer's contact details or to its official website, making it easy for the application to access additional information or to close a deal. One of the key features of the application is the "Start AR" block (Figure 8a), which enables the use of augmented reality technology. Once this function is activated, the user can use the camera of his mobile device to take a picture of a real space, in which he can then place the selected product (Figure 8c). This feature provides a realistic visualization that allows the user to imagine the product in a specific environment, thus facilitating the decision-making process. If the mobile device does not support augmented reality, the application offers an alternative in the form of a "3D model" block (Figure 8a). Once selected, it opens the web interface of the Sketchfab platform, which allows browsing the three-dimensional product model directly in the web browser (Figure 8d). This option ensures that users with less powerful devices can continue to obtain detailed and visually sophisticated information about the selected product.

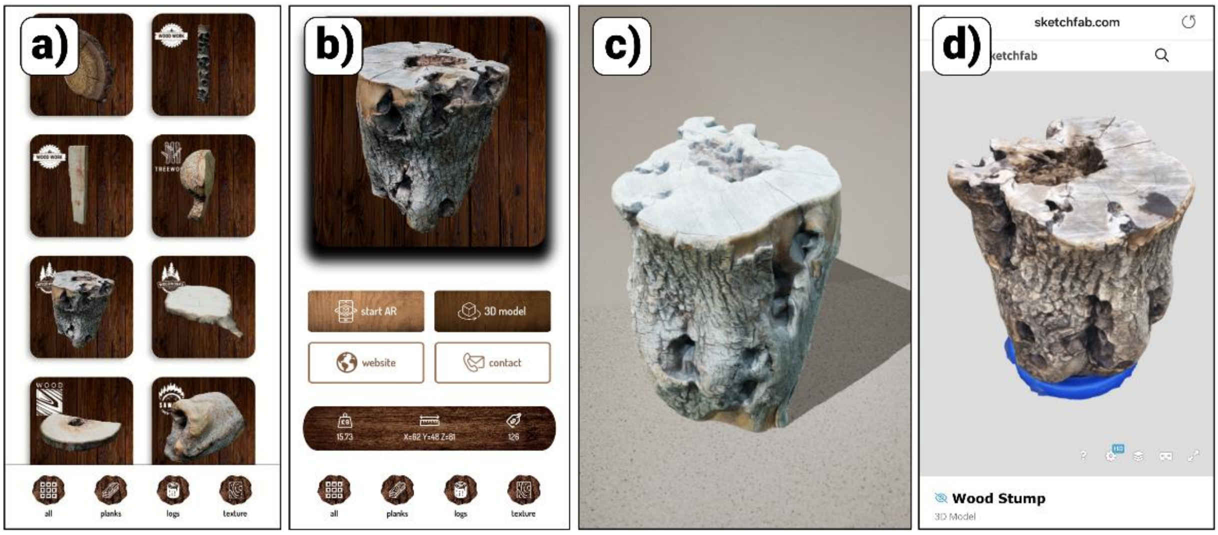


**Figure 8.** (**a**)—screen of the catalog of available products, (**b**)—screen of the selected item from the catalog, (**c**)—augmented reality view, (**d**)—model displayed on the Sketchfab platform.

### *3.4. Link to e-Shop and Web Alternatives*

The app provides the option to go to the manufacturer's e-shop or other online platforms where the user can purchase the product. This feature supports a seamless transition from visualization to purchase, increasing the efficiency of the sales process. For device users without AR support, the app offers an alternative in the form of interactive model viewers on platforms such as Sketchfab. The app is designed to be compatible with different types of devices that use the Android operating system. The optimization ensures smooth functioning even on devices with average performance.

## 4. Discussion

We see the effect of the attractive presentation of wood products, or forest products in general, to consumers in the substitution of massively used non-renewable materials. The bioeconomy produces and develops a spectrum of interesting substitutes for traditional products based on renewable materials in the frame of the sustainability and circular economy concepts. Educating consumers about the benefits of such substitution aims at reducing consumption, reuse of products at the end of their life cycle, and benefits for humans and their environment. Effective sales techniques can also help this transformation. In this work, we present the use of innovative techniques to display unique wood samples through AR. This represents a practical application of the benefits of digitization and virtualization in the marketing communication of entities producing, working with, and selling a full spectrum of wood products.

Some major players in the retail market of this sector (such as IKEA) have already implemented AR technology in their mobile apps, allowing customers to view furniture from their catalogs directly in real space. Such a tool tends to be in the portfolio of large companies, as the development of such applications requires significant financial resources and technological background. For smaller retailers, such a solution is often economically and technically unfeasible. Therefore, there is significant potential here to create a universal platform that would allow a wide range of smaller manufacturers/retailers to easily integrate and use AR technology to support sales.

In this spirit, a simple version of the application called "*Virtual Designer*" has also been developed based on the methodology described for the development of the *Virtual Wood Market* application. It allows users to furnish their interiors with furniture using AR in a mobile application. The key was the implementation of a floor plan scanning functionality, which allows users to retrieve the floor plan of the room where they plan to furnish the interior. Another feature was the integration of the ability to scan cards with images of furniture from a catalog and the ability to place them in the virtual environment based on the floor plan of the room. This allows 3D furniture models to be presented using AR in real interiors through the camera of a mobile device. The control allows users to conveniently and efficiently plan and visualize their interior in augmented reality without the need for complicated controls or specialized knowledge. Linking to real reference images on cards helps to improve the accuracy and reliability of virtual object placement in real environments. The fact that this leads to a more authentic experience is also pointed out by Kim and Jun [38]. This approach to controlling 3D visualization in augmented reality is innovative in that the technology is applicable regardless of the technical ability or prior experience of individuals with AR applications. The combination of ease of use, experiential form, and accuracy of results satisfies the needs of a wide range of users in the planning and visualization of interior spaces.

