WEB DEVELOPMENT FOR GUITAR 3D CUSTOMIZATION

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ABSTRACT

Custom guitar became an option for some people who want to have a guitar with attention to the specifications of every part of the guitar it self. In making a custom guitar, consumers find it difficult in making a design for custom guitar, specification of model an prices are not well provide by the owner of custom guitar shop, and a picture or photos are available on the internet is not enough to describe the final result of the design of custom guitar model in detail. Utilizing web to provide an information about price and specification and WebGL as a tool to help consumers design the guitar in detail interactively by using a 3-dimensional object. In using the web, consumers can pick a model and materials for a custom guitar and consumer also can interact with the 3 dimensional object provide by the web such as rotating, panning, zoom in or zoom out. The result obtained from the study showed that by applying these web applications can help consumers make it easier to design a custom guitar, make an order, and shows the information about specification and the estimation of the price of a custom guitar designed.

Keywords : E-Commerce, Web3D, WebGL, Interactive 3D, Simulation.

1. INTRODUCTION

Wolf Master Guitar is one of the places of manufacture of acoustic guitar or electric guitar locally in Bandung, which has recently been formed. Wolf Guitar Master is more focused on the manufacture of acoustic guitar made of solid wood.

Wolf Guitar Master use social media as a media promotion. Wolf Guitar Master explains the price list for his custom guitar but the price list which is explained only about wood material used in the manufacture of the guitar itself particularly to the body of the guitar that is part of the top, side, back and neck part guitar, as for the other parts not described specifically.

From the results of the interview with Mr. Hari Gunawan as the owner of the work on the Branding & Strategy, Wolf Guitar Master already has prospective investors from all over Indonesia. Wolf Guitar Master it self was a workshop and does not yet have stores and there is no example of a guitar on display in his workshop because of the business processes used by ordering the custom guitar first after it was freshly made. The absence of examples of guitar making, consumers who want to order, consumers can't see or try samples of guitar that would like to order. Many consumers who want to order a custom guitar brings the image of the desired custom guitar using a photo or image they are looking for via the internet. Consumers who want to order sometimes like to get an visualization of the final result will be a custom guitar he wants. The result of custom guitars ever ordered ever does not correspond to the desired consumer expectations, so the risk incurred is the loss by making a custom ordered guitars back or with a warranty repair. Mr. Hari Gunawan also expects to have a website that can be used for various things such as promotions, display products, delivery of complete information about custom guitars that are on the Wolf Guitar Masters ranging from specifications, prices, and booking a guitar.

From the results of a questionnaire distributed online, 76% of respondents feel difficulty in designing a custom guitar. As many as 73% of the respondents consider drawing or photo model guitars on the internet is not enough to describe the design of the guitar in detail. One person the respondent ever order a custom guitar in at Wolf Guitar Master respond if his order does not fit custom guitar is expected because of the discrepancy from the specifications that have been planned. Respondents wo response need of visualizing the end result of the desired custom guitar design in detail.

In accordance with the needs and problems of the lack of guitar display, specs and price are less obvious, as well as the difficulty of designing

and visualizing the end result of the design of custom guitar models who want to be ordered in detail, then the solution is given is using Web3D. The website that can be easily accessed to provide information, prices, specifications and detailed guitar design visualization in the form of interactive simulation using 3-dimensional model.

Based on existing problems, then the purpose which would like delivered is to build a website using 3-dimensional model as a tool to help users update the custom guitar in getting the final result visualization in detail of the specification mode, the desired price and guitar.

The goals from this study are:

1. Gives an information about guitar specification and prices in detail.
2. Helping consumers designing a custom guitar with model provides by Wolf Guitar Master.
3. Helping consumers to visualize the end result of a custom guitar with 3-dimensional model .

2. CONTENT OF RESEARCH

2.1 Base Theory

Used in the construction of this system with elaborate explanation will the theories as a base analysis and supporting the construction of web 3d guitar customization.

