Android Based Application for Immersive Image Processing Learning

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Abstract: This project aims to develop an Immersive Image Processing learning application to assist in the Image Processing lecture class for Faculty of Electronic and Electrical Engineering (FKEE), in University Tun Hussein Onn Malaysia (UTHM). The immersive Image Processing learning application focuses on seven important modules covered in the Image Processing syllabus. The Graphical User Interface (GUI) development of Android based for Immersive Image Processing learning application is implemented by using Android Studio software. The portability of the Android Image Processing learning application makes users easier to learn image processing and editing image at anywhere and anytime. The application is provided with the notes of the seven modules to users more understanding with the theory. The performance analysis of the Image Processing learning application is evaluated through data collection from survey conducted. Immersive Image Processing learning application market test survey discusses the awareness of respondents on Android Studio software, basic knowledge of respondents in Image Processing course and the implementation of existing Image Processing learning application. In a meanwhile, performance review discusses the performance analysis of the Immersive Image Processing learning application. 100% of the respondents agreed that the application was extremely helpful in assisting in better understanding in image processing.

Keywords: Immersive Image Processing, Learning Application, Android Application

1. Introduction

Learning is a process of acquiring new or modifying existing knowledge or skills by a person through studying, practicing and experiences in daily lives. It is a hypothetical construct in which it will relatively change the person's behavior performance permanently, which cannot be directly observed [1]. Nowadays the learning process is divided into two main types, which are conventional learning and

E-learning. Conventional learning focuses on face-to-face education in classes while E-learning focuses on online learning tools and interfacing learning platform which integrates the conventional education system with technology-oriented system [2].

Basically, the conventional learning method is a theory- based learning process. On the other hand, the modern learning method is an interactive-based where the technological advances are included in the active learning process of the interactive problem-solving to improve the quality of both teaching and learning [3].

Nowadays, image processing is among one of the rapidly growing technologies with the fast development of the digital computer, electronic technology, and network communication. Image processing learning process can be conducted in both conventional and E-learning ways to ensure the students understand the described algorithms and the respective parameters. Immersive image processing refers to a method to enhance and manipulate the image or to extract the useful information from the respective image by performing some operation on it. Basically, the digital image will be the input of the system and the system will process the image using algorithms to give the image an output. The set of efficient algorithms in the operation can be used to enhance, transform, modify as well as filter the selective images. In this digital visual word, the image processing has already widely applied in our daily lives.

1.1 Problem statement

Existing learning platform available usually is very traditional and single in which the educators mainly focus on the basic concept and related theories with the lack of visual demonstration. This method is considered disadvantageous because it can lower students' interest in learning. To overcome this problem, previously proposed application has been developed for Image Processing course in FKEE. However, it is not portable since it uses MATLAB for laptop version [4]. On the other hand, another application developed from latest study is Mobile Application for The Image Processing Learning Use [5]. Although the latest proposed application developed for Image Processing course in FKEE is portable, it still lacks in appearance of the layout of application. This application is not capable to capture image from device camera, retrieve image from device storage and provides brief explanation on the theories.

1.2 Aim and objectives

The aim of this project is to develop an Android application for the image processing learning purpose. Basically, the project has the following objectives to achieve the goal: (i) to design a Graphical User Interface (GUI) for visual demonstration of the image processing learning processes and effects (ii) to develop an Android application for mobile image processing learning use (iii) to analyze the performance of developed Android application.

2. Materials and Methods

2.1 Material

The Android version of the Graphical User Interface (GUI) for immersive image processing learning applications is designed by importing OpenCV library and implementing alhazmy13 GitHub using Android Studio software.

