Development of Balmer Series Experiment Simulator in Mobile and Android Applications

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Development of Balmer Series Experiment Simulator in Mobile and Android Applications

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Abstract. The need for application of android-based experimental physics is urgent, beside to facilitate students to do the lab, students can reach the simulator through gadget. Previously Balmer series experimental physics applications have been made in the form of Java Applet with the concept of 2D Virtual Reality and it has been used since 2010 until 2016. However, for security reasons, since 2015 the development of Internet technology is no longer support Applet in its web browser. Therefore, the Balmer series Experimental Physics simulator needs to be overhauled into another form that is easier and safer to access in to the form of Android applications. In this research android applications engine generator has been made for Balmer series Experimental Physics simulator so that applications based on Java Applet on PC can be run in Android gadget. The engine consists of image processing, object transformation, browser connector, interactor and visualizer. In this report we show the Balmer series Experimental Physics modules that have been successfully created in the form of android applications.

1. Introduction

Previous physics experimental applications have been made in the form of Java Applets with 2D Virtual Reality concepts and were used from 2010 to 2016. This application was created as a training media for experimental physics practitioners before they did actual lab work in the Experimental Physics Laboratory of FMIPA Universitas Brawijaya, with the aim of minimizing damage to equipment due to improper arrangement, mismanagement or other errors during the practicum which are posted as one of the pages on the website http://fisika.ub.ac.id, in the facilities menu and sub menu of the Experiment Physics Simulator [1]. Participant can directly access this application through their PC or laptop web browser, or computer in the Computational Laboratory Laboratory of Physics, University of Brawijaya at any time, and Balmer series practicum during lectures Required Subject Experimental Physics Practicum as we can see at Figure 1 [2].

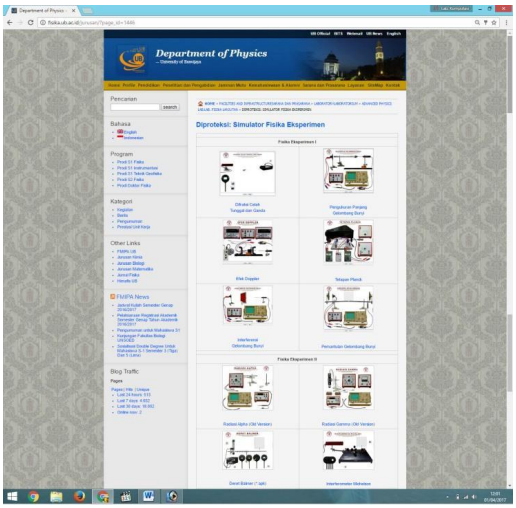

Figure 1. Screenshot Physics simulator from web version

One example of the conversion process from Java Applet on one of the topics on this study is Balmer series practicum. The results of the trial to form an Android application are shown in Figure 2. The development of this application is contained in the Computational Lab [3]. The Computational Lab is the name of the Android developer that was originally under the Computing Laboratory of the Department of Physics, University of Brawijaya Malang. This developer was founded at the end of 2014 by one of the former Computing Laboratory staffs with the support of the Head of the Computing Laboratory at that time. Currently the developer has produced approximately 64 applications and Android games. Initially the purpose of the establishment of the Developer was as one of the funding sources for the development of the Computing Laboratory to renew old laboratory equipment, and also to accommodate students who wished to publish their android applications through the Google Play Store. Until this article was released, Computational Lab was still under development and all revenues were still to cover production costs. One of the products that the developer has produced is the Greenfoot Java Applet conversion engine to the Android application, which in this study can be used to convert the Balmer Series Applet to an android application.