2.1.1 Software Development Method

Software development method for this web for guitar 3d customization are using a MDLC (*Multimedia Development Life Cycle*) method.

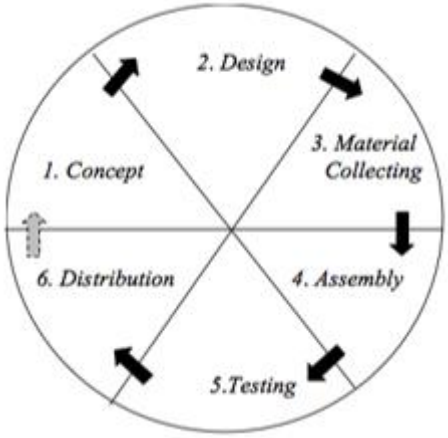


Figure 1 Multimedia Development Life Cycle Method

According to Iwan Binanto this MDLC method by Arch Luther:

1. *Concept*
   The scope of the concept is the identification of the user applications, this type of application, purpose, application. Basic rules for stages design is set up and determined as the style, the size of the application, the platform used, and more. The result of this step a kind of report which is a descriptive narrative of the proposed multimedia software [1].
2. *Design*
   The design needed to determine in detail the architecture, style, and all of the material to be used in multimedia software. This stage expected enough detail so that the next stages can be done without the need for other alternative decisions [1].
3. *Material Collecting*
   The collection of content material. This work was done in parallel with the stages of assembly, especially if the system allowed the dummy content for use until the content is actually there. the content of the material can be obtained from an external source or create your own to suit your needs [1].
4. *Assembly*
   The material has been collected and then merged, depending on what is already done in the previous stage, there is a possibility of no jobs at this stage should be done precisely or overall [1].
5. *Testing*
   Applications that are already built and the content of the material already added into the application are tested to make sure that everything is running with a desire [1].
6. *Distribution*
   The distribution of applications that are already fully prepared to use the prepared and adapted to the environment actually is. The development should have several alternatives for distributing [1].

2.1.2 Web3D

In the journal by Bentar Priyopradono and Fajar Antariksa Perdana about the Web3D to interior design. Web3D basically has a simple concept that is interactive 3D content is displayed through the web [2].

Beginning of Web3D introduced an idea to display and navigate the website using 3D graphics. A web3d term now used for all interactive 3D content displayed via the web that can be accessed through a web browser. Penggunanan Web3D meant that users can explore a 3-dimensional content. The user can see the 3-dimensional objects clearly from each side. Users can also interact with the 3-dimensional object that is displayed by using the mouse or the keyboard so users can shift, rotate,

or can he does zoom in or zoom out toward the 3-dimensional object shown..

2.1.3 WebGL

WebGL (Web-based Graphics Library) is platform Application Programming Interfaces (APIs) 3-dimensional graphics library that allows a web browser can be used to create a 3-dimensional form by means of a simple and efficient regardless of the performance provided a web browser [2].

Webgl is introduced by a software engineer named Vladimir Vukicevic which are then standardized and WebGL started developed by Khronos Group. WebGL using client-based rendering approach where elements or parts of a 3 dimensional model of unity downloaded from the server, all the processes required to process 3D models or 3D model assets for itself such as pictures, performed locally using the graphics hardware of the client [2].

WebGL technology has a several advantages:

1. WebGL is a javascript that it can facilitate the application deep integration with WebGL libraries like jquery or other javascript with HTML5 technology other [2].
2. Unlike OpenGL or other similar technology, where the presence of special operations in allocating and keep the memory manually. WebGL will automatically empty the memory that is not already used, so as to facilitate programming, reducing the required code and easy to understand [2].
3. The WebGL can be implemented on a mobile platform [2].
4. The performance of applications that use the technology equivalent of a standalone application WebGL, due to the ability of WebGL that can access local graphics hardware [2].

