V4Design

Visual and textual content re-purposing FOR(4) architecture, Design and virtual reality games

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D7.1

Initial use case scenarios and user requirements

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Abstract

This deliverable describes the initial pilot use cases, as well as the user requirements, which derive from the analysis of these pilot use cases. Moreover, it outlines the prioritization methodology that has been adopted in order to sort the user requirements and select the ones, which will drive the development of the V4Design platform and its main components. The deliverable also includes a short outline of the evaluation methodology, which will be used in order to assess how the final components and the entire V4Design platform have fully realised the initial vision.

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History

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0.1	24/01/2018	Creation of ToC	Yash Shekhawat
0.2	19/04/2018	Use case definition and user requirements elicitation for PUC3 and PUC4	Eva Lopez
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Executive Summary

The current deliverable reports on the initial set of user requirements for V4Design, based on the profound analysis of the four Pilot Use Cases (**PUCs**): a) Architectural design, related to existing or historical buildings and their environments; b) Architectural design, related to artworks, historic or stylistic elements; c) Design of virtual environments, related to TV series and Virtual Reality (VR) video games; d) Design of virtual environments, related to actual news for VR (re-) living the date. This work is targeted to document the identified user needs as derive from the PUCs and the users' expectations regarding the V4Design platform and ensures consistency among different contexts.

First, the deliverable introduces the PUCs and their scenarios. Furthermore, it explains how the outcomes of this deliverable will contribute on the progress of the project driving the design of the V4Design architecture and the specification of its main components.

Then, the deliverable elaborates the methodology adopted in order to define the user requirements derived by the PUCs, which mainly relies on the **MoSCoW** framework. This framework defines the elicitation and prioritisation techniques that are used to gather and rank the user requirements based on their importance towards the implementation of PUCs and more generally towards the deployment of a robust system.

In particular, the deliverable analyses each PUC providing:

- **Executive summary** which contains a brief summary of the PUC.
- **Rationale** which describes how the PUC will exploit V4Design so as to demonstrate the system's capabilities and enlightens how V4Design could benefit the PUC's business processes.
- **Detailed description** which provides a thorough documentation of the PUC, including the actors that are involved, along with its motivation and usability.
- **Story** which dictates how the PUCs can be implemented in a real life environment and defines the actors that are involved and the use of V4Design components.
- **User requirements** which have been compiled so far. The user requirements describe the special requirements of the particular PUC and the users' needs for the realisation of the PUC.

The deliverable continues with the profound analysis of the V4Design user requirements, which have been gathered from various stakeholders such as developers, content providers and content producers, architects and game creators. The requirements are classified into functional and non-functional and their importance is indicated by the MoSCoW framework.

The deliverable concludes with an outline of the evaluation methodology that will be used to evaluate the usability of the platform. It describes several smaller processes that will be created in order to determine the functionality of the platform and KPIs which will help to assess the best flow of each process.

Abbreviations and Acronyms

AR	Augmented Reality
DoA	Description of Action
IP	Intellectual Property
KPI	Key Performance Indicator
NPV	Net Present Value
MMF	Minimal Marketable Features
OAI-PMH	Open Archives Initiative Protocol for Metadata Harvesting
PUC	Pilot Use Case
UIX	User Interface Experience
USP	Unique Selling Proposition
VR	Virtual Reality
VUS	Virtual Urban Simulation
WLAA	Weighted Look Ahead Approach

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1 INTRODUCTION

The increasing need of capturing real world environments and depicting them in virtual environments and 3D design platforms has recently appeared in architecture and video game design. More specifically, we can see that creative industries are agonizingly searching for new ways to reduce the computational time to produce 3D-models of interior/exterior environments and objects by reusing and repurposing existing content.

V4Design aims to address this need by developing and bringing to the market a platform for architects and game designers, which will enable the creation of 3D models from movies, images and other multimedia resources. More specifically, the main idea behind V4Design is to reuse: (i) visual content: movies, documentaries, paintings and images from other artwork; and (ii) textual content: textual documentations in films, critics, catalogues and museum guides; and re-purpose it in a way that will be useful for the targeted creative industries.

The goal of this deliverable is to define the Pilot Use Cases (PUCs) and elicit the appropriate user requirements. The initial PUCs, which were already defined in the proposal preparation phase, are extended and redefined in this deliverable in order to construct realistic and meaningful use case scenarios. Additionally, the deliverable defines a clear methodology that describes the elicitation procedure of the user requirements, the consortium partners that are involved in each PUC and a short outline of the evaluation methodology. Furthermore, the deliverable acts as a basis for the implementation of the PUCs with the requirements laid down in this deliverable. A clear plan of action can be created on when and how the pilot will run during the project lifecycle.

The importance of this deliverable is clearly highlighted when observing the necessity that it produces in several other tasks. In particular, it will provide input to the following tasks:

- **T6.1**: Technical requirements and system architecture
- **T6.2**: Development of VR and 3D game authoring tool
- **T6.3**: Tool development for architects and designers
- **T7.3**: Tools user training and testing
- **T7.4**: Evaluation plan and evaluation of game application
- **T7.5**: Evaluation plan and architecture tool evaluation

1.1 Pilot use cases overview

Regarding the PUCs that have been formulated so far, we can distinguish two main categories based on the needs of the targeted user groups that V4Design aims to satisfy. PUC1 and PUC2 are mainly targeted to architects that focus on interior and exterior design, while PUC3 and PUC4 are targeted to video game creators and data content providers/producers. Thus, we can identify the following four PUCs:

- **PUC1 - Architectural design, related to existing or historical buildings and their environments:**

This PUC demonstrates the use of V4Design so as to extract the 3D models of existing and past architecture structures, using visual footage. Furthermore, V4Design will be used to provide a gallery of aesthetics textures and textual information related to the targeted area so as to help architects and video game designers to create a realistic virtual environment.

This PUC demonstrate the capabilities that an architect could have when he wants to design/refurbish/extend an exterior environment, such as a square or building, by using the V4Design platform.

This PUC is motivated by the growing demand to preserve the built environment in world heritage sites, not only physically, but also digitally, so as to store and transcribe information about built world heritage. It is important to understand the built environment, cities and buildings, interior and exterior spaces, as an ever-changing landscape which society constantly shapes. Architects and designers intervene in the built environment with their work, so they have to carefully take buildings and their surroundings, either man-made or natural landscapes, under serious consideration in their design. Therefore, they rely strongly on precise records of the built and surrounding environment, increasingly using 3D digitization and modelling in recent years.

- **PUC2 - Architectural design, related to artworks, historic or stylistic elements:**

This PUC will demonstrate the ability of V4Design to extract small furniture items and various 3D objects inspired from a specific art period and/or location. The PUC will also give the capability to architects to design an interior architecture object with reference to a specific area or style, such as a set of furniture or abstract object, by using the V4Design platform.

This PUC is motivated by the high demand for visual representations of objects, with a clear intention to explore and create new forms and designs. Those concepts may be motivated by the interpretation of a certain art period and reflect its stylistic attribute, or any other properly articulated design principle (e.g., well-defined local variations, surface appearance characteristics such as colour, decoration and texture – leading to stylistic classifications). In this challenge, architects, designers and artists will have the opportunity to reinterpret key aspects of artworks and produce designs and objects (e.g. furniture collections, decorative objects, lighting accessories, etc.) that are original but at the same time stylistic and historically charged.

- **PUC3 - Design of virtual environments, related to TV series and VR video games:**

This PUC will demonstrate the ability of V4Design to extract small furniture items and various 3D objects inspired from a specific art period and/or location. The PUC will also give the capability to architects to design an interior architecture object with reference to a specific area or style, such as a set of furniture or abstract object, by using the V4Design platform.

This PUC is motivated by the high demand for visual representations of objects, with a clear intention to explore and create new forms and designs. Those concepts may be motivated by the interpretation of a certain art period and reflect its stylistic attribute, or any other properly articulated design principle (e.g., well-defined local variations, surface appearance characteristics such as colour, decoration and texture – leading to stylistic classifications). In this challenge, architects, designers and artists will have the opportunity to reinterpret key aspects of artworks and produce designs and objects (e.g. furniture collections, decorative objects, lighting accessories, etc.) that are original but at the same time stylistic and historically charged.

- **PUC4 - Design of virtual environments, related to actual news for VR (re-) living the date:**

This PUC is developed to demonstrate how V4Design can be used so as to develop immersive documentaries from historical footage from news articles and other repositories in order to re-live a time in the history in a particular location.

