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A Portable Distance Learning Approach for Image Processing Course in FKEE, UTHM

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Abstract: This study discusses a portable distance learning method for the Image Processing course in FKEE, UTHM. The traditional teaching method mainly focuses on the theories with the lack of visual demonstration. It has been difficult to imagine the actual output image through only the theories and equations in notes. In this study, an Android-based Image Processing learning application is developed using Android Studio software. The Open CV (Open Source Computer Vision) library is added to the Android Studio as a library of programming functions for real-time image processing. This application provides the complete theoretical chapters based on the image processing course syllabus as well as the real-time processing functions. There are 10 sample images provided for users to perform image processing. Then, the users can apply the desired image processing techniques provided to the selected image depending on their needs. The survey is conducted to analyze the performance of applications. In conclusion, the Image Processing application has been successfully developed. This proposed Android application is believed to assist students in better understanding of image processing.

Keywords: Image Processing, Distance Learning, Android Application

1. Introduction

Image processing refers to the manipulation of digital images to extract more information than the actual visible ones in the original image [1]. Image processing is widely used in various research fields and has been integrated into the learning course. Distance learning has become an established part of the educational world with the evolution of communication technologies and other information technologies. Some of the best distance learning approaches include educational Android applications, online learning platforms, and other resources. Many developed applications are designated for specific courses. These academic mobile applications are available on portable Android and iOS devices.

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Up till now, many image processing systems or applications have been developed in the field of science and technology. They are used for face detection, robotics, computer graphics, and medical applications. The literature on face recognition systems [2] studies the use of image processing to build an E-learning model that can detect the facial features of students, which enables educators to identify their students easily. There is an image processing simulator [3] has been developed for robotic soccer purposes. This simulator allows robot soccer developers to take values on objects used by robot soccer. In order to optimize the distance learning of the Image Processing course in FKEE, several applications have been developed. In [4], the application developed is portable and provides a real-time simulation platform. This application includes all the techniques in the syllabus of the Image Processing course, FKEE, UTHM. However, it does not provide detailed notes, and the processing image is limited to the usage of the provided test image set. The application developed in [5] has made an improvement from the previous study. Nevertheless, it lacks functionality in Chapter 7 (Wavelets and Image Compression), and some buttons and layouts are not responsive to different screen sizes. Hence, the proposed application is developed to overcome this shortcoming of the previous application. The proposed application adds several new features. The new features include capturing images, retrieving images from device storage, and providing complete-chapter techniques and notes, which are intended to help the users understand the theories behind the process and its effects.

2. Materials and Methods

The development of the proposed image processing Android learning application is implemented by using Android Studio software. The development process started with Graphical User Interface (GUI) design. The GUI was built and designed by dragging UI elements into a visual design editor or writing layout XML manually in the Android Studio Layout Editor. To create the interactive user interface, the image processing Android application is programmed with the Java programming language. Java code will play the role in displaying and driving the user interface. The OpenCV library 3.2.0 vc14 is imported into the Android Studio software to help in writing the program and easy to modify the code as it includes thousands of image processing algorithms [6]. The image processing techniques provided in the proposed application are based on the seven modules included in the syllabus of Image Processing courses: Module 1: Introduction to Image Processing; Module 2: Intensity Transformation and Spatial Filtering; Module 3: Filtering in the Frequency Domain; Module 4: Image Restoration and Reconstruction; Module 5: Image Segmentation; Module 6: Morphological Image Processing; Module 7: Wavelets and Image Compression.

After creating the Graphical User Interface (GUI), the Android application is executed on the Android Emulator or a connected device to test the functionality of the application. USB is used to connect the mobile device with the Android Studio. The APK of the application is then installed and run on the mobile device. Afterward, the application goes through the testing and troubleshooting process. The final completed application was then published to Google Play Store through Google Play Console [7].

Two sets of questionnaire surveys were conducted to analyze the effectiveness of Image Processing application toward the image processing understanding level improvement of students. The purpose of the market test survey is to understand the market needs for image processing learning applications and the respondents' basic knowledge about image processing. The application's performance review survey is conducted to investigate the helpfulness of the application to the respondents and also the knowledge level of respondents after using the Image Processing application.

3. Results and Discussion

The Image Processing application was successfully developed and published in the Google Play Store. The buttons are designed to be orderly and well organized, which makes the application user-friendly. This application starts with a Splash Screen and then moves to the Main page. The GUI for

the main page of the proposed application is shown in Figure 1. There are 2 buttons available in this interface, which are the "Theory" button and the "Real-Time Processing" button. "Theory" is the button that leads the users to access the notes provided. The desired PDF notes are able to open up after tapping one of the chapter buttons provided. With regard to the "Real-Time Processing" button, users will be navigated to the interface that is illustrated in Figure 2. There are three methods to get the image for real-time processing, "Sample", "Gallery", and "Camera". For the "Sample" button, there are 10 sample images provided for the user to do the filtering process or image processing. The "Image Processing technique selection" interface includes seven modules as shown in Figure 3. The users are able to choose one of the image processing techniques to be applied to the image.