2.1.4 glTF

A 3-dimensional model of the traditional format designed to store data 3-dimensional models for offline usage, especially for support on desktop systems. The 3-dimensional format made by some person or graphics industry allows for the sharing of assets between 3D modeling application that is different but the types of formats that are provided are not optimal. Growing 3D web-based computing and mobile which is used for the visualization of products such as digital marketing e-commerce, entertainment, etc., requires fast and efficient processing.

glTF created to solve the problem, a neutral format that can be used by many applications of 3D modeling efficiently by using the JSON format as a basis so that a minimum of processing are used [3]. *glTF* are designed for goals [3]:

1. Compact file sizes
2. Fast loading
3. Runtime-independence
4. Complete 3d scene representation
5. Extensibility

2.2 Analysis Of System

System analysis is done to solve the problem with break it into several parts by studying the parts to reach the expected destination.

2.2.1 Problem Analysis

Corresponds to the background which has been described previously, then can be identified problems that occur:

1. Gives an information about guitar specification and prices in detail.
2. Helping consumers designing a custom guitar with model provides by Wolf Guitar Master.
3. Helping consumers to visualize the end result of a custom guitar with 3-dimensional model.

2.2.2 Analysis of The Running System

Wolf Guitar Master order system.

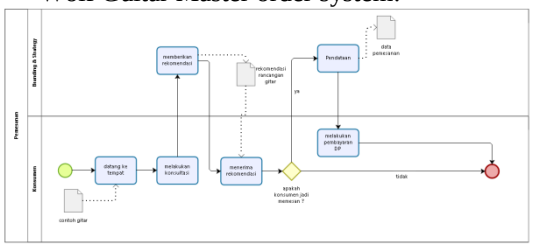


Figure 2 Order System Process

Description of the process flow that occors

1. The consumer comes with picture examples of a guitar.
2. consultation with the Consumer.
3. Branding & Strategy gives a guitar recommendation.
4. Consumers receiving recommendations are given.
5. If the consumer agrees with the recommendation of the design of the guitar, specs, and price and already sure of custom guitars to be made, it will be done on logging order desired, guitar specs and data consumers.
6. Consumers do initial payment in the form of DP or directly pay off.

2.2.3 Analysis Of System Architecture

Analysis of system architecture to be built using web service APIs Endpoint for communication of data request data such as 3d models, images, or other data. Here is a picture of the system architecture to be built.

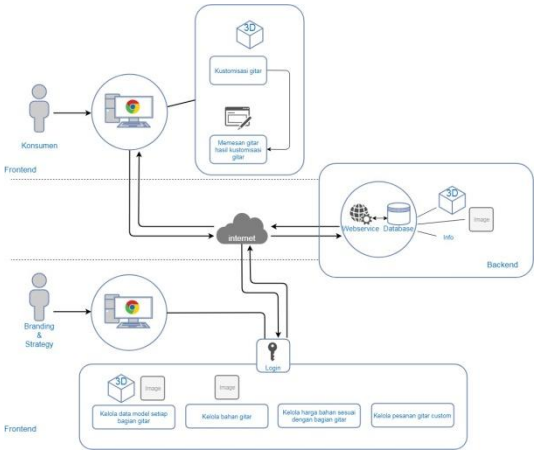


Figure 3 System Architecture

Explanation of the architecture to be built.

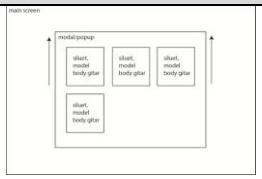
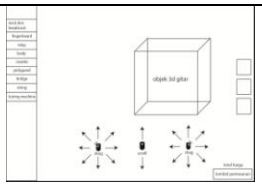
1. Front End
   a. Consumer access website for guitar customization using web browser.
   b. the consumer can do 3d guitar customization and custom guitar make a booking that has been designed.
   c. part of the Branding & Strategy of accessing the special page to perform data management, which must first do login.
   d. Part Branding & Strategy can manage customization model guitar by filling out the data and upload images and 3d models.
   e. part of the Branding & Strategy can do maintenance materials guitar for customization to be done is to fill in the data and upload the image texture wood.
   f. Part of Branding & Strategy can manage price for guitar parts in accordance with the wood material has been uploaded before.
   g. Part of Branding & Strategy can manage guitar custom orders consumers do.
2. Backend
   Backend web service form as the door to doing the request. There is a database for storing the data in the form of info, images, and 3d models.