This PUC is motivated by the fact that it is preferable and more educative to leverage immersive VR technologies to experience a historic event rather than watching a typical news broadcast. Furthermore, these technologies provide an entirely different way of News experience that can enable viewers to become engaged with the topics on a far deeper emotional level creating a sense of presence and evoking empathy. The use of VR technology can enhance the consumption of News or News related topics for worldwide users and transform the consumption of News into tomorrow's full immersion newscasts.

2 METHODOLOGY

This section describes the approach that has been adopted to i) define the PUCs and scenarios and ii) specify the V4Design user requirements.

2.1 Pilot use cases creation methodology

We have used as a starting point the initial PUCs as defined in the proposal preparation phase and asked our end users' guidance in order to further elaborate them. Our end user partners are experts in the fields of architecture and video/VR gaming and have the expertise in defining realistic PUCs. Specifically, the experts from HdM and AUTH were involved in defining the architecture and design PUCs and scenarios (PUC1 & PUC2). On the other hand, the experts from NURO were consulted in defining PUCs regarding video and VR game creation (PUC3 & PUC4). DW experts also provided important guidance in defining PUC3 and PUC4 as being PUC's main content provider.

In addition, we have analysed the current market state (see D8.3) and what kind of existing tools are offered to the targeted user groups (i.e. architects and game designers). Several discussions between the users and the content providers have also been made through the biweekly teleconferences so as to conclude in the first version of these PUCs. Furthermore, a dedicated user workshop has been conducted in Koln, during M3, so as to have a more intimate conversation between the user and technical parties of the consortium.

Further interviews and discussions with relevant stakeholders that will be chosen individually by each end user partner with regard to the specifics of their individual use case scenarios are planned to be made in the near future so as to acquire a more realistic and more general approach of the PUCs and the user requirements. The format of these interviews and discussions (one-to-one interviews, focus groups and committees) will vary depending on the provisions of the Description of Action (DoA) and depending on what will be considered the most suitable approach.

Valuable feedback on the first version of these PUCs is also expected to be provided by our external users (i.e. the user group members).

2.2 User requirements extraction methodology

With respect to the user requirements elicitation, it is worth mentioning that a traditional style of software development is applied, along the project lifespan, with one or more iteration cycles and releases. Consequently, it is expected to apply such a planning to the user requirements process as well.

Table 1 delivers an insight into good practices for managing the user requirements [1]. For V4Design, we plan to use this table as a reference so as to elicit useful and meaningful user requirements and manage them appropriately, once they are identified and prioritized.

Table 1: Good practices for requirements management

Good Practice	Cost of Introduction	Cost of Application	Guideline Classification	Key Benefits
Uniquely identify each requirement	Very low	Very low	Basic	Provides unambiguous references to specific

				requirements
Define policies for requirements management	Moderate	Low	Basic	Provides guidance for all involved in requirements management
Define traceability policies	Moderate	Moderate to High	Basic to Intermediate	Maintains consistent, traceable information
Maintain a traceability manual	Low	Moderate to high	Basic	Records all project-specific traceability information
Use a database to manager requirements	Moderate to high	Moderate	Intermediate	Makes it easier to manage large number of requirements
Define change management policies	Moderate to high	Low to moderate	Intermediate	Provides a framework for systematically assessing change
Identify global system requirement	Low	Low	Intermediate	Finds requirements likely to be most expensive to change
Identify volatile requirements	Low	Low	Advanced	Simplifies requirements change management
Record rejected requirements	Low	Low	Advanced	Saves re-analysis when rejected requirements are proposed again

The requirements elicitation process started by analysing the initial PUCs and scenarios reported with the DoA [2] – Section 1.3.3, pages 11 to 13 – which represented the common baseline for all teams (developers, content providers and content producers, architects and game creators). It was agreed a specific questionnaire so as to gather the user requirements directly from the end user partners in the first iteration of the requirement gathering while external stakeholders will be involved in the next iterations.

2.2.1 Short review of different user requirements extraction methodologies

There are several user requirements extraction methodologies. Some of them are listed below:

- **MoSCoW Framework:** The MoSCoW framework is essentially a prioritization method used for software development in Agile environments[1]. The framework allows the stakeholders and the developers to come to a common understanding regarding the priority to a particular requirement.
- **Equity Model:** In this methodology, the prioritisation of the gathered requirement is based on the fairness. This is usually done based on the budget that can be allocated inside an organisation on the development of a particular component and priority is given to it.

[1] https://www.agilealliance.org/agile101/

- **Classes of Service:** This model is the easiest method to implement in various projects, the simple idea is to ensure that whoever makes a request for the requirement also takes responsibility for the pressure they put in the development process. This method is not effective in collaboration development and projects with multiple partners involved.
- **Weighted Look Ahead Approach (WLAA):** This approach considers the development process as a Net Present Value (NPV) generated by a sequence of Minimal Marketable Features (MMFs). One system can have multiple components coming in to form an MMF. Since MMFs are interdependent on each other in most softwares, the idea of WLAA is not recommended where all components needs to be developed for the system to work in perfect synchronicity.

After analysing all the above-mentioned methodologies and other methodologies[2], and more specifically taking into account that V4Design is a multidimensional project, with a great deal of partners of different business background (i.e. data provides, MSEs, architecture offices, SW companies, research institutes), which have different requirements, different components to deploy and different way of thinking and working, we reached on the unanimous agreement to continue with the MoSCoW framework for the requirement gathering and prioritisation.

2.2.2 The MoSCoW framework

The MoSCoW prioritization technique was developed by Dai Chegg as part of Dynamic Systems Development Method[3]. All the requirements are considered important but the prioritization method is used to establish a delivery timelines of the requirements with regards to the business benefits and needs. The method contains of the following categories:

1. **Must Have**: Requirements labelled as 'Must Haves' have the highest priority in the development and delivery timeline. These are the requirements without which the program would not make sense from a business perspective and the project delivery is considered a failure.
2. **Should Have**: Requirements labelled as 'Should Have' are quite important but not considered as necessary as the 'Must Have'. They are less time-critical and often have alternatives to fulfil their purpose in the program.
3. **Could Have**: Requirements with 'Could Have' label are mostly requirements which are desirable but not necessary. These requirements are considered to be developed in case of extra resources.
4. **Won't Have**: Requirements labelled as 'Won't Have' are the ones agreed by the stakeholders as the least desirable and have the lowest priority and are usually not included in the development plans.

The MoSCoW prioritization technique helps the team to rank and classify items in order to get a successful product. The key benefits are:

- It is based on experts' opinion.
- It is quick and easy to complete.

[2] https://labs.openviewpartners.com/prioritization-methods-for-developers/
[3] https://en.wikipedia.org/wiki/Dynamic_systems_development_method

- It is good in defining the priorities of projects that are in progress.

Although being a great technique for elicitation and prioritization of requirements, the key assumptions and the weakest points are:

- MoSCoW rules can be subjective. If there is no effective cooperation, this prioritization method may be inaccurate.
- The technique requires the team to have good familiarity with the product features. When the participants have different levels of familiarity with the product, it is difficult for them to classify or rank the items. In this case, the expert conclusions will be unhelpful.

Since, V4Design has partners with specific expertise in their domain the abovementioned weak points are handled quite easily.

Therefore, we used the MoSCoW framework to define the user requirements that will drive the development plan of the first version of the V4Design platform and the functionalities expected by the users. Although the plan will use these user requirements as the basis of the development, regular feedback loops with the users will be applied to test and verify the methodology along with an updated user requirement document during the project lifespan.

2.2.3 Functional and Non-Functional requirements

To start defining the requirements, it is quite important to know which requirement is classified as a functional requirement and which as non-functional requirement.

Functional requirements can be calculations, technical details, data manipulation and processing of specific functionality that define what a system is supposed to accomplish. These are the requirements and functionalities that a PUC is supposed to test and evaluate.

Non-Functional requirements specify the criteria that can be used to judge the system. They provide input on how the user wishes the system to perform during the tasks. Other terms for non-functional requirement can be “qualities”, ”quality goals”, ”constraints” or ”quality of service” of the platform.

2.2.4 User requirements extraction in V4Design

A wiki page was created (**Figure 1**) explaining the methodology for the requirement elicitation and a shared spread sheet document (**Figure 2**) for the easy collaboration between various stakeholders containing 5 major columns.