Figure 1: GUI for the main page

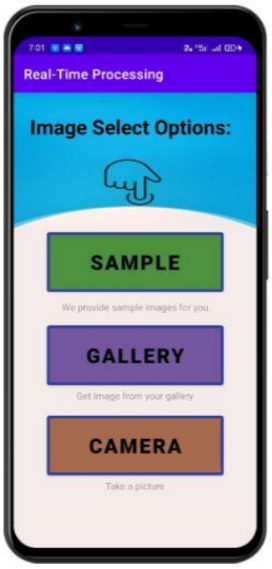

Figure 2: GUI for the image select options

Figure 3: GUI for the image processing techniques selection

The original image is placed in the output interface so that users can easily see the effect of image processing techniques from each module applied to the sample images as shown in Figures 4 to Figure 10. Figure 4 illustrates the result of the Grayscale Conversion from Module 1. The color image turns to a grey color. The result of the Gaussian Filter in Module 2 is shown in Figure 5. The output image becomes blurry. As a result of the Ideal Lowpass Filter in Module 3, there is a ringing effect that occurs on the output image, as shown in Figure 6. Next, the result of Salt and Pepper Noise is illustrated in Figure 7. There are white and black pixels randomly scattered across the image. The result of the Canny filter is shown in Figure 8. It can be seen that the edge of the image is detected. The result of the Erosion and HH (Diagonal) filters is shown in Figure 9 and Figure 10 respectively.

Figure 4: Result of the Grayscale Convers

Figure 5: Result of the Gaussian filter

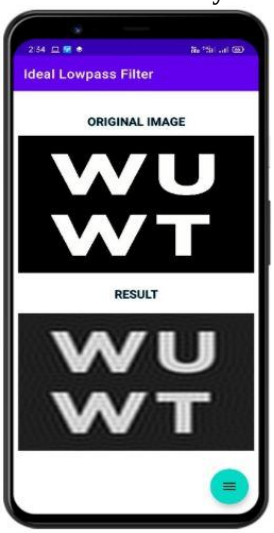

Figure 6: Result of the Ideal Lowpass Filter

Figure 7: Result of Salt and Pepper Noise Filter

Figure 8: Result of Canny filter

Figure 9: Result of Erosion filter

Figure 10: Result of HH (Diagonal) filter

Table 1 shows the data collected from the market test review and the application's performance review survey, which shows the comparison of the knowledge of respondents in image processing before and after using the proposed application.

Table 1: Comparison of knowledge of respondents in image processing before and after using the proposed application

Rating of respondents' knowledge level in image processing (%)	Number of respondents (before using the application)	Number of respondents (after using the application)
Less than 40	4	0
40-49	2	1
50-59	3	1
60-69	1	2
70-79	0	4
Greater than 80	0	2

According to Table 1, most of the respondents (4 respondents) rated their knowledge level in image processing as less than 40% before using the proposed application, and none of the respondents have a knowledge level that is higher than 70%. After using the proposed application, the data collected from the application's performance review survey shows that there is an obvious enhancement in knowledge of image processing as there are 6 respondents who rated their knowledge level higher than 70%, and 2 of those 6 respondents have knowledge level that is greater than 80%. This proves that the proposed application helped effectively.

4. Conclusion

Overall, the proposed Android-based Image Processing learning application was developed to assist students in distance learning, especially those enrolled in the Image Processing course. This application is designed with a user-friendly interface and provides the theoretical notes as well as real-time processing with complete-chapter image processing techniques. Users are able to filter the image by using the sample image. Based on what the result analysis showed, the functions provided in the proposed application are capable of improving knowledge while learning image processing.

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References

[1] S. N. Mark and S.A. Alberto, "Image Processing," 2015. [Online]. Available: https://www.sciencedirect.com/topics/computer-science/image-processing [Accessed October 19, 2020]

[2] S. G. Rabiha and H. Ham, "Image processing model based E-Learning for student's authentication," in 2017 International Conference on Information Management and Technology (ICIMTech). Yogyakarta, Indonesia. November, 2017, IEEE, 2017. pp.187-191.

[3] S. Sendari and R. M. N. Salim, "Development of Image Processing Simulator: Case Study on Robotic Soccer," 2019 2nd International Conference of Computer and Informatics Engineering (IC2IE). Banyuwangi, Indonesia, September, 2019, IEEE, 2019. pp.33-38.

[4] Z. Y. Low, "Mobile Application for the Image Processing Learning Use," Undergraduate Project Report, Dept. Elect. Eng., Universiti Tun Hussein Onn Malaysia, Johor, 2019

[5] C. R. Punyavan, "Android Based Application for Immersive Image Processing Learning," Undergraduate Project Report, Dept. Elect. Eng., Universiti Tun Hussein Onn Malaysia, Johor, 2020

[6] Saurabh Pal, "16 OpenCV Functions to start your Computer Vision journey (with Python code)," 2019. [Online]. Available: https://www.analyticsvidhya.com/blog/2019/03/opencv-functions-computervision-python [Accessed December 7, 2020]

[7] Google Play Console. Retrieved from https://play.google.com/intl/au/console/about/?utm_source=google&utm_medium=cpc&utm_campaign=Console2020-Branded&utm_term=google%20play%20console%7ce&utm_content=496541133530&gclid=Cj0KCQjw--GFBhDeARIsACH_kdbIwnikEexjkiX8oMQ-p-LsjD7tyF3W4GPFboiVR3iVo9kwt0v1MXIaArklEALw_wcB