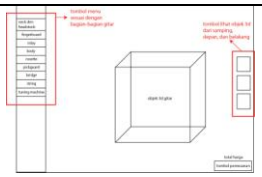
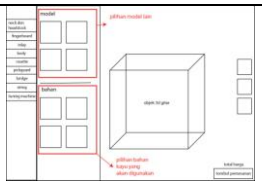
2.2.4 Analysis Application Development

3d guitar customization of web applications will be built this loaded model from every part of the guitar that would later be used for customization as well as wood that will be used. Visualization of the final result of the design of custom guitar is shown in the form of 3d simulation in which this simulation is a representation of an object that is in the guitar world.

2.2.4.1 Storyboards

Storyboards as an explanation will use, the interaction of web 3d guitar customization and also the concept of the application to be built

	Scene	Description
1		His photos page or the beginning scene is before entering the scene/guitar customization page. In this scene when users access the web will bring up a popup (capital) fade up from bottom to top that contains images in the form of a silhouette of the basic model which will be used for customization of guitars When the user selects a silhouette image of yesteryear will enter the scene 2
2		Guitar customization page for customization of guitars and guitar model simulation of 3d displays Users can perform the interaction to the simulation of 3d models of guitars that are displayed by using a mouse torotate 3d objects, shift, and zoom in or zoom out

3		Still on the customization page, on the right there are three buttons that are used to view the 3d object guitar from 3 different sides seeming i.e. side view from the front, it looks, and looks back On the left, there are buttons used for guitar parts guitar 3d customization by choosing the model and the materials to be used
4		This scene is a display which featured a sidebar list of choices of models and materials for customization guitar animated slide from right to left when users press the parts of the guitar

2.2.4.2 Analysis Of The Guitar

Here is an anatomical parts on the guitar as an ingredient analysis and as an ingredient for a 3 dimensional object modeling.
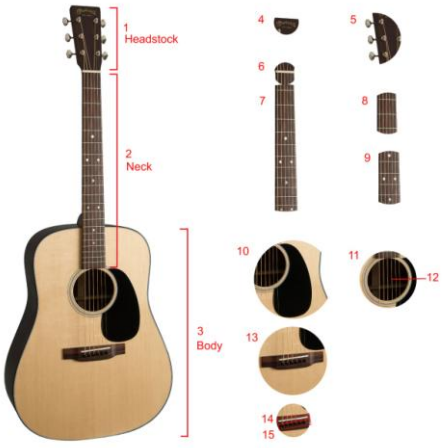


Figure 4 Guitar Anatomy

The following is the name of every part of the guitar and an indicator of customization that can be done.

Table 1 Analysis Of Guitar Customization

No	Parts	Indicators of customization
1	Headstock	Models and materials. Model and material effect on the price.
2	Neck	Models and materials. Model and material effect on the price.
3	Body	Models and wood, there are 3 parts of the body of the guitar that can be customized wood material used the body top, and body side + back, and bindings. Model and material effect on the price of.
4	Logo Headstock	Models and materials. Model and material effect on the price.
5	Tuning Machine	Models. Tuning machine model effect on the price of.
6	Nut	Nut effect on prices. The nut cannot be customized because Wolf Master Guitar using the default model and nut that is made from bone nut e.
7	Fingerboard	Material effect on the price. The model of the fingerboard is not customizable
8	Fret	Effect on prices. Fret not because of customizable Wolf by default Master Guitar fret is a fret used Dunlop
9	Inlay	Models and materials. Model and material effect on the price.
10	Pickguard	Models and materials. Model and material effect on the price.
11	Rosette	Models and materials. Model and material effect on the price.
12	String (senar)	Model effect on the price
13	Bridge	Models and materials.