1. **Role**: This column specifies the end user of the particular requirement. The partners were asked to insert who they imagine, with respect to their expertise, would be using this requirement or would need this requirement the most.
2. **Requirement Identified:** This column contains the actual requirement identified for the role specified previously.
3. **Elaboration based on each PUC**: This column gives the stakeholders the ability to elaborate a requirement to a specific PUC, so as to give a better understanding of the requirement.
4. **Functional or Non-functional**: This column is used to identify if a requirement is functional or non-functional.

5. **MoSCoW framework**: The column provides 4 options of “Mo”,”S”,”Co”,”W” representing the priority level ‘Must have’, ‘should have’, ‘could have’, ‘won’t have’ respectively.

Following the user requirement session that took place in user meeting in Cologne, all the PUCs have been defined in detail regarding the way that they will be deployed in a demanding real life scenario. The partners have also decided to work on a shared spread sheet to define their requirements for each PUC and define their expectations for the V4Design platform. In addition, the MoSCoW framework has been presented to the partners as well as the way to use it in order to document and prioritize their requirements.

Based on the PUCs, initial high level requirements were defined, which subsequently analysed into more detailed user requirements (reflected by simple user stories) to better understand them and make it easier to elaborate on them in the future when needed. The spread sheet gives the technical team an overview of the users’ expectations while they can work on the technical aspects of the platform during the development and the iteration phase.

Due to the involvement of multiple actors with varying expertise in the requirement elicitation process, we believe that the methodology is able to provide a strong overview to the produced PUCs and user requirements from the relevant users.

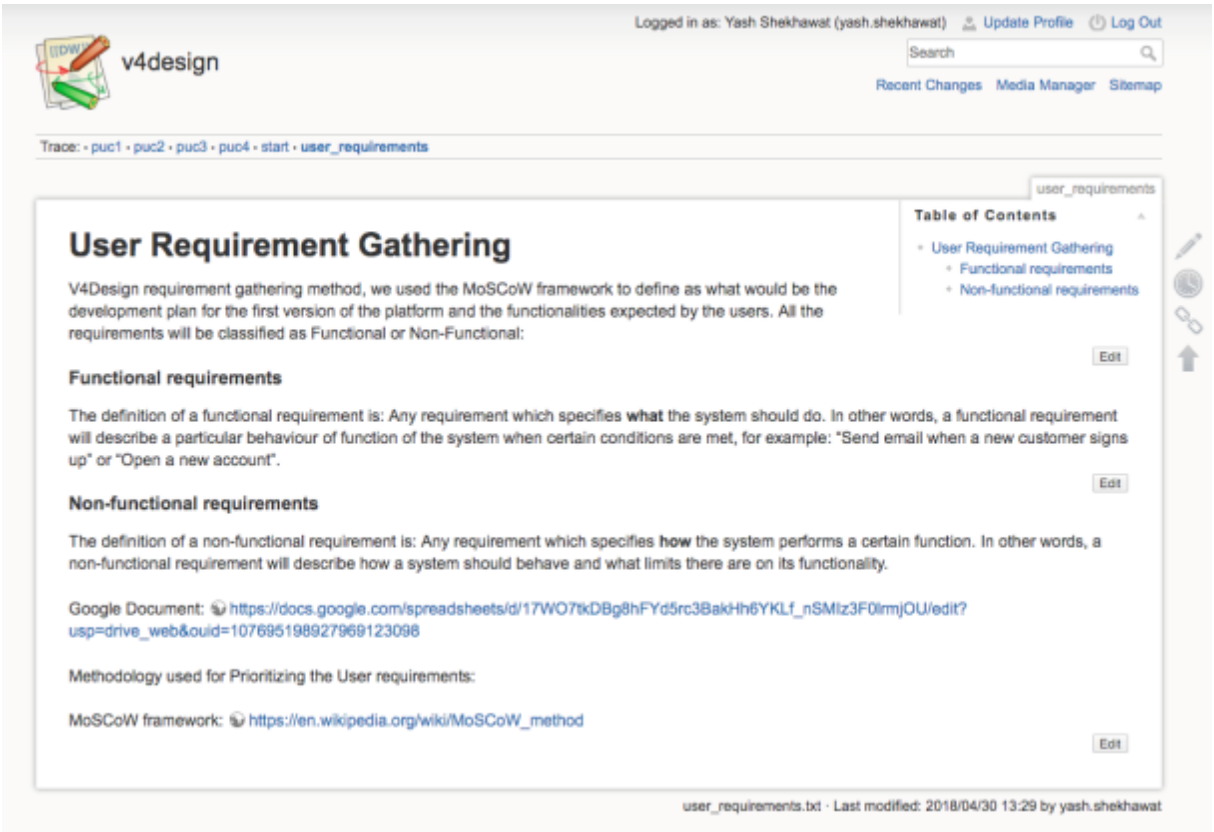

Figure 1: V4Design Wiki page for Requirement gathering

B	C	D	E	F	G	H	I	J
V4Design - User Requirements								
S no.	Role	Requirment Identified	Specific Elaboration of the requirement for each use case				Functional or Non-Fuctional	MoSCoW Framwork based analysis
			PUC - 1	PUC - 2	PUC - 3	PUC - 4		
1	As an Architect I want	to be able to use the platform with an easy to use GUI to upload videos	As I would not like to write lines of codes to upload file and therefore wont use the platform				Non- Functional	S
2	As a Content Provider I want	that the system detects new content on the server and starts a processing loop					Functional	S
3	As a game developer I want	to be able to export the 3D objects to .Obj or .fbx			To create the game in Unity a fbx or obj file is needed in the authoring tool		Functional	Mo

Figure 2: Overview of user requirements

3 USE CASE SCENARIOS

This section will elaborate on the four PUCs and the associated user requirements, which were defined during proposal preparation phase and have been extended during the 1st user workshop and the next teleconferences. The PUCs are therefore described with rationale on the development of the PUCs and with relevance to the business perspective. Following that, each subsection has provided several user requirements from V4Design to make their business processes faster and easier. The PUCs will finally help us to identify the needs of the end-users and evaluate the system performance and capability.

Regarding the structure that is followed, each PUC is analysed under the terms of an/a:

- **Executive summary** which contains a brief summary of the PUC,
- **Rationale** which describes how the PUC will exploit V4Design so as to demonstrate the system's capabilities and enlightens how V4Design could benefit the PUC's business processes.
- **Detailed description** which provides a thorough documentation of the PUC, including the actors that are involved, along with its motivation and usability.
- **Story** which dictates how the PUCs can be implemented in a real life environment and defines the actors that are involved and the use of V4Design components.
- **User requirements** which have been compiled so far. The user requirements describe the special requirements of the particular PUC and the users' needs for the realisation of the PUC.

3.1 Architectural design, related to existing or historical buildings and their environments

3.1.1 Executive summary

The pilot for "Architectural design, related to existing or historical buildings and their Environments" is designed to use the capabilities of V4Design so as to acquire digital models of existing architecture, whether it is about landscapes or buildings. The pilot will use existing content, images and/or videos from various content providers and additionally free content available on the web. This content will be used for the 3D reconstructions of existing places.

Scenario 1 Topic: Historical landscape in the Mediterranean region, Delphi, Greece

The first scenario of PUC 1 is the area of the archaeological site of Delphi in Greece (**Figure 3**). In the first use case scenario the authoring tool will be used to help the architects to reconstruct the landscape and the various spatial elements that articulate it. Further on, V4Design will support the designing of open-air infrastructures, such as pavilions, landart elements and scenographic arrangements for the archaeological site of Delphi. It can also be used for temporary infrastructure for drama and theatre plays, outdoor events, accessibility solutions, etc.

Figure 3: Example of a Delphi landscape

Scenario 2 Topic: New building in central Berlin, Germany

The second scenario of PUC 1 is modelled after a typical design process which an architecture studio undergoes when developing a concept and delivering a design project in the early stages design. In early phases, designers usually spent a lot of time on gathering information about the project's context. In addition to the physical surroundings, infrastructure and any site-specific data, architects will also research in other fields such as the historical, cultural or sociological dimension of the projects context.

In this scenario, the V4Design tool shall be used to help architects in the reconstruction of the surrounding space and its specific spatial elements. Further on, this PUC shall illustrate how V4Design tools can support the design process of an entirely new design on a given plot.

