

A Learning Platform for 3D Digital Single Lens Reflex (DSLR) Camera

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Abstract—The use of Digital Single Lens Reflex (DSLR) camera is becoming increasingly popular. However, the selling price for these cameras is relatively high, especially for users who are on a tight budget and just getting started with photography. Therefore, we have developed a multimedia learning platform for Digital Single Lens Reflex (DSLR) camera to provide an interactive environment between users and the camera before they make their purchasing decisions. The main contribution in our platform is the modeling of a 3D DSLR camera equipped with the necessary lens and operation buttons that allows a realistic experience for users in real-time interactions with a mouse. Furthermore, a visual simulator is built into the platform to show how different aperture and shutter settings affect the outcome of a digital photo. First, the 3D DSLR model is constructed using 3Ds MAX, a professional modeling software. It is then exported to a Virtual Reality Markup Language (VRML) file format supported by the powerful 3D interactive software called WireFusion. Finally, the entire object is published on the internet with additional learning tools and multimedia resources to enhance learning delivery. Several screenshots of the platform are also presented in this paper.

Keywords-3D DSLR Camera; interactive visualization; multimedia application;

I. INTRODUCTION

Digital Single Lens Reflex camera (DSLR) cameras have become popular since the existence of digital photography in 1975 [12]. People like to capture and preserve their precious memories in high quality with this gigantic yet powerful device. Nevertheless, the features of Digital Single Lens Reflex (DSLR) camera are complicated to master in order to take good photos, and users, generally, lack of hands-on experience before they decide to purchase any devices. Moreover, selling prices are relatively high for the beginner who lives on a tight budget.

In response to these issues, the existing online learning platform consists of two types of contents: (1) online lessons and tutorials [2][4], (2) online lessons and tutorials, a virtual simulator that allows user to control the settings, for example, the shutter speed, in order to dictate the desire effects and outcomes of the given photos [15], and (3) online lessons and tutorials, a virtual simulator with some instant advices and tips to review the chosen settings of the camera in order to improve the quality of the capture photo [14].

Although these developed platforms are effective, a DSLR camera is displayed in a 2-dimensional picture, or, in other words, image. A plain image does not provide an interactive visualization for the user. Hence, a virtual testing on the camera is impossible before the purchasing decisions.

This paper presents a combination of multimedia, 3-dimensional graphics visualization and a web-based application in order to provide a realistic experience with easy access for the user in haptic interaction using only mouse operations [13]. Users are able to visualize the 3-dimensional DSLR camera by rotating it in different angles. The main components for the camera, such as Universal Serial Bus (USB) port can be operated and controlled by a simple click to view the descriptions (Fig. 3).

Furthermore, we have included both the tutorials and simulation tools to be in the same platform to facilitate the learning process, so users have an in-depth understanding of the respective functionalities. The users are able to operate and control the buttons of the three-dimensional model by setting different functions of the camera and capture photos to see the effects.

In addition, the platform also provides an instant feedback to the users on the improvements they would do to make the photos better. This is an effective and efficient way to learn and improve their skills rather than reading from reference books.

The 3-dimensional DSLR is first modeled with the famous professional modeling software called 3Ds MAX including the camera accessories, such as lens and a tripod. The created 3-dimensional model is then exported as Virtual Reality Markup Language (VRML) (.wrl) to be used and designed in WireFusion. WireFusion is an authoring tool for creating 3-dimensional interactive presentations that are supported in any web browser in order to provide easy access to users anywhere and anytime.

The remainder of this paper is organized as follows: Section 2 summarizes the previous platforms and implementation relevant to our approach. Section 3 explains the details and the interfaces of our platform. Users' surveys are presented in Section 4. Section 5 concludes the paper and refers to future work.



Figure 1. The first page of our platform [13].

II. RELATED WORKS

There are several learning platforms for DSLR camera that can be found in the literature. These are the common online methods to teach beginners how to use DSLR cameras.

