Bilkent University

Department of Computer Engineering

Senior Design Project

craftual: a 3D model viewer and an asset management, presentation-based cloud platform

Project Specification Report

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1. Introduction

3D is gaining in popularity and has an impact on everyone's life. Many different fields use 3D technology, from architecture, to entertainment. Look at James Cameron's movie 'Avatar'. This movie transformed the 3D industry by using 3D concepts to create the planet in the movie. Something we hadn't seen before in movies[1].

Any design you wish to present can be much more detailed and compelling when presented as 3D as opposed to 2D. 3D models not only give you a more vivid depiction of your design but also enables you to quickly see how little changes will affect the overall design. Being able to easily see how minor or major changes influence the final product is a huge benefit regarding efficiency as it will prevent costly adjustments that weren't foreseen. Easy remodelling and editing makes more accurate designs which means less cost and time invested.

A report presented by Sheryl Staub and Atul khanzode found that these technologies had a dramatic impact on project execution, including -

- Elimination of field interferences
- Less rework
- Increased productivity
- Fewer requests for information
- Fewer change orders
- Less cost growth
- A decrease in time from start of construction to facility turnover[2].

Furthermore, 3D designs are very user friendly since they require little to no instructions as opposed to 2D designs which often need precise instructions to get the design information. It also presents the opportunity to clearly show the physical dimensions of objects and their distances with relation to other objects without having to use precise numerical figures. The aforementioned features are some of the main reasons why 3D models are rapidly becoming more popular.

Our project, *craftual*, aims to create a platform where users from different practises can search for existing models, share their models with each other easily and create presentations with them.

1.1 Description

craftual, is a 3D model viewer and an asset management, presentation cloud platform. With *craftual* users can visualise and inspect 3D models on mobile devices with Augmented Reality (AR) by intuitive hand gestures and navigations and can create presentations compatible with AR.

From mobile and web interfaces, users can browse graphical assets and presentations from others. They can publish their own models and presentations or simply comment and give feedback on them.

The ability to discover new models by tags or categories and to download published models for private usage, as well as having an option to share those models is what makes *craftual* an interactive virtual tool, from engineers and architects to artists.

Our application will provide users a platform where they can publish their new ideas or hobby projects in a real-time 3D environment. The users can get feedback from others about their design choices and/or any updates they make on a previous model they have published.

Collaboration we offer to our users will be most useful when having a different perspective is invaluable.

1.2 Constraints

1.2.1 Implementation Constraints

- Our solution will have a web and a mobile application.

- Vue.js and React Native are our proposed Javascript frameworks for implementing the frontend.

- Figma will be used to design our project UI.

- ARCore and ARKit will be used to develop and present our 3D models.

- We are planning to use NoSQL based systems for the database.

1.2.2 Economic Constraints

In our project we are aiming to develop a product with minimal cost, therefore, the majority of the technologies we will be using are either open source or free to use.

Figma is free to use. ARCore and ARKit are also free to use for developers.

We plan to use NoSQL based systems for the database.

1.2.3 File Formats Constraints

On the first prototype we are planning to support the industry standard file format for graphical models which is `.obj`. However, `.obj` is a closed format meaning it is a proprietary product of Wavefront Technologies which is also outdated in today's standards. Meanwhile `.glTF` is a format developed by Khronos Group and also has a MIT Licence with full support of JSON. [3]

1.2.4 Language Constraints

Our product will be be available in English and there is an open prospect of

supporting other languages as well.

1.2.5 Privacy constraints

The customer information will be confidential and will not be shared with any

third-party organisation under any scenario. Any 3D model or presentation

developed by the user will only be visible to other users that have the access

information.

Users will also be able to share their projects with the public.

1.3 Professional and Ethical Issues

Due to the nature of our application, users will be able to upload and store models in our database to share and make presentations with them. 3D contents, user login and profile data and records are the data we need to register in our system. It is our obligation to ensure the security of those personal data according to the laws of KVKK [4]. Again, according to the KVKK laws, users should be informed which data we will keep and which ones we will process and share with third-party organizations.

The above-mentioned data will be kept in our system. Users' models will be processed under personal data protection law to optimize the application. It is our obligation to protect the data of users who upload their models privately to the system. If users want to delete their personal information, all information will be deleted from the system if they apply to us in writing. No user data will be shared with third-party organizations to provide a more reliable platform. Our application will be responsible for any personal data to be shared without notice. We will strive to

properly maintain our application and provide a user-friendly interface after making sure that personal data is protected by the law of KVKK.