As an example and showcase, we have chosen a real-world scenario of a site in central Berlin, Germany, More specifically a plot at the Kulturforum, a collection of cultural building in Berlin. HdM is currently working on a commission to design a new building for the Neue Nationalgalerie (**Figure 4**) – Museum des 20. Jahrhunderts (New National Gallery – Museum of the 20th Century) on a plot between the iconic Neue Nationalgalerie (designed by Mies van der Rohe in 1968) and the Berlin Philharmonic Concert Hall (designed by architect Hans Scharoun, in 1960).

The prominent location comprising several architectural landmark buildings, large scale artworks and sculptures, as well the eventful urban history of Berlin shall provide a multitude of existing content to work with.

Figure 4: New national gallery in Berlin

3.1.2 Rationale

V4Design aims to develop technologies to extract 3D models of spaces, from images and video sources. Therefore, the data repository of content providers, partners of the consortium (Europeana, Solaris film production and Artfilms) constitutes a good source for the V4Design platform to demonstrate its capabilities. There is need of applications that can help the architects and designers to find new ways to organise more effectively and productively the designing procedure. The development of V4Design gives them an easy-to-use tool to develop such applications, repurpose existing documentaries and re-use their archived footage.

The pilot intends to validate the following system characteristics:

1. To extract 3D assets from video archive material, as well as from new footage
2. To extract patterns and textures from 2D image material
3. To support the design procedure as part of the architects' task

The V4Design tool will use 3D models of topography, 3D models of ancient ruins, 3D models of local flora (logs, trees etc.), point clouds of designated areas of the site, 3D models of related architectural element (column, capital, shaft, base etch). The tool will use 2D geometry of patterns, colour palettes and colour codes from related images and artworks, shape grammars, material library, textures (grains, mosaic, emboss, engravings etc.), metadata of related texts (ex. most visited areas of the site, texts by social media, online reviews etc.)

3.1.3 Detailed description

Today there is growing demand to preserve the built environment in world heritage sites, not only physically, in the analogue world, but also digitally, so as to store and transcribe information about the built world heritage. It is important to understand the built

environment inside and outside cities as an ever-changing landscape which society constantly shapes. Architects and designers intervene in the built environment with their work, so they have to carefully take the surroundings, either man-made or natural landscapes, under serious consideration in their design. Therefore, they rely strongly on precise records of the built and surrounding environment, increasingly using 3D digitization and modelling in recent years. Architects need to have accessibility to all the relevant data and information about existing historic building and the surroundings. Moreover, they need to be able to access all necessary digital tools that will facilitate the design procedure and make it more time effective and productive.

Nowadays architects, designers and artists often use digital files to search existing data to examine environments associated with historic buildings or their surroundings. These files are usually disorganized, with no direct access to them. An additional difficulty is the fact that this data exists only in image format, and not in 2D or 3D models in manageable and editable formats. However, architects need a sophisticated tool that will have access to 2D and 3D digital media referenced to certain historical sources, and that will provide information and data in an easy and fast way.

Academic partner (AUTH) and the professional architectural office (HdM) will use the authoring tool to extract and reconstruct 2D and 3D models of spaces belonging to historical buildings and landscapes from video sources and images. The V4Design tool will also reconstruct and generate models of small scale objects and related interior spaces, using point clouds of related environments, 3D models of dominant shapes and geometries and 3D models of architectural elements (columns, roofs etc.).

The procedure that is followed is described as follows: First, architects users academic partner (AUTH) and the professional architectural office (HdM) discussed and defined the topics of PUC 1 scenario 1&2. They generated a list of related keywords, related to the selected cases. Content providers (Europeana, Artfilms and Solaris film production) used the list of relevant keywords, so as to effectively search into their archives of images and videos and the material repositories. The search for material has produced a list of available material, images and videos, which has been properly classified. Available material has been enriched by free video sources found online, through appropriate sharing licences (creative commons). Initial tests have been made so as to move towards the reconstruction of spaces and spatial elements.

Figure 5: Delphi Landscape 2

Figure 6: Delphi Landscape 3

Figure 7: Delphi Landscape 4

3.1.4 Story

Scenario 1 Topic: Historical landscape in the Mediterranean region, Delphi, Greece

Local authorities commissioned an independent festival organizer to make proposals for outdoor temporary installations (pavilions, land-art elements, and scenographic installations) for an historical site in the greater area of the archaeological site of Delphi, Greece, e.g. temporary infrastructure for drama and theatre plays, outdoor events, accessibility etc. The creative team responsible for the task will use V4Design in order to find related material for research upon the topic. They are going to need information (3D, 2D and textual) of local natural and cultural environment and the topography in order to examine the possibilities of the site of intervention. V4Design will be used to support the design procedure for the new, temporary installations and make it more effective. Also they will use it to produce all the necessary material to better communicate their design proposals to the organizers. The output from the tool is going to be used to produce 360° Images, animations, Class A Rendering, VR Scenes, final proposal explanatory texts and analysis etc., images and other visual content.

Scenario 2 Topic: New building in central Berlin, Germany

An architecture office is commissioned to design a new building (a cultural space extension) in the selected plot in central Berlin, Germany in direct relation to a landmark building of 60's Modernism. The plot is between the Neue (New) National Gallery (designed by iconic architect Mies van der Rohe) and the Berlin Philarmonic Concert Hall (designed by famous architect Hans Scharoun). The building will host culture related activities. V4Design is going to assist the first design phases of the project. It is going to provide all the necessary material and information (3D, 2D and textual) to examine and analyse the site of intervention and its context. Also it will facilitate the presentation and visualization of the proposal to the clients.

The output from the tool is going to be used to produce 360° Images, 360°Animations, Class A Rendering, Animation, VR Scenes, final proposal explanatory texts and analysis etc., images and other visual content.

3.1.5 High level user requirements

We envision V4Design components that provide the following functionalities:

High LvL User Requirement	Description of Action (DoA)
HLUR_001	Architects and designers can extract 3D models of places, buildings and objects out of videos and images of old and new buildings and landscapes, urban or natural
HLUR_002	Architects and designers can extract 3D textures, cg materials from 2D images of old and new buildings and landscapes
HLUR_003	Architects and designers have a tool that can assist in formulating new, innovative architectural ideas
HLUR_004	The 3D environment helps architects and designers to have an overall view of the area or building or object they are designing
HLUR_005	Architects and designers will be able to have point cloud models and meshes of the 3D reconstructions and they will be able to edit the point cloud before the creation of the mesh
HLUR_006	Assets can be 2D videos/images, textual information, etc.

3.2 Architectural design, related to artworks, historic or stylistic elements

3.2.1 Executive summary

Scenario topic: Exhibition elements on East Asian, Japanese Visual Culture

The pilot for "Architectural design, related to artworks, historic or stylistic elements" is designed to use the capabilities of V4Design for designing interior and exterior spaces. It will be used for acquiring digital models of stylistic interest, culturally sensitive, of existing architectural settings. The pilot will use existing content, images and/or videos from various content providers and additionally free content available on the web. This content will be used for the 3D reconstructions of small-scale elements, furniture, textures, and industrial objects.

3.2.2 Rationale

V4Design aims to develop technologies to extract 3D models of small scale elements, from images and video sources. Therefore, the data repository of content providers, partners of the consortium (Europeana, Solaris film production and Artfilms) constitutes a good source for the V4Design platform to demonstrate its capabilities. There is need of applications that can help the architects and designers to find new ways to organise more effectively and productively the designing procedure. The development of V4Design gives them an easy-to-use tool to develop such applications, repurpose existing documentaries and re-use their archived footage.

The pilot intends to validate the following system characteristics:

1. Extract 3D assets from video archive material, as well as from new footage
2. Extract patterns and textures from 2D image material
3. Support the design procedure as part of the architects' task

The V4Design tool will use 2D and 3D models of elements related to East Asian and more specifically Japanese visual culture. This includes visual material about calligraphy, traditional textiles, fabrication techniques and cultural rituals. It also includes 2D and 3D models of local flora (logs, trees etc.), point clouds of designated spatial configurations, 3D models of specific architectural small-scale elements (furniture, equipment, etc.). The tool will use 2D geometry of patterns, colour palettes and colour codes from related images and artworks, shape grammars, material library, textures (grains, mosaic, emboss, engravings etc.), metadata of related texts (ex. texts by social media, online reviews etc.)