A survey report [1] has proposed that the best way to teach the students is through online learning. The reason is because the course materials are accessible all year long and can be shared globally across different time zones.

As described in Section I, there are several online learning platforms. McHugh [2] provides a comprehensive and all the necessary resources to guide users on the terminologies, concepts and techniques for photographing with a DSLR camera. These resources include tutorials, photography tools and fora among users to share their technical knowledge. This online platform is suitable for the beginners, while [4] is mainly for advance users since their tutorials focus on photographing skills. However, both of the online platforms lack of interaction features and simulator.

There are a few online sites combined both tutorials and an additional virtual simulator which allows user to control the basic settings and view the outcome of the photo without providing any instant feedback to compare the used settings [14][15].

Wendzich [14] offers a simple yet straightforward tutorials about the concepts and terminologies of DSLR camera. In addition, they have a real-time visual feedback so user is able to see the results of their changes without committing to the shutter. Unfortunately, user has no option to change the photo and no advices are provided in the simulator.

The proposal in [15] allows user to control only the light of the camera: shutter and aperture to view the effects of the capture photo. Although this online platform offers a very valuable teaching but an incomplete virtual simulator.

Similarly, the solution in [16] has a very simple explanation for the features of camera, very limited controls for the settings and offered only three images in their virtual simulator.

On the other hand, CameraSim [3] consists of a virtual simulator that displays the effects of the photo under various settings such as the aperture, shutter speed, International Standards Organisation (ISO) speed and etc. Nonetheless, they are lack of teaching contents, no proper advices for the

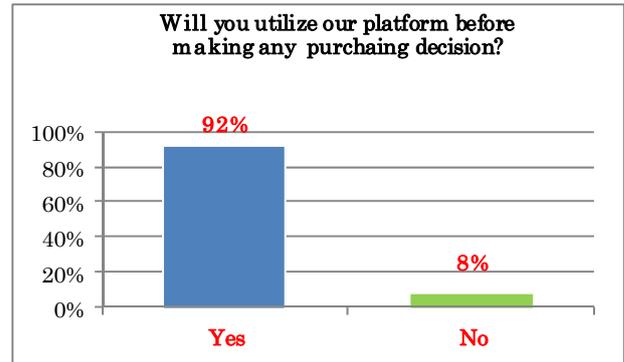


Figure 2. 92% of the respondents are interested to utilize our platform before making the purchase of a DSLR.

settings in the virtual simulator unless the user purchases the licences, and a limited number of example shots.

Canon [17] developed an online website to describe the basic manual settings for visual effects. They provide only one image to dictate the outcome and effects of the basic settings of DSLR camera. However, they give a detailed review and feedback for the capture photo.

As summarized above, the existing online platforms implemented the necessary contents to train the beginners and give them a grasp of the photographing foundation. Nevertheless, there is no integration between the user and the DSLR camera that can enhance their tactile involvement and intuitive understanding before they make a purchasing decision. Our platform [13] includes complete tutorials, the virtual simulator with extra features, and the highlight of the platform is the interactive 3D DSLR camera for the visualization assistance.

Sun et al. [5] describe a method for designing and developing a 3D virtual DSLR camera based on VRML and JavaScript languages. The authors built a 3D model by using 3Ds Max, professional modeling software, and exported it to a document supported by VRML. The purpose of this is to publish the program online for users to access anytime. Although the mentioned 3D model is available in this online learning platform, there is no visual simulator to visualize the effect of the captured photos. In addition, the platform lacked of guidance regarding the features for 3D DSLR cameras.

Recently, Moser et al. [6] presented a tangible photography education system that invites people to explore and learn about the technical settings involved in DSLR cameras. The user can physically manipulate and explore how these settings interact with one another to produce different types of photographic expressions. However, it would be more instructional for the the user to physically experience the 3D DSLR camera instead of in an online, electronic (and, thus, indirectly) context.