No	Parts	Indicators of customization
		Model and material effect on the price..
14	Saddle	Effect on prices. saddle can't be customizable because by default using a saddle model and standard materials, saddle made from bone.
15	Bridge Pin	Effect on prices. Bridge pin can not be customizable because by default using the model and standard materials

2.2.4.3 glTF Format Uses

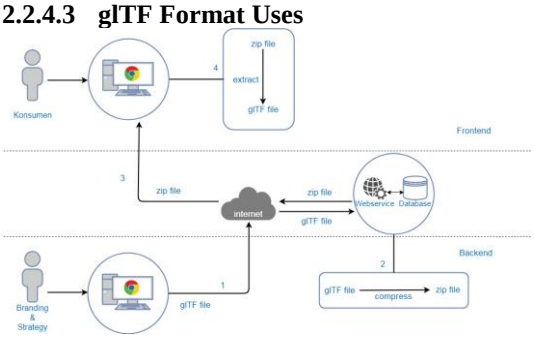


Figure 5 Architectural Use Of glTF File In System

1. The user part of the branding strategy & download file upload glTF to the server
2. The server receives files compressed into a are performed then glTF form zip file and stored on the server
3. Consumers when making customizations the guitar will access a zip file containing the 3d model files in the format of glTF
4. When web browser clients receive the zip file and then extract the file, extract the glTF has been stored in the cache and then in rendering and displayed to the web browser using the library three.js. Cache utilization for file gltTF to reduce HTTP request when accessing 3d models

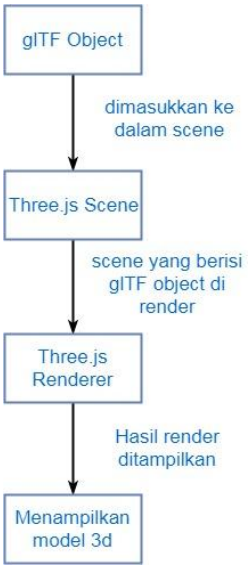


Figure 6 glTF Render In Application

2.2.5 Non Functional Requirement Analysis

A functional needs analysis is details about things need to be done system. Non-functional requirements analysis for estimating system requirements.

2.2.5.1 Users Analysis

Analysis of the user to know the characteristics of the web user this 3d guitar customization in order to note the user's characteristics, level of experience and understanding of the users of the system.

Table 2 User Characteristic

User Characteristic	
Users	Consumers / *Branding & Strategy* / Administrator
Age	Above 12 years old
Gender	Male / Female
Hand Used	One / Both are in good condition
Disability	No
Color blindness	No

Table 3 User Knowledge And Experience (consumers)

User Knowledge And Experience	
Computer knowledge	Can operate the computer basics
Application experience	Can use a web browser or application can use selling stuff online
Reading skills	Can read with good and true
Education level	Highschool or Above
Typing skills	10 WPM Minimum

Language skills	Indonesia and English

Table 4 User Knowledge And Experience (Branding & Strategy)

User Knowledge And Experience	
Computer knowledge	Can operate the computer basics
Application experience	1. Can use web-based applications or other common applications 2. Can use image processing applications 3. Can use 3 dimensional object processing applications (3D)
Reading skills	Can read with good and true
Education level	Highschool or Above
Typing skills	10 WPM Minimum
Language skills	Indonesia and English

2.2.5.2 Hardware Analysis

Analysis of hardware to learn the bare minimum hardware that is required for the implementation of.

Table 5 Hardware Specifications In Place Of Research

Hardware	**Specification**
CPU	2 *core*
RAM	2 GB
Display	1366 x 768 Resolution
Mouse	1 Unit Standard
Keyboard	1 Unit Standard
Internet Connection	10 Mbps

Table 6 Hardware Specification Of System Implementation

Hardware	**Specification**
CPU	2 *core*
RAM	512 MB
Display	800 x 600 Resolution
Mouse	1 Unit Standard
Keyboard	1 Unit Standard
Internet Connection	100 kBps

Judging from the comparison of the two tables can be said if existing hardware in place of research already eligible for system implementation.