2. Requirements

2.1 Functional Requirements

2.1.1 Creating 3D Content

- *craftual* shall allow automatic generation of 3D models from CAD drawings

- *craftual* shall accept the following 3D model and animated 3D model input formats:
    - AutoDesk (OBJ, FBX)
    - Khronos Group (glTF)
    - Apple, Pixar (USDZ)

2.1.2 Deployment of The Software

- *craftual* shall allow the user to access from browser by supporting all of the below
    - Chrome
    - Firefox
    - Edge
    - Safari
- craftual mobile application shall be deployed to digital distribution platform listed all of the below:
    - Google Play
    - App Store

2.1.3 Ease of Use

- *craftual* shall have a user interface that can be learned by non-software literate users.

2.1.4 Zoom

- *craftual* shall allow the user to pinch finger tips together to zoom in.

- *craftual* shall allow the user to pull finger tips apart to zoom out.

2.1.5 Geometry Rotation

- *craftual* shall allow the user to rotate 3D content.

- *craftual* shall allow the user to:

  - Rotate fingertips to rotate 3D content

  - Utilize a single finger sliding left/right/up/down to rotate 3D content

- *craftual* shall support the ability for the user to lock the 3D AR content view.

2.1.6 Asset Storage

- *craftual* shall allow the user to select content storage by supporting all of the below
  - Local (on the smart device or desktop)
  - Cloud-Based

2.1.7 Field of View

- *craftual* shall support devices that provide 85 degree field of vision in both directions (vertical and horizontal) where AR content can be displayed.

2.1.8 On-board Storage

- *craftual* shall support devices that have a minimum on-board free memory storage of 128 MB.

2.1.9 On-board OS

- *craftual* shall support Apple devices with iOS 11.0 or later and an iOS device with an A9 or later processor.

- *craftual* shall support Android devices with Android 8.0 or later and Android devices with x86 or x86_64 based AVD processor.

2.1.10 Display

- *craftual* shall support mobile devices with a minimum resolution of 1920x1080.

- *craftual* shall support mobile devices with a minimum of 60Hz refresh rate.

2.1.11 Social Platform

- *craftual* shall support the user to comment, like and share the graphical assets that are publicly visible.

- *craftual* shall support the user to download the 3D model and animated 3D models in the all of the formats below
    - AutoDesk (OBJ, FBX)
    - Apple, Pixar (USDZ)
    - Khronos Group (glTF)

2.2 Non-Functional Requirements

2.2.1 Usability

- *craftual* shall provide mobile application available to download from digital distribution platform listed all of the below:
    - Google Play
    - App Store

- *craftual* shall have a user interface that can be learned by non-software literate users (e.g. not a software engineering major).

- *craftual* shall provide a user-friendly interface for the user to create presentations.

2.2.2 Reliability

- craftual shall reside in Cloud-Based systems for high-availability.[5]

- *craftual* shall store all of the user created content at the Cloud-Based systems to ensure data-consistency

- *craftual* shall be consistent by adapting software testing principles.

2.2.3 Security

2.2.3.1 User Authentication

- *craftual* shall store passwords of the user with a combination of hashing and salting.

- *craftual* shall provide 2-factor authentication.

2.2.3.1 Sanitizing and Validating User Input

- *craftual* shall sanitize the input from interactive form fields to prevent database injections and cross-site scripting (XSS) attacks. [6]

2.2.3.2 Data Exposure

- *craftual* makes sure that any model that is shared privately, cannot be seen and modified by other users.

- *craftual* shall have an SSL Certificate (HTTPS) to ensure the protection of user-data.[6]

2.2.4 Performance

- *craftual* shall provide an efficient loader for 3D contents.

- *craftual* shall provide responsive and low latency user-interface.

- *craftual* shall provide high performance rendering of the 3D models to offer real-time inspection to the user.

2.2.5 Scalability

- *craftual* shall handle multiple simultaneous uploads and downloads from multiple users by efficiently utilizing the network I/O.

- Even though the number of users logging into the system is excessive, the system takes care of these requests without getting into a bottleneck.

3. References

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[3] *Godot Engine - Why We Should All Support glTF 2.0 As The Standard Asset Exchange Format For Game Engines.* [online] GodotEngine.org. Available at: https://godotengine.org/article/we-should-all-use-gltf-20-export-3d-assets-game-engines [Accessed 12 October 2020].

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