2.2 Methods

Software development flow diagram is an important guide for new developer to create Android App (Figure 1). It consists of four parts, Part 1: Software Setup; Part 2: GUI design; Part3: Image Processing Algorithm Development; Part 4: Performance Analysis.
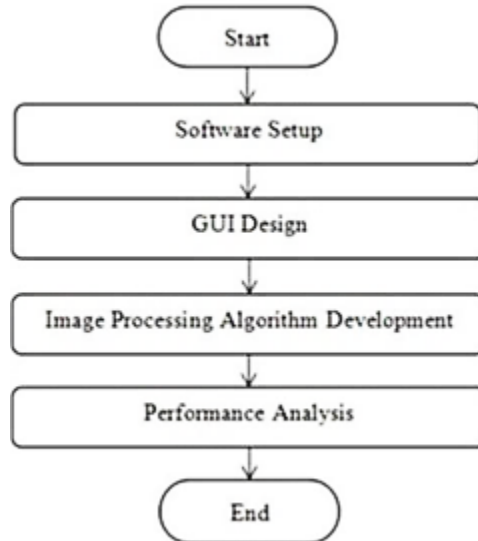

Figure 1: Flowchart of software development

Part 1 involves the installation of Android Studio software and OpenCV's library folder on the computer. In part 2, the GUI design of the Android image processing learning application was performed in the Android Studio layout editor by dragging UI elements into the visual design editor instead of manually writing the layout XML. The third part is the development of image processing algorithms by importing the OpenCV library and implementing alhazmy13 GitHub into Android Studio software and writing in Java language.

The proposed application of this project, the developed Android Based for Immersive Image Processing Learning consists of several steps for guiding users. There are five steps on the flows for this proposed application: Step 1: Select image acquisition source; Step 2: Choose photo from camera, Gallery or Test Image; Step 3: Display input image; Step 4: Display technique list and information or theories; Step 5: Select a technique to apply; Step 6: Perform technique to image; Step 7: Show output image; Step 8: Apply other technique; Step 9: Save output image. As the first step, image must be selected from acquisition source. For step 2, you will have three options which is Take photo from camera, Choose photo from gallery and Test Image. Input image or chosen image will be displayed in Step 3. Technique list and information or theories about the technique will be displayed in Step 4. In Step 5, you start applying a technique from the chosen photo. In Step 6, the chosen technique in step 5 will be performed to the image. Step 6 shows the output image. Depends on Step 8, other options will appear for you to choose whether to apply other techniques to the same photo or continue to the next steps. Step 8 is called as multiple filter application for single image editing. In step 9, you can save the filtered image and continue to choose another photo to filter it.
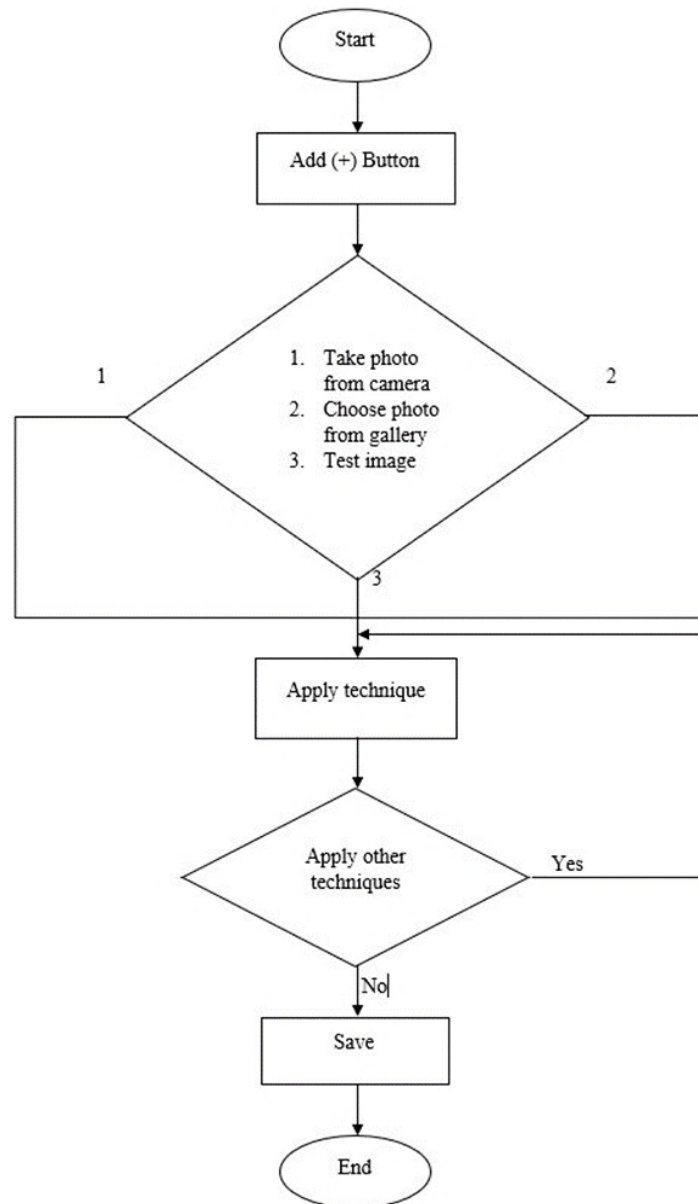
Figure 2: Flowchart of the flows of this proposed application