III. INTERFACES

A survey was conducted before the platform is established to determine the usefulness of 3D DSLR learning platform. Based on the results collected from 50 people, 92% of them will utilize the 3D DSLR learning platform before they decide to purchase a real one, as shown

in Fig. 2. Furthermore, a learning platform equipped with a 3D DSLR is yet a novel idea. Thus, we decided to develop this web application, as shown in Fig. 1.

A. Home

A user is able to interact with 3D DSLR camera displayed in Fig. 3 by rotating and zooming operation with the mouse. The 3D DSLR camera is first modeled by 3Ds MAX that can be downloaded for free [7] to be used for educational purposes. There are many tutorials and references which can be found in [8] and [10]. Actually the 3D DSLR camera is created based on the guidance in [9] and texture is added to the created model for a realistic effect. Whereas the bitmap image used for texturing is created with the use of Adobe Photoshop. The position for both texture image and the 3D DSLR camera must be matched exactly. Following this, a diffuse bitmap is selected in the material editor map of 3Ds MAX to diffuse the bitmap image on certain components in the 3D DSLR camera.

The second step involves, exporting the 3D content that was created into VRML97 (.wrl) file format that is supported by WireFusion 5.0. This is powerful software that is privately held by Demicron [11], a Swedish company dedicated to create an interactive 3D technology for used to visualize products and market them on the internet using Java programming language. It is a visual tool with event-driven programming. Users are able to download the manual from [11] and to learn the fundamental through a series of hands-on examples.

When users click the “Start” button shown in Fig. 3, the hotspot labels for camera components are presented as seen in Fig. 1. A brief description and a short animation are displayed when one of these hotspots is selected. For instance, the lens, mode dial, USB, lens release button and others are being labeled. Thus, users are able to gain an insight into the functionality of these components. These interactivities are completed using WireFusion 5.0.

Lastly, the end product of 3D DSLR camera is deployed as Java Applet in a Hyper Text Markup Language (HTML) file in order to publish to internet after all the necessary adjustment.

B. Tool Kits

This new tab page called “Tool Kits” is included in our learning platform that is not able to be found in other existing DSLR websites (see Fig. 5). Apart from DSLR camera, there are various accessories that can be used to improve the quality of photographs. The most common DSLR accessories including extra batteries, Ultra Violet (UV) filter, cleaning kits, lens, tripod and etc.

This page offers an interactive environment with descriptive tutorials that are useful for effectively understanding the functions of these accessories. Users are able to attach or change them by simply a mouse click. For instance, in Fig. 6, when user clicks on either macro lens or normal lens, the changing process is shown in real time. In order to see the effects of these lenses, user is required to



Figure 3. Several components of 3D DSLR camera are labeled with hotspots.

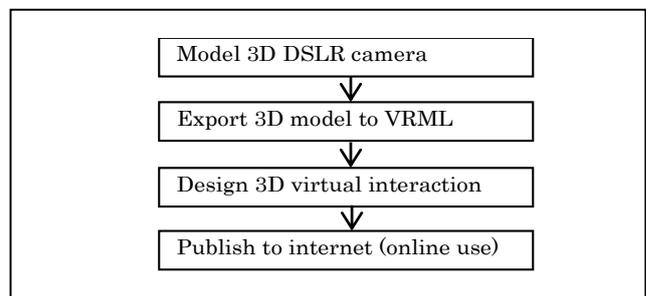


Figure 4. Several components of 3D DSLR camera are labeled with hotspots.



Figure 5. Toolkits: Lens tutorial for normal lens and macro lens.

press the button with camera icon. The background of the resulting photo is blurred and the subjects are sharpened when macro lens is used as shown in Fig. 7 (left). Macro lens is suitable for portrait capturing. On the other hand, normal lens is suitable to capture a neutral photo as shown in Fig. 7 (right).

Apart from the lenses, users are able to navigate with the tripod (see Fig. 8). Fig. 9 shows the differences between photos taken with tripod and without tripod during nighttime. Thus, users are able to make a decision whether to purchase these additional accessories without actually visiting the shops.