3.2.3 Detailed description

Nowadays there is high demand for visual representations of objects, with a clear intention to explore and create new forms and designs. Those concepts may be motivated by the interpretation of a certain art period and reflect its stylistic attribute, or any other properly articulated design principle (e.g., well-defined local variations, surface appearance characteristics such as colour, decoration and texture – leading to stylistic classifications). In this challenge, architects, designers and artists are given the opportunity to reinterpret key aspects of artworks and produce designs and objects (e.g. furniture collections, decorative objects, lighting accessories, etc.) that are original but at the same time stylistic and historically charged. Architects need to have accessibility to all the relevant data and

information about existing culturally located material. Moreover, they need to be able to access all necessary digital tools that will facilitate the design procedure and make it more time effective and productive.

Figure 8: East Asian Visual Culture example

Nowadays architects, designers and artists often use digital files to search existing data to examine environments associated with stylistic and culturally sensitive settings. These files are usually disorganized, with no direct access to them. An additional difficulty is the fact that this data exists only in image format, and not in 2D or 3D models in manageable and editable formats. However, architects need a sophisticated tool that will have access to 2D and 3D digital media referenced to certain stylistic frames, and that will provide information and data in an easy and fast way.

Academic partner (AUTH) and the professional architectural office (HdM) will use the authoring tool to extract and reconstruct 2D and 3D models of small scale elements, belonging to specific cultural end stylistic frames, from video sources and images. The V4Design tool will also reconstruct and generate models of small scale objects and related interior spaces, using point clouds of related environments, 3d models of small scale architectural elements (furniture, equipment etc.).

The procedure that is followed is described as follows: First, architects users academic partner (AUTH) and the professional architectural office (HdM) discussed and defined the topics of PUC 2. They generated a list of related keywords, related to the selected cases. Content providers (Europeana, Art Films and Solaris film Production) used the list of relevant keywords, so as to effectively search into their archives of images and videos and the material repositories. The search for material has produced a list of available material, images and videos, which has been properly classified. Available material has been enriched by free video sources found online, through appropriate sharing licences (creative commons). Initial tests have been made so as to move towards the reconstruction of small scale elements.

3.2.4 Story

Scenario topic: Exhibition elements on East Asian, Japanese Visual Culture

An architecture office is commissioned to design elements of the interior environment of an exhibition space in east Asia, specifically in Japan, (M+ Museum by HdM) in order to host a

thematic temporary exhibition on Japanese visual culture and calligraphy. The creative team responsible for the task (HdM and AUTH) will use V4Design in order to find related material for research upon the selected topic. They are going to need information (3D, 2D and textual) of local stylistic and cultural environment in order to examine the possibilities for designing elements for the exhibition space. Design includes furniture and exhibition partitions. The creative team will use V4Design to analyse elements of East Asian, Japanese culture and experiment with them. V4Design will be used to support the design procedure for the exhibition installations and make it more effective. They are going to use output from 3D, 2D and textual analysis in order to further develop design novelties, products, physical prototypes and additional visual material to shape their proposal and communicate it to the public. The output from the tool is going to be used to produce 360° Images, animations, Class A Rendering, VR Scenes, final proposal explanatory texts and analysis etc., images and other visual content.

3.2.5 High level user requirements

We envision V4Design components that provide the following functionalities:

High LvL User Requirement	Description of Action (DoA)
HLUR_007	Architects and designers can extract 3D models of places, buildings and objects out of videos and images of artworks and culturally sensitive space elements
HLUR_008	Architects and designers can extract 3D textures, cg materials from 2D images of artworks and culturally sensitive space elements
HLUR_009	Architects and designers can extract 2D patterns of artworks and culturally sensitive space elements in editable vector format
HLUR_010	Architects and designers have a tool that can assist in formulating new, innovative architectural ideas
HLUR_011	Assets can be 2D videos/images, textual information, etc.

3.3 Design of virtual environments, related to TV series and VR video games

3.3.1 Executive summary

The PUC concentrates on a business need based on new market segments to develop games/applications from 3D objects extracted in to a VR environment from different entertainment, eLearning TV-shows and other video content. The PUC will develop a game based on an environment coming from video footage currently in DW archives. The footage would mostly be from a telenovela called 'Nicos Weg' and the game planned would include the environments and exercises inspired from the Telenovela.

Figure 9: Nicos Weg PUC

3.3.2 Rationale

The components of V4Design includes the NURO Authoring tool which will be capable of developing 3D environments for use in VR games from the models extracted by V4Design. The particular PUC will be demonstrates V4Design ability to extract 3D models and textual analysis from archives of DW and other content providers. The PUC uses the following features of V4Design platform:

1. To be able to extract smaller 3D objects
2. To be able to extract textures of walls
3. To be able to create 3D environments for use in VR games
4. To be able to easily modify how the game environment interacts with assets
5. To be able to drag and drop 3D models

3.3.3 Detailed description

When a pre-existing video telenovela is adapted to a new medium, the 'adapter' will encounter different challenges – especially when the company is a not tech-savvy person. This is where V4Design and its components come into play. In this PUC we work in developing a 3D environment for a VR based game that can be developed by a production company with little knowledge. The game will contain various different levels of language learning based on the episodes of "Nicos Weg" and storyline behind the episodes. Each level is a different scenario of the use case.

Example Scenario 1: Vocabulary learning inside an apartment

In this scenario, the environment will be from apartment where Nico lives in, in the telenovela. The environment will contain various smaller assets that are present inside the apartment that the user can move around. The scene starts in apartment's living room and the user is able to interact with various assets (small objects), as soon as he/she comes near an object or points inside the environment, there is information displayed about the object along with the ways it is identified in different languages, so the user can relate to it in German language. Once the user has interacted with the objects inside the living room, he will have the option to move to a different room after passing a small quiz near the door to test his learning and knowledge based on the interactions inside the room. Similarly, during the scenario the player is able to explore the entire apartment.

The apartment's walls will have the similar textures as Nico's apartment in the telenovela, which will be extracted using V4Design components, the environment using the authoring tool and the quizzes will be created using an easy to use interface inside the authoring tool. The information about the smaller assets, extracted from V4Design and downloaded from other asset libraries.

Figure 10: Grocery items inside the video archives of Nicos Weg

The following scenario can be adapted to specific topics in vocabulary learning such as food items, household items, grocery items, entertainment items etc. Example Scenario 2: Interaction with other people inside the apartment

In this scenario, a similar environment like previous scenario will be generated to develop a gameplay of the level where the player has to interact with other flatmates/characters based on Nico's flatmates. The interaction will consist of basic conversation in German, along with the ability of the player to also view the conversation in their native language. The player will then have to complete a quiz/exercise to move to a different room and talk to a new character.

Figure 11: Interaction with other people in the telenovela

Example Scenario 3: Interaction with random people and objects in an open environment

This scenario will work in development of an open 3D environment using the authoring tool with various 3d objects and assets from the V4Design repository as well as other asset stores. The player will be able to interact with the assets and create a storyline and information for the object that the player will see inside the scenario. The player will be able to walk around and interact with assets which can be objects or characters based on the developer.

Figure 12: Market Scene in the telenovela

3.3.4 Story

DW (A production Company) with a successful language learning telenovela would like to develop a more immersive experience for its audiences in a new vertical as this would help them in acquiring more users/viewers. They would like to not hire a team with special skills to develop such a game therefore they would like to use which can help them in creating such an experience at a low cost with using a tool like V4Design to develop the environments and the assets from their video archives.

The production company can then use V4Designe's Authoring tool and other components to create such an experience. Firstly, the platform takes in the video footage from the archives and develops 3D assets of the objects inside the videos wherever possible and extracts other features such as textual information, characters etc. to be used in the VR environment. Following this, V4Design's authoring tool gives the ability to easily create this environment as a game component and export the game with Unity game Engine to various App stores.

3.3.5 High level user requirements

We envision a V4Design platform that provides the following functionalities:

High LvL User Requirement	Description of Action (DoA)
HLUR_012	The student finds her-/himself in an environment, where she or he can study by watching a 2D video (= episode of Nicos Weg) and do the corresponding exercises.
HLUR_013	The exercises are derived from already established exercises actually designed for Nicos Weg suing easy to use UI.
HLUR_014	The gameplay takes place in three dimensional environments inspired by

	2D content, such as Nicos Weg.
HLUR_015	Assets can be 3D objects, audio, 2D videos/images, textual information, etc.
HLUR_016	The gameplay considers state of the art of gameplay, meaning satisfying gaming elements, such as levelling up.
HLUR_017	The template of the gameplay meets the requirements in regard to language learning didactic.
HLUR_018	The components should also be able to extract the following: (i) Avatar, structure, etc. from DW telenovela; (ii) Avatar, structure, etc. from non-DW footage
HLUR_019	Video game creators would like to have a tool that can assist in the design of new, immersive VR environments for language learning purposes

3.4 Design of virtual environments, related to actual news for VR (re-) living the date

3.4.1 Executive summary

The pilot for re-living the date is designed in order to use the capabilities of V4Design for development of environments from news and videos captured previously. The pilot is designed specifically for production or broadcasting company for development of interactive documentary styled content for their audiences. The pilot will use the existing content from various content providers, as well as look into new content that has been captured of a particular scene. NURO authoring tool will be used to create a similar environment as the real life throughout history so that the user is able to interact with the environments and the same time gain more knowledge about the location or event.