3. Results and Discussion

The proposed application is designed with an attractive visual demonstration for the effective learning of Immersive Image Processing functions by developing a Graphical User Interface (GUI) using OpenCV library in Android Studio software for Android platform. The main objectives of the application are to assist in traditional image processing lectures to improve the FKEE student performance, especially for students that involved with Image Processing course. The structure of the system is designed three options on the homepage for the users. The first options provided theoretical notes according to chapters that mentioned on methodology. And the second options provided hands-on experience using provided sample images in the gallery of the application. The third options provided functions to use images from device storage and also capture image by using device's camera.

3.1 Graphical user interface (GUI) for android platform

The main interface design of the Android version Learn Image Processing Apps is shown in Figure 3.
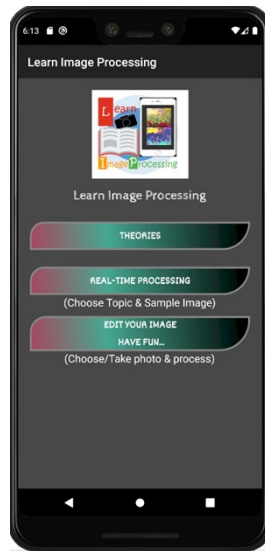

Figure 3: Main interface design for android version learn image processing learning apps

The main interface includes a logo for the apps and also has three optional buttons. "Theories", "Real-Time Processing" and "Edit Your Image".

3.2 Multiple filter applications for single image editing

In part of "EDIT YOUR IMAGE" as shown in Figure 3, the users able to apply multiple times of filter to the same image from device storage or camera. After applying the filter to the image, the users also can save the image or reset back to the original image.
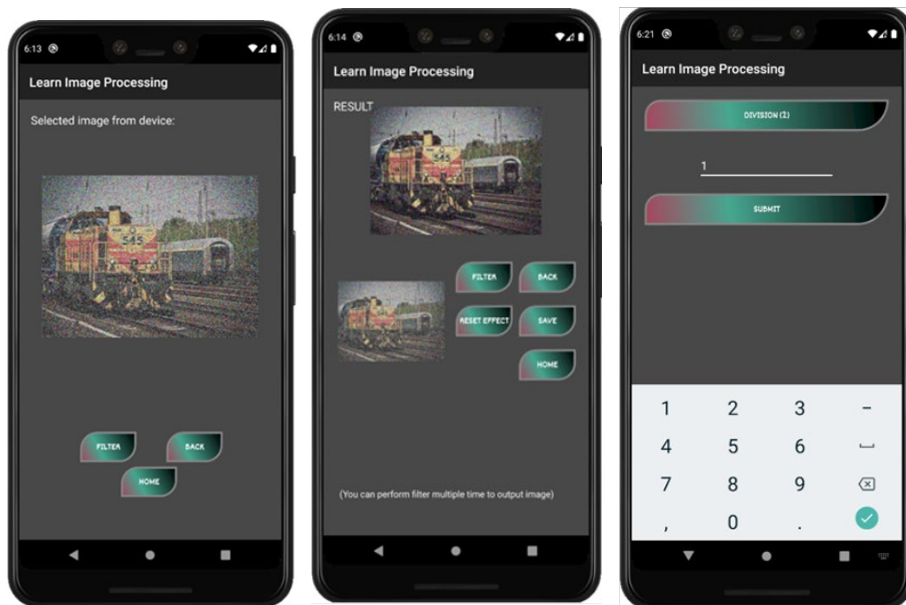
(a) Image from device storage   (b) 3x3 median filter   (c) insert division value
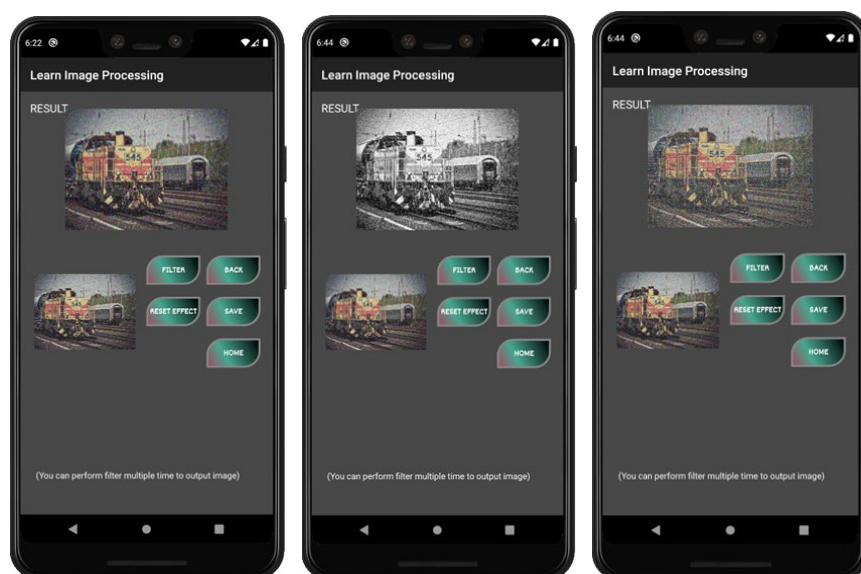
(d) Division (1)   (e) histogram equalization   (f) reset