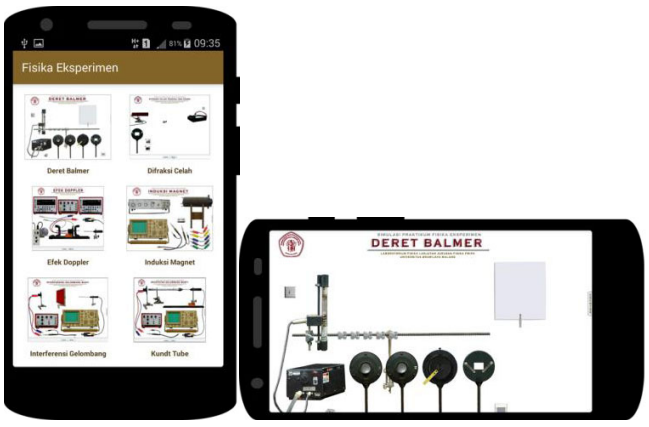

Figure 2. Physics simulator screenshots of the Android version

Along with the development of technology, the Java Applet not to be supported by web browsers as part of web pages. Most web browsers block this application due to security reasons [4]. As a result the Balmer Series that has been made becomes difficult to access, and the practitioner needs to learn first how to do Java Applet security permissions, before they can use it [5].

Because Balmer Series application has the potential to be used every semester by Physics students, it is necessary to change the application to other forms that are more accessible, so that students are easier to access applications in learning and do virtual labs before they actually do lab work [6]. One option is to change the Derrick Balmer application that has been made in the form of an Android application, because the Java Applet and Android applications are both made using the Java programming language.

2. Methodology

In this study the implementation was carried out in three stages, which are Adjustment of the Android, Computational Lab engine, Application Creation, Trial experiment on the practitioner. Although the Greenfoot application conversion engine [7] to Android has been successfully created by Computational Lab. But in its implementation, adjustments are still needed in this study, especially regarding memory consumption [8]. In addition, the engine, not all functions in Greenfoot have been replaced. So that the engine adjustment stage is needed, including the efficiency of memory consumption and the addition of functions that have not yet been replaced. And improvements to the design of display performance for the use of applications on Android devices that have different screen sizes and pixel sizes, such as differences on smartphones or tablets.

Then the next step is making an application, that includes the migration of Greenfoot functions used, module placement and user feedback. These three things are important, in addition to know whether there are bugs or not, feedback in the form of questionnaires is useful to add to the lack of the features are needed by users, which were not previously available in the Applet version. So that this research is not only aimed at making the Greenfoot application conversion engine to Android only, but also adding features that are needed by users that did not yet exist in the Applet.

While for the third stage is the stage of validation and testing to the practitioner, the application will be asked to students who have done the Experimental Physics Practicum. This is so that the application can be felt in advance for users who have carried out actual experiments in the Laboratory, to determine the level of suitability of practicum contents. At the time this report was made a trial application to the practitioner could not be implemented, because there was no lab schedule for students to experiment on the simulator.

3. Result and Discussion

In this study conversion is prioritized for adjusting the Android engine from the Computational Lab. and more leads to efficient memory consumption. It's because in addition to the size of the lab tools photo that are inserted into large applications, however, the ability to process images by the processor on Android is not as good as on a desktop computer. So if the desktop version of the twelve practicum titles has been made in the form of one interconnected application, then based on the engine that has been made, the Experimental Physics Application [1] on each topic is made into each one of its own Android applications.

3.1. Convert Java Applet to Android

The conversion results carried out in this study are in the form of the Android version of Greenfoot library. This means that commands that should be called through libraries are only found in Greenfoot software on desktop computers, as if they can be called also on Android, even though the Android device does not have Greenfoot installed. So that image manipulation commands such as translation, rotation,

scaling and pixel processing, which should be through Greenfoot, can also be called on Android made and equipped in this study. The working scheme of library conversion can be seen as shown in Figure 3.

This study utilizes data and modules that have been made previously in Balmer Series application to obtain the Greenfoot version of the Android library. The library complements functions that have been created by the previous Computational Lab, or adds Greenfoot functions that do not yet exist. Making this version of the Greenfoot library as a whole users software (IDE) called Android Studio 2.3.