Figure 13: Gendanmarkt Square

One of the most popular use cases of VR is creating experiences from locations and dates to help people gain experiences that previously were not possible. Creation of such experiences in an immersive environment has always been a problem for developers due to the lack of tools to facilitate the process. V4Design will help to solve the issues faced by creating specific tools to create such experiences from previously captured videos.

3.4.2 Rationale

V4Design aims to develop technologies to extract 3D models from a video source; therefore the data repository of DW and other content providers becomes a good source for the platform to demonstrate its capabilities. Companies such as DW are in need of applications that can input various video footage and B-roll to be re-used into development of interactive documentaries and other VR environments. The development of V4Design gives them an easy-to-use application to develop such applications and documentaries that can re-use their archived footage.

The pilot intends to validate the following system characteristics:

1. To deliver a VR environment using the Authoring tool
2. To extract 3D assets from the archival as well as new footage
3. To be able to create multiple 3D environments in one application
4. To be able use search inside V4Design database for assets.

3.4.3 Detailed description

Media companies, such as Deutsche Welle, have great collection of archives, where – among others – video footage is stored/archived. Nowadays, audio-visual material is used multiple times for different channels – for TV, online publishing and Social Media. What if journalists want to add another medium and create an immersive, journalistic piece? In journalism everything is about the stories that are told, the content is core, nevertheless, the representation of it is almost equally important as the medium carries the story. Once the journalists decide on a topic they want to cover in their interactive and immersive VR experience in the form of a documentary prose (the journalists want their audience to not only learn about a topic but also experience the story), they look into storytelling aspects. This includes finding adequate video material that suits the requirements, meaning it can be converted to actual 3D content. The interactive documentary needs a “starting environment” on which the story is based; in this case it can be footage of a square, such as Gendarmenmarkt (Berlin, Germany), La Rambla (Barcelona, Spain), Trafalgar Square (London, U.K.), etc. In accordance with the overall story the journalists will pick 3D assets and decide on interactive elements, such as a timeline, to enrich the starting material and build the actual story. That is where the authoring platform comes into play.

Figure 14: Various buildings at Gendanmarkt Square

The idea of Virtual Urban Simulation (VUS) has become more relevant due to the increase in the adaptability and decrease in the cost of VR devices as a simulation tool. Various new uses for these simulations have arrived in the past few years. This pilot brings a previously untouched use of these devices and the methodology for VUS design for developers.

The current production process of development on VUS includes three major steps:

1. Data Collection
2. 3D Modelling
3. Presentation

The pilot targets all the steps of the production process and how V4Design can help transform the production process with better and faster results.

3.4.4 Story

DW (a production company) wants to develop a documentary which immersive for its user using the existing footage they have from various news and locations. They have in-house software engineers who have basic knowledge of Unity Engine and designing. The content curator at DW puts in the relevant video inside V4Design non-semantic database and the software engineer can start the loop in V4Design to extract 3D Models, textual data using the metadata of the videos.

Once the 3D environment is extracted in the Backend tool of V4Design, using the Authoring tool developed on top unity the software engineer can import it into their scene and the authoring tool will be able to setup a camera location which will help in development of one

piece of the interactive documentary intended. Similarly, the software engineer can import assets from various times and locations to create a story that they would like to tell and develop it into a timeline or automated scenes for the VR Application.

To export the VR application, the engineer can directly view it using the Unity's player to export it to various devices using the pre-defined templates in the Unity application and put them on the store they like.

Figure 15: Small objects at Gendanmarkt Square

3.4.5 High level user requirements

We envision V4Design components that provide the following functionalities:

High LvL User Requirement	Description of Action (DoA)
HLUR_020	Ability to develop multiple environments for the same scene
HLUR_021	Ability to change the environments using scrollbar
HLUR_022	Ability to change storyboards to easily develop a story
HLUR_023	Ease to put assets inside the environment and toggle switch to enable interaction inside the environment
HLUR_024	Get data about the video asset is extracted from
HLUR_025	Video game creators would like to have a tool that can assist in the design of new, immersive VR environments for reliving a significant past event
HLUR_026	Assets can be 3D objects, audio, 2D videos/images, textual information, etc.

4 ANALYSIS OF V4DESIGN REQUIREMENTS

This section will analyse the high level user requirements into more detail user requirements. Thus, the following table (**Table 2**) accumulates the user requirements that have been developed until now, based on the high level user requirements grabbed from each PUC. The user requirements are taken from the use case section (Section 3) and are documented/ prioritized under the needs for MoSCoW framework (Section 2).

Table 2: Analysis of user requirements

#User requirement (UR)	Associated High LvL User requirement (HLUR)	Detailed description of the user requirement	Associate Pilot Use Case (PUC)	Functional or Non-Functional (FR/N-FR)	MoSCoW Should Have (SH) Must Have (MH) Could Have (CH) Won't Have (WH)
UR_001	HLUR_003, HLUR_010, HLUR_019, HLUR_025	As an architect/video game designer I would like to be able to upload videos in V4Design platform using a simple GUI	PUC1, PUC2, PUC3, PUC4	N-FR	SH
UR_002	HLUR_001, HLUR_007	As an Architect I want to be able to retrieve 3D-Models	PUC1, PUC2	FR	MH
UR_003	HLUR_002, HLUR_008	As an Architect I want to be able to retrieve high and reduced resolution textures	PUC1, PUC2	FR	MH
UR_004	HLUR_002, HLUR_008,	As an Architect I want to be able to reuse textures (Pattern extraction / seamless texture generation)	PUC1 PUC2	FR	CH
UR_005	HLUR_006, HLUR_011	As an Architect I want the tool to support extraction of material layers: diffuse, normal-map, bump, displacement, ambient occlusion	PUC1 PUC2	FR	CH

#User requirement (UR)	Associated High LvL User requirement (HLUR)	Detailed description of the user requirement	Associate Pilot Use Case (PUC)	Functional or Non-Functional (FR/N-FR)	MoSCoW Should Have (SH) Must Have (MH) Could Have (CH) Won't Have (WH)
UR_006	HLUR_003, HLUR_010, HLUR_024	As an user I want further details about the acquired footage (semantic data/tags)[4] i.e., Input footage quality, extracted data quality, bounding box of extracted 3D model (unit independent), geo-location, date/time of scan, author, copyrights, visible colours, related scans.	PUC1 PUC2 PUC4	FR	MH
UR_007	HLUR_006, HLUR_011, HLUR_015, HLUR_026	As an user I want augmented data of the acquired 3D model (semantic data/tags) i.e. Description, related Wikipedia articles, summarization of textual content related to the 3D model, social media entries about/around scanned area/object.	PUC1 PUC2 PUC3 PUC4	FR	SH
UR_008	HLUR_006, HLUR_011, HLUR_015,	As a user I want various file formats as outputs:	Needed for all PUCs	FR	It is a MH for some formats at the

[4] https://www.allegorithmic.com/products/bitmap2material

#User requirement (UR)	Associated High LvL User requirement (HLUR)	Detailed description of the user requirement	Associate Pilot Use Case (PUC)	Functional or Non-Functional (FR/N-FR)	MoSCoW Should Have (SH) Must Have (MH) Could Have (CH) Won't Have (WH)
	HLUR_026	• 3D Model: OBJ, FBX • Textures: JPG, TIFF, BMP, PNG • Material: vrmat, mdl • Colour Palette: Adobe swatches library			beginning of the project and SH by the end of development.
UR_009	HLUR_003, HLUR_010	As an Architect I want UIX: 3D-gallery i.e. A distraction free interface with rendered preview thumbnails.[5]	PUC1 PUC2	N-FR	MH
UR_010	HLUR_003, HLUR_010	As an Architect I want UIX: VR usage scenario	PUC1 PUC2	N-FR	SH
UR_011	HLUR_003, HLUR_010	As an Architect I want UIX a detailed view of: • Gallery of 3D model (with/without texture), usage examples from other users. • Additional data: palette of visible colours + bounding box size, author, copyright • Team/Public	PUC1 PUC2	N-FR	MH