Figure 6. The changing process: (Left) Macro lens is changed. (Right) Normal Lens is changed.



Figure 7. (Left) Using macro lens and the subjects are sharper than the background. (Right) Using normal lens.



Figure 8. Tool Kits: Tripod tutorial.

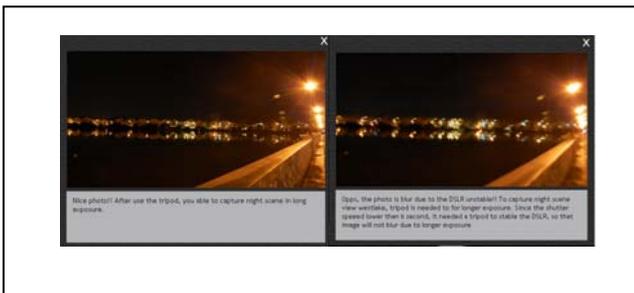


Figure 9. Picture taken at night. (Left) With tripod. (Right) Without tripod

C. Tutorials

The essential part of developing an intuition for photography is to master the use of camera exposure. A photograph's exposure determines how light or dark an image will appear when it's been captured by the camera. This is determined by just three camera settings or in other words the exposure triangle defined as follows:

- Aperture: A camera's aperture setting controls the area over which light can pass through the camera lens. It is specified in terms of f-stop value, which can at times be counterintuitive, because the area of the opening increases as the f-stop decreases. In photographer slang, when someone says they are "stopping down" or "opening up" their lens, they are referring to increasing and decreasing the f-stop value, respectively.
- Shutter Speed: A camera's shutter determines when the camera sensor will be opened or closed to incoming light from the camera lens. The shutter speed specifically refers to how long this light is permitted to enter the camera. Shutter speed and exposure time refer to the same concept, where a faster shutter speed means a shorter exposure time.
- ISO: The ISO speed determines how sensitive the camera is to incoming light. Similar to shutter speed, it also correlates 1:1 with how much the exposure increases or decreases. However, unlike aperture and shutter speed, a lower ISO speed is almost always desirable, since higher ISO speeds dramatically increase image noise. As a result, ISO speed is usually only increased from its minimum value if the desired aperture and shutter speed aren't otherwise obtainable.

The visual simulator is included in the tutorial to improve users' skills. With this simulator, users are not only limited to the facts and definitions for these settings, but they have the opportunity to visualize the effects that are caused by these exposure triangle.

As described above, aperture and shutter speed are closely related to each other. Thus, we placed their settings in the same page as shown in Fig. 10. Their settings are contradictory to get a perfect shot for the photo (see Fig. 11).

In addition, the visual simulator furnishes with an evaluator that gives useful advices and comments based on the chosen settings for further improvements. For instance, the resulting photo is dark when the user slide to F/ 22 for aperture and 1/ 1000 seconds for shutter speed using respective slider buttons (see Fig. 12). The evaluator advised user to decrease the aperture value and increase the shutter speed for a better shot, as shown in Fig. 11.

On the other hand, the resulting photo is bright, as shown in Fig. 13, when user selects F/ 5.6 for aperture and 1/ 125 seconds for shutter speed. In this situation, the evaluator suggested user to increase the shutter speed.

Technically, we applied the straightforward if-then-else logical operators for these evaluations. The following lists out all the advices and comments in the learning platform.