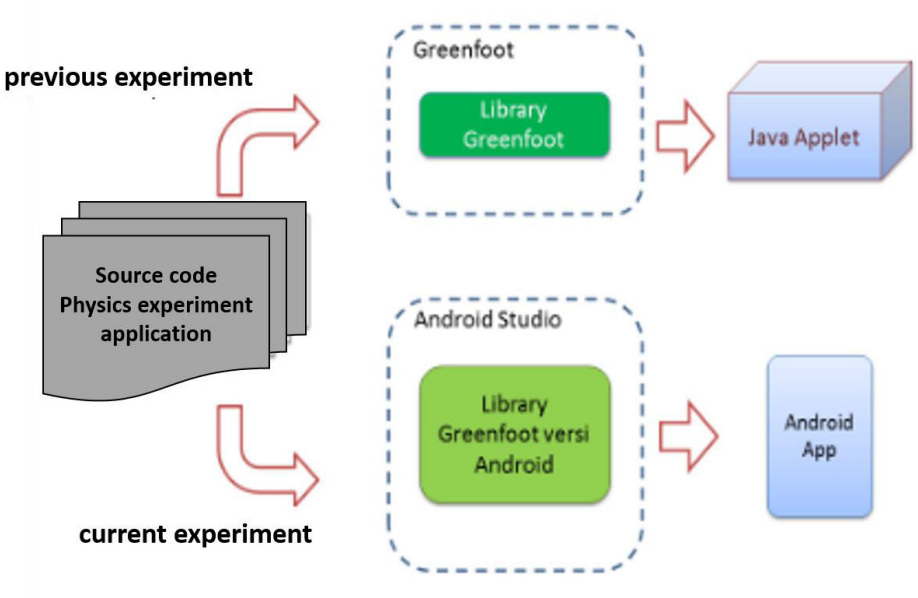

Figure 3. Library conversion scheme

3.2. Image Processing, Interactors, and Visualizers

Greenfoot's Android version of image processing is actually the same as the desktop version of Greenfoot. Both of them use a class called Canvas. Photograph of each tool attached to the Canvas media. The difference on the canvas at Greenfoot uses the Canvas class from Java, while Canvas on Android uses the Canvas class from Android which requires additional class Paint input. Another fundamental difference is about interaction. Image transformation is not only due to the initial conditions of the object itself, but also in the Greenfoot desktop version due to mouse interactions in the form of clicks, double clicks, drag and press. The four mouse interactions are more used for image transformation in the form of translation and rotation. Whereas the Android version of Greenfoot is different, the transformation of images is more influenced by touch interactions called gesture. Where the interaction can be in the form of one-finger touch interactions for the transformation of translational and rotational images, and for touching with 2 fingers or more for the transformation of scaling images.

Based on the conditions and interactions of touch, the method of attaching images of practical instruments in the form of photographs. The photo is drawn on each frame and updated when a new interaction occurs. The place to put pictures on Android is called a canvas. As for the description of each photo of the tool in the Canvas parameter like the following program code:

```
Matrix matrix=new Matrix();
matrix.postTranslate(-gambar.getWidth() / 2, -gambar.getHeight() / 2);
```

```
matrix.postRotate(rotation);
matrix.postTranslate(pox + gambar.getWidth() / 2,poy+gambar.getHeight() / 2);
canvas.drawBitmap(gambar,matrix,paint);
```

The matrix parameter is a parameter used to put translation and rotation variables. Translation and rotation are included as a result of user interaction. This drawing command is carried out on each photo. The efficiency carried out in this study is the addition of matrix parameters, which previously had to be drawn twice without the use of a matrix.

Then to facilitate storage, the usage module for each lab is placed on a different media, namely hosting http://edugameapp.com. The command to connect the application to the web is placed in the menu and as the code below:

```
public boolean onNavigationItemSelected(MenuItem item)
{

   int id = item.getItemId();
   if (id == R.id.nav_camera) {
      Intent browserIntent = new Intent(Intent.ACTION_VIEW, Uri.parse(
"http://edugameapp.com/FisikaEksperimen/
Deret%20Balmer/Balmer.html"));
      startActivity(browserIntent);
   }

   DrawerLayout drawer = (DrawerLayout) findViewById(R.id.drawer_layout);
   drawer.closeDrawer(GravityCompat.START);
   return true;
}
```

Conversion makes the Balmer Series module from the application and its module contains a brief description, purpose, literature review, procedures and several examples of virtual lab data collectiontables. In addition, a video tutorial is also included in arranging practical tools embedded through youTube media. Whereas the questionnaire contains questions about the level of conformity with the actual practicum in the Laboratory. This level of suitability is divided into 5 points, with the lowest points showing discrepancies and the highest showing very suitable. The selection of these 5 points is intended so that users do not judge from just one parameter, because the application is not only judged by the appropriateness of the appearance of the tools, but also the compatibility of the interaction between these tools when practicing virtually. So with the questionnaire's new feedback, it can be seen the level of compatibility between practicum virtually using an Android application, and in real terms in a real laboratory. Some sample footage resulting from the conversion of desktop applications to Android are shown in Figures 4 to Figure 7.