2.2.5.3 Software Requirement Analysis

Software needs analysis intended to find out the needs of the software that will be used for the development or implementation of a system of.

Table 7 Software Development System

Software	**Specification**
Operating System	Windows 7
Web browser	Chrome
Node js	Version 6.11.4
Composer Package Manager	Version 1.4.2
SQLyog	Ultimate Version
Blender	Version 2.7.8
Adobe Illustrator	Adobe Illustrator CS6
XAMPP	XAMPP with PHP version 7
Sublime Text	Sublime Text 3
Postman	Postman latest version

Table 8 Minimum Software Specifications For System Implementation

Software	**Specification**
Web browser	Chrome

2.2.6 Functional Requirement Analysis

A functional needs analysis should be available and how to react to a system process inputs and how the system behaves in certain situations [3].

2.2.6.1 Use Case Diagram

Activity modeling system that will be built as a representation of a software requirements specification.

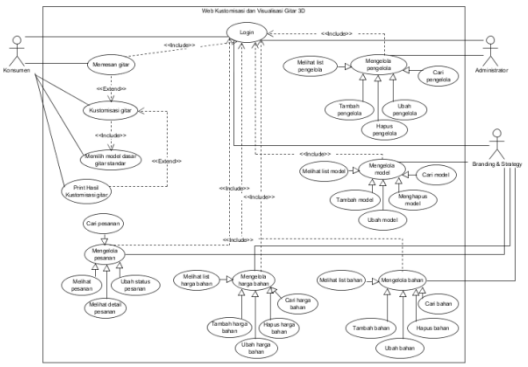


Figure 7 Use Case Diagram

2.2.6.2 Class Diagram

Class Diagrams to model all the classes and the relationships between the classes in the system. The following is the class diagram of the whole system to be built.

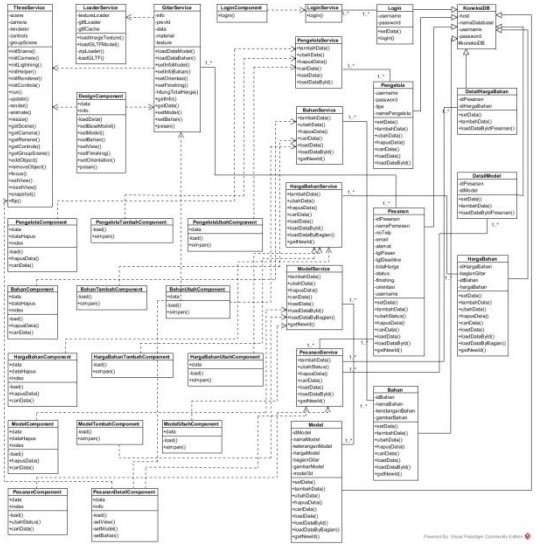


Figure 8 Class Diagram

2.2.6.3 Databases Analysis

Entity Relationship Diagram (ERD) as storage data that exists on the system. The following is a draft of the ERD to built.

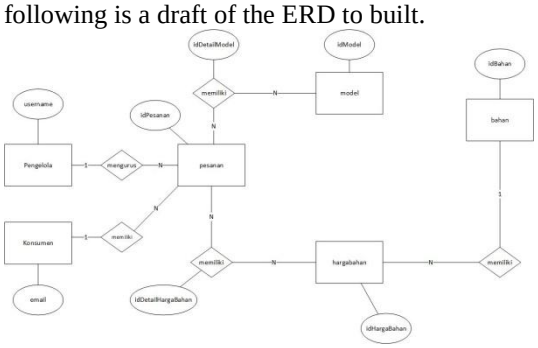


Figure 9 Entity Relationship Diagram

2.3 User Interface Implementation

Implementation of the interface of the system built the 3d guitar customization.

