

## **Image Processing Application: Assistance for Pandemic Online Learning**

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**Abstract** : Mobile learning applications are playing a significant role during the COVID-19 pandemic. Especially during this pandemic time, students are compelled to continue their education through distance learning. Learning application will contribute to the learning process as it enables learning using the simulated environment that might increase the interest and understanding level of the users. In this study, an Image Processing application is developed to act as an educational tool, which elevates students to a higher level of knowledge on basic principles of image processing. The development of the Android-based Image Processing learning application is implemented by using the Android Studio software. The Open Source Computer Vision (Open CV) library is added into the Android Studio as a library of programming functions for real-time image processing. This application provides the complete chapter based on the image processing course syllabus as well as the real-time processing functions. The notes provided in this application included 7 chapters which cover related digital image processing theories. The image processing techniques available are based on the notes provided. There are 10 sample images provided for users to perform image processing. Users are also able to retrieve images from their device's gallery or capture images using the device's camera. Then, the users can apply desired image processing techniques provided to the selected image depending on the users' needs. The survey is conducted to analyze the performance of applications. In conclusion, the Image Processing application is developed and available for download in the Google Play Store. In addition, the results of the evaluation are encouraging and showed that the application has the potential to improve students' knowledge of image processing.

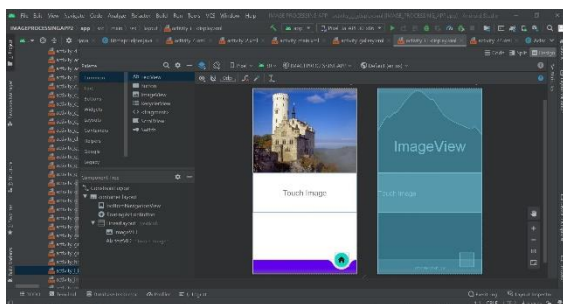
**Keywords:** Image Processing, Distance Learning, Android Application

## 1. Introduction

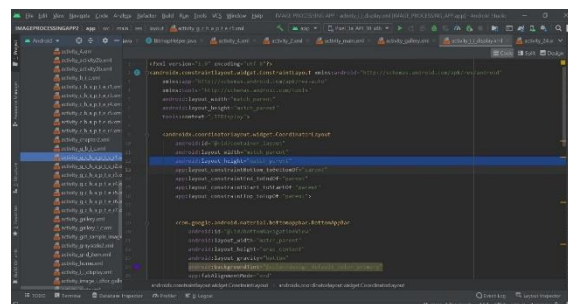
The closure of the educational institutions due to the pandemic not only impacted the students but also the learning applications. The pandemic has increased the usage of learning applications among students and lecturers. According to [1], student have great interest in using E-learning resources, and there is an increasing use of E-learning programmes for academic use during the lockdown period due to COVID-19 pandemic. Over the years, image processing technologies have been growing fast, and they were widely applied within the field of science and technology, which purposely helps in daily life. There is a face recognition system [2] has been developed using image processing to detect the face features of the students, which enables educators to identify the existence of learners during the E-Learning process. To learn the image processing, there are some of the image processing-based applications are available in the Google Play Store. An Image Processing application [3] found in the Google Play Store is developed purposely to be used as an educational tool by the educators in the classes to increase the understanding among the students. It is a portable application which provided real-time simulation platform. Due to the Graphical User Interface (GUI) designed by the developer, this application is limited to the usage of the provided test image set. Hence, the application named Image Processing Apps is developed to overcome this shortcoming of the previous application [3]. The proposed application added several new features. The new features included capture images, retrieve images from device storage and providing brief notes on the topics related to Digital Image Processing [4] which intended to help the users to understand the theories of the process and its effects. The application can be downloaded from the Google Play Store (using Android device only) [5].

## 2. Materials and Methods

The development of the proposed image processing Android learning application is implemented by using Android Studio software. The development process is started with Graphical User Interface (GUI) design. The GUI was built and designed by dragging UI elements into a visual design editor (**Figure 1**) or writing layout XML manually (**Figure 2**) in the Android Studio Layout Editor. In the programming part, the image processing Android application is written in the Java programming language. The OpenCV library 3.2.0 vc14 is imported into the Android Studio software, which includes thousands of algorithms that help in writing the program and easy to modify the code [6]. After creating the Graphical User Interface (GUI), the Android application is executed on the Android Emulator or a connected device (smartphone) 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. Afterwards, 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].



**Figure 1: The visual design editor in the Android Studio Layout Editor**



**Figure 2: The XML Layout Editor in the Android Studio software**

Two sets of questionnaire surveys were conducted to analyse the effectiveness of Image Processing application toward the image processing understanding level of 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 application toward the respondents and also the knowledge level of respondents after using the Image Processing application.