Thus, we can see the possibilities of considerable variability in the adaptation of the application to the needs of different producers/sellers of wood products. Our position on the effect of using AR capabilities in selling wood product sales is supported by the results of the study by Schmidt et al. [39]. They point out that AR applications induce positive emotions in (in their case, online) shopping and also have an impact on the perceived amount of information. The study highlights that AR positively influences both cognitive (information processing) and affective (emotional) components, which in turn increases shopping behavior. When consumers feel informed and emotionally engaged, they are more likely to make a purchase.

Of course, AR has applications not only in retail sales but also in the optimization of corporate processes in the woodworking sector. Cousin et al. [40] describe the use of augmented reality technology to improve material efficiency in wood construction. With the support of AR in design, workflows and the production of non-standard construction elements are facilitated due to the optimized use of available materials. At the same time, the environmental impact of construction is significantly reduced. Lee [41] points out that in wooden furniture manufacturing, AR is used to bridge the gap between the designer's vision and the final prototype, due to inconsistencies between 2D drawings and 3D models. With AR, designers and sample makers can more accurately compare virtual and physical shapes, so AR technology increases the accuracy and efficiency of the furniture prototyping process. Kyjanek et al. [42] present the benefits of digitizing manufacturing processes, where AR plays a key role in facilitating human–robot collaboration in wood prefabrication. The integration of head-mounted augmented reality displays allows designers to plan robot trajectories, influence production sequences, and display superimposed diagnostic feedback. Using augmented reality in this context increases digital integration and accessibility, making manufacturing workflows more efficient and intuitive. Other authors [43] point to improved supply chain management in the forest-based industry by (i) linking processes, where AR is part of Industry 4.0 technologies and improves the interconnection of process steps within the timber supply chain (e.g., harvest planning, organization, control, operations, transport, logistics, and timber sales); (ii) information flow, where AR integration enables the actual flow and allocation of information, making the supply chain environment more flexible and adaptable.

## 5. Future Research Directions

We see impulses for further research and development in extending the described tools with new functionalities or creating applications adapted for a wider range of wood products. For example, a challenge for better user functionality of the *Virtual Designer* application is the implementation of automatic recognition and generation of 3D models from floor plans. Users could simply scan a floor plan, and the application would automatically identify individual elements such as walls, windows, and doors. It would then use these data to create an accurate 3D model of a virtual copy of the floor plan. Despite the ability of current technologies to support such functionality, its implementation would be time- and resource-intensive for developers. It would require the development of advanced image recognition and modeling algorithms, as well as rigorous testing and debugging.

Other potential functionalities include the ability to customize floor and wall materials, including color selection directly in the app, as well as the ability to interactively place furniture models from the database directly in the user's real space by simply clicking a finger on the screen. Such visualization contributes to a better user experience when planning interiors, as it helps consumers clarify their own preferences, simplifies product presentation, and converges the ideas of dealers and clients.

## 6. Conclusions

Scanning real objects and converting them to virtual form can be frustrating and difficult to learn for the average user. By analyzing the available scanning methods, we were able to determine the simplest process for transforming wood feature samples into 3D objects. Using Apple's Lidar-type sensors implemented on a common mobile device, scanning is accessible to both experts and laypeople. In conjunction with Epic's Real Capture app, the iPhone becomes the optimal tool for scanning objects and then using them in a wide range of applications. Thanks to the Sketchfab site with which the app communicates, scanned objects can be viewed by anyone, anywhere.

For the experienced user, Agisoft Metashape remains the leader in transforming objects into virtual copies. Data processing takes longer, and more power is required for the device on which the 3D model generation process takes place. However, its great advantage is the ability to enter the individual generation steps and thus influence the final output of the processed inputs. That is why we chose Agisoft Metashape as the main process for processing wood feature samples for our mobile application. A key factor in the choice of method was precisely to achieve an optimized virtual model with preservation of all details of a given sample while keeping the load on the display device as low as possible.

The mobile app offers a database of 3D models of real wood samples. A promotional leaflet of the simulated vendor is associated with the application, containing basic information about the individual samples as well as their reference images. The application can scan these images individually or in groups and place virtual copies (3D models) of the given samples in the image at their positions in real time. In this way, we have achieved a very intuitive control of the application, which reduces the frustration of an unfamiliar user interface. In conjunction with the brochure, the Virtual Wood Market becomes a powerful tool for both education and the commercial sphere—depending on who the end user will be.

The concurrently developed Virtual Designer application allows a detailed picture of room layouts and sizes to be obtained after scanning the floor plan. The scan is then interactively presented in augmented reality, allowing users to virtually tour the space. Subsequently, the application allows virtual furniture models in 3D format to be placed directly on the floor plan. It provides clients, retailers, and designers with the tools they need to visualize and optimize interiors.

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**Data Availability Statement:** The data presented in this study are available on request from the corresponding author due to the development of the application (not freely available).

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