- 1) *Ooops! The exposure is too long until the photo looks blank and bright. You should adjust higher aperture value and higher shutter speed value.*
- 2) *The exposure is too long due to low shutter speed value. Windmill: look dim. Background building: disappeared. You should adjust higher shutter speed value.*

3) *The exposure is too long due to low shutter speed value. Windmill: look ambiguous. Background building: disappeared. You should adjust higher shutter speed value.*

4) *The exposure is too long due to low shutter speed value. Windmill: look ambiguous. Background building: bright and unclear. You should adjust higher shutter speed value.*

5) *The exposure is too long due to low shutter speed value. Windmill: Hardly visible and ambiguous. Background building: bright and unclear. You should adjust higher shutter speed value.*

6) *The exposure is too long due to low shutter speed value. Windmill: Visible but out of focus. Background building: bright and unclear, yet better. You should adjust higher shutter speed value.*

7) *Not bad, the photo look nice! But...Windmill: look ambiguous and out of focus. Background building: clear but bright. You should adjust higher shutter speed.*

8) *The exposure is too long! The photo is too bright. Windmill: bright and out of focus. Background building: clear but bright. You should adjust higher shutter speed value.*

9) *Good! But the photo is too bright. Windmill: look bright and out of focus. Background building: clear but bright. You should adjust higher shutter speed value.*

10) *Great! You are achieving the correct exposure, but...Windmill: out of focus. Background building: clearest. You should adjust higher shutter speed to freeze the windmill movement.*

11) *Well done! The photo looks perfect. You are achieving the correct exposure and the motion of windmill is frozen. Windmill and building background: Look clearer and sharper.*

12) *Perfect! The photo looks perfect. You are achieving the correct exposure and the motion of windmill is frozen. Windmill and building background: look clearer and sharper.*

13) *Not bad! You have freeze the motion of the windmill, but the photo looks dark due to underexposed. Windmill and building background: Look clearer and sharper, the darker. You should adjust lower aperture value.*

14) *Great! You have freeze the motion of the windmill. Windmill and building background: Look clearer and sharper, but it looks dark. You should adjust lower aperture.*

15) *Great! The photo looks perfect. You are achieving the correct exposure and the motion of windmill is frozen. Windmill and building background: look clearer and sharper.*

16) *The photo looks dark due to the area over which light can pass through the camera lens is small, thus, underexposed. You should be decreasing the f-stop value/ adjust to lower aperture value to increase light passes through the camera lens.*

17) *Wow, feel like raining?! The photo looks dark due to the area over which light can pass through the camera lens is small, thus, underexposed. You should be decreasing the f-stop value/ adjust to lower aperture value to increase light passes through the camera lens.*

Table I summarizes the comments that will display when the user selects the respective camera settings.

TABLE I. THE COMMENTS AND ADVICES BASED ON THE CAMERA SETTINGS.

CAMERA EXPOSURE		
Shutter speed (in seconds)	Aperture	Comments/ Advices
Less than or equal to 1/8	F/5.6	1)
	F/8.0	2)
	F/11.0	3)
	F/16.0	4)
Less than or equal to 1/30	F/5.6 F/8.0	5)
	F/11.0	6)
	F/16.0 F/22.0	4)
Less than or equal to 1/60	F/5.6 F/8.0	4)
	F/11.0	7)
	F/16.0	
	F/22.0	
Less than or equal to 1/125	F/5.6	8)
	F/8.0	9)
	F/11.0 F/16.0 F/22.0	10)
Less than or equal to 1/500	F/5.6	11)
	F/8.0	12)
	F/11.0	14)
	F/16.0 F/22.0	13)
Less than or equal to 1/1000	F/5.6	12)
	F/8.0	15)
	F/11.0	16)
	F/16.0 F/22.0	17)

Meanwhile, there is a separate visual simulator for ISO settings, as shown in Fig. 14 (left). As described above, ISO is to determine the amount of incoming light of the camera. Users are able to adjust the ISO values using the main command dial of 3D DSLR camera as displayed in Fig. 14 (Right). Furthermore, there are two types of the sample photos: indoor and outdoor. Fig. 15 (left) visualizes the effects of ISO 200 which caused darkness for this indoor photo. The evaluator suggested that user should use higher ISO values for a better picture, whereas in Fig. 15 (right) illustrated the effects of ISO 3200 that were too high for the outdoor photo. In this situation, the evaluator advised to lower the ISO value for a balanced effects. The evaluations and comments for indoor and outdoor pictures are listed in Table II.