Figure 4: Process of multiple filters to the same image

Figure 4 shows the process of multiple filters to the single image editing. First of all, selected image from device will appear after the users choose image from device storage or take photo from camera as shown in Figure 4(a). From the interface for multiple filter has been shows some buttons, such as "FILTER" button can be used to open technique(s) in sequence of the chapters, "BACK" button to go back interface on Figure 4, "SAVE" button for save processed image, "RESET EFFECT" button for reset filtered image back to original image, and "HOME" button for go back to the homepage of the apps. And then, the first technique was applied to the image, which is 3x3 Median Filter as shown in Figure 4(b). Figure 4(c) and (d) shows the second technique, Division (1) applied to the same image. After that, as shown in Figure 4(e) the third technique Histogram Equalization was applied to the same image with third time filtering. And for Figure 4(f) shows the output image back to the original image without any effects after the user clicked the "RESET" button.

3.3 Discussion

Before the respondent (13 students enrolled in Image Processing class for Semester 2, 2019/2020 in FKEE) started the immersive image processing application, the image processing post-survey form is conducted. The respondents need to evaluate the application by filling out post-survey form based on their experience and satisfaction level to verify the effectiveness of the image processing learning application after testing the image processing learning application. Feedback collected from respondents to improve the design of image processing applications is considered a future recommendation for the project. A comparison of data collection between the before and after application demonstration based on both surveys among respondents with formal Image Processing knowledge is carried out. From the post-survey form, there was obviously prove that the immersive image processing application able to assist the users more understanding each of the filter in the image processing course. 100% of the respondents agreed that the application was extremely helpful in assisting in better understanding in image processing. 53.8% respondents have responded that the application was extremely helpful; 38.5% respondents think that it was moderately helpful, and 7.7% respondents have responded that the application was helpful understanding of Image Processing theories through the application.

4. Conclusion

The Android version of immersive image processing learning application for the image processing course in FKEE, UTHM is being developed in this project. Learn Image Processing Apps is developed by importing OpenCV library into Android Studio software. In conclusion, this project has successfully achieved its goal as the developed Android immersive image processing learning application can form a communication bridge between lecturer and students in Image Processing course, with 100% of the respondents agreed that the application was extremely helpful in assisting in better understanding in image processing.

Acknowledgement

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