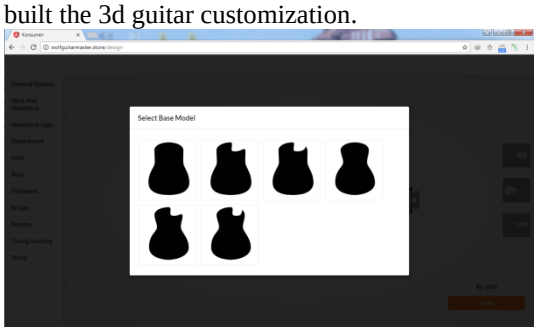


Figure 10 User Interface Choose The Basic Model Standard Guitar

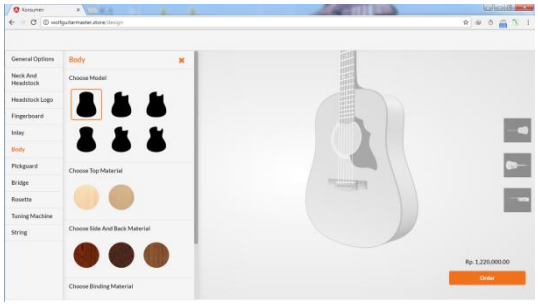


Figure 11 User Interface 3D Guitar Customization

2.4 System Testing

The testing system of web 3d guitar customization is done with a test plan that is functional testing, performance testing with the variables tested are page size and page load, and beta testing is given directly to the end user.

2.4.1 Functionnal Testing

Testing to test whether the functionality of the system has been running as desired. This is a test for the guitar customization functionality.

Table 9 Choose A Base Model Guitar Standard Testing Result

No	Kasus Uji	Hasil Yang Diharapkan	Hasil Yang Didapat	Kesimpulan
1	Pengguna menklik diluar modal	Modal tidak menghilang	Tidak terjadi apa-apa	[✓] Diterima [ ] Ditolak
2	Pengguna menklik gambar model dasar gitar	Menutup modal dan menampilkan model 3d yang sesuai dengan gambar yang dipilih	Modal menghilang dan menampilkan model 3d yang sesuai	[✓] Diterima [ ] Ditolak

Table 10 Guitar Customization Testing Result

No	Kasus Uji	Hasil Yang Diharapkan	Hasil Yang Didapat	Kesimpulan
1	Pengguna menklik menu general options dan memilih orientasi gitar	Model 3d berubah flip/mirroring menyesuaikan dengan orientasi gitar	Model 3d berubah sesuai dengan orientasi gitar	[✓] Diterima [ ] Ditolak
2	Pengguna memilih model sesuai bagian gitar yang ada pada menu	Model 3d berubah sesuai dengan bagian gitar	Model 3d berubah sesuai dengan bagian gitar	[✓] Diterima [ ] Ditolak
3	Pengguna memilih bahan untuk model bagian gitar yang dipilih	Texture model 3d berubah sesuai dengan gambar yang dipilih	Texture model 3d berubah sesuai dengan yang dipilih	[✓] Diterima [ ] Ditolak
4	Total harga berubah sesuai dengan model dan bahan yang dipilih	Total harga berubah dan sesuai nilai sesuai dengan keseluruhan model dan bahan yang dipilih	Total harga sesuai dengan model dan bahan yang telah dipilih	[✓] Diterima [ ] Ditolak
5	Pengguna menekan tombol *view side, view back* atau *view front*	Model 3d memperlihatkan visualisasi tampak pinggir, depan, atau samping sesuai dengan tombol yang ditekan	Model 3d memperlihatkan visualisasi tampak depan, samping, atau pinggir sesuai dengan tombol	[✓] Diterima [ ] Ditolak

Conclusion the results obtained for the 3d guitar customization functionality received already running as expected.

2.4.2 Performance Testing

Performance testing was done in the form of page size, the time the page loads. Testing performed on the chrome web browser. Testing the page size and page load is done by using the tools provided online i.e. GTMetrix [5].