[5] dtHUB© Herzog & de Meuron, Basel LTD. / https://megascans.se/library/latest

#User requirement (UR)	Associated High LvL User requirement (HLUR)	Detailed description of the user requirement	Associate Pilot Use Case (PUC)	Functional or Non-Functional (FR/N-FR)	MoSCoW Should Have (SH) Must Have (MH) Could Have (CH) Won't Have (WH)
		relation functions: Rating system, Personal notes/ marking/ save to favourites, share functionality for social media.			
UR_012	HLUR_003, HLUR_010	As an Architect I want UIX: Search by semantic tags (keywords) • Tags organized in tree structure and search field for typing tag. Personal tags (non-public tags)	PUC1 PUC2	N-FR	MH
UR_013	HLUR_003, HLUR_010	As an Architect I want UIX: Detailed search by features: • Quality (3d model/texture), Footage features, augmented data	PUC1 PUC2	N-FR	SH
UR_014	HLUR_003, HLUR_010	As an Architect I want UIX: Download settings (saveable profiles): • Mesh quality/format, Texture quality/ format/ layers (checkboxes), Material definition file	PUC1 PUC2	N-FR	MH

#User requirement (UR)	Associated High LvL User requirement (HLUR)	Detailed description of the user requirement	Associate Pilot Use Case (PUC)	Functional or Non-Functional (FR/N-FR)	MoSCoW Should Have (SH) Must Have (MH) Could Have (CH) Won't Have (WH)
		Colour palette (e.g.: adobe swatches)			
UR_015	HLUR_003, HLUR_010	As an Architect I want to upload/extract UI requirements: • Personal footage uploads with detailed upload and extraction progress. Status notification system (email, sms, webhook)	PUC1 PUC2	N-FR	SH
UR_016	HLUR_003, HLUR_010	As an Architect I want a Timeline: • Max. 10min. coarse extraction for pre-evaluation of scan results. • Max. 1h for full quality extraction. • Possible cancelation of full quality extraction process.	PUC1 PUC2	N-FR	SH
UR_017	HLUR_002, HLUR_004, HLUR_008, HLUR_009	As an Architect I want texture and material recognition that might appear in images and videos.	PUC1 PUC2	N-FR	CH
UR_018	HLUR_003,	As an Architect I	PUC1	N-FR	CH

#User requirement (UR)	Associated High LvL User requirement (HLUR)	Detailed description of the user requirement	Associate Pilot Use Case (PUC)	Functional or Non-Functional (FR/N-FR)	MoSCoW Should Have (SH) Must Have (MH) Could Have (CH) Won't Have (WH)
	HLUR_010	want to have the "intelligence" of an architectural synthetic tool (combination of texture, colours, shapes)	PUC2		
UR_019	HLUR_003, HLUR_010	As an Architect I want to browse assets(materials, textures, bumps etc.) in VR/AR environment (not only in screen)	PUC1 PUC2	N-FR	CH
UR_020	HLUR_005, HLUR_009	As an Architect I want the ability to have the point cloud and the mesh of the 3D reconstruction	PUC1 PUC2	N-FR	SH
UR_021	HLUR_005, HLUR_009	As an Architect I want the ability to edit (and clean) the point cloud before the creation of the mesh	PUC1 PUC2	N-FR	SH
UR_022	HLUR_003, HLUR_010	As an Architect I want Simple and clear visual UI. Simple enough for non-specialised users	PUC1 PUC2	N-FR	SH
UR_023	HLUR_003, HLUR_010	As an Architect I want have access to the code of the tool	PUC1 PUC2	N-FR	CH
UR_024	HLUR_003, HLUR_010,	As a Content Provider I want the	PUC1 PUC2	N-FR	SH

#User requirement (UR)	Associated High LvL User requirement (HLUR)	Detailed description of the user requirement	Associate Pilot Use Case (PUC)	Functional or Non-Functional (FR/N-FR)	MoSCoW Should Have (SH) Must Have (MH) Could Have (CH) Won't Have (WH)
	HLUR_019, HLUR_025	system to start a new processing loop when detecting new content on the server	PUC3 PUC4		
UR_025	HLUR_001, HLUR_006, HLUR_007, HLUR_011, HLUR_015, HLUR_026	As a user I would like to have an easy way to serendipitously find content I might want to reuse • To have access to lists of 3D models, but also find contextual information, other assets and related work	PUC1 PUC2 PUC3 PUC4	N-FR	SH
UR_026	HLUR_003, HLUR_010, HLUR_019, HLUR_025	As a Content Provider I want to be able to download in STL format from the V4Design platform to aggregate and distribute freely reusable 3D models, for instance, Wikimedia Commons	PUC1 PUC2 PUC3 PUC4	FR	SH
UR_027	HLUR_003, HLUR_010, HLUR_019, HLUR_025	As a Content Provider I want an OAI-PMH endpoint to harvest data form the V4Design platform for re-use, so there is no need to manually scrape freely reusable	PUC1 PUC2 PUC3 PUC4	FR	SH

#User requirement (UR)	Associated High LvL User requirement (HLUR)	Detailed description of the user requirement	Associate Pilot Use Case (PUC)	Functional or Non-Functional (FR/N-FR)	MoSCoW Should Have (SH) Must Have (MH) Could Have (CH) Won't Have (WH)
		content			
UR_028	HLUR_003, HLUR_010, HLUR_019, HLUR_025	As a Content Provider I want to receive statistics about which items are being seen and/or downloaded from my repository, so I can generate reports on the impact of my content • To know what extent one can re-use and repurpose, and possibly have to attribute, the on-going works	PUC1 PUC2 PUC3 PUC4	N-FR	MH
UR_029	HLUR_003, HLUR_010, HLUR_019, HLUR_025	As a content provider I want to receive user statistics of the amount of users that are using the platform, the retention rate, the bounce rates, and other user metrics • Usability and Analytics feature for users	PUC1 PUC2 PUC3 PUC4	N-FR	SH
UR_030	HLUR_003, HLUR_010, HLUR_019, HLUR_025	As a content provider I want clear and transparent labelling of the reuse rights and copyright	PUC1 PUC2 PUC3 PUC4	N-FR	MH

#User requirement (UR)	Associated High LvL User requirement (HLUR)	Detailed description of the user requirement	Associate Pilot Use Case (PUC)	Functional or Non-Functional (FR/N-FR)	MoSCoW Should Have (SH) Must Have (MH) Could Have (CH) Won't Have (WH)
		status of every item in the V4Design platform so as to enable better communication and IP protection to content providers.			
UR_031	HLUR_015, HLUR_026	As a game designer I want to get information about the asset sizes in the video content • To create a real life sized assets for VR 3D environments	PUC3 PUC4	FR	SH
UR_032	HLUR_015, HLUR_026	As a game designer I want to get information about the assets • Textual and semantic data about the 3D assets • Textual summaries describing the 3D models	PUC3 PUC4	FR	SH
UR_033	HLUR_012, HLUR_013, HLUR_014, HLUR_017,	As a game designer I want to get information about the entire series • While creating 3D environments from telenovelas, to create a	PUC3	N-FR	CH

#User requirement (UR)	Associated High LvL User requirement (HLUR)	Detailed description of the user requirement	Associate Pilot Use Case (PUC)	Functional or Non-Functional (FR/N-FR)	MoSCoW Should Have (SH) Must Have (MH) Could Have (CH) Won't Have (WH)
		gameplay game developer should be able to know everything about the series			
UR_034	HLUR_015, HLUR_026	As a game designer I want to get background audio assets, as there is always a need to add sounds in the gameplay for better immersiveness. V4Design should have related sounds in the data repository.	PUC3 PUC4	N-FR	SH
UR_035	HLUR_012, HLUR_013, HLUR_014, HLUR_016, HLUR_017, HLUR_018	As a content provider I want to be able to access a template of game design document • This will help in the better sharing of IPs and involvement all the actors in game development	PUC3	N-FR	CH
UR_036	HLUR_019	As a content provider I want to have game analytics from the authoring tool • Any game require analytics to better serve	PUC3	N-FR	CH