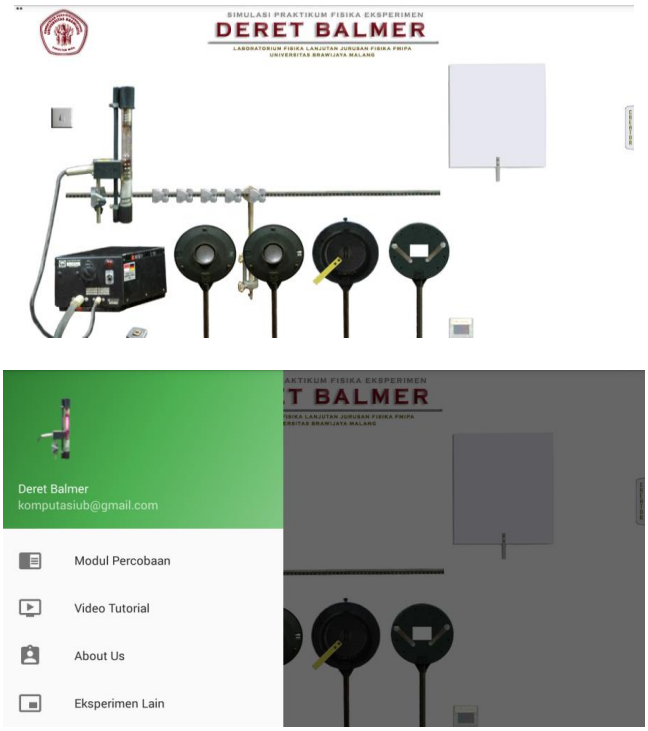

Figure 4. The main display of topic Simulator Application Series Balmer

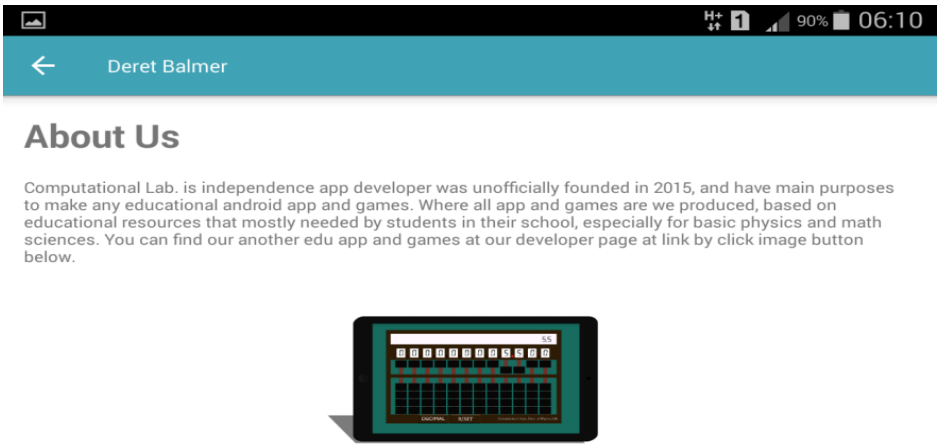

Figure 5. Display of the About Us page.