Table 11 Page Size Testing Result

No	Deskripsi	Hasil Yang Diharapkan	Hasil Yang Didapat	Kesimpulan
1	Kustomisasi gitar untuk konsumen	Kurang dari 1.4 MB	1.66 MB	[ ] Diterima [✓] Ditolak
2	Login, kelola pengelola hak akses untuk administrator, dan kelola data untuk bagian *Branding & Strategy*	Kurang dari 1.4 MB	596 KB atau 0.58 MB	[✓] Diterima [ ] Ditolak

Table 12 Page Load Testing Result

No	Deskripsi	Hasil Yang Diharapkan	Rata-rata Hasil Yang Didapat	Kesimpulan
1	*Connection Cable (5/1 Mbps, 30ms)*	Kurang dari 5 detik	6.7 detik	[ ] Diterima [✓] Ditolak
2	*Connection DSL (1.5 Mbps/384 Kbps, 50ms)*	Kurang dari 5 detik	12.3 detik	[ ] Diterima [✓] Ditolak
3	*Connection 3G Mobile (1.6 Mbps/768 Kbps, 200ms)*	Kurang dari 5 detik	15.66	[ ] Diterima [✓] Ditolak

It can be concluded for testing page size, the size of the web for 3d guitar customization is still quite large. For a time the page is loaded, the web 3d guitar customization requires a long time to be accessed.

2.4.3 Beta Testing

Beta testing is done to determine if the system is built is in compliance with the expected objectives by using the Likert scale questionnaire, as a means of determining the value.

Tabel 13 Likert Scale Range Value

Description	Value
Strongly Agree	5
Agree	4
Neutral	3
Disagree	2
Strongly Disagree	1

The calculation is done to determine the value of any answer given the respondents using the formula provided on a Likert scale, i.e.:

$$P = \frac{S}{\text{Ideal Score}} \; X \; 100\%$$

2.4.3.1 Testing Results

1. First Objective Assesment Results
   Based on the results of the questionnaires for the first goal, namely to provide information would clearly specs and price, the value of the answers of the respondents i.e. 4.21, then we can say if the first goal is achieved.
2. Second Objective Assesment Results
   Based on the results of the questionnaire for the second objective, namely help design by giving an overview of the model as it is in the Wolf Guitar Master, the value of the answers of the respondents i.e. 4.38, then we can say if the second goal has been reached..
3. Third Objective Assesment Results
   Based on the results of the questionnaire for the third objective, namely help visualize the end result of the design of the model in detail using the 3D form, the value of the answers of the respondents i.e. 4.38, then we can say if the third objective has been reached..

3. CLOSING

3.1 Conclusion

Based on the results obtained from the stage of beta testing that has been done before in reference to research purposes, then it can be inferred:

1. This web Application can already provide information in the form of specification of prices clearly and estimate the price of your desired custom guitar.
2. This Web can already help the prospective buyer in designing custom guitar is corresponding with the desired available at Wolf Guitar Master.
3. The Model shown in this web can already help to visualize the end result of a custom guitar model design in detail.

3.2 Advice

Web 3d guitar customization is still need further development, including:

1. Web 3d this guitar customization does not yet have an example of the resulting sound design of custom guitars. The addition of examples of sound generated so that prospective buyers can also learn the sound quality produced from the guitar custom it wants.
2. Enhancements in the form of custom text logo so that consumers who try this 3d web guitar customization can make custom logos text yourself by selecting the type of font you want to use and then type in the word that will be used as the

logo and be shown dynamically on 3d models.

3. The addition of the custom logo upload feature if there are prospective buyers who want to use homemade custom logo that can be uploaded and displayed dynamically into 3d model.
4. Responsive web so that it can be used comfortably on a mobile web browser.
5. Customization model dynamically where the position of the 3d model can match with other 3d models that have been previously selected
6. Utilization of compressed 3d models i.e Draco Compression.
7. Optimization of the source code and assets are used to improve performance.

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