#User requirement (UR)	Associated High LvL User requirement (HLUR)	Detailed description of the user requirement	Associate Pilot Use Case (PUC)	Functional or Non-Functional (FR/N-FR)	MoSCoW Should Have (SH) Must Have (MH) Could Have (CH) Won't Have (WH)
		to the customers			
UR_037	HLUR_019, HLUR_025	As a film production company I would like to able to decide to import send the asset to the database after analysing it first	PUC3 PUC4	N-FR	CH
UR_038	HLUR_019, HLUR_020, HLUR_021, HLUR_025	As a film production company I want to be able to put location of the assets, such as putting the asset in the exact place as intended. A 3D drag-and-drop would be required	PUC3 PUC4	N-FR	CH
UR_039	HLUR_024	As a game designer I want to be able to get background info about the history of the video content • This will help in the decision of using an asset or not and also give perspective about the video footage used for the asset	PUC3 PUC4	N-FR	CH
UR_040	HLUR_023	As a film production company I want to be able to choose each asset for a time span	PUC4	N-FR	CH

#User requirement (UR)	Associated High LvL User requirement (HLUR)	Detailed description of the user requirement	Associate Pilot Use Case (PUC)	Functional or Non-Functional (FR/N-FR)	MoSCoW Should Have (SH) Must Have (MH) Could Have (CH) Won't Have (WH)
		• This will help in IP protection and also help in development of updated assets			

5 OUTLINE OF THE EVALUATION METHODOLOGY

The evaluation procedure is divided into i) **user evaluation** and ii) **system evaluation**. The user evaluation is based on experts' feedback as derived from usability reviews and testing. The system evaluation is the technical evaluation of the platform and its components and is based on the performance indicators, which have been specified in D1.1, and well established benchmarks.

This section presents the initial user evaluation plan. More specifically, it describes **who** will validate the V4Design prototype, **when** and **how**. In general, the evaluation of the first prototype will be mainly carried out by internal test persons, as the system and its performance will be too immature to be tested by external experts. Based on the experiences of this first evaluation we will update the evaluation plan for further evaluation rounds.

D7.2 will extend this initial user evaluation plan and include expected values for performance indicators both for the user and system evaluation.

5.1 Evaluation plan for architecture design pilot use cases

The evaluation of the architecture PUCs (PUC1 and PUC2) will mainly be based on: (i) A competitive market analysis (see D8.3) and (ii) in-depth expert-interviews and discussions with architects of interior and exterior design – either individually or in focus groups. Thus, both methods should be used for evaluating the V4Design system.

Existing tools that have been tested in the course of the market analysis (D8.3) will serve as a benchmark for the V4Design system and its prototypes. Through the competitive market analysis, advantages and disadvantages of already existing tools have been identified, showing their shortcomings and thereby helping to define a market gap and a possible Unique Selling Proposition (USP) for the envisioned V4Design system in a professional architecture design environment. Based on these insights, specific user requirements have been derived. The performance of the V4Design system should therefore be evaluated with regard to the performance of existing tools. The goal must be to compare V4Design's functionalities with regard to a possible additional value to the market.

Following a user centred design approach, the second phase of the evaluation will focus on actual user-tests (HdM, AUTH), involving real users from the target audience. The evaluation will consist of a mix of presentation, personal trials and interviews. Ideally, in a one-on-one situation, the users will be presented with the V4Design project story. Starting with an overview of the project goals and its progress, users will be introduced to the necessary details and basic knowledge to perform the evaluation in an unbiased manner. Functionalities will be presented as well as their state of progress in as much detail as necessary to understand their purpose. This is to ensure a correct evaluation of the prototypes and project results, independent from the state of the V4Design application.

The actual user test will then be performed on the basis of a number of preset tasks. These tasks will be written in accordance with the project's state of progress, again taking into account that not all functionality may already be implemented or as perfect as aimed for at this stage. The order in which these tasks are exercised will follow a preset schedule. This includes standardisation in terms of number of questions, time for each step of the

evaluation, support during the test etc. This method ensures comparable results over a number of test subjects and test sequences.

The progress and outcomes of these tests will be documented on the fly. All tests will be followed by individual interviews of the test persons based on a standardised questionnaire. Test users will be asked to comment on the tasks that they have performed, judging the system's functionalities and performance and also to express their overall assessment of the system. The latter questions are aiming at getting feedback on the tools usefulness for day-to-day professional work, its usability, and its economic potential for a bigger market.

The evaluation of the first prototype with regard to the architecture PUCs will pursue the following steps:

Table 3: Steps in first evaluation of the prototype for designers and architects

What?	When?	Who?	How?
First prototype available	M18	-	-
First evaluation round	M19-20	Focus group with architects and interior designers	The first V4Design prototype will be presented to a group of HdM and AUTH architects and interior designers that are familiar and passionate users of Rhino platform. They will be asked to validate the overall impression of the first prototype, its main goals, interface and usability as well as specific functionalities that are already available. The focus group will also be asked to assess the performance of the first V4Design prototype in comparison with other already existing tools and the improvement that it brought in Rhino platform.
Second evaluation round	M19-20	One-to-one interviews with architects and interior designers	A selected number of HdM and AUTH architects and interior designers (as well as available UG members) will be confronted with specific tasks that represent a near-real-world environment. After completion of these tasks they will be asked to validate the prototype's performance based on a standardised questionnaire.
First prototype evaluation report (D7.3)	M20	-	The first evaluation report will describe and analyse the evaluation process and results. Based on these findings it will eventually update user requirements and recommend certain improvements. It will also contain the plan for the second evaluation round (M27-28).

5.2 Evaluation plan for video/VR game pilot use cases

The evaluation of video game PUCs (PUC3 and PUC4) will follow a similar evaluation plan with the evaluation of architecture design PUCs. The targeted user groups will include two separate groups, namely a) video game creators that focus on immersive VR environments, b) content providers/producers that want to transfer their product in a VR environment.

Following a user centred design approach, the second phase of the evaluation will focus on actual user-tests, involving real users from the target audience (NURO, DW). The evaluation will again consist of a mix of presentation, personal trials and interviews. Ideally, in a one-on-

one situation, the users will be presented with the V4Design project story. Starting with an overview of the project goals and its progress, users will be introduced to the necessary details and basic knowledge to perform the evaluation in an unbiased manner. Functionalities will be presented as well as their state of progress in as much detail as necessary to understand their purpose.

The actual user test will then be performed on the basis of a number of pre-set tasks. These tasks will be written in accordance with the project's state of progress, again taking into account that not all functionality may already be implemented or as perfect as aimed for at this stage. The order in which these tasks are exercised will follow a pre-set schedule. This includes standardisation in terms of number of questions, time for each step of the evaluation, support during the test etc. This method ensures comparable results over a number of test subjects and test sequences.

The evaluation of the first prototype with regard to the video/VR game PUCs will pursue the following steps:

Table 4: Steps in first evaluation of the video/VR game prototype

What?	When?	Who?	How?
First prototype available	M18	-	-
First evaluation round	M19-20	Focus group with video game designers and content providers/ producers	The first V4Design prototype will be presented to a group of NURO video game designers and DW content providers. They will be asked to validate the overall impression of the first prototype, its main goals, interface and usability as well as specific functionalities that are already available. The focus group will also be asked to assess the performance of the first V4Design prototype in comparison with other already existing tools.
Second evaluation round	M19-20	One-to-one interviews with designers and content providers/ producers	A selected number of NURO video game designers and DW content providers (as well as available UG members) will be confronted with specific tasks that represent a near-real-world environment. After completion of these tasks they will be asked to validate the prototype's performance based on a standardised questionnaire.
First prototype evaluation report (D7.3)	M20	-	The first evaluation report will describe and analyse the evaluation process and results. Based on these findings it will eventually update user requirements and recommend certain improvements. It will also contain the plan for the second evaluation round (M27-28).

6 CONCLUSIONS

The deliverable summarises the initial PUCs that have been designed to test and evaluate the idea behind the creation of a platform such as V4Design. The PUCs are described in detail along with various scenarios inside each PUC. The deliverable also describes the initial user requirements based on all these PUCs and stakeholders' expectation to enhance the experience of the V4Design platform. Finally, the deliverable outlines an evaluation methodology that will be used to evaluate the platform against each user requirement and define Key Performance Indicators (KPIs) in order to achieve better usability and ease-of-access.

The user requirements in the deliverable will drive the specification of the first set of functionalities needed in the first version of the V4Design and shape the technical architecture of the platform. The use case scenarios and the user requirements will be further elaborated and extended in the subsequent versions of the deliverable (i.e., D7.2, D7.3 and D7.4).

7 REFERENCES

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