TABLE II. THE COMMENTS BASED ON THE ISO SETTINGS FOR INDOOR AND OUTDOOR PICTURE.

ISO Settings	INDOOR PICTURE	OUTDOOR PICTURE
	Comments/ Advices	Comments/ Advices
200	Not Bad! But for indoor low light, you might want to adjust a higher ISO values.	Well done! ISO 200 is suitable for outdoor picture.
400	Well Done! ISO 400 is suitable for indoor picture.	Perfect! For outdoor with low light, ISO 400 is the most suitable.
800	Perfect! ISO 800 is the most suitable for indoor low light	Hmmm, this photo considered okay, but looked bright, you might want to lower down the ISO value
1600	Hmmm, this photo is considered okay, but consists of high ISO noise; you might want to adjust lower ISO values.	The photo is bright; you might want to lower down the ISO value.
3200	You should lower down the ISO values; the photo is too bright and noisy.	You should lower down the ISO value; the photo is too bright and noisy.
6400	Opps, ISO is too high! You should lower the ISO values for a better picture.	Opps, ISO value is too high! The photo is too bright and noisy. You should lower down the ISO values for a better picture.



Figure 12. An example of bad settings (too dark) of aperture F/22 and shutter speed 1/1000.

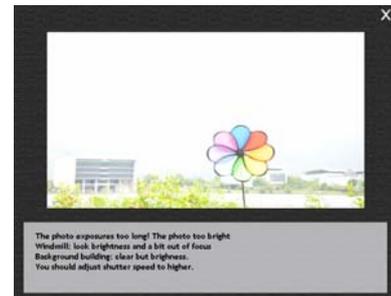


Figure 13. Another example of bad settings (too bright) of aperture F/5.6 and shutter speed 1/125



Figure 10. A visual simulator with aperture and shutter speed slider buttons.



Figure 14. A visual simulator with ISO settings. (Left) The starting page. (Right) Use the main command dial to adjust the ISO values.



Figure 11. A perfect shot with aperture F/2.8, shutter speed 1/1000 seconds.



Figure 15. (Left) An indoor photo with low ISO values. (Right) An outdoor picture with high ISO values.

The sample photos in the visual simulator are taken using the real DSLR camera. Therefore, the quality and the accuracy of the photos are preserved.

IV. USERS' SURVEYS – RESULTS

We have collected only 10 participants for the survey due to time limitation. Based on the results, 100% of them thought they'll have better learning about DSLR cameras through our website [13].

Moreover, we have compared our platform with several existing platform that has a visual simulator [3], [15], [16] and [17] and found out that, 89% agreed that they'll learn better if the website furnishes with a 3D model. Furthermore, the tools provided are very useful to them and, 64% enjoyed it since we have additional tools tutorials and more reality with a 3D model.

89% will visit our website before they decide to purchase a real one while 67% will revisit our website again after they bought a DSLR camera for tutorial purposes.

V. DISCUSSIONS AND FUTURE WORKS

In summary, our 3D DSLR learning platform [13] provides an interactive environment for users especially the beginners. This platform allows them to gain experience in photographing and the opportunity to test the virtual DSLR before their purchasing decision is made. There is a local company which runs a mentorship-driven startup accelerator for student entrepreneurs in Asia attracted to this benchmarking and claimed that it has a great potential as a gateway for the DSLR camera manufacturers to advertise their model in three-dimensional. They can utilize this platform to advertise their new model/s and attract their buyers.

This platform can be furthered enhanced by adding more features such as video tutorials and, higher levels of photography lessons since this platform is targeted to the beginners. Additionally, more tools can be added to the tool kits page such as flashlights, memory cards, batteries and others.

Besides the extension in commercialization, there is also a research value in this platform. We can have an investigation into modifying the software's presentation according to the user's experiences with the camera incorporating some learning algorithm. We also hope to increase the number of participants for our surveys in order to obtain a stronger justification.

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