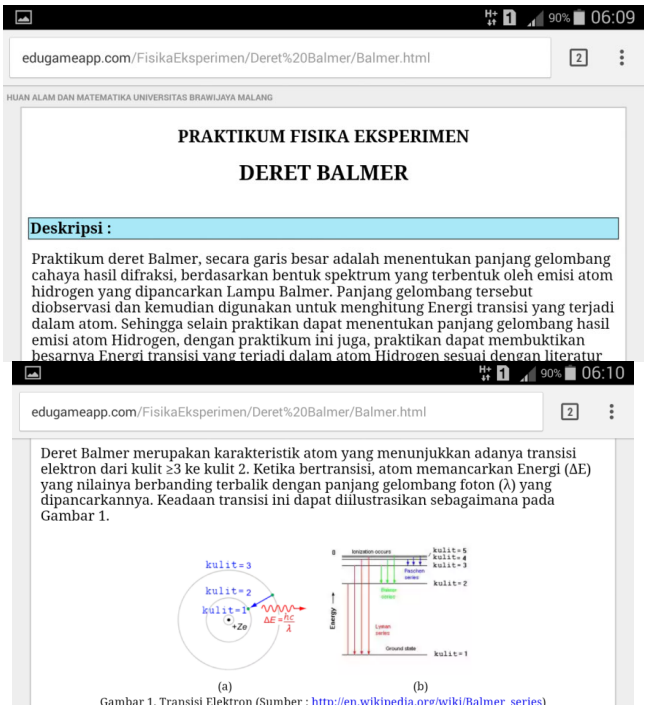

Figure 6. Display page module usage.

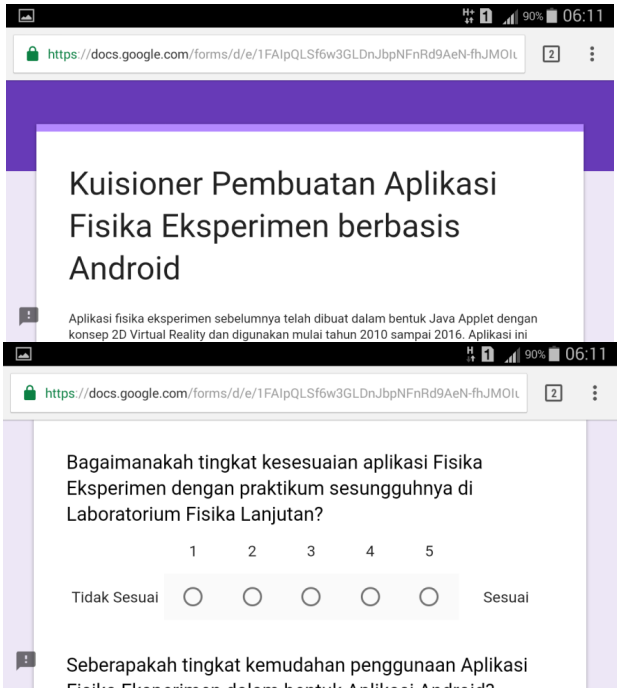

Figure 7. Questionnaire page display.

4. Conclusion

Based on the Balmer Series desktop PC, this research has successfully developed an Android application generator engine so that the Balmer Series previously based on PCs can be run on an Android machine. The Balmer series that was made in the desktop version has been able to be converted into an android application and can be embedded in any gadjet with an adroid operating system through the application that has been made. Furthermore, the Advanced Physics Laboratory based on PCs and real equipment can be developed by using an android application for Experimental Physics labs.

References

[1] Anonymous. (2010). *Petunjuk Praktikum Fisika Eksperimen II*. Laboratorium Fisika Lanjutan Jurusan Fisika FMIPA Universitas Brawijaya.
[2] Developers, A. (2014). Android, the world's most popular mobile platform. *Android, the World's Most Popular Mobile Platform | Android Developers*.
[3] Anonimous. (n.d.). Computational Lab: Educational App and Games. Retrieved from https://play.google.com/store/apps/dev?id=908565604275158123
[4] Nikica Fulir. (2017). The Death of the Applet. DZone. Retrieved from https://dzone.com/articles/test-test-test-7
[5] Java. (2016). Learn About Java Technology.
[6] Android.com. SurfaceView. Android. 2015. Retrieved from https://developer.android.com/reference/android/view/SurfaceView.html
[7] Meier, R. (2010). *Android Application Development*. *Android*. http://doi.org/9781118102275
[8] Kölling, M. (2010). Greenfoot: Introduction to Java with Games and Simulations. *J. Comput. Sci. Coll.*