### 3. Results and Discussion

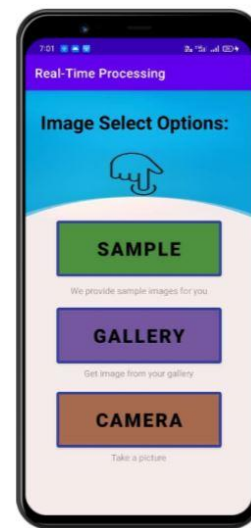
The Image Processing application was successfully developed and published in Google Play Store. The GUI for the main page of the proposed application is shown in **Figure 3**. There are 2 buttons available in this interface which are the “Theory” button and “Real-Time Processing” button. “Theory” is the button that leads the users to access the notes provided. After pressing the “Theory” button, users can start to browse the contents of every chapter of the Image Processing course, as shown in **Figure 4**. The PDF file of the selected chapter will be displayed as shown in **Figure 9**. “Real-Time Processing” button will navigate users to the interface that illustrates in **Figure 5**. Users are required to select the method to get the image for image processing from 3 buttons: Sample, Gallery, or Camera. For “Sample” option, there are 10 sample images provided with grid view as demonstrated in **Figure 6** and users are free to choose any images provided for further action. For “Gallery” and “Camera” option, users will access to device storage and camera to get the image. The “Image Processing technique selection” interface includes seven modules as shown in **Figure 7**. For each module, there are sub-module. **Figure 8** shows an example of sub-module interface from Module: Image Segmentation. The users are able to choose one of the image processing techniques to be applied to the image.



**Figure 3: GUI for the main page**



**Figure 4: GUI for the theory chapter selection**



**Figure 5: GUI for the image select options**

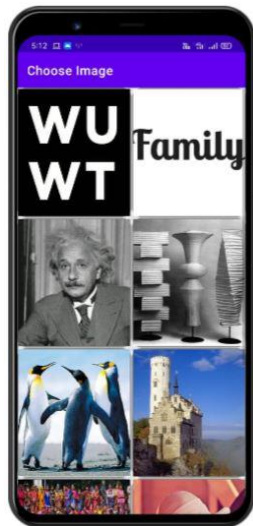


Figure 6: Sample image provided

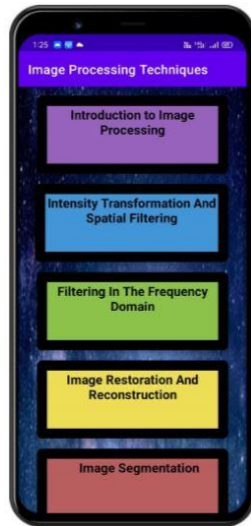


Figure 7: GUI for the image processing technique selection

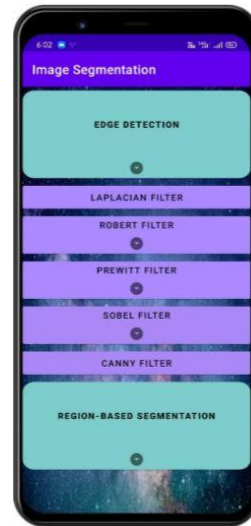


Figure 8: Sub-interface design of the Image Segmentation

For output interface design, the original image is placed in the output interface so that the users are able to observe the effect of image processing easily. There are 2 examples of image processing techniques applied to the sample images are shown in **Figure 8** and **Figure 9**. **Figure 8** illustrated the result of the Gaussian filter. The output image becomes blurry. The result of the Canny filter is shown in **Figure 9**. It can be seen that the edge of the image is detected.

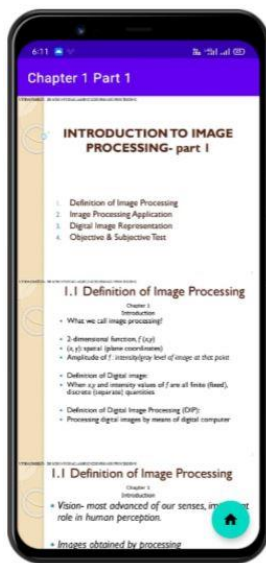


Figure 9: PDF view of the note for Chapter 1 part 1



Figure 10: Result of the Gaussian filter



Figure 11: Result of Canny filter

The test survey was conducted among the class of Image processing course in UTHM. There are 10 respondents involved in the survey. The sample size is calculated by using the online sample size calculator [8]. The population size is 180 students. However, the number of students taking the course for a semester is estimated as 30 students per class. Based on calculation, the recommended sample size is 26 respondents for a population of 180 in order to have a confidence level of 90% that the real value

is within  $\pm 15\%$  of the surveyed value. The number to invite is 60 respondents, with the estimated response rate of 44%. Hence, this survey will conduct six semesters to meet the required sample size.

**Table 1** is the data collected from the market test review and the application's performance review survey, which shows the comparison of 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 proposed application**

Rating of respondents' knowledge level in image processing (%)	Number of respondents (before using application)	Number of respondents (after using 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 less than 40% before using the proposed application and no 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 rated their knowledge level higher than 70%, and 2 out of that 6 respondents have knowledge level that greater than 80%. This proves that the proposed application is helped effectively.

#### 4. Conclusion

In this project, an Android-based Image Processing learning application was developed to assist students in online learning during Covid-19 pandemic. Based on the result analysis showed, the functions provided in the proposed application are capable of improving in knowledge while learning image processing. However, the small sample size of the study may influence the accuracy of the research findings. Therefore, further implementation of the survey can be done to improve the level of